Schedule (MTN)-2

RATE SCHEDULE RS-PIV
(Residential Service – Plug-In Vehicle Charging)

AVAILABILITY
Available for full domestic service to individually metered residential customers, including rural domestic customers, engaged principally in agricultural pursuits, who own or lease a plug-in vehicle which requires electric service to provide periodic battery charging and who are not participants of Rider "REVCP" and who would otherwise be eligible to take electric service under Rate Schedule "RS".

The customer agrees to allow the Company to maintain necessary equipment (if applicable) to monitor or manage the PIV load.

	SUMMER June Through September	**WINTER** October Through May
Delivery Service Charges:		
Customer Charge ($/Month)	$5.77	$5.77
Distribution Rates ($/kWH)		
First Block	$0.065547	$0.059995
(Summer <= 750 kWh; Winter<= 500kWh)		
Excess kWh	$0.076291	$0.059995
Non-Utility Generation Charge (NGC) ($/kWH)	See Rider NGC	
Green-PIV (Optional) ($/kWH)	$0.054300	$0.0543000
Societal Benefits Charge ($/kWh)		
Clean Energy Program	See Rider SBC	
Universal Service Fund	See Rider SBC	
Lifeline	See Rider SBC	
Uncollectible Accounts	See Rider SBC	
Transition Bond Charge (TBC) ($/kWh)	See Rider SEC	
Market Transition Charge Tax (MTC-Tax) ($/kWh)	See Rider SEC	
Transmission Service Charges ($/kWh):		
Transmission Rate	$0.020425	$0.020425
Reliability Must Run Transmission Surcharge	$0.000000	$0.000000
Transmission Enhancement Charge ($/kWh)	See Rider BGS	
Basic Generation Service Charge ($/kWh)		
On-Peak	$0.145744	$0.158411
Off-Peak	$0.029640	$0.042773
Regional Greenhouse Gas Initiative Recovery Charge ($/kWh)	See Rider RGGI	

RATE SCHEDULE RS-PIV (Continued)
(Residential Service – Plug-In Vehicle Charging)

CORPORATE BUSINESS TAX (CBT)
Charges under this rate schedule include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)
Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT
None, except that reasonable notice of service discontinuance will be required.

TERMS AND CONDITIONS
See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE
A customer on this Rate Schedule "RS-PIV" may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

PEAK HOURS
For Rate Schedule "RS-PIV", On-Peak hours are considered to be 12:00 PM to 8:00 PM, Monday through Friday, including holidays falling on weekdays. All other hours are Off-Peak.

RESIDENTIAL ELECTRIC VEHICLE CHARING PROGRAM
RIDER "REVCP"

AVAILABILITY

The Company's Residential Electric Vehicle (EV) Charging Program Rider (Rider "REVCP") includes three offerings: (1) rebate program for up to (300) eligible residential customers with existing Plug-in-Vehicles (PIV) and charging equipment for a Company approved connected car telematics device ("C2"); (2) a rebate program for (1500) eligible customers on a first-come-first-served basis to install Smart EV Level 2 (L2) Electric Vehicle Supply Equipment (EVSE). This rebate is for Company approved devices and will cover 50% of EVSE cost as well as 50% of the associated installation costs. The 50% EVSE and 50% installation rebate is not available to Customer's with existing EVSE equipment; and (3) a 5 cent per kilowatt hour incentive for off-peak charging net of any on-peak charging as defined in Rider "REVCP" in the form of an off-bill rebate. Customer's receiving either rebate (1) or (2) will be automatically enrolled in the off-peak off-bill rebate (3). Rebates (1) and (2) are mutually exclusive. These offers are only available to Rate Schedule "RS".

RESIDENTIAL CONNECTED CAR TELEMATICS DEVIC, MANAGED CHARGING PROGRAMS, AND OFF-PEAK CHARGING INCENVTIVE PROGRAMS - OPERATION

The Company has three residential program offerings under Rider "REVCP" to eligible customers who install a qualifying a Connected Car Telematics Device or an EV L2 Smart Charger and have at least one plug-in vehicle ("PIV):

1. **Residential Connected Car Telematics Device:** The Company will offer 300 C2 devices valued at $99 each to eligible residential customers for the purchase and installation of a qualifying connected car telematics device including telecommunications cost. The C2 device would be located behind-the-meter and would be owned and operated by the customer receiving the rebate. The C2 device must be located on customer-owned property, or in the case of rental property, with approval from the owner of record. This program offers customers a maximum of one $99 C2 device per premise covering the purchase. Applications can be made beginning xxxx and C2 devices will be awarded on a first-come basis based on the completed application date and the application meeting all of the program requirements. Customers will be notified by mail when an application is complete.

   Customers are required to take electric service under Schedule "R" in order to be eligible for this program. Customers taking service under Schedule "R" and also Rider "NEM" (Net Energy Metering) are eligible for this program under Rider "REVCP". Applicants taking service under Schedule 'R" are not required to receive their energy supply through the Company's Standard Offer Service.

   The Customer is required to submit an application with all of the necessary documentation within 30 days. Applicants agree to share the charging data from the C2 device with the Company. A list of qualified C2 device manufacturers and models is available on the Company's website as of xxxx for use by customers in making decisions about qualifying C2 device purchases. Customers must also sign a customer participation agreement with the Company regarding program terms, conditions, and duration.

   Customers may refer to the Company's website to find information about applying for a C2 device under this program, the complete list of eligibility and documentation requirements, and the online form for submitting applications. The program has a 3-year enrollment window and only applies to applications received on or after xxxx and the program will end on xxxx.

2. **Discounted Level 2 Smart Charger Program (Managed Charging):** The Company will offer a 50% discounted L2 Smart Charger, 50% discounted installation of the Smart Charger for customers who do not already own EVSE equipment. This Program is limited up to 1500 participating customers on a first-come-first-served basis.

   The Smart Charger would be located behind-the-meter and would be owned and operated by the customer receiving the program incentives under this offering. The Smart Charger must be located on customer-owned property, or in the case of rental property, with approval from the owner of record. Applications will be awarded on a first-come basis based on the completed application date and the application meeting all the program requirements. Customers will be notified by mail when an application is complete.

Customers are required to take electric service under Rate Schedule "RS". Customers taking service under Rider "NEM" (Net Energy Metering) are eligible for this Program under Rider "REVCP". Program applicants under Schedule "RS" are not required to receive their energy supply through the Company's Standard Offer Service.

The Customer is required to submit an application with all of the necessary documentation within 30 days. Applicants will be required to provide proof of purchase of an eligible EV charger and agree to share the charging data from the Smart Charger with the Company. A list of qualified Smart Charger manufacturers and models is available on the Company's website as of xxxx for use by customers in making decisions about qualifying EV charger purchases. Customers must also sign a customer participation agreement with the Company regarding program terms, conditions, and duration.

Customers may refer to the Company's website to find information about applying for this program, the incentives offered, the complete list of eligibility and documentation requirements, and the online form for submitting applications. The program has a 3-year enrollment window and only applies to Smart Chargers purchased and installed on or after xxxx and the program will end on xxxx.

3. **Off-Peak Off-Bill Rebate:** Customer's receiving either equipment and/or rebates under offerings (1) and (2) within Rider "REVCP" will be automatically enrolled in the off-peak charging incentive. This incentive will utilize the data from (1) the C2 device and (2) the Smart Charger to determine on and off-peak usage. For purposes of the off-bill rebate, the total monthly measured off-peak PIV charging net of any on-peak charging will receive a $0.05 per kilowatt hour rebate. Where the on and off-peak periods are:
   On-Peak: 12:00 PM (noon) to 8:00 PM., Monday through Friday including holidays falling on Weekdays;
   Off-Peak: 8:01 PM to 11:59 AM, and all Weekends.

RESIDENTIAL ELECTRIC VEHICLE CHARING PROGRAM
RIDER "REVCP"

CORPORATE BUSINESS TAX (CBT)
Charges under this rider include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)
Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT
The customer agrees to pay for plug-in vehicle charging at the point of sale.

TERMS AND CONDITIONS
See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE
A customer may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

COMMERCIAL ELECTRIC VEHICL CHARING PROGRAM
RIDER "CEVCP"

AVAILABILITY – Available only for non-residential customers. Each customer is allowed to be on to a single offering under Rider "CEVCP": (1) Multi-dwelling Unit Charging; (2) Workplace Charging; (3) Fleet Charing, upon application by the customer and approval by the Company, qualifying non-residential customers who have purchased and installed an eligible Electric Vehicle (EV) charging station within the Company's electric distribution service territory on or after xxxx, may be eligible for two incentives: (1) rebates for installed Electric Vehicle Supply Equipment (EVSE) including telecommunication cost and associated installation costs and (2) receive an off-bill rebate to partially offset their monthly distribution demand charge. The customer agrees to provide the Company with usage data from the charger and the Company will pay the telecommunications cost to access the charging data. Rider "CEVCP" is available for Rate Schedules: "MGS-SECONDARY", "MGS-PRIMARY", "AGS-SECONDARY", "AGS-PRIMARY", and "TGS".

Application submission will begin on xxxx and terminate on xxxx. No new applications will be accepted after xxxx, and all project completion documentation must be submitted to the Company by xxxx. The demand rebate will be available beginning xxxx and will be a fixed amount and will be an off-bill rebate for the account with the eligible installed and operational L2 charging station(s). The maximum allowable term for the demand charge credit until the end of the 5-year PIV Program, or xxxx, regardless of the date of application and documentation approval.

COMMERCIAL REBATE AND DEMAND CHARGE REBATE PROGRAMS (Offerings)

1. **Multi-dwelling Unit Charging** – Intended for customers who own or operate condominiums and apartment complexes where dedicated parking can be made available for EVSE infrastructure. A rebate of 50% of qualified Smart Level 2 (L2) chargers and up to $10,000 per location for the eligible installation costs from point of service connection to the charger location. This offering is limited to 200 EVSE, and 6 EVSE per customer at a maximum of 3 locations per customer. Customers would also be enrolled in the demand charge rebate.

2. **Workplace Charging** – Intended for qualified customers who own or operate office buildings or garages where dedicated parking can be made available for PIV charging infrastructure. A rebate of 50% of qualified Smart L2 chargers installed behind the meter of an existing account for qualified customers. This offering does not include any rebates for installation costs. This offering is limited to 150 EVSE, and 6 EVSE per customer at a maximum of 3 locations per customer. Customers would also be enrolled in the demand charge rebate.

3. **Fleet Charging** – Intended for fleet/light duty charging infrastructure for customers who own or operate vehicle fleets. This offering includes a rebate of 50% of qualified Smart L2 chargers installed behind the metered of an existing account for qualified customers. This offering does not include any rebates for installation costs. This offering is limited to 150 EVSE, and 6 EVSE per customer at a maximum of 3 locations per customer. Customers would also be enrolled in the demand charge rebate.

COMMERCIAL ELECTRIC VEHICLE CHARING PROGRAM
RIDER "CEVCP"

Demand Charge Rebate:
Demand charge credits are an off-bill rebate applied to the Customer's bill only for a portion of the maximum distribution demand charge resulting from the addition of EV chargers to the Customer's facility service and metered load. The demand charge credit amount will be calculated as 50% of the maximum nameplate capacity for new or added L2 EV chargers' times the prevailing Rate Schedule's demand charge. The demand rebate credit cannot exceed the Customer's monthly distribution demand charge. The demand charge rebate requires that the charger be put into service and available for use.

Demand Charge Credit Structure

EV Charging Station Type	Maximum Credit	Credit Length
Level 2 Charging Station	50% Nameplate Capacity	Until the end of the 5-year PIV Program

The customer must submit an application and documentation of the completed EV Charging station installation on the Company's EVSmart webpage in order to become eligible for the demand credit (including receipts and/or invoices of the EV chargers, as well as proof of the installation from a certified electrician). The Company's third-party vendor will determine acceptance, calculate the demand charge credit amount and communicate these results to the Customer. Chargers installed outside the utility approved tariff, Rider "CEVCP", are not available for the demand charge rebate.

CORPORATE BUSINESS TAX (CBT)
Charges under this rate schedule include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)
Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT
The customer agrees to make parking available for EVSE charging and to keep charging stations available for use.

TERMS AND CONDITIONS
See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE
A customer may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

RATE SCHEDULE PC-PIV
(Public Charging – Plug-In Vehicle Charging)

AVAILABILITY – Available only for the purpose of Plug-in Vehicle ("PIV") battery charging from Company-operated Level 2 (L2) and Direct Current Fast Charging (DCFC) public electric vehicle (EV) charging stations. All public EV charging stations will be sited on property either owned by government entities or government-associated organizations or controlled by those entities and other non-governmental entities (such as through easements, right-of-ways, or similar legal or equitable mechanisms). L2 charging stations shall cover applications with demand loads up to 19.2 kW. DCFC charging stations cover applications with demand loads greater than 19.2 kW.

The service provided under Schedule "PC-PIV" allows EV operators to charge their EV at a Company-owned public charging station. EV operators who reside either within the Company's service territory or outside the Company's service territory are eligible to charge their EV at a Company-owned station.

CHARGING RATE FOR EV OPERATOR

Charges under Schedule "PC-PIV" will be administered and billed through the Company's third-party vendor (Network Provider) on behalf of the Company. Information on opening an account with the Company's Network Provider is available on the Company's website. EV operators that charge their vehicle at a Company-owned station are subject to the payment terms of the Company's Network Provider.

Any EV operator using Company-operated public EV charging stations for the purpose of PIV battery charging shall pay for such service at the rates listed below. These rates are subject to change periodically, subject to Commission approval.

L2 Charging Stations:	$ x. xx per kwhr
DCFC Charging Stations:	$ x. xx per kwhr

Schedule "PC-PIV" is provided in conjunction with the contract for service under the applicable Rate Schedule (the Controlling Rate Schedule), as determined by the availability of each Rate Schedule. Controlling Schedule provisions apply, unless they are specifically altered herein.

APPLICABLE RIDERS

The applicable Riders for Schedule "PC-PIV" are determined by the Controlling Rate Schedule, unless they are specifically altered herein.

Rider "PIV-Green" provides 100% renewable energy on a mandatory basis to the Controlling Rate Schedules associated with Schedule "PC-PIV." Rider "PIV-Green" will be included in addition to the rates stated on Rate Schedule "PC-PIV".

RATE SCHEDULE PC-PIV
(Public Charging – Plug-In Vehicle Charging)

CORPORATE BUSINESS TAX (CBT)
Charges under this rate schedule include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)
Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT
The customer agrees to pay for plug-in vehicle charging at the point of sale.

TERMS AND CONDITIONS
See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE
A customer may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

NON-UTILITY OWNED PUBLIC DIRECT CURRENT FAST CHARGING (DCFC) RIDER “NUOPDCFC”

AVAILABILITY – Available only for non-residential customers with commercial owned properties. Where each property owner commits to the charger’s availability for public use at all times. Rider “NUOPDCFC” is limited to 120 Direct Current Fast Chargers (DCFC) and a maximum of 30 locations, with each location limited to a maximum of 4 DCFC. Rider “NUOPDCDC” is not available to existing customers with installed DCFC. The utility will deploy and own the “make ready” work up to the point of charger connection. This includes the service connection and a meter. The DCFC will be owned and operated by the customer. Rider “NUOPDCFC” includes a rate incentive described herein. Rider “NUOPDCFC” is available for Rate Schedules: “MGS-SECONDARY”, “MGS-PRIMARY”, “AGS-SECONDARY”, “AGS-PRIMARY”, and “TGS”. All other tariff surcharges and riders apply to the aforementioned Rate Schedules.

Application submission will begin on xxxx and terminate on xxxx. No new applications will be accepted after xxxx, and all project completion documentation must be submitted to the Company by xxxx. The rate incentive will be available beginning xxxx and will be determined each month as in Rider “NUOPDCFC” and will be an off-bill rebate for the account with the eligible installed and operational DCFC charging station(s). Charging stations must be put into service and avail be for use before the rate incentive in Rider “NUOPDCFC” will take effect. The maximum allowable term for the rate incentive rebate until the end of the 5-year PIV Program, or xxxx, regardless from the date of application and documentation approval.

Rate Incentive – The rate incentive fixes the cost of electricity for customers under Rider “NUOPDCFC” at a “Set point” of $0.20 cents per kilowatt hour (kWh). In a given billing month an off-bill rebate is provided to the customer if the customer’s monthly cost of electricity (MCE) is greater than $0.20 per kilowatt hour, where the customer’s cost of electricity in a given month is calculated as the total monthly bill costs (in dollars) divided by the total monthly bill kilowatt hours (in $/kWh). The rebate in a given month is:

((MCE - $0.20) multiplied by monthly kilowatt hours) = Monthly Rebate.

The rebate will vary from month to month and will be zero when the MCE is equal to or less than the set point of $0.20 cents per kilowatt hour.

CORPORATE BUSINESS TAX (CBT)

Charges under this rate schedule include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)

Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT

The customer agrees to make parking available for EVSE charging and to keep charging stations available for use.

TERMS AND CONDITIONS

See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE

A customer may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

PIV COMMUNITY AND TRANSIT CHARGING PROGRAMS
RIDER "CTCP"

AVAILABILITY – This rider describes the (3) Plug-in-vehicle Community and Transit Programs available to customers. Interested Customers should submit an application with the Company to see if they are eligible to participate in any of the (3) Programs as described herein. The Company at its discretion will determine if and how much funding / grants will be awarded to the applicant.

INNOVATION FUND

The innovation fund is intended to support transportation electrification area needs within the Company's service territory. Projects include but are not limited to: PIV Car Sharing, Vehicle to Grid charging, port electrification, and battery / resiliency pilots. Each potential project must be related to vehicle electrification. The proposed awards under the Innovation fund would be a grant that would be limited to 50% of the net project amount after applying all other applicable incentives, grants, awards and discounts.

ELECTRIC SCHOOL BUS FUND

The Electric School Bus Fund is for public K-12 school districts within the Company's service territory. This Fund will be limited to 20 electric school buses and $250,000 for the incremental cost of an electric school bus compared to a traditional diesel-based bus vehicle. There is a limit of two buses per district. In addition, The Electric School Bus Fund will provide the required charging infrastructure for the electric school buses to a maximum of $25,000 per Electric Vehicle Supply Equipment (EVSE) and a maximum of 2 EVSE per district.

NEW JERESY TRANSIT BUS ELECTRIFICATION

The New Jersey Transit Bus Electrification Program within RIDER "CTCP" is targeted at New Jersey Transit bus depots in the Company's service territory. The bus depots in the Company's service territory include depots in the following Townships (1) Egg Harbor Township and (2) Washington Township. This offer is exclusive to one bus depot within the Company's service territory as selected by New Jersey Transit, and provides up to $2.5 million in funding for electrification of a bus depot.

GREEN ADDER
RIDER "PIV-GREEN"

AVAILABILITY – This rider provides 100% renewable energy on an opt-in basis to Schedules "RS-PIV", and on a mandatory basis to the Controlling Rate Schedules associated with Schedule "PC-PIV".

This rider is a dollar per kilowatt-hour rate and is applied to the Customer's billed kilowatt-hours. This rider will be updated based on the most up-to-date market prices, the New Jersey Renewable Portfolio Standards, and include a true-up from the difference between the previous 12-month period of revenues received from Rider "PIV-GREEN" and expenses (from Renewable Energy Credit purchases) with short-term interest. The true-up portion of the charge (in dollars per kilowatt hour) will be determined by dividing the difference in revenues and expenses by the total annual forecast kilowatt hour sales. The charge reflected within RIDER "PIV-GREEN" will be the sum of (1) the most up-to-date market prices and (2) the true-up charge as described herein. Rider "PIV-Green" will be updated on or about February 1st of each year.

The current applicable Rider "PIV-Green" rate is equal to $0.054300 per kilowatt-hour.

GREEN ADDER
RIDER "PIV-GREEN"

CORPORATE BUSINESS TAX (CBT)
Charges under this rate schedule include a component for Corporate Business Taxes as set forth in Rider CBT.

NEW JERSEY SALES AND USE TAX (SUT)
Charges under this rate schedule include a component for New Jersey Sales and Use Tax as set forth in Rider SUT.

TERM OF CONTRACT
The customer agrees to pay Rider "PIV-Green" to receive 100% renewable energy. The customer may opt-out of Rider "PIV-Green" at any time, and will take effect in the next billing cycle.

TERMS AND CONDITIONS
See Section II inclusive for Terms and Conditions of Service.

"In accordance with P.L. 1997, c. 162, the charges in this Rate Schedule includes provision for the New Jersey Corporation Business Tax and the New Jersey Sales and Use Tax. When billed to customers exempt from one or more of these taxes, as set forth in Riders CBT and SUT, such charges will be reduced by the relevant amount of such taxes included therein."

PRICE TO COMPARE
A customer may not choose to receive electric supply from a third party supplier as defined in Section 11 of the Standard Terms and Conditions of this Tariff.

Schedule (MTN)-3

Atlantic City Electric - New Jersey - Proposal - Summary

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
	Cost Component			Capital Costs	Regulatory Asset Costs	Estimated Total Cost	Total Cost to Residential Customers ($)	Total Cost to Other Customers ($)
(1)	Whole House TOU (Offering 1)			$ 120,000.00	$ 428,133.00	$ 548,133.00	$ 548,133.00	$ -
(2)	Off Peak Charging Incentive (Offering 2)			$ 24,000.00	$ 1,037,156.00	$ 1,061,156.00	$ 1,061,156.00	$ -
(3)	Residential Rebate/ Manage Charging Program (Offering 3)			$ 1,875,000.00	$ 4,273,883.09	$ 6,148,883.09	$ 6,148,883.09	$ -
(4)	Multi-Dwelling Unit Charging (Offering 4)			$ 167,500.00	$ 2,635,102.00	$ 2,802,602.00	$ -	$ 2,802,602.00
(5)	Workplace Charging (Offering 5)			$ 118,750.00	$ 1,519,528.00	$ 1,638,278.00	$ -	$ 1,638,278.00
(6)	Fleet Charging (Offering 6)			$ 118,750.00	$ 1,519,529.00	$ 1,638,279.00	$ -	$ 1,638,279.00
(7)	Utility-Owned DCFC's (Offering 7)			$ 4,174,200.00	$ 1,032,633.00	$ 5,206,833.00	$ 3,088,975.34	$ 2,117,857.66
(8)	Utility-Owned Public Level 2 Charging (Offering 8)			$ 6,776,700.00	$ 1,787,633.00	$ 8,564,333.00	$ 5,080,464.37	$ 3,483,868.63
(9)	Non-Utility-Owned Public Chargers (Offering 9)			$ 1,650,000.00	$ 2,848,913.00	$ 4,498,913.00	$ -	$ 4,498,913.00
(10)	Innovation Fund (Offering 10)			$ -	$ 2,000,000.00	$ 2,000,000.00	$ 1,188,118.38	$ 811,881.62
(11)	Electric School Bus Fund (Offering 11)			$ -	$ 5,500,000.00	$ 5,500,000.00	$ 3,267,325.54	$ 2,232,674.46
(12)	NJ Transit Bus Electrification (Offering 12)			$ -	$ 2,500,000.00	$ 2,500,000.00	$ 1,485,147.97	$ 1,014,852.03
(13)	Total			$ 15,024,900.00	$ 27,082,510.09	$ 42,107,410.09	$ 21,868,203.68	$ 20,239,206.40

Source: Refer to Lines (1) to (10) & (13) to (25) of "Class Weighting", Page 4 of 12

	Rate Impact Calculation - Residential	Reg Asset Amount	Capital Amount	Total	
(14)	Levelized Annual Residential Revenue Requirement - Capital	$0	$988,307	$988,307	Source: Line (30) of "Cap Asset Amortization - Capital - Residential", Page 8 of 12.
(15)	Levelized Annual Residential Revenue Requirement - Reg Asset	$2,172,469	$0	$2,172,469	Source: Line (31) of "Program Regulatory Asset Amortization - Residential", Page 9 of 12.
(16)	Levelized Residential Revenue Requirement - Total	$2,172,469	$988,307	$3,160,776	Calculation: Line (14) + Line (15)
(17)	Annual kWh per Class	3,983,153,885	3,983,153,885	3,983,153,885	Source: Line (1) of "As-Billed Billing Determinants", Page 6 of 12.
(18)	Rate ($/kWh)	$ 0.000545	$ 0.000248	$ 0.000794	Calculation: Line (16) / Line (17)
(19)	Typical Monthly Usage	679.00	679.00	679.00	Source: Page 3 of the 3/13/2019 Decision (BPU Docket No. ER18080925).
(20)	**Cost Per Residential Customer Per Month**	**$ 0.37**	**$ 0.17**	**$ 0.54**	Calculation: Line (18) x Line (19)

ACE EV Filing - Reg Asset Cost Breakdown Analysis

Offering 1 - Whole House TOU

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(1)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(2)	Individual Offering Total				$ 428,133.00

Offering 2 - Residential Off-Peak: Based On Vehicle Data

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(3)	Vehicle Charging Device	Program Cost	300	$ 99.00	$ 29,700.00
(4)	Systems Interfaces and Updates	Program Cost			$ 417,000.00
(5)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(6)	Off Bill / Off Peak Incentive Delivered	Program Cost			$ 162,323.00
(7)	Individual Offering Total				$ 1,037,156.00

Offering 3 - Residential Managed Charging: Based On EVSE Data

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(8)	Home Assessment/Visit for Prequalification	Program Cost	1875	$ 500.00	$ 937,500.00
(9)	Rebate: New Smart Level 2 EVSE (50% of allowed costs)	Program Cost	1500	$ 500.00	$ 750,000.00
(10)	Rebate: Installation (50% of allowed costs)	Program Cost	1500	$ 500.00	$ 750,000.00
(11)	Systems Interfaces and Updates	Program Cost			$ 450,000.00
(12)	Customer Enrollment and Outreach	Program Cost			$ 428,134.00
(13)	Off Bill / Off Peak At Home Incentive Delivered	Program Cost			$ 958,249.09
(14)	Individual Offering Total				$ 4,273,883.09

Offering 4: Commercial - MDU (Multi-Dwelling Units - Condos, Apartments)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(15)	Facility Assessment/Visit for Prequalification	Program Cost	83	$ 800.00	$ 66,400.00
(16)	Rebate: New Smart Level 2 EVSE (50% of allowed costs, w/ payment module & cell)	Program Cost	200	$ 2,500.00	$ 500,000.00
(17)	Rebate: Installation - (100% of allowed costs, up to $10,000 max per site)	Program Cost	67	$ 10,000.00	$ 670,000.00
(18)	Systems Interfaces and Updates	Program Cost			$ 402,000.00
(19)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(20)	Demand Charge Credit Incentive Delivered	Program Cost			$ 568,569.00
(21)	Individual Offering Total				$ 2,635,102.00

Offering 5: Commercial - Workplace (Charging For Employees)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(22)	Facility Assessment/Visit for Prequalification	Program Cost	38	$ 800.00	$ 30,400.00
(23)	Rebate: New Smart Level 2 EVSE (50% of allowed costs, w/ payment module & cell)	Program Cost	150	$ 2,500.00	$ 375,000.00
(24)	Rebate: Installation - (no incentive for "make ready" or EVSE installation)	Program Cost	30	$ -	$ -
(25)	Systems Interfaces and Updates	Program Cost			$ 285,000.00
(26)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(27)	Demand Charge Credit Incentive Delivered	Program Cost			$ 400,995.00
(28)	Individual Offering Total				$ 1,519,528.00

Offering 6: Commercial - Fleet (Charging For Fleet Vehicles)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(29)	Facility Assessment/Visit for Prequalification	Program Cost	38	$ 800.00	$ 30,400.00
(30)	Rebate: New Smart Level 2 EVSE (50% of allowed costs, w/ payment module & cell)	Program Cost	150	$ 2,500.00	$ 375,000.00
(31)	Rebate: Installation - (no incentive for "make ready" or EVSE installation)	Program Cost	30	$ -	$ -
(32)	Systems Interfaces and Updates	Program Cost			$ 285,000.00
(33)	Customer Enrollment and Outreach	Program Cost			$ 428,134.00
(34)	Demand Charge Credit Incentive Delivered	Program Cost			$ 400,995.00
(35)	Individual Offering Total				$ 1,519,529.00

Offering 7: Utility Owned DCFC For Public Use

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(36)	EVSE Warranty	Program Cost	45	$ -	$ -
(37)	All Other Development Costs (signage, lighting, bollards, landscaping, etc)	Program Cost	15	$ 8,000.00	$ 120,000.00
(38)	Project Management	Program Cost	15	$ 15,780.00	$ -
(39)	Construction Contingency	Program Cost	15	$ 26,300.00	$ 394,500.00
(40)	Systems Interfaces and Updates	Program Cost			$ 90,000.00
(41)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(42)	Other Overhead (G&A, E &S, etc)	Program Cost	15	$ -	$ -
(43)	Individual Offering Total				$ 1,032,633.00

Offering 8: Utility Owned L2 For Public Use

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(44)	EVSE Warranty	Program Cost	200	$ -	$ -
(45)	All Other Development Costs (signage, lighting, bollards, landscaping, etc)	Program Cost	65	$ 8,000.00	$ 520,000.00
(46)	Project Management	Program Cost	65	$ 6,180.00	$ -
(47)	Construction Contingency	Program Cost	65	$ 8,300.00	$ 539,500.00
(48)	Systems Interfaces and Updates	Program Cost			$ 300,000.00
(49)	Customer Enrollment and Outreach	Program Cost			$ 428,133.00
(50)	Other Overhead (G&A, E &S, etc)	Program Cost	65	$ -	$ -
(51)	Individual Offering Total				$ 1,787,633.00

Offering 9: DCFC - Non Utility Public DCFC Incentive

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(52)	Customer Enrollment and Outreach	Program Cost			$ 428,134.00
(53)	Demand Charge Credit (via "set-point" design: 20 cents/kwhr)	Program Cost			$ 2,420,779.00
(54)	Individual Offering Total				$ 2,848,913.00

Offering 10 - Innovation Fund

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(55)	Innovation Fund	Program Cost			$ 2,000,000.00

Offering 11 - Electric School Bus - Bus Incentive and Charging Infrastructure

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(56)	Electric School Bus - Bus Incentive and Charging Infrastructure	Program Cost			$ 5,500,000.00

Offering 12 - NJ Transit - Charging Infrastructure

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(57)	NJ Transit - Charging Infrastructure	Program Cost			$ 2,500,000.00

(58)	**Total Reg Asset**		$ 27,082,510.09

Column (E): Sum of "Estimated Cost ($)" for each individual offering by cost component. Please refer to the note associated with "*".

* Represents the "Estimated Cost ($)" for each cost component assuming only that individual offering is approved.

ACE EV Filing -Capital Cost Breakdown Analysis

Offering 1 - Whole House TOU

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(1)	Replace Interval Meter	Capital Asset	300	$ 100.00	$ 30,000.00
(2)	Meter Upgrade (labor and other installation costs by utility)	Capital Asset	300	$ 300.00	$ 90,000.00
(3)	Individual Offering Total				$ 120,000.00

Offering 2 - Residential Off-Peak: Based On Vehicle Data

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(4)	Software	Capital Asset			$ 24,000.00
(5)	Individual Offering Total				$ 24,000.00

Offering 3 - Residential Managed Charging: Based On EVSE Data

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(6)	Software	Capital Asset			$ 1,875,000.00
(7)	Individual Offering Total				$ 1,875,000.00

Offering 4: Commercial - MDU (Multi-Dwelling Units - Condos, Apartments)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(8)	Software	Capital Asset			$ 167,500.00
(9)	Individual Offering Total				$ 167,500.00

Offering 5: Commercial - Workplace (Charging For Employees)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(10)	Software	Capital Asset			$ 118,750.00
(11)	Individual Offering Total				$ 118,750.00

Offering 6: Commercial - Fleet (Charging For Fleet Vehicles)

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(12)	Software	Capital Asset			$ 118,750.00
(13)	Individual Offering Total				$ 118,750.00

Offering 7: Utility Owned DCFC For Public Use

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(14)	Site Engineering and Development (assessment, contracting, design, permits)	Capital Asset	15	$ 15,000.00	$ 225,000.00
(15)	New Service & Infrastructure -> EVSE (service drop, new meter, transformer, etc)	Capital Asset	15	$ 40,000.00	$ 600,000.00
(16)	DCFC EVSE (assumes at least 50KW units, CHaDEMO/CCS)	Capital Asset	45	$ 50,000.00	$ 2,250,000.00
(17)	Installation (EVSE installation, testing, commissioning, network activation)	Capital Asset	15	$ 50,000.00	$ 750,000.00
(18)	Project Management	Program Cost	15	$ 15,780.00	$ 236,700.00
(19)	Software	Capital Asset			$ 112,500.00
(20)	Individual Offering Total				$ 4,174,200.00

Offering 8: Utility Owned L2 For Public Use

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(21)	Site Engineering and Development (assessment, contracting, design, permits)	Capital Asset	65	$ 15,000.00	$ 975,000.00
(22)	New Service & Infrastructure -> EVSE (service drop, new meter, transformer, etc)	Capital Asset	65	$ 40,000.00	$ 2,600,000.00
(23)	L2 EVSE (assumes dual-plugs 7.2KW, J1772)	Capital Asset	200	$ 5,000.00	$ 1,000,000.00
(24)	Installation (EVSE installation, testing, commissioning, inspection, activation)	Capital Asset	65	$ 20,000.00	$ 1,300,000.00
(25)	Project Management	Capital Asset	65	$ 6,180.00	$ 401,700.00
(26)	Software	Capital Asset			$ 500,000.00
(27)	Individual Offering Total				$ 6,776,700.00

Offering 9: DCFC - Non Utility Public DCFC Incentive

	(A)	(B)	(C)	(D)	(E) = (D) x (C)
	Program Components	Type	Units	Cost Per Unit	Estimated Cost*
(28)	Site Engineering and Development (assessment, contracting, design, permits)	Capital Asset	30	$ 15,000.00	$ 450,000.00
(29)	New Service & Make-Ready -> EVSE (service drop, new meter, transformer, etc)	Capital Asset	30	$ 40,000.00	$ 1,200,000.00
(30)	Individual Offering Total				$ 1,650,000.00

(31)	**Total Capital**				$ 15,024,900.00

Column (E): Sum of "Estimated Cost ($)" for each individual offering by cost component. Please refer to the note associated with "*".

* Represents the "Estimated Cost ($)" for each cost component assuming only that individual offering is approved.

Class Weighting

Calculation of the Allocation of Capital Asset Costs

	(A)	(B)	(C)	(D)	(E) = (B) x (C)	(F) = (B) x (D)
	Offering #	Total Capital Assets	Residential %	Other Customer %	Residential Contribution	Other Customer Contribution
(1)	Whole House TOU (Offering 1)	$ 120,000.00	100%	0%	$ 120,000.00	$ -
(2)	Off Peak Charging Incentive (Offering 2)	$ 24,000.00	100%	0%	$ 24,000.00	$ -
(3)	Residential Rebate/ Manage Charging Program (Offering 3)	$ 1,875,000.00	100%	0%	$ 1,875,000.00	$ -
(4)	Multi-Dwelling Unit Charging (Offering 4)	$ 167,500.00	0%	100%	$ -	$ 167,500.00
(5)	Workplace Charging (Offering 5)	$ 118,750.00	0%	100%	$ -	$ 118,750.00
(6)	Fleet Charging (Offering 6)	$ 118,750.00	0%	100%	$ -	$ 118,750.00
(7)	Utility-Owned DCFC's (Offering 7)	$ 4,174,200.00	59%	41%	$ 2,479,721.87	$ 1,694,478.13
(8)	Utility-Owned Public Level 2 Charging (Offering 8)	$ 6,776,700.00	59%	41%	$ 4,025,760.90	$ 2,750,939.10
(9)	Non-Utility-Owned Public Chargers (Offering 9)	$ 1,650,000.00	0%	100%	$ -	$ 1,650,000.00
(10)	Total	$ 15,024,900.00			$ 8,524,482.77	$ 6,500,417.23

Column (B): Refer to Column (E) of "Capital Cost Breakdown Analysis", Page 3 of 12, for each respective offering

Column (C) and (D): For Commercial Offerings, 100% of costs associated with capital assets are allocated to Commercial customers; for Residential Offerings, 100% are allocated to residential customers; for all other offerings, shared costs associated with capital assets are allocated based on the split of Total Delivery Revenues as shown on Lines (11) and (12) of "Total Delivery Revenues", Page 5 of 12.

Allocation of Regulatory Asset Costs

	(A)	(B)	(C)	(D)	(E) = (B) x (C)	(F) = (B) x (D)
	Offering #	Total Regulatory Asset	Residential %	Other Customer %	Residential Contribution	Other Customer Contribution
(13)	Whole House TOU (Offering 1)	$ 428,133.00	100%	0%	$ 428,133.00	$ -
(14)	Off Peak Charging Incentive (Offering 2)	$ 1,037,156.00	100%	0%	$ 1,037,156.00	$ -
(15)	Residential Rebate/ Manage Charging Program (Offering 3)	$ 4,273,883.09	100%	0%	$ 4,273,883.09	$ -
(16)	Multi-Dwelling Unit Charging (Offering 4)	$ 2,635,102.00	0%	100%	$ -	$ 2,635,102.00
(17)	Workplace Charging (Offering 5)	$ 1,519,528.00	0%	100%	$ -	$ 1,519,528.00
(18)	Fleet Charging (Offering 6)	$ 1,519,529.00	0%	100%	$ -	$ 1,519,529.00
(19)	Utility-Owned DCFC's (Offering 7)	$ 1,032,633.00	59%	41%	$ 609,253.47	$ 423,379.53
(20)	Utility-Owned Public Level 2 Charging (Offering 8)	$ 1,787,633.00	59%	41%	$ 1,054,703.47	$ 732,929.53
(21)	Non-Utility-Owned Public Chargers (Offering 9)	$ 2,848,913.00	0%	100%	$ -	$ 2,848,913.00
(22)	Innovation Fund (Offering 10)	$ 2,000,000.00	59%	41%	$ 1,188,118.38	$ 811,881.62
(23)	Electric School Bus Fund (Offering 11)	$ 5,500,000.00	59%	41%	$ 3,267,325.54	$ 2,232,674.46
(24)	NJ Transit Bus Electrification (Offering 12)	$ 2,500,000.00	59%	41%	$ 1,485,147.97	$ 1,014,852.03
(25)	Total	$ 27,082,510.09			$ 13,343,720.91	$ 13,738,789.17

Column (B): Refer to Column (E) of "Reg Asset Cost Breakdown Analysis", Page 2 of 12, for each respective offering

Column (C) and (D): For Commercial Offerings, 100% of costs associated with capital assets are allocated to Commercial customers; for Residential Offerings, 100% are allocated to residential customers; for all other offerings, shared costs associated with capital assets are allocated based on the split of Total Delivery Revenues as shown on Lines (11) and (12) of "Total Delivery Revenues", Page 5 of 12.

Program Cost Allocation Percentage

	(A)	(B)	
(11)	Residential	59%	Source: Line (11) of "Total Delivery Revenues", page 5 of 12.
(12)	Other Customer	41%	Source: Line (12) of "Total Delivery Revenues", page 5 of 12.

Total Delivery Revenue (Proposed Revenue)

	(A)	(B)	(C)	(D)
	Type	Rate Schedule	Amount	% Allocation
(1)	Residential	RS	$ 252,856,698	59%
(2)	Other Customer	MGS-SECONDARY	$ 76,125,408	18%
(3)	Other Customer	MGS-PRIMARY	$ 1,439,528	0%
(4)	Other Customer	AGS-SECONDARY	$ 59,322,342	14%
(5)	Other Customer	AGS-PRIMARY	$ 11,486,945	3%
(6)	Other Customer	TGS-Sub Transmission	$ 3,525,450	1%
(7)	Other Customer	TGS-Transmission	$ 2,141,460	1%
(8)	Other Customer	Streetlighting Service	$ 18,182,872	4%
(9)	Other Customer	Direct Dist. Connection	$ 561,561	0%
(10)	Total		$ 425,642,264	100%

Column (C): Source: "Exhibit A", Page 1 of 12, from the 3/13/2019 Decision and Order Adopting Initial Decision and Stipulation of Settlement. (BPU Docket No. ER18080925).

Column (D): Calculation: Column (C), Line (1) / Column (C), Line (10) for Column (D), Line 1; and so on.

Total Delivery Revenue - Residential Vs. Other Customer

(11)	Residential	59%	Source: Column (E), Line (1)
(12)	Other Customer	41%	Calculation: 1 - Line (11)

As-Billed Billing Determinants (Exclude Lighting & Direct Distribution Connection)

	(A)	(B)	(C)
	Type	Rate Schedule	kWh
(1)	Residential	RS	3,983,153,885
(2)	Other Customer	MGS-SECONDARY	1,262,257,212
(3)	Other Customer	MGS-PRIMARY	37,625,999
(4)	Other Customer	AGS-SECONDARY	-
(5)	Other Customer	AGS-PRIMARY	-
(6)	Other Customer	TGS-Sub Transmission	-
(7)	Other Customer	TGS-Transmission	-
(8)	Total		5,283,037,096

Column (C): Source: "Exhibit A", Pages 2 to 12 of 12, from the 3/13/2019 Decision and Order Adopting Initial Decision and Stipulation of Settlement (BPU Docket No. ER18080925).

As-Billed Billing Determinants- Residential Vs. Other Customer

(9)	Residential	3,983,153,885	Calculation: Line (1)
(10)	Other Customer	1,299,883,211	Calculation: Line (2) + Line (3) + ... + Line (6) + Line (7)

ACE NJ
Residential Revenue Requirement - Summary

(1)	ACE NJ - Residential Rev Rqmt	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
(2)	Net Levelized Annual Revenue Requirement - Capital	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 14,824,610
(3)	Levelized Annual Revenue Requirement - RA	$ 2,172,469	$ 2,172,469	$ 2,172,469	$ 2,172,469	$ 2,172,469	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,862,343
(4)	Revenue Requirement - Total	$ 3,160,776	$ 3,160,776	$ 3,160,776	$ 3,160,776	$ 3,160,776	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 988,307	$ 25,686,953

(5)	Cost-Benefit Analysis Input	Amount
(6)	Year 1-8 Revenue Requirement	$ 18,768,802

(7)	ACE NJ - Levelized Monthly Bill Impact	Amount
(8)	Levelized Monthly Bill Impact - Capital	$ 0.17
(9)	Levelized Monthly Bill Impact - O&M	$ 0.37
(10)	Total Levelized Monthly Bill Impact	$ 0.54

ACE New Jersey
Cap Asset Amortization - Capital - Residential

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
(1) **Rate Base:**															
(2) Unamortized Balance	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900	$ 15,024,900
(3) Amortized Balance	$ 1,001,660	$ 2,003,320	$ 3,004,980	$ 4,006,640	$ 5,008,300	$ 6,009,960	$ 7,011,620	$ 8,013,280	$ 9,014,940	$ 10,016,600	$ 11,018,260	$ 12,019,920	$ 13,021,580	$ 14,023,240	$ 15,024,900
(4) Net Rate Base	$ 14,023,240	$ 13,021,580	$ 12,019,920	$ 11,018,260	$ 10,016,600	$ 9,014,940	$ 8,013,280	$ 7,011,620	$ 6,009,960	$ 5,008,300	$ 4,006,640	$ 3,004,980	$ 2,003,320	$ 1,001,660	$ -
(5) **Operating Income:**															
(6) Depreciation	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660
(7) SIT-Current	$ (119,051)	$ (116,987)	$ (114,922)	$ (112,858)	$ (110,794)	$ (108,729)	$ (106,665)	$ (104,600)	$ (102,536)	$ (100,472)	$ (98,407)	$ (96,343)	$ (94,278)	$ (92,214)	$ (90,149)
(8) FIT-Current	$ (252,786)	$ (248,402)	$ (244,019)	$ (239,635)	$ (235,252)	$ (230,868)	$ (226,485)	$ (222,101)	$ (217,718)	$ (213,334)	$ (208,951)	$ (204,568)	$ (200,184)	$ (195,801)	$ (191,417)
(9) Deferred Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(10) Total Operating Expenses	$ 629,823	$ 636,271	$ 642,719	$ 649,167	$ 655,615	$ 662,062	$ 668,510	$ 674,958	$ 681,406	$ 687,854	$ 694,302	$ 700,750	$ 707,198	$ 713,645	$ 720,093
(11) Return Required	$ 992,845	$ 921,928	$ 851,010	$ 780,093	$ 709,175	$ 638,258	$ 567,340	$ 496,423	$ 425,505	$ 354,588	$ 283,670	$ 212,753	$ 141,836	$ 70,918	$ -
(12) Required Oper. Income	$ 1,622,669	$ 1,558,199	$ 1,493,729	$ 1,429,260	$ 1,364,790	$ 1,300,320	$ 1,235,851	$ 1,171,381	$ 1,106,911	$ 1,042,442	$ 977,972	$ 913,502	$ 849,033	$ 784,563	$ 720,093
(13) Revenue Conversion Factor	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101	1.39101
(14) **Revenue Requirement**	$ 2,257,155	$ 2,167,476	$ 2,077,798	$ 1,988,120	$ 1,898,442	$ 1,808,764	$ 1,719,086	$ 1,629,407	$ 1,539,729	$ 1,450,051	$ 1,360,373	$ 1,270,695	$ 1,181,016	$ 1,091,338	$ 1,001,669
(15) **Income Statement Check**															
(16) Revenue	$ 2,257,155	$ 2,167,476	$ 2,077,798	$ 1,988,120	$ 1,898,442	$ 1,808,764	$ 1,719,086	$ 1,629,407	$ 1,539,729	$ 1,450,051	$ 1,360,373	$ 1,270,695	$ 1,181,016	$ 1,091,338	$ 1,001,660
(17) Depreciation & Amortization	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660
(18) Interest Expense	$ 321,132	$ 298,194	$ 275,256	$ 252,318	$ 229,380	$ 206,442	$ 183,504	$ 160,566	$ 137,628	$ 114,690	$ 91,752	$ 68,814	$ 45,876	$ 22,938	$ -
(19) Net income before Taxes	$ 934,362	$ 867,622	$ 800,882	$ 734,142	$ 667,402	$ 600,662	$ 533,921	$ 467,181	$ 400,441	$ 333,701	$ 266,961	$ 200,221	$ 133,480	$ 66,740	$ -
(20) Income Tax - Current	$ 262,649	$ 243,889	$ 225,128	$ 206,367	$ 187,607	$ 168,846	$ 150,085	$ 131,325	$ 112,564	$ 93,803	$ 75,043	$ 56,282	$ 37,521	$ 18,761	$ -
(21) Income Tax - Deferred	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(22) Earnings	$ 671,713	$ 623,734	$ 575,754	$ 527,775	$ 479,795	$ 431,816	$ 383,836	$ 335,857	$ 287,877	$ 239,898	$ 191,918	$ 143,939	$ 95,959	$ 47,980	$ -
(23) Return on Equity per WACC	$ 671,713	$ 623,734	$ 575,754	$ 527,775	$ 479,795	$ 431,816	$ 383,836	$ 335,857	$ 287,877	$ 239,898	$ 191,918	$ 143,939	$ 95,959	$ 47,980	$ -
(24) MACRS	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660	$ 1,001,660

(25) **Revenue Requirement Summary**	
(26) Period (years)	15.00
(27) NPV of Cost Rev Req.	$15,785,669
(28) Levelized Annual Revenue Requirement	$1,741,950
(29) % Assigned to Residential Class	57%
(30) Levelized Annual Revenue Requirement - Residential	$988,307.32
(31) Annual Residential kWh	3,983,153,885
(32) $/kWh Residential Charge	$ 0.0002
(33) ACE NJ - Typical Monthly Residential Usage	679.00
(34) ACE NJ - Typical Monthly Residential Cost	$ 0.168

ACE New Jersey
Program Regulatory Asset Amortization - Residential

		Year 1	Year 2	Year 3	Year 4	Year 5
(1)	Rate Base:					
(2)	Unamortized Balance	$ 27,082,510	$ 27,082,510	$ 27,082,510	$ 27,082,510	$ 27,082,510
(3)	Amortized Balance	$ 2,668,744	$ 5,337,488	$ 8,006,233	$ 10,674,977	$ 13,343,721
(4)	Net Rate Base	$ 24,413,766	$ 21,745,022	$ 19,076,278	$ 16,407,533	$ 13,738,789
(5)	Operating Income:					
(6)	Amortization	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744
(7)	SIT-Current	$ (290,504)	$ (285,003)	$ (279,503)	$ (274,003)	$ (268,503)
(8)	FIT-Current	$ (616,836)	$ (605,157)	$ (593,478)	$ (581,799)	$ (570,121)
(9)	Deferred Taxes	$ -	$ -	$ -	$ -	$ -
(10)	Total Operating Expenses	$ 1,761,404	$ 1,778,583	$ 1,795,763	$ 1,812,942	$ 1,830,121
(11)	Return Required	$ 1,728,495	$ 1,539,548	$ 1,350,600	$ 1,161,653	$ 972,706
(12)	Required Oper. Income	$ 3,489,899	$ 3,318,131	$ 3,146,363	$ 2,974,595	$ 2,802,827
(13)	Revenue Conversion Factor	1.39101	1.39101	1.39101	1.39101	1.39101
(14)	**Revenue Requirement**	**$ 4,854,498**	**$ 4,615,567**	**$ 4,376,635**	**$ 4,137,704**	**$ 3,898,772**
(15)	**Income Statement Check**					
(16)	Revenue	$ 4,854,498	$ 4,615,567	$ 4,376,635	$ 4,137,704	$ 3,898,772
(17)	Depreciation & Amortization	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744
(18)	Interest Expense	$ 559,075	$ 497,961	$ 436,847	$ 375,733	$ 314,618
(19)	Net income before Taxes	$ 1,626,679	$ 1,448,862	$ 1,271,044	$ 1,093,227	$ 915,410
(20)	Income Tax - Current	$ 457,259	$ 407,275	$ 357,291	$ 307,306	$ 257,322
(21)	Income Tax - Deferred	$ -	$ -	$ -	$ -	$ -
(22)	Earnings	$ 1,169,419	$ 1,041,587	$ 913,754	$ 785,921	$ 658,088
(23)	Return on Equity per WACC	$ 1,169,419	$ 1,041,587	$ 913,754	$ 785,921	$ 658,088
(24)	MACRS	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744	$ 2,668,744

(25)	**Revenue Requirement Summary**	
(26)	Period (years)	5.00
(27)	NPV of Cost Rev Req.	$18,040,168
(28)	Levelized Annual Revenue Requirement	$4,409,258
(29)	Less: Public Charging Revenues	TBD
(30)	% Assigned to Residential Class	49%
(31)	Levelized Annual Revenue Requirement - Residential	$2,172,469
(32)	Annual Residential kWh	3,983,153,885
(33)	$/kWh Residential Charge	$ 0.0005
(34)	ACE NJ - Typical Monthly Residential Usage	679.00
(35)	ACE NJ - Typical Monthly Residential Cost	$ 0.370

Regulatory Asset - Capital - Amortization

(1)	Total Capital	$ 15,024,900.00

(2)	ACE NJ - Residential	Year 1	Year 2	Year 3	Year 4	Year 5
(3)	Deployment Schedule (5-Year)	100%	0%	0%	0%	0%

(4)	ACE NJ - Residential	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
(5)	Incremental Gross Plant	$ 15,024,900.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(6)	Accumulated Gross Plant	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00	$ 15,024,900.00
									$ 1,636,279.00							

(7)	ACE NJ - Residential	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
(8)	Amortization Expense - Year 1	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 15,024,900.00
(9)	Amortization Expense - Year 2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(10)	Amortization Expense - Year 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(11)	Amortization Expense - Year 4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(12)	Amortization Expense - Year 5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(13)	Total Amortization Expense	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 1,001,660.00	$ 15,024,900.00

(14)	ACE NJ - Residential	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
(15)	Cumulative Amortization	$ 1,001,660.00	$ 2,003,320.00	$ 3,004,980.00	$ 4,006,640.00	$ 5,008,300.00	$ 6,009,960.00	$ 7,011,620.00	$ 8,013,280.00	$ 9,014,940.00	$ 10,016,600.00	$ 11,018,260.00	$ 12,019,920.00	$ 13,021,580.00	$ 14,023,240.00	$ 15,024,900.00

WACC Capital Structure	Weight	Rate	Weighted Rate
Long Term Debt	50.06%	4.58%	2.29%
Common Stock	49.94%	9.60%	4.79%
Total	100.00%		7.08%
Source: BPU Docket No. ER18080925			

	Revenue Conversion Factor		
	Tax Rates		**Source / Notes:**
(1)	Federal Income Tax Rate	0.210000	**Current Federal Corporate Income Tax Rate**
(2)	New Jersey State Income Tax Rate	0.090000	**Current NJ Corporate Income Tax Rate**
(3)	New Jersey - BPU Assessment and Ratepayer Advocate	0.00245	**Current NJ BPU Assessment and Ratepayer Advocate**
	Conversion Factor (Income Tax Only)		
(4)	NJ Taxable Income	1.000000	**(4) = 1**
(5)	NJ Income Tax	0.090000	**(5) = (2) x (4)**
(6)	Federal Taxable Income	0.910000	**(6) = (4) - (5)**
(7)	Federal Income Tax	0.191100	**(7) = (1) x (6)**
(8)	Total Additional Taxes	0.281100	**(8) = (5) + (7)**
(9)	Increase in Earnings (1 - Additional Taxes)	0.718900	**(9) = 1 - (8)**
(10)	Revenue Conversion Factor (1 / Increase in Earnings)	1.391014	**(10) = 1 / (9)**
	Conversion Factor (Including BPU Assessment / Ratepayer Advocate)		
(11)	NJ Assessment	1.000000	**(11) = 1**
(12)	NJ Assessment Tax Rate	0.002452	**(12) = (3) x (11)**
(13)	NJ Taxable Income	0.997548	**(13) = (11) - (12)**
(14)	NJ Income Tax	0.089779	**(14) = (2) x (13)**
(15)	Federal Taxable Income	0.907769	**(15) = (11) - (12) - (14)**
(16)	Federal Income Tax	0.190631	**(16) = (15) x (1)**
(17)	Total Additional Taxes	0.282863	**(17) = (12) + (14) + (16)**
(18)	Increase in Earnings (1 - Additional Taxes)	0.717137	**(18) = 1 - (17)**
(19)	Revenue Conversion Factor (1 / Increase in Earnings)	1.394433	**(19) = 1 / (18)**

Schedule (MTN)-4

ACE - Rate Schedule Summary

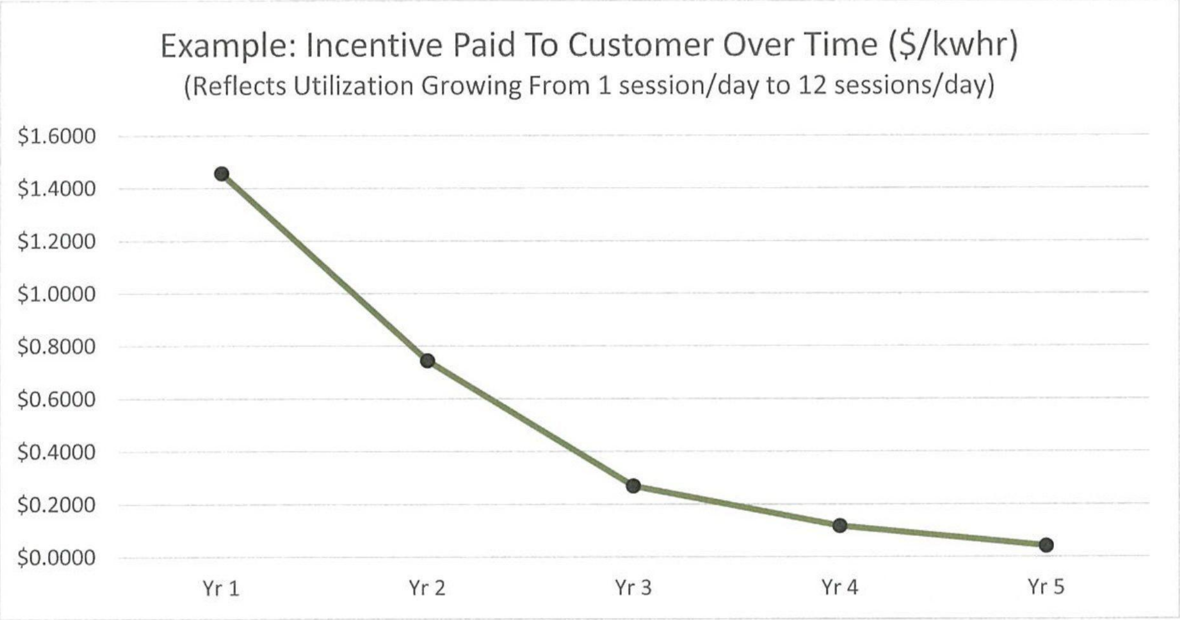
(1)	**Offering**	**Original Petition**	**Amended Petition**
(2)	Offering 1	RS-PIV	RS-PIV
(3)	Offering 2	IR-PIV	REVCP
(4)	Offering 3	IR-PIV	REVCP
(5)	Offering 4	MFDU-PIV	CEVCP
(6)	Offering 5	WP-PIV	CEVCP
(7)	Offering 6	PC-PIV	CEVCP
(8)	Offering 7	PC-PIV	PC-PIV
(9)	Offering 8	N/A	PC-PIV
(10)	Offering 9	N/A	NUOPDCFC
(11)	Offering 10	N/A	CTCP
(12)	Offering 11	N/A	CTCP
(13)	Offering 12	N/A	CTCP
(14)	Offering 13	N/A	PIV-Green

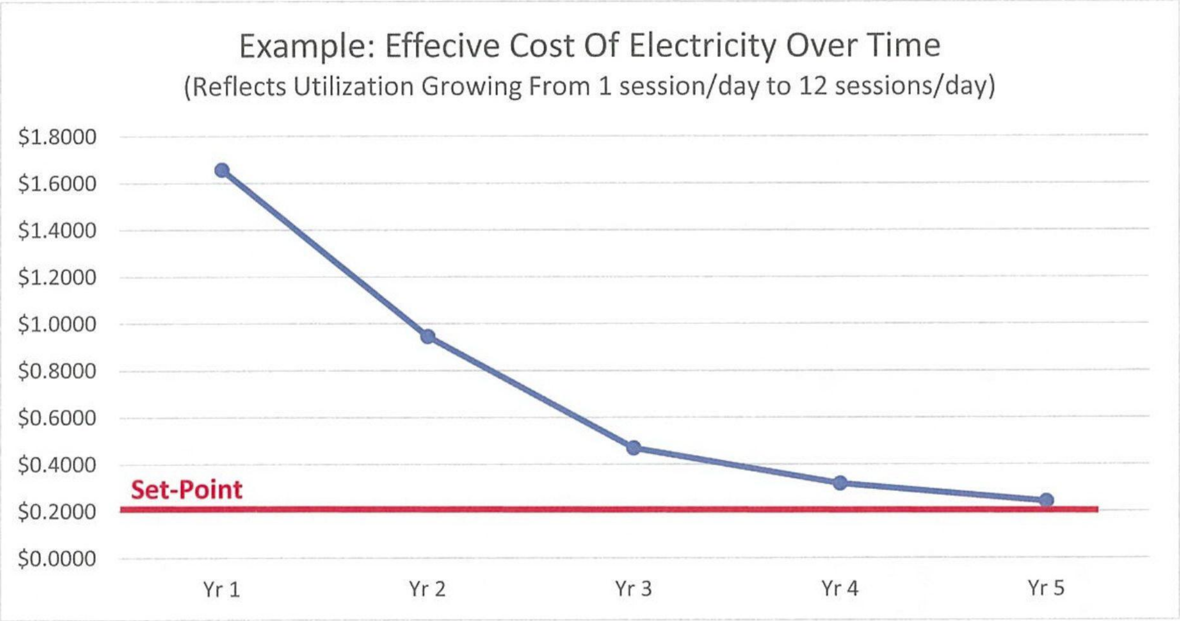
Schedule (MTN)-5

Schedule (MTN)-5
Page 1 of 2

Example Incentive Decline Over Time: two 50KW charger configuration

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Charging Sessions Per Day (measured at the location)	1	3	6	9	12	
KWHRs Delivered Per Session	20	25	30	35	40	
Effective Cost Of Electricity (AGS Tariff)	$1.6563	$0.9451	$0.4691	$0.3177	$0.2412	
Set Point	$0.2000	$0.2000	$0.2000	$0.2000	$0.2000	
Annual Customer Cost For Electricity - Without Offer 9	$12,091	$25,871	$30,820	$36,531	$42,261	$147,574
Annual Customer Cost For Electricity - WITH Offer 9	$1,460	$5,475	$13,140	$22,995	$35,040	$78,110
Incentive Paid To Customer ($/Yr)	$10,631	$20,396	$17,680	$13,536	$7,221	$69,464
Incentive Paid To Customer ($/kwhr)	$1.4563	$0.7451	$0.2691	$0.1177	$0.0412	


Example: Incentive Paid To Customer Over Time ($/kwhr)
(Reflects Utilization Growing From 1 session/day to 12 sessions/day)
$1.6000
$1.4000
$1.2000
$1.0000
$0.8000
$0.6000
$0.4000
$0.2000
$0.0000
Yr 1
Yr 2
Yr 3
Yr 4
Yr 5


Example: Effecive Cost Of Electricity Over Time
(Reflects Utilization Growing From 1 session/day to 12 sessions/day)
$1.8000
$1.6000
$1.4000
$1.2000
$1.0000
$0.8000
$0.6000
$0.4000
$0.2000
$0.0000
Set-Point
Yr 1
Yr 2
Yr 3
Yr 4
Yr 5

BOARD OF PUBLIC UTILITIES
STATE OF NEW JERSEY

IN THE MATTER OF THE PETITION OF
ATLANTIC CITY ELECTRIC
FOR APPROVAL OF ITS
NEW JERSEY PLUG-IN ELECTRIC VEHICLE PROGRAM
BPU DOCKET NO. EO18020190

TESTIMONY

OF

MARK WARNER

ON BEHALF OF

Atlantic City Electric Company

December 17, 2019

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I. INTRODUCTION

Q1. What is your name and business address?

A1. My name is Mark Warner and my business address is 417 Denison Street, Highland Park, New Jersey, 08904. I am presently employed as a Vice President at Gabel Associates, Inc., an energy, environmental, and public utility consulting firm.

Q2. What is your professional experience and educational background?

A2. At Gabel Associates, Inc, I lead a team of analysts that provides specialized economic, financial, environmental, and policy analysis related to energy markets and a variety of clean energy technology applications. I have been leading technical teams for over 35 years across a variety of utility industries, and I have been specializing in energy market policy and analysis since 2001. I have recognized expertise in economic modeling and policy development for new clean energy technologies, particularly regarding utility implications and market impact. My primary focus areas include renewable energy, energy storage, microgrids, advanced "behind the meter" energy project development, and electric vehicles, particularly Plug-In Electric Vehicles ("PIVs"). I support a wide variety of public and private clients, including energy utilities, and I interact closely with a variety of government agencies and regulatory authorities. I lead our firm's practice on PIV research and policy development, where we have been active for approximately four years. I am a co-founder of the ChargEVC electric vehicle coalition, which is currently active in New Jersey and growing throughout the region. I am also able to draw on the expertise and resources of Gabel Associates, which is a widely recognized consulting firm specializing in energy markets with expertise in energy procurement, project development, energy policy, environmental analysis, in-depth economic analysis, and overall energy markets including generation, regional operators (especially PJM), and utilities. I received my education from the Georgia Institute of Technology where I received a B.S. and M.S in Mechanical Engineering. I was recognized as Clean Energy Market Innovator of the Year by the New Jersey Board of Public Utilities in 2008, and I served on the board of the Mid-Atlantic Solar Industry Association for four years.

Q3. What experience do you have with the electric vehicle market?

A3. The emerging PIV market has been my primary focus area for the last four years. I routinely monitor industry developments, support a variety of clients with specialized market research, work with utilities that are developing programs as a subject matter expert, and interact with a wide variety of policy makers in multiple states regarding market development initiatives for PIVs. A key focus area has been the development of new tools and methodologies for assessing PIV impacts on energy markets and utility infrastructure, and rigorous methods for analyzing and documenting potential benefits, costs, and the net-benefit resulting from widespread PIV adoption. I have worked with nine different utilities in five different states on development of their PIV programs, including tasks such as forecasting, opportunity assessment, strategic planning, PIV program design, budgeting, regulatory filing support (including preparation of testimony), benefit-cost analysis, and program implementation support. In addition, in support of market development efforts by ChargEVC[1] in New Jersey, I was the lead investigator for a comprehensive benefit-cost study for the State entitled *Electric Vehicles in New Jersey, Costs and Benefits: The Opportunities, Impacts, and Market Barriers to Widespread Vehicle Electrification in New Jersey.*[2] This analysis was unique because it is based on detailed simulation modeling of both impacted energy markets and physical infrastructure loading, tuned specifically for conditions in New Jersey. Those tools and datasets have been refined over the last two years to enable highly specialized assessment of PIV impacts on the electricity markets and infrastructure, and rigorous determination of benefits, costs, and Benefit-Cost Analysis ("BCA") using net-benefit merit tests specific to proposed utility PIV filings. I am a frequent public speaker in a wide variety of forums regarding the electric vehicle market, policy development for electric vehicles, and utility implications of widespread electric vehicle adoption.

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[1] ChargEVC is a not-for-profit coalition of diverse stakeholders that support development of the electric vehicle market in New Jersey. Stakeholders include all four electric utilities, both local and national environmental groups, New Jersey car retailers, vehicle manufacturers, charging companies, consumer advocates, and others.

[2] See http://www.chargevc.org/wp-content/uploads/2018/03/ChargEVC-New-Jersey-Study.pdf

Q4. Did you prepare the benefit-cost analysis included in this filing?

A4. Yes. I developed projections of benefits and potential costs, and I prepared the BCA based on multiple merit tests that examine both the market-wide impact of vehicle electrification, as well as merit tests customized for each of the utility program offers. These Offering-specific merit tests are needed since each proposed utility Offering impacts the market in different ways. To the greatest extensive possible, these merit tests were adapted from standardized tests typically used for evaluating utility Energy Efficiency programs.

Q5. What is the purpose of your testimony?

A5. The purpose of this testimony is to present the methodology and results of the BCA that was performed regarding the PIV Program proposed by Atlantic City Electric Company ("ACE" or "the Company"). My testimony is being submitted as part of ACE's Amended Petition for approval of the Company's PIV Program, which amends the Company's Original Petition filed on February 22, 2018.

II. BENEFIT-COST ANALYSIS APPROACH AND METHODOLOGY

Q6. Did you evaluate the proposed program for benefits and costs?

A6. Yes. I evaluated the impacts expected to result from the Program and related PIV use. Based on these impacts, I prepared an inventory of projected benefits and potential costs. This portfolio of benefits and costs was used to calculate a variety of net BCA merit tests. Many of the impacts from PIV use result from vehicle charging impacts on electricity markets and utility infrastructure. These impacts have physical, market, and environmental dimensions that can be quantified on an economic basis, in addition to broader strategic implications. The BCA is therefore based primarily on quantifying the net impact of displacing gasoline consumption with electricity use, and considering the impact of that change on the electricity market, implications for utility infrastructure, changes in environmental emissions, and other relevant factors for impacted populations.

Q7. What assumptions were used regarding PIV adoption?

A7. This BCA analysis is based on a forecast of PIV adoption within the ACE territory from 2020 through 2035. This forecast was taken from previous work to project PIV adoption in the State of New Jersey, with allocations to each utility territory commissioned by ChargEVC. This projection is based on the most recent information available about historical PIV sales in New Jersey, including detailed geo-mapping to particular territories. Please refer directly to the previously published study, *Electric Vehicle Adoption in the State of New Jersey* (September 18, 2019, Mark Warner), which is respectfully submitted as part of this testimony as Schedule (MW)-1. The projection accounts for growth of the PIV fleet through new sales, as well as vehicle retirements, in both Battery Electric Vehicles ("BEVs") and Plug-in Hybrid Vehicles ("PIHVs") segments. The overall PIV-projection is used for the market-wide tests as described in more detail below, but the number of impacted vehicles is used when considering individual Program Offering.

As summarized in more detail in the ChargEVC report referenced above, the vehicle adoption projection blends an extrapolation of historical sales in the short term with transition to the adoption trajectory needed to meet the State's goal of 330,000 PIVs on the road by 2025. ChargEVC developed a stakeholder-consensus market development roadmap in 2017, which included projections for sales through 2035 that would allow New Jersey to achieve adoption parity with other states leadership levels of PIV adoption. These "market leadership parity" goals were used to project sales requirements after 2025, including a goal for 2,000,000 PIVs on New Jersey roads by 2035. The forecast is based on the number of PIVs in New Jersey as of the end of 2018, as reported by the New Jersey Department of Environmental Protection ("NJDEP") based on vehicle registration data, mapped to each utility's service territory by zip code. Please refer to the previously referenced ChargEVC study (Schedule (MW)-1 for details on methodology and projection assumptions.

Q8: How does the analysis quantify physical impacts from PIV adoption?

A8. The model translates the number of PIVs on the road (from the projection described above) into predominantly physical impacts on miles driven (gasoline vs. electric), changes in electricity consumption (in megawatt hours ("MWhs"), changes in load profile (time-of-day MW distributions), and the resulting changes in emissions (net between tailpipe and power plant). These impacts are calculated for the baseline case (where there is no growth in PIV use), and the PIV adoption case under both "natural" and "managed" charging scenarios. Natural charging assumes that there are no programs or policies to influence charging behavior, and that residential charging loads begin to ramp up when most drivers return home from work. Managed charging assumes that policies and programs are in place to influence when charging happens, moving vehicle charging load from on-peak times to preferred off-peak periods. These physical impacts, for each of the three cases (baseline, natural, and managed), is calculated for each year from 2020 to 2035. The impact of PIV adoption is calculated as the difference in each impact-parameter between the PIV adoption cases and the baseline case.

Q9: How do these physical impacts translate into costs and benefits?

A9. All of the physical impacts are quantified in terms of their economic cost. Total cost for each of the three cases (baseline with no PIV use growth, with PIVs under natural charging, and with PIVs under managed charging) are computed considering the cost of electricity, operating expenses for vehicles, and the costs associated with emissions. If costs go down in the PIV case compared with the baseline, they are considered a benefit for the BCA calculation. If costs go up in the PIV case compared with the baseline, they are considered a cost for the BCA calculation. Some other direct costs and benefits, such as the tax incentives associated with a PIV purchase (a benefit) or the expense to install vehicle charging infrastructure (a cost), are also calculated to provide a complete view of the cost and benefit portfolios. The model maps these costs and benefits to three impacted populations: utility customers that do not drive PIVs, PIV owner/operators, and society at large, the latter of which collectively bears the consequences of externalities such as air pollution or greenhouse gas emissions. The Net Present Value ("NPV") of all costs and benefits are computed based on a discount rate of 6.44%, which was provided by ACE based on their Weighted Average Cost of Capital. Note that benefit/cost ratio results are not strongly dependent on the discount rate selected, since it typically applies equally to both costs and benefits.

Q10. What methods were used to quantify costs and benefits for utility customers due to changes in electricity costs?

A10. Determining how PIV charging affects electricity costs is a primary focus for the BCA analysis, and is quantified through a comprehensive model that examines wholesale market impacts, implications for capacity and transmission costs, and impacts on the distribution revenues collected by the utility. Both aggregate and unit-cost impacts are quantified to allow for determination of electricity cost changes that affect all ratepayers. If rates are determined to go down in a PIV adoption case, that is considered a ratepayer benefit. The key electricity cost components considered are summarized as follows:

a. **Utility Distribution Costs**: The utility provided information regarding gross utility revenue requirements, including both the costs for distribution and related sur-charges. Based on this historical information, a baseline utility distribution revenue requirement was established for 2020, and projected forward using a growth rate of 0.8% per year. This rate was synthesized using both utility and Energy Information Administration ("EIA") statistics on distribution revenue growth. These gross costs represent the relatively fixed costs for utility distribution services, not including the proposed PIV programs which are accounted for as a separate cost.

b. **Wholesale Costs**: PIV charging, especially if done during off-peak times, changes the shape of the aggregate load curve. This modified load curve results in a change in the average wholesale cost of electricity since more electricity is purchased during lower cost, off-peak times. Gabel forecasts these impacts based on a detailed asset dispatch simulation based on AURORAxmp ("AURORA"). AURORA is an industry-leading software and data package that simulates the hourly commitment and dispatch of electric generators to serve load, recognizing utility-level peak demand, transmission constraints, operational characteristics of generators, delivered fuel prices, emissions prices, etc. Gabel completed hour-by-hour market simulations using AURORA, for every year from 2020 to 2035, for each of the three cases (baseline, with PIVs natural charging, and with PIVs managed charging). Total electricity costs ($ per year) and generation emissions (tons of CO_2, NO_X, and SO_2) are the primary outputs of the simulation. Many other studies on PIV benefits are based on generalized assumptions about PJM costs or emission profiles. By contrast, this study looks at wholesale electricity costs (and emission) impacts based on detailed dispatch simulations.

c. **Capacity and Transmission Costs**: The physical impact model summarized above can be used to create an aggregate load curve associated with PIV charging. This model accounts for the fact that vehicle charging takes place across a variety of segments (at home, at work, at public chargers, etc.), and computes the aggregate load impact for both the natural and managed charging cases. Separately, an analysis of the historical PJM-wide coincident peaks used for allocation of capacity and transmission costs was conducted. In 2018 and 2019, eight of the ten coincident-peak periods were between 4PM and 5PM on the peak days. The PIV charging load during the 4PM-5PM period, for both the natural and managed charging cases, were used as an indicator for potential PIV charging impacts for peak-related costs. PJM costs for capacity ($/MW-day) and transmission ($/MW for the year) were projected through 2035 based on recent PJM market data. The capacity and transmission costs, multiplied by the PIV charging loads at PJM-wide peak times (during the 4PM-5PM period), allow for an estimate of potential capacity and transmission costs associated with PIV charging. These are generally additional costs compared with the no-PIV baseline case since load (in MW) has increased. A capacity reserve factor of 8.89% was used based on recent PJM guidance, along with a transmission and distribution efficiency factor of 92.851% based on information about losses from ACE.

d. **Total Electricity Costs:** Utility distribution costs, wholesale electricity costs, and capacity and transmission costs are combined to create an overall electricity cost indicator. This indicator is determined for each of the three cases (no PIV baseline, with PIV s natural charging, and with PIV managed charging) for each year of the study period. Changes in the indicator between the PIV and baseline cases indicate how electricity costs change *for all ratepayers* as a result of PIV charging. This model captures several dynamics associated with PIV charging impacts on electricity costs:

- Overall electricity use (total megawatt hours ("MWhs") goes up due to the increased electricity use associated with vehicle charging;

- Unit costs (dollars per kilowatt hour ("kWh") go down due to the combination of dilution of distribution costs through increased MWh volume and reductions in average wholesale unit costs due to more optimal loading (*i.e.*, increased capacity factors);

- Capacity and transmission costs go up due to the increasing load, although they increase more for natural charging than managed charging;

- Of these three affects, the dilution effect is the strongest and generally results in net reduction in unit costs, on a per-kWh basis;

- This change in aggregate costs (between the with-PIV and baseline cases) is applied against just the baseline load to determine the impact on utility customers that do not drive a PIV.

Q11. What methods were used to quantify costs and benefits for PIV drivers?

A11 Impacts on vehicle operating expense were computed based on both the difference between fueling with electricity versus gasoline, combined with projected changes in maintenance expense. It costs less to "fuel" a PIV with electricity than it does to fuel a traditional vehicle with gasoline based on differences in vehicle efficiencies and basic energy costs (electricity versus gasoline). Furthermore, early market evidence suggests that PIVs cost less to maintain due to the simplified drive train. The combination of these two factors generate significant savings in operating expense for PIV owners/operators. The fuel savings are computed based on a projection of electricity and gasoline prices, average vehicle efficiency factors (miles/kWh, or miles/gallon) while maintenance savings are estimated based on results from a vehicle maintenance study by the American Automobile Association ("AAA") on a per-mile basis.[3] To ensure a fair comparison, an additional expense is assumed for PIV owners based on replenishment of the infrastructure funding lost through avoided State and federal gasoline taxes. Details on these calculations are provided below:

a. Vehicle Charging Electricity Costs: Since most charging (85%-95%) of vehicle charging happens at home, the residential cost of electricity is used for computing the costs of vehicle charging given average miles driven and average vehicle efficiency (in miles/kWh) for each year in the study period. The model computed BEV and PIHV charging costs separately, given unique efficiency parameters for each.

b. Cost of Gasoline: EIA projections[4] on the cost of gasoline through 2035 were used as the basis for the cost of fueling traditional vehicles and the fueled fraction of PIHV travel, as normalized by a comparison of New Jersey versus national gasoline costs from the price tracking website gasbuddy.com. Projections of fuel costs, combined with projections of the average miles driven and average vehicle efficiency (in miles/gallon) of the base of light duty vehicles being displaced by PIVs were used to compute gasoline costs for each year in the study period.

c. Infrastructure Tax Adders: An operating expense for PIV drivers is added that is equivalent to the federal and district gas tax to ensure fair comparison between gasoline-fueled and electrically-powered scenarios. The current gas tax in New

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[3] American Automobile Association, *Your Driving Costs*, 2019 Edition.

[4] Federal Energy Information Administration, Energy Outlook 2019, published January 24, 2019, Table 12

Jersey, combining both federal and state taxes, is 59.8 cents/gallon. That is translated to a cost-per-mile based on average vehicle efficiency (miles/gallon) for each year in the study period, and is included as an operating expense for PIV drivers.

d. Maintenance Costs: A variety of recent studies have documented early market experience with the costs of maintaining traditional vehicles compared with electric vehicles (both BEVs and PIHVs). I used the 2019 data from AAA for these factors (as cited above), and applied the relevant maintenance costs per mile to each vehicle type to determine changes in maintenance costs. The general trend is that maintenance costs for PIVs are lower than with traditional vehicles, given the simplified drive train, and the elimination of routine maintenance such as oil changes and tune-ups.

e. PIV driver operating expenses are determined based on the combination of the costs of electricity for vehicle charging, the costs of gasoline use, maintenance costs, and the Transportation Trust Fund tax replenishment adder.

f. Vehicle operating expenses in New Jersey are significant, amounting to $10 billion to $15 billion a year in fuel and maintenance expense. The reductions in operating expenses associated with vehicle electrification therefore represent billions of dollars of increased disposable income for New Jersey households as high levels of adoption are achieved. These savings are accessible by any New Jersey household that makes use of an electrified vehicle.

Q12. Are there other costs and benefits that accrue to PIV drivers?

A12. Yes, in addition to impacts from fueling and maintenance costs, PIV drivers experience both a price premium for the initial vehicle purchase (a cost), and a one-time federal tax incentive associated with their new vehicle purchase (a benefit), and a variety of non-economic advantages.

a) PIVs of all types currently command a price premium, measured as the higher average Manufacturers Suggested Retail Price ("MSRP") for typical PIVs compared with traditional internal combustion engine vehicles. This cost premium is declining over time, based on increasing competition, larger industry scale, and especially the reduced cost of vehicle batteries. An estimate for this price premium over time was used based on projections by the National Renewable Energy Laboratory ("NREL")[5]. This price premium is considered an incremental cost absorbed by PIV drivers. The projections from NREL were corroborated based on New Jersey-specific research I recently completed on base MSRP and likely as-sold prices for both PIVs and traditional vehicles on a detailed market segment-basis.

b) The federal government provides a tax credit for purchase of a qualified PIV. The amount of the credit varies by vehicle type and range, up to a maximum of $7,500. It is generally modeled as a benefit, since that economic incentive flows to New Jersey PIV owners from an external source (*i.e.*, the federal government). That tax credit begins to decline when at least 200,000 PIVs from a particular manufacturer have been sold, and several market leaders (such as Tesla, Nissan, and Chevrolet) have already surpassed that threshold. As part of the BCA analysis, an assessment of cumulative sales rates for different PIV manufacturers was completed to determine the current average incentive level available, and the expected decline rate, based on volume-weighted sales in the U.S. Overall, the average incentive declines as more manufacturers surpass the 200,000 vehicle threshold. This declining incentive is

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[5] National Renewable Energy Laboratory, Electrification Futures Study – End Use Technology Costs and End Use Projections through 2050, Published 2017

included as a benefit for all PIVs purchased in the ACE territory through 2026 (for BEVs) and 2028 (for PIHVs).

c) PIV owner/operators (and drivers) enjoy a variety of non-monetary benefits, including the potential for increased safety (due to a lower center of gravity and state of the art safety features), reduced road noise, increased "fueling" convenience (no trips to the gas station), fewer maintenance events, elimination of State vehicle inspections, state of the art design with desired technical features, appreciation for the environmental, societal, and geopolitical benefits associated with reduced petroleum use, and an enjoyable driving experience. While these non-economic considerations are very important to many PIV drivers and consumers, they were not considered as part of the formal BCA.

Q13. **What methods were used to quantify the economic impact of changes in emissions realized by society-at-large?**

A13. Current levels of vehicle emissions impose significant costs on society through health care expenses, extreme weather damage, lost worker and business productivity, asset devaluation, etc. Although frequently considered an "externality," there is real economic value that accrues to society due to the avoided emissions enabled by widespread PIV adoption. More generally, greenhouse gases (especially CO_2) are widely considered the primary drivers of climate change, which imposes significant costs as well. The BCA model calculates the value of these avoided emissions based on net change in emissions per year and societal-cost-per-ton factors provided by independent sources as noted below:

a) Emission Changes: The model considers CO_2, NOx, and SO_2, and models emissions in the baseline case (traditional vehicle only, fueled by gasoline) compared with emissions in the PIV adoption case using predominantly electricity instead of gasoline (100% electricity for BEVs, and a combination of electricity and gasoline use for PIHVs). This model considers the *net* impact of the change in fueling considering both emissions at the vehicle tailpipe and emissions at the electricity generation facility. Emission factors for electricity generation were calculated based on dispatch simulation by Aurora for the actual vehicle charging loads projected. Emission factors for the mobile sources (pounds of emissions per gallon of fuel consumed) were from estimates of the United States Environmental Protection Agency ("EPA").[6]

b) Economic Value Of Reduced CO_2 Emissions: To determine the economic value of reduced CO_2 emissions, the BCA model uses the "Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866" produced by the Interagency Working Group on Social Cost of Greenhouse Gases, United States Government, as updated August 2016. Specifically, the analysis used the "3% Average" case that represents a mid-point of the three primary CO_2 cost scenarios. This analysis, when adjusted to nominal dollars/ton in each year of emissions, provides an economic estimate of the value of avoided CO_2 emissions. Since CO_2 is easily and widely dispersed from any source regionally, economic impact factors are the same for both mobile and stationary electricity generation sources.

c) Economic Value of Reduced NOx and SO_2 Emissions: To quantify the benefits of SO_2 and NOx reductions, the model incorporates results from a recent EPA study that allocates public health costs associated with emissions across a variety of segments on a nominal dollar per ton of emissions basis. That EPA study provides different factors for "on-road" mobile sources and stationary sources at electricity generation plants. The difference between these factors therefore accounts for not just the changes in the amount of emissions, but the fact that *vehicle electrification changes where the emissions happen* – shifting from typically more developed and populated areas along roadways to more remote power plant locations.[7]

d) The model computes the total emissions from gasoline use in the baseline case, the PIV case, and based on that difference, applies the economic factors to determine total environmental costs. As a general trend, overall economic costs due to emissions

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[6] United States Environmental Protection Agency, Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, published in October 2008

[7] United States Envrionmental Protectin Agency, Technical Support Document, Estimating Benefit Per Ton Benefit of PM2.5 Precursors from 17 Sectors, Published February 2018

decline significantly due to PIV adoption given the lower net emissions rate and the shift in emissions geography. These impacts are recognized by "society at large," but are also felt by utility customers since air quality affects all residents of the State.

Q14. Are there any other costs or benefits incorporated into the model?

A14. In addition to the benefits and costs realized directly by the three primary sub-populations (PIV drivers, utility customers, and society at large), the model also accounts for a variety of other economic impacts on other market participants as summarized below:

a) **Utility Investments in Charging Infrastructure:** ACE is proposing a variety of customer Offerings that provide equipment and services that directly support customers driving an PIV, and development of the PIV market overall in support of State goals. These utility costs include the capital and expense associated with delivering those programs, non-revenue neutral rate incentives, and general costs associated with information technology, data and network licenses, and customer acquisition. This portfolio of utility program costs is comprehensive and includes all potential program costs subject to recovery from ratepayers. These costs are recognized when incurred according to the program deployment plan, as summarized in the following figure.

Figure 1: ACE PIV Program Budget

	Deployment Goals	Costs
Offer 1: Wholehouse TOU Rate	Unlimited, 300 assumed for budget	$120,000
Offer 2: Off-Peak Charging Incentive	300 customers	$192,023
Offer 3: Managed Charging Program	1,500 L2 EVSE	$3,395,749
Offer 4: Multi-Family	200 L2 EVSE, ~67 locations	$1,804,969
Offer 5: Workplace	150 L2 EVSE, ~30 locations	$806,395
Offer 6: Fleets	150 L2 EVSE, ~30 locations	$806,395
Offer 7: Utility Owned Public DCFC	45 DCFC Chargers, ~15 locations	$4,576,200
Offer 8: Utility Owned Public L2	200 L2 Chargers, ~65 locations	$7,336,200
Offer 9: Privately Owned Public DCFC	30 DCFC locations available for public use	$4,070,779
Offer 10: Innovation Fund	TBD	$2,000,000
Offer 11: Electric School Buses	20 electric school buses and chargers	$5,500,000
Offer 12: NJ Transit	1 depot location, partially electrified	$2,500,000
Offer 13: Green Adder	N/A	$0
Billing, IT, Admin, Marketing	N/A	$8,998,700
Total:		$42,107,410

b) **<u>Revenues from Utility-Owned Charging Infrastructure</u>:** ACE is proposing two Offerings under which the Company would own and operate public charging infrastructure. One is focused on lower-power "Level 2" chargers, while the other is focused on the higher-power Direct Current Fast Chargers ("DCFCs") that address consumer concerns about range anxiety. These Offerings are designed to only address a part of the public charging market need, focused on those applications that are under-served by competitive PIV charging providers. The Company intends to charge PIV drivers for use of these facilities, the revenues of which will be used to offset ratepayer impacts. These revenues are captured as a benefit since they offset costs.

c) **Utility Investments in Grid Reinforcement:** Beyond the proposed PIV programs noted above, there may be the need for additional utility investment in grid reinforcement. As PIV adoption grows, the Company will be required to deliver more electricity in support of vehicle charging. An *estimate* of these potential grid reinforcement investments, which are longer-term in nature, has been provided to ensure complete characterization of PIV adoption costs. See the section below on potential utility distribution impacts and how those potential costs were determined. Note that these costs have been included in the BCA as a possible longer-term cost, but they are not formally budgeted as part of the current utility Program proposal.

d) **Investments by Non-Utility Entities in Charging Infrastructure:** In addition to actions by utilities, other market participants will be making incremental investments as part of more widespread PIV adoption. Primary examples include customer investments in vehicle chargers (commercial and residential), and investments by private capital in public charging infrastructure. A detailed model to estimate total infrastructure requirements across a variety of segments has been developed, including chargers in residential settings, workplace chargers, fleet chargers, and a variety of public chargers. The investment in a growing base of charging infrastructure is based on the vehicle adoption projection noted above. Unit costs for different types of chargers have been estimated based on market data, while also ensuring consistency with cost assumptions inherent in the utility program filing. In most cases, both equipment costs and installation costs have been considered, which vary considerably by segment. Long-term estimates of those costs have been included (net of utility incentives) as part of the costs associated with market-wide vehicle electrification. Under this methodology, the combination of utility investments and non-utility investments fully capture the charging infrastructure investment requirements over time.

Q15. Will there be impacts on utility distribution infrastructure resulting from PIV charging, and were those costs included?

A15. Yes, it would be prudent to assume distribution system impacts due to increased loading from PIV charging longer term, especially in the residential sector where most charging takes place, and we have included an estimate of those costs in this analysis. We did not assess the physical impacts on the ACE distribution infrastructure at an engineering level as part of this study. However, Gabel has conducted in-depth engineering analysis of PIV implications on utility infrastructure for other territories.[8] Those studies identified several general conclusions that we believe are applicable across a variety of territories, and those guidelines were used to *estimate* potential costs for grid reinforcement resulting from PIV charging loads in the ACE territory. In particular, utility infrastructure impacts vary over time as the PIV population increases, and it is useful to think about utility response (and associated costs) in three phases. Key guidelines for characterizing these three phases include:

a) When the PIV population is small (as an aggregate percentage of the overall light duty vehicle population in the territory), there is generally sufficient capacity within the distribution system to handle those incremental PIV charging loads, although clustering affects (*i.e.*, multiple PIVs within a single neighborhood) could cause localized distribution system loading issues.

b) During this early market phase, vehicle charging impacts, if they emerge, will be relatively localized and can be dealt with within the boundaries of routine maintenance and upgrade budgets already supported by the utility.

c) Based on consideration of a wide variety of PIV loading scenarios, my analysis suggests that more systemic loading impacts on the distribution system will emerge

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[8] Detailed physical infrastructure impact studies were completed for a utility in New Jersey as part of the ChargEVC market opportunity assessment (Electric Vehicles in New Jersey – Costs and Benefits, ChargEVC, principle investigator Mark Warner, Gabel Associates Inc and Energy Initiatives Group LLC, January 26, 2018), and also specifically for the utility infrastructure on Long Island (Electric Vehicles On Long Island – Costs and Benefits, Principal Investigator: Mark Warner, Gabel Associates Inc. and Energy Initiatives Group LLC, July 10, 2018).

first on residential single-phase transformers. Larger impacts on conductor capacity, sub-station elements, and transmission infrastructure would likely emerge in the longer term, if they emerge at all. The timing, and impact scope, of PIV charging depends heavily on residential PIV charging patterns, and managed charging – if fully deployed – can defer (but probably not completely eliminate) these impacts in time. The PIV programs being proposed by the utility are intended to encourage residential managed charging, and managed charging was therefore assumed to be the dominant scenario for this analysis.

d) Once the PIV population exceeds the number of single-phase transformers, distribution loading issues will become more common since that condition begins to guarantee multiple vehicle charging loads on a given residential transformer. Past that point, more proactive grid reinforcement would be prudent to ensure responsible support for increased loading related to PIV charging. However, not all residential PIV charging happens at the same power levels, and loads can range from 1.3 kW (for a typical "Level 1" charger, more typically used by PIHV owners), to a higher powered 7.2 kW charger (for a Level 2 solution favored by BEV owners with larger batteries). The model accounts for this portfolio of diverse loads on the distribution system and estimates that *in the case where natural charging is dominant*, more systemic impacts will begin to emerge once the number of PIVs exceeds approximately 0.75 times the number of single-phase transformers. By comparison, in the case where managed charging is dominant, more system impacts are estimated to emerge when the number of PIVs exceeds approximately 2.7 times the number of single-phase transformers. For a given number of transformers and PIV adoption rate, this analysis can estimate when system grid reinforcement becomes necessary for both the natural and managed cases.

e) There are approximately129,000 single phase transformers currently in ACE's service territory. Based on the current projection for PIV adoption in the ACE territory, more proactive grid reinforcement begins to become important around 2030 if natural charging is the dominant residential charging behavior. In the case of high levels of managed charging, grid reinforcements are deferred beyond 2035. This dynamic highlight the economic and strategic value of managed charging, and why it is an important element of the proposed ACE PIV Program.

f) The associated grid reinforcement costs are scheduled in the cost model over time in proportion to PIV adoption, beginning in 2030 for the natural charging case, and assumes that the reinforcement takes place over a 15-year period. This high-level analysis assumes complete upgrade replacement of impacted single-phase transformers, at a cost of $15,000 each, although other technical options (such as feeder reorganization) may be determined to be optimal at that time. This analysis is significant, however, in that it assumes that eventually upgrade of most, if not all, of the residential transformer base may be required. The costs for that reinforcement, from 2030 through 2035, are accounted for in this analysis as a market-wide cost. I consider this a highly conservative assumption since it reflects significant reinforcement investments that may ultimately not be required if other alternatives – such as strong managed charging programs or other feeder re-organization strategies – are ultimately used instead. No costs for grid reinforcement are required in the managed charging case, since that strategy defers impacts beyond the scope of this BCA analysis.

g) Distribution impacts will be felt most strongly on residential circuits, where the majority of vehicle charging electricity is delivered. Impact on commercial circuits, for workplace, fleet, public charging, and other specialized infrastructure (*i.e.*, electric buses, etc.) have not been assessed in detail. While those installation are much smaller in number (compared with residential chargers), they may have higher power requirements that need to be assessed on a case-by-case basis.

h) The above guidelines demonstrate the importance of strong deployment of effective managed charging programs, especially for residential customers. While price signals that defer charging start into off-peak hours is a very effective strategy short term, eventually, as PIV penetration increases, these programs will be about to more actively coordinate vehicle charging through staggered starts, power throttling, and curtailment in extreme cases. If managed charging is not implemented, larger impacts on infrastructure are likely to result as represented in the grid reinforcement costs associated with natural charging. As a rough rule of thumb, effective managed charging programs reduce or mitigate distribution impacts by about a factor of four.

i) Note that these upgrades, although motivated by PIV loads, will also accomplish other reinforcement objectives, potentially including improved instrumentation, better resiliency, improved overall capacity, etc. Many of these transformers would require upgrade over a similar period anyway, even if PIV adoption did not happen. This assumption of full transformer upgrade is therefore extremely conservative, and probably overstates the costs that should be "booked" to PIV adoption, while also understating the associated benefits.

Q16. How did the analysis determine merit for the proposed Program?

A16. Merit tests assess the *net* impact of benefits after costs are accounted for. A wide variety of merit tests are available, and they differ based on which costs and benefits are included, and which impacted populations are considered.[9] Numerous studies on vehicle electrification have focused primarily on market-wide net benefits considering the full impact of all electric vehicles on the road. This approach is helpful for understanding the overall policy merit of vehicle electrification, but implicitly overstates benefits associated with a particular utility Offering since it considers the impact of *all* PIVs, beyond the market-impact scope of a particular utility proposal. In addition, other studies have attempted to evaluate proposed utility PIV programs based exclusively on traditional – and relatively standardized – net benefit programs associated with energy efficiency ("EE") filings. Those protocols, if applied simplistically with narrow boundaries, can be confounded by the fact that vehicle charging *increases* electricity consumption, which is fundamentally different than the outcome expected from an EE measure. It is therefore

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[9] California Standard Practice Manual, *Economic Analysis Of Demand Side Programs And Projects*, California Public Utilities Commission, October 2001, *available at*: http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/CPUC_STANDARD_PRACTICE_MANUAL.pdf

necessary to apply the principles associated with standard tests to conditions applicable to the PIV market. Specifically, I consider two different views on net benefit that together provide a comprehensive perspective on the utility programs being proposed. These two perspectives are based on a market-wide[10] Societal Cost Test ("SCT"), and customized merit tests for each of the proposed utility Offerings that focus on non-participating utility customer impacts (*i.e.*, impacts on utility customers that do not own a PIV). Details on those merit tests are summarized below:

a) **Market-Wide Merit:** The SCT measures net costs based on the total costs of the Program, including both the utility's costs and the costs incurred by all other market participants. Similarly, all benefits are included, regardless of the impacted population, including externalities. The SCT used in this analysis is based on the standard EE-focused SCT as applied to PIVs and is an intentionally broad test that helps determine if society is better or worse off overall as a result of the tested market change (*i.e.*, increased PIV adoption). My design of this SCT is consistent with other studies that have attempted to quantify SCT-merit for proposed utility PIV programs.

b) **Merit Per Utility Program Offering**: In addition to the market-wide SCT described above, I also designed customized merit tests per utility program Offering. This approach is necessary since particular Offerings impact the market in very different ways. The impact of a residential off-peak Time-Of-Use ("TOU') rate (ACE's Offering 1), for example, impacts the market in a fundamentally different way than public charging Offerings (ACE's Offerings 7, 8, and 9). This per-Offering merit assessment only considers costs and benefits that are directly tied to the particular Offering. In general, these are very narrow tests that focus on utility customer impacts from the recovered cost of the proposed Offering, and the benefits that are realized directly by all utility customers through either change in electricity costs (as evident on their utility bill) or the value of cleaner air through PIV-induced emission reductions. Unlike the market-wide SCT, which considers the impacts of all electric vehicles on

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[10] In the context of the SCT, "market-wide" means the number of PIVs in the ACE territory, but also reflecting pricing dynamics based on the PJM market of which ACE is a part.

the road in the utility territory, these per-Offering tests capture only benefits induced by the directly impacted PIVs.

c) **Portfolio Merit Test:** The costs and benefits of each of the Offerings (1 through 9) can be combined to provide a view of the net benefit at the overall program level[11]. Since this test is an aggregation of the Offering-specific tests, it provides a narrow assessment of the net impacts on non-participating ratepayers (*i.e.*, *all* utility customers that don't own a PIV) for the overall Program.

d) **Multiple Perspectives:** Providing multiple perspectives on merit, including both a market-wide SCT, a customized test per utility program Offering, and a portfolio test provides an appropriate, fair, and comprehensive perspective on both the overall Program and the individual offerings. The SCT provides important context for market-wide impacts from vehicle electrification overall and reflects a broad scope of market development activities that implicitly include the proposed utility Program. In parallel, the per-Offering merit tests are highly customized to reflect the impacts of each Offering, and the impact-scope (*i.e.*, number of vehicles and number of directly impacted customers) associated with the proposed scope and design of each Offering. The portfolio test quantifies the impact on utility customers from the proposed Offerings in aggregate.

Q17. Why did you use the SCT as the market-wide merit test?

A17. Widespread PIV adoption will introduce profound changes in electricity markets and infrastructure, with a related beneficial impact on energy use, emissions, economics, and numerous other factors. There is therefore impact beyond that experienced by PIV owner/operators, and significant societal benefit associated with PIV adoption externalities. I therefore consider the SCT to be a strong measure of market-wide merit for PIV adoption, and it provides important context for considering strategic and policy

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[11] BCA was not completed for Offerings 10 – 12, since the exact use of funds, and the associated benefits, are not knowable at this time.

implications of the overall vehicle electrification transition of which the utility programs are an instrumental part.

Q18. How are the benefits and costs described above considered in the SCT?

A18. As noted above, the market-wide SCT incorporates *all* costs and benefits associated with PIV adoption in ACE's service territory regardless of the sub-group impacted. The following inventory of benefits and costs were included over the analysis period from 2020 – 2035 (methodologies for quantifying these elements are summarized in the sections above):

a) **Avoided Wholesale Electricity Costs:** Projected changes in wholesale unit costs due to changes of the aggregate load profile, particularly the increased fraction of overall consumption in lower-cost, off-peak times. In most cases, this is a benefit since average wholesale electricity costs decline as PIV charging increases off-peak consumption (especially with managed charging). These wholesale cost changes are applied to the non-PIV charging loads (*i.e.*, electricity use by utility customers not participating in the utility PIV Program) to determine utility customer impacts.

b) **Dilution of Utility Revenues:** An estimate of how unit-cost (dollars/kWh) of the relatively fixed utility distribution revenue requirements are diluted as volume increases due to vehicle charging. This effect is the reverse of the dynamic associated with EE programs that decrease overall consumption volume and lead to increased ratepayer unit costs, but in this case is strongly beneficial. These dilution impacts on a per-kWh basis are applied to the non-PIV charging loads (*i.e.*, electricity use by utility customers that do not own a PIV not participating in the utility PIV Program) to determine utility customer impacts.

c) **Capacity and Transmission:** An estimate of how incremental vehicle charging loads would change capacity and transmission costs. Transmission and Distribution losses and typical PJM capacity reserve factors are taken into consideration. A projection of both capacity and transmission costs, based on recent and projected cost factors, were used as the basis for estimating these impacts. Specifically, the projected charging load (from all charging segments) during the peak period from 4 pm to 5 pm, compared with the typical ACE baseline at those times, is the basis for these costs. Since PIV charging typically imposes an incremental load, these are typically incremental costs in the BCA. Note that two variations of the SCT are provided, reflecting the natural and managed charging scenarios that introduce variations in the capacity and transmission impacts as well as variations in the wholesale price impacts noted above.

d) **Net Value of Avoided Emissions:** The economic value of changes in physical air emissions induced by PIV charging, including the benefit of reduced CO_2 and NOx, as offset slightly by an increase in SO_2. These economic factors reflect changes in where the emissions take place: as a result of PIV charging emissions are lower in high population density areas along roadways, and higher is less populated areas near power plants. When the economic impact of net emissions go down, these impacts are captured as a benefit, but when the economic impact of net emissions go up, this impact is captured as a cost.

e) **Net Savings on PIV Driver Operating Expenses:** The long-term net savings for PIV owner/operators based on avoided gasoline costs, incurred costs of electricity for charging, and changes in costs for maintenance. This analysis also assumes that PIVs incur an additional expense to replace lost gas tax revenues so that roadway funding is retained. These impacts are all (strongly) beneficial over the period, and are included as a benefit.

f) **Utility PIV Program Investments:** Capital and expenses for the proposed utility PIV Program, to be recovered from utility customers through rates. The majority of these programs are related to providing charging infrastructure, encouraging the adoption of managed charging solutions and related off-peak rate incentives, and other rate-related incentives. The overall PIV Program budget includes all elements of Program cost, including administration, IT integration costs, ongoing data license and network costs, and proposed marketing and outreach programs. It is important to note that these costs are not really absolute costs to a utility customer – they are a component of cost considered in a net benefit test, which when combined with other costs and benefits, determine whether there is a *net* impact to the utility customer.

g) **Utility Revenues for Utility-Owned Public Charging:** The utility will be collecting revenues from PIV drivers that use utility-owned and operated public chargers. Those revenues will be used to offset the recovery from ratepayers for those investments, and are therefore are included as a benefit.

h) **Utility Operating Costs for Utility-Owned Public Chargers:** For the utility-owned and operated public chargers, there are operating costs such as the cost of delivered electricity (just the supply component) and other maintenance costs. These costs are included as a cost in the net benefit test.

i) **Utility Investments in Grid Reinforcement:** Estimated costs for utility reinforcement of the distribution system medium term, with costs beginning in 2030. Only costs through 2035, which is the boundary for this analysis period, are included.

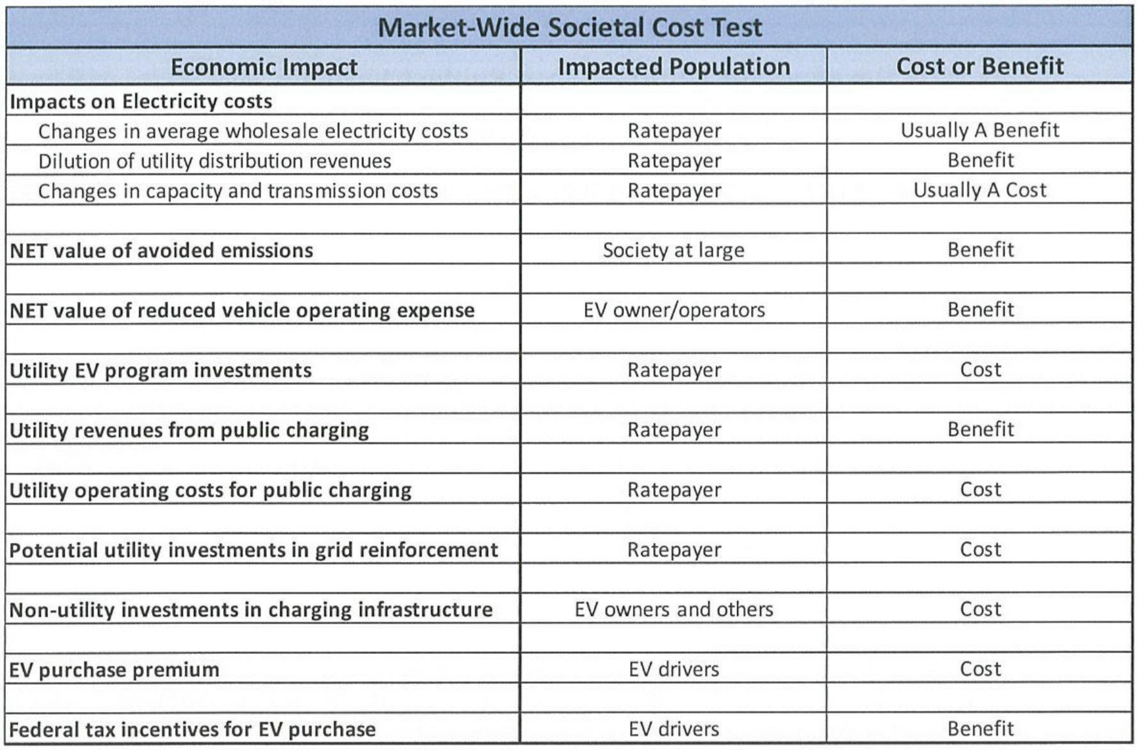
j) **Non-Utility Investments in Charging Infrastructure:** Potential costs incurred by non-utility market participants (PIV drivers and other private investors) for charging infrastructure over the analysis period *net* of any investments made by the utility through the proposed Program.

k) **PIV Driver Vehicle Purchase Premium:** An estimate of the purchase premium paid by purchasers of PIVs, captured as a cost.

l) **Value of Federal Tax Credits for PIV Purchase:** The federal tax incentive provided for PIVs, declining over time, based on distinct eligibility rules for BEVs and PIHVs, captured as a benefit.

The following figure summarizes how each of these elements were included in the SCT:

Figure 2: Market-Wide Societal Cost Test



Market-Wide Societal Cost Test		
Economic Impact	**Impacted Population**	**Cost or Benefit**
Impacts on Electricity costs		
Changes in average wholesale electricity costs	Ratepayer	Usually A Benefit
Dilution of utility distribution revenues	Ratepayer	Benefit
Changes in capacity and transmission costs	Ratepayer	Usually A Cost
NET value of avoided emissions	Society at large	Benefit
NET value of reduced vehicle operating expense	EV owner/operators	Benefit
Utility EV program investments	Ratepayer	Cost
Utility revenues from public charging	Ratepayer	Benefit
Utility operating costs for public charging	Ratepayer	Cost
Potential utility investments in grid reinforcement	Ratepayer	Cost
Non-utility investments in charging infrastructure	EV owners and others	Cost
EV purchase premium	EV drivers	Cost
Federal tax incentives for EV purchase	EV drivers	Benefit

The SCT result is based on a benefit/cost ratio (NPV of benefits divided by the NPV of costs) and the NPV of benefits minus costs (per year) over the analysis period. A benefit/cost ratio over 1.0 is considered beneficial, and a positive NPV implies that the benefits exceed the costs.

Q19: How were the net benefits of the specific utility Offerings assessed?

A19. The Offering-specific merit tests quantify the costs and benefits specific to each proposed utility Offering. These are very narrow tests designed to focus on impacts for non-participating utility ratepayers (*i.e.*, all utility customers that do not drive a PIV). This test is based on the costs specific to the Offering under consideration, and the scale of the Offering proposed (*i.e.*, number of participants and/or vehicles impacted). In contrast to the SCT – which compares the market with PIVs to the market without PIVs – these Offering-specific tests focus on the direct change created in the market by the proposed utility Program. Each utility Offering is targeted at different customer groups, and has a different market impact, which motivates the need for these customized merit tests. These tests have been specifically designed to quantify the net benefit of utility Offerings that impose recovery costs on ratepayers, and the benefit realized by all ratepayers. These benefits vary by Offering depending on the impact, but generally reflect how electricity costs for all ratepayers are affected by the Offering, and in some cases the value of induced environmental benefits as well. As with most typical net benefit tests, the merit test quantifies a benefit/cost ratio based on the NPV of benefits divided by NPV of costs. What differs in each merit test is the portfolio of benefits and costs included for each utility Offering, and the scope of Offering costs and impacts considered for each.

Q20: If these Offering-specific merit tests are intended to quantify ratepayer impact, why are environmental benefits included?

A20. As noted, in most cases the merit tests focus on the impact that vehicle charging associated with the specific Offering will have on the cost of electricity for all rate payers. In some cases, an Offering also has significant indirect impact through environmental benefits. I believe it is fair to account the value of environmental benefits for Offerings that are instrumental in inducing increased PIV adoption, especially since improved air quality positively impacts all ratepayers. Unlike the SCT, however, only the subset of environmental benefits that are directly induced by the Offering are considered, and only those environmental benefits that affect all rate payers are considered. For example, the savings from reduced PIV operating costs are not considered in the customized per-Offering tests because they do not directly impact non-participating ratepayers. The sections below outline the specific costs and benefits associated with each customized Offering merit test.

Q21: What were the Offering design parameters assumed as part of the benefit-cost analysis?

A21. Please refer to the utility filing and other supporting testimony for detailed descriptions of the Offering. All references to "Offering costs" include direct costs the Offering, and an allocation (based on share of overall budget) for cross-Offering costs such as administration, IT integration, and marketing. The following figure summarizes the customer-visible elements for each of the proposed utility program offers.

Figure 3: Offering Incentive Summary

		Charger Rebate $	Charger Install $	Off-Peak Incentive	Demand Incentive	Make - Ready	Other	Custom BCA
Residential	**Offer 1:** Wholehouse TOU			Y			Y	Y
	Offer 2: Off-Peak (vehicle data)			Y				Y
	Offer 3: Managed Charging	Y	Y	Y		*(Y)*		Y
Commercial	**Offer 4:** Multi-Family L2	Y	Y		Y	*(Y)*		Y
	Offer 5: Workplace L2	Y			Y			Y
	Offer 6: Fleet L2	Y			Y			Y
Public	**Offer 7:** Utility Owned Public DCFC						Y	Y
	Offer 8 : Utility Owned Public L2						Y	Y
	Offer 9: Privately Owned Public DCFC				Y	Y		Y
Community	**Offer 10:** Electric School Buses		Y			Y	Y	
	Offer 11: NJ Transit Electrification		Y			Y		
	Offer 12: Innovation Fund						Y	
	Offer 13: Green Adder						Y	

Note that benefit-cost analysis is not included for the community Offerings, since the exact details of how those funds will be spent, and the associated benefits are not knowable at this time.

Q22: What methodology was used for calculating net benefits for Offering 1, the residential "whole-house" TOU rate?

A22: Offering 1 is targeted to new or existing PIV drivers who want to charge their vehicle at home, but do not elect to participate in the ACE's proposed managed charging program (Offering 3). Offering 1 considers PIV charging as part of overall household load, and provides an incentive for *all* electricity consumption during off-peak times as defined by the applicable tariff. The customer is free to charge their PIV with any charger they desire, and no incentive related to the charging hardware itself will be provided by ACE. Offering 1 is a rate incentive implemented through a standard revenue-neutral tariff, and the economic incentive is realized directly by the customer through electricity cost savings on their electric bill. This merit test is very narrow and reflects only the impact the Offering has on shifting load to off-peak times; dilution is not considered as a benefit, since these customers are assumed to be charging anyway and the only impact of the Offering is to influence *when* they charge. The only benefit considered is therefore the avoided harm associated with increased capacity and transmission costs. A "success factor" is included to capture the fraction of kWhs that are actually shifted to off-peak times, and this factor was developed based on the success rates exhibited by similar programs in other territories. The costs included are the costs of the utility Offering itself, which is primarily the cost of installation (or upgrade, as appropriate) of a residential interval meter.

Q23: What methodology was used for calculating net benefits for Offering 2, the residential off-peak vehicle charging incentive?

A23. Offering 2 is targeted to new or existing PIV drivers who want to charge their PIV at home, but which do not want to participate in the utility's managed charging program (Offering 3). The customer is free to charge their vehicle with any charger they desire, but they are required to install a utility provided device in their PIV to track charging transactions (and other data). Offering 2 provides an off-bill incentive, at the rate of 5 cents/kWh, for all PIV charging during designated off-peak times as defined by the applicable tariff, *net* of any charging during on-peak times. The data for computing the incentive is collected by the utility from the vehicle, which allows the utility to encourage off-peak charging to customers that want to use their own charger, including non-network chargers. This merit test is very narrow, and reflects only the impact the Offering has on shifting load to off-peak times. Dilution is not considered as a benefit, since these customers are assumed to be charging anyway and the only impact of the Offering is to influence *when* they charge. The only benefit considered is therefore the avoided harm associated with increased capacity and transmission costs. A "success factor" is included to capture the fraction of kWhs that are actually shifted to off-peak times, and this factor was developed based on the success rates exhibited by similar Offerings in other utility service territories. The costs included in merit test are the costs of the utility Offering itself, which is primarily the cost of the vehicle interface device, the associated network and service fees, and the value of the off-peak incentive provided to the PIV customer. Beyond the direct impact on consumer charge scheduling, Offering 2 will also provide extremely valuable information about PIV use and charging behavior to ACE. This information is critical for future Program design and benefit cost assessment.

Q24: What methodology was used for calculating net benefits for Offering 3, the residential managed charging program?

A24. Offering 3 is a highly strategic platform solution that is targeted to new PIV drivers. The Offering allows the customer to select a networkable Level 2 charger from an ACE-approved list, and provides a rebate to cover 50% of the equipment and 50% of the installation costs, plus an off-bill incentive for charging during designated off-peak times as defined by the applicable tariff *net* of any on-peak charging. The off-peak incentive will be 5 cents/kWh. The transaction information required to compute the off-bill incentive is collected by the Company directly from the networked residential charger. This Offering has two market impacts: (a) it addresses consumer barriers associated with customers that are uncertain about how to charge their vehicles at home; and (b) it enables managed charging programs that encourage residential charging at optimal off-peak times. This merit test is very narrow, however, and reflects only the impact the Offering has on shifting load to off-peak times. Dilution is not considered as a benefit, because these customers are assumed to be charging anyway, and the primary impact of the Offering is to influence *when* they charge. The only benefit considered is therefore the avoided harm associated with increased capacity and transmission costs. A "success factor" is included to capture the fraction of kWhs that are actually shifted to off-peak times, and this factor was developed based on the success rates exhibited by similar programs in other territories. The costs included are the costs of the utility Offering itself, which is primarily the cost of the networked charger rebate, the associated network and service fees, and the value of the off-peak incentive provided to the PIV customer. Other important strategic benefits, such as increased PIV adoption resulting from addressing consumer adoption barriers related to home charging uncertainty, and the fact that some of these start-up costs associated with this Offering (especially regarding IT integration) could be leveraged through future programs are not explicitly quantified in this analysis.

Q25: What methodology was used for calculating net benefits for Offering 4, the multi-family charger solution?

A25. Offering 4 addresses the fact that residential chargers in multiple dwelling units ("MDUs") are virtually non-existent in New Jersey. This segment includes all New Jersey residents that live in multi-family housing with parking in shared lots, shared parking decks, or on-street parking. Many consumers that cannot count on a routine charging solution at home will simply choose not to drive a PIV, and the absence of chargers in the multi-family environment is therefore a major barrier for those consumers. 1Offering 4 specifically addresses a need not being met by the competitive market, and the PIV drivers impacted by this Offering are expected to mostly be *new* PIV drivers. Offering 4 allows the commercial customer (typically the property owner, or homeowner association) to select a networkable Level 2 charger from a utility-approved list and provides a rebate to cover 50% of the equipment costs and up to $10,000 per site for installation costs, and an additional rate incentive to offset 50% of the demand charges typically induced by vehicle chargers on commercial tariffs. ACE will be able to collect transaction information from all chargers provided through this Offering, which will help improve utility understanding of potential grid impacts from vehicle charging. This merit test is very narrow, and reflects the dilution effect associated with the vehicle charging consumption (kWhs) for directly-impacted PIV drivers (based on the increase in electricity use associated with PIV charging, and the reduced unit cost of utility distribution revenues over that increased volume), and consideration of the environmental value associated with charging of the supported vehicles. These environmental impacts are appropriate to include since the induced emission reduction benefits all ratepayers through cleaner air. The costs included are the costs of the utility Offering itself, which is primarily the cost of the networked charger rebate (including installation), the associated network and service fees, and the value of the demand charge offset incentive provided to the commercial customer.

Q26: What methodology was used for calculating net benefits for Offering 5, the commercial workplace charger solution?

A26. Offering 5 addresses demonstrated benefits of providing PIV charging at the workplace, for use by employees. Chargers at the workplace serve as an important "back-up" or "range extender" for PIV drivers that have routine charging at home, may serve as the primary routine charging facility for customers in a multi-family home, and strongly impact consumer awareness and adoption. The PIV drivers impacted by this Offering are expected to mostly be *new* PIV drivers. Offering 5 allows a commercial customer (typically the business owner or commercial landlord) to select a networkable Level 2 charger from a utility-approved list, and provides a rebate to cover a fraction of the equipment (but not installation costs) and an additional rate incentive to offset a fraction of the demand charges typically induced by PIV chargers on commercial tariffs. ACE will be able to collect transaction information from all chargers provided through this Offering, which will help improve utility understanding of potential grid impacts from vehicle charging. This merit test is very narrow, and reflects only the dilution effect associated with the vehicle charging consumption (kWhs) for directly impacted PIV drivers (based on the increase in electricity use associated with vehicle charging, and the reduced unit cost of utility distribution revenues over that increased volume), and consideration of the environmental value associated with the supported vehicles. These environmental impacts are appropriate to include since the induced emission reduction benefits all ratepayers through cleaner air. The costs included are the costs of the Offering itself, which is primarily the cost of the networked charger rebate (not including installation), the associated network and service fees, and the value of the demand charge offset incentive provided to the commercial customer.

Q27: What methodology was used for calculating net benefits for Offering 6, the commercial fleet charger solution?

A27. Offering 6 facilities the installation of routine charging infrastructure for owners of vehicle fleets, including State, local government, commercial or industrial, and not-for-profit entities. Fleet owners can potentially have a large impact on accelerating PIV adoption because: (1) they account for approximately 9% of all registered light-duty vehicles; (2) fleet owners are strongly attracted to the operating cost advantages of PIVs; and (3) a commitment to PIVs by fleet operators can result in bringing many PIVs onto New Jersey roads relatively quickly. The electrification of these fleet vehicles also impacts consumer awareness. Charging infrastructure for fleet vehicles is critical to enabling fleet electrification, and the proposed utility solution facilitates installation of PIV chargers by fleet owners. The PIV drivers that are impacted by Offering 6 are expected to mostly be *new* PIV owner/operators, since a fleet operator will typically *not* choose to electrify a portion of the fleet unless a routine charging solution has been identified. ACE's proposed Offering 6 will allow the commercial customer (typically the business owner or landlord) to select a networkable Level 2 charger from a utility-approved list, and provides a rebate to cover 50% of the equipment (but not installation) costs and an additional rate incentive to offset 50% of the demand charges typically induced by vehicle chargers on commercial tariffs. ACE will be able to collect transaction information from all chargers provided through this Offering, which will help improve utility understanding of potential grid impacts from vehicle charging. This merit test is very narrow, and reflects only the dilution effect associated with the vehicle charging consumption (kWhs) for directly impacted PIV drivers, and consideration of the environmental value associated with the supported vehicles. These environmental impacts are appropriate to include since the induced emission reduction benefits all ratepayers through cleaner air. The costs included are the costs of the utility program itself, which is primarily the cost of the networked charger rebate (not including installation), the associated network and service fees, and the value of the demand charge offset incentive provided to the commercial customer.

Q28: What methodology was used for calculating net benefits for Offering 7, utility-owned public DCFC?

A28. Offering 7 addresses the market need for public DCFC. The single largest consumer adoption barrier for PIVs is the lack of a sufficient number of DCFC locations for public use. These facilities have distinct and legitimate use cases that address the needs of both long-distance drivers and local drivers that find themselves in a "must charge" situation due to driving beyond their vehicle range. Although the need for these chargers is relatively rare when compared with the number of times the driver of a traditional vehicle visits a gas station to refuel, DCFCs are nonetheless necessary. Consumer attitude surveys have consistently identified the shortage of public fast charging as a consumer barrier, even when the driver has access to charging at home or work or a PIV with a large battery. Improving access to these facilities is therefore a critical market development need that is only partially being met by the competitive market. The proposed utility-owned public DCFC will be targeted at those segments that are not well served by private investors today, and will leverage private investments significantly. Under Offering 7, ACE will charge PIV drivers for the charging services delivered, and those expected revenues are included as a benefit that offsets the ratepayer recovery burden. This Offering-specific net benefit test is very narrow, and captures the dilution effect associated with the electricity volume delivered by these facilities and the value of the emission reduction associated with the vehicle charging delivered by these public chargers. The costs include the cost for the equipment and installation, and ongoing operating costs (including the supply costs of the delivered electricity).

Q29: What methodology was used for calculating net benefits for Offering 8, the utility-owned public Level 2 charging solution?

A29. Offering 8 addresses the market need for public Level 2 chargers, typically in commercial, not-for-profit, and municipal settings. Level 2 public chargers are not as directly beneficial in addressing consumer range anxiety concerns as public DCFCs, but they support expanded consumer awareness, are easier to install than high-power DCFC, and provide a more ubiquitous base of "back up" charging for many drivers, and a routine charging solution for some PIV drivers (such as residents in MDUs). Level 2 chargers are typically installed in retail or other destination settings where consumers will include vehicle charging as part of other activities, such as shopping. The utility-owned public Level 2 solution will be targeted at those segments that are not well served by private investors today. The utility will charge PIV drivers for the charging services delivered, and those revenues are included as a benefit that offsets the ratepayer recovery burden. This Offering-specific net benefit test is very narrow, and captures the dilution effect associated with the electricity volume delivered by these facilities and the value of the emission reduction associated with the vehicle charging delivered by these public chargers The costs include the cost for the equipment and installation, and ongoing operating costs (including the supply costs of the delivered electricity).

Q30: What methodology was used for calculating net benefits for Offering 9, the privately owned public DCFC rate incentive?

A30. This Offering differs from those discussed above in that it does not deal directly with installing charger hardware or influencing off-peak charging. Instead, it addresses the biggest barrier identified by private investors in public DCFC facilities--the challenging economics associated with low utilization of these facilities while the PIV population is still low, and the related impacts that demand charges have on operating costs. For a privately-owned public DCFC facility, which inherently has high demand charges (associated with the high-power equipment), but potentially a modest number of kWhs dispensed (during the first few years), operating costs are prohibitive. This dynamic limits private investment in public DCFCs, and focuses private development only on locations where there is expected to be exceptionally high usage. This results in insufficient geographic coverage overall, and broad gaps in the coverage map. The ACE territory currently suffers from these "charging deserts." A utility is uniquely able to address this market barrier since it is a rate-related issue. The proposed "set point" solution in Offering 9 provides only the level of incentive required for each charging location, and the amount of incentive naturally declines as utilization increases. This approach avoids either under- or over-incentivizing a particular DCFC location, and transitions to zero when the incentive is no longer needed. Under Offering 9, commercial DCFC operators will own and operate the public DCFC facilities, based on private investment, will install new service on a standard commercial tariff, and will apply to participate in ACE's Offering based on defined rules. Importantly, the utility Offering also includes a "make-ready" solution to help offset up-front installation costs, and the off-bill incentive that offsets the economic impacts of low utilization and demand charges for a set period of time. Costs are based on the hard costs associated with the make-ready work, and the value of the set point incentive. Benefits reflect the dilution effect associated with the kWhs delivered by these commercially-owned DCFCs, and a consideration of environmental benefits associated with public chargers similar to that defined for Offering 7. These environmental impacts are appropriate to include since the induced emission reduction benefits all ratepayers through cleaner air. Offering 9 is specifically designed to encourage private investment in public charging, focusing on the component of the economic barrier that can be uniquely addressed by an electric utility through a rate-related incentive, and is temporary in nature until utilization increases. The utility has sized this Offering to support approximately twice as many privately-owned locations as utility-owned locations.

Q31: What portfolio of costs and benefits were included in each of the Offering-specific merit tests?

A31. Please see the figure below.

Figure 4: Offering-Specific Merit Tests

Offering-Specific Merit Tests		
Merit Test	**Impacted Population**	**Cost or Benefit**
Offering 1: Residential Whole-house TOU rate		
Value of "avoided harm" due to off-peak charging	Ratepayer	Benefit
Program costs (mostly meter replacement)	Ratepayer	Cost
Rate incentive (none, revenue netural)	N/A	N/A
Offering 2: Residential Off-Peak Incentive		
Value of "avoided harm" due to off-peak charging	Ratepayer	Benefit
Program costs (vehicle device, operating costs)	Ratepayer	Cost
Rate incentive (off peak, off-bill)	Ratepayer	Cost
Offering 3: Residential Managed Charging		
Value of "avoided harm" due to off-peak charging	Ratepayer	Benefit
Program costs (equipment/installation rebate)	Ratepayer	Cost
Rate incentive (off peak, off-bill)	Ratepayer	Cost
Offering 4: Multi-Family Charger Solution		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Program costs (equipment/installation rebate)	Ratepayer	Cost
Rate incentive (demand charge offset, off-bill)	Ratepayer	Cost
SENSITIVITY: No Pull-through		
Offering 5: Workplace Charger Solution		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Program costs (equipment rebate)	Ratepayer	Cost
Rate incentive (demand charge offset, off-bill)	Ratepayer	Cost
SENSITIVITY: No Pull-through		
Offering 6: Workplace Charger Solution		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Program costs (equipment rebate)	Ratepayer	Cost
Rate incentive (demand charge offset, off-bill)	Ratepayer	Cost
SENSITIVITY: No Pull-through		
Offering 7: Utility Owned DCFC For Public Use		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Collected revenues	Ratepayer	Benefit
Program costs (equipment & installation)	Ratepayer	Cost
Utility operating costs (including electricity)	Ratepayer	Cost
SENSITIVITY: No Pull-through		
Offering 8: Utility Owned Level Two For Public Use		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Collected revenues	Ratepayer	Benefit
Program costs (equipment & installation)	Ratepayer	Cost
Utility operating costs (including electricity)	Ratepayer	Cost
SENSITIVITY: No Pull-through		
Offering 9: Privately Owned DCFC For Public Use		
Dilution value (for volume delivered)	Ratepayer	Benefit
Pull-through of environmental benefit	Ratepayer	Benefit
Program costs (make-ready)	Ratepayer	Cost
Rate incentive (demand charge offset, off-bill)	Ratepayer	Cost
SENSITIVITY: No Pull-through		

Q32: Can the results of the Offering merit tests be combined to provide a perspective on net benefit of the overall portfolio of Offerings?

A32. Yes, an additional merit test considers the net benefit of the portfolio of Offerings One through Nine. This test aggregates the total costs, and all benefits, for each of the included offerings to provide a portfolio-level view. As with the Offering-specific merit tests, this analysis considers only the costs and benefits that directly impact ratepayers, i.e. utility customers that do not own an EV. Both electricity cost impacts and emission impacts are considered in the primary case. A sensitivity case considers only electricity cost impacts as realized by ratepayers. This portfolio-level test provides the best perspective on how the overall Program will impact ratepayers.

III. BENEFIT-COST ANALYSIS RESULTS

Q33. How would you summarize your overall conclusions?

A33. This analysis represents an evaluation of both physical and economic impacts from widespread PIV adoption in the ACE territory. Detailed projections of the benefits and costs are summarized in the sections below, as used in a market-wide SCT, and customized net benefit calculations for the Offering-specific merit tests. The SCT demonstrates that increased PIV adoption market-wide (within ACE's service territory), considering a wide range of costs and benefits by a variety of market participants, delivers substantial positive net benefit for both the natural and managed charging scenarios. Customized tests for each Offering, refined to reflect only the costs, benefits, and market impact associated with each Offering, demonstrate similar net benefit. Based on these results, it is my assessment that expanded market-wide PIV adoption in the ACE service territory delivers significant public benefits, the projected benefits exceed expected costs, and the proposed Program is strongly beneficial on a net basis for all impacted populations. In addition, the individual Offerings proposed by the Company each demonstrate positive net benefit, based on a customized merit test that considers the unique impact and scale of each particular utility Offering. The following figure summarizes those merit test results for the primary case:

Figure 5: Merit Test Summary – Primary Case

	Primary Case			
	B/C Ratio	**Net Benefit NPV**	**Impacted Group**	**Impacts Considered**
Market-Wide SCT (Natural)	1.49	$613,771,476	All	Electricity $, PIV OpEx, Env.
Market-Wide SCT (Managed)	2.05	$973,247,471	All	Electricity $, PIV OpEx, Env.
Offering 1: Residential Wholehouse TOU	3.83	$328,871	Ratepayers	Electricity Costs & Emissions
Offering 2: Residential Off-Peak	2.83	$908,439	Ratepayers	Electricity Costs & Emissions
Offering 3: Residential Managed Charging	1.10	$488,731	Ratepayers	Electricity Costs & Emissions
Offering 4: Commercial Multi-family	1.31	$677,066	Ratepayers	Electricity Costs & Emissions
Offering 5: Commercial Workplace	3.03	$2,159,031	Ratepayers	Electricity Costs & Emissions
Offering 6: Commercial Fleet	3.03	$2,159,031	Ratepayers	Electricity Costs & Emissions
Offering 7: Utility Owned Public DCFC	2.01	$5,721,900	Ratepayers	Electricity Costs & Emissions
Offering 8: Utility Owned Public L2	1.49	$4,767,740	Ratepayers	Electricity Costs & Emissions
Offering 9: Privately Owned Public DCFC	4.14	$11,846,055	Ratepayers	Electricity Costs & Emissions
Portolio Ratepayer Impact (Offerings 1-9)	2.67	$48,252,824	Ratepayers	Electricity Costs & Emissions

A sensitivity was also considered, that looked only at electricity costs directly evident to non-participating utility customers (*i.e.*, ratepayers that do not use a PIV). The following figure summarizes the results of that sensitivity (where applicable).

Figure 6: Merit Test Summary – Sensitivity Cases

	Sensitivity			
	B/C Ratio	**Net Benefit NPV**	**Impacted Group**	**Impacts Considered**
Market-Wide SCT (Natural)				
Market-Wide SCT (Managed)				
Offering 1: Residential Wholehouse TOU				
Offering 2: Residential Off-Peak				
Offering 3: Residential Managed Charging				
Offering 4: Commercial Multi-family	0.51	-$1,070,546	Ratepayers	Electricity Costs Only
Offering 5: Commercial Workplace	1.16	$169,367	Ratepayers	Electricity Costs Only
Offering 6: Commercial Fleet	1.16	$169,367	Ratepayers	Electricity Costs Only
			Ratepayers	
Offering 7: Utility Owned Public DCFC	1.66	$3,756,718	Ratepayers	Electricity Costs Only
Offering 8: Utility Owned Public L2	1.11	$1,015,509	Ratepayers	Electricity Costs Only
Offering 9: Privately Owned Public DCFC	1.60	$2,255,122	Ratepayers	Electricity Costs Only
Portolio Ratepayer Impact (Offerings 1-9)	1.28	$8,021,579	Ratepayers	Electricity Costs Only

Q34. In summary, what are physical impacts of increased PIV use in the ACE territory?

A34. Widespread PIV adoption is projected to displace significant gasoline consumption, increase electricity use overall with modest impacts on PJM coincident peak, and reduce transportation-induced air emissions. Key results include:

a) In ACE's service territory over the period from 2020 through 2035, PIVs will account for 19.3 billion electrically-powered miles, resulting in an estimated displacement of 873 million gallons of gasoline. This displacement of gasoline with electricity will have a profound impact for PIV drivers, resulting in changes in vehicle operating expenses, as quantified in the economic sections below.

b) Electricity use is projected to increase due to PIV charging. PIVs will require an estimated 3,910 kWhs per year for charging for each vehicle (average over the period 2020 to 2035). PIVs will add an estimated 11.2 GWhs of electricity consumption in 2020, increasing in lockstep with PIV adoption to 1,031 GWhs of electricity consumption in 2035. These changes in electricity volume and the aggregate load curve will have a significant, but predominantly beneficial, impact on ratepayer economics as quantified in the merit tests outlined below.

c) Although increased electricity use increases power plant emissions, tailpipe emissions are eliminated through PIV use, and the *net* impact is highly beneficial. After accounting for both tailpipe and power plant impacts, every electrically-fueled mile in ACE's service territory is projected to be 60.4% cleaner than a gasoline fueled mile (average over the period), and this "cleanup factor" will increase as the fraction of electricity supplied by renewable sources grows. A total of 10.4 billion pounds of CO_2 are projected to be avoided over the period, along with 25.0 million pounds of NOx. SO_2 is expected to increase slightly (at the power plants), adding a total of 5.3 million pounds of additional SO_2 over the period.

d) Most of the economic benefits quantified below are induced by the physical impact that vehicle charging has on gasoline consumption, changes in electricity consumption, and reductions in emissions.

Q35. What are your net-benefit conclusions based on the market-wide Societal Cost Test?

A35. The economic benefits and costs were combined to determine *net* benefit using the SCT as described in the methodology section above. ***The market-wide SCT delivered a net benefit on an NPV basis, with a SCT Benefit/Cost ratio of 1.49 for the natural charging case,***

and a significantly higher ratio of 2.05 for the managed charging case. This difference in outcome reflects the deferred distribution-reinforcement costs resulting from managed charging. These results demonstrate that benefits strongly outweigh costs, and that there is public benefit to vehicle electrification overall, based on market development costs that include ACE's proposed Offerings. The following chart summarizes how benefits and costs were combined in the SCT and the resulting net benefit ratio for both the natural and managed charging cases. Note that the managed charging case is the most relevant, because ACE's proposed Program includes a scalable platform for widespread managed charging, especially in the residential sector.

Figure 7: Market-wide SCT: Natural Charging

	Benefit	**Cost**
Benefit: Electricity Cost Reductions	$293,408,884	0
Benefit: PEV OpEx	$1,236,799,569	0
Benefit: Emission Reductions	$234,479,376	0
Benefit: Federal Tax Incentives	$93,998,288	0
Benefit: Revenues From Charger Use	$16,292,899	0
Cost: Private EVSE Investment	0	$302,504,443
Cost: Utility Incentives	0	$35,036,731
Cost: Incremental PEV Costs	0	$588,859,675
Cost: Potential Grid Reinforcement	0	$334,806,690
Total:	$1,874,979,016	$1,261,207,540
Benefit To Cost Ratio:	1.49	
NPV of Net Benefits:	$613,771,476	

Figure 8: Market-wide SCT: Natural Charging

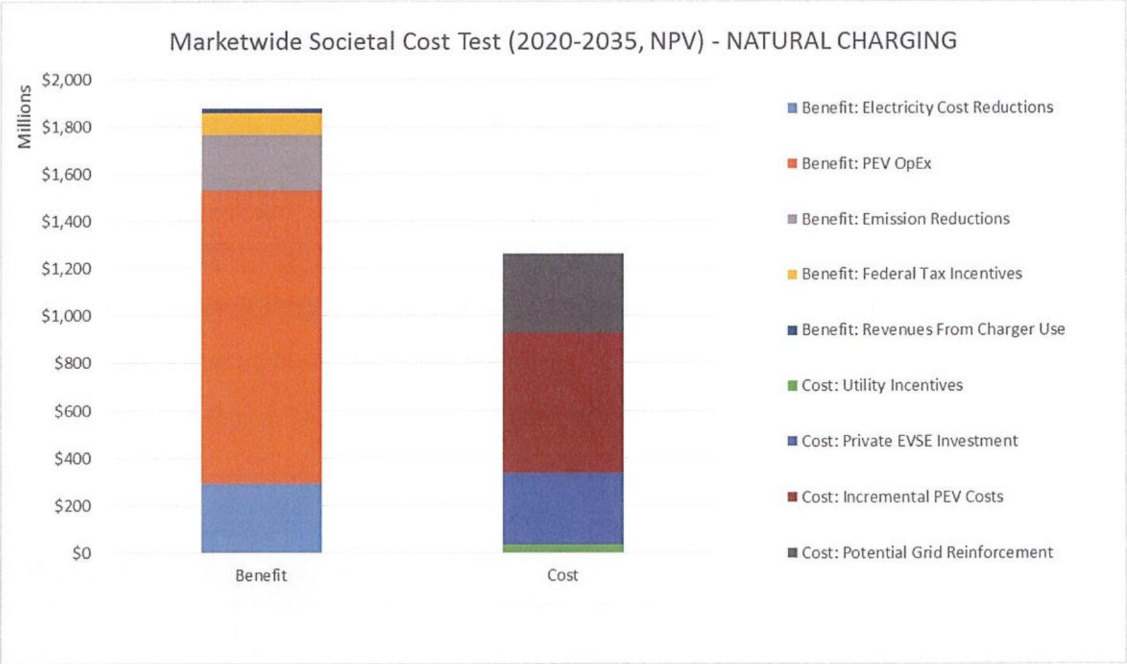
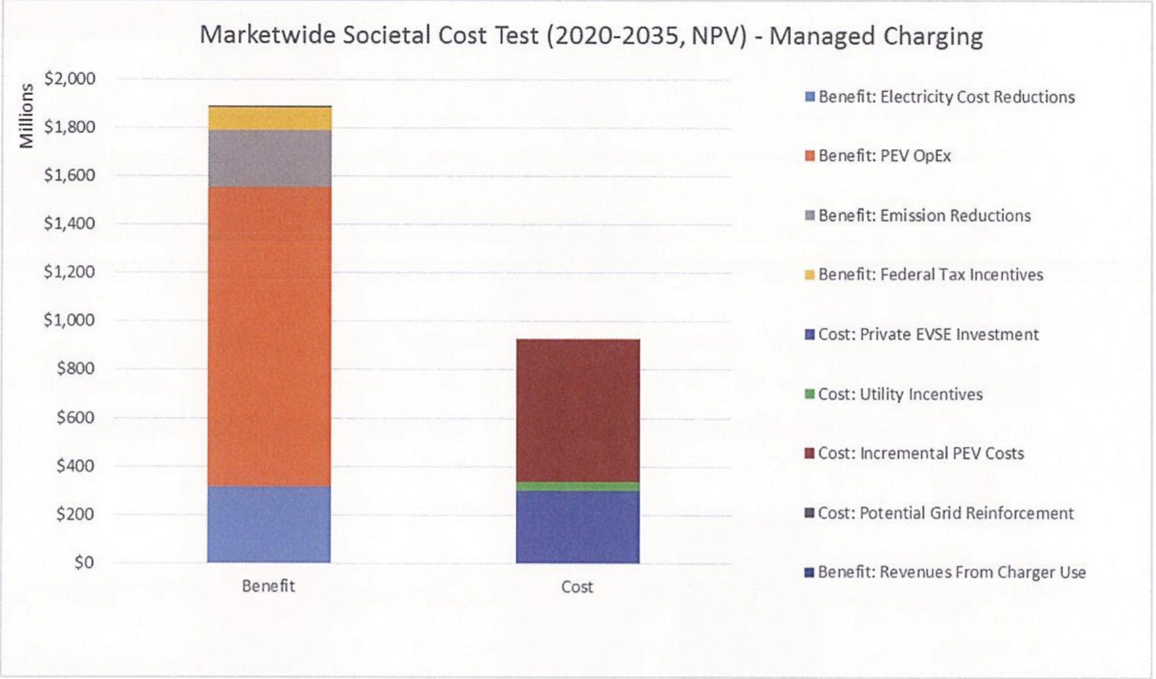


Figure 9: Market-wide SCT: Managed Charging

	Benefit	Cost
Benefit: Electricity Cost Reductions	$318,078,189	0
Benefit: PEV OpEx	$1,236,799,569	0
Benefit: Emission Reductions	$234,479,376	0
Benefit: Federal Tax Incentives	$93,998,288	0
Benefit: Revenues From Charger Use	$45,227	0
Cost: Private EVSE Investment	0	$302,504,443
Cost: Utility Incentives	0	$35,036,731
Cost: Incremental PEV Costs	0	$588,859,675
Cost: Potential Grid Reinforcement	0	$0
Total:	$1,883,400,650	$926,400,850
Benefit To Cost Ratio:	2.05	
NPV of Net Benefits:	$973,247,471	

Figure 10: Market-wide SCT: Managed Charging



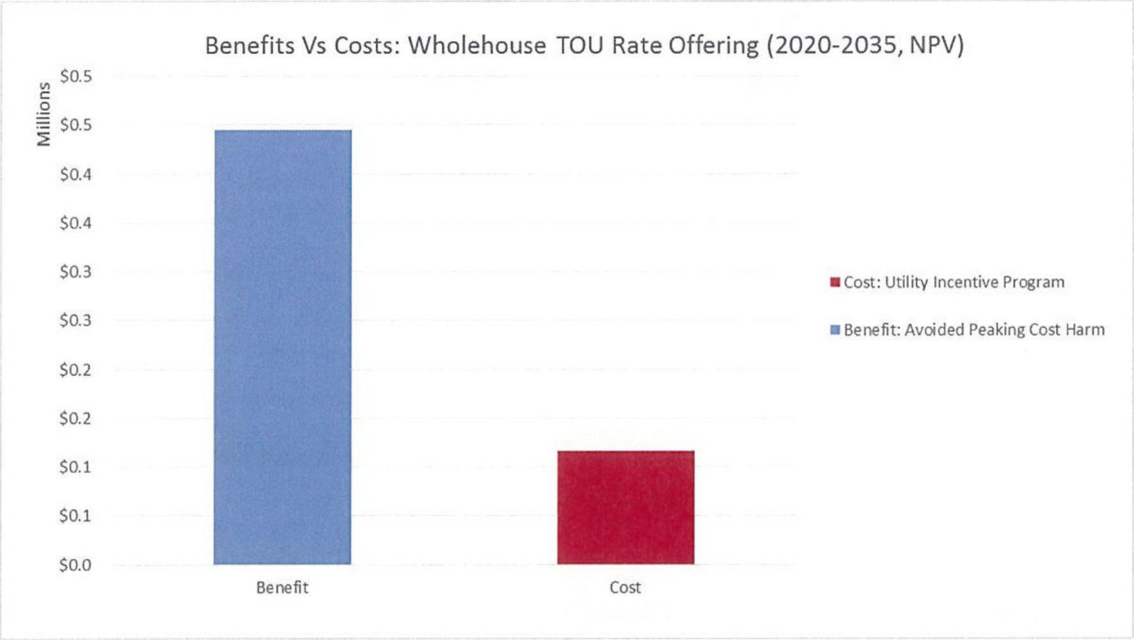
Q36. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 1 (Whole-House TOU rate)?

A36. Offering 1 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 3.83***. As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and *only* the benefits related to shifting charging load to off-peak periods. These results demonstrate that benefits strongly outweigh costs for ACE customers as realized through changes in electricity costs for all ratepayers, and that there is therefore public benefit to implementing ACE's proposed Offering 1. The following figures summarize benefits and costs for this test.

Figure 11: Factors Included in the Offering 1 Merit Test

	Benefit	Cost
Benefit: Avoided Peaking Cost Harm	$445,065	0
Cost: Utility Incentive Program	0	$116,194
Total:	$445,065	$116,194
Benefit To Cost Ratio:	3.83	
NPV of Net Benefits:	$328,871	

Figure 12: Benefits and Costs for the Offering 1 Merit Test



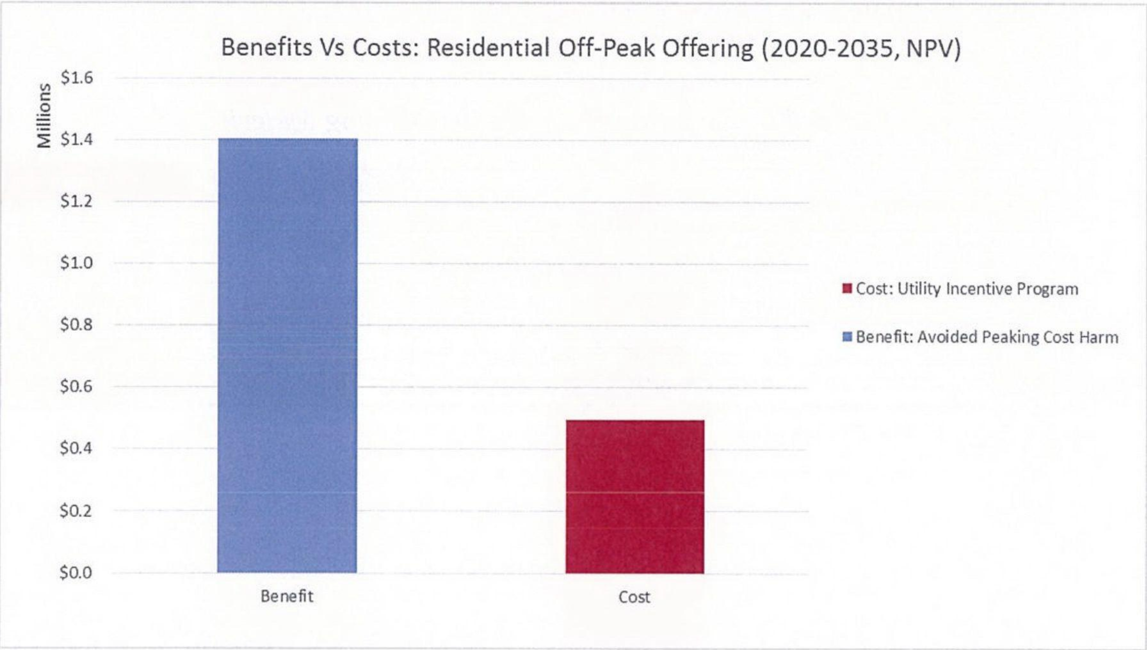
Q37. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 2 (Residential Off-Peak Incentive)?

A37. Offering 2 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 2.83***. As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and *only* the benefits related to shifting charging load to off-peak periods. These results demonstrate that benefits strongly outweigh costs for ACE customers as realized through changes in electricity costs for all ratepayers, and that there is therefore public benefit to implementing ACE's proposed Offering 2. This Offering also provides significant value in that it allows existing PIV owners, who will typically already have a charging solution in place, participate in off-peak charging. In addition, this Offering will allow for the collection of crucial customer behavior and charging transaction data that will be used to optimize future program design and inform BCA. All those benefits are not quantified in the BCA outcome, but should be considered as strategic implications of significant merit. The following figures summarize benefits and costs for this test.

Figure 13: Factors Included in the Offering 2 Merit Test

	Benefit	Cost
Benefit: Avoided Peaking Cost Harm	$1,404,935	0
Cost: Utility Incentive Program	0	$496,495
Total:	$1,404,935	$496,495
Benefit To Cost Ratio:	2.83	
NPV of Net Benefits:	$908,439	

Figure 14: Benefits and Costs for the Offering 2 Merit Test



Q38. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 3 (Residential Managed Charging)?

A38. Offering 3 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.10***. As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and *only* the benefits related to shifting charging load to off-peak periods. These results demonstrate that benefits outweigh costs for all ACE customers as realized through changes in electricity costs for all ratepayers, and that there is therefore public benefit to implementing ACE's proposed Offering 3. This Offering is also strategic because it addresses consumer concerns about how they will charge their vehicle at home, and therefore helps encourage PIV adoption (and market growth) while also shifting charging loads off-peak. This initial Offering also results in the development of a scalable platform that allows ACE to interact with the Smart EVSE in the home, creating opportunities for more advanced managed charging mechanisms in the future as charging loads increase (coordinated start scheduling, power throttling, demand-response style curtailment, ultimately Vehicle-to-Grid[12] ("V2G") capability). The platform developed with this Offering can be reused for potential future managed charging programs. Those benefits are not quantified in the BCA outcome, but should be considered as strategic implications of significant merit. The following figures summarize benefits and costs for this test.

Figure 15: Factors Included in the Offering 3 Merit Test

	Benefit	**Cost**
Benefit: Avoided Peaking Cost Harm	$5,389,533	0
Cost: Utility Incentive Program	0	$4,900,802
Total:	$5,389,533	$4,900,802
Benefit To Cost Ratio:	1.10	
NPV of Net Benefits:	$488,731	

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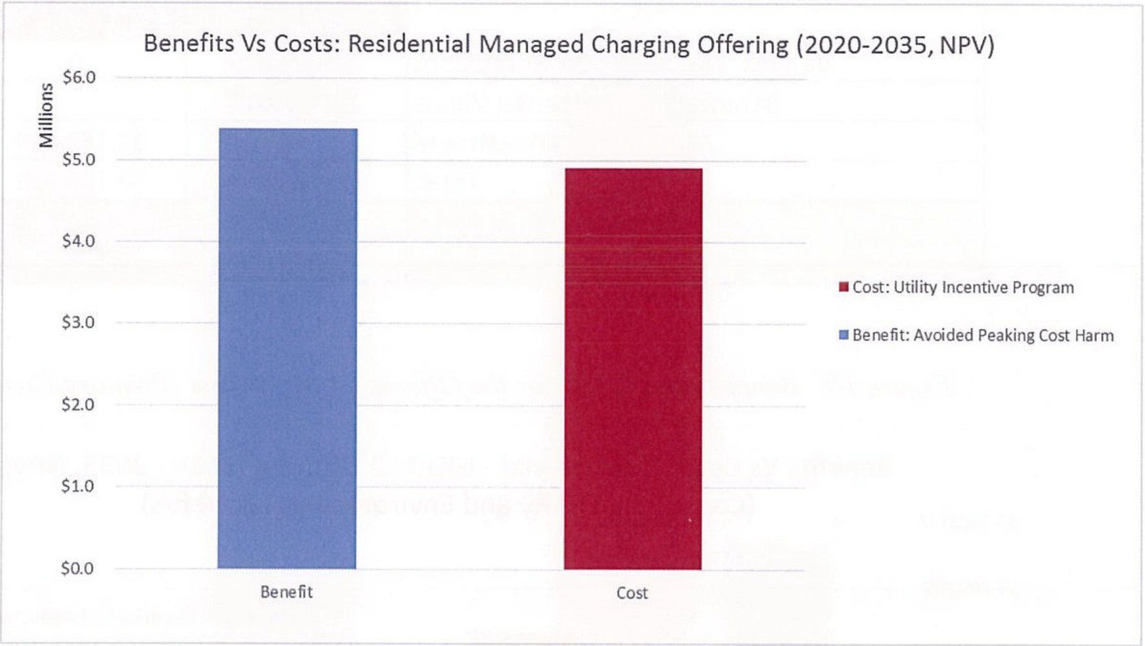
[12] "Vehicle-to-Grid" refers to the capability of smart EVSE to control a bi-directional flow of energy either into, or out of, the vehicle battery. When electricity is flowing from the battery to the grid, it is acting as a storage asset that can be used to shave peak load or firm local power quality. Managing a large and distributed group of V2G-capable vehicles can help optimize grid loading and reduce ratepayer costs. This technology can also allow the vehicle batter to power the home or building, providing resiliency value during extreme grid outage events.

Figure 16: Benefits and Costs for the Offering 3 Merit Test



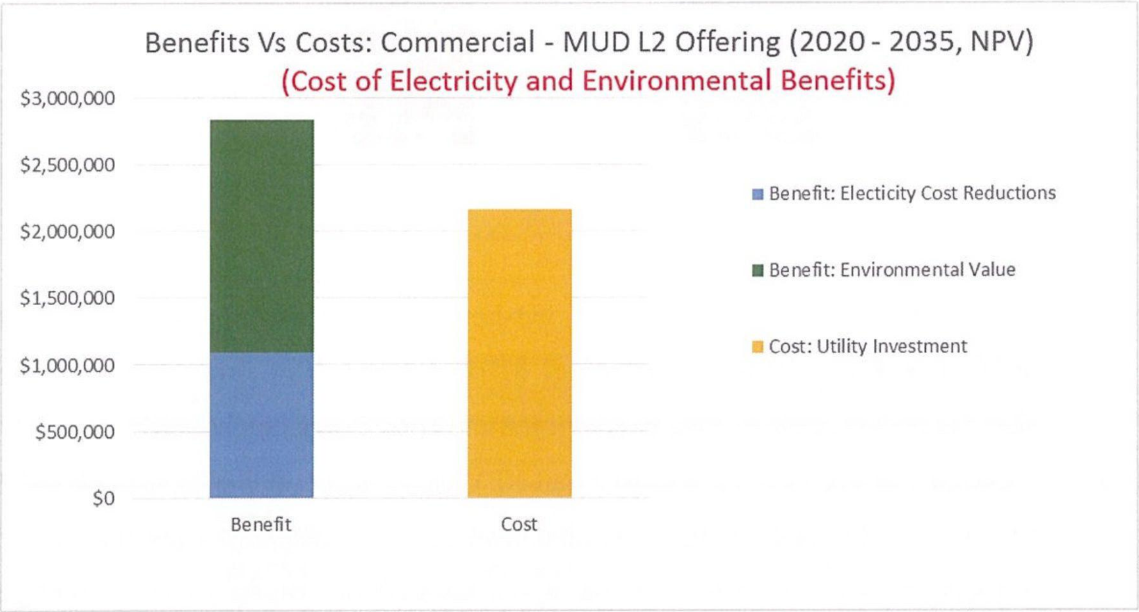
Q39. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 4 (Commercial MDU L2), for the principal case where both electricity cost impacts and environmental impacts are considered?

A39. Offering 4 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.31*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offering 4. The following figures summarize benefits and costs for this test.

Figure 17: Factors Included in the Offering 4 Merit Test (Primary Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,092,875	0
Benefit: Environmental Value	$1,747,612	
Cost: Utility Investment	0	$2,163,420
Total:	$2,840,487	$2,163,420
Benefit To Cost Ratio:	1.31	
NPV of Net Benefits:	$677,066	

Figure 18: Benefits and Costs for the Offering 4 Merit Test (Primary Case)



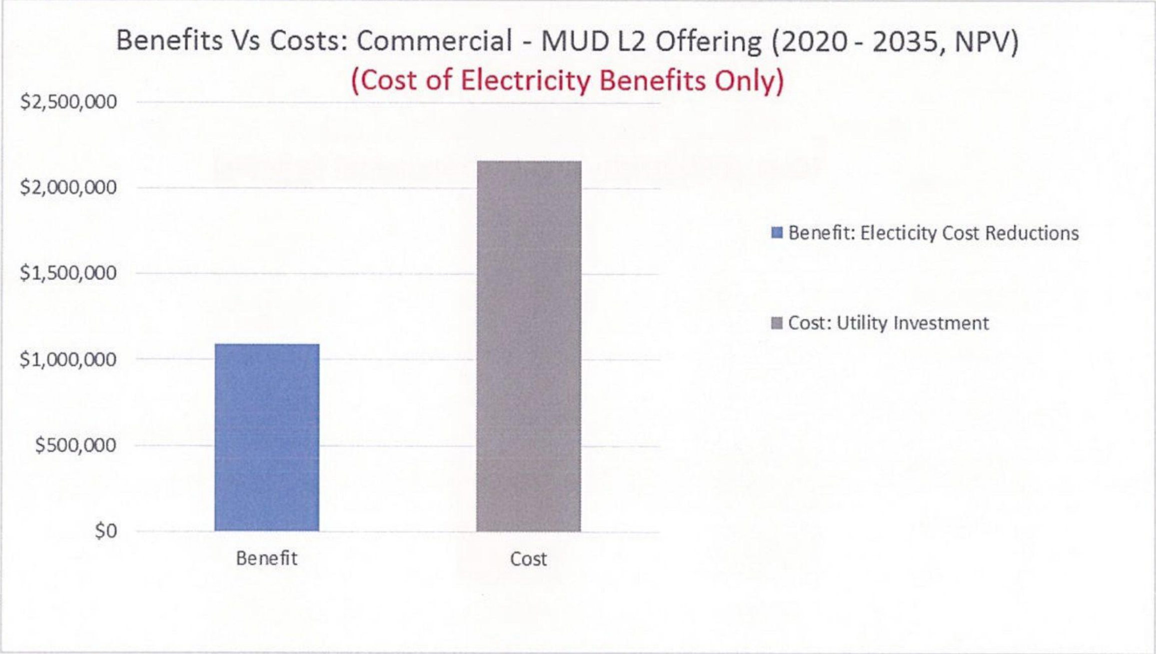
Q40. How would the BCA outcome change for Offering 4 (Commercial MDU L2) in the sensitivity case where only impacts on electricity costs are considered?

A40. On that narrow basis, Offering 4 does not deliver a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 0.51.*** The fact that the Benefit/Cost ratio is below 1.0 implies that cost exceed benefit. This is a very narrow test, however, and discounts the fact that charging infrastructure is typically not available for consumers that reside in a MDU, and that without access to routine charging they would be unlikely to adopt a PIV. Strategically, this Offering addresses equity concerns in the market, and helps ensure access to charging infrastructure across the socio-economic spectrum. The environmental (and other) benefits enabled by this offer should be considered as demonstrated in the primary cost noted above. This sensitivity, however characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered. The following figures summarize benefits and costs for this test.

Figure 19: Factors Included in the Offering 4 Merit Test (Sensitivity Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,092,875	0
Cost: Utility Investment	0	$2,163,420
Total:	$1,092,875	$2,163,420
Benefit To Cost Ratio:	0.51	
NPV of Net Benefits:	-$1,070,546	

Figure 20: Benefits and Costs for the Offering 4 Merit Test (Sensitivity Case)



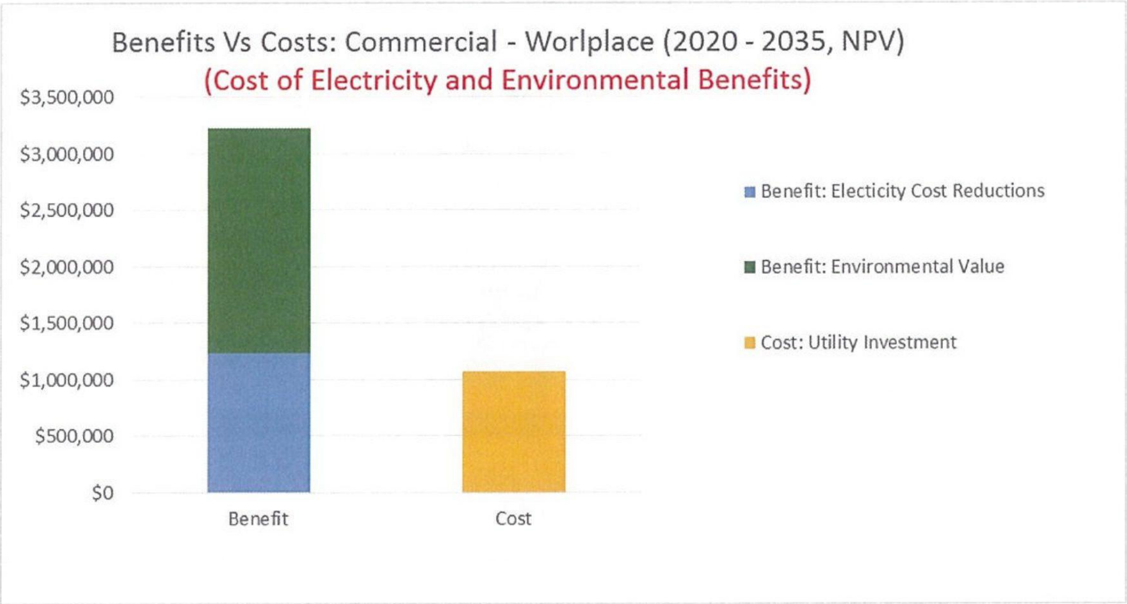
Q41. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 5 (Commercial Workplace L2), for the principal case where both electricity cost impacts and environmental impacts are considered?

A41. Offering 5 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 3.03.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits strongly outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offering 5. The following figures summarize benefits and costs for this test.

Figure 21: Factors Included in the Offering 5 Merit Test (Primary Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,235,052	0
Benefit: Environmental Value	$1,989,663	
Cost: Utility Investment	0	$1,065,684
Total:	$3,224,715	$1,065,684
Benefit To Cost Ratio:	3.03	
NPV of Net Benefits:	$2,159,031	

Figure 22: Benefits and Costs for the Offering 5 Merit Test (Primary Case)



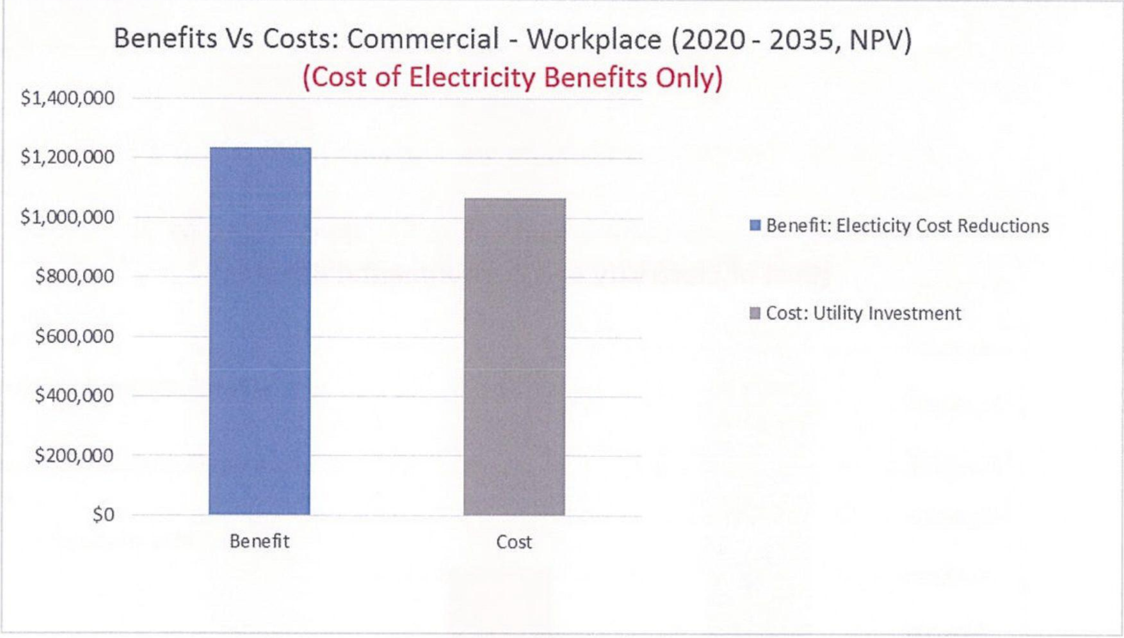
Q42. How would the BCA outcome change for Offering 5 (Commercial Workplace L2) in the sensitivity case where only impacts on electricity costs are considered?

A42. Even on that narrow basis, Offering 5 still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.16***. This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, discounting the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. This Offering is also highly strategic since it can be a routine charging solution for PIV drivers living in MDU settings (and therefore has significant equity value), and has a large positive impact on PIV awareness building and PIV adoption rates. The following figures summarize benefits and costs for this test.

Figure 23: Factors Included in The Offering 5 Merit Test (Sensitivity Case)

	Benefit	**Cost**
Benefit: Electicity Cost Reductions	$1,235,052	0
Cost: Utility Investment	0	$1,065,684
Total:	$1,235,052	$1,065,684
Benefit To Cost Ratio:	1.16	
NPV of Net Benefits:	$169,367	

Figure 24: Benefits and Costs for The Offering 5 Merit Test (Sensitivity Case)



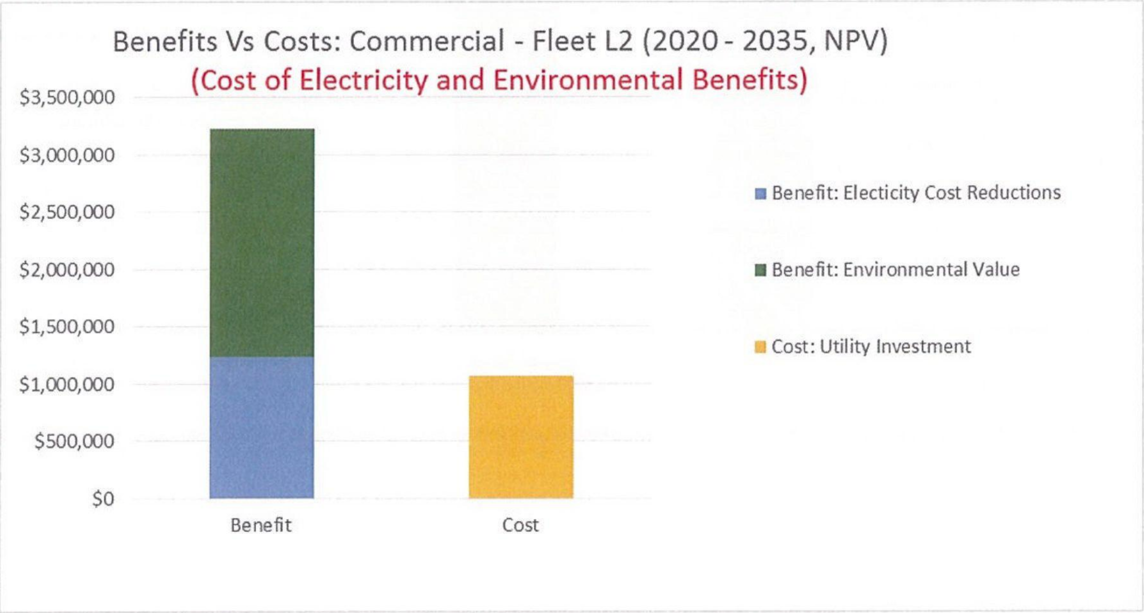
Q43. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 6 (Commercial Fleet L2), for the principal case where both electricity cost impacts and environmental impacts are considered?

A43. Offering 6 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 3.03.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits strongly outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offering 6. The following figures summarize benefits and costs for this test.

Figure 25: Factors Included in the Offering 6 Merit Test (Primary Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,235,052	0
Benefit: Environmental Value	$1,989,663	
Cost: Utility Investment	0	$1,065,684
Total:	$3,224,715	$1,065,684
Benefit To Cost Ratio:	3.03	
NPV of Net Benefits:	$2,159,031	

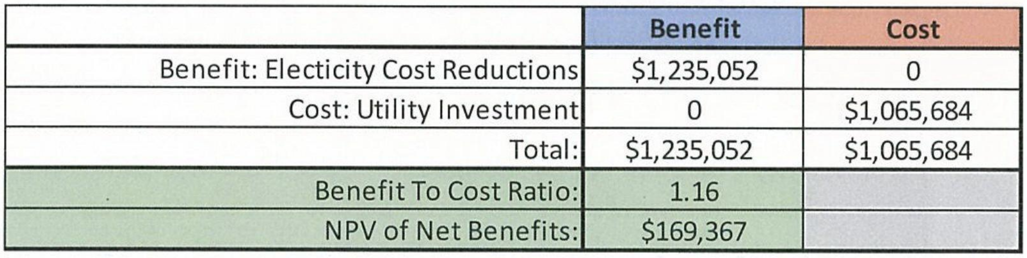
Figure 26: Benefits and Costs for the Offering 6 Merit Test (Primary Case)



Q44. How would the BCA outcome change for Offering 6 (Commercial Fleet L2) in the sensitivity case where only impacts on electricity costs are considered?

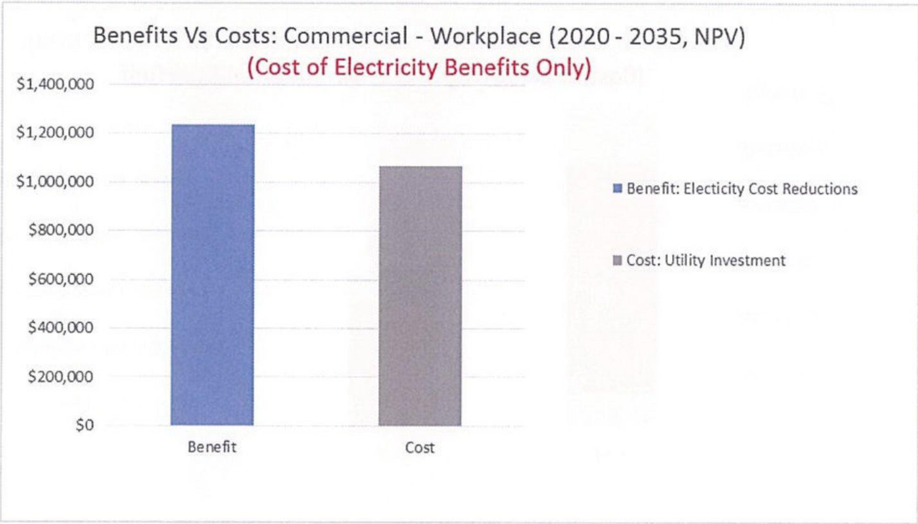
A44. Even on that narrow basis, Offering 6 still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.16.*** This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, discounting the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. This Offering is also highly strategic since fleet owners are strongly motivated by the operational savings associated with PIVs, and supporting adoption within this segment can result in a large number of PIVs on New Jersey roads in support of State objectives. The following figures summarize benefits and costs for this test.

Figure 27: Factors Included in the Offering 6 Merit Test (Sensitivity Case)



	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,235,052	0
Cost: Utility Investment	0	$1,065,684
Total:	$1,235,052	$1,065,684
Benefit To Cost Ratio:	1.16	
NPV of Net Benefits:	$169,367	

Figure 28: Benefits and Costs for the Offering 6 Merit Test (Sensitivity Case)



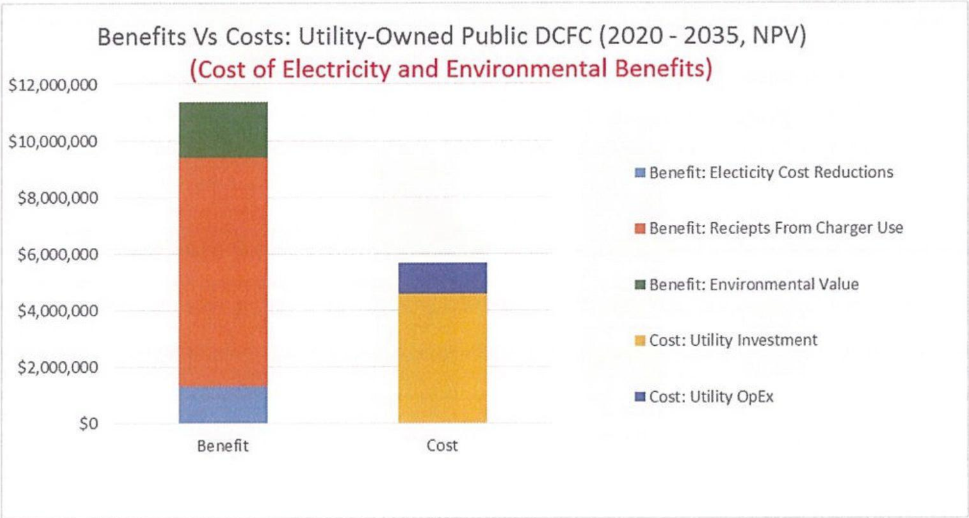
Q45. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 7 (Utility-owned DCFC for public use), for the principal case where both electricity cost impacts and environmental impacts are considered?

A45. Offering 7 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 2.01.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits strongly outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offering 7. The following figures summarize benefits and costs for this test.

Figure 29: Factors Included in the Offering 7 Merit Test (Primary Case)

	Benefit	**Cost**
Benefit: Electicity Cost Reductions	$1,303,883	0
Benefit: Reciepts From Charger Use	$8,113,067	0
Benefit: Environmental Value	$1,965,182	
Cost: Utility Investment	0	$4,590,362
Cost: Utility OpEx	0	$1,069,870
Total:	$11,382,131	$5,660,232
Benefit To Cost Ratio:	2.01	
NPV of Net Benefits:	$5,721,900	

Figure 30: Benefits and Costs for the Offering 7 Merit Test (Primary Case)



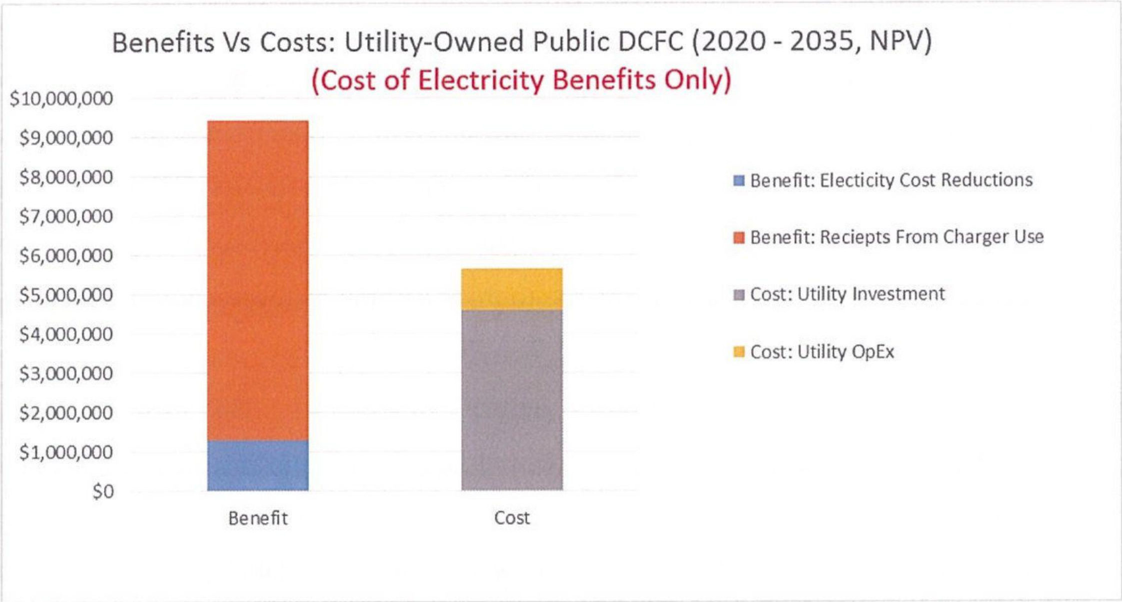
Q46. How would the BCA outcome change for Offering 7 (Utility-owned DCFC for public use) in the sensitivity case where only impacts on electricity costs are considered?

A46. Even on that narrow basis, Offering 7 still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.66.*** This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, discounting the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. This Offering is also highly strategic since it ensures availability of the fast charging infrastructure needed to address consumer range anxiety concerns, with a focus on serving areas not well supported by the competitive market, and providing for appropriate geographic coverage of fast charging facilities. The equipment and services used by the utility in implementation of this Offering will be provided by the competitive market, and these utility investments therefore help stimulate growth in that industry. The following figures summarize benefits and costs for this test.

Figure 31: Factors Included in the Offering 7 Merit Test (Sensitivity Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$1,303,883	0
Benefit: Reciepts From Charger Use	$8,113,067	0
Cost: Utility Investment	0	$4,590,362
Cost: Utility OpEx	0	$1,069,870
Total:	$9,416,950	$5,660,232
Benefit To Cost Ratio:	1.66	
NPV of Net Benefits:	$3,756,718	

Figure 32: Benefits and Costs for the Offering 7 Merit Test (Sensitivity Case)



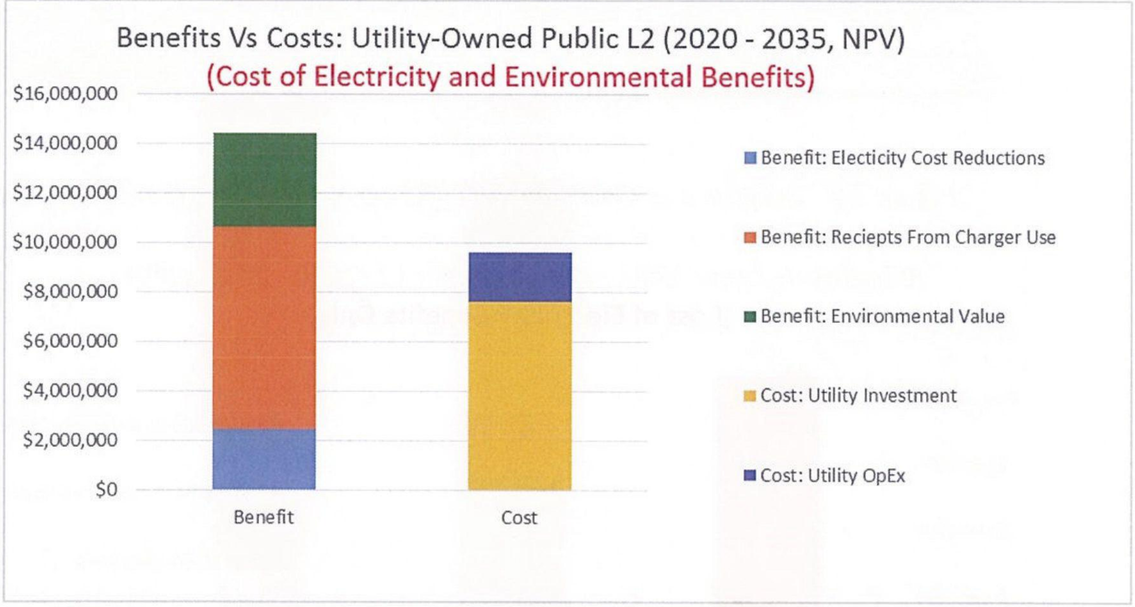
Q47. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 8 (Utility-owned L2 for public use), for the principal case where both electricity cost impacts and environmental impacts are considered?

A47. Offering 8 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.49.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offering 8. The following figures summarize benefits and costs for this test.

Figure 33: Factors Included in the Offering 8 Merit Test (Primary Case)

	Benefit	Cost
Benefit: Electicity Cost Reductions	$2,472,511	0
Benefit: Reciepts From Charger Use	$8,179,832	0
Benefit: Environmental Value	$3,752,232	
Cost: Utility Investment	0	$7,606,018
Cost: Utility OpEx	0	$2,030,816
Total:	$14,404,574	$9,636,834
Benefit To Cost Ratio:	1.49	
NPV of Net Benefits:	$4,767,740	

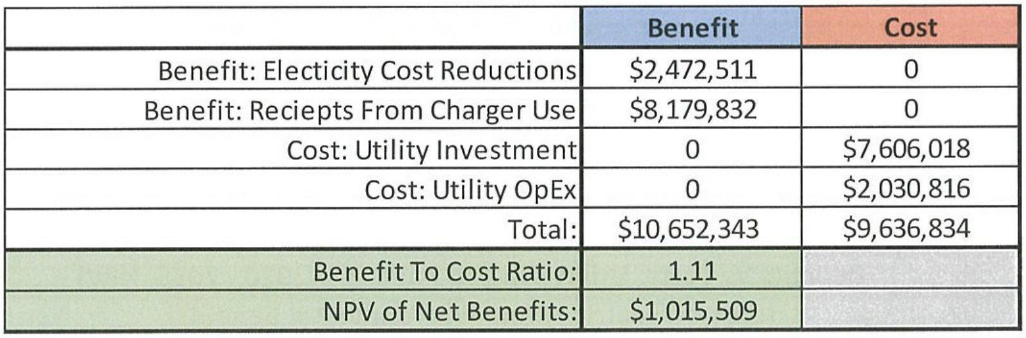
Figure 34: Benefits and Costs for the Offering 8 Merit Test (Primary Case)



Q48. How would the BCA outcome change for Offering 8 (Utility-owned L2 for public use) in the sensitivity case where only impacts on electricity costs are considered?

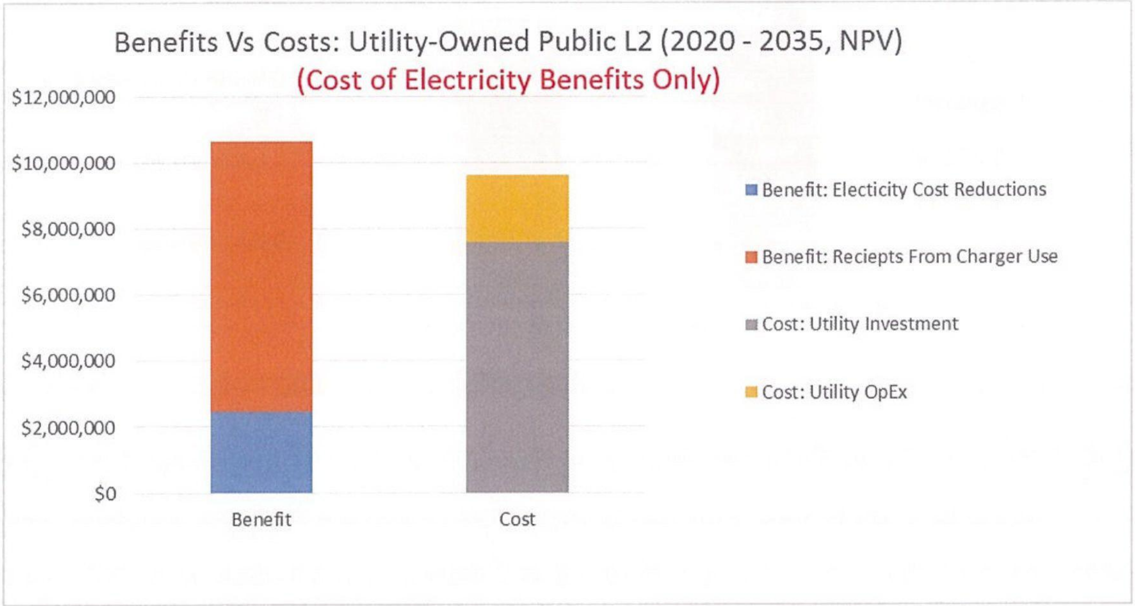
A48. Even on that narrow basis, Offering 8 still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.11.*** This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, discounting the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. This Offering provides community-level access to routine charging L2 facilities, which could be used by MDU residents or any other PIV driver in need of a charge. The equipment and services used by the utility in implementation of this Offering will be provided by the competitive market, and these utility investments therefore help stimulate growth in that industry. The following figures summarize benefits and costs for this test.

Figure 35: Factors Included in the Offering 8 Merit Test (Sensitivity Case)



	Benefit	Cost
Benefit: Electicity Cost Reductions	$2,472,511	0
Benefit: Reciepts From Charger Use	$8,179,832	0
Cost: Utility Investment	0	$7,606,018
Cost: Utility OpEx	0	$2,030,816
Total:	$10,652,343	$9,636,834
Benefit To Cost Ratio:	1.11	
NPV of Net Benefits:	$1,015,509	

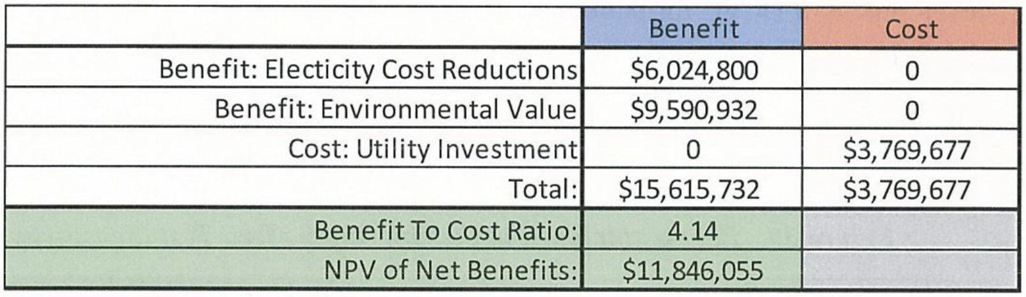
Figure 36: Benefits and Costs for the Offering 8 Merit Test (Sensitivity Case)



Q49. What are the costs, benefits, and net-benefit result associated with the merit-test applied to Offering 9 (privately-owned DCFC for public use), for the principal case where both electricity cost impacts and environmental impacts are considered?

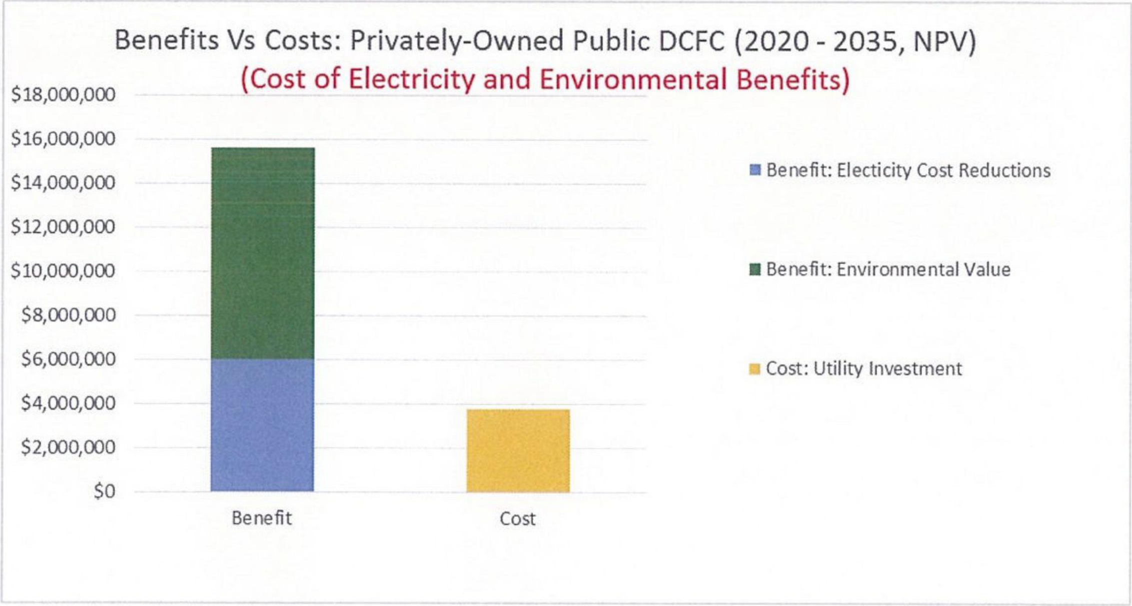
A49. Offering 9 delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 4.14.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits outweigh costs for all ratepayers to an exceptional degree, and that there is public benefit to implementing ACE's proposed Offering 9. The following figures summarize benefits and costs for this test.

Figure 37: Factors Included in the Offering 9 Merit Test (Primary Case)



	Benefit	Cost
Benefit: Electicity Cost Reductions	$6,024,800	0
Benefit: Environmental Value	$9,590,932	0
Cost: Utility Investment	0	$3,769,677
Total:	$15,615,732	$3,769,677
Benefit To Cost Ratio:	4.14	
NPV of Net Benefits:	$11,846,055	

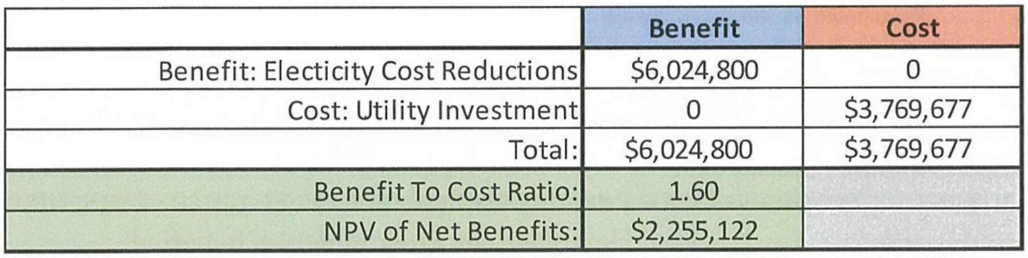
Figure 38: Benefits and Costs for the Offering 9 Merit Test (Primary Case)



Q50. How would the BCA outcome change for Offering 9 (privately-owned DCFC for public use) in the sensitivity case where only impacts on electricity costs are considered?

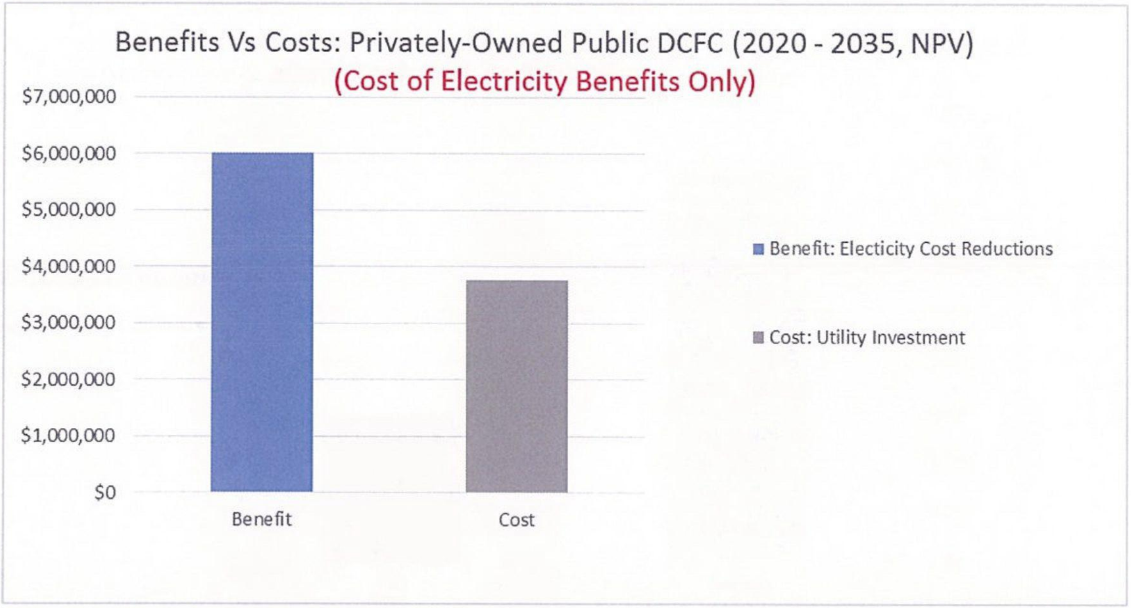
A50. Even on that narrow basis, Offering 9 still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.60.*** This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, discounting the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. This Offering directly supports development of DCFC for public use by private investors, and utility investments through this Offering leverage significant private investment. The following figures summarize benefits and costs for this test.

Figure 39: Factors Included in the Offering 9 Merit Test (Sensitivity Case)



	Benefit	Cost
Benefit: Electicity Cost Reductions	$6,024,800	0
Cost: Utility Investment	0	$3,769,677
Total:	$6,024,800	$3,769,677
Benefit To Cost Ratio:	1.60	
NPV of Net Benefits:	$2,255,122	

Figure 40: Benefits and Costs for the Offering 9 Merit Test (Sensitivity Case)



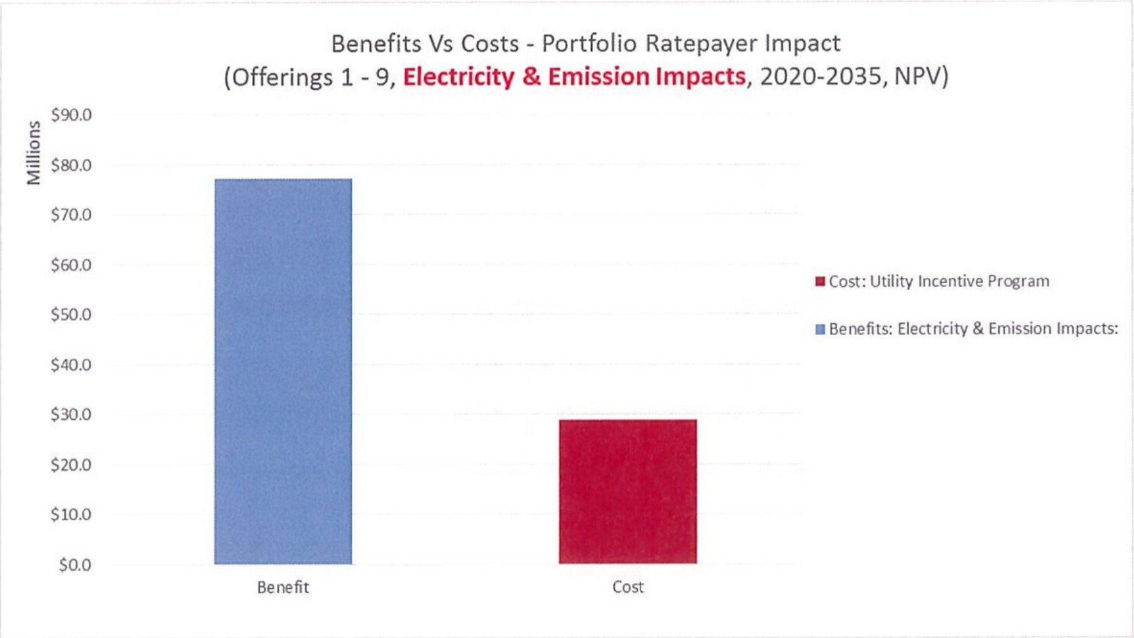
Q51. What would the BCA results be if you considered the Offerings at a portfolio level?

A51. When combining the costs and benefits of Offerings 1 through 9, the portfolio delivered a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 2.67.*** As described in the methodology section above, this is a very narrow test that considers only impacts on utility customers, including the costs of the proposed ACE Offering and both the direct economic impacts (through electricity costs) and environmental benefits (which impact all ratepayers). These results demonstrate that benefits strongly outweigh costs for all ratepayers, and that there is public benefit to implementing ACE's proposed Offerings (1-9) even when considered in aggregate. The following figures summarize benefits and costs for this test.

Figure 41: Factors Included In Portfolio Merit Test (Primary Case)

	Benefit	Cost
Benefits: Electricity & Emission Impacts:	$77,127,848	0
Cost: Utility Incentive Program	0	$28,875,024
Total:	$77,127,848	$28,875,024
Benefit To Cost Ratio:	2.67	
NPV of Net Benefits:	$48,252,824	

Figure 42: Benefits and Costs for the Portfolio Merit Test (Primary Case)



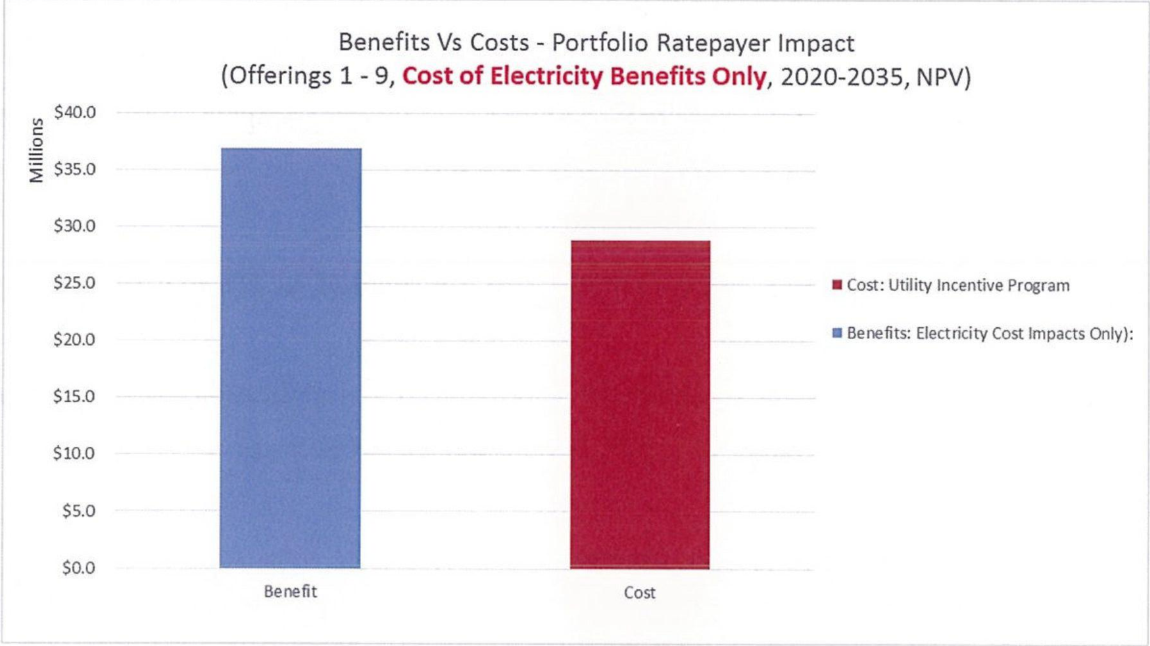
Q52. How would the Portfolio BCA outcome change the sensitivity case where only impacts on electricity costs are considered?

A52. Even on that narrow basis, the aggregate portfolio still delivers a net benefit on an NPV basis, with a ***Benefit/Cost ratio of 1.28***. This sensitivity characterizes the net benefit in the very narrow case where only impacts on electricity costs are considered, ignoring the environmental benefits realized by all ratepayers due to this Offering as represented in the primary BCA case noted above. Despite restricting benefits exclusively to economic impacts visible on customer utility bills, this Offering delivers net benefit. The following figures summarize benefits and costs for this test.

Figure 43: Factors Included in the Portfolio Merit Test (Sensitivity Case)

	Benefit	Cost
Benefits: Electricity Cost Impacts Only):	$36,896,603	0
Cost: Utility Incentive Program	0	$28,875,024
Total:	$36,896,603	$28,875,024
Benefit To Cost Ratio:	1.28	
NPV of Net Benefits:	$8,021,579	

Figure 44: Benefits and Costs for the Portfolio Merit Test (Sensitivity Case)



IV. CONCLUSIONS

Q53. In summary, what were the results of your analysis?

A53. The proposed utility PIV program is projected to be cost-effective and is expected to provide quantified net benefits to the customers of ACE. The market-wide SCT, and each of the Offering-specific merit tests deliver positive *net* benefits after accounting for estimated potential costs, and all deliver benefit/cost ratio greater than 1.0. Several sensitivities were included, reflecting Offering-specific merit tests where environmental value was not included. In all those cases except one (for Offering 4, multi-family charging solution), the electricity-cost-impact-only sensitivity (without environmental value) was still greater than one, indicating that non-participating rate payers will realize a direct economic benefit as realized directly on their electricity bill.

Q54. What conclusions do you draw from these results?

A54. Based on these results, it is our assessment that the projected benefits exceed expected costs, and are strongly beneficial on a net basis across all merit tests considered. For utility ratepayers in particular, increases in electricity costs (due to PIV program costs and potential grid reinforcement) are more than offset by decreases in utility costs (due to beneficial PIV impacts related to vehicle charging), and these benefits accrue to utility customers that do not own an PIV. The managed charging programs proposed by the utility are critical to achieving these rate payer benefits.

Q55. Based on the results, do you recommend approval of ACE's PIV Program proposed in its Amended Petition?

A55. Yes. The Board would be justified in approving ACE's application based on the substantial net benefits to the ratepayers, PIV drivers, and society at large.

Q56. Does this conclude your testimony?

A56. Yes.

Schedule (MW)-1

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Projections Of Electric Vehicle Adoption In New Jersey

Prepared For ChargEVC By Gabel Associates, Inc.

September 18, 2019

Acknowledgements

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Acknowledgments: This report benefited greatly from the input, guidance, and active collaboration from many parties, especially subject matter experts at various New Jersey state agencies, colleagues at the New Jersey Climate Change Alliance, and Jeff Foltz in association with NJCAR.

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1 Executive Summary

ChargEVC, a coalition of stakeholders that support vehicle electrification in New Jersey, commissioned Gabel Associates to complete an update to the original Plug-In Electric Vehicle (PEV) market study issued in January 2018. This updated study will incorporate new information about recent developments, build on updated data sources, and incorporate a variety of improvements to the model for assessing impacts, costs, and benefits. The foundation for this new study is an updated projection of PEV adoption in New Jersey, incorporating several additional years of market data, and benefiting from a fundamentally new projection methodology. This report summarizes the results of that new PEV adoption study.

The study combined four elements to project PEV adoption levels in New Jersey through the period 2035 and 2050:

- In depth research on recent sales activity in New Jersey, vehicle registration data, national sales statistics, and other relevant market trends;

- A survey of projection methods used for PEV adoption, and development of a methodology that meets the needs of the New Jersey market at the current time; the projection model is based on a blended approach that couples short term sales projections to recent market trends, but transitions to the adoption levels needed to achieve state goals in 2025, 2035, and 2050.

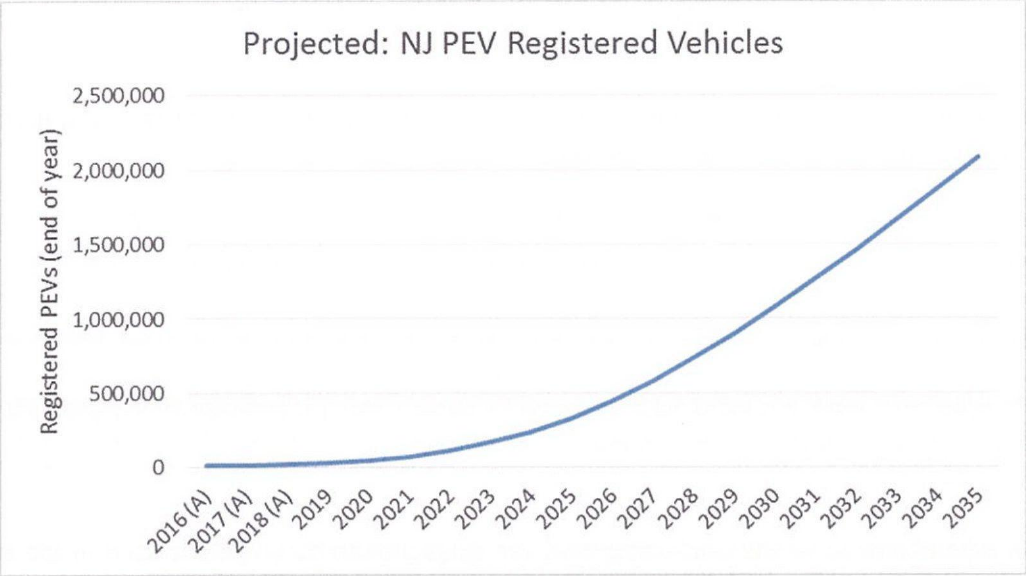
- A projection model that estimates sales of both Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) and computes the population of registered PEVs each year over the study period;

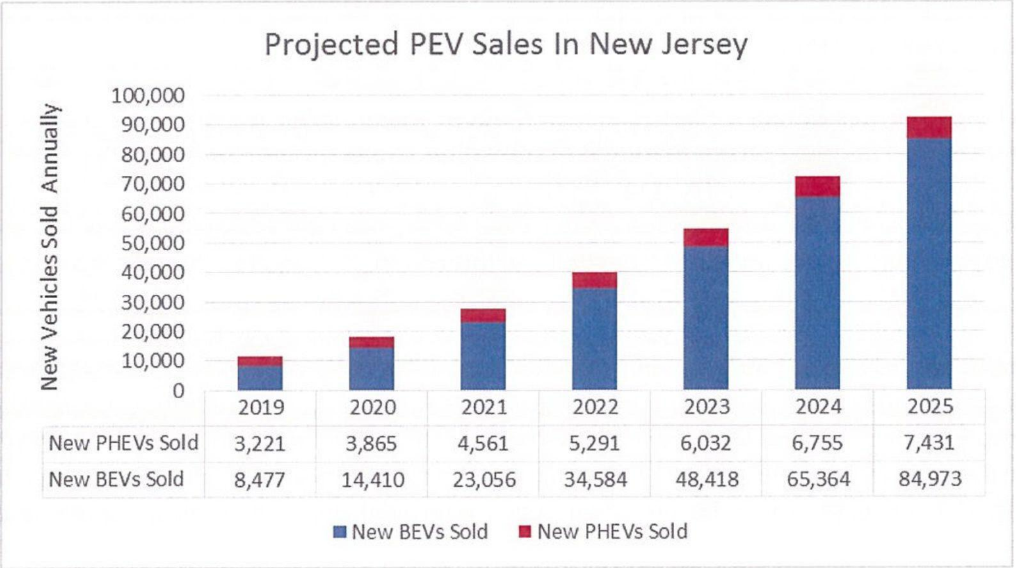
- An assessment as to the probability that the sales growth assumptions used in the model are achievable based on considerations of PEV coverage of the New Jersey market, measures of consumer interest, benchmark comparisons, and estimates of the likely impact the planned vehicle purchase rebate will have on market growth.

The model incorporates detailed market research about recent sales statistics and trends, and those results indicate that the New Jersey market is in transition. Sales growth for both BEVs and PHEVs have been strong in New Jersey since 2016, with PEVs year-over-year growth exceeding 83% in 2018. **Based on market growth since 2011 through June 2019, New Jersey has now attained 8.1% of its 2025 vehicle adoption goal.** These results indicate strong natural interest in PEVs by New Jersey consumers.

More recently, however, sales growth appears to be softening. Sales at the national level have begun to weaken in the second half of 2019, and sales for the first half of 2019 in New Jersey are significantly lower than the same period in 2018. Simultaneously, the market (nationally, in New Jersey, and in other leading states) is experiencing a strong shift toward BEVs being a larger fraction of the market. Concurrent with these transition dynamics, however, are indicators for strong future growth, including a large number of new PEV models expected over the next two years, improved prices and longer range, and growing consumer awareness and interest.

Those factors, by themselves, would suggest a slight reduction in sales growth rates short term, with growing strength as the market continues to develop. However, New Jersey is planning a vehicle rebate program with initial funding of $30M, which is expected to become available in 2020. In addition, several utilities are proposing new programs that could stimulate infrastructure development and help address consumer barriers, and new consumer awareness programs are being planned. The study combined these considerations in estimating sales growth over the next few years, and identified the sales growth assumptions necessary to achieve 330K vehicles in 2025 and 2M in 2035. The resulting model provides detailed quantification of BEV and PHEV sales rates, the number of registered vehicles each year, and estimated projections of vehicle adoption within each electric utility territory. The following graphs the number of registered PEVs through 2035, and a detailed sales projection through 2025.





	2019	2020	2021	2022	2023	2024	2025
New PHEVs Sold	3,221	3,865	4,561	5,291	6,032	6,755	7,431
New BEVs Sold	8,477	14,410	23,056	34,584	48,418	65,364	84,973

The projection model estimates that PEVs will account for approximately 16% of new Light Duty Vehicle (LDV) sales by 2025, and will represent approximately 5% of the LDV population. BEVs will be dominant by that point in time, accounting for 95% of the PEV population. The necessary sales growth rates peak when the rebate program is introduced, but then maintain strong growth while declining slightly year-over-year consistent with the behavior typical of maturing markets. By 2035, the model projects that PEVs will represent approximately 42% of new LDV sales, and 33% of the LDV population. This is consistent with goals established by global market leaders that are targeting approximately 30% PEV penetration in the 2030-2035 timeframe. The long term projection estimates that PEVs will approach 100% of LDV sales by 2050, at which point approximately 80% of the LDV population will be electrified. Attainment of these benchmarks, at a minimum, are required for the state to achieve its aggressive state greenhouse gas (GHG) reduction goals.

The feasibility assessment considered whether the assumptions used in the model are likely to be achieved (or not) from a variety of perspectives. There is basic coverage of the vehicle market, when assessed at a per segment basis, to deliver the adoption rates assumed – although that coverage is minimal in many segments, and price premiums for PEVs remain significant. Product coverage is therefore considered sufficient to meet the model assumptions short term, but higher levels of adoption, especially in the period from 2025 to 2035, will depend on additional product availability and improved pricing. Consumer awareness is growing, and recent studies (at both the national and state level) confirm that there is already sufficient interest to support the levels of adoption assumed in the short term. The sales growth assumptions for the next few years a) have been achieved (and exceeded) in New Jersey in recent years, and b) are no more optimistic than sales growth evident in other leading PEV adoption states. Most importantly, the market experience in Colorado provides a meaningful example of the potential impact of the new vehicle rebate in New Jersey, and the sales growth rates assumed in the model are within the expected range of impact.

Taken together, these considerations suggest that the sales growth assumptions used in the model are feasible, but **strong, sustained, sales growth will be necessary to achieve state goals**, and success will depend heavily on the planned vehicle rebate program to address current affordability issues, combined with overcoming barriers related to charging infrastructure, continued introduction of new models in key segments with strong inventory availability, and successful efforts to expand consumer awareness significantly. **The projection is therefore considered a "most likely" trajectory of adoption over the next few years given current market conditions, but in the medium term (2023 – 2025), attainment of state goals will depend heavily on the sustained success of market stimulation initiatives under development.**

Longer term, attainment of the high levels of electrification expected to be required by 2050 will depend heavily on the EV adoption momentum established over the next few years. As part of the market research associated with this study, the team explored dozens of alternative adoption trajectories. If the next five years are not leveraged to create strong initial momentum, attainment of longer term goals becomes significantly less likely since unrealistically high growth levels become necessary in the out years. **The State therefore faces a unique opportunity since early action to build momentum now makes long term electrification success much more likely.**

2 Introduction

ChargEVC, a coalition of stakeholders that support vehicle electrification in New Jersey, has commissioned Gabel Associates to complete an update to the original Plug-In Electric Vehicle (PEV) market study issued in January 2018. This updated study will incorporate new information about recent developments, build on updated data sources, and incorporate a variety of improvements to the model for assessing impacts, costs, and benefits. The foundation for this new study is an updated projection of PEV adoption in New Jersey, incorporating several additional years of market data, and benefiting from a fundamentally new projection methodology. This report summarizes the results of the new PEV adoption study.

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- A survey of projection methods used for PEV adoption, and development of a methodology that meets the needs of the New Jersey market at the current time; the projection model is based on a blended approach that couples short term sales projections to recent market trends, but transitions to the adoption levels needed to achieve state goals in 2025, 2035, and 2050.
- A projection model that estimates sales of both Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) and computes the population of registered PEVs each year over the study period;
- An assessment as to the probability that the sales growth assumptions used in the model are achievable based on considerations of PEV coverage of the New Jersey market, measures of consumer interest, benchmark comparisons, and estimates of the likely impact the planned vehicle purchase rebate will have on market growth.

This forecast covers Light Duty Vehicles (LDVs) in New Jersey. A separate forecast (and related modeling assumptions) is under development for diesel displacement opportunities (i.e. Medium and Heavy duty vehicles).

Terminology: This projection is focused on LDVs powered by electricity. This vehicle class includes pure Battery Electric Vehicles (BEVs) that do not have a petroleum fueled engine of any kind, and Plug-In Hybrid Electric Vehicles (PHEVs) that make use of both an electric motor and a fueled engine for motive power. Both vehicle types provide for charging of an on-board battery or similar storage device from primary energy sources external to the vehicle, and are collectively called Plug-In Electric Vehicles – i.e. all vehicles with a plug. **Throughout this document, the term Plug-In Electric Vehicles (PEVs) and Electric Vehicles (EVs) are used synonymously and interchangeably.** This vehicle group purposefully does not include traditional hybrid vehicles (without a plug for charging), or other alternative fuel vehicles such as compressed natural gas (CNG), hydrogen, or liquefied petroleum gas (LPG).

3 Historical Market Statistics

The study team completed detailed research on the PEV market in New Jersey, especially historical trends regarding general market conditions, actual vehicle sales, vehicle registrations, and other considerations that impact key projection assumptions. This section summarizes those results, updated through the end of 2018 and (in selected cases) through the first half of 2019, which provided the baseline for the projection over the study period.

3.1 EV Adoption Scorecard

As summarized in more detail below, New Jersey has established a goal of 330K PEVs on the road in New Jersey by the end of 2025. As of the end of June 2019, an estimated 30,539 new PEVs[a] (including both BEVs and PHEVs) have been sold in New Jersey since 2011. Based on the most recent snapshot of vehicle registration data by the New Jersey Department of Environmental Protection (NJDEP), those sales have resulted in 26,840 PEVs and PHEVs on the road in New Jersey as of the end of June 2019, net of retirements and changes due to used cars entering or leaving the state. **New Jersey has therefore achieved 8.1% of its 2025 goal**, a significant improvement over the 5.4% attainment achieved by the end of June 2018.

For calendar year 2018, PEVs represented an estimated 1.77% of new LDV sales, and approximately 0.35% of the LDV population (i.e. vehicles "on the road").

As detailed in further detail throughout this report, PEV sales in the state are beginning to slow, and the strong sales needed to meet the 2025 goal will depend on robust and immediate market development initiatives.

3.2 New Jersey Market Conditions

PEVs have been available in New Jersey since the introduction of first generation vehicles in 2010, and those sales have generally increased year-over-year. Compared with other leading states, however, New Jersey has so far implemented few policies, programs, or market development initiatives to achieve the higher level of sales that may be possible. This section outlines New Jersey's market conditions that could influence projected sales, including several recent changes and details about planned programs:

- **Sales Tax Exemption:** The New Jersey legislature implemented a state sales tax exemption for Zero Emission Vehicles (ZEVs, N.J.S.A. 54:32B-8.55) as defined under the California Zero Emission Vehicle program. The incentive applies to any ZEV that is purchased, leased, or rented after May 1, 2004. This is a significant incentive that eliminates what would otherwise be several thousand dollars in tax for a purchased vehicle. The value of this incentive is captured at the point of sale

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[a] This statistic represents only new vehicle sales, and does not capture used vehicle transactions. At the current time, used EV transactions are not expected to change the EV population in the state significantly, since the vehicle was already in the state, and often remains in the state after the transaction. Any retirement or import/export impacts are captured in the difference between the cumulative sales and total registered vehicles statistics.

if the customer supplies a "sales tax exemption waiver" (ST-4) form. The NJDEP maintains a list of vehicles that are eligible for earning the Sales Tax Exemption.

- **Section 177 Waiver (ZEV Compliance Program):** As allowed under the federal Clean Air Act, New Jersey opted-in to the California Zero Emission Vehicle compliance program. New Jersey is one of ten states that have opted into that framework, and is therefore referred to as a "Section 177" state in reference to the enabling Clean Air Act provision. This framework requires that large volume automobile manufacturers ensure that a certain percentage of new vehicle sales are based on zero emission vehicles (ZEVs, such as fuel cell or pure battery electric cars), or transition zero emission vehicles (TZEVs such as plug-in hybrids) each year. The percentage of ZEVs and TZEVs increases each year, and is managed through a "credit" system. The NJDEP is responsible for tracking credit compliance and banking in the state. New Jersey's participation in the ZEV program has a real and significant practical implication for the PEV market: automobile manufacturers prioritize the allocation of PEVs in "Section 177 states" like New Jersey, thereby making stronger PEV adoption feasible.

- **The ZEV MOU and State Goals (recent development):** Many of the "Section 177" states developed, and signed on to a regional Memorandum Of Understanding (MOU). This MOU outlined a variety of EV market development policies and programs intended to encourage accelerated adoption of EVs in the participating states. Primary elements of the MOU include a commitment to certain levels of EV penetration (approximately 5% of the LDV population by 2025), and development of the infrastructure necessary to support those vehicles. Governor Murphy committed New Jersey to this multi-state MOU in April of 2018.[b] Like the Section 177 opt-in, participation in this initiative positions New Jersey as a market leader, helps attract EV inventory to the state, and stimulates the programs necessary to achieve the stated goals. Consistent with the MOU, the State has communicated a goal of 330K EVs on New Jersey roads by 2025. This objective is consistent with the short term goals identified in the ChargEVC roadmap.

- **Inter-Agency Partnership (recent development):** To facilitate realization of the MOU goals, and in support of broader vehicle electrification priorities being identified by the State, Governor Murphy announced a new inter-agency partnership in June of 2019.[c] The New Jersey Board of Public Utilities (NJBPU), the NJDEP, and the Economic Development Authority (EDA) have formed the "Partnership to Plug-In" to coordinate agency activities on EV market development, especially as it relates to charging infrastructure.

- **Vehicle Electrification in the EMP (recent development):** As required by law, the State is required to periodically update its Energy Master Plan (EMP), and the Murphy administration is coordinating the development of a comprehensive new plan. Based on the draft version released in June 2019, and for the first time in a New Jersey EMP, vehicle electrification has been identified as a primary strategy for realizing GHG reductions, among other anticipated benefits. The proposed focus on vehicle electrification has received strong support from many stakeholders.

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[b] https://www.nj.gov/governor/news/news/562018/approved/20180403b_emissions_standards.shtml

[c] https://www.nj.gov/governor/news/news/562019/approved/20190603b.shtml

The EMP is scheduled to be finalized by the end of 2019, and will provide a framework for coordinating state policy and programs to achieve vehicle electrification goals. These activities are expected to significantly enhance the EV market conditions in New Jersey, and to accelerate EV adoption over time as a result.

- **Utility Program Filings (recent development):** Two New Jersey electric utilities, Public Service Electric and Gas (PSE&G) and Atlantic City Electric (ACE), have submitted proposed programs to the NJBPU. These programs, if approved, would provide substantial incentives that could grow EV adoption and use, including (among other efforts) expanded availability of public charging, help for new EV buyers that need a charger at home (including multi-family settings), and incentives to encourage off-peak charging.

- **NJDEP Workplace Charger Incentive:** The NJDEP, in collaboration with the NJBPU, has sponsored an incentive program by providing rebates to employers that install PEV charging infrastructure for use by their employees after June 15, 2016. Current incentive levels are $250 for a Level One charger, and up to $5,000 per Level Two charging station. The program is part of the NJDEP's overall "Drive Green New Jersey" program[d], and given high levels of interest, the NJDEP currently intends to continue providing this incentive subject to funding availability. This incentive is available state-wide.

- **Proposed Vehicle Purchase Rebate (recent development):** As part of the State budget for the next fiscal year, a $30M fund has been included to launch a new vehicle purchase rebate program. Efforts are underway (primarily at the NJBPU) to design and implement this substantial new program, potentially beginning in 2020. The introduction of this program, especially if augmented with ongoing funding after the initial budget, could have a large positive impact on EV sales growth.

- **Infrastructure Development Activity:** Electric vehicles require new infrastructure for charging, and the competitive markets – funded mostly through private capital – have launched efforts to serve that new market demand. A wide variety of companies now operate in New Jersey that can serve both private and public charging needs in a variety of segments. Some companies focus on hardware and/or services offerings, while others offer financing solutions for certain applications. In some cases, charging infrastructure companies have partnered with automobile manufacturers or other "channel partners" to provide the infrastructure required. See more details on charging infrastructure availability in Section 3.4 below.

- **Market Planning and Development Efforts:** A variety of loosely coupled organizations have been working over the last decade to improve the EV market in New Jersey, including:
  - ➢ The NJ Clean Cities Coalition (led by Chuck Feinberg) has been active in the State for approximately a decade, and published an EV infrastructure development plan in October 2011.

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[d] http://www.drivegreen.nj.gov/programs.html

- Several local environmental groups, especially Sierra Club, Environment NJ, and the Association of New Jersey Environmental Commissions (ANJEC) have been promoting PEVs over the last few years. Environment NJ published its "Driving Cleaner" report in June 2014, and a guide promoting "50 steps to carbon-free transportation" in the Fall of 2016.

- The local metropolitan planning authorities, including the North Jersey Transportation Planning Authority (NJTPA) covering north Jersey and the Delaware Valley Regional Planning Commission (DVRPC) covering the New Jersey region around Philadelphia, have become active in PEV matters, and NJTPA recently sponsored an initiative focused on municipal EV readiness.

- Sustainable Jersey, a not-for-profit organization focused on supporting schools and municipalities in sustainability advancements statewide, introduced PEV actions in 2014 which have helped socialize the potential for municipal support of PEV market development by local government units.

- Most recently, a new coalition called ChargEVC was formed in 2016 , which focuses specifically on PEV market development in New Jersey. The ChargEVC coalition, based on consensus building within its diverse stakeholder membership, published a roadmap for New Jersey Plug-In Vehicle Market Development in September of 2017, and a market opportunity and benefit-cost study in January of 2018. ChargEVC commissioned and funded the research project upon which this updated projection report is based.

- **Commercial PEV Availability (recent development):** After an initial ban, New Jersey legislation allows Tesla to sell vehicles through its "factory direct" business model (i.e. not through independent retailers), but with limitations and requirements. Many consumers, however, will look to their traditional car retailer to purchase a PEV. That commercial environment remains relatively immature in New Jersey compared with some other ZEV states, making widespread EV market growth difficult. The national Sierra Club completed a study of EV buying experiences across a variety of states, including New Jersey, and found that in many cases the consumer buying experience was not conducive to EV adoption.[e] New Jersey scored in the lowest category ("Barely Moving") on factors such as sales staff being knowledgeable about incentives and prominent display of EVs on the lot. The report attributes these conditions to automobile OEM policies as well as the retailers themselves. That situation has started to change in New Jersey, especially under the leadership of the NJ Coalition of Automotive Retailers (NJ CAR), which has been focused on increasing awareness and retailer support for this new class of vehicles. NJ CAR is a ChargEVC member, and is developing a dealer certification program that will help prepare, educate, and motivate traditional dealers to sell EVs. This program could have a large positive impact on the consumer buying experience, with a direct impact on EV sales.

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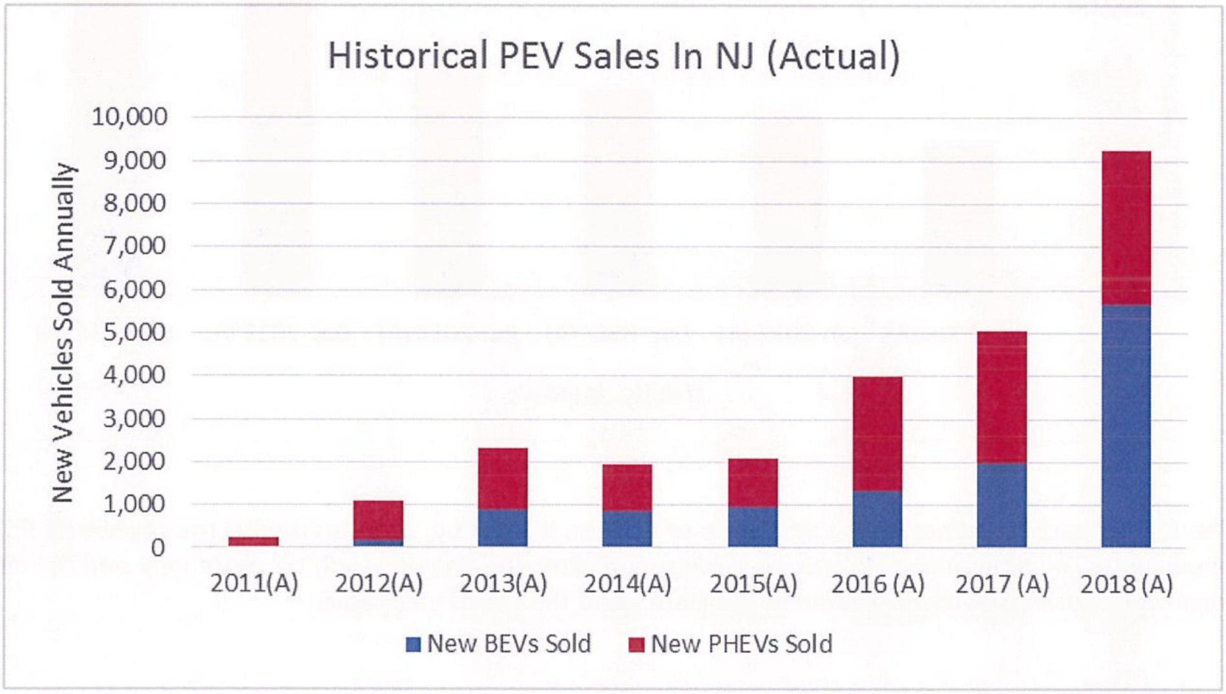
[e] Multi-State Study of the Electric Vehicle Shopping Experience by Sierra Club (Mary Lunetta and Gina Coplon-Newfield), 2016

3.3 Historical EV Market Performance

This section summarizes key historical statistics that establish the quantitative baseline for the projection analysis. The following chart summarizes BEV and PHEV sales in New Jersey, from 2011 (the first year data is available) through year-end 2018.[f]



These results represent year-over-year sales growth for PEVs of 89.9%, 26.5%, and 83.4% (for 2016, 2017, and 2018 respectively). Sales for the first half of 2019 demonstrated 55.4% growth over the same period in 2018, demonstrating strong growth but a slow-down compared with the average of the prior three years. This softening is expected to continue in the second half of 2019 (see Section 4.3 below for further details on this market dynamic).

These sales, after accounting for retirements and the net impact of vehicles entering or leaving the State, have resulted in substantial growth in the number of registered EVs on the road in New Jersey. That trend is summarized in the chart below, based on snapshots of vehicle registration data developed by the NJDEP[g] (year-end 2016 is the first year for which there is data available under the current methodology). Note that these numbers represent the PEV population, not annual sales.

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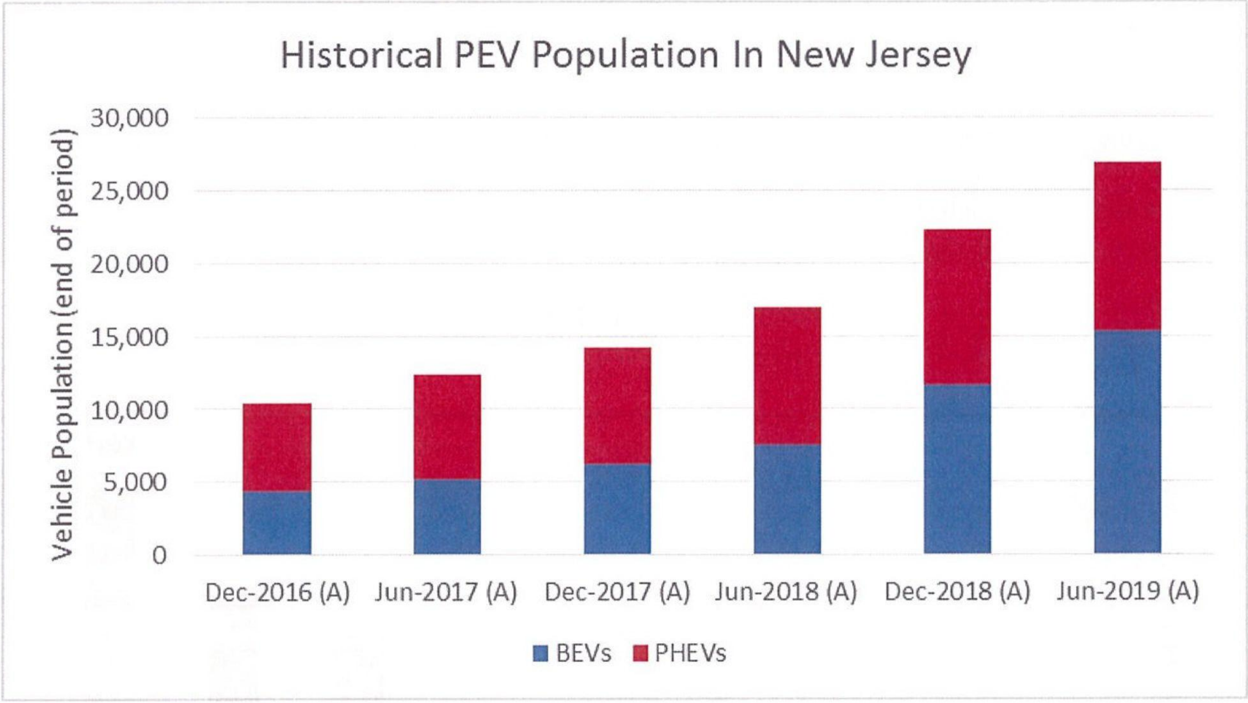
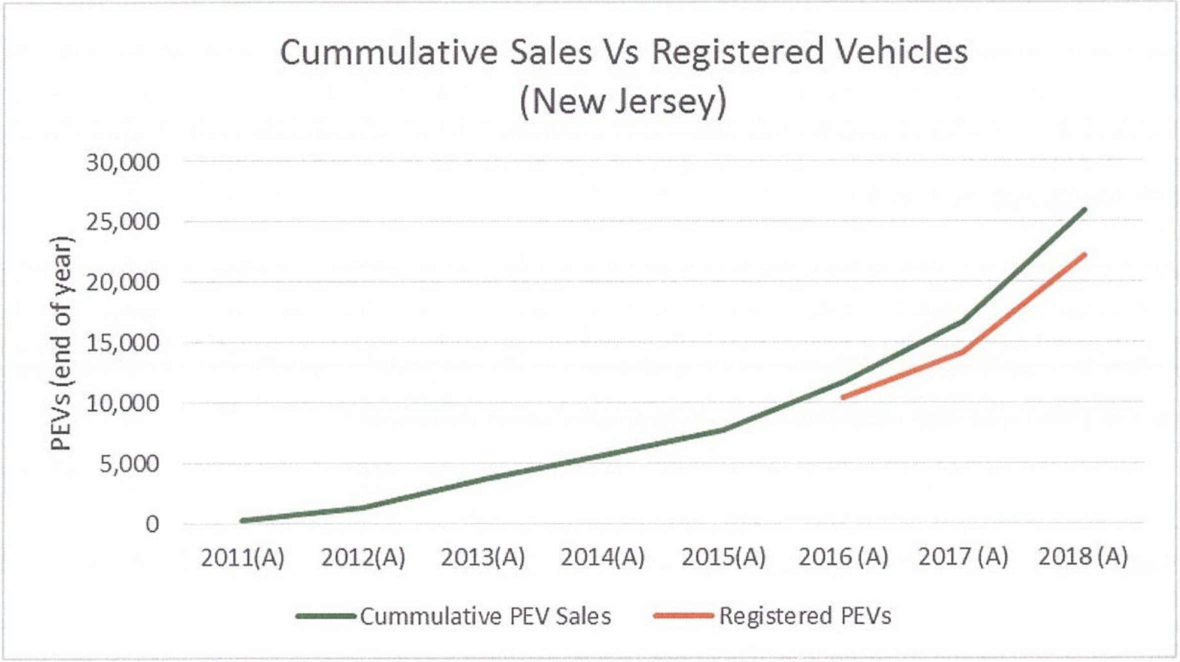
[f] https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/, based on data extracted in September 2019.

[g] All NJDEP statistics in this report are based on an amended version of registration data issued by the NJDEP in August of 2019, reflecting corrections in minor prior-year methodology issues.



The following chart summarizes cumulative sales over the period, compared with the registered PEV population. The difference between the curves represents the impact of vehicle retirement and the net impact of vehicles moving into or out of the state (as of the end of each year).

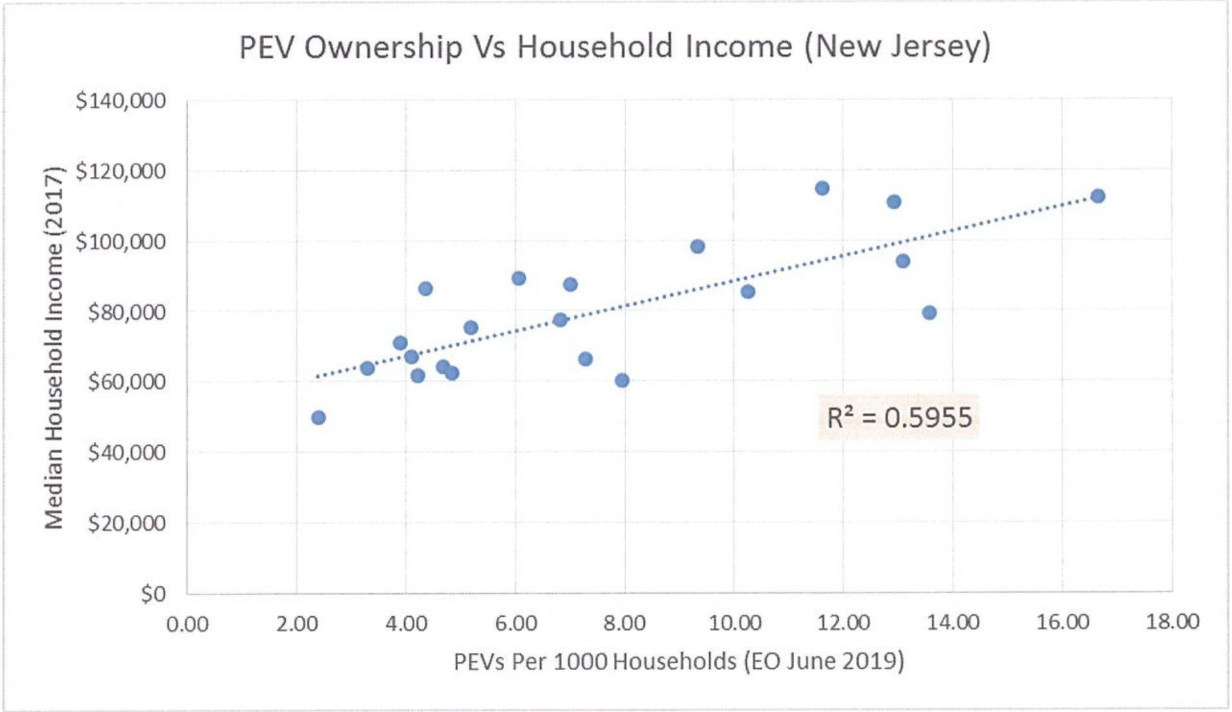


The following table summarizes the PEV distribution by county (end of June 2019), and related demographic metrics regarding PEV penetration.

County	Battery Electric Vehicles (BEVs)	Plug-In Hybrid Electric Vehicles (PHEVs)	Total Plug-In Electric Vehicles (PEVs)	PEVs Per 1000 Residents	PEVs Per 1000 Households	PEV Percentage Of Registered Vehicles
Atlantic	212	201	413	1.53	4.23	0.20%
Bergen	2,341	2,097	4,438	4.68	13.09	0.62%
Burlington	577	571	1,148	2.56	7.00	0.30%
Camden	864	526	1,390	2.72	7.28	0.36%
Cape May	84	109	193	2.03	4.84	0.23%
Cumberland	49	72	121	0.78	2.39	0.11%
Essex	1,319	948	2,267	2.80	7.95	0.47%
Gloucester	214	244	458	1.57	4.36	0.20%
Hudson	626	406	1,032	1.49	4.10	0.34%
Hunterdon	337	268	605	4.81	12.93	0.47%
Mercer	1,048	702	1,750	4.67	13.57	0.60%
Middlesex	1,785	1,138	2,923	3.47	10.26	0.46%
Monmouth	1,254	948	2,202	3.52	9.33	0.39%
Morris	1,333	770	2,103	4.21	11.62	0.50%
Ocean	381	501	882	1.48	3.90	0.18%
Passaic	361	424	785	1.53	4.67	0.22%
Salem	40	39	79	1.24	3.29	0.14%
Somerset	1,261	654	1,915	5.71	16.65	0.74%
Sussex	123	202	325	2.26	6.06	0.23%
Union	788	510	1,298	2.30	6.83	0.31%
Warren	92	123	215	2.01	5.19	0.21%
Unknown	210	88	298			
Totals	**15,299**	**11,541**	**26,840**	2.98	8.34	0.39%

Private vehicle ownership generally scales with household income, although the automobile market is over a century old in the United States and has had time to develop affordable solutions for most buyer segments. The PEV market is relative new: vehicles are currently more available in higher-end segments, and typically command a premium compared with equivalent traditional models.

The following chart shows the relationship between PEV ownership (PEVs per 1,000 households as of the end of June 2019) and median household income (on a per-county basis). The fairly strong correlation between these factors suggests that price is still a significant factor in PEV ownership. It is worth noting that a given level of PEV ownership was consistently associated with a ~$30K band of median household income across the market.



PEV ownership varied widely across the four electric utilities as summarized in the following chart (reflecting year-end (YE) 2018 data). Note that the rate of PEV adoption does not scale strongly with the residential population in a given territory, probably reflecting significant differences in demographics across the counties. Key potential factors include degree of private vehicle ownership, building stock variations (single family vs. multi-family), typical travel characteristics, and the differences in median household income noted above. These percentages are expected to converge toward the fraction of LDV ownership in each territory as the PEV market matures.

	BEV Count (YE 2018)	PHEV Count (YE 2018)	*Total Count (YE 2018)*	Utilty-% Of Total (YE 18)
PSE&G	6,302	6,446	*12,748*	**54.79%**
Rockland Electric	627	414	*1,041*	**4.47%**
ACE	582	951	*1,533*	**6.59%**
JCP&L	3,783	3,533	*7,316*	**31.44%**
Municipal	141	116	*257*	**1.10%**
All Others	235	137	*372*	**1.60%**
Total	***11,670***	***11,597***	***23,267***	**100.00%**

3.4 Public Charging Infrastructure

PEVs require charging infrastructure in a variety of segments, including home, work, and in public places (see further details in the original ChargEVC New Jersey Study). A key metric of PEV market maturity, and related sales growth rates, is the number of public charging assets – both charging devices and the number of charging plugs provided by those devices – on a per capita and per PEV basis [h] [i]. These metrics are considered especially important because they directly respond to consumer concerns about range anxiety. Within that range anxiety context, however, these two metrics characterize different market needs: stations per capita are, in part, a metric for general coverage and associated perceptions by consumers who are not yet PEV owners, while plugs per PEV suggest the level of public charger availability for current PEV drivers and their need for public charging capacity [j]. Both factors are important in understanding the current state of public charging capability in New Jersey, and the associated impact on potential EV adoption rates.

Within the public charging segment, both Level Two (240V devices based on the J1772 connection standard) and Direct Current Fast Chargers (DCFC) (higher powered devices with a variety of plug types) are typically considered. For most mainstream consumers, the ability to obtain a fast and convenient charge while "on the road" is a primary consideration in potential PEV adoption. The following characterization therefore focuses on the DCFC assets in the State that are available for public use (to varying degrees).

Based on the federal U.S. Department of Energy (USDOE) national database[k], as of September 2019, there are 82 PEV public DCFC locations (sites, or physical address), supporting 324 plugs (or outlets). These assets varied by plug-standard: "Tesla Chargers" use a proprietary plug that can only be used by Tesla vehicles, while "Standardized Plugs" are based on either the SAE Combo Charging Standard (CCS) or CHaDEMO plugs which together can support all vehicles on the road today, including Tesla (with an adaptor). Note that DCFC facilities are only needed, or used by, BEVs. This translates to charging asset density factors as summarized in the following chart. The following statistics are based on a New Jersey population of 8,908,520 (US Census Quickfacts, as of July 1, 2018), and a BEV population of 15,299 as of the end of June 2019 (from the NJDEP registration snapshot).

Plug Type	Total Count (location/plug)	Locations/10,000 People	Plugs/BEV
High Power (Tesla)	22/200	0.0247	0.0131
High Power (CCS or CHaDEMO)	60/124	0.0674	0.0081

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[h] Multi-State Study of the Electric Vehicle Shopping Experience by Sierra Club (Mary Lunetta and Gina Coplon-Newfield), 2016

[i] An Integrated Perspective on The Future of Mobility by Bloomberg New Energy Finance, McKinsey & Company [October 2016]

[j] The ABC's of EVs; Guide for Policy Makers and Consumer Advocates by Martin R. Cohen of the Citizens Utility Board of Illinois [April 2017]

[k] https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC

When considering these statistics, however, it is important to note that there are significant inconsistencies in reporting conventions associated with this data. Not all locations are truly available as public charging assets as desired. For example, chargers located inside a repair bay at a car dealer are only available during business hours and are really intended to be used for charging demonstration vehicles. Just as important, the interpretation of "plugs" varies widely across vendors, with some vendors reporting "two plugs per charger" when in fact only one can be used at a time. Given these factors, and based on a detailed review of individual assets associated with the data noted, these statistics probably over-estimate *the useful* public charging capacity in New Jersey significantly.

Despite these complications, this USDOE data is useful for comparing infrastructure capability. When compared with other "peer states" New Jersey's infrastructure levels are relatively low.

ZEV States	**DCFC Outlets Per 1000 PEVs**	**DCFC Outlets Per 1000 PEVs (rank)**
California	3.55	16
Oregon	8.72	4
New York	3.62	14
New Jersey	4.97	15
Massachussetts	5.35	12
Maryland	12.40	1
Connecticut	7.42	8
Rhode Island	8.14	6
Vermont	10.28	3
Maine	10.59	2
Colorado	7.80	7
Leading Non-ZEV States		
Washington State	6.73	9
Georgia	6.66	10
Florida	6.14	11
Texas	8.29	5
Illinois	5.21	13

For reference, the ChargEVC roadmap calls for an essential level of public charging, based on at least 300 locations supporting a minimum of 600 standards-based plugs (CCS and CHaDEMO), with appropriate equipment reliability and high levels of customer access (i.e. minimal physical site or customer use or payment restrictions). The "essential level of service" corresponds with the public DCFC capacity required to address mainstream consumer concerns about public charging availability (i.e. a significant component of range anxiety). For comparison to the chart above, that roadmap objective represents 27 DCFC plugs per PEV on the road in NJ (as of the end of 2018). **By that metric, New Jersey has attained only 18% of the physical locations or plugs needed to provide an essential level of public fast charging**, or even less once access and "plug count" reporting inconsistencies are considered.

4 Projection Methodology

The study team developed an updated methodology to meet the needs of the New Jersey PEV market at the current time. The methodology was developed to consider a) recent sales results and market trends, b) PEV adoption goals, and c) general characteristics about how emerging markets mature over time. The model was designed to provide the following information:

- The number of new BEV, PHEV, and PEV sales each year through the study period
- The BEV and PHEV, and total PEV, population at the end of each year, after accounting for net changes due to vehicle retirement, or vehicles leaving and entering the state
- Estimates of overall LDV sales and LDV population to provide context for PEV adoption

The historical market statistics summarized in Section 3 provided the baseline for the forward projection. This section describes how that information, and consideration of other market trends, were combined to generate the projection.

4.1 Projection Methodology

In preparation for developing the updated projection, the study team examined a wide variety of projection methods evident in other planning efforts, consultant studies, and industry analysis. Key strategies identified from that survey include:

- **Hypothetical Planning Scenarios**: Many studies are based on hypothetical "low, medium, and high" adoption cases. The original ChargEVC study took this approach, which was helpful at the time (three years ago) for initial goal setting and opportunity assessment. These scenarios are speculative, and in many cases aspirational, and may not reflect the real sales or vehicle population likely in the short term.

- **Simple Extrapolations:** Many projections simply extrapolate recent sales trends, which is a reasonable method in mature markets. The PEV market is relatively immature, however, and data for even the last three years does not establish a high confidence trend for projection, especially in cases when significant policy initiatives may fundamentally change the market short term. There is diversity about the basis for these extrapolations, with some studies projecting PEV marketshare as a fraction of LDV sales, others estimating year-over-year sales growth rates, while others focus on estimating overall PEV population changes from year to year. Each of these approaches, by themselves, are not well matched to current market conditions in New Jersey at this time, and the granularity required for the resulting projection.

- **Goal Attainment Projections**: Many states, like New Jersey and other Section-177 ZEV states, have set PEV goals (say in 2025, 2035, or 2050). A wide variety of projections are in place that illustrate the adoption needed to achieve those goals. These models really represent a "projection of need", rather than what is likely to happen.

Despite their prevalence in other studies performed, none of the reviewed methodologies meet the needs of the New Jersey market at this time. Given the rapid advancement of market development policies in New Jersey, and the need for real planning around potential program budgets, utility load impacts, various benefit/cost studies, etc, the projection needs to represent a realistic "most likely" scenario for the sales and population over the next several years. At the same time, the State is setting aspirational goals that are intended to serve as policy drivers. The projection needs to fairly represent what attainment of these goals would require from the market and associated costs.

Given these needs, the study team developed a hybrid projection method that blends a) tight coupling of short term projections with recent sales activity in New Jersey, b) combined consideration of relevant market dynamics and trends that impact key assumptions, and c) transitions to the lowest risk adoption profile possible that still achieves targeted adoption levels in 2025 and 2035. "Lowest Risk" in this case means the minimum sales growth assumptions needed to attain the relevant goals.

The resulting projection therefore represents an adoption trajectory that starts with the known registered EV population at the end of 2018, assumes short term sales activity for the next few years that are tied to current market conditions but sufficient to achieve the 2025 goal of 330K EVs, and then maintains the long term growth needed to achieve two million EVs on the road by 2035 consistent with the ChargEVC roadmap. The assumptions across these different phases of growth have been refined to exhibit year-over-year growth profiles consistent with key market trends and general characteristics of maturing markets, as informed by statistics evident in the EV market in both New Jersey and nationwide. Within this model, the key assumptions are the year-over-year sales growth rates, by year, for both BEVs and PHEVs. Separately, a method for estimating retirements, and the net impact of vehicles entering or leaving the state, has been developed. BEV and PHEV trends are computed separately, with the population at the end of the year being equal to the population at the end of the previous year, plus new sales, minus net retirements/vehicle entering/vehicles exiting.

4.2 General Market Considerations

Beyond the historical baseline summarized in Section 3, the study team considered key trends that should inform model assumptions. The PEV market is small enough that specific industry events, or sales performance of a given vehicle, can change overall results significantly. Strategic consideration of these trends were combined with the historical baseline to establish projection assumptions.

The trends indicates a market that is in transition, at both the national level and in New Jersey. Key trends identified by the study team include:

- 2018 was an exceptional year for PEV sales, internationally, in the United States, and in New Jersey. 2018 was the best sales year in the history of the industry, and was heavily influenced by the production ramp-up of the Tesla Model 3 in the second half of the year. This exceptional deployment rate, which essentially doubled the size of the PEV market over several months, was isolated to a single vehicle from a single supplier. This ramp-up distorted 2018 results as a basis for longer term projection, especially as the Tesla Model 3 achieves more steady state production in the second half of 2019.

- The growth in the market is not homogeneous across different vehicle manufacturers. Taking Tesla Model 3 data out of the results for the last few years, growth in the rest of the market has been relatively soft, and more recently declining. This reality has been "masked" by the Model 3 ramp-up, which essentially compensated for softness across the rest of the market. Now that the Model 3 is approaching steady-state sales, that compensating effect is fading, which suggests weaker year-over-year sales growth in the short term.

- Meanwhile, there are several structural factors that are weighing on PEV growth short term. Of particular importance, several of the most popular vehicles have now passed (or are about to pass) their federal tax credit threshold, and the value of the available credit is quickly declining. For most consumers, this essentially looks like a price increase for PEVs. Simultaneously, global markets (especially in Europe and Asia) are very strong, benefiting from robust consumer interest and policy support. These dynamics are creating drag on the strong growth evident in the United States the last few years.

- In addition to factors that affect overall sales growth, there is a significant shift emerging in the market, with BEVs now becoming a much more dominant fraction of the market. This trend is evident nationally, but is especially striking in New Jersey: PHEVs ranged from 56% to 66% of the PEVs sold in New Jersey from 2014 – 2017, but dropped to a share of 38% in 2018. PHEV share in the first half of 2019 was down to 25%, and the growth rate (over the same period in 2018) was a *negative* 34%. This outcome results from the growth of the Model 3 (which increased BEV share), combined with the discontinuation of the popular Chevy Volt PHEV. Regardless, this appears to be a long term trend by which consumer preference focuses on BEVs compared with PHEVs. Given the large number of new PHEVs entering the market in the next three years, however, PHEVs are expected to remain an important, but smaller fraction of the market moving forward.

- The combination of the trends noted above have combined to depress 2019 sales rates year-to-date. At the national level, PEV sales for the first half of 2019 grew only 29.3% over the same period in 2018, compared with a growth rate of 39.6% in first half 2018 (over first half 2017). Sales for the first half of 2019 in New Jersey are significantly lower than the same period in 2018. The primary short term drivers of this outcome is the Tesla Model 3 approaching steady state deployment, general weakness in well established models (like the Bolt and Leaf), and most importantly, apparent inventory limitations in New Jersey for new vehicles that have been very well received in other markets (like the Hyundai Kona, Kia Niro, and Audi eTron).

- The trend considerations above are critical for determining appropriate short term sales projections, since various "anomalous events" need to be distilled out of the raw trends. Concurrent with these transition dynamics, however, are indicators for strong growth medium term, including a large number of new models expected over the next two years, improved prices and longer range, improved availability of charging infrastructure, and growing consumer awareness and interest.

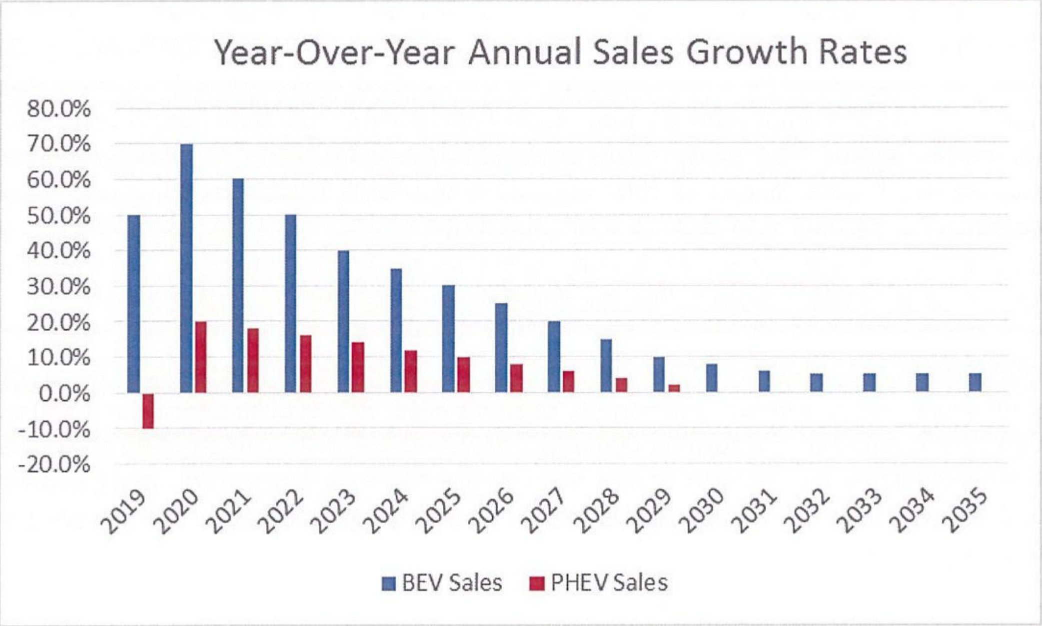
Those factors, by themselves, would motivate significant reductions in sales growth in the short term, with growing strength as the market continues to mature. However, New Jersey is planning a vehicle rebate program with initial funding of $30M, which is expected to become available in 2020. Several utilities are proposing new programs that could stimulate infrastructure development and help address consumer barriers, and new consumer awareness programs are being planned. The study combined these considerations in estimating sales growth over the next few years, especially for the critical years 2020 and 2021. The projection therefore assumes a significant positive impact from the rebate program and other programs under development, offsetting the growth rate decline that might have otherwise emerged.

4.3 Key Projection Assumptions

Based on a synthesis on the historical baseline summarized in Section 3, and strategic consideration of the trends outlined in Section 4.2, the following assumptions were developed for use in the projection:

- The number of registered PEVs in New Jersey at the end of 2018 included 11,670 BEVs and 10,566 PHEVs, for a total of 22,236 PEVs "on the road".

- The following year-over-year sales growth rates were used, which as noted in the methodology of Section 4.1, reflect recent sales activity and consideration of current trends short term, transitioning to the lowest growth rate assumptions necessary to achieve the state goals in 2025 (330K PEVs) and 2035 (2M PEVs). The growth rates in 2020 and 2021 have been adjusted to reflect the expected impact of the new rebate program, combined with significant new vehicle availability. The assumptions reflect a shift to BEV dominance over time, with PHEV growth becoming flat in 2030.



- The model accounts for more than just new sales, and estimates vehicle retirements, and the net impact of vehicles coming into, or moving out of, the New Jersey market. There is limited data available in the early years, and simple assumptions were made based on historical evidence: 150 net BEV retirements in 2019, growing linearly to 350 in 2026, and flat 1,000 net PHEV retirements from 2019 through 2030. Once a critical mass of vehicle is established, in 2027 for BEVs and 2030 for PHEVs, the model computes the expected number of vehicles leaving the market every year (based on historical data), and allocates those changes to PEVs in proportion to the PEV fraction of the market 11 years prior. Eleven years was selected as the "retirement lookback window" since on average, the New Jersey LDV population "turns over" (i.e. is replaced by new vehicles) every 11 years.

- The study assumes that the proposed New Jersey rebate program is implemented in 2020, and that market stimulation offsets the emerging growth deceleration evident in recent market sales statistics.

4.4 Goal Attainment Implications

As part of assessing the historical baseline and other strategic market trends, the team considered a wide variety of growth assumptions to assess the feasibility of different scenarios. The team considered low growth followed by high growth, high growth followed by low growth, fairly consistent growth over the period, and numerous other permutations. Several dozen growth trend scenarios were evaluated.

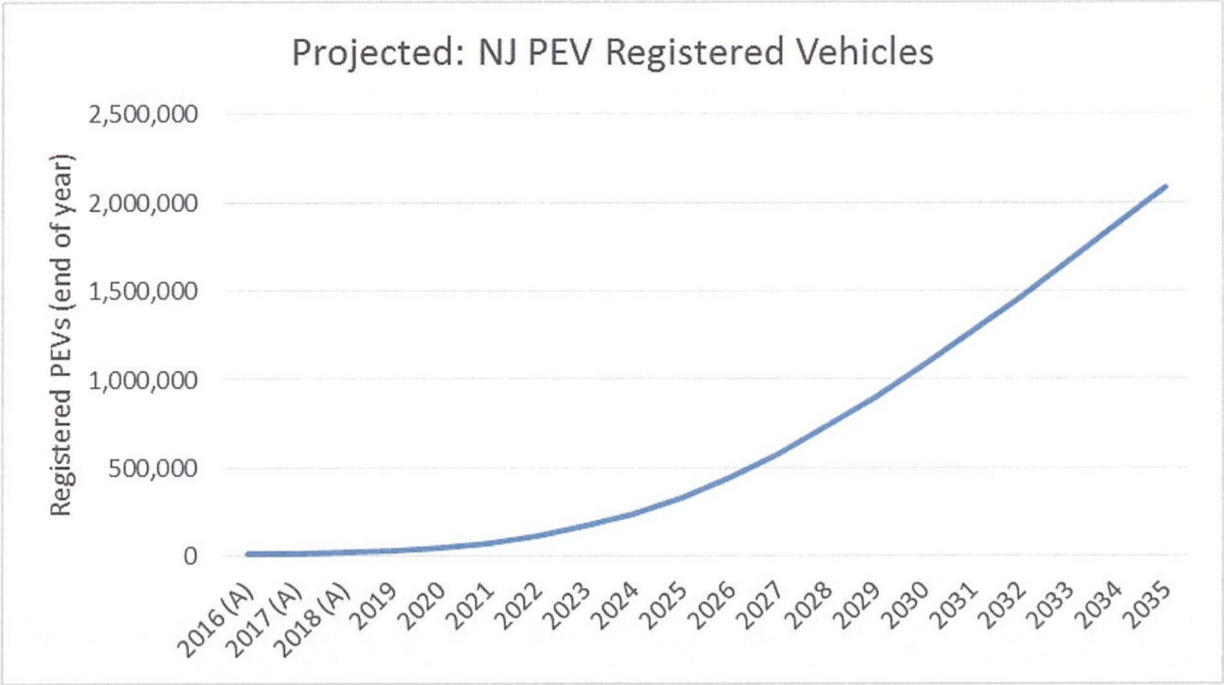
As a result of this analysis, a key implication emerged: the feasibility of attaining state goals in 2035, and even more importantly the strategic goals for 2050, depend heavily on the momentum established prior to 2025. If growth remains modest through 2025, exceptionally high (and probably un-attainable) growth levels would then be required to meet the goals in 2035 and 2050. **The State therefore faces a unique opportunity since early action to build momentum now makes long term electrification success much more likely.**

5 Key Findings: EV Projections

Based on the historical baseline summarized in Section 3, and the projection methodology summarized in Section 4, the study prepared a detailed projection of BEV and PHEV adoption in New Jersey through 2035 and 2050. Annual sales for both BEVs and PHEVs were computed, with aggregation into overall PEV population per year (after accounting for retirement and vehicles entering or leaving the State). These trajectories represent the curve that a) starts with the registered PEV population at the end of 2018, b) strongly reflects recent sales results in the State for the next three years, as calibrated by consideration of relevant market trends, but c) transitioning to the lowest-risk adoption profile necessary to achieve the targets of 330K PEVs by YE-2025, and 2M PEVs by YE-2035.

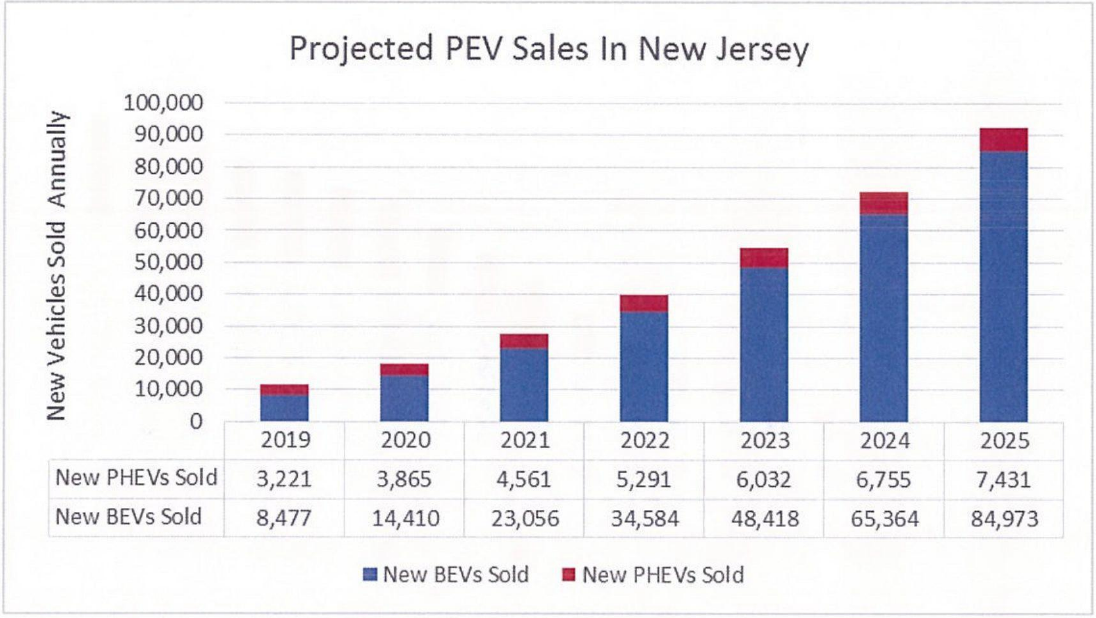
5.1 Projection Through 2035

The following graph summarizes the projected PEV population through 2035.



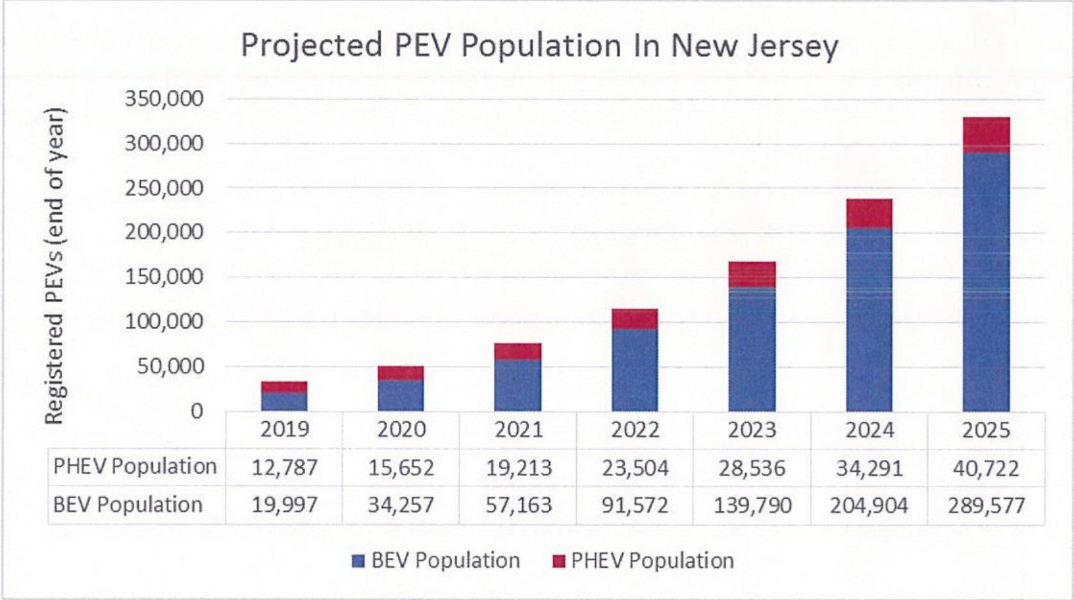
This projection estimates that PEVs will represent approximately 16% of LDV sales in 2025, and just over 5% of the LDV population. By 2035, PEVs will account for 41% of LDV sales, and nearly 32% of the LDV population. This benchmark is approximately aligned with global leaders (mostly in Europe) that are targeting 30% PEV penetration within the 2030 – 2035 timeframe.

The following chart provides a more detailed view of the projection through 2025, including the break-out between BEVs and PHEVs. Consistent with recent market trends, BEVs are expected to become a more dominant share of the market, especially given expected BEV price reductions in the medium term.



	2019	2020	2021	2022	2023	2024	2025
New PHEVs Sold	3,221	3,865	4,561	5,291	6,032	6,755	7,431
New BEVs Sold	8,477	14,410	23,056	34,584	48,418	65,364	84,973

The following chart provides the detailed break-down of BEV and PHEV populations through 2025.



	2019	2020	2021	2022	2023	2024	2025
PHEV Population	12,787	15,652	19,213	23,504	28,536	34,291	40,722
BEV Population	19,997	34,257	57,163	91,572	139,790	204,904	289,577

Based on detailed mapping of the PEV population across utilities (using vehicle registration data by zip-code), and assuming that the utility allocation transitions to alignment with overall LDV ownership by 2035,[i] the PEV adoption projection breaks-out per utility as follows.

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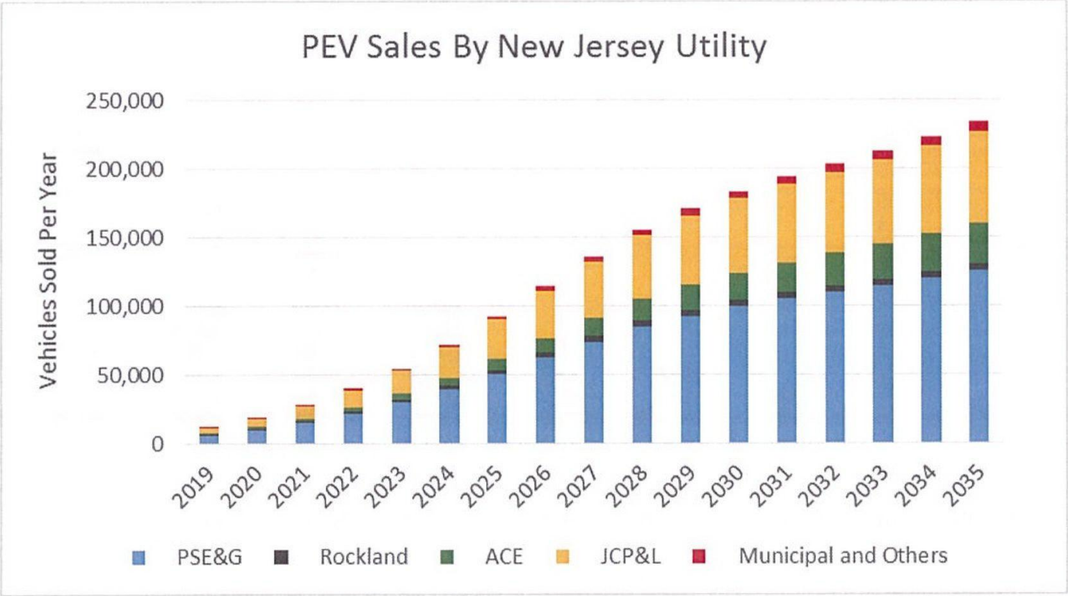
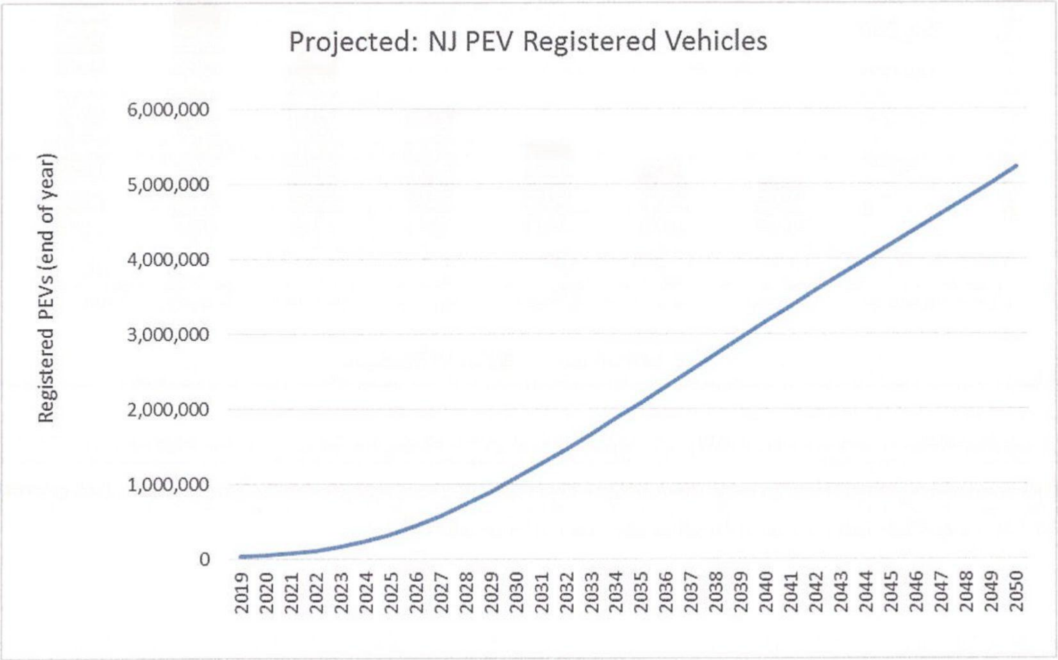
[i] Mapping of LDV ownership to utility is underway. For this analysis, utility fraction of residential load, which correlates strongly with vehicle ownership, is used as a proxy.



5.2 Projection Through 2050

Adoption trends were also estimated for the period from 2036 to 2050, which is needed to assess the role of vehicle electrification in the State's broader clean energy goals. Under this projection, PEVs represent ~100% of LDV sales and ~80% LDV electrification by 2050. The 2050 projection of PEV population is summarized in the following graph.



6 Key Findings: Assessment Of Projection Feasibility

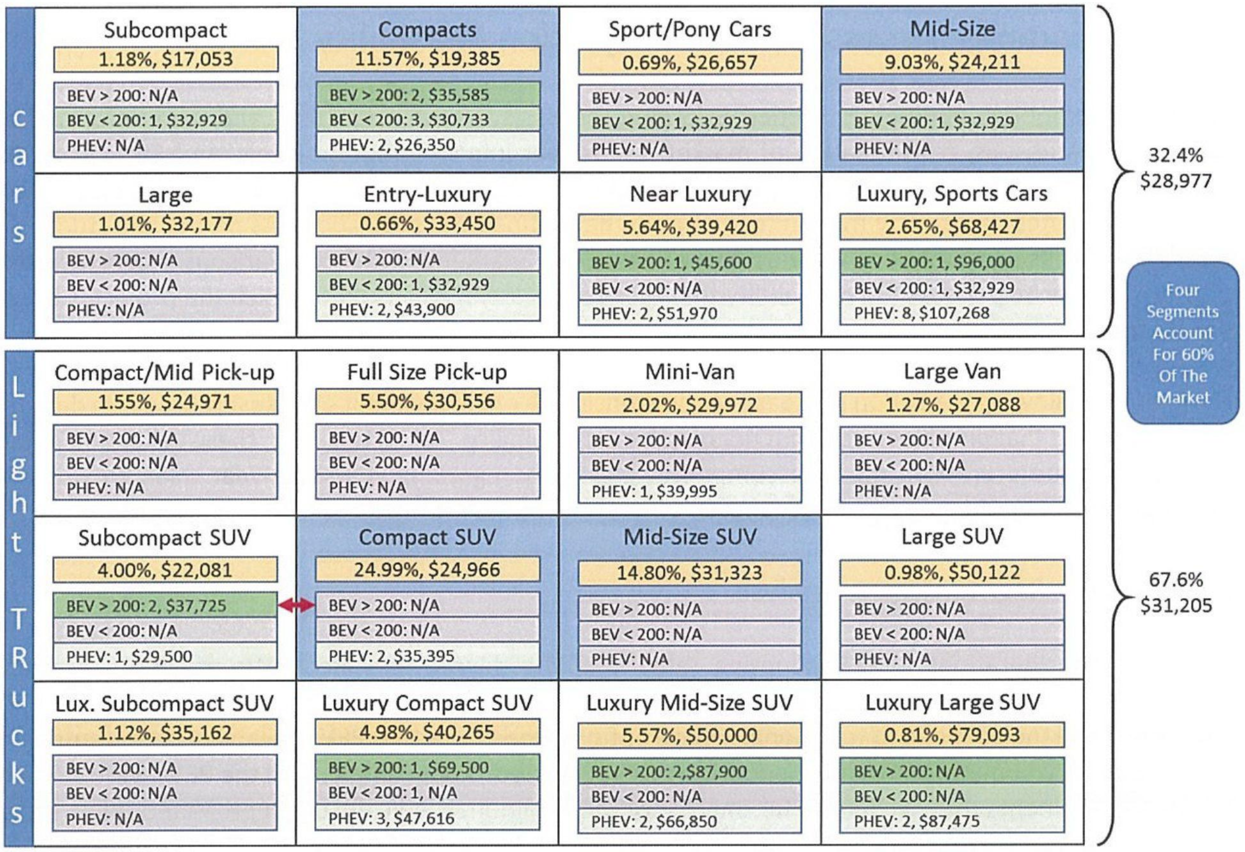
The key assumptions outlined in Section 5 formed the basis for the projection, and were informed by recent sales statistics, consideration of market trends that impact adoption levels, and State goals for 2025 and 2035. The "lowest risk" adoption assumptions were used, which represent the lowest possible sales growth rates that satisfy the multiple criteria that defined the projection. As part of the study, the feasibility of these assumptions were evaluated based on "market analog" comparisons. Consideration of these factors help assess the probability that the growth assumptions upon which the project is based will be realized.

None of the following validation perspectives are conclusive on its own, but each test is based on detailed market analysis that provides a relevant perspective on feasibility. Taken together, these validation points indicate that the projection model assumptions, especially regarding year-over-year sales growth rate assumptions, are within a reasonable range.

6.1 Market Segmentation Analysis

Some key considerations in PEV adoption rates is a) the degree to which PEVs provide a practical alternative to traditional vehicle choices for the consumer, b) the price differential between the PEV alternative and the portfolio of traditional vehicle options, and c) whether PEV availability covers sufficient potential sales volume to achieve the adoption rates projected. For example, if all the PEVs were suitable for market segments that accounted for only 5% of the traditional vehicles sold, a projected sales rate of 15% would be considered unreasonable.

The study team partnered with NJCAR (the trade association for NJ Car Retailers) to complete a detailed market segmentation analysis to assess how well current PEV offerings support the buying behaviors of consumers in relation to the way they purchase LDVs today. The results of that study are summarized in the following infographic. Please see Appendix B for a larger version of the same image.



Cars	Subcompact 1.18%, $17,053 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A	Compacts 11.57%, $19,385 BEV > 200: 2, $35,585 BEV < 200: 3, $30,733 PHEV: 2, $26,350	Sport/Pony Cars 0.69%, $26,657 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A	Mid-Size 9.03%, $24,211 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A
	Large 1.01%, $32,177 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Entry-Luxury 0.66%, $33,450 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: 2, $43,900	Near Luxury 5.64%, $39,420 BEV > 200: 1, $45,600 BEV < 200: N/A PHEV: 2, $51,970	Luxury, Sports Cars 2.65%, $68,427 BEV > 200: 1, $96,000 BEV < 200: 1, $32,929 PHEV: 8, $107,268
Light TRucks	Compact/Mid Pick-up 1.55%, $24,971 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Full Size Pick-up 5.50%, $30,556 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Mini-Van 2.02%, $29,972 BEV > 200: N/A BEV < 200: N/A PHEV: 1, $39,995	Large Van 1.27%, $27,088 BEV > 200: N/A BEV < 200: N/A PHEV: N/A
	Subcompact SUV 4.00%, $22,081 BEV > 200: 2, $37,725 BEV < 200: N/A PHEV: 1, $29,500	Compact SUV 24.99%, $24,966 BEV > 200: N/A BEV < 200: N/A PHEV: 2, $35,395	Mid-Size SUV 14.80%, $31,323 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Large SUV 0.98%, $50,122 BEV > 200: N/A BEV < 200: N/A PHEV: N/A
	Lux. Subcompact SUV 1.12%, $35,162 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Luxury Compact SUV 4.98%, $40,265 BEV > 200: 1, $69,500 BEV < 200: 1, N/A PHEV: 3, $47,616	Luxury Mid-Size SUV 5.57%, $50,000 BEV > 200: 2,$87,900 BEV < 200: N/A PHEV: 2, $66,850	Luxury Large SUV 0.81%, $79,093 BEV > 200: N/A BEV < 200: N/A PHEV: 2, $87,475

32.4%
$28,977

Four Segments Account For 60% Of The Market

67.6%
$31,205

This infographic contains a large amount of information about both the traditional LDV market in New Jersey (for the 2018 sales year), and how current PEV offerings map onto that landscape (for products available in New Jersey as of May 2019). The LDV market is organized into two large macro-segments: cars and light duty trucks. Cars include traditional passenger vehicles, from small compacts to luxury sports cars. Light trucks include pick-up trucks, small commercial vans, mini-vans, cross-overs, and SUVs. These categories are further parsed into 20 segments reflecting variations in size, cost, and luxury. In general, the segments in the infographic are organized with smaller, basic, less expensive vehicles in the upper left, to larger, more luxurious, more expensive vehicles in the bottom right. Note that four segments represent 60% of the market (on a vehicle count basis). A key trend is that car segments are generally declining in volume, while the small to mid-range cross-over/SUVs are growing.

Within each segment, the yellow box characterizes current consumer preferences and the portfolio of traditional vehicle offerings. The numbers within each box summarize the fraction of the market represented by that segment (based on vehicle count), and the average base Manufacturer Suggested Retail Price (MSRP) [m] for those vehicles.

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[m] The statistics in this analysis are all based on average BASE MSRP. Typical "as sold" configurations are on average $5 - $10K higher in actual selling price (not including taxes, title, registration, or delivery fees).

The three lower boxes represent potential PEV offerings in each segment, covering BEVs with electric range greater than 200 miles, BEVs with less than 200 miles of electric range, and PHEVs. The numbers in each box represent the number of PEVs currently available within each segment, and the average base MSRP of those vehicles.

This information allows segment level evaluation of the number of PEV alternatives available to consumers in each segment, the average price differential (on a base MSRP basis). There are forty PEVs currently available across twelve LDV segments, which together total over 63% of traditional sales. Twenty-seven of the forty vehicles are in six luxury segments representing approximately 20% of current vehicle sales.

While there is at least basic coverage across multiple segments, in many cases only one or two PEV options are available, which implies that there is a very limited consumer selection compared with the existing vehicle portfolio. More importantly, there is a $10-15K difference in price between the average base MSRP of the traditional vehicle portfolio and the PEV models currently available. This difference is a key adoption barrier for most price-sensitive mainstream consumers. Most importantly, however, the key cross-over/SUV segments that represent a large fraction of the market, and where most growth is currently concentrated, has few PEV alternatives. In the critical compact SUV segment (25% of the market and growing), there are only two PHEV options, with a price premium of ~$10K. PEV options are beginning to become available in this segment, and there is some consumer elasticity for consideration of PEV offerings in the sub-compact SUV segment (as indicated by the red arrows). A key threshold for stronger PEV adoption growth medium term is better coverage in these key mid-range light truck segments, combined with overall reductions in MSRP.

Based on this assessment, the study team concludes that there are sufficient PEV offerings to support the projected adoption levels through 2035, far above the 15% market share of LDV sales at that point in time, but a) there are limited PEV options in many key segments, and b) current MSRP premiums will be a limiting factor for many price-sensitive mainstream consumers. Additional PEV offerings, in the more popular light truck segments, along with price reductions of $10-15K, will be necessary to achieve the higher levels of adoption needed after 2025. Current OEM announcements suggest that the necessary vehicle offerings may be available prior to 2025, although the magnitude of PEV pricing premiums remains uncertain. This analysis also suggests that maximum MSRP for the most popular PEVs, after accounting for typical "as sold" configuration prices, is in the range of $45K - $50K.

6.2 Consumer Interest

One of the most important factors in the adoption of any new product is consumer awareness and interest. Mainstream awareness of PEVs remains relatively small – but it is growing. Two recent surveys, at both the national and state level, suggest that consumer interest in PEVs is improving. The study team considered two recent consumer attitude studies that directly quantify consumer interest in choosing a PEV for their next new vehicle purchase:

- In a new poll released by the Union of Concern Scientists and Consumer reports (July 2019) [n], a sample of national respondents indicates that 5% of prospective car buyers will definitely buy an EV within the next two years, while an additional 31% would consider it. This suggests a potential market of 36% of new car buyers over the next two years willing to at least consider a PEV.

- Looking specifically at the attitudes of New Jersey consumers, a recent survey by Eagleton done for the New Jersey Climate Change Alliance (April 2019)[o], indicated that 50% of respondents said they will buy a new car within the next five years, and 38% of that group (19% of the respondents) said they would consider buying an EV for their next purchase. Two percent of this group reported already having an EV.

Together, these studies validate that approximately a third of new car buyers over the next 2-5 years would be willing to at least consider a PEV purchase. The projection model assumed market share of annual LDV sales increasing from 2.2% in 2019 to 15.1% in 2025. Those adoption levels are feasible within the range of consumer interest demonstrated in the surveys noted, although high levels of conversion (of interest to an adoption decision) will be required in the period approaching 2025. Adoption at the levels required between 2025 and 2035 will depend on significantly higher levels of consumer awareness and interest, but that is highly feasible as the market matures, especially if there are investments in marketing, education, and consumer outreach.

6.3 Benchmark Comparisons

As part of the feasibility assessment, the study team compared the sales growth assumptions with benchmarks from other leading states as a real world comparison of feasibility. If the model assumed higher growth rates than other leading states were achieving, that would weaken confidence in the projection. As noted in more detail below, this benchmarking analysis indicated that even the high point of sales growth rate assumptions in the projection are well within the range of results being realized by other leading states. These benchmarks therefore provide a "proof of concept" that the assumed growth rates are achievable.

Benchmarking between states on EV sales is challenging, since the states are all very different. They are different sizes, at different levels of maturity (the west coast states started much earlier), different demographics, and all have very different policy environments. It is therefore difficult to compare absolute sales results between states. Regardless, a comparison of year-over-year growth rates for a sample of leading states provides some sanity check on the assumptions being made in the projection model. We compared the New Jersey projection model assumptions to the ten states that had the highest three year average year-over-year PEV sales growth (2016 – 2018). This sample essentially represents the ten fastest growing states on an aggregate year-over-year percentage basis, and included New Hampshire,

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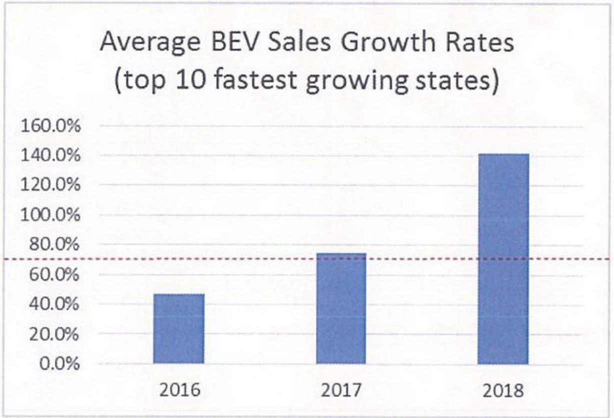
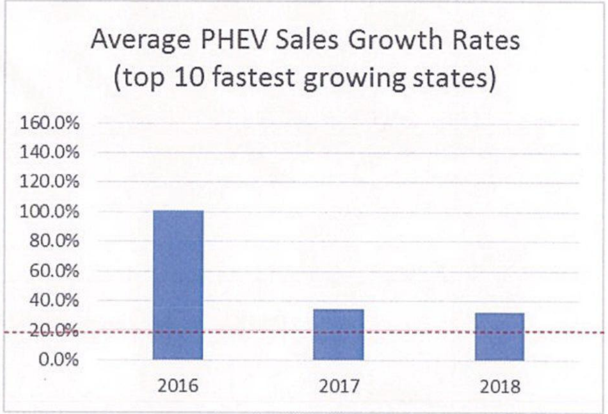
[n] Electric Vehicle Survey Findings and Methodology, Union of Concerned Scientists and Consumer Reports, July 2019.
[o] Climate Change Attitudes in New Jersey, a collaboration between Rutgers Eagleton for Public Interest Polling the New Jersey Climate Change Alliance, Ashley Koning, April 2019.

Massachusetts, District of Columbia, Rhode Island, Maryland, New York, Maine, Pennsylvania, Colorado, and Delaware[p].

These ten sample states demonstrate a clear trend regarding the difference in growth rates between BEVs and PHEVs. In general, the growth rate is increasing for BEVs, and declining for PHEVs, consistent with an apparent overall shift to increased BEV fraction in the market. The charts below summarize the average year-over-year sales growth rate for the sample states for 2016 – 2018. The red dashed line represents the highest sales growth rate assumed in the projection model relative to the historical experience seen in the sample states (i.e. a 70% growth in BEV sales in 2020, and 20% in PHEV sales, when the rebate program launches in New Jersey).





Consistent with the trends evident in the sample states, the projection model assumes continued strong growth for BEVs, but declining growth for PHEVs. This trend was reinforced in early data for the first half of 2019 across all states considered (including New Jersey). The projection model assumptions are relatively conservative compared with known sales growth factors evident in the sample states.

The following charts provide further detail about the projection model assumptions compared with performance in the sample states. These graphs summarize the AVERAGE year-over-year sales growth rate in each of the sample states, from 2016 – 2018, compared with the assumptions in the projection model. As with the charts above, the red dashed line represents the highest growth assumptions used in the projection.

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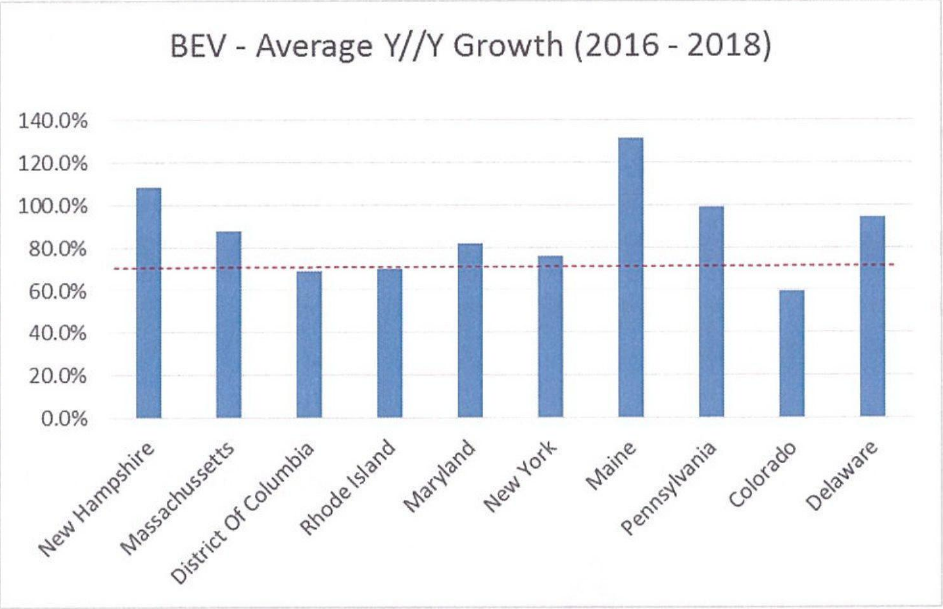
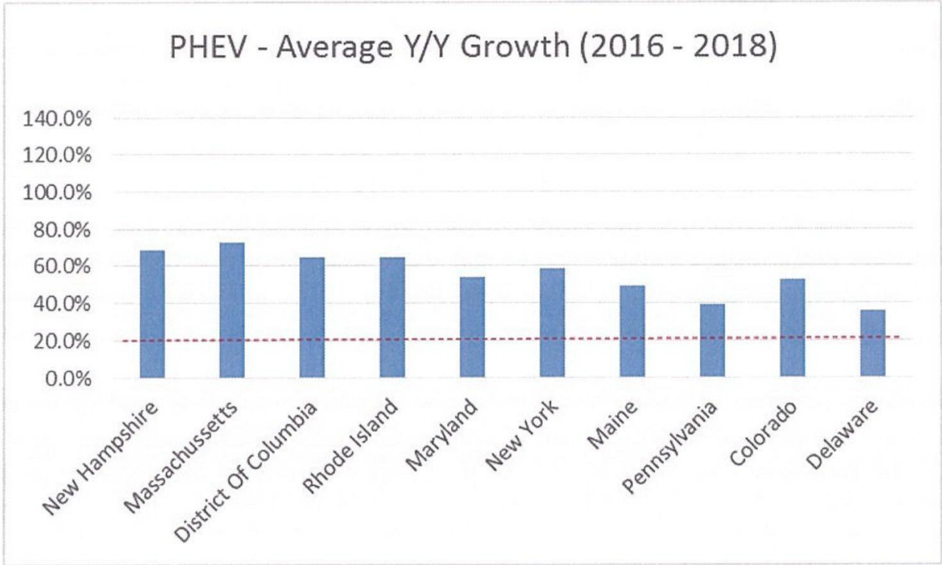
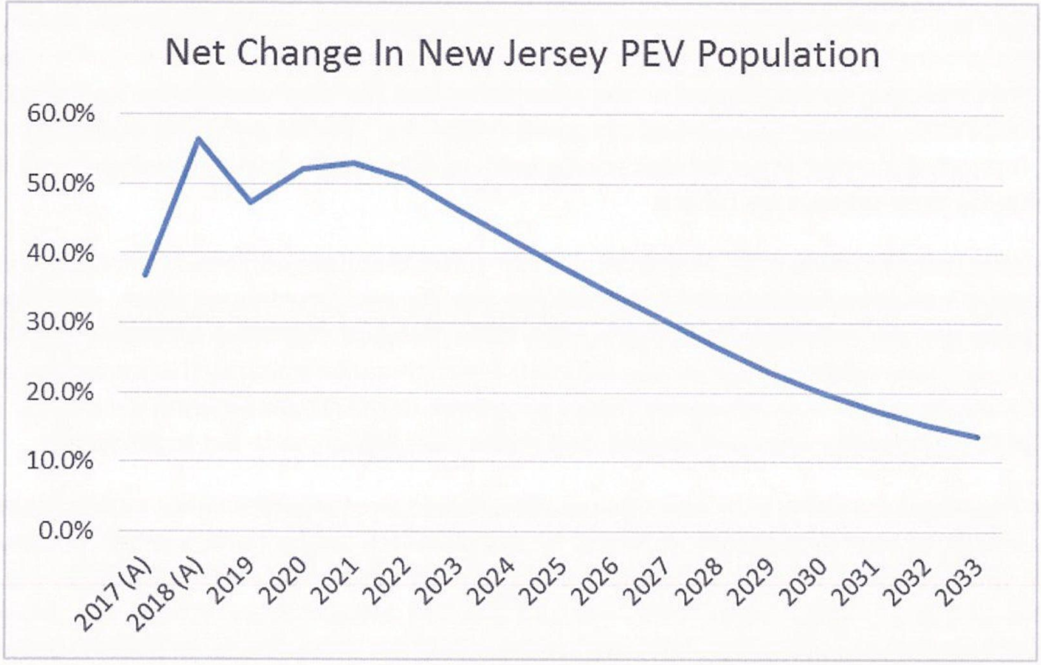
[p] Although the western coastal states (California, Oregon, Washington) demonstrate strong PEV sales each year, in absolute vehicle count, their year-over-year sales growth rate is somewhat smaller because the market is more mature. The sample states tended to have higher growth rates since they are earlier in their market development cycle, and many of them are also relevant as peer ZEV states in the mid-Atlantic region.





As with the BEV/PHEV trend noted above, the projection model assumptions are well within the range of actual performance seen in the sample states. Eight of the 10 sample states demonstrated average 3-yr growth rates higher than the maximum assumed in the New Jersey projection. The PHEV assumptions are significantly below historical trends for the sample states, reflecting the emerging decline of PHEV sales growth moving forward. These benchmarks suggest that even the maximum growth rate assumptions during the year of rebate introduction (2020), are reasonable compared with the historical sales results demonstrated in leading states.

Beyond benchmarking with other states, the team also considered the net impact of all the moving parts relative to historical baseline in New Jersey. The net annual change in PEV population size reflect the aggregate impact of all model dynamics in a single metric, and those trends tend to be relatively predictable. The net change in PEV population in New Jersey resulting from this projection is summarized in the chart below.



This trend makes sense conceptually, since it reflects a) the actual growth in 2017 and 2018, where New Jersey was in a strong growth mode, b) more modest growth in 2019 due to the current slow-down, c) a rebound in 2020 and 2021 based on the new rebate (and other positive factors, like new vehicle introductions), and c) a reasonable long term trajectory consistent with how maturing markets typically behave.

Finally, the projection assumptions were compared to a variety of recent studies that estimate PEV adoption in the US. That portfolio of studies represents a range of estimates through 2030 (or beyond), and the projection assumptions were within the range of estimates available, especially when focusing on the results expected within leading ZEV (Section-177) states. For example, the recent projection from Bloomberg New Energy Finance estimates that PEVs will represent about 40% of vehicles on the road by 2040[q], average across the country, with higher penetration in leading states.

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[q] https://about.bnef.com/electric-vehicle-outlook/

6.4 Potential Impact Of NJ Rebate

As noted in Section 4, the sales growth assumptions in the projection model balanced several antagonistic trends in the market. Sales growth in 2019 is weakening overall, as quantified in sales statistics for the first half of the year at both the national and state levels. There are structural reasons for this slow-down, which would motivate modest sales assumptions in 2020, with strengthening over time as those structural issues are addressed by the maturing market. At the same time, however, New Jersey plans to introduce a new vehicle purchase rebate that is expected to significantly stimulate growth. The projection model is based on the assumption that the new rebate program in 2020 will help stimulate sales, allowing for a stronger projection than the "slow down" trend would otherwise suggest. In short, the model assumed that sales growth in 2020 is approximately twice what it would have otherwise been without the rebate.

As a feasibility test, the study team examined all other states that have implemented rebate programs to assess what market impact could be expected from the planned New Jersey rebate. The experience in many states was not considered relevant in many cases, because they were of fundamentally different design, they were in states at very different levels of market maturity (i.e. numerous other factors in place that could simultaneously impact adoption), or the rebate program were so far in the past (when PEV availability was more limited, and prices were higher) as to not be relevant.

However, the recent experience in Colorado was identified as a reasonable market analog for predicting the likely impact on sales growth in New Jersey. First, Colorado is similar to New Jersey in many important ways: residents of each state have a similar affinity for the PEV value proposition (i.e. strong environmental values), similar levels of PEV market maturity[r], and similar levels of median household income (both states were in the top 15 for median income in the United States in 2017 [s]). Second, Colorado currently provides a vehicle purchase rebate that is very similar to that proposed by New Jersey: a $5,000 rebate that can be realized by the buyer at the time of purchase. Third, the Colorado experience is relatively recent (introduced in 2017), with similar levels of vehicle availability and pricing to what New Jersey consumers will see in 2020 when the rebate is introduced. Any comparison based on "before and after" perspectives on sales rates is not perfect, since there may be (and probably are) other factors at play in the market that also affect adoption. However, for purposes of anticipating possible vehicle rebate impact on sales, Colorado was identified as the mostly closely matched market analog, providing the most recent perspective on a rebate design that is very similar.

The following chart illustrates the impact on sales in Colorado over a multi-year period, including a "before" and "after" view relative to rebate implementation. The rebate was implemented early in 2017, and the average of annual year-over-year sales growth for PEVs in 2015 and 2016 was 32.9%,

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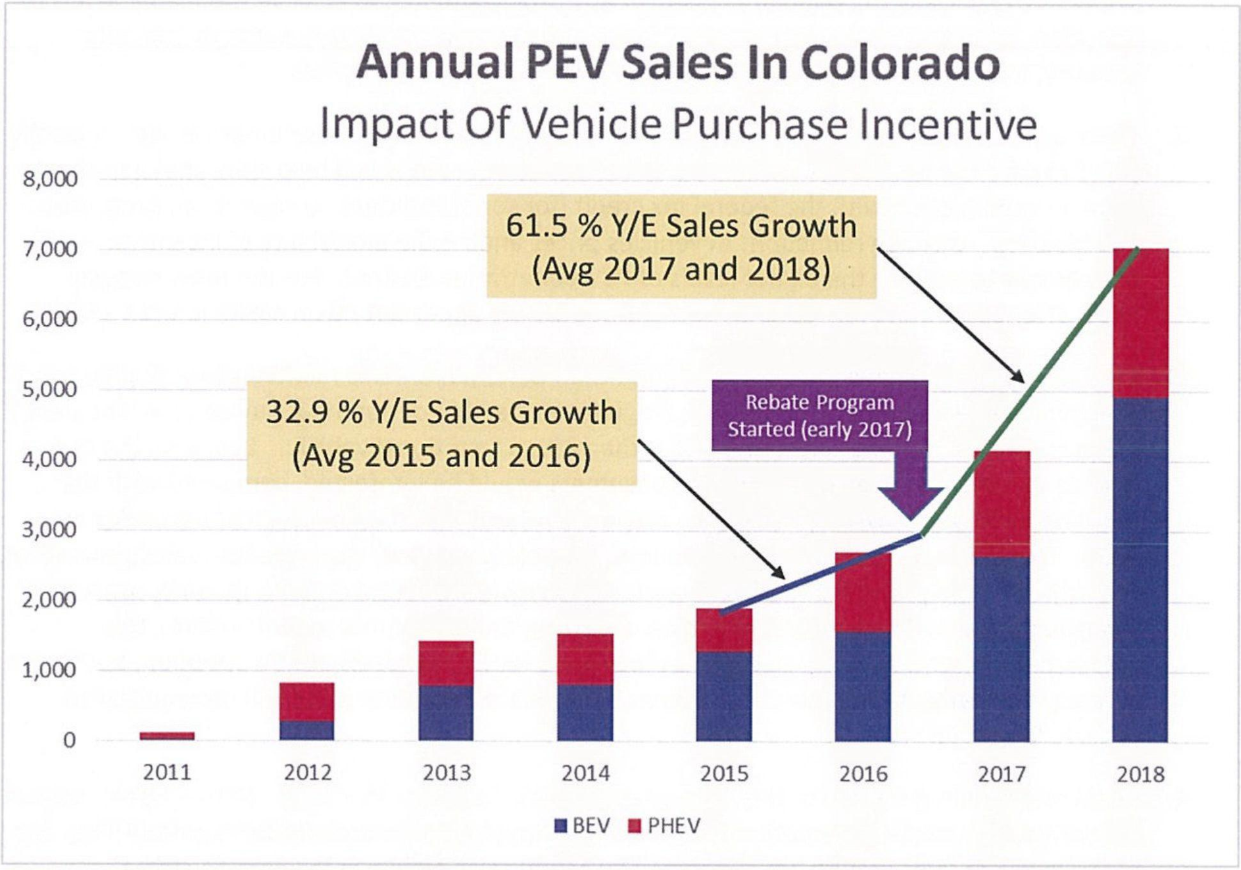
[r] New Jersey opted-in to the Section 177 ZEV framework early, but delayed signing on the regional ZEV MOU, and has delayed implementing programs or policies that would ensure attainment of those goals. That has changed recently, including New Jersey signing on to the ZEV MOU, and setting a goal of 330K PEVs on the road by 2025. Similarly, Colorado experienced reasonably strong levels of PEV sales, although there were few policies in place to encourage those sales. Colorado just opted into the Section 177 ZEV framework in 2019. Both New Jersey and Colorado were approximately cotemporaneous in their commitment to Section 177 goals and supporting policies.

[s] http://worldpopulationreview.com/states/median-household-income-by-state/#undefined

compared with an average of 61.5% in 2017 and 2018. The year-over-year sales growth numbers were on average almost twice as large after the rebate as the two years prior to rebate introduction.



As noted above, this visual correlation is not perfect – there are numerous other market factors that could be involved in the sales rate changes noted. But the study team considers Colorado the best available market analog for anticipating the potential impact of a $5,000 rebate in New Jersey due to the high degree of similarity between the two states' market conditions and rebate design. This context provides some confirmation of the rebate program impact assumed in the projection model.

6.5 Feasibility Assessment Conclusions

The study team completed a "sanity check" of the key assumptions in the projection model, looking at feasibility from several different perspectives. Generally, these validations support the range of assumptions made in the model, but also suggest needed advancements in the market to sustain the higher levels of adoption projected longer term. Key conclusions include:

1. PEV models are available in enough segments to provide options for consumers interested in considering a PEV rather than a traditional vehicle. The market share represented by those "covered segments" is more than sufficient to support the adoption levels needed in the short term (through 2025). Longer term, however, additional vehicles will be needed in more segments, especially the popular cross-over and SUV segments, to achieve the higher levels of adoption required to meet state goals. Given announcements already made by the auto industry, that need is expected to be addressed over the next five years.

2. There are still substantial price premiums for PEVs compared with traditional vehicles, typically $10-$15K for the base MSRP. The proposed New Jersey rebate will help close that gap short term, in combination with the federal tax credit (for some vehicles). Longer term, progress on affordability - through reductions in vehicles prices and/or the availability of incentives – will be required to achieve the higher levels of PEV penetration desired. For the most popular PEVs, after accounting for "as sold" configurations, the upper bound on MSRP is $45K - $50K.

3. Even though general awareness of PEVs and their benefits remains relatively low, that is changing. Recent studies indicate that a significant fraction of potential buyers (over the next 2 – 5 years) would at least consider a PEV rather than a traditional vehicle. Based on the two studies considered, an average 38% of consumers would be interested, compared with the more modest model assumptions that ramp up to about 16% market share of new sales in 2025. There is therefore sufficient consumer interest to support the projected sales short term, but achieving the projected market share longer term will depend on both growing consumer awareness, and a high level of conversion of consumer interest into actual buyers. This research suggests that New Jersey is fertile ground for higher levels of PEV adoption, but that a focus on achieving high levels of "conversion" of that interest into sales will be required to achieve longer term goals.

4. Benchmarks with a sample of the ten highest growth states for PEV sales (2016 – 2018) suggest that projection model assumptions for a) a transition to a preference for BEVs over PHEVs, and b) the levels of sales growth are supported by actual sales results in the sample states.

5. The projection model assumes that BEV sales in 2020 for New Jersey will be relatively strong due to the planned rebate, approximately twice the growth rate that would have otherwise been expected. This "rebate impact" assumption is consistent with the actual sales result in Colorado, who implemented a rebate program similar to the design being considered for New Jersey. This correlation isn't perfect given other market dynamics that may be at play, but after an investigation into all rebate programs offered in the country, Colorado appears to be the closest to New Jersey as a market analog, and their experience validates the assumptions made in the projection model.

7 Findings and Conclusions

The projection model is based on a blended approach that starts with known registrations as of the end of 2018, extrapolates sales growth over the next few years consistent with recent trends, and transitions to the sales growth rates needed to achieve key objectives: the State goal of 330K PEVs by 2025 and the ChargEVC roadmap goal of 2M PEVs on the road by 2035. This methodology couples the projected sales strongly with recent market performance short term, but achieves attainment of key goals medium term while reflecting transition characteristics consistent with maturing markets.

The model incorporates detailed market research about recent sales statistics and trends, and those results suggest that the New Jersey market is in transition. While sales growth for both BEVs and PHEVs have been strong in New Jersey since 2016, with PEVs year-over-year growth exceeding 83% in 2018, growth appears to be softening. Sales at the national level have begun to weaken, and sales for the first half of 2019 in New Jersey are significantly lower than the same period in 2018. Simultaneously, the market (nationally, in New Jersey, and in other leading states) is experiencing a strong shift toward BEVs being a larger fraction of the market. Concurrent with these transition dynamics, however, are indicators for strong future growth, including a large number of new PEV models expected over the next two years, improved prices and longer range, and growing consumer awareness and interest.

Those factors, by themselves, would motivate significant reductions in sales growth in the short term, with growing strength as the market continues to mature. However, New Jersey is planning a vehicle rebate program with initial funding of $30M, which is expected to become available in 2020. Several utilities are proposing new programs that could stimulate infrastructure development and help address consumer barriers, and new consumer awareness programs are being planned. The study combined these considerations in estimating sales growth over the next few years, especially for the critical years 2020 and 2021. The projection therefore assumes a significant positive impact from the rebate program and other programs under development, offsetting the growth rate decline that might have otherwise emerged.

The projection model estimates that PEVs will account for approximately 16% of new LDV sales by 2025, and will represent approximately 5% of the LDV population. BEVs will be dominant by that point in time, accounting for 95% of the PEV population. The necessary sales growth rates peak when the rebate program is introduced, but then maintain strong growth while declining slightly year-over-year consistent with the typical behavior of maturing markets. By 2035, the model projects that PEVs will represent approximately 42% of new LDV sales, and 33% of the LDV population. This is consistent with goals established by global market leaders that are targeting approximately 30% PEV penetration in the 2030-2035 timeframe. The long term projection estimates that PEVs will approach 100% of LDV sales by 2050, at which point approximately 80% of the LDV population will be electrified. Attainment of these benchmarks, at a minimum, are required for the State to achieve its aggressive state GHG reduction goals.

The feasibility assessment considered whether the assumptions used in the model are likely to be achieved (or not) from a variety of perspectives. There is basic coverage of the vehicle market, when assessed at a per segment basis, to deliver the adoption rates assumed – although that coverage is minimal in many segments and price premiums for PEVs remain significant. Product coverage is therefore considered sufficient to meet the model assumptions short term, but higher levels of adoption, especially in the period from 2025 to 2035, will depend on additional product availability and improved pricing. Consumer awareness is growing, and recent studies (at both the national and state level) confirm that there is already sufficient interest to support the modest levels of adoption assumed in the short term. The sales growth assumptions for the next few years, for example, a) have been achieved (and exceeded) in New Jersey in recent years, and b) are no more optimistic than sales growth evident in other leading PEV adoption states. Most importantly, the market experience in Colorado provides a meaningful example of the potential impact of the new vehicle rebate in New Jersey, and the sales growth rates assumed in the model are within the expected range of impact.

Taken together, these considerations suggest that the sales growth assumptions used in the model are feasible, but **strong, sustained, sales growth will be necessary to achieve state goals**, and success will depend heavily on the planned vehicle rebate program to address current affordability issues, combined with overcoming barriers related to charging infrastructure, continued introduction of new models in key segments with strong inventory availability, and successful efforts to expand consumer awareness significantly. **The projection is therefore considered a "most likely" trajectory of adoption over the next few years given current market conditions, but in the medium term (2023 – 2025), attainment of state goals will depend heavily on the sustained success of market stimulation initiatives under development.**

Longer term, attainment of the high levels of electrification expected to be required by 2050 will depend heavily on the EV adoption momentum established over the next few years. As part of the market research associated with this study, the team explored dozens of alternative adoption trajectories. If the next five years are not leveraged to create strong initial momentum, attainment of longer term goals becomes significantly less likely since unrealistically high growth levels become necessary in the out years. **The State therefore faces a unique opportunity since early action to build momentum now makes long term electrification success much more likely.**

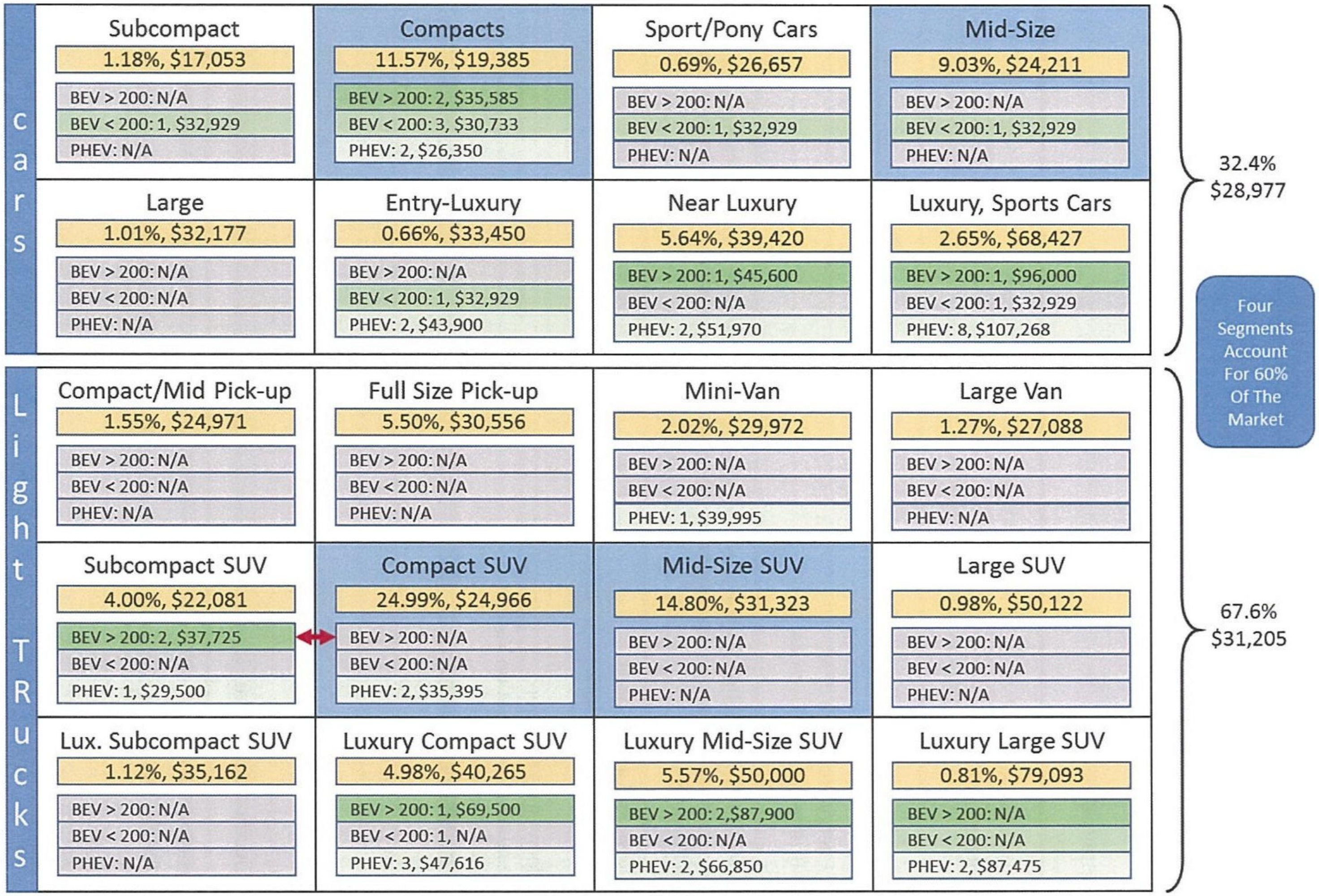
Appendix A: ChargEVC Members

The following list summarizes all ChargEVC members as of the date of this study. Please go to www.chargevc.org for more details.

AAA
Association of NJ Environmental Coalitions
Atlantic City Electric
BYD
Center for Sustainable Energy
Clearview Energy
EN Engineering
Environment New Jersey
Environmental Defense Fund
EVgo
Fuel Force
Greenfaith
Greenlots
Independent Energy Producers of NJ
International Brotherhood of Electrical Workers
International Council of Shopping Centers
Isles, Inc.
Jersey Central Power & Light
JuiceBar
Natural Resources Defense Council
New Jersey Coalition of Automotive Retailers
New Jersey Clean Cities Coalition
New Jersey League of Conservation Voters
NJR Clean Energy Ventures
New Jersey State Electrical Workers Association
Plug-In America
Proterra
PSE&G
Rockland Electric
Sierra Club NJ Chapter
Sussex Rural Electric Cooperative
Tesla
Union of Concerned Scientists
Work Environmental Council

Associate Members
Cherry Hill Township
Cranford Environmental Commission
Princeton
Secaucus

Appendix B: Market Segmentation Results



Cars	Subcompact 1.18%, $17,053 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A	Compacts 11.57%, $19,385 BEV > 200: 2, $35,585 BEV < 200: 3, $30,733 PHEV: 2, $26,350	Sport/Pony Cars 0.69%, $26,657 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A	Mid-Size 9.03%, $24,211 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: N/A
	Large 1.01%, $32,177 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Entry-Luxury 0.66%, $33,450 BEV > 200: N/A BEV < 200: 1, $32,929 PHEV: 2, $43,900	Near Luxury 5.64%, $39,420 BEV > 200: 1, $45,600 BEV < 200: N/A PHEV: 2, $51,970	Luxury, Sports Cars 2.65%, $68,427 BEV > 200: 1, $96,000 BEV < 200: 1, $32,929 PHEV: 8, $107,268
Light Trucks	Compact/Mid Pick-up 1.55%, $24,971 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Full Size Pick-up 5.50%, $30,556 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Mini-Van 2.02%, $29,972 BEV > 200: N/A BEV < 200: N/A PHEV: 1, $39,995	Large Van 1.27%, $27,088 BEV > 200: N/A BEV < 200: N/A PHEV: N/A
	Subcompact SUV 4.00%, $22,081 BEV > 200: 2, $37,725 BEV < 200: N/A PHEV: 1, $29,500	Compact SUV 24.99%, $24,966 BEV > 200: N/A BEV < 200: N/A PHEV: 2, $35,395	Mid-Size SUV 14.80%, $31,323 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Large SUV 0.98%, $50,122 BEV > 200: N/A BEV < 200: N/A PHEV: N/A
	Lux. Subcompact SUV 1.12%, $35,162 BEV > 200: N/A BEV < 200: N/A PHEV: N/A	Luxury Compact SUV 4.98%, $40,265 BEV > 200: 1, $69,500 BEV < 200: 1, N/A PHEV: 3, $47,616	Luxury Mid-Size SUV 5.57%, $50,000 BEV > 200: 2,$87,900 BEV < 200: N/A PHEV: 2, $66,850	Luxury Large SUV 0.81%, $79,093 BEV > 200: N/A BEV < 200: N/A PHEV: 2, $87,475

32.4%
$28,977

Four Segments Account For 60% Of The Market

67.6%
$31,205

IN THE MATTER OF THE PETITION OF ATLANTIC CITY ELECTRIC COMPANY FOR APPROVAL OF A VOLUNTARY PROGRAM FOR PLUG-IN VEHICLE CHARGING	**STATE OF NEW JERSEY** **BOARD OF PUBLIC UTILITIES**

CERTIFICATION OF SERVICE

ANDREW J. MCNALLY, of full age, certifies as follows:

1. I am an attorney at law of the State of New Jersey and am Assistant General Counsel to Atlantic City Electric Company, the Petitioner in the within matter, with which I am familiar.

2. I hereby certify that, on December 17, 2019, I caused the within Verified Petition and supporting appedixes thereto to be filed with the New Jersey Board of Public Utilities, by hand delivery, one original and ten copies to the Office of the Secretary to the Board, Board of Public Utilities, 44 South Clinton Avenue, 9th Floor, Trenton, New Jersey 08625-0350, Attention: Aida Camacho-Welch. I also caused an electronic copy to be sent to the Board Secretary's office at board.secretary@bpu.state.nj.us.

3. I further certify that, on December 17, 2019, I caused a complete copy of the Verified Petition and supporting appendixes thereto to be hand delivered and sent by electronic mail to the Division of Rate Counsel at 140 East Front Street, Trenton, New Jersey 08625. I also caused a complete copy to be hand delivered and sent by electronic mail to the Division of Law, Pamela L. Owen, Esquire, Deputy Attorney General, 25 Market Street, Trenton, New Jersey 08625. A copy was delivered by electronic mail and Federal Express to Peter Van Brunt, Esquire, Deputy Attorney General, 124 Halsey Street, Newark, New Jersey 07101.

4. I further certify that, on December 17, 2019, I caused a complete copy of the Verified Petition and supporting appendixes to be sent by electronic mail and Federal Express to all remaining members of the Service List.

5. I further and finally certify that the foregoing statements made by me are true. I am aware that, if any of the foregoing statements made by me are willfully false, I am subject to punishment.

Dated: December 17, 2019

Andrew J. McNally

ANDREW J. MCNALLY

Atlantic City Electric Company
150 West State Street
Trenton, New Jersey 08608
(609) 909-7033 – Telephone
(609) 393-0243 – Facsimile
andrew.mcnally@exeloncorp.com

I/M/O Petition of Atlantic City Electric Company for Approval of a
Voluntary Program for Plug-In Vehicle Charging
BPU Docket No. EO18020190

Service List

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