CHARGEVC

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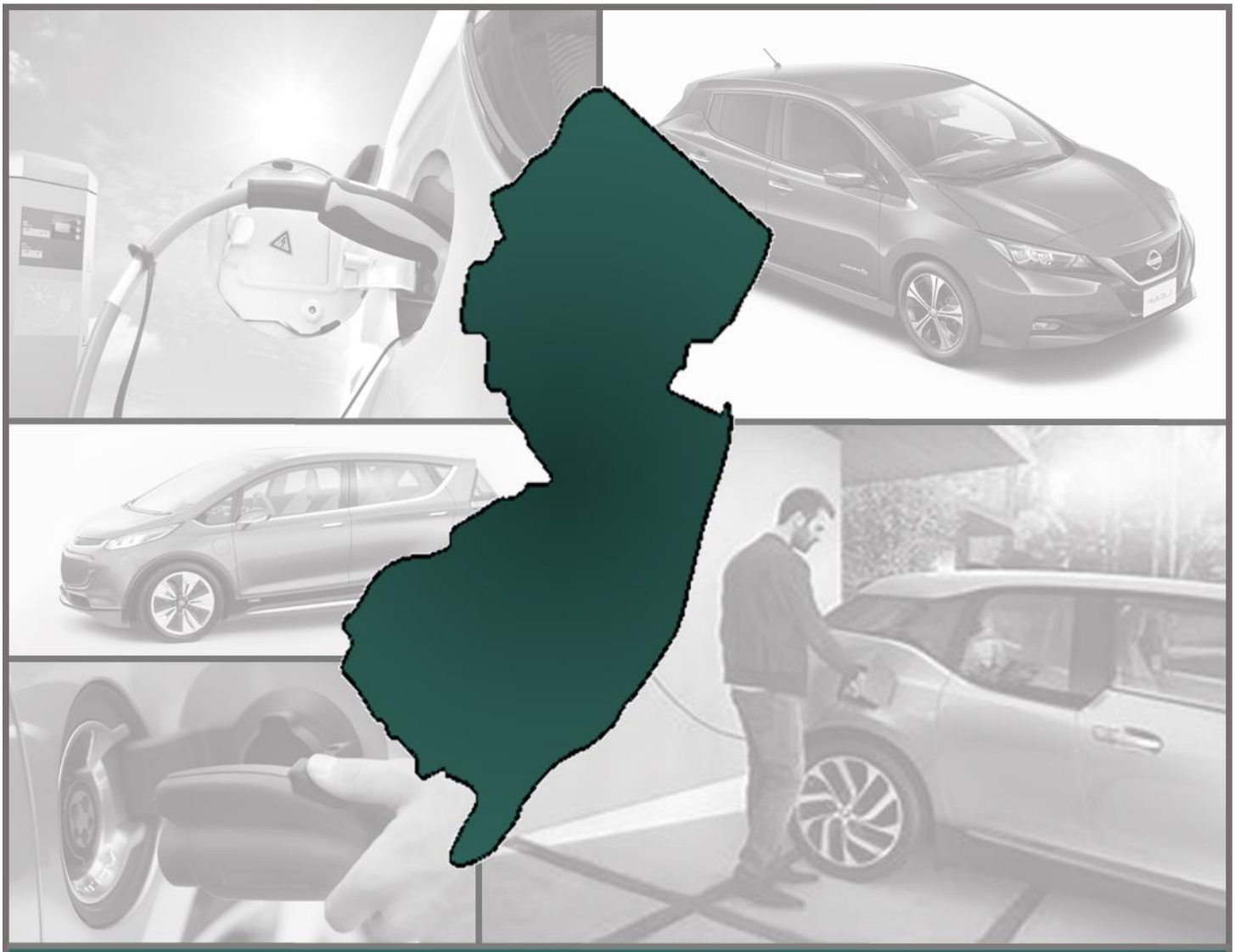

# Projections Of Electric Vehicle Adoption In New Jersey

Prepared For ChargEVC By Gabel Associates, Inc.

September 18, 2019

## Acknowledgements

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# 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.

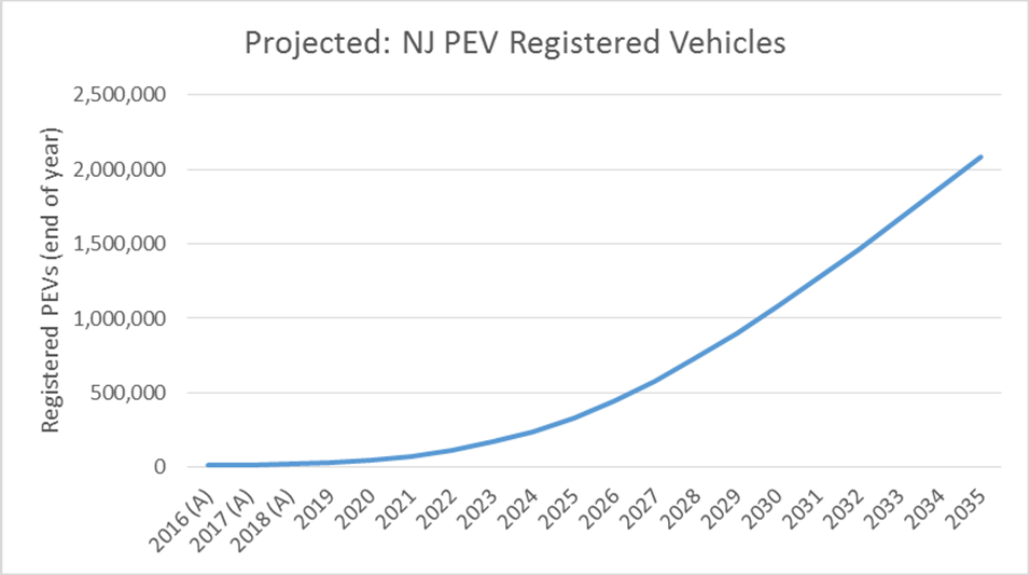
- A projection model that estimates sales of both Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) and computes the population of registered PEVs each year over the study period;

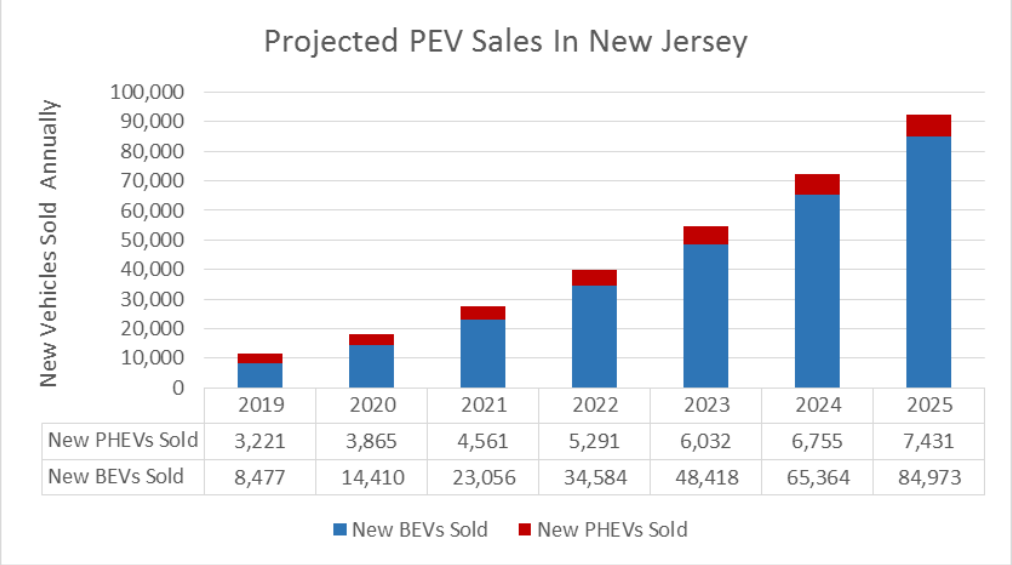
- An assessment as to the probability that the sales growth assumptions used in the model are achievable based on considerations of PEV coverage of the New Jersey market, measures of consumer interest, benchmark comparisons, and estimates of the likely impact the planned vehicle purchase rebate will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



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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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

[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.

[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.

[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.

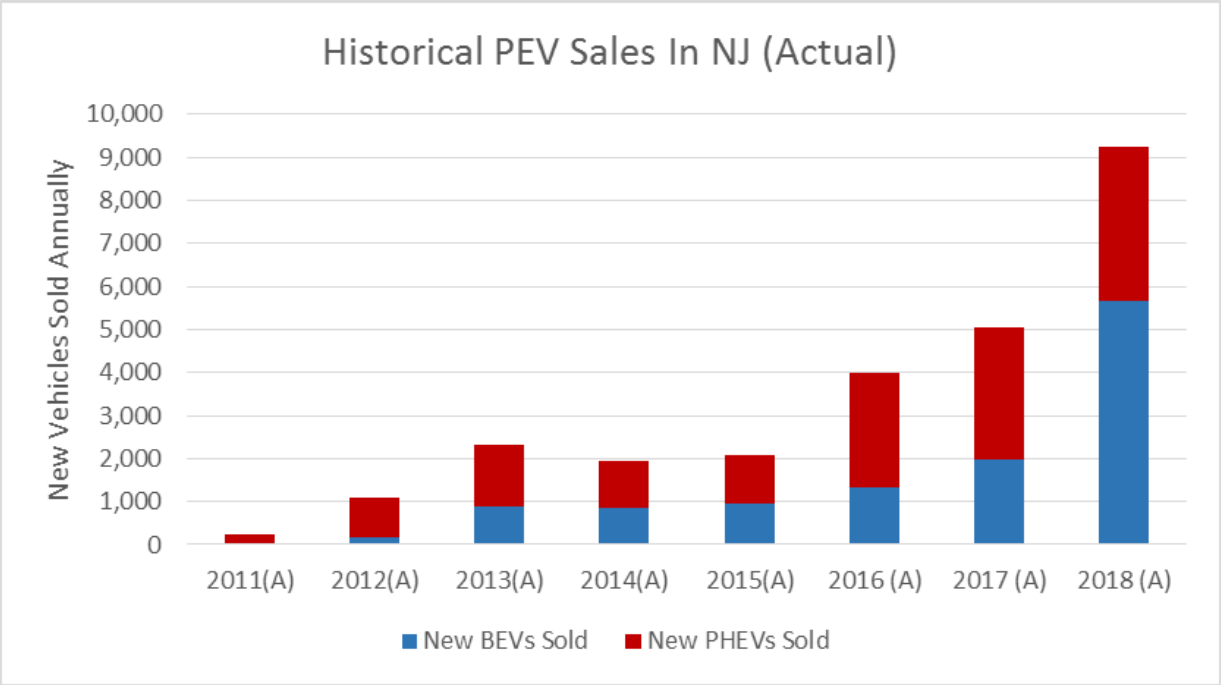
- Most recently, a new coalition called ChargEVC was formed in 2016 , which focuses specifically on PEV market development in New Jersey. The ChargEVC coalition, based on consensus building within its diverse stakeholder membership, published a roadmap for New Jersey Plug-In Vehicle Market Development 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.

[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]

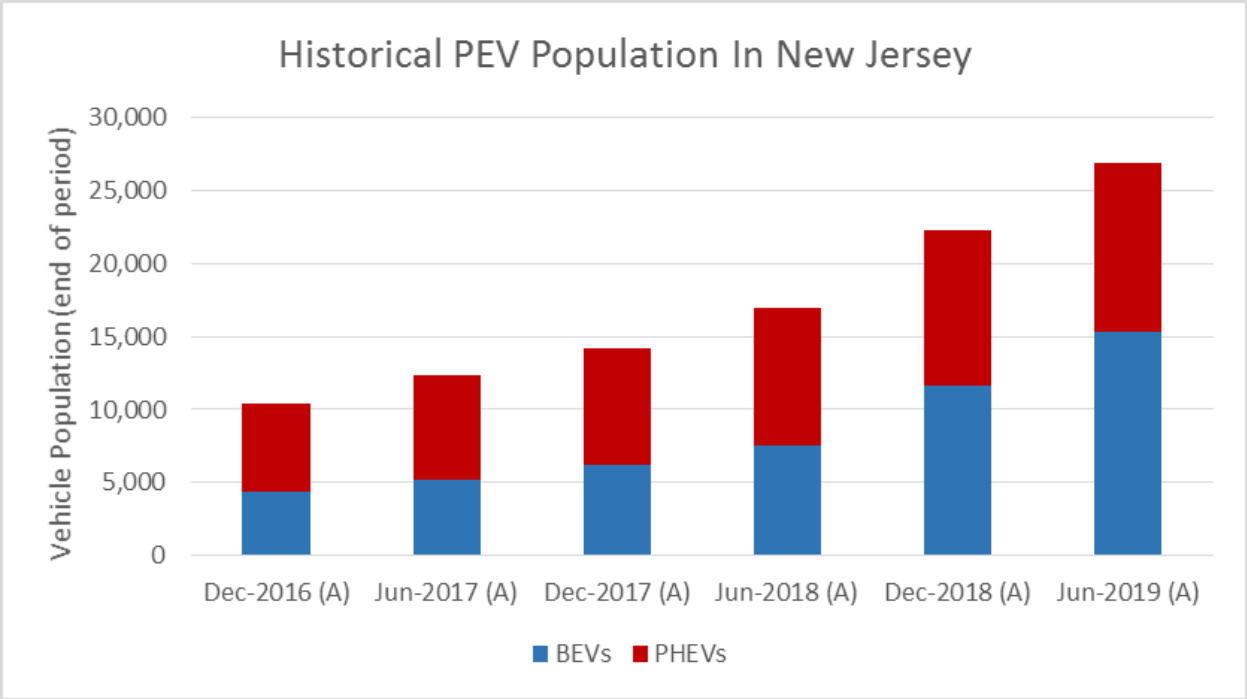



These results represent year-over-year sales growth for PEVs of 89.9%, 26.5%, and 83.4% (for 2016, 2017, and 2018 respectively). Sales for the first half of 2019 demonstrated 55.4% growth over the same period in 2018, demonstrating strong growth but a slow-down compared with the average of the prior 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).

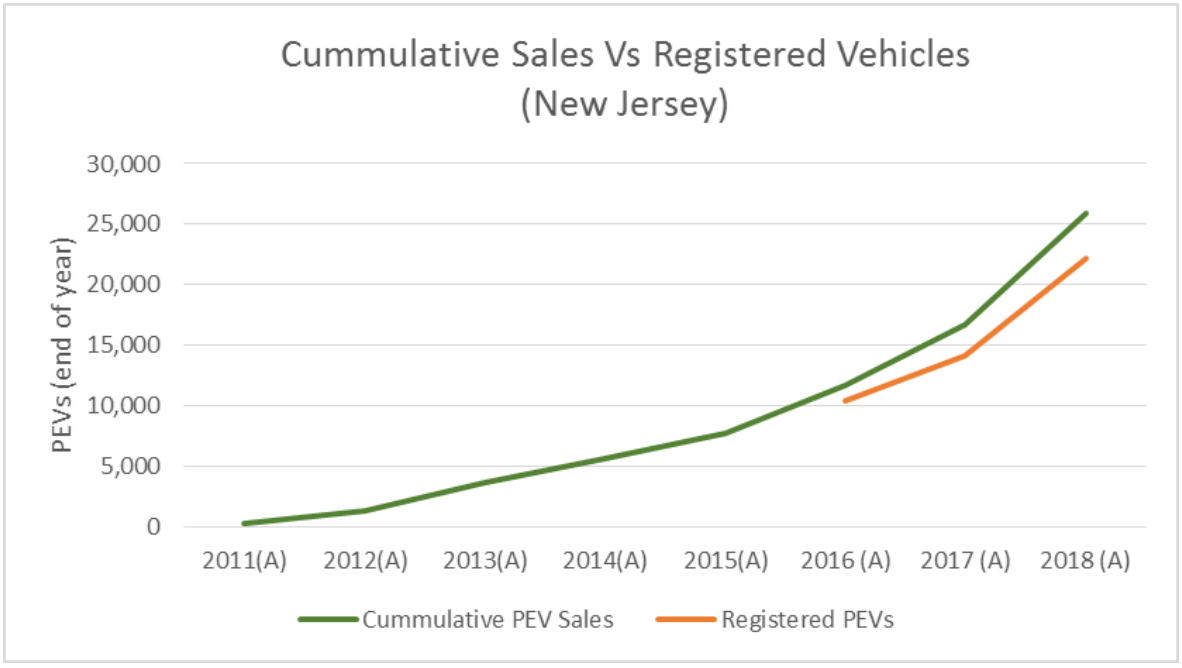
These sales, after accounting for retirements and the net impact of vehicles entering or leaving the State, have resulted in substantial growth in the number of registered EVs on the road in New Jersey. That trend is summarized in the chart below, based on snapshots of vehicle registration data developed 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.

[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).

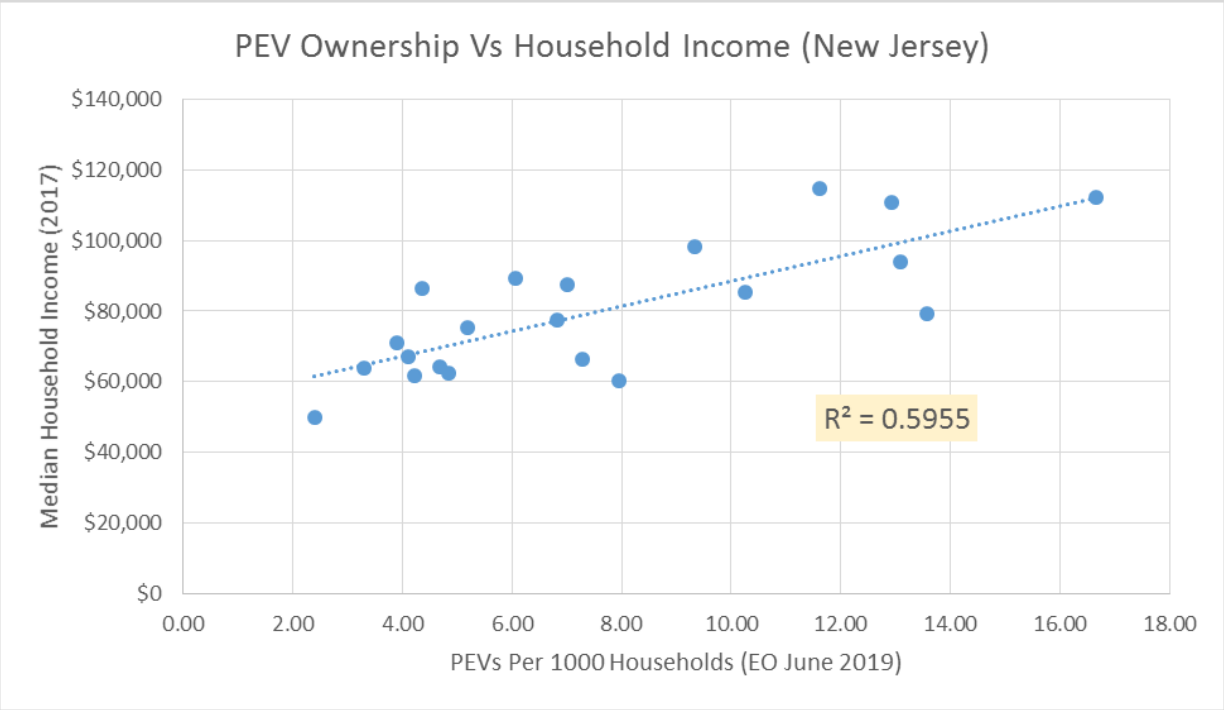


The following table summarizes the PEV distribution by county (end of June 2019), and related demographic metrics regarding PEV penetration.

| 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 |

[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.

| | DCFC Outlets Per | DCFC Outlets Per |
|---|---|---|
| **ZEV States** | **1000 PEVs** | **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.

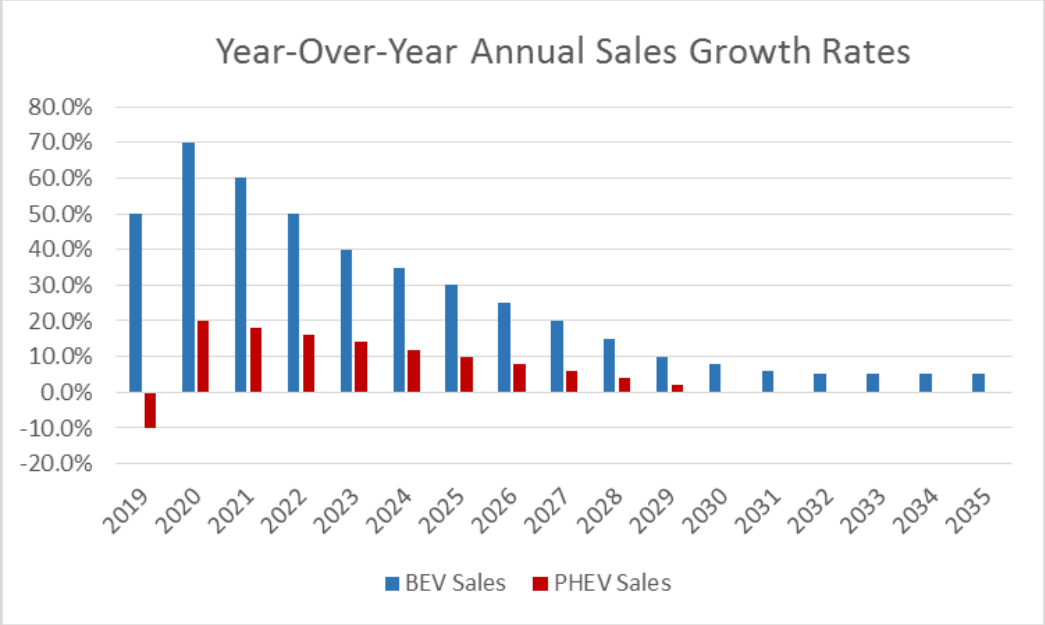
Those factors, by themselves, would motivate significant reductions in sales growth in the short term, with growing strength as the market continues to mature. However, New Jersey is planning a vehicle rebate program with initial funding of $30M, which is expected to become available in 2020. Several 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.

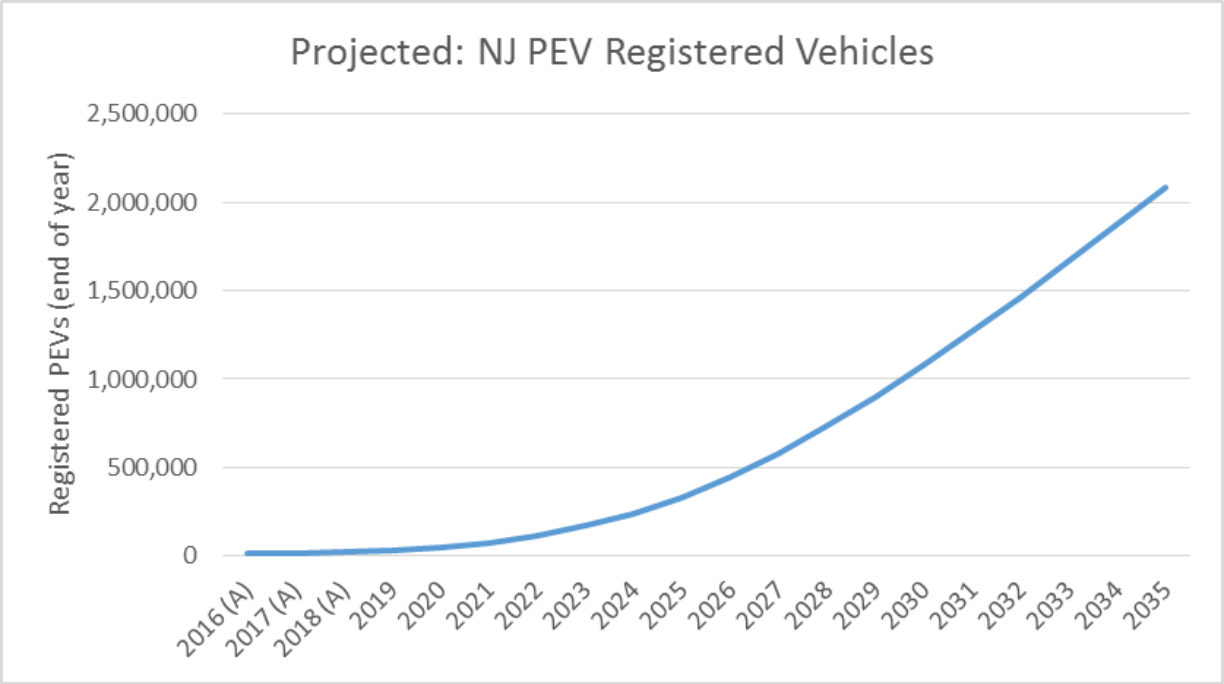
As a result of this analysis, a key implication emerged: the feasibility of attaining state goals in 2035, and even more importantly the strategic goals for 2050, depend heavily on the momentum established prior to 2025. If growth remains modest through 2025, exceptionally high (and probably un-attainable) 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.

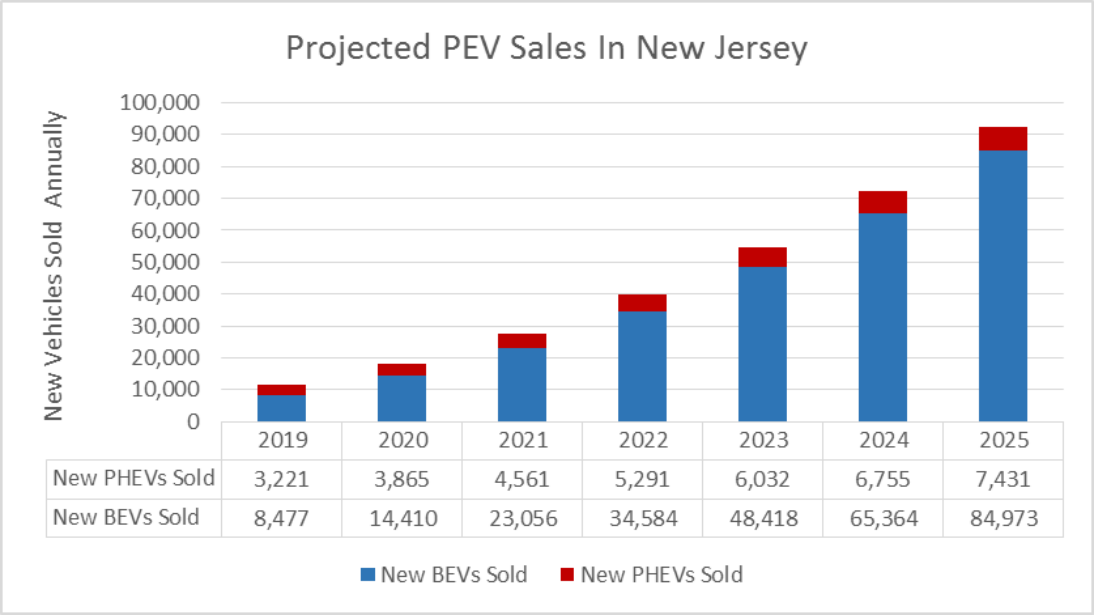
## 5.1 Projection Through 2035

The following graph summarizes the projected PEV population through 2035.

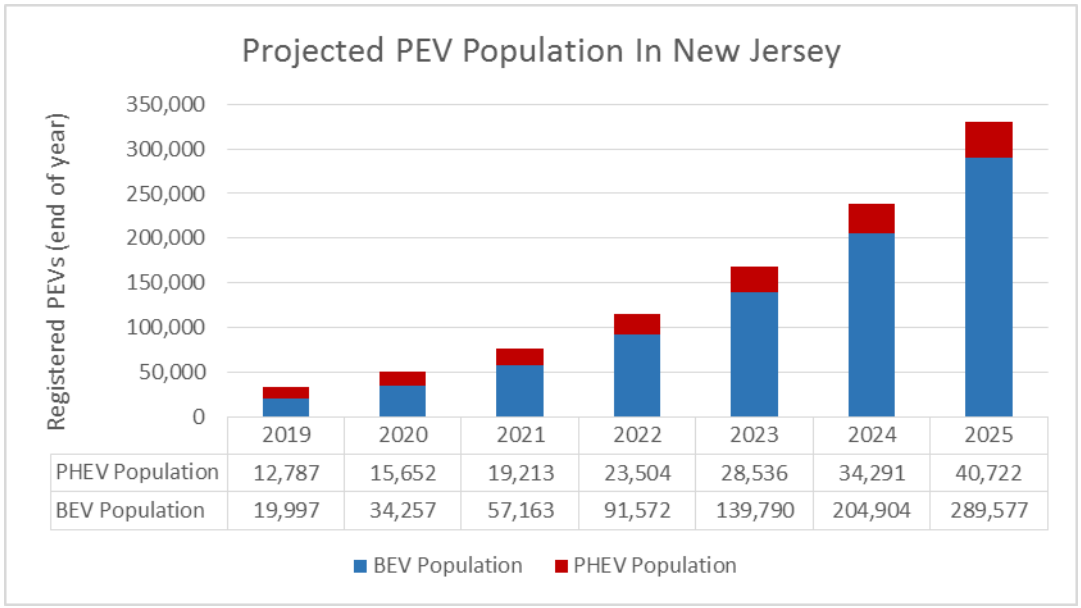



This projection estimates that PEVs will represent approximately 16% of LDV sales in 2025, and just over 5% of the LDV population. By 2035, PEVs will account for 41% of LDV sales, and nearly 32% of the LDV population. This benchmark is approximately aligned with global leaders (mostly in Europe) that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

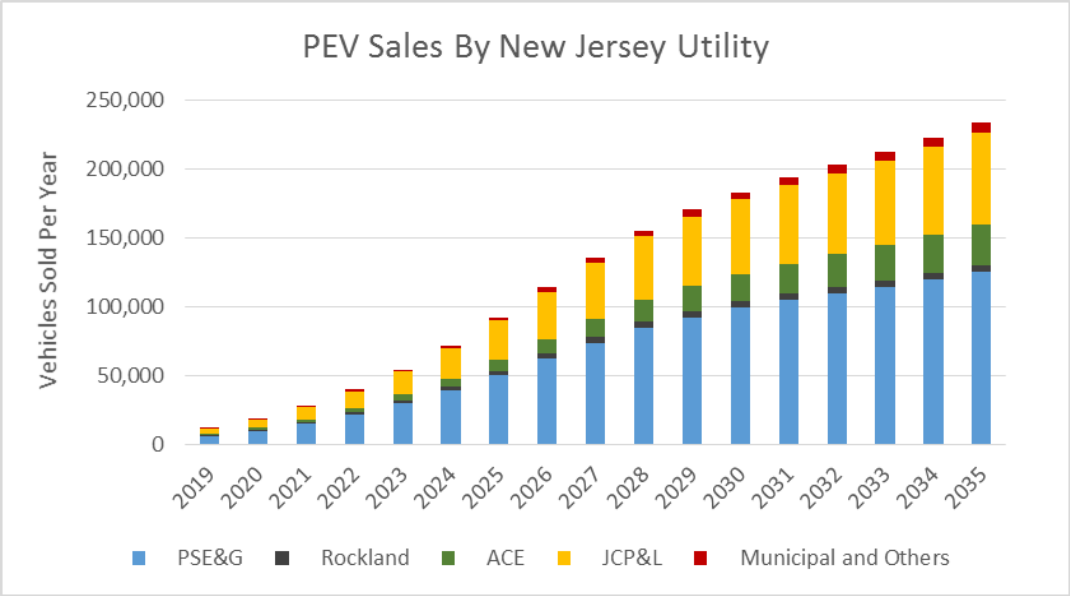



The following chart provides the detailed break-down of BEV and PHEV populations through 2025.



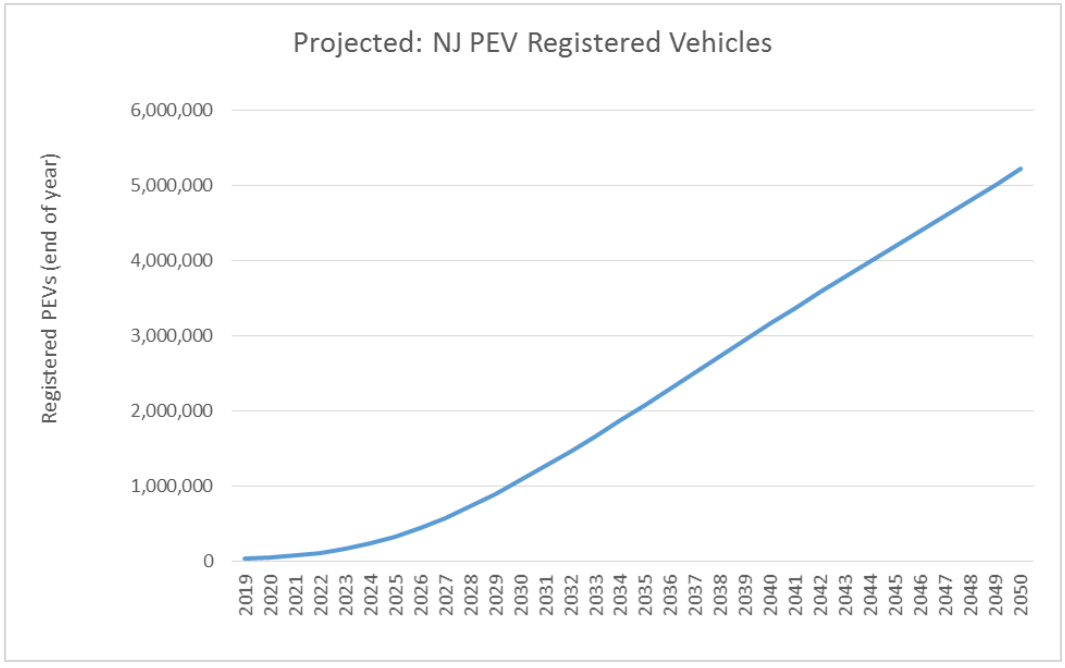

Based on detailed mapping of the PEV population across utilities (using vehicle registration data by zip-code), and assuming that the utility allocation transitions to alignment with overall LDV ownership by 2035,[I] the PEV adoption projection breaks-out per utility as follows.

[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

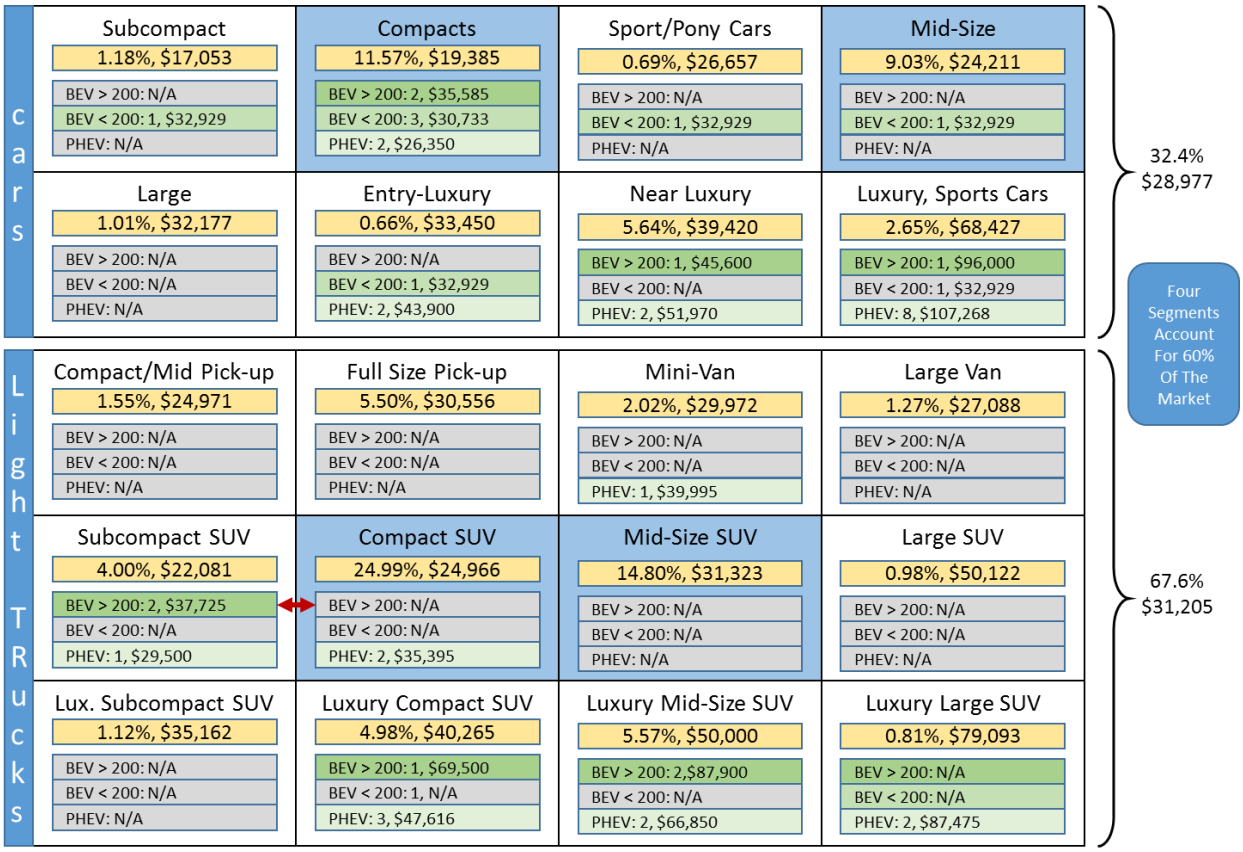
The key assumptions outlined in Section 5 formed the basis for the projection, and were informed by recent sales statistics, consideration of market trends that impact adoption levels, and State goals for 2025 and 2035. The "lowest risk" adoption assumptions were used, which represent the lowest possible 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.




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.

[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

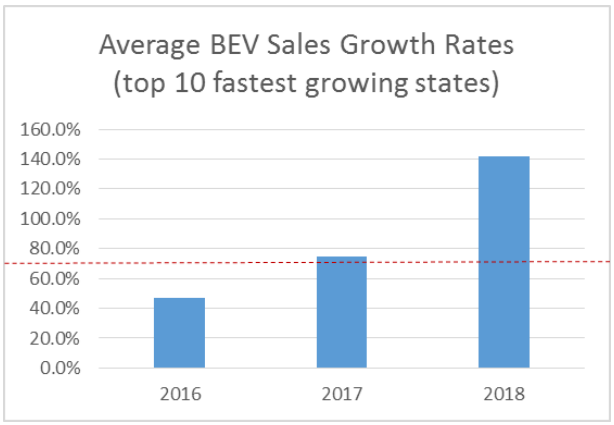
As part of the feasibility assessment, the study team compared the sales growth assumptions with benchmarks from other leading states as a real world comparison of feasibility. If the model assumed higher growth rates than other leading states were achieving, that would weaken confidence in the projection. 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.

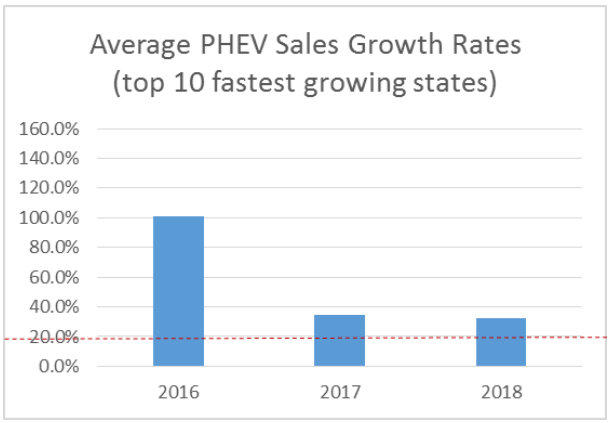
Benchmarking between states on EV sales is challenging, since the states are all very different. They are different sizes, at different levels of maturity (the west coast states started much earlier), different demographics, and all have very different policy environments. It is therefore difficult to 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,

[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).

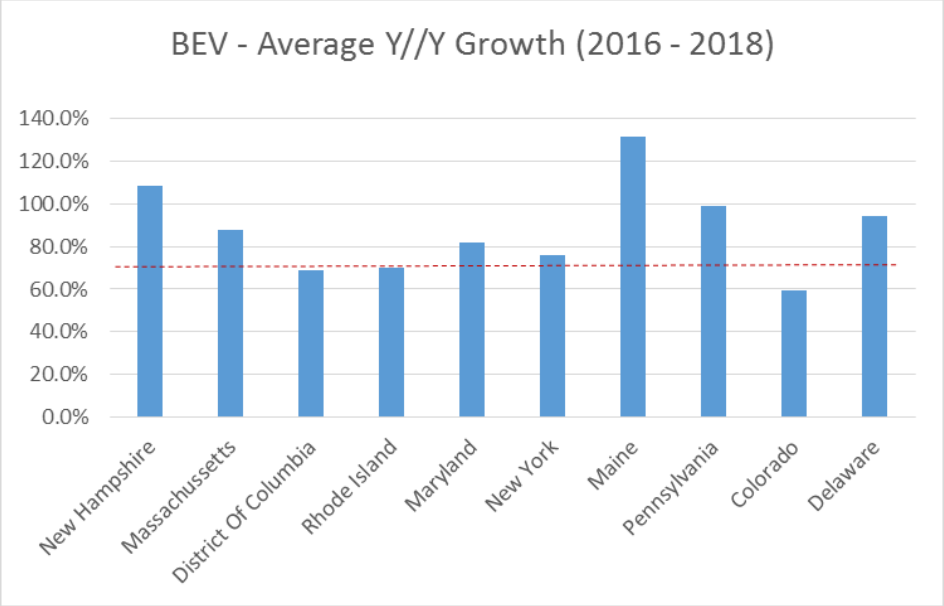


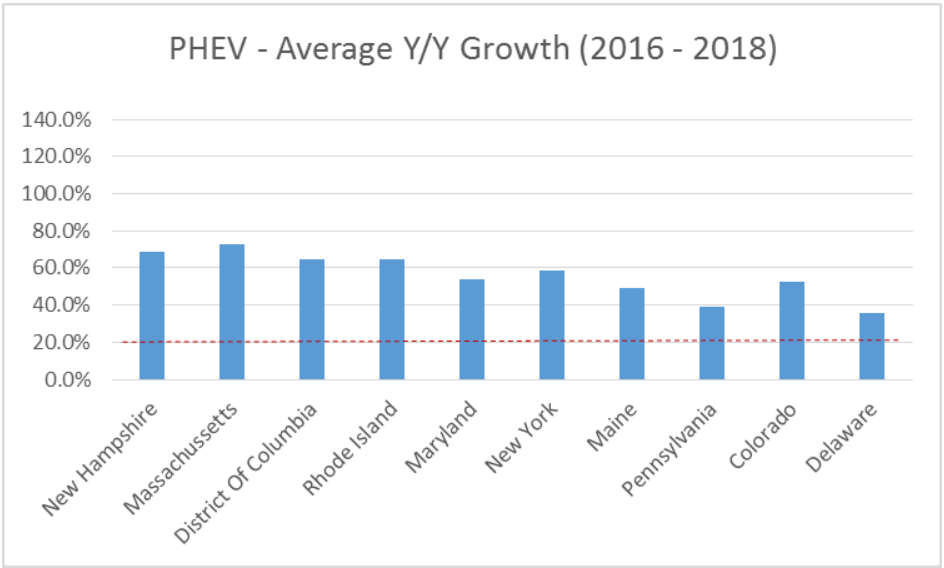




Consistent with the trends evident in the sample states, the projection model assumes continued strong growth for BEVs, but declining growth for PHEVs. This trend was reinforced in early data for the first half of 2019 across all states considered (including New Jersey). The projection model assumptions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

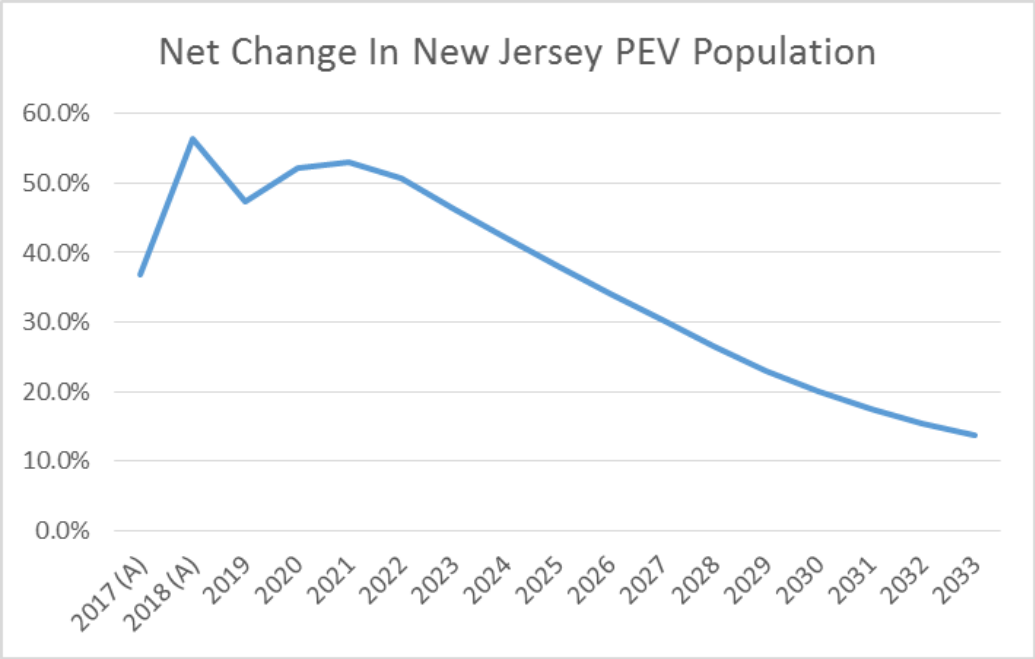
[p] Although the western coastal states (California, Oregon, Washington) demonstrate strong PEV sales each year, in absolute vehicle count, their year-over-year sales growth rate is somewhat smaller because the market is more mature. The sample states tended to have higher growth rates since they are 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.

[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.

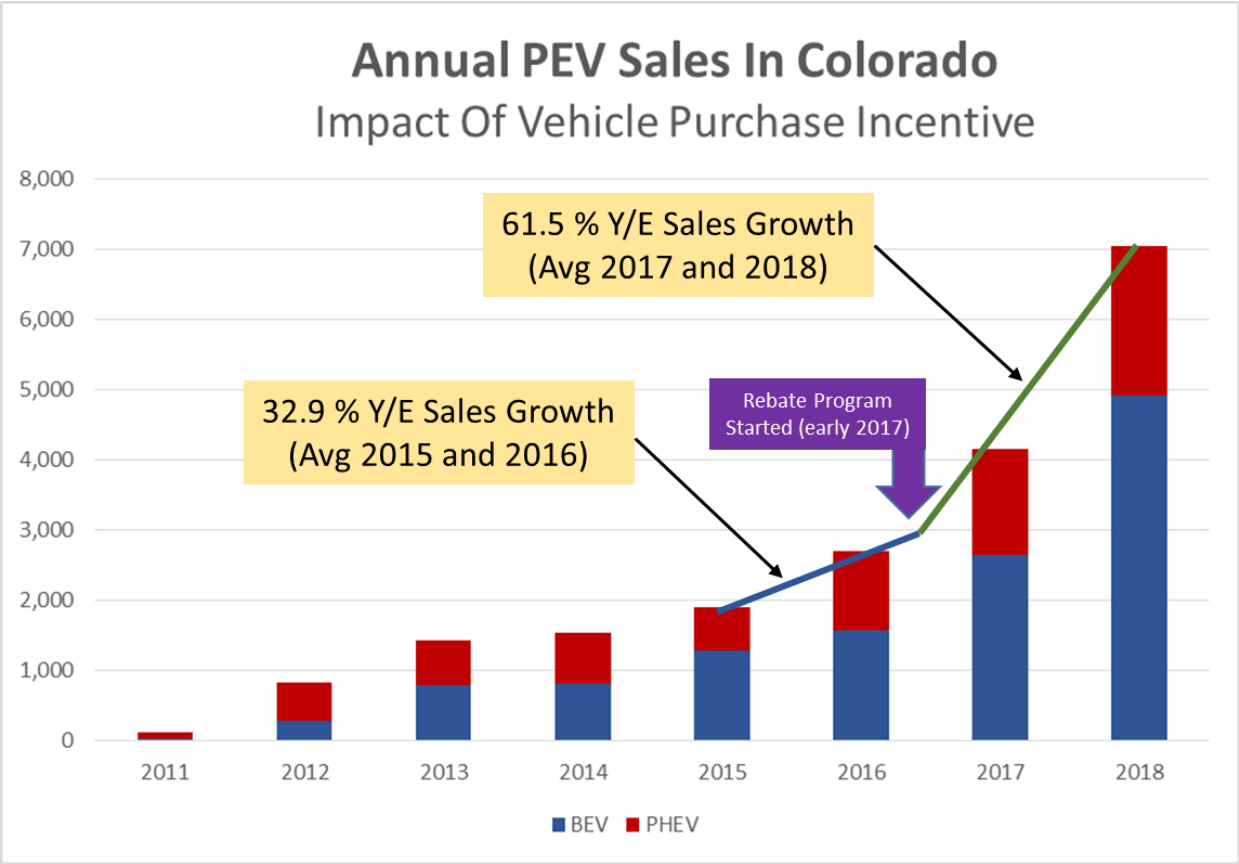
However, the recent experience in Colorado was identified as a reasonable market analog for predicting the likely impact on sales growth in New Jersey. First, Colorado is similar to New Jersey in many important ways: residents of each state have a similar affinity for the PEV value proposition (i.e. 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%,

[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