STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF DUKE ENERGY INDIANA, LLC PURSUANT TO IND. CODE §§ 8-1-2-42.7 AND 8-1-2-61, FOR (1) AUTHORITY TO MODIFY ITS RATES AND CHARGES FOR ELECTRIC UTILITY SERVICE THROUGH A STEP-IN OF NEW RATES AND CHARGES USING A FORECASTED TEST PERIOD; (2) APPROVAL OF NEW SCHEDULES OF RATES AND CHARGES, GENERAL RULES AND REGULATIONS, AND RIDERS; (3) APPROVAL OF A FEDERAL MANDATE CERTIFICATE UNDER IND. CODE § 8-1-8.4-1; (4) APPROVAL OF REVISED ELECTRIC DEPRECIATION RATES APPLICABLE TO ITS ELECTRIC PLANT IN SERVICE; (5) APPROVAL OF NECESSARY AND APPROPRIATE ACCOUNTING DEFERRAL RELIEF; AND (6) APPROVAL OF A REVENUE DECOUPLING MECHANISM FOR CERTAIN CUSTOMER CLASSES	**CAUSE NO. 45253**

INDIANA OFFICE OF UTILITY CONSUMER COUNSELOR

TESTIMONY OF

LAUREN M. AGUILAR – PUBLIC'S EXHIBIT NO. 8

OCTOBER 30, 2019

Respectfully submitted,

Scott Franson
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Deputy Consumer Counselor

TESTIMONY OF OUCC WITNESS LAUREN M. AGUILAR
CAUSE NO. 45253
DUKE ENERGY INDIANA, LLC

I. INTRODUCTION

Q: Please state your name and business address.

A: My name is Lauren M. Aguilar, and my business address is 115 W. Washington St., Suite 1500 South, Indianapolis, IN, 46204.

Q: By whom are you employed and in what capacity?

A: I am employed as a Utility Analyst in the Electric Division for the Indiana Office of Utility Consumer Counselor ("OUCC"). Appendix A contains a summary of my qualifications.

Q: What is the purpose of your testimony in this proceeding?

A: I present my analysis of the following Duke Energy Indiana, LLC ("DEI" or "Petitioner") proposals:

(1) Electric Transportation ("ET") Pilot;

(2) Fee-free payment program; and

(3) Meter tampering penalties.

Ultimately, the OUCC recommends the Commission:

(1) Delay DEI's proposed ET Pilot and associated request to defer cost recovery, until a collaborative determines the optimal approach for the ET Pilot design that is best suited for Indiana;

(2) Deny DEI's request to include its proposed fee-free payment program costs in base rates; and

(3) Deny DEI's request for meter tampering penalties for residential customers and non-residential customers.

Q: What have you done to evaluate DEI's request in this Cause?

A: I reviewed testimony and exhibits submitted in DEI's case-in-chief regarding the proposals listed above. I generated discovery requests, reviewed responses, and participated in technical meetings with DEI staff. I reviewed prior relevant Indiana Utility Regulatory Commission ("Commission") orders, filings and orders from utility regulatory entities in other jurisdictions, and applicable Federal and Indiana laws. I reviewed current studies and information regarding electric vehicle deployment, user statistics, and Indiana's management of the Volkswagen mitigation trust fund ("VW Fund") through the Indiana Volkswagen Environmental Mitigation Trust Fund Committee ("VW Committee"). I attended all VW Committee meetings, either in person or via livestream.[1] Other materials I reviewed are included in my testimony as citations or attachments.

Q: To the extent you do not address a specific item or adjustment, does this mean you agree with those portions of Petitioner's proposal?

A: No. Excluding any specific adjustments or amounts DEI proposes does not indicate my approval of those adjustments or amounts. Rather, the scope of my testimony is limited to the specific items addressed herein.

[1] https://www.in.gov/idem/airquality/2712.htm.

Q: Please describer your attachments.

A: I sponsor the following attachments:

- Attachment LMA-1: discovery requests and responses
- Attachment LMA-2: Electric Vehicle Cost-Benefit Analysis- Plug-in Electric Vehicle Cost-Benefit Analysis: Minnesota, M.J. Bradley & Associates, July 2018.
- Attachment LMA-3: Electric Vehicle Cost-Benefit Analysis- Plug-in Electric Vehicle Cost-Benefit Analysis: Florida, M.J. Bradley & Associates, January 2019.
- Attachment LMA-4: State of North Carolina Utilities Commission, Docket E-2, Sub 1197, and E-7, Sub 1195, Public Staff's Comments, July 5, 2019.
- Attachment LMA-5: Electrify America, "National ZEV Investment Plan: Cycle 1, Public Version," April 9, 2017.
- Attachment LMA-6: Electrify America, "National ZEV Investment Plan: Cycle 2, Public Version," February 4, 2019.

II. ELECTRIC TRANSPORTATION PILOT PROGRAM

Q: Is the OUCC against the concept of expanding the use of electric vehicles?

A: Not at all. The OUCC is supportive of well-structured electric vehicle pilots that offer flexibility, reduce the subsidy from non-participants and collect data in a fair and meaningful way. The OUCC is aware of the momentum towards electrification, but each proposal needs to be examined for merit. The OUCC is open and supportive to changing technology and carbon reduction.

Q: Please summarize the six (6) programs DEI proposes as part of its ET Pilot.

A: DEI proposes:

(1) A Direct Current ("DC") Fast Charge Program where DEI proposes to construct, own, and operate public charging stations. DEI plans to monitor its rate charged to users and will adjust the rate to align with DEI's calculated state average.[2] Any adjustment beyond DEI's costs to construct, own, and operate will be passed on to ratepayers as a credit, but will not cover the entire cost of the project.[3] DEI is considering a submission to recover any eligible Fast Charging infrastructure costs.[4]

(2) A School Bus Rebate Program offered on a first-come-first-served basis, subsidizing the cost of electric buses.[5] DEI will retain ownership of the batteries for possible future repurposing.[6] DEI will encourage participants to leverage monies from the VW Fund to complement monies received through DEI's ET Pilot program.[7]

(3) An Electric Transit Bus Program where DEI will install DEI-owned "EV supply equipment, including charging stations" at no cost to customers who

[2] Petitioner's Exhibit 31, Direct Testimony of Lang W. Reynolds, page 4, lines 12 to 13, and page 4, line 21 to page 5, line 2.
[3] Reynolds Direct, page 5, lines 18 to 21.
[4] Reynolds Direct, page 21, lines 2 to 3.
[5] Reynolds Direct, page 8, lines 16 to 18, and page 19, lines 9 to 10.
[6] Reynolds Direct, page 9, lines 4 to 6.
[7] Reynolds Direct, page 20, lines 14 to 16. Attachment LMA-1, OUCC DR 7.2.

acquire new electric buses for transit.[8] Program participation is on a first-come-first-served basis.[9]

(4) A Residential Program for electric vehicle charging involving a rebate coupled with paid quarterly participation incentives.[10] Customers who install Level 2 charging equipment will receive a $500 rebate.[11] They will also receive $40 per quarter for allowing "utility management of home charging."[12] DEI proposes allowing residential electric vehicle users to charge at any time of day; however, during a "load control" event, DEI will notify an EV user during a specific time and ask them to reduce or stop charging for up to 30 minutes.[13] The customer may choose not to respond to a load control event.[14] DEI's events will adhere to its Residential Program specifications. This includes not paying the participants the quarterly benefit if they choose not to participate in a predetermined number of load control events.[15]

(5) A Commercial Program providing rebates for electric vehicle charging equipment, related infrastructure, and installation costs at commercial

[8] Reynolds Direct, page 10, lines 18 to 19, and line 22 to page 11, line 1.
[9] Reynolds Direct, page 11, lines 15 to 16.
[10] Reynolds Direct, page 13, lines 9 to 10, and lines 17 to 18.
[11] Reynolds Direct, page 13, lines 7 to 10.
[12] Reynolds Direct, page 13, lines 18 to 20.
[13] Reynolds Direct, page 14, lines 6 to 7.
[14] Reynolds Direct, page 14, line 8.
[15] Reynolds Direct, page 14, lines 3 to 10.

locations.[16] Commercial Program benefit distribution is on a first-come-first–served basis.[17]

(6) Education and Outreach.

Q: What cost recovery is DEI requesting for its proposed ET Pilot?

A: DEI is requesting $15,299,250 for the three-year ET Pilot program. DEI proposes to defer cost recovery up to a cap of $15.3 million, plus carrying costs. This amount is comprised of approximately $11.4 million in capital expenditures and approximately $3.9 million in operations and maintenance expenses, as shown below:[18]

- DC Fast Charge Program: $6,120,000
- Electric School Bus Program ($215,000 per bus, up to 20 buses) $4,335,000
- Electric Transit Bus Program w/ Charging Infrastructure: $1,184,000
- Residential EV Charging Rebate Program: $ 500,000
- Commercial EV Charging Rebate Program: $ 2,500,000
- Education and Outreach: $ 660,000

Q: Has DEI articulated any measurements of success in order to evaluate the ET Pilot?

A: No. DEI identified no measurements of success it will use to evaluate the ET Pilot upon completion. With no way to measure success, there is no way to determine if future investment should occur, thus negating the point of a pilot program.

[16] Reynolds Direct, page 16, lines 16 to 18.
[17] Reynolds Direct, page 17, lines 1 to 2.
[18] Reynolds Direct, page 19, lines 5 to 7 and Table 1 page 20.

Q: Is this rate case the appropriate forum to request approval of an ET Pilot?

A: No. When Indiana Michigan Power Company ("I&M") requested an electric vehicle ("EV") tariff in one of its previous rate cases, the Commission's Final Order stated in part:

> …we do not believe it is appropriate to grant Petitioner cost recovery for an electric vehicle program without that issue being fully explored through a separate proceeding, such as those we have conducted for other utilities with [plug-in electric vehicle] pilot programs. Therefore, we deny Petitioner's proposed tariff.[19]

Q: Is it appropriate to use ratepayer funds to redo studies already performed and gather information already publically available?

A: No. Pilots typically involve experimenting with new offerings on a limited time and limited capital investment basis. DEI's own submitted evidence establishes (1) what typical hours EV users tend to charge, (2) increasing load can add additional costs over time, especially when added during peak hours; and (3) customers can and will respond to utility signals if given the correct incentive. DEI provided a benefit/cost analysis that includes much of this information, which states:

> Some people charge at work early in the day, but most charge at home in the late afternoon and early evening.[20]
>
> ***
>
> [A]dditional costs […] would be incurred by utilities to secure additional generating capacity, and to upgrade distribution systems, to handle the incremental load from PEV charging.[21]
>
> ***

[19] Commission Cause No. 44075, Final Order, page 132, ordering paragraph 5, subsection (g), February 13, 2013.
[20] Petitioner's Exhibit 31-A (LWR), Electric Vehicle Cost-Benefit Analysis, page 13.
[21] Petitioner's Exhibit 31-A (LWR), page 6.

> Real world experience […] demonstrates that, without a 'nudge', drivers will generally plug in and start charging immediately upon arriving home after work, exacerbating system-wide evening peak demand. However, if given a 'nudge' - in the form of a properly designed and marketed financial incentive - many Indiana drivers will choose to delay the start of charging until later times, thus reducing the effect of plug-in electric vehicle charging on evening peak electricity demand.[22] [Footnote omitted]

Further, DEI's benefit/cost analysis is very similar to one performed by the same author for a Minnesota Utility[23] and Duke Energy Florida, LLC.[24] The OUCC is concerned with allowing DEI to spend ratepayer funds to redo studies and gather the same information readily available from other jurisdictions. The Public Staff of the North Carolina Utilities Commission share these concerns. Public Staff filed testimony on July 5, 2019, expressing in summary:

> [T]he Public Staff concludes that the Companies' overall proposal does not meet the parameters of a pilot in which the Companies would undertake a proof-of-concept through a scalable project. The Companies have failed to demonstrate that spending $76 million over a three-year period is necessary to learn more about serving current and future EV load. The Companies and their affiliates have conducted similar programs both in North Carolina and in other jurisdictions. The Companies have provided no evidence demonstrating that North Carolina customers are sufficiently unique to justify another pilot program or that the results of previous or ongoing pilot projects are insufficient to meet the Companies' needs. There is also a significant amount of industry-level data available to help inform the Companies' evaluation and design of EV programs. Finally, the proposal contains no metrics or other

[22] Petitioner's Exhibit 31-A, page 23 and page 24.
[23] Attachment LMA-2, Electric Vehicle Cost-Benefit Analysis- Plug-in Electric Vehicle Cost-Benefit Analysis: Minnesota, M.J. Bradley & Associates, July 2018.
[24] Attachment LMA-3, Electric Vehicle Cost-Benefit Analysis- Plug-in Electric Vehicle Cost-Benefit Analysis: Florida, M.J. Bradley & Associates, January 2019.

standards for evaluating whether the programs are successful and appropriate to expand and implement in the future.[25]

Q: Is the OUCC concerned DEI is not the appropriate entity to increase electric vehicles and related infrastructure deployment?

A: Yes. Utility encouraged deployment by closuring capital cost gap within the school bus market allowing electric school buses to compete with diesel buses is not appropriate. Rather, these actions are more the role of a government body, composed of elected individuals charged with representing the public at large. Other states have chosen to pursue increased electric vehicle usage through government actions. Some states have been successful with increasing electric vehicle usage by allowing high occupancy vehicle lane access or providing a reduction in tolls assessed on toll roads.[26] The state government of Massachusetts invested nearly $1.4 million in a pilot program to increase electric school bus deployment.[27] The City of Indianapolis used federal government grant money to invest in electric transit buses,[28] and increased tax assessments to fund electric transit buses and infrastructure.[29]

[25] Attachment LMA-4, State of North Carolina Utilities Commission, Dockets E-2, Sub 1197 and E-7, Sub 1195, Public Staff Comments, July 5, 2019, page 2-3.
[26] https://www.chargepoint.com/blog/quick-guide-ev-hov-lane-access-and-toll-reductions/.
[27] https://islandpumpandtank.com/cng/massachusetts-puts-1-4-million-into-electric-school-bus-pilot-program/.
[28] https://www.indygo.net/indygo-electric-buses-now-serving-passengers/.
[29] https://www.citylab.com/perspective/2019/08/indianapolis-electric-bus-rapid-transit-system-routes-brt/596470/.

Q: Are utilities the only market participants involved in public charging stations for electric vehicles?

A: No. Market participants in Indiana include Tesla, EVgo, Chargepoint, Blink, and SemaConnect.[30] Another market participant, Electrify America, as a subsidiary of Volkswagen Group, was created through the same settlement providing funds currently being distributed by the VW Committee in Indiana. Electrify America is specifically charged with investing in public charging infrastructure. Electrify America's investment will occur in cycles: "Charging stations will be located first in the areas with the highest anticipated ZEV demand; this is based on the forecast penetration rates of ZEVs in each region and the estimated gap between the supply and demand of charging infrastructure in those regions."[31] Electrify America's investment for Cycles 1 and 2 did not target Indiana for investment.[32]

The ability to leverage guaranteed ratepayer funding for electric vehicle projects must be approached with caution, as DEI and other regulated utilities will have a funding advantage over other market participants. In this context, without the involvement of statewide-minded stakeholders such as the Commission and the OUCC, it is difficult for DEI to consider the impacts it will have on other market

[30] https://www.google.com/search?rls=com.microsoft:en-US:IE-SearchBox&q=fast+charge+stations+indiana&npsic=0&rflfq=1&rlha=0&rllag=39808199,-86114031,12126&tbm=lcl&ved=2ahUKEwjaj_qWqo3lAhVLQ6wKHXc2CVQQjGp6BAgKEC4&tbs=lrf:!2m1!1e3!3sIAE,lf:1,lf_ui:3&rldoc=1#rlfi=hd:;si:;mv:[[40.4631095,-85.8759384],[39.585958,-86.867222]];tbs:lrf:!2m1!1e3!3sIAE,lf:1,lf_ui:3&spf=1570560594122.

[31] Attachment LMA-5, Electrify America, "National ZEV Investment Plan: Cycle 1, Public Version," page 4.

[32] Attachment LMA-5, Targeted Markets for electrify America cycle 1: New York City, Washington D.C., Chicago, Portland, Boston, Seattle, Philadelphia, Denver, Houston, Miami, and Raleigh. Electrify America, "National ZEV Investment Plan: Cycle 1, Public Version," page 20. Attachment LMA-6, Electrify America, "National ZEV Investment Plan: Cycle 2, Public Version," Table 6, page 37.

participants. In a perfect environment, a statewide task force would be implemented to study electric vehicles in Indiana. However, absent such a study, a collaborative approach is better than DEI alone making decisions without input from other stakeholders.

Q: Is electric vehicle demand and penetration in Indiana signaling investment must occur expeditiously?

A: No. Within Indiana, electric vehicles are still a very small minority. In 2018, electric vehicles' market share in Indiana was 0.82%.[33] A statistically significant market share is not predicted until 2040 and, even then, market forecasts vary in agreement.[34]

Q: Did DEI provide a benefit/cost analysis?

A: Yes. However, the benefit/cost analysis, Petitioner's Exhibit 31-A, purports to only support the residential portion of the pilot.

Q: Does DEI's benefit/cost analysis support its proposed residential program?

A: No, and the OUCC is concerned with the disconnect between DEI's proposed residential electric vehicle charging program and the program modeled in the benefit/cost analysis. DEI's benefit/cost analysis is premised on a residential program that assumes managed charging by shifting on peak charging to off peak charging. DEI's analysis states: "For this analysis, managed charging is modeled as 85% of PEV owners that arrive home between noon and 11 pm delaying the start of charging until between Midnight and 2 am."[35] DEI's proposed program, as

[33] https://evadoption.com/ev-market-share/ev-market-share-state/.
[34] https://qz.com/1620614/electric-car-forecasts-are-all-over-the-map/.
[35] Petitioner's Exhibit 31-A (LWR), page 4, footnote 6.

summarized above, does not shift charging to off-peak, rather, possibly prevents charging during one peak timeframe (up to 30 minutes). Without identifying a specific time for a customer to shift to (off-peak), a customer could shift their charging to another peak time, providing no benefit. Therefore, the benefit/cost analysis provided does not apply to DEI's proposed PEV program.

Q: Is it credible for DEI to assume there will be any additional net revenues from DC fast charging infrastructure passed to ratepayers as a credit?

A: No. DEI plans to run this pilot for three years and the breakeven point for the DC fast charging program is estimated by DEI to occur between years 10 to 12.[36] Any perceived credit to offset the costs of the pilot is too far off to be considered support for DEI's request.

Q: Is the OUCC concerned with DEI offering rebates to residential electric vehicle owners for Level 2 charging equipment?

A: Yes. New electric vehicles range in cost from $23, 900 for a range of 58 miles to $88,000 for a range of 370 miles.[37] The median new electric vehicle is still well over $39,000[38] and customers who can afford to pay this amount are unlikely influenced by a $500 rebate. The OUCC finds more value in time-of-use rates and on-peak load shifting than in rebates to customers likely able to afford the necessary charging equipment to properly integrate vehicle charging into the system for benefit all electric utility customers.

[36] Attachment LMA-1, OUCC DR 7.4 and Attachment 7.4A.
[37] https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/.
[38] Id.

Q: Is the OUCC concerned with DEI's proposed "load management events"?

A: Yes. Although experimental, the OUCC finds the concept of managed load events to be complicated, and unlikely to produce useful data. Customers must plan their charging 24 hours in advance of the load management event, be readily available to make a decision about opting out of the event, and must track how many events they opt out of in order to be eligible for the quarterly payment. Overly complicated programs are not useful in encouraging adoption of DEI's vehicle charging proposal.[39] In addition to the unnecessary complicated nature of the program, DEI has submitted unconvincing evidence to support it is reasonable and necessary for residential electric vehicle users to need an incentive, funded by all customer's rather participating or not, in order to participate in load management events. To establish a baseline, DEI is not planning to call events in the first year of the program. As discussed above, DEI is already aware of residential customers' "baseline" charging behavior. In addition, if there are no events and customers are behaving as "normal," it is not reasonable to pay participation payments.

Q: Please explain the OUCC's concern with offering rebates on a first–come, first-served basis.

A: DEI lists certain aspects about charging it hopes to learn with the electric school bus program, electric transit bus program, and the commercial electric vehicle rebate program.[40] DEI plans to evaluate the effects on its system based on region,

[39] https://www.utilitydive.com/news/keys-to-developing-an-effective-utility-ev-charging-program/446379/.
[40] *See* Reynolds Direct, page 7, line 7 to page 8, line 1 (DC Fast Charging); page 10, lines 8 to 15 (Electric School Bus); page 12, lines 15 to 30 (Electric Transit Bus); page 15, line 6 to page 16, line 1 (Residential); and. page 18, line 20 to page 19, line 6 (Commercial).

and offering these programs on a first–come, first-served basis does not guarantee DEI will receive this information. DEI should select a statistically significant amount of customers in representative regional areas in order to get the appropriate information.

Q: Please explain the OUCC's concerns with how DEI plans to integrate other funding sources into its programs.

A: Concentrating numerous funding awards to a small amount of participants limits the number of participants and limits the amount of data. DEI assisting parties who have already received funds from other programs, such as the VW Fund, may increase the amount of buses or infrastructure that particular customers can acquire, but may prohibit other customers from participating.

Q: Does the OUCC have any topics it recommends the collaborative explore?

A: Yes. Members of an ET Pilot collaborative could determine:

(1) PEV deployment aspects needing experiment and study (and are not readily available through other means).

(2) Measurements of success for the pilot.

(3) Whether residential customer rebates are needed to encourage participation.

(4) If it is reasonable for DEI to pay quarterly incentives to residential customer participants.

(5) If DEI's proposed load events are too complicated.

(6) Whether it is reasonable to offer the commercial rebate, electric transit rebate, and the electric school bus rebate on a first–come, first-served basis.

(7) Whether it is reasonable to provide rebates to customers who are already receiving funds from other sources.

(8) The appropriate amounts and types of rebates DEI should offer.

(9) If DEI participates in the DC fast-charging market, what would be the effects on other market participants?

Q: Does the OUCC have initial opinions on the topics identified above?

A: Yes. For the Residential Program, do not run a baseline, as this is known. Instead, offer a hybrid approach with off-peak rates and load management events to experiment with customer's willingness to respond and eliminate participation payments. This approach would ensure the benefits of downward rate pressure; the electric vehicle owner receives a reduced rate to charge, subsidization from nonparticipating ratepayers is reduced, and DEI is allowed to experiment with load management events.

Regarding offering rebates for electric school buses, electric bus transit infrastructure, and commercial rebates on a first come first served basis, Predetermined categories must be established, where at least one participating customer is needed and ensure those categories are populated. At least one participating customer from suburban, urban, and rural area must be selected. Rebates should not be offered to customers who have already received funding from another source. Specifically for electric school buses, rebates should be targeted to districts who would not otherwise be able to afford an electric school bus. A specific indicator of this could be school districts with the majority of

students on government sponsored free and reduced lunch. Specifically with electric transit bus infrastructure, rebates should be offered to customers in areas where transit infrastructure is not well developed.

For DC fast-charging, DEI should employ a mixture of DEI owned equipment with a site host or third party owned and operated charging stations. In order to participate the third party would need to provide assurances they will share data with DEI, the Commission, and the OUCC. Further, participants must provide assurances that stations will not be allowed to fall in disrepair for at least the duration of the pilot.

Q: Would delaying deployment of the ET Pilot to allow for collaboration amongst interested stakeholders, including the OUCC, harm DEI?

A: No. Time is not of the essence. As described above, Indiana currently has a small market share. In addition, market forecasts and predictions do not indicate it is time sensitive to deploy electric vehicle infrastructure in the near term. Nevertheless, the OUCC is open and excited to explore the development of Indiana electric vehicle deployment in a comprehensive, flexible, and fair manner to meet the needs of ratepayers (participants and non-participants), citizens, and Duke. While pilot programs' designs should be experimental in nature, there is also a need to exercise caution and minimize the risk of abandoned investments. DEI states the break-even point for the fast charging stations is between 10 and 12 years.[41] DEI chose not to undertake owning these chargers through an unregulated affiliate, signaling the

[41] Attachment LMA-1, OUCC DR. 7.4(c).

time of return on investment is too risky. VW fund disbursements are governed separately, will happen regardless of DEI's start date of a pilot, and should not be used as a demonstration that time is of the essence.

Q: What does the OUCC recommend regarding DEI's proposed ET Pilot in this Cause?

A: The OUCC recommends the Commission require DEI to take a collaborative approach to develop an ET Pilot and engage interested stakeholders. At a minimum, participants should include the OUCC and Commission staff. Further, the Commission should delay DEI's proposed ET Pilot until the conclusion of a collaborative, at which time DEI can seek recovery in a separate proceeding.

III. FEE-FREE PAYMENT PROGRAM

Q: What is DEI requesting in its fee-free payment program?

A: Currently, DEI's customers pay a $1.50 fee directly to a third party company, Speedpay, for using credit cards, debit cards, and electronic checks to pay their electric bills.[42] With the fee-free payment program, DEI proposes to eliminate the direct charge to customers who pay their bills with credit cards, debit cards, or electronic checks and instead include an amount in rates all customers pay regardless of the means of payment. DEI is seeking to include $4,528,000 in rates for credit card payment fees.[43] DEI sets forth the $4,528,000 is composed of current credit card usage plus 34% multiplied by $1.50 per transaction owed to Speedpay.[44]

[42] Petitioner's Exhibit 29, Direct Testimony of Lesley Quick page 13, lines 17 to 19.
[43] Quick Direct page 18, line 3.
[44] Quick Direct, page 18, lines 1-5.

Q: DEI claims there will be savings from the fee-free payment program. Does DEI quantify these savings?

A: No. DEI has no idea how much money offering this program will save all residential customers who are ultimately responsible for paying for the program. In response to OUCC discovery, DEI refers to any customer savings as "quantifiably immaterial."[45]

Q: DEI mentions I&M's similar fee-free program as support for its proposal. Do you agree?

A: No. The Commission approved I&M's similar program in Cause No. 44967 as part of a settlement agreement. DEI does not reference evidence I&M provided to support its proposal. Additionally, the OUCC took no position on the issue in Cause No. 44967[46] and, since it is part of a settlement, it is not precedential and does not provide support for DEI's proposed program.

Q: What does the OUCC conclude and recommend regarding DEI's proposed fee-free payment program?

A: Not all of DEI's residential customers should be required to pay for benefits used by a subset of customers. The OUCC recommends denying DEI's proposal to recover credit card fees through inclusion of $4,528,000[47] in base rates.

Q: Does this recommendation mean the OUCC does not support fee-free payment programs?

A: No. DEI is free to offer this option; however, it should not be permitted to place these projected costs into base rates. Any savings DEI has yet to quantify can cover the costs of the program.

[45] Attachment LMA-1, OUCC DR 18.1(d).
[46] The OUCC not addressing a specific item or adjustment in Cause No. 44967 does not mean it is in agreement with those portions of I&M's proposal.
[47] Petitioner's Exhibit 6, Direct Testimony of Christa L. Graft page 11, lines 20-21, Schedule OM20.

IV. METER TAMPERING PENALTIES

Q: Please summarize DEI's proposal regarding meter tampering penalties.

A: DEI is proposing to impose a penalty for tampering with metering equipment. The proposed penalty is $200 for residential customers and $1,000 for non-residential customers.[48]

Q: Is DEI proposing the penalty in order to cover DEI's costs of dealing with meter tampering?

A: No. DEI witness Ms. Lesly Quick states: "The cost of implementation of the additional fee is negligible, as the Company's existing labor, legal, and regulatory personnel would implement the program.[49] Ms. Quick also states: "When a customer tampers with Company equipment, the customer is responsible for previous usage, field personnel investigation charge, and equipment damage. However, there presently is not a *penalty* or fee to *deter customers from doing it again*."[50] (Emphasis Added). DEI proposes penalties it collects be used as revenue, and has identified $194,400 as the amount it expects to collect. [51] Petitioner adds this amount to its Exhibit 9-C (RAF) Schedule REV 7, which shows $662,000 as the pro forma adjustment to revenue and includes seven different adjustments.

[48] Quick, page 22, lines 7 to 9.
[49] Quick, page 22, lines 12 to 13.
[50] Quick, page 22, lines 2 to 5.
[51] Quick, page 23, lines 3 to 6.

Q: Does DEI have many repeat tampering offenders?

A: DEI does not presently know how many repeat meter tampering offenders it has.[52] The OUCC has serious concerns with instituting a penalty for a problem that DEI is not sure it has.

Q: Should DEI discover it has a problem with repeat offenders, is the OUCC convinced a penalty will deter them?

A: No. DEI provides no evidence to suggest assessing a penalty would deter repeat offenders and, as explained above, cannot prove repeat offenders are currently an issue.[53]

Q: Is tampering with meters against the law?

A: Yes. Meter tampering is theft, a class D felony per Ind. Code § 35-43-4-2.

Q: Has DEI pursued prosecution of recent meter tampering occurrences?

A: No.[54] DEI did not seek prosecution of any of the 892 cases of residential tampering, and 16 instances of non-residential tampering that occurred in 2018.[55]

Q: What does the OUCC conclude and recommend regarding tampering penalties?

A: DEI is already made whole if a customer tampers with equipment. DEI charges the responsible customer for previous usage, a field personnel investigation, and equipment damage.[56] Meter tampering is against the law and pursuit of criminal prosecution should occur as a means of deterring repeat offenders. The OUCC recommends denying DEI's proposed meter tampering penalties in any amount and

[52] Attachment LMA-1, OUCC DR 18.7.
[53] Attachment LMA-1, OUCC DR 28.3.
[54] Attachment LMA-1, OUCC DR 18.9.
[55] *Id.*
[56] Quick Direct, page 22, lines 2 to 5. Attachment LMA-1, OUCC DR 18.7.

removing DEI's $194,000 revenue adjustment found in Petitioner's Exhibit 9-C (RAF) Schedule REV 7.

V. RECOMMENDATIONS

Q: What does the OUCC recommend?

A: The OUCC recommends the Commission:

(1) Delay approval of DEI's proposed ET Pilot and associated request to defer cost recovery in the amount of $15,299,250, plus carrying charges, until a collaborative determines the optimal approach for the ET Pilot design that is best suited for Indiana;

(2) Deny DEI's request to include $4,528,000 in base rates for its proposed fee-free payment program; and

(3) Deny DEI's request for metering tampering penalties of $200 for residential customers and $1,000 for non-residential customers, and the $194,000 resulting pro forma adjustment to revenue.

Q: Does this conclude your testimony?

A. Yes.

APPENDIX A

Q: Summarize your professional background and experience.

A: I graduated from Michigan State University in 2008 with a Bachelor of Science degree in Environmental Science and Management. I graduated from Florida State University College of Law in May 2011 with a Juris Doctorate and Environmental Law certificate. I spent over two years while in law school as a certified legal intern, providing pro bono legal services to poverty level residents of Tallahassee, FL. I worked in the legal department of Depuy Synthes, a Johnson & Johnson Company, where I assisted with patent filings and nondisclosure agreements. Starting in 2013, I worked for the Indiana Department of Environmental Management as a rule writer, in which I worked extensively with the public at large, special interests groups, and affected regulated entities to understand the rulemaking process and to respond to their comments on ongoing environmental rules. I joined the OUCC in July of 2017.

Q: Describe some of your duties at the OUCC.

A: I review and analyze utilities' requests and file recommendations on behalf of consumers in utility proceedings. As applicable, my duties may also include analyzing state and federal regulations, evaluating rate design and tariffs, examining books and records, inspecting facilities, and preparing various studies. The majority of my expertise is in environmental science, environmental state and federal regulation, and state agency administration.

Q: Have you testified before the Commission?

A: Yes.

OUCC
IURC Cause No. 45253
Data Request Set No. 7
Received: August 23, 2019

OUCC 7.2

Request:

In reference to Petitioner's Exhibit 31, the Verified Direct Testimony of Lang W. Reynolds, on page 8, line 16, Mr. Reynolds states: "Duke Energy Indiana is proposing to fund up to $215,000 per bus, for procurement, delivery, and installation of EV School Buses and associated EV Supply Equipment."

a. Please explain how Duke Energy Indiana LLC ("DEI") determined that $215,000 per bus would be the appropriate amount of funding? Provide any documentation and analysis used to support your answer.

b. Please explain how DEI determined that funding $215,000 per bus would be an essential component of its proposed pilot program. Provide any documentation and analysis used to support your answer.

Response:

a. The $215,000 per bus is split into two portions. Up to $15,000 will be used to install charging infrastructure on the customer's property including the charging station. This amount is made up of traditional Duke Energy distribution work, electrical contractor (hired by Duke Energy) work from the customer's load center to the final charging station, and the actual school bus charging station.

The remaining funding ($200,000 maximum) is budgeted to offset the cost of the bus itself. New all-electric school buses are quoted in the $350,000 to $450,000 range. The proposed amount of funding was designed to eliminate the capital cost gap between a conventional diesel bus and an electric school bus. Due to the emerging nature of the market, this value has been difficult to pinpoint precisely and pricing from manufacturers has not been approaching a single average value.

The ultimate goal of this funding level is to ensure that deployment of electric school buses is possible. Based on discussions with customers and suppliers, the current gap between previously budgeted municipal funding and bus pricing is too high a hurdle for projects to occur. Therefore, a three-part structure is proposed pursuant to this Pilot: (1.) Duke Energy Indiana Electric Transportation Pilot investment of $200,000; (2.) School Corporation funding a similar amount to the cost of a new diesel school bus of (~ $100,000); and (3.) Indiana Volkswagen Mitigation Settlement Funding to cover the remaining amount.

b. See Duke Energy Indiana's response to subpart a.

Witness: Lang W. Reynolds

OUCC
IURC Cause No. 45253
Data Request Set No. 7
Received: August 23, 2019

OUCC 7.4

Request:

In reference to Petitioner's Exhibit 31, the Verified Direct Testimony of Lang W. Reynolds, on page 5, beginning on line 18, Mr. Reynolds states: "Any additional net revenue, over the cost of providing energy, from the Fast Charging Program will be applied as an offset to the cost of the program, but is not anticipated to recover the full cost of the charging infrastructure within the term of the Pilot."

a. Please provide any forecasts DEI has of the total expected "additional net revenue, over the cost of providing energy, from the Fast Charging Program".

b. What does DEI consider to be the total "cost of the Fast Charging Program"? Please provide the total program cost and an itemized breakdown of that total.

c. What is DEI's estimated break-even point (*i.e.*, how long will it take before the total "additional net revenue, over the cost of providing energy" covers the full cost of DEI's proposed Fast Charging Program?

Response:

a. Please see Attachment OUCC 7.4-A.

b. Please reference Table 1 found in the Direct Testimony of Lang W. Reynolds, Petitioner's Exhibit 31, on page 20, beginning on line 1. Duke Energy Indiana considers the total cost of the Fast Charging Program to be $6 million capital plus an additional $30,000 in O&M annually for a pilot total of $6.12 million.

c. Please see Attachment OUCC 7.4-A. The estimated break-even point is between years 10-12.

Witness: Lang W. Reynolds

Estimated Net Revenue from DC Fast Charging

Summary	DCFC #	3 Yr Total	10 Yr Total
DEI Net Revenue	60	$ 41,087	$ 2,579,567
DEI MWh Consumed		2,628	24,568

Assumptions and Inputs (in Green)	
Utilization = 3% to 5% in years 1-3, 22% increase YOY through year 12	
Hours/Yr available	8760
Rate Escalator	3.00%
Avg Session Time (hrs)	0.5
Avg Demand (kW)	50
Avg Session Energy (kWh)	25.0

Year		1	2	3	4	5	6	7	8	9	10
Utilization	Inputs	2.0%	3.0%	5.0%	6.1%	7.4%	9.1%	11.0%	13.5%	16.4%	20.0%
Hours/Yr/Unit		175.2	262.8	438.0	533.9	650.9	793.4	967.1	1178.9	1437.1	1751.9
Avg kWh/Yr/Unit		8,760	13,140	21,900	26,696	32,543	39,669	48,357	58,947	71,857	87,593
Total kWh/Yr for 60 units		525,600	788,400	1,314,000	1,601,766	1,952,553	2,380,162	2,901,417	3,536,828	4,311,393	5,255,588
Avg kWh/Mo per meter (2 units)		1,460	2,190	3,650	4,449	5,424	6,612	8,059	9,825	11,976	14,599
Fast Charge Fee ($/kWh)		$ 0.212	$ 0.219	$ 0.225	$ 0.232	$ 0.239	$ 0.246	$ 0.254	$ 0.261	$ 0.269	$ 0.277
Est O&M $/yr for 60 units		$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
Est O&M $/kWh		$ 0.06	$ 0.04	$ 0.02	$ 0.02	$ 0.02	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01
Operating Cost ($/kWh)		$ 0.25	$ 0.22	$ 0.18	$ 0.17	$ 0.16	$ 0.15	$ 0.15	$ 0.14	$ 0.14	$ 0.13
Charging Revenue per year per unit		$ 1,860	$ 2,874	$ 4,933	$ 6,194	$ 7,777	$ 9,764	$ 12,260	$ 15,393	$ 19,327	$ 24,267
Operating Costs ($/Yr)		$ 2,172	$ 2,854	$ 3,956	$ 4,520	$ 5,208	$ 6,046	$ 7,068	$ 8,314	$ 9,833	$ 11,684
Net Revenue Per Charger $/Yr		$ (312)	$ 19	$ 977	$ 1,674	$ 2,569	$ 3,718	$ 5,192	$ 7,079	$ 9,494	$ 12,582
Total DCFC Net Revenue		**$ (18,718)**	**$ 1,164**	**$ 58,641**	**$ 100,432**	**$ 154,142**	**$ 223,087**	**$ 311,493**	**$ 424,735**	**$ 569,652**	**$ 754,938**

Estimated DCFC Operating Cost

Proposed 2019 Secondary Rate LLF	
LLF connection charge	$ 22.83000
first 300 kwh	$ 0.205328
Next 700 kwh	$ 0.165102
next 1500 kwh	$ 0.148783
Over 2500 kWh	$ 0.110648
Load Factor Provision if hours use over 110	$ 0.098225
Load Factor Provision if hours use over 300	$ 0.089103
Estimated Riders	$ 0.007000

Year	1	2	3	4	5	6	7	8	9	10
kWh/Mo	1460	2190	3650	4449	5424	6612	8059	9825	11976	14599
block	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83	$ 22.83
300	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60	$ 61.60
700	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57	$ 115.57
1500	$ 68.44	$ 177.05	$ 223.17	$ 223.17	$ 223.17	$ 223.17	$ 223.17	$ 223.17	$ 223.17	$ 223.17
2500	$ -	$ -	$ 127.25	$ 215.69	$ 323.51	$ 454.94	$ 615.15	$ 810.44	$ 1,048.51	$ 1,338.71
Note: Load Factor Provisions are excluded as the maximum total average peak (100kW) per meter will not exceed 190hrs per month until utilization rates are around 25% (beyond year 10)										
Rider total	$ 10.22	$ 15.33	$ 25.55	$ 31.15	$ 37.97	$ 46.28	$ 56.42	$ 68.77	$ 83.83	$ 102.19
Total	$ 278.66	$ 392.38	$ 575.97	$ 670.01	$ 784.65	$ 924.39	$ 1,094.74	$ 1,302.39	$ 1,555.52	$ 1,864.08
$/kWh	**$ 0.19**	**$ 0.18**	**$ 0.16**	**$ 0.15**	**$ 0.14**	**$ 0.14**	**$ 0.14**	**$ 0.13**	**$ 0.13**	**$ 0.13**

Note: Rate LLF values taken from Petitioner's Exhibit 9-A, Duke Energy Indiana 2019 Base Rate Case

OUCC
IURC Cause No. 45253
Data Request Set No. 18
Received: September 5, 2019

OUCC 18.1

Request:

In reference to Petitioner's Exhibit 29, the Verified Direct Testimony of Leslie G. Quick at page 17, lines 18 to 20, Ms. Quick states, in part: "Giving customers options to pay by the method of their choice without incurring additional fees will lead to more satisfied customers and, ultimately, customer savings."

a. Please explain what DEI means by "customer savings".

b. Please quantify DEI's expected "customer savings" if the Commission approves its proposed elimination of itemized fees for credit card payments.

c. Please provide copies of all documents and spreadsheets supporting your quantification of the above "customer savings".

d. Is DEI proposing a downward adjustment to its base rates to reflect these anticipated "customer savings"? If not, why not? Please explain the reasons behind your response.

Objection:

Duke Energy Indiana objects to this request to the extent it seeks a calculation or compilation that has not already been performed and that Duke Energy Indiana objects to performing.

Response:

Subject to and without waiving or limiting its objections, and in the spirit of cooperation, Duke Energy Indiana responds as follows:

a. Generally, customers who self-serve, pay on time, and are satisfied with the options available to them are the least expensive to serve, which is a benefit to all customers. Customers who do not pay on time and enter the credit collections cycle drive increased costs, which are ultimately paid for by all customers. Lastly, customers who are not satisfied tend to call Customer Service more frequently. Every call that comes into the call center costs money that is included in the cost of service.

b. See objection.

c. See objection.

d. See objection. Duke Energy Indiana is currently unable to quantify with specificity these savings until after program implementation. Any downward adjustment to its base rates to reflect customer savings, which would most likely be quantifiably immaterial, following program implementation would be reflected in future base rate cases.

Witness: Lesley G. Quick

OUCC
IURC Cause No. 45253
Data Request Set No. 18
Received: September 5, 2019

OUCC 18.7

Request:

Ms. Quick states at page 22, lines 2 to 5: "When a customer tampers with Company equipment, the customer is responsible for previous usage, field personnel investigation charge, and equipment damage. However, there presently is not a penalty or fee to deter customers from doing it again."

a. Please provide 10 or more examples of what DEI customers have been required to pay for "previous usage, field personnel investigation charge, and equipment damage", indicating the amount associated with each category.

b. Please provide copies of all documentation supporting the proposition that a penalty or fee would deter a customer from "doing it again".

Objection:

Duke Energy Indiana objects to this request to the extent it seeks a calculation or compilation that has not already been performed and that Duke Energy Indiana objects to performing. Duke Energy Indiana further objects to this request to the extent requests confidential customer information.

Response:

Subject to and without waiving or limiting its objections, and in the spirit of cooperation, Duke Energy Indiana responds as follows:

a. Please see Attachment OUCC 18.7-A.

b. Duke Energy Indiana does not possess such specific documentation.

Witness: Lesley G. Quick

OUCC
IURC Cause No. 45253
Data Request Set No. 28
Received: September 23, 2019

OUCC 28.3

Request:

As a follow up to OUCC DR 18.9, how many of those tampering cases were repeat offenders?

Objection:

Duke Energy Indiana objects to this request to the extent it seeks a calculation or compilation that has not already been performed and that Duke Energy Indiana objects to performing.

Response:

See objection.

Witness: Lesley Quick

OUCC
IURC Cause No. 45253
Data Request Set No. 18
Received: September 5, 2019

OUCC 18.9

Request:

Ms. Quick states at page 22, lines 19 to 20: "In 2018, there were 892 cases of residential tampering, and 16 instances of nonresidential tampering." How many of those tampering cases were prosecuted? Please provide copies of all supporting documentation.

Response:

None.

Witness: Lesley G. Quick

Electric Vehicle Cost-Benefit Analysis

Plug-in Electric Vehicle Cost-Benefit Analysis: Minnesota

MJB&A

July 2018

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About M.J. Bradley & Associates

M.J. Bradley & Associates, LLC (MJB&A), founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies.

Our multi-national client base includes electric and natural gas utilities, major transportation fleet operators, clean technology firms, environmental groups and government agencies.

We bring insights to executives, operating managers, and advocates. We help you find opportunity in environmental markets, anticipate and respond smartly to changes in administrative law and policy at federal and state levels. We emphasize both vision and implementation and offer timely access to information along with ideas for using it to the best advantage.

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Executive Summary

This study estimated the costs and benefits of increased penetration of plug-in electric vehicles (PEV) in the state of Minnesota, for two different penetration levels between 2030 and 2050.[1] The "Moderate PEV" scenario is based upon near-term (2025) Zero Emission Vehicle goals adopted by states that together comprise about a third of the automotive market.[2] The "High PEV" scenario is based on the PEV penetration that would be required to achieve Minnesota's long-term goals for economy wide greenhouse gas (GHG) reduction of 80 percent below 2005 levels by 2050.

This study focused on passenger vehicles and trucks; there are additional opportunities for electrification of non-road equipment and medium- and heavy-duty trucks and buses, but evaluation of these applications was beyond the scope of this study.

The study estimated the benefits that would accrue to all electric utility customers in Minnesota due to increased utility revenues from PEV charging. This revenue could be used to support operation and maintenance of the electrical grid, thus reducing the need for future electricity rate increases. These benefits were estimated for a baseline scenario in which Minnesota drivers plug in and start to charge their vehicles as soon as they arrive at home or work. The study also evaluated the additional benefits that could be achieved by providing Minnesota drivers with price signals or incentives to delay the start of PEV charging until after the daily peak in electricity demand (managed off-peak charging).

Increased peak hour load increases a utility's cost of providing electricity and may result in the need to upgrade distribution infrastructure. As such, managed off-peak PEV charging can provide net benefits to all utility customers by shifting PEV charging to hours when the grid is underutilized, and the cost of electricity is lower.

See Figure 1 for a summary of how the projected utility net revenue from PEV charging might affect average residential electricity bills for all Minnesota electric utility customers.[3] As shown in the figure, under the High PEV scenario with managed off-peak charging the average Minnesota household could realize approximately $171 in annual utility bill savings in 2050 (nominal dollars).

In addition, the study estimated the annual financial benefits to Minnesota drivers – from fuel and maintenance cost savings compared to owning gasoline vehicles, and societal benefits that would result from reduced greenhouse gas (GHG) and nitrogen oxide (NOx) emissions due to vehicle electrification.

As shown in Figure 2 (Moderate PEV scenario), if Minnesota meets short term (2025) goals for PEV penetration, and the increase in percent PEV penetration then continues at the same annual rate in later years, the net present value of **cumulative net benefits from greater PEV use in Minnesota will exceed $4.6 billion state-wide by 2050**.[4] Of these total net benefits:

- At least $0.6 billion will accrue to electric utility customers in the form of reduced electric bills[5],
- $2.0 billion will accrue directly to Minnesota drivers in the form of reduced annual vehicle operating costs

[1] PEVs include battery-electric vehicles (BEV) and plug-in hybrid vehicles (PHEV).

[2] In 2013, six Northeast/Mid-Atlantic states (MD, MA, NY, CT, RI, VT) and two Pacific coast states (CA, OR) joined in a Zero Emission Vehicle Memorandum of Understanding to enact policies that will ensure the deployment of 3.3 million ZEVs by 2025. Minnesota is not a signatory of the MOU but has enacted policies found in the other states, such as state fleet procurement requirements, designed to accelerate EV sales.

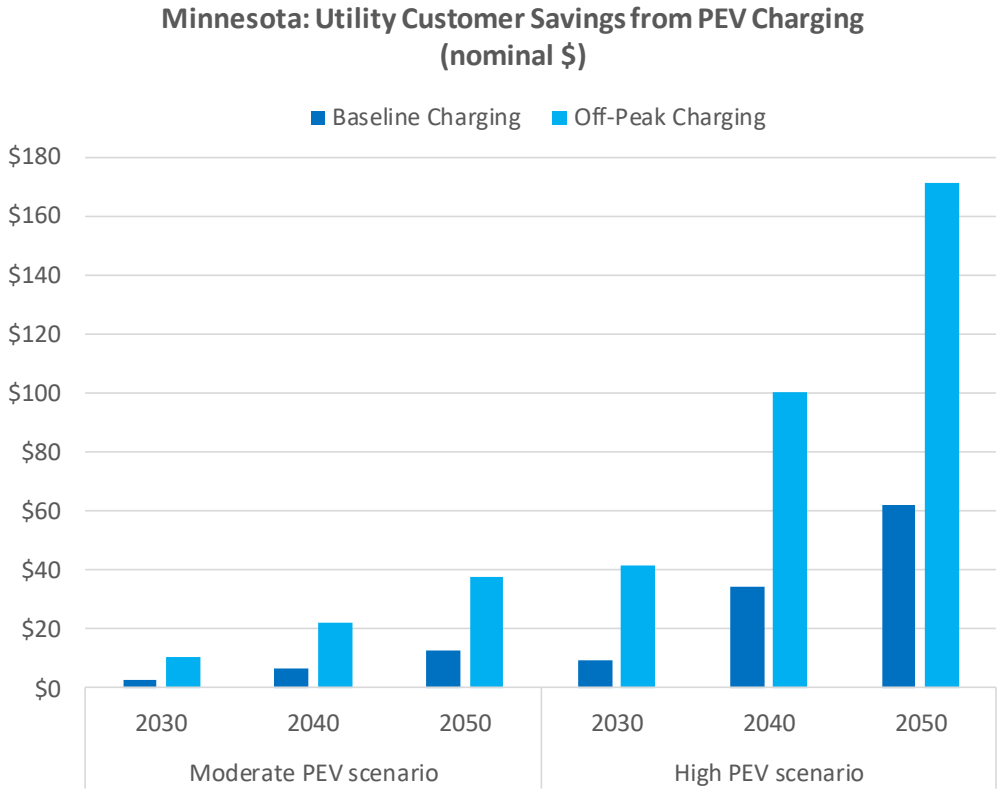
[3] Based on 2015 average electricity use of 8,792 kWh per housing unit in Minnesota.

[4] Using a 3 percent discount rate

[5] Figure 2 includes utility customer savings under the baseline charging scenario; savings would be higher under the managed off-peak charging scenario.

- $1.8 billion will accrue to society at large, as the value of reduced GHG emissions, and
- $0.15 billion will accrue to society at large, as the value of reduced NOx emissions.

Figure 1 Potential Effect of PEV Charging Net Revenue on Utility Customer Bills (nominal $)



As shown in Figure 3 (High PEV scenario), if the state meets long-term goals to reduce light-duty fleet and economy-wide GHG emissions by 80 percent from 2005 levels by 2050, which requires even greater PEV penetration, the net present value of **cumulative net benefits from greater PEV use in Minnesota could exceed $30 billion state-wide by 2050**. Of these total net benefits:

- $10.2 billion will accrue to electric utility customers in the form of reduced electric bills
- Up to $9.0 billion will accrue directly to Minnesota drivers in the form of reduced annual vehicle operating costs[6]
- $10.4 billion will accrue to society at large, as the value of reduced GHG emissions, and
- $0.7 billion will accrue to society at large, as the value of reduced NOx emissions

[6] Figure 3 includes utility customer savings under the managed off-peak charging scenario; savings would be lower under the baseline charging scenario.

Figure 2 *NPV Cumulative Societal Net Benefits from MN PEVs – Moderate PEV scenario*

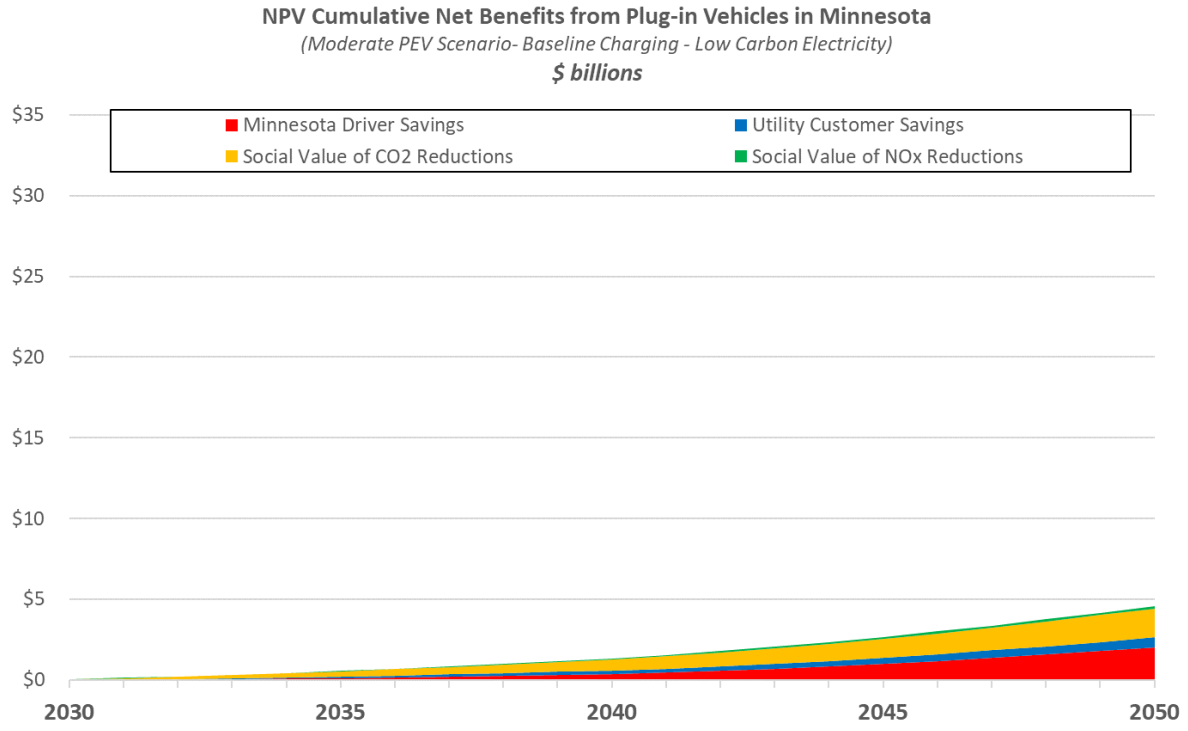
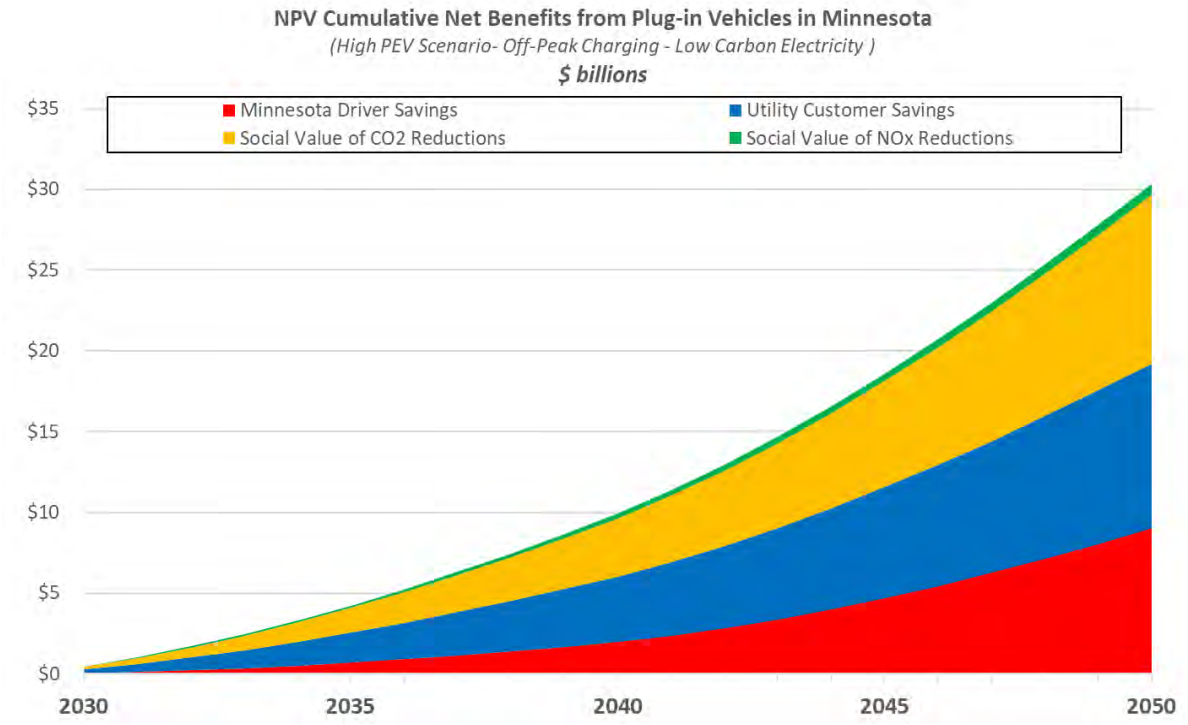


Figure 3 *NPV Cumulative Societal Net Benefits from MN PEVs – High PEV scenario*



By 2050, PEV owners are projected to save nearly $550 per vehicle (nominal $) in annual operating costs, compared to owning gasoline vehicles. A large portion of this direct financial benefit to Minnesota drivers derives from reduced gasoline use—from purchase of lower cost, regionally produced electricity instead of gasoline imported to the state. Under the Moderate PEV scenario, PEVs will reduce cumulative gasoline use in the state by more than 1.8 billion gallons through 2050 – this cumulative gasoline savings grows to 10.6 billion gallons through 2050 under the High PEV scenario. In 2050, annual average gasoline savings will be approximately 94 gallons per PEV under the Moderate PEV scenario, while projected savings under the High PEV scenario are 136 gallons per PEV.

This projected gasoline savings will help to promote energy security and independence and will keep more of vehicle owners' money in the local economy, thus generating even greater economic impact. Studies in other states have shown that the switch to PEVs can generate up to $570,000 in additional economic impact for every million dollars of direct savings, resulting in up to 25 additional jobs in the local economy for every 1,000 PEVs in the fleet [1].

In addition, this reduction in gasoline use will reduce cumulative net GHG emissions by nearly 19 million metric tons through 2050 under the Moderate PEV scenario, and over 110 million metric tons under the High PEV scenario.[7] The switch from gasoline vehicles to PEVs is also projected to reduce annual NOx emissions in the state by over 825 tons in 2050 under the Moderate PEV scenario, and by over 4,000 tons under the High PEV scenario.

[7] Net of emissions from electricity generation

Background - Minnesota

In December 2006, Minnesota Governor Tim Pawlenty unveiled his strategy to reduce Minnesota's emissions of greenhouse gases (GHG). As part of the initiative, the Governor tasked the Center for Climate Strategies with developing Minnesota's Climate Mitigation Action Plan and formation of the Minnesota Climate Change Advisory Group. The Action Plan contained strategy and policy recommendations for reducing emissions from the different sectors of Minnesota's economy. [2]

In May 2007, Gov. Pawlenty signed Minnesota's Next Generation Energy Act, which set out a plan to protect the state against climate impacts, including goals to reduce GHG emissions. The plan included the most aggressive renewable energy standard to date, requiring Minnesota's electric utilities to provide 25 percent renewable electricity by 2025. In addition, the bill established aggressive state-wide GHG reduction goals across all sectors; these targets are a reduction in GHG emissions of at least 15 percent below 2005 levels by 2015; 30 percent by 2025 and 80 percent by 2050. [3]

The electricity sector accomplished the state's first GHG reduction milestone (15 percent by 2015) and the sector is currently on pace to dramatically exceed the next milestone (30 percent by 2025). [4] In addition, there have been a number of clean energy commitments from utilities:

- Xcel Energy, which accounts for nearly half of the electricity sales in the state, projects its energy mix will be 76 percent carbon free by 2022 (a 50 percent GHG emissions reduction over 2005 levels), and it aims to get to 85 percent carbon free energy by 2030;
- Great River Energy has already reduced GHG emissions by 35 percent (relative to 2005 levels), and the Company has publicly committed to get 50 percent of its energy from renewables by 2030
- Minnesota Power projects its energy mix will be 44 percent renewable by 2025, which would reduce GHG emissions by roughly 45 percent below its 2005 level.
- Otter Tail Power's projected energy mix for 2021 is 31 percent renewable, which would exceed its 2025 Renewable Energy Standard requirement, and would be a GHG reduction of about 30 percent relative to 2005.

To further their commitment to clean energy and technology, Minnesota put forth a statute that requires electric utilities to create an EV-specific tariff that offers discounted off-peak EV charging to its customers. [5] Another state statute, tailored to state agencies, requires that, "the commissioner or the agency shall purchase a motor vehicle that is capable of being powered by cleaner fuels, or a motor vehicle powered by electricity or by a combination of electricity and liquid fuel, if the total life-cycle cost of ownership is less than or comparable to that of other vehicles and if the vehicle is capable of carrying out the purpose for which it is purchased."[6]

Dakota Electric, along with offering EV-specific charging rates, provides a rebate of up to $500 to cover the cost of installing a charger on their EV charging rate plans. [7]

As of January 2018, there were approximately 6,300 PEVs (including battery-electric and plug-in hybrid vehicles) registered in Minnesota and they comprised about 0.08 percent of the 5.1 million cars and light trucks registered in the State. In 2014 and 2015, sales of new PEVs in the state were less than one half of one percent of new vehicle sales. [8]

Study Methodology

This section briefly describes the methodology used for this study. For more information on how this study was conducted, including a general discussion of the assumptions used and their sources, see the report: *Mid-Atlantic and Northeast Plug-in Electric Vehicle Cost-Benefit Analysis, Methodology & Assumptions* (October 2016).[8] This report can be found at:

http://mjbradley.com/sites/default/files/NE_PEV_CB_Analysis_Methodology.pdf

This study evaluated the costs and benefits of two different levels of PEV penetration in Minnesota between 2030 and 2050. These PEV penetration scenarios bracket short and long-term policy goals for ZEV adoption and GHG reduction which have been adopted by other states, and localities.[9]

> **Moderate PEV Scenario:** Penetration of PEVs equivalent to Minnesota's participation in a program similar to the *8-state ZEV Memorandum of Understanding*. Compliance with this MOU would require approximately 6 percent of in-use light duty vehicles in Minnesota to be ZEV by 2025. Assuming the increase in percent PEV penetration then continues at the same annual rate in later years, PEV penetration is assumed to be 8.9 percent in 2030, 14.7 percent in 2040, and 20.6 percent in 2050.[10]
>
> **High PEV Scenario:** The level of PEV penetration required to reduce total light-duty GHG emissions in Minnesota in 2050 by 80 percent from 2005 levels with 80 percent carbon free electricity, to meet the goals specified in the Next Generation Energy Act. This will require PEV penetration of 35 percent in 2030, 65 percent in 2040 and 98 percent in 2050.

Both of these scenarios are compared to a baseline scenario with very little PEV penetration and continued use of gasoline vehicles. The baseline scenario is based on future annual vehicle miles traveled (VMT) and fleet characteristics (e.g., cars versus light trucks) as projected by the Minnesota Department of Transportation.

Based on assumed future PEV characteristics and usage, the analysis projects annual electricity use for PEV charging at each level of penetration, as well as the average load from PEV charging by time of day. The analysis then projects the total revenue that Minnesota' electric distribution utilities would realize from sale of this electricity, their costs of providing the electricity to their customers, and the potential net revenue (revenue in excess of costs) that could be used to support maintenance of the distribution system.

For each PEV penetration scenario this analysis calculates utility revenue, costs, and net revenue for two different PEV charging scenarios: 1) a baseline scenario in which all PEVs are plugged in and start to charge as soon as they arrive at home each day, and 2) a managed off-peak charging scenario in which a significant portion of PEVs delay the start of charging until non-peak periods each day.

[8] This analysis used the same methodology as described in the referenced report, but used different PEV penetration scenarios, as described here. In addition, for this analysis fuel costs and other assumptions taken from the Energy Information Administration (EIA) were updated from EIA's Annual Energy Outlook 2016 to those in the Annual Energy Outlook 2018. For projections of future PEV costs, this analysis also used updated July 2017 battery cost projections from Bloomberg New Energy Finance. In addition, as further described in this section, this analysis used a modified methodology to calculate incremental energy, generation capacity and transmission/distribution costs associated with PEV charging. This analysis also includes an estimate of NOx reductions resulting from transportation electrification; the methodology used is not included in the cited report but is described here.

[9] The states of CA, CT, FL, MA, MD, ME, MN, NH, NJ, NY, OR, RI, and VT have all set economy-wide goals of 75-80 percent GHG reduction by 2050. The starting point for the target 2050 GHG reduction percentage varies by state, from 1990 to 2006. The District of Columbia has also adopted a goal to reduce GHG emissions by 80 percent from 2006 levels by 2050.

[10] While the 8-state MOU counts fuel cell vehicles and PEVs as zero emission vehicles, this scenario assumes that all ZEVs will be PEV given the fact fuel cell technology lags behind battery technology and fuel cell vehicles face a greater infrastructure challenge.

Real world experience from the EV Project demonstrates that, without a "nudge", drivers will generally plug in and start charging immediately upon arriving home after work (scenario 1), exacerbating system-wide afternoon/evening peak demand.[11] However, if given a "nudge" - in the form of a properly designed and marketed financial incentive - many Minnesota drivers will choose to delay the start of charging until off-peak times, thus reducing the effect of PEV charging on evening peak electricity demand (scenario 2). [9]

In fact, in Minnesota, Xcel Energy already offers a Residential EV Charging Service, which charges lower rates ($/kWh) for EV charging during off-peak hours - between 9 PM and 9 AM on weekdays, as well as on weekends and holidays. Over the last two years, the share of charging done during off-peak hours by customers on this rate has ranged from 90 to 95 percent. [10] The managed off-peak charging scenario modeled for this analysis is structured similar to the current Xcel program; the off-peak period is assumed to start at 9 PM, and 92 percent of all PEVs that arrive at home after noon each day are assumed to delay the start of charging until after 9 PM. This scenario further assumes that off-peak charging will be managed by staggering charge start times between 9 PM and 4 AM for individual PEVs, to avoid a sharp secondary peak at 9 PM.[12]

The costs of serving PEV load include the cost of electricity generation, the cost of transmission, incremental peak generation capacity costs for the additional peak load resulting from PEV charging, and annual infrastructure upgrade costs for increasing the capacity of the transmission and secondary distribution systems, to handle the additional load.

This analysis calculates average system-wide electricity generation costs based on projections by the Energy Information Administration, but then adds incremental costs associated specifically with PEV charging load under each charging scenario, based on timing of the charging load. This was done using MISO Locational Marginal Prices at the Minnesota hub for 2017 and 2016. [11] This data shows that the cost for Minnesota utilities to purchase bulk electricity varies by month and time of day, with average annual costs ($/MWh) about 40 percent higher during the day (9 AM – 9 PM) than at night. As discussed below, compared to baseline charging managed off-peak charging shifts load from the late afternoon/early evening to the early morning hours, thus reducing the cost to utilities to purchase the necessary electricity.

To calculate the costs associated with adding generation and transmission/distribution capacity to handle the incremental PEV charging load this analysis uses values calculated by Xcel Energy, and approved by the Minnesota Public Utilities Commission, for the purpose of calculating savings associated with the state's Conservation Improvement Program [12]. The values used were $60.07/kW-year for Generation Avoided Capacity Costs and $36.23/kW-year for Transmission and Distribution Avoided Costs.[13]

For each PEV penetration scenario, this analysis also calculates the total incremental annual cost of purchase and operation for all PEVs in the state, compared to "baseline" purchase and operation of gasoline cars and light trucks. For both PEVs and baseline vehicles annual costs include the amortized cost of purchasing the vehicle, annual costs for gasoline and electricity, and annual maintenance costs. For PEVs it also includes the amortized annual cost of the necessary home charger. This analysis is used to estimate average annual financial benefits to Minnesota drivers.

For each PEV penetration scenario this analysis also calculates annual greenhouse gas (GHG) emissions from electricity generation for PEV charging and compares that to baseline emissions from operation of gasoline

[11] The EV Project is a public/private partnership partially funded by the Department of Energy which has collected and analyzed operating and charging data from more than 8,300 enrolled plug-in electric vehicles and approximately 12,000 public and residential charging stations over a two-year period.

[12] Utilities have multiple policy and technical options for implementing managed charging. This analysis does not endorse any particular methodology.

[13] Under the Conservation Improvement Program these values are used to calculate savings associated with reducing load. We used the values to calculate costs associated with adding load. These values are for 2017. Costs in future years were escalated at 2.3 percent (generation) and 2.24 percent (transmission and distribution) per year, per Xcel assumptions.

vehicles. For the baseline and PEV penetration scenarios GHG emissions are expressed as carbon dioxide equivalent emissions (CO_2-e) in metric tons (MT). GHG emissions from gasoline vehicles include direct tailpipe emissions as well as "upstream" emissions from production and transport of gasoline.

For each PEV penetration scenario GHG emissions from PEV charging are calculated based on a "low carbon electricity" scenario. This low carbon electricity scenario is based on Minnesota reducing average GHG emissions from the electric grid to 80 percent below 2005 levels by 2050, in accordance with goals established under the Next Generation Energy Act.

Net annual GHG reductions from the use of PEVs are calculated as baseline GHG emissions (emitted by gasoline vehicles) minus GHG emissions from each PEV penetration scenario. The monetized "social value" of these GHG reductions from PEV use are calculated using the Social Cost of Carbon ($/MT), as calculated by the U.S. government's Interagency Working Group on Social Cost of Greenhouse Gases. The Interagency Working Group calculated GHG social values based on discount rates of 2.5 percent, 3 percent, and 5 percent; for this analysis we used the average values generated with a 3 percent discount rate, which is in the middle of the range of reported values. The values used are $41 per metric ton in 2015, rising to $79/MT in 2050 (constant 2015$).

The Minnesota Public Utilities Commission has also adopted high and low "externality values" for the social cost of the CO_2 associated with electricity production. [13] These values are $8.44 per ton (low) and $39.76/ton (high) in 2017, rising to $15.20/ton and $69.48/ton in 2050 (constant 2015$). This equates to $9.30 - $43.83/MT in 2017, rising to $16.76 - $76.59/MT in 2050. The values for social cost of GHGs used in this analysis are therefore very close to the "high" externality values adopted by the Minnesota PUC.

Finally, this analysis projected annual net reductions in nitrogen oxide (NOx) emissions under each PEV penetration scenario that would result from the use of electric vehicles instead of gasoline vehicles.[14] This projection is based on national-level modeling done in 2015 by the Electric Power Research Institute (EPRI), in conjunction with the Natural Resources Defense Council (NRDC) [14]. The monetized social value of these NOx reductions was calculated using a national average value of $15,909 per ton of NOx in 2018, escalated in future years using EIA inflation assumptions. The 2018 value was derived from modeling done by the Environmental Protection Agency using their Response Surface Model [15]; this value represents a national average for mobile source NOx.

The Minnesota Public Utilities Commission has also adopted high and low "externality values" for the social damage cost of NOx and other pollutants associated with electricity production. [16] These values range from $1,985/ton NOx (low – rural area) to $7,893/ton NOx (high – urban area), in 2016 dollars. For this analysis we chose to use EPA's values, rather than Minnesota PUC's values, because the projected reductions in NOx emissions will come from vehicles, rather than power plants. Differences in the location of emissions from vehicles and power plants, and resulting differences in population exposure, likely account for the difference in EPA NOx damage values compared to those adopted by the PUC.

[14] These reductions are net of projected NOx emissions from production of electricity required to charge the PEVs.

Study Results

This section summarizes the results of this study, including the projected number of PEVs; electricity use and load from PEV charging; projected GHG reductions compared to continued use of gasoline vehicles; benefits to utility customers from increased electricity sales; and projected financial benefits to Minnesota drivers compared to owning gasoline vehicles.

All costs and financial benefits are presented as net present value (NPV), using a 3 percent discount rate.

Plug-in Vehicles, Electricity Use, and Charging Load

Vehicles and Miles Traveled

The projected number of PEVs and conventional gasoline vehicles in the Minnesota light duty fleet under each PEV penetration scenario is shown in Figure 4, and the projected annual miles driven by these vehicles is shown in Figure 5. [15]

There are currently 2.081 million cars and 3.028 million light trucks registered in Minnesota, and these vehicles travel 59 billion miles per year. Both the number of vehicles and total annual vehicle miles are projected to increase by 15 percent through 2050, to 5.9 million light duty vehicles traveling 68.1 billion miles annually[16].

In order to meet the Moderate PEV scenario, the number of PEVs registered in Minnesota would need to increase from approximately 6,300 today, to 317,952 by 2025. Assuming the same annual increase in percent PEV penetration in later years, there would be 492,000 PEVs in the state in 2030, 842,000 in 2040, and 1.2 million in 2050 (Moderate PEV penetration scenario).

In order to put the state on a path to achieve an 80 percent reduction in light-duty GHG emissions from 2005 levels by 2050 (High PEV scenario) there would need to be approximately 1.9 million PEVs in Minnesota by 2030, rising to 3.7 million in 2040, and 5.8 million in 2050.

Note that under both PEV penetration scenarios the percentage of total VMT driven by PEVs each year is lower than the percentage of plug-in vehicles in the fleet. This is because PEVs are assumed to have a "utility factor" less than one – i.e., due to range restrictions neither a battery-electric nor a plug-in hybrid vehicle can convert 100 percent of the miles driven annually by a baseline gasoline vehicle into miles powered by grid electricity. In this analysis BEVs with 200-mile range per charge are conservatively assumed to have a utility factor of 90 percent in 2030 increasing to 95 percent in 2050, while PHEVs are assumed to have an average utility factor of 75 percent in 2030, rising to 85 percent in 2050. This analysis estimates that Minnesota could reduce light-duty fleet GHG in 2050 by 80 percent from 2005 levels if 88 percent of miles were driven by PEVs on electricity (Figure 5). However, in order to achieve this level of electric miles 98 percent of light-duty vehicles would need to be PEVs (Figure 4).

[15] This analysis only includes cars and light trucks. It does not include medium- or heavy-duty trucks and buses.
[16] Vehicle fleet and VMT growth is assumed to mirror projected population growth.

Figure 4 Projected Minnesota Light Duty Fleet

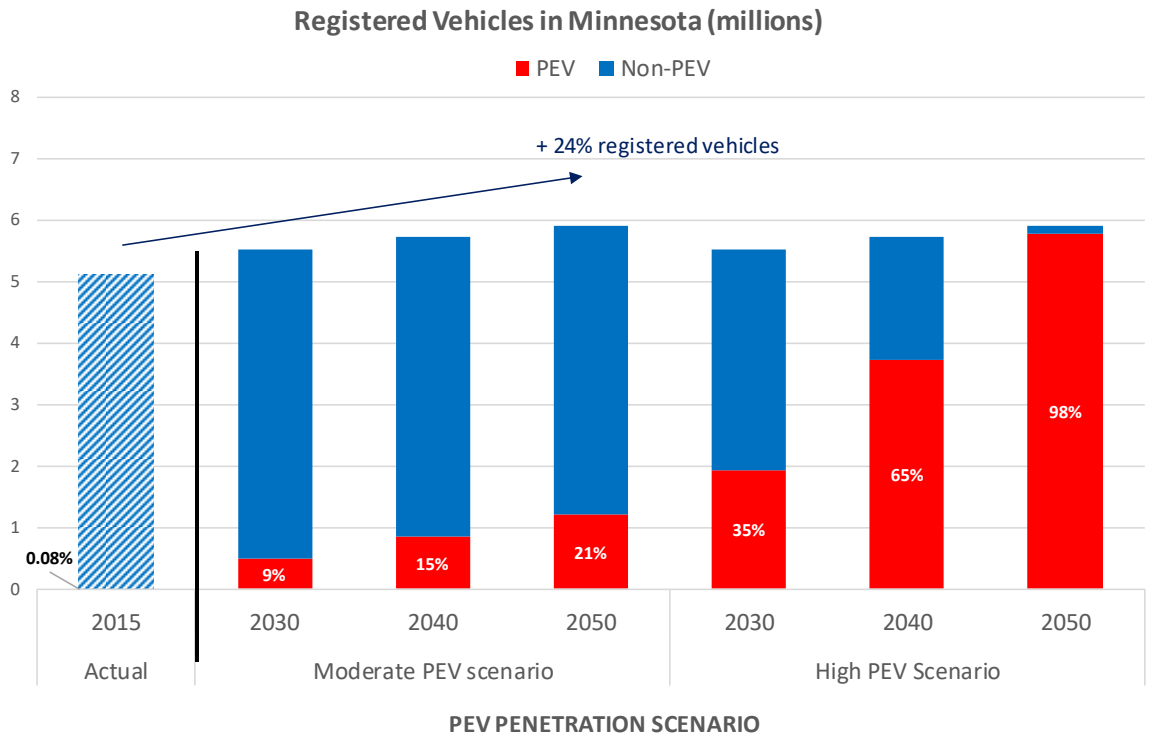
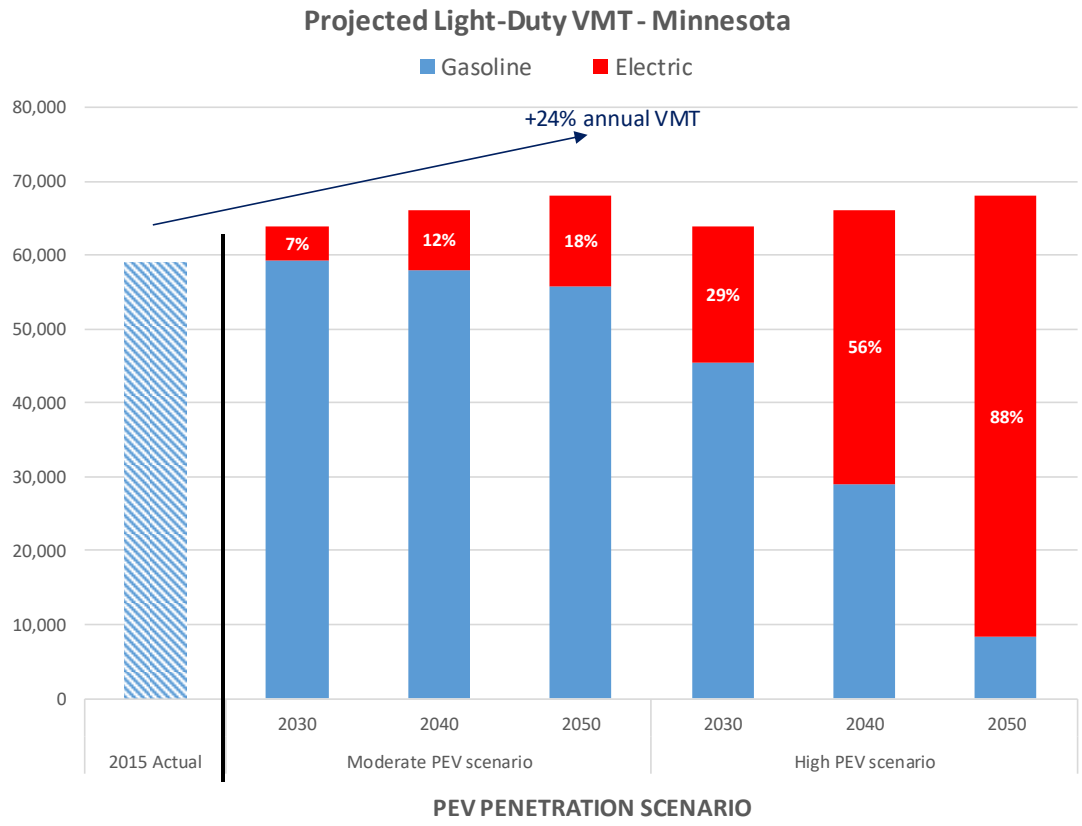


Figure 5 Projected Minnesota Light Duty Fleet Vehicle Miles Traveled

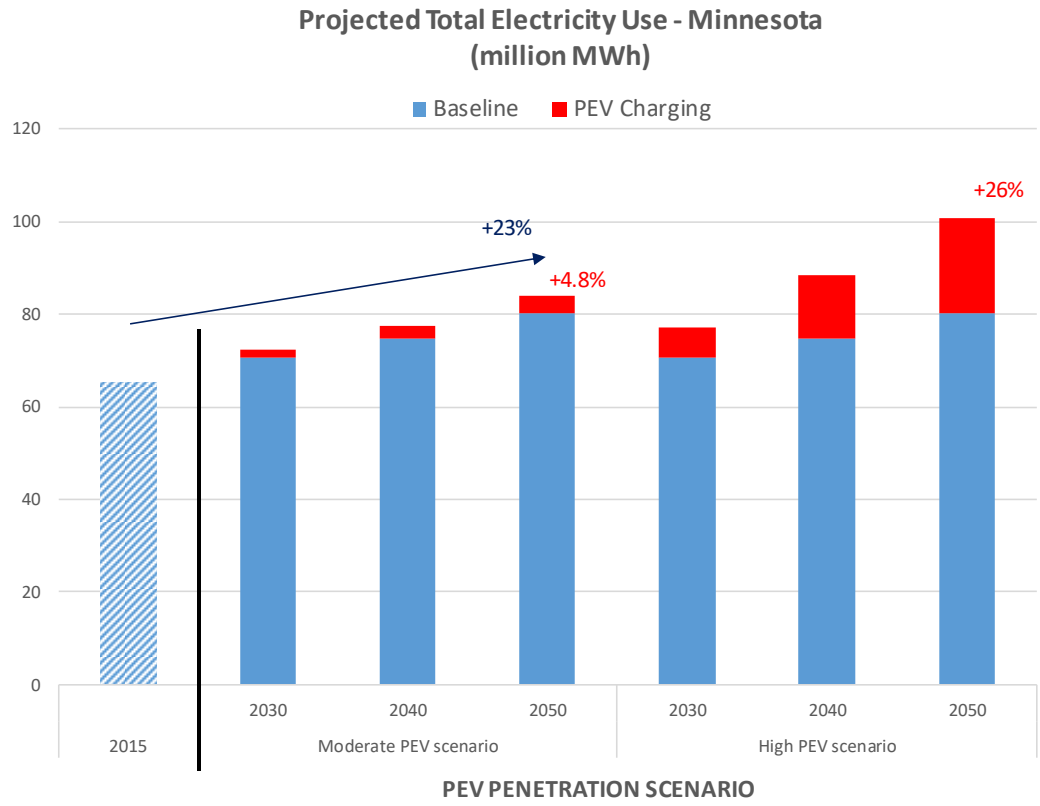


PEV Charging Electricity Use

The estimated total PEV charging electricity used in Minnesota each year under the PEV penetration scenarios is shown in Figure 6.

In Figure 6, projected baseline electricity use without PEVs is shown in blue and the estimated incremental electricity use for PEV charging is shown in red. State-wide electricity use in Minnesota is currently 65 million MWh per year. Annual electricity use is projected to increase to 70.6 million MWh in 2030 and continue to grow after that, reaching 80 million MWh in 2050 (23 percent greater than 2015 level).

Figure 6 Estimated Total Electricity Use in Minnesota



Under the Moderate PEV penetration scenario, electricity used for PEV charging is projected to be 1.6 million MWh in 2030 – an increase of 2.2 percent over baseline electricity use. By 2050, electricity for PEV charging is projected to grow to 3.8 million MWh – an increase of 4.8 percent over baseline electricity use. Under the High PEV scenario electricity used for PEV charging is projected to be 6.5 million MWh in 2030, growing to 20.6 million MWh and adding 26 percent to baseline electricity use in 2050.

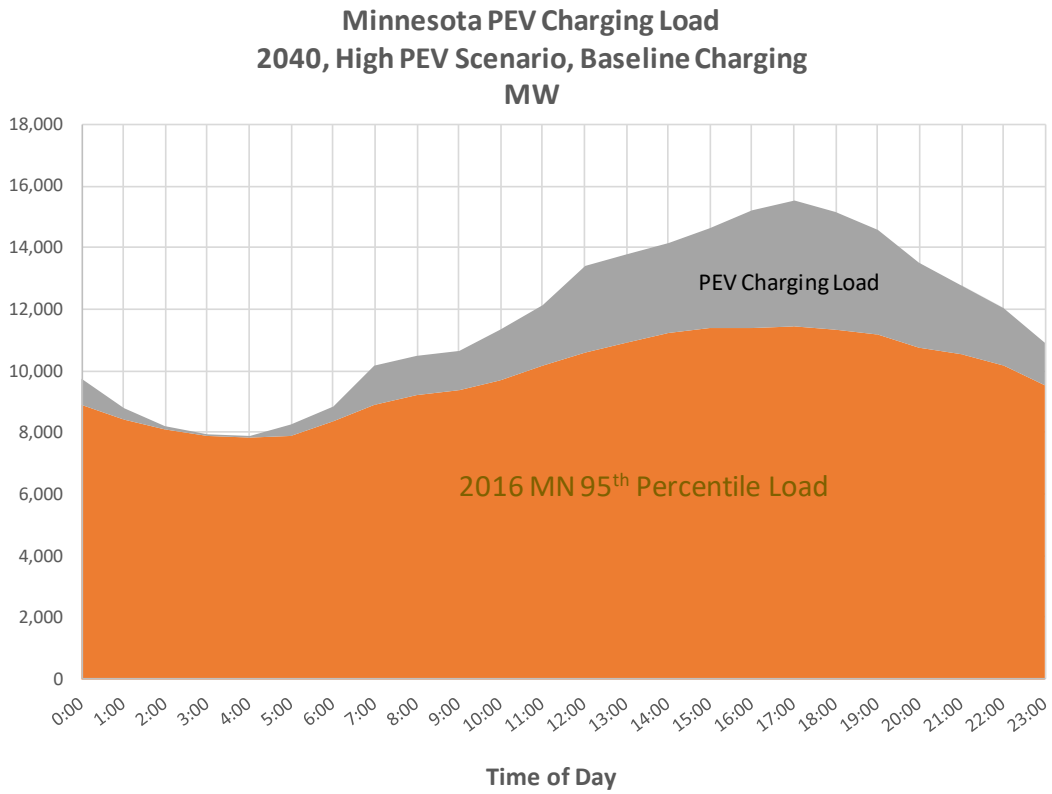
PEV Charging Load

This analysis evaluated the effect of PEV charging on the Minnesota electric grid under two different charging scenarios. Under both scenarios, 81 percent of all PEVs are assumed to charge exclusively at home and 19 percent are assumed to charge both at home and at work. Under the baseline charging scenario, all Minnesota drivers are assumed to plug-in their vehicles and start charging as soon as they arrive at home or at work (if applicable) each day. Under the managed off-peak charging scenario 92 percent of Minnesota drivers who arrive at home after noon each day are assumed to delay the start of home charging until after 9 PM – in response to a price signal or

incentive provided by their utility.[17] Further, this scenario assumes that off-peak charging will be managed by staggering charge start times between 9 PM and 4 AM for individual PEVs, to avoid a sharp secondary peak at 9 PM.[18]

See Figure 7 (baseline) and Figure 8 (managed off-peak) for a comparison of PEV charging load under the baseline and managed off-peak charging scenarios, using the 2040 High PEV penetration scenario as an example. In each of these figures, the 2016 Minnesota 95th percentile load (MW) by time of day is plotted in orange, and the projected incremental load due to PEV charging is plotted in grey. [19]

Figure 7 2040 Projected Minnesota PEV Charging Load, Baseline Charging (High PEV scenario)

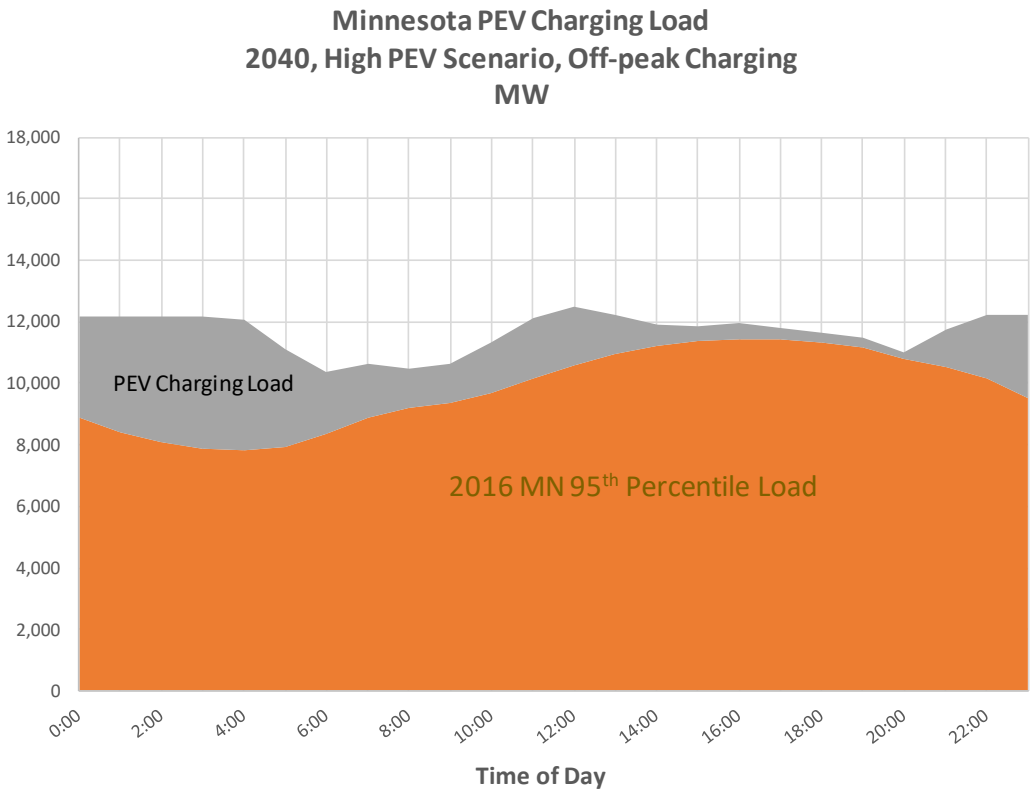


In 2016 daily electric load in Minnesota was generally in the range of 7,800 – 8,900 MW from midnight to 5 AM, ramping up through the morning and early afternoon to peak at approximately 11,422 MW between 3 PM and 5 PM, and then falling off through the late afternoon and evening hours.

[17] Utilities have many policy options to incentivize off-peak PEV charging. This analysis does not compare the efficacy of different options.
[18] Utilities have multiple policy and technical options for implementing managed charging. This analysis does not endorse any particular methodology.
[19] For each hour of the day actual load in 2015 was higher than the value shown on only 5 percent of days (18 days).

As shown in Figure 7, baseline PEV charging is projected to add load primarily between 7 AM and midnight, as people charge at work early in the day and then at home later in the day. The PEV charging peak coincides with the existing afternoon peak load period between 3 PM and 5 PM. As shown in Figure 8, off-peak charging significantly reduces the incremental PEV charging load during the afternoon peak load period but distributes load through the late evening and continuing into the early morning hours, between 9 PM and 6 AM. The shape of this late evening/early morning peak can potentially be controlled based on the design of off-peak charging incentives[20]. It should also be noted that those early morning hours are often the hours of the day when wind generation peaks.

Figure 8 2040 Projected Minnesota PEV Charging Load, Off-peak Charging (High PEV scenario)



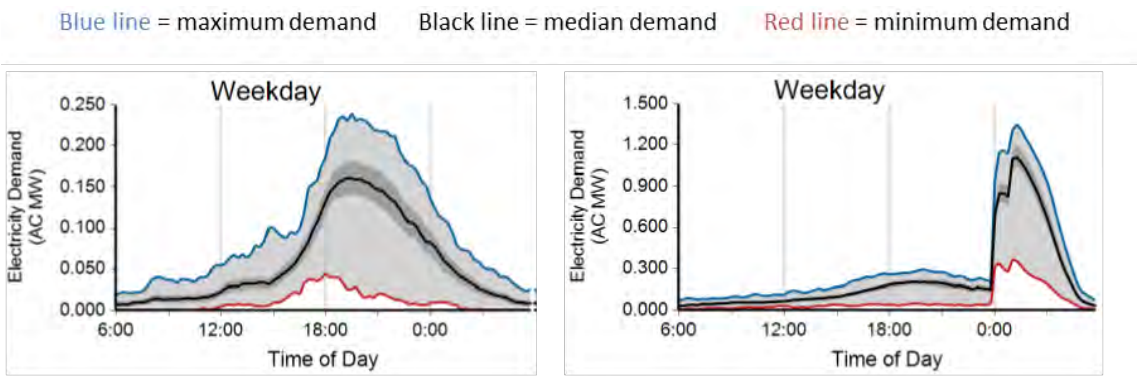
These baseline and off-peak load shapes are consistent with real world PEV charging data collected by the EV Project, as shown in Figure 9. In Figure 9 the graph on the left shows PEV charging load in the Dallas/Ft Worth area where no off-peak charging incentive was offered to drivers. The graph on the right shows PEV charging load in the San Diego region, where the local utility offered drivers a time-of-use rate with significantly lower costs ($/kWh) for charging during the "super off-peak" period between midnight and 5 a.m.[9] [21] In Minnesota, Xcel Energy already offers a Residential EV Charging Service, which charges lower rates ($/kWh) for EV charging during off-peak hours - between 9 PM and 9 AM on weekdays, as well as on weekends and holidays.

[20] This analysis assumes off-peak charging will be managed, with individual vehicles starting to charge between 9 PM and 4 AM. Based on annual mileage per vehicle, and projected PEV energy use, the average over-night charge is projected to take less than 3 hours using Level 1 and level 2 home chargers.

[21] Off-peak charging start times in San Diego are not actively controlled based on the design of the incentive, so there is typically a sharp peak in load at midnight, the start of the 'super off-peak" period with lower energy costs.

Over the last two years the share of charging done during off-peak hours by customers on this rate has ranged from 90 to 95 percent. [10]

Figure 9 PEV Charging Load in Dallas/Ft Worth and San Diego areas, EV Project



Dallas/Ft Worth (standard rates)

San Diego (time-of-use rates)

See Table 1 for a summary of the projected incremental afternoon peak hour load (MW) in Minnesota, from PEV charging under each penetration and charging scenario. This table also includes a calculation of how much this incremental PEV charging load would add to the 2016 95th percentile peak hour load.

Under the Moderate PEV penetration scenario, PEV charging would add 497 MW load during the afternoon peak load period on a typical weekday in 2030, which would increase the 2016 baseline peak load by about 4 percent. By 2050, the afternoon incremental PEV charging load would increase to 1,227 MW, adding almost 11 percent to the 2016 baseline afternoon peak. By comparison the afternoon peak hour PEV charging load in 2030 would be only 67 MW for the off-peak charging scenario, increasing to 164 MW in 2050.

Under the High PEV penetration scenario, baseline PEV charging would increase the total 2016 afternoon peak electric load by about 56 percent in 2050, while off-peak charging would only increase it by about 7 percent.[22]

Table 1 Projected Incremental Afternoon Peak Hour PEV Charging Load (MW)

		Moderate PEV			High PEV		
		2030	**2040**	**2050**	**2030**	**2040**	**2050**
Baseline Charging	PEV Charging (MW)	497.2	850.7	1,226.7	2,122.7	4,083.9	6,335.9
	Increase relative to 2016 Peak	*4.4%*	*7.4%*	*10.7%*	*18.6%*	*35.8%*	*55.5%*
Off-Peak Charging	PEV Charging (MW)	66.5	113.8	164.1	272.7	524.6	813.9
	Increase relative to 2016 Peak	*0.6%*	*1.0%*	*1.4%*	*2.4%*	*4.6%*	*7.1%*

[22] Given projected significant increases in total state-wide electricity use through 2050, baseline peak load (without PEVs) is also likely to be higher in 2050 than 2016 peak load; as such the percentage increase in baseline peak load due to high levels of PEV penetration is likely to be lower than that shown in Table 1.

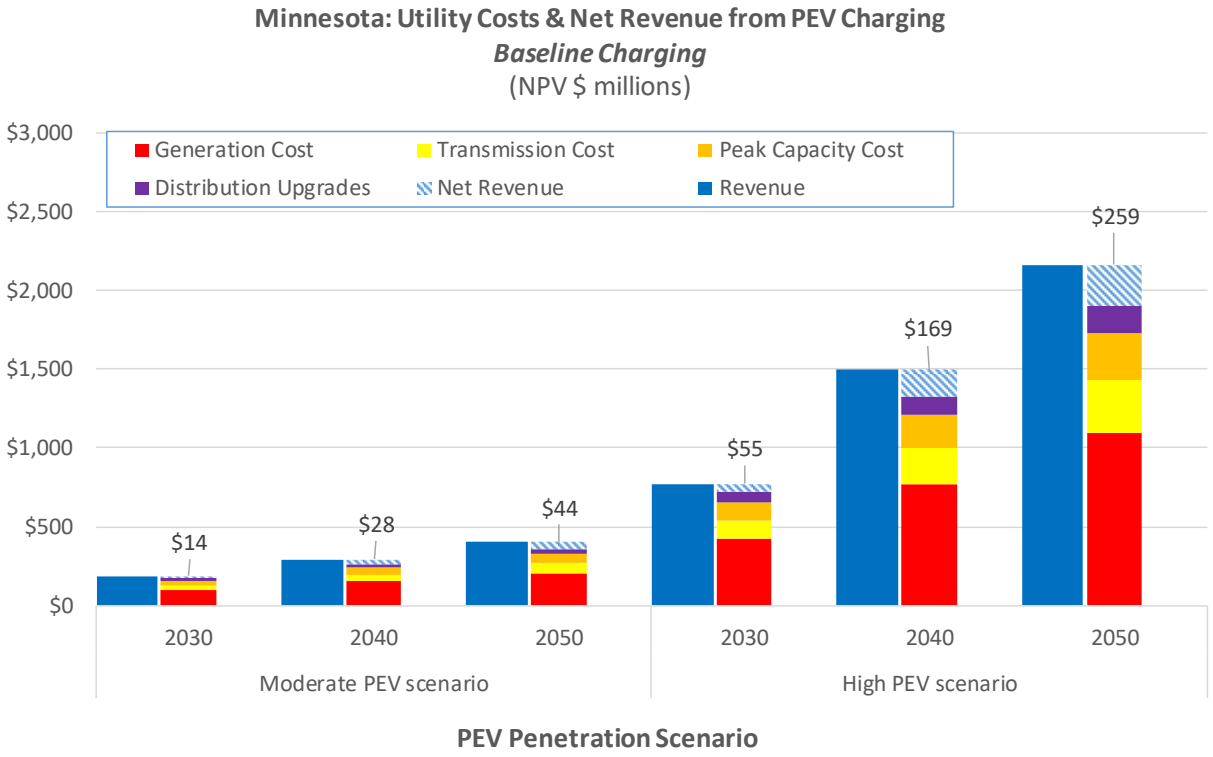
As discussed below, increased peak hour load increases a utility's cost of providing electricity, and may result in the need to upgrade distribution infrastructure. As such, off-peak PEV charging can provide net benefits to all utility customers by bringing in significant new revenue in excess of associated costs.

Utility Customer Benefits

The estimated NPV of revenues and costs for Minnesota' electric utilities to supply electricity to charge PEVs under each penetration scenario are shown in Figure 10, assuming the baseline PEV charging scenario.

In Figure 10, projected utility revenue is shown in dark blue. Under the Moderate PEV penetration scenario, the NPV of revenue from electricity sold for PEV charging in Minnesota is projected to total $185 million in 2030, rising to $401 million in 2050. Under the High PEV scenario, the NPV of utility revenue from PEV charging is projected to total $773 million in 2030, rising to $2.2 billion in 2050.

Figure 10 NPV of Projected Utility Revenue and Costs from Baseline PEV Charging



The different elements of incremental cost that utilities would incur to purchase and deliver additional electricity to support PEV charging are shown in red (generation), yellow (transmission), orange (peak capacity), and purple (transmission and distribution upgrade cost). Generation and transmission costs are proportional to the total power (MWh) used for PEV charging, while peak capacity costs are proportional to the incremental peak load (MW) imposed by PEV charging. Transmission and distribution upgrade costs are costs incurred by the utility to upgrade their own distribution infrastructure to handle the increased peak load imposed by PEV charging.

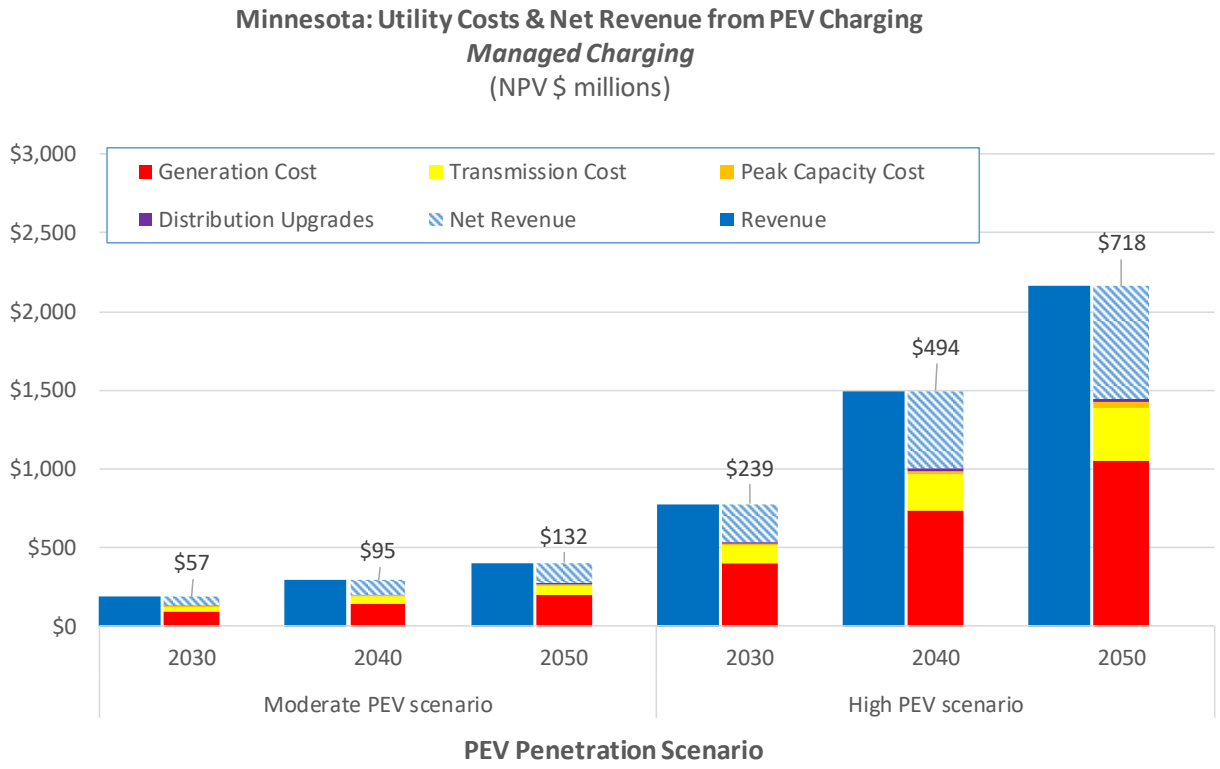
The striped light blue bars in Figure 10 represent the NPV of projected "net revenue" (revenue minus costs) that utilities would realize from selling additional electricity for PEV charging under each PEV penetration scenario. Under the Moderate PEV penetration scenario, the NPV of net revenue in Minnesota is projected to total $14 million in 2030, rising to $44 million in 2050. Under the High PEV scenario, the NPV of utility net revenue from

PEV charging is projected to total $55 million in 2030, rising to $259 million in 2050. The NPV of projected annual utility net revenue averages $28 per PEV in 2030, and $36 - $45 per PEV in 2050.

Figure 11 summarizes the NPV of projected utility revenue, costs, and net revenue for off-peak charging under each PEV penetration scenario. Compared to baseline charging (Figure 10) projected revenue, and projected transmission costs are the same, but projected generation, peak capacity and transmission and distribution upgrade costs are lower due to a smaller incremental peak load (see Table 1), and shifting of load to night-time hours when utilities' cost to purchase bulk electricity is lower.

Compared to baseline charging, off-peak charging will increase the NPV of annual utility net revenue by $43 million in 2030 and $88 million in 2050 under the Moderate PEV penetration scenario, due to lower costs. Under the High PEV scenario, off-peak charging will increase the NPV of annual utility net revenue by $184 million in 2030 and $459 million in 2050. This analysis estimates that compared to baseline charging, off-peak charging will increase the NPV of annual utility net revenue by $91 per PEV in 2030 and $76 per PEV in 2050.

Figure 11 NPV of Projected Utility Revenue and Costs from Off-peak PEV Charging

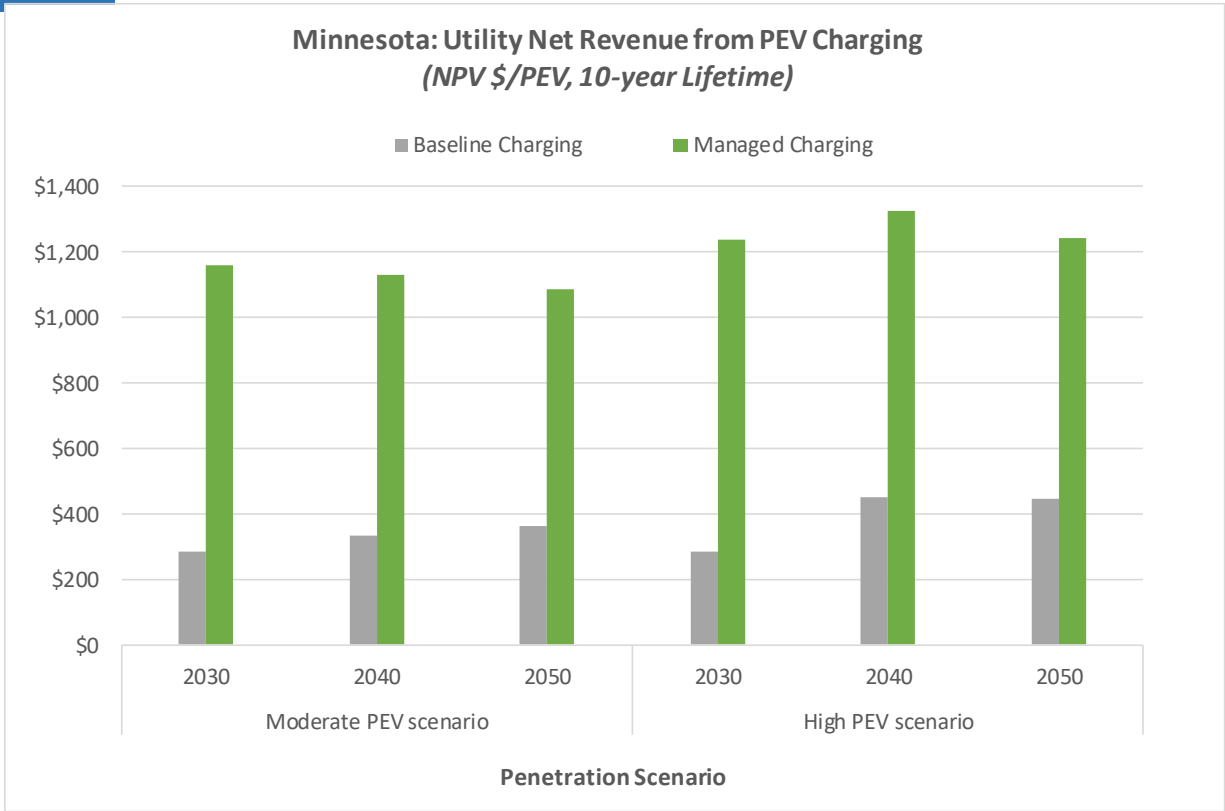


Of note is the effect of managed off-peak charging on generation costs. Based on the 2016 daily load shape, and MISO Locational Marginal Prices at the Minnesota hub [11], this analysis estimates that Minnesota utilities paid an average of approximately $23.44/MWh for bulk power in 2016 and 2017. Under the baseline charging scenario the cost of the power needed to charge PEVs would average almost $26/MWh, approximately 11 percent more than the current average, due to the timing of the load, with a greater percentage during high-cost day-time hours. Under the managed off-peak charging scenario, load shifting to lower-cost night-time hours will reduce average bulk power costs for PEV charging to just over $20/MWh, more than a 20 percent reduction compared to the baseline scenario. This reduction is reflected in the net revenue figures shown in Figures 11 and 12.

The NPV of projected life-time utility net revenue per PEV is shown in Figure 12. Assuming a ten-year life, the average PEV in Minnesota in 2030 is projected to increase utility net revenue by over $1,088 over its life-time, if

charged off-peak. PEVs in service in 2050 are projected to increase utility net revenue by almost $1,242 over their life time (NPV) if charged off-peak.

Figure 12 NPV of Projected Life-time Utility Net Revenue per PEV

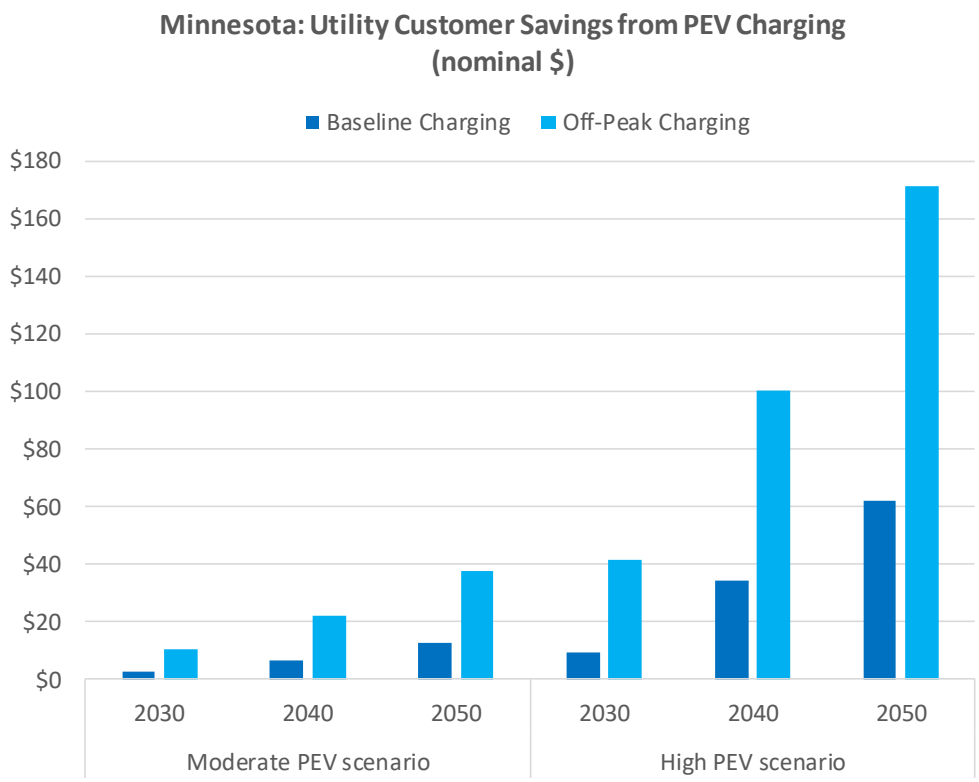


In general, a utility's costs to maintain their distribution infrastructure increase each year with inflation, and these costs are passed on to utility customers in accordance with rules established by the state's Public Utilities Commission (PUC), via periodic increases in residential and commercial electric rates. However, under the PUC's "revenue decoupling" regulations, the majority of projected utility net revenue from increased electricity sales for PEV charging would in fact be passed on to utility customers in Minnesota, not retained by the utility companies. In effect this net revenue would put downward pressure on future rates, delaying or reducing future rate increases, thereby reducing customer bills.[23] The revenue decoupling mechanism in place in Minnesota would ensure this happens automatically.

See Figure 13 for a summary of how the projected utility net revenue from PEV charging might affect average residential electricity bills for all Minnesota electric utility customers.[24] As shown in the figure, under the High PEV scenario projected average electric rates in Minnesota could be reduced up to 5 percent by 2050, resulting in an annual savings of approximately $171 (nominal dollars) per household in Minnesota in 2050.

[23] Some of this net revenue may also be passed directly to PEV owners as an incentive to charge off-peak, in recognition of the significant benefits this would provide.
[24] Based on 2016 average electricity use of 8,792 kWh per housing unit in Minnesota.

Figure 13 Potential Effect of PEV Charging Net Revenue on Utility Customer Bills (nominal $)



Minnesota Driver Benefits

Current PEVs are more expensive to purchase than similar sized gasoline vehicles, but they are eligible for various government purchase incentives, including up to a $7,500 federal tax credit. These incentives are important to spur an early market, but PEVs are projected to provide a total lower cost of ownership than conventional vehicles in Minnesota on an unsubsidized basis by 2030, as described below.

The largest contributor to incremental purchase costs for PEVs compared to gasoline vehicles is the cost of batteries. Battery costs for light-duty plug-in vehicles have fallen from over $1,000/kWh to less than $400/kWh in the last 5 years; many analysts and auto companies project that battery prices will continue to fall – to below $125/kWh by 2025. [17]

Based on these battery cost projections, this analysis projects that the average annual cost of owning a PEV in Minnesota will fall below the average cost of owning a gasoline vehicle by 2030, even without government purchase subsidies.[25] See Table 2 which summarizes the average projected annual cost of Minnesota PEVs and gasoline vehicles under each penetration scenario. All costs in Table 2 are in nominal dollars, which is the primary reason why costs for both gasoline vehicles and PEVs are higher in 2040 and 2050 than in 2030 (due to inflation). In addition, the penetration scenarios assume that the relative number of PEV cars and higher cost PEV light trucks will change over time; in particular the High PEV scenario assumes that there will be a significantly higher percentage of PEV light trucks in the fleet in 2050 than in 2030, which further increases the average PEV purchase cost in 2050 compared to 2030.

[25] The analysis assumes that all battery electric vehicles in-use after 2030 will have 200-mile range per charge and that all plug-in hybrid vehicles will have 50-mile all-electric range.

Table 2 Projected Fleet Average Vehicle Costs to Vehicle Owners (nominal $)

GASOLINE VEHICLE		Moderate PEV scenario			High PEV scenario		
		2030	2040	2050	2030	2040	2050
Vehicle Purchase	$/yr	$4,399	$5,650	$7,579	$4,639	$6,851	$9,071
Gasoline	$/yr	$1,206	$1,416	$1,806	$1,248	$1,648	$2,105
Maintenance	$/yr	$260	$328	$423	$264	$344	$443
TOTAL ANNUAL COST	**$/yr**	**$5,865**	**$7,393**	**$9,807**	**$6,151**	**$8,843**	**$11,620**

PEV -MN		Moderate PEV scenario			High PEV scenario		
Baseline Charging/Standard Rate		2030	2040	2050	2030	2040	2050
Vehicle Purchase	$/yr	$4,878	$6,070	$7,809	$5,121	$7,375	$9,544
Electricity	$/yr	$567	$703	$902	$604	$817	$1,023
Gasoline	$/yr	$188	$183	$165	$166	$188	$189
Personal Charger	$/yr	$81	$102	$129	$81	$102	$129
Maintenance	$/yr	$143	$188	$253	$147	$196	$261
TOTAL ANNUAL COST	**$/yr**	**$5,858**	**$7,246**	**$9,259**	**$6,120**	**$8,678**	**$11,147**
Savings per PEV	**$/yr**	**$7**	**$147**	**$548**	**$31**	**$166**	**$473**

As shown in Table 2, even in 2050 average PEV purchase costs are projected to be higher than average purchase costs for gasoline vehicles (with no government subsidies), but the annualized effect of this incremental purchase cost is outweighed by significant fuel cost savings, as well as savings in scheduled maintenance costs. In 2030, the average Minnesota driver is projected to save $7 – $31 per year compared to the average gasoline vehicle owner, without government subsidies. These annual PEV savings are projected to increase to an average of $147 - $166 per PEV in 2040, and $473 - $548 per PEV in 2050, as relative PEV purchase costs continue to fall, and the projected price of gasoline continues to increase faster than projected electricity prices. The NPV of annual savings for the average PEV owner in Minnesota is projected to be $14 in 2030, rising to $187 in 2050.

The NPV of total annual cost savings to Minnesota drivers from greater PEV ownership are projected to be $2 million in 2030 under the Moderate PEV penetration scenario, rising to $61 million in 2040 and $244 million in 2050. Under the High PEV scenario, the NPV of total annual cost savings to Minnesota drivers from greater PEV ownership are projected to be $40 million in 2030, rising to $303 million in 2040 and $1.0 billion in 2050.

Other Benefits

Fuel and Emissions Reductions

Along with the financial benefits to electric utility customers and PEV owners described above, light-duty vehicle electrification can provide additional benefits, including significant reductions in gasoline fuel use and transportation sector emissions.

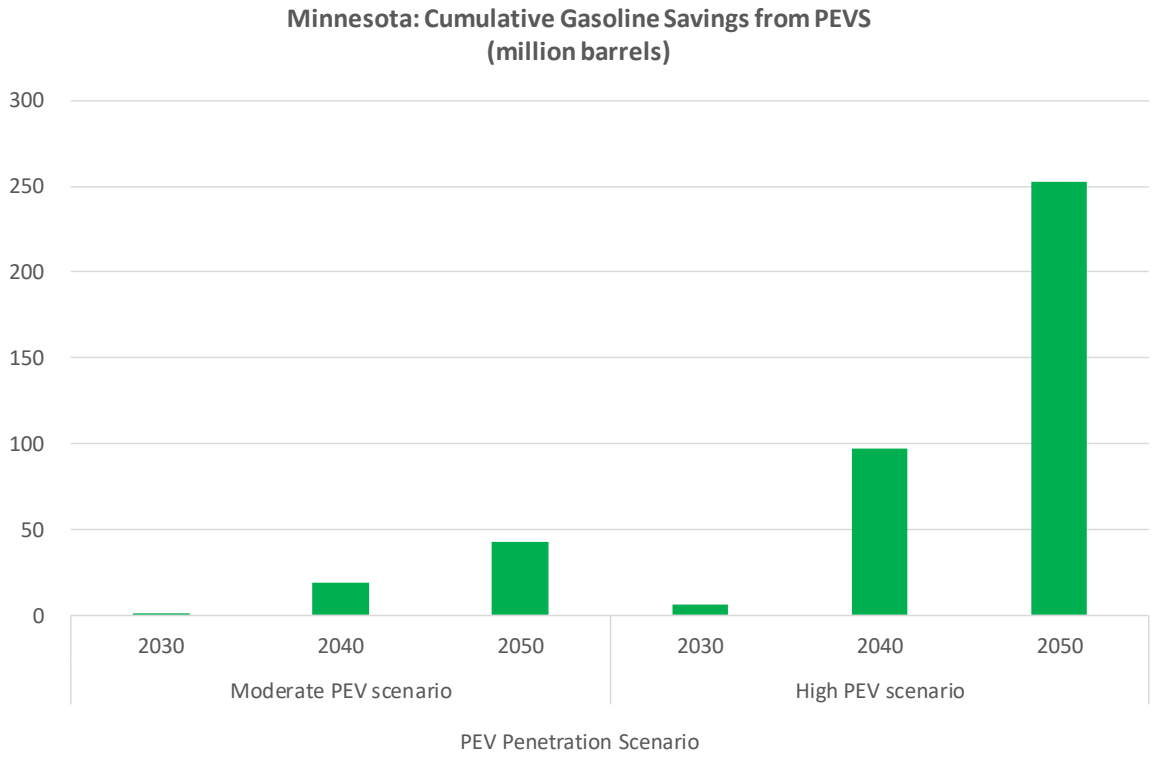
The estimated cumulative fuel savings (barrels of gasoline) from PEV use in Minnesota under each penetration scenario are shown in Figure 14. [26] Annual fuel savings under the Moderate PEV penetration scenario are projected to total 1.6 million barrels in 2030, with cumulative savings of more than 43 million barrels by 2050. For the High PEV scenario, annual fuel savings in 2030 are projected to be 6.1 million barrels, and by 2050 cumulative savings will exceed 252 million barrels.

[26] One barrel of gasoline equals 42 US gallons.

These fuel savings can help put the U.S. on a path toward energy independence, by reducing the need for imported petroleum. In addition, a number of studies have demonstrated that EVs can generate significantly greater local economic impact than gasoline vehicles - including generating additional local jobs - by keeping more of vehicle owners' money in the local economy rather than sending it out of state by purchasing gasoline.

Economic impact analyses for the states of California, Florida, Ohio and Oregon have estimated that for every million dollars in direct PEV owner savings, an additional $0.29 - $0.57 million in secondary economic benefits will be generated within the local economy, depending on PEV adoption scenario. These studies also estimated that between 13 and 25 additional in-state jobs will be generated for every 1,000 PEVs in the fleet. [1]

Figure 14 Cumulative Gasoline Savings from PEVs in Minnesota



The projected annual greenhouse gas (GHG) emissions (million metric tons carbon-dioxide equivalent, CO_2-e million tons) from the Minnesota light duty fleet under each PEV penetration scenario are shown in Figure 15. In this figure, projected baseline emissions from a gasoline fleet with few PEVs are shown in red for each year; the values shown represent "wells-to-wheels" emissions, including direct tailpipe emissions and "upstream" emissions from production and transport of gasoline. Projected total fleet emissions for each PEV penetration scenario are shown in blue; this includes GHG emissions from generating electricity to charge PEVs, as well as GHG emissions from gasoline vehicles in the fleet.

For the PEV penetration scenarios, projected GHG emissions are shown for a "low carbon" electricity scenario (light blue). This low carbon electricity scenario is based on Minnesota achieving long-term goals to reduce total GHG emissions from electricity generation by 80 percent from 2005 levels by 2050.

Figure 15 Projected GHG Emissions from the Light Duty Fleet in Minnesota

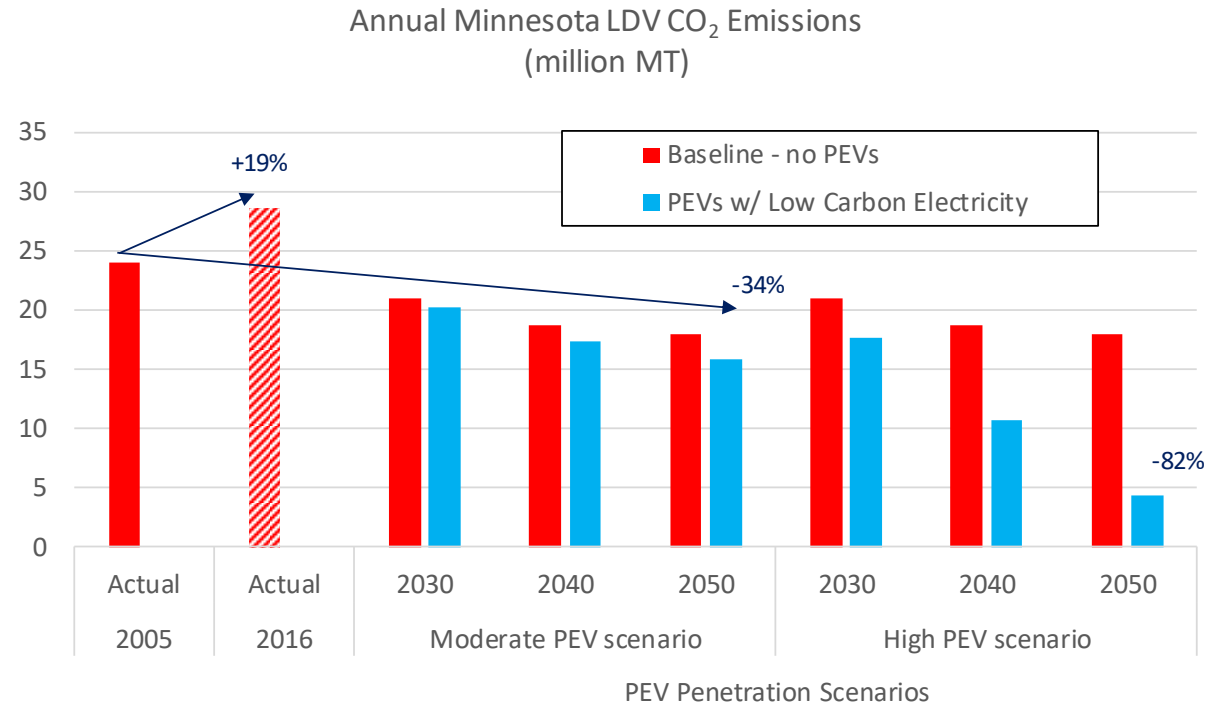
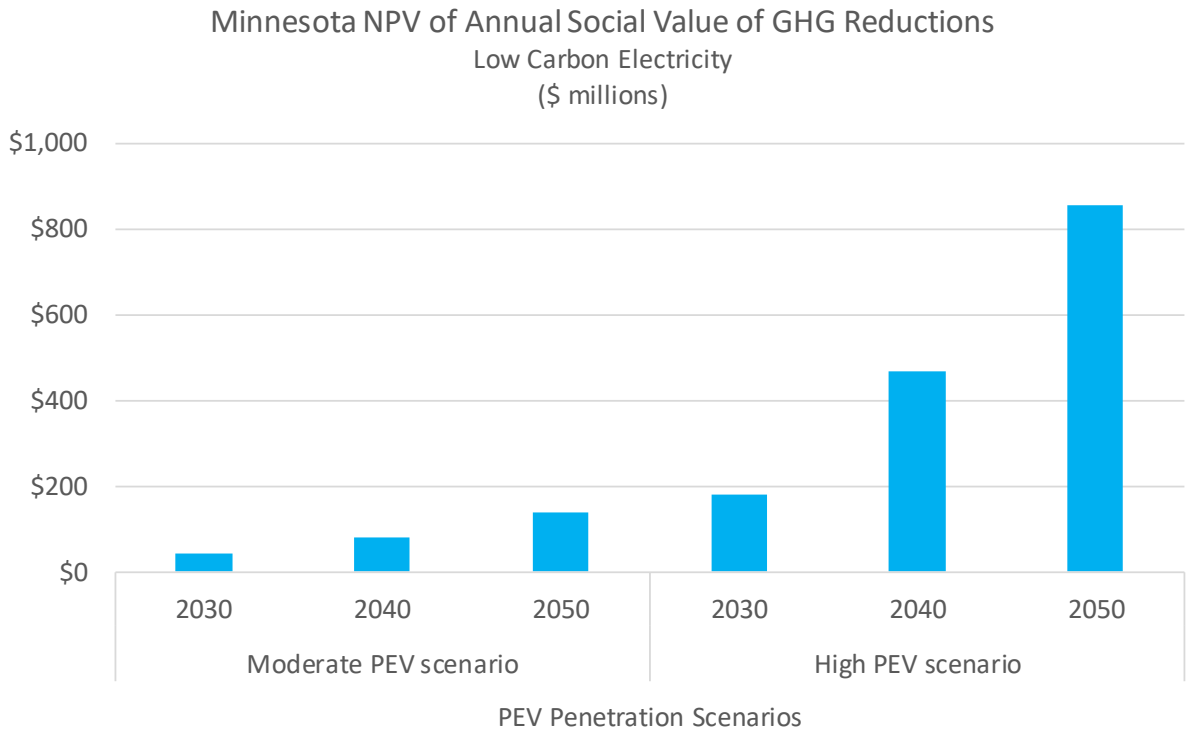


Figure 16 NPV of Projected Social Value of PEV GHG Reductions



As shown in Figure 15, GHG emissions from the light duty fleet were approximately 24.0 million tons in 2005, but they increased by 19 percent through 2016, to 28.5 million tons. However, even without significant PEV penetration, baseline annual fleet emissions are projected to fall to 17.9 million tons by 2050, a reduction of 25 percent from 2005 levels and 37 percent from current levels. This projected reduction is based on turnover of the existing vehicle fleet to more efficient vehicles that meet more stringent fuel economy and GHG standards issued by the Department of Transportation and Environmental Protection Agency. Under the Moderate PEV penetration scenario, PEVs are projected to reduce annual light duty fleet emissions by up to 11.5 million tons in 2050 compared to baseline emissions (-34 percent). Under the High PEV scenario, annual GHG emissions in 2050 will be as much as 17.2 million tons lower than baseline emissions (-82 percent).

Figure 16 summarizes the NPV of the projected monetized "social value" of GHG reductions that will result from greater PEV use in Minnesota. The social value of GHG reductions represents potential cost savings from avoiding the negative effects of climate change, if GHG emissions are reduced enough to keep long term warming below two degrees Celsius from pre-industrial levels. The values summarized in Figure 16 were developed using the Social Cost of CO_2 ($/MT) as calculated by the U.S. government's Interagency Working Group on Social Cost of Greenhouse Gases.

The NPV of the monetized social value of GHG reductions resulting from greater PEV use is projected to total $43 million per year in 2030 under the Moderate PEV penetration scenario, rising to as much as $138 million per year in 2050. Under the High PEV scenario the NPV of the monetized social value of GHG reductions from greater PEV is projected to be $179 million per year in 2030, rising to as much as $856 million per year in 2050.[27]

The NPV of the projected monetized social value of annual GHG reductions averages $48 per PEV in 2030, and $47 - $73 per PEV in 2050.

NOx Emissions

In 2015 the Electric Power Research Institute (EPRI), in conjunction with the Natural Resources Defense Council (NRDC), conducted national-level modeling to estimate GHG and air quality benefits from high levels of transportation electrification [14]. Under their electrification scenario EPRI estimated that NOx would be reduced by 11.4 tons and VOCs would be reduced by 5.5 tons, for every billion vehicle miles traveled.[28]

Extrapolating from this data, under the Moderate PEV Scenario, by 2050 light-duty vehicle electrification in Minnesota could reduce annual NOx emissions by 827 tons and reduce annual VOC emissions by 399 tons. Under the High PEV Scenario, total NOx reductions in 2050 could reach more than 4,005 tons per year, and total VOC reductions could reach almost 1,933 tons per year.[29]

Based on EPA's national average damage value of $15,909/ton of mobile source NOx, these NOx reductions would have a social value of $6.4 million in 2030 under the Moderate PEV Scenario, rising to $27.7 million in 2050. Under the High PEV Scenario the social value of these NOx reductions would be $25.9 million in 2030, rising to $134 million in 2050.

[27] These figures are roughly equivalent to estimates of the value of GHG reduction that would be derived by using the high end of CO_2 externality values adopted by the Minnesota PUC. If the low CO_2 externality values adopted by the Minnesota PUC were used the totals would be approximately 78 percent lower.

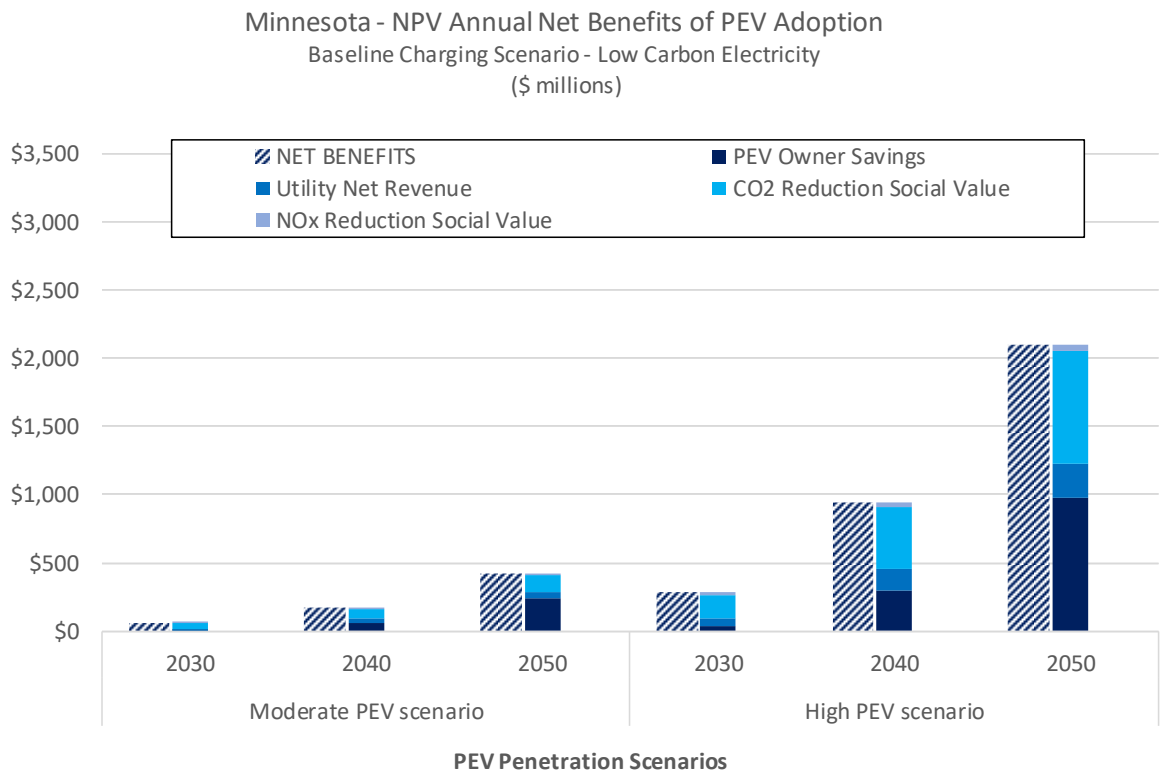
[28] For light-duty vehicles the analysis assumed that by 2030 approximately 17 percent of annual vehicle miles would be powered by grid electricity, using PEVs. Based on current and projected electric sector trends the analysis also assumed that approximately 49 percent of the incremental power required for transportation electrification in 2030 would be produced using solar and wind, with the remainder produced by combined cycle natural gas plants.

[29] Across the entire state, estimated annual light-duty vehicle miles traveled (VMT) totals 0.73 trillion miles in 2050. Of these miles approximately, 6 percent are powered by grid electricity under the Moderate PEV penetration scenario, and 87 percent are powered by grid electricity under the High PEV penetration scenario

Total Societal Benefits

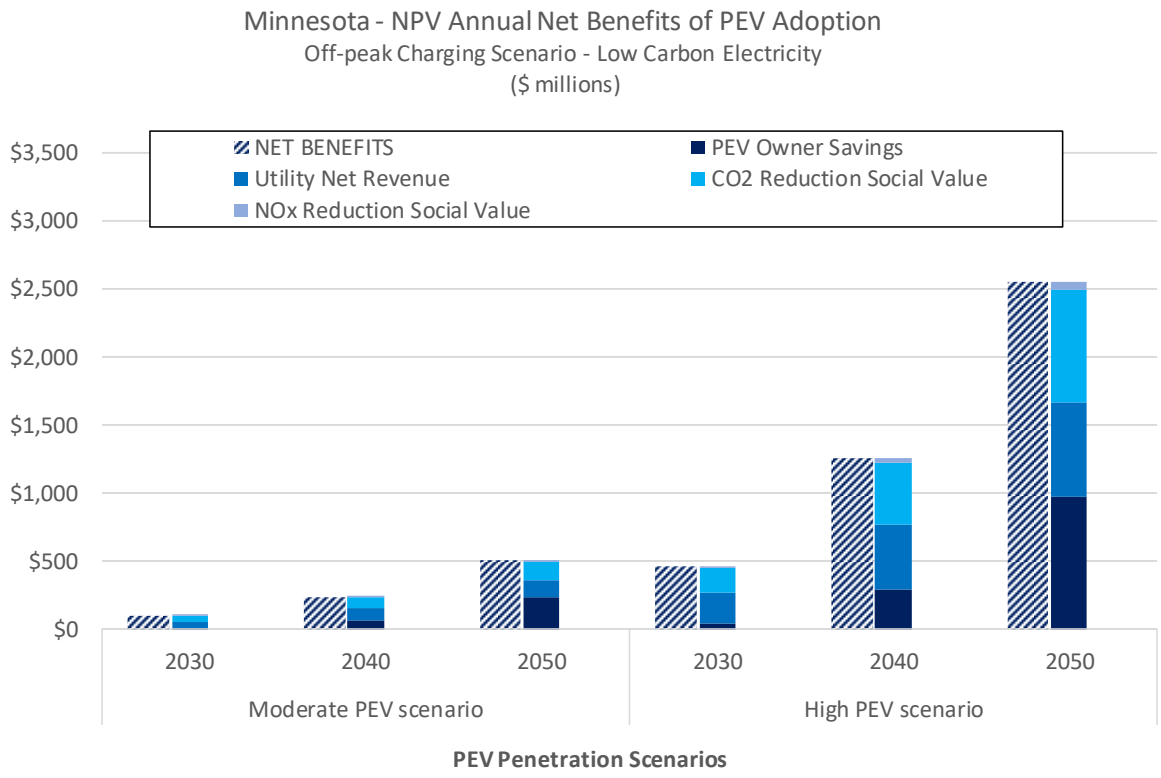
The NPV of total estimated societal benefits from increased PEV use in Minnesota under each PEV penetration scenario are summarized in Figures 17 and 18. These benefits include cost savings to Minnesota drivers, utility customer savings from reduced electric bills and the monetized benefit of reduced GHG and NOx emissions. Figure 17 shows the NPV of projected societal benefits if Minnesota drivers charge in accordance with the baseline charging scenario. Figure 18 shows the NPV of projected societal benefits if Minnesota drivers charge off-peak.

Figure 17 Projected NPV of Total Societal Benefits from Greater PEV use in MN – Baseline Charging



As shown in Figure 17, the NPV of annual societal benefits are projected to be a minimum of $424 million per year in 2050 under the Moderate PEV penetration scenario and $2.1 billion per year in 2050 under the High PEV scenario. Approximately 46 percent of these annual benefits will accrue to Minnesota drivers as a cash savings in vehicle operating costs, 12 percent will accrue to electric utility customers as a reduction in annual electricity bills, 2 percent will accrue to society at large in the form of reduced damage costs associated with reduced NOx emissions, and 40 percent will accrue to society at large in the form of reduced pressure on climate change due to reduced GHG emissions.

Figure 18 Projected NPV of Total Societal Benefits from Greater PEV use in MN – Off-peak Charging



As shown in Figure 18, the NPV of annual societal benefits in 2050 will increase by $86 million under the Moderate PEV penetration scenario, and $446 million under the High PEV scenario if Minnesota drivers charge off-peak. Of these increased benefits, all will accrue to electric utility customers as an additional reduction in their electricity bills.

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Acknowledgements

Lead Authors: Dana Lowell, Brian Jones, and David Seamonds

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Charge Up Midwest is a partnership of environmental and clean energy organizations actively working to increase electric vehicle deployment throughout the region in Illinois, Missouri, Michigan, Minnesota, and Ohio. Fresh Energy is a non-profit organization that works to speed Minnesota's transition to a clean energy economy – including putting Minnesota on the pathway to being a national renewable energy leader, and promoting clean transportation options for Minnesota's growing economy.

This study is one of nine state-level analyses of plug-in electric vehicle costs and benefits developed for different U.S. states, including Colorado, Connecticut, Illinois, Maryland, Massachusetts, Michigan, Minnesota, New York, and Pennsylvania.

These studies are intended to provide input to state policy discussions about actions required to promote further adoption of electric vehicles.

This report, and the other state reports, are available at www.mjbradley.com.

Electric Vehicle Cost-Benefit Analysis

Plug-in Electric Vehicle Cost-Benefit Analysis: Florida

MJB&A

January 2019

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About M.J. Bradley & Associates

M.J. Bradley & Associates, LLC (MJB&A), founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies.

Our multi-national client base includes electric and natural gas utilities, major transportation fleet operators, clean technology firms, environmental groups and government agencies.

We bring insights to executives, operating managers, and advocates. We help you find opportunity in environmental markets, anticipate and respond smartly to changes in administrative law and policy at federal and state levels. We emphasize both vision and implementation, and offer timely access to information along with ideas for using it to the best advantage.

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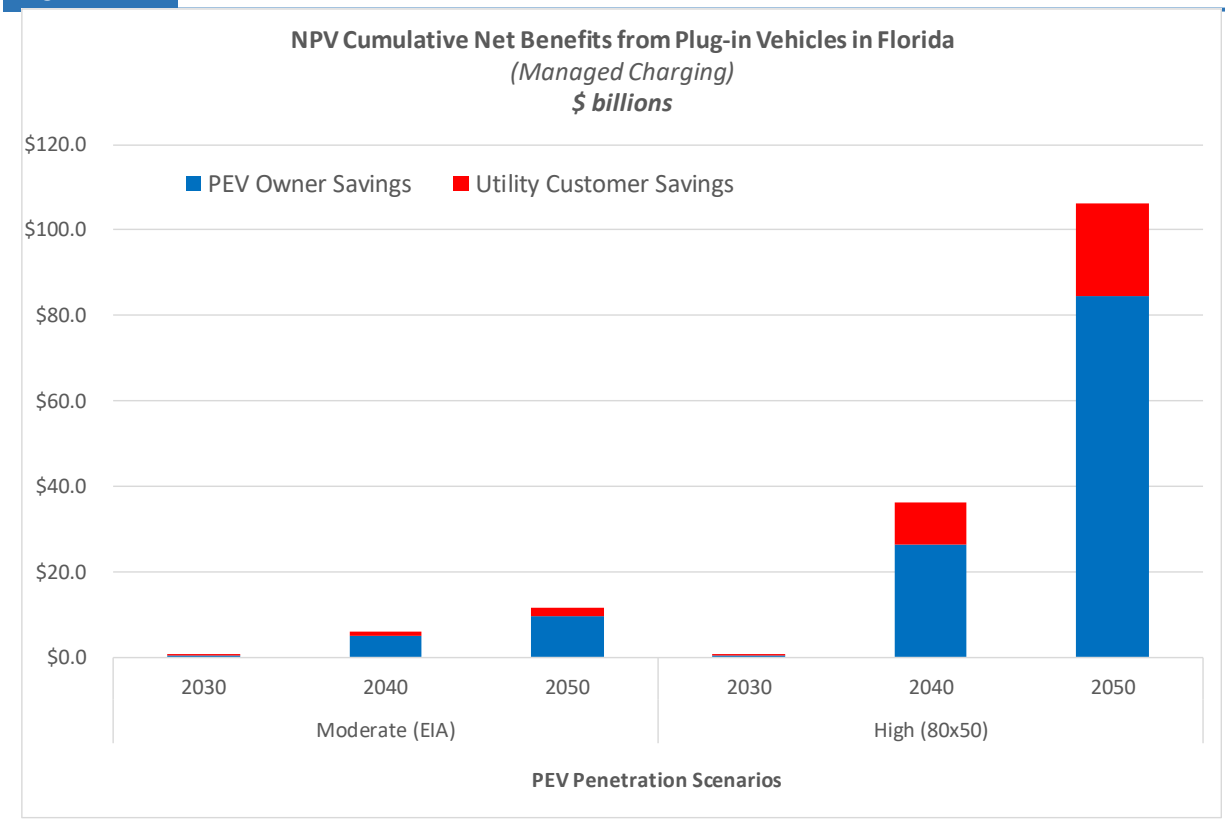
Executive Summary

This study estimated the costs and benefits of increased adoption of plug-in electric vehicles (PEVs) in the state of Florida. The study estimated the financial benefits that would accrue to all electric utility customers in Florida due to greater utilization of the electric grid during low load hours, and resulting increased utility revenues from PEV charging. In addition, the study estimated the annual financial benefits to Florida drivers from owning PEVs—from fuel and maintenance cost savings compared to owning gasoline vehicles. The study also estimated reductions in gasoline consumption, and associated greenhouse gas (GHG) and nitrogen oxide (NOx) emission reductions from greater use of PEVs instead of gasoline vehicles.

Figure 1 NPV Cumulative Societal Net Benefits from FL PEVs



This study evaluated PEV costs and benefits for two distinct levels of PEV adoption – essentially a "business as usual" scenario of modest PEV penetration (EIA), and a much more aggressive scenario based on the PEV penetration that would be required to get the state onto a trajectory to reduce light-duty GHG emissions by 70 – 80 percent from current levels by 2050 (80x50). The levels of PEV penetration in the high 80x50 scenario are unlikely to be achieved without aggressive policy action at the state and local level, to incentivize individuals to purchase PEVs, and to support the necessary roll-out of PEV charging infrastructure.

As shown in Figure 1, if Florida PEV adoption follows the moderate trajectory currently assumed by the Energy Information Administration (EIA), the net present value of **cumulative net benefits from greater PEV use in the state will exceed $11.7 billion state-wide by 2050**.[1] Of these total net benefits:

[1] Using a 3% discount rate

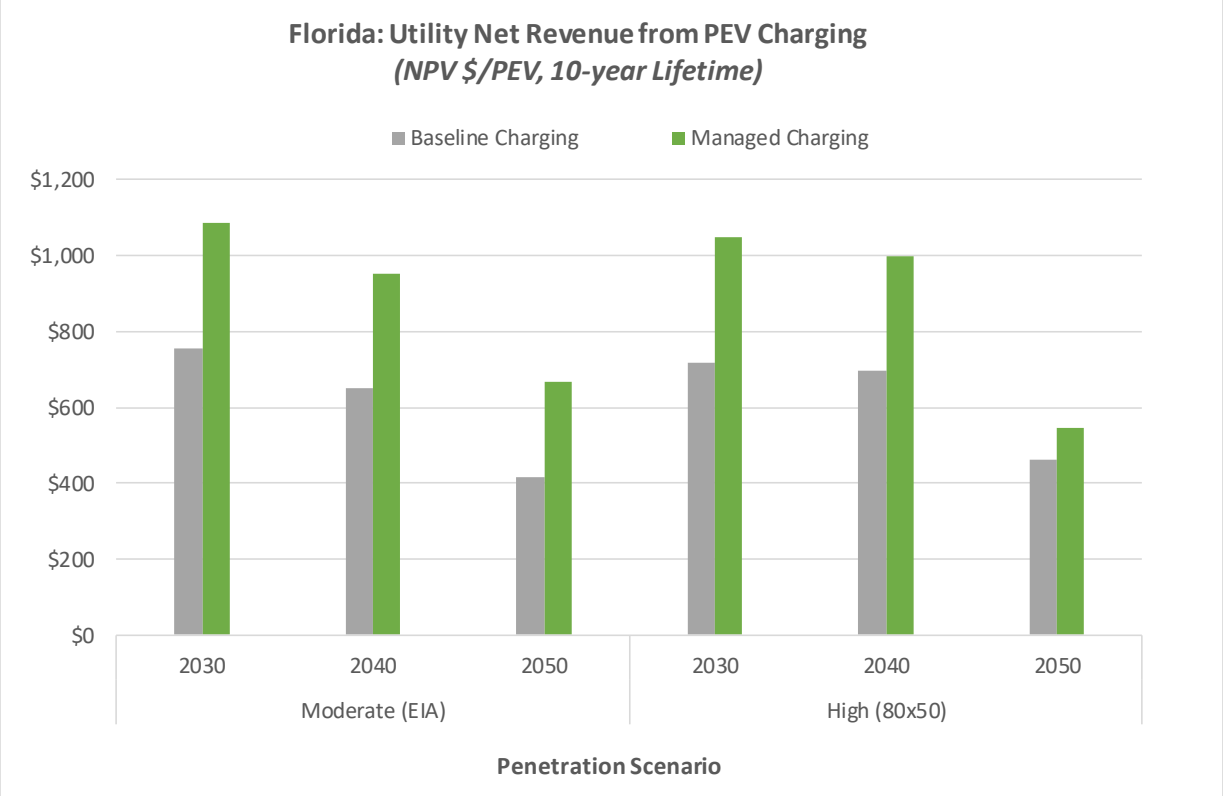
- $2.2 billion will accrue to electric utility customers in the form of reduced electric bills, and
- $9.5 billion will accrue directly to Florida drivers in the form of reduced annual vehicle operating costs.

Also shown in Figure 1, if PEV sales in Florida were high enough to get the state onto a trajectory to reduce light-duty GHG emissions by 70 – 80 percent from current levels by 2050 (80x50), the net present value of **cumulative net benefits from greater PEV use in Florida could exceed $106.2 billion state-wide by 2050**. Of these total net benefits:

- $21.7 billion would accrue to electric utility customers in the form of reduced electric bills, and
- $84.5 billion would accrue directly to Florida drivers in the form of reduced annual vehicle operating costs.

Utility customer savings result from net revenue received by the state's utilities, from selling electricity to charge PEVs. This net revenue is net of additional costs that would be incurred by utilities to secure additional generating capacity, and to upgrade distribution systems, to handle the incremental load from PEV charging. The NPV of projected life-time utility net revenue per PEV is shown in Figure 2. Assuming a ten-year life, the average PEV in Florida in 2030 is projected to increase utility net revenue by about $1,068 over its life-time, if charging is managed. PEVs in service in 2050 are projected to increase utility net revenue on average by about $607 over their life time (NPV) if charging is managed.

Figure 2 NPV of Projected Life-time Utility Net Revenue per PEV



In addition, by 2050 PEV owners are projected to save more than $925 per vehicle (nominal $) in annual operating costs, compared to owning gasoline vehicles. A large portion of this direct financial benefit to Florida drivers derives from reduced gasoline use—from purchase of lower cost, regionally produced electricity instead of gasoline imported to the state. Under the Moderate PEV (EIA) scenario, PEVs will reduce cumulative gasoline use in the state by more than 4.5 billion gallons through 2050 – this

cumulative gasoline savings grows to 51.3 billion gallons through 2050 under the high PEV (80x50) scenario. In 2050, annual average gasoline savings will be approximately 169 gallons per PEV under the Moderate PEV (EIA) scenario, while projected savings under the High PEV (80x50) scenario are nearly 207 gallons per PEV.

This projected gasoline savings will help to promote energy security and independence, and will keep more of vehicle owners' money in the local economy, thus generating even greater economic impact. Studies in other states have shown that the switch to PEVs can generate up to $570,000 in additional economic impact for every million dollars of direct savings, resulting in up to 25 additional jobs in the local economy for every 1,000 PEVs in the fleet [1].

In addition, this reduction in gasoline use will reduce cumulative net GHG emissions by over 47 million metric tons[2] through 2050 under the moderate PEV scenario, and over 536 million metric tons under the high PEV scenario. The switch from gasoline vehicles to PEVs is also projected to reduce annual NOx emissions in the state by over 1,100 tons in 2050 under the moderate PEV (EIA) scenario, and by over 17,300 tons under the high PEV (80x50) scenario.

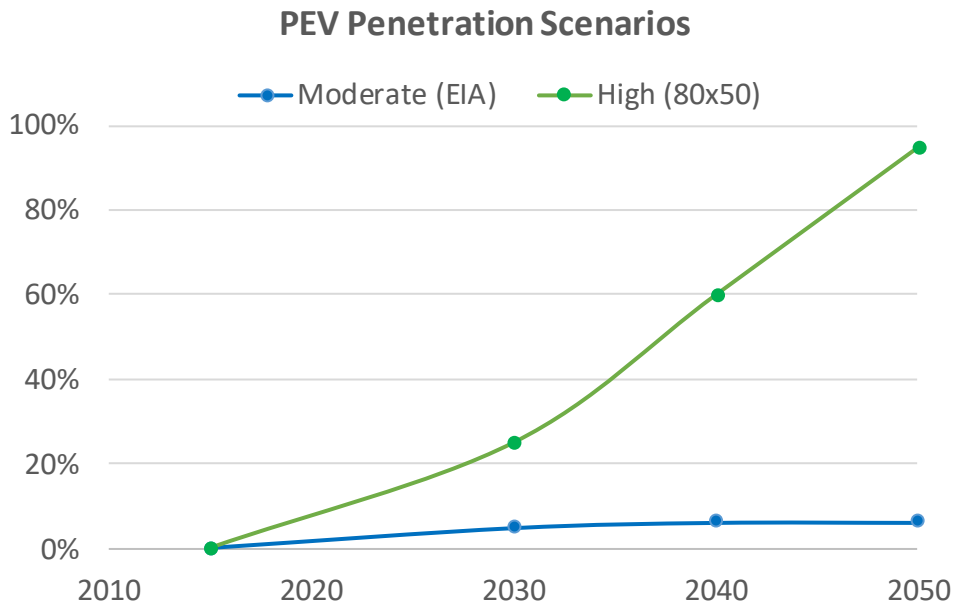
[2] Net of emissions from electricity generation

Study Results

This section summarizes the results of this study, including: the projected number of PEVs; electricity use and load from PEV charging; projected gasoline savings and GHG reductions compared to continued use of gasoline vehicles; financial benefits to utility customers from increased electricity sales; and projected financial benefits to Florida drivers compared to owning gasoline vehicles. All costs and financial benefits are presented as net present value (NPV), using a 3 percent discount rate.

Two different PEV penetration levels between 2030 and 2050 are utilized to estimate costs and benefits.[3] The "Moderate PEV" scenario is based on current projections of annual PEV sales from the Energy Information Administration (EIA). The "High PEV" scenario is based on the level of PEV penetration that would be required to get onto a trajectory to reduce light-duty GHG emissions in the state by 70 - 80 percent from current levels by 2050. The moderate PEV (EIA) scenario is essentially a "business as usual" scenario that continues current trends. However, the significantly higher levels of PEV penetration in the high 80x50 scenario are unlikely to be achieved without additional aggressive policy action at the state and local level, to incentivize individuals to purchase PEVs, and to support the necessary roll-out of PEV charging infrastructure. See Figure 3 for a comparison of the two scenarios through 2050.

Figure 3 Comparison of PEV Penetration Scenarios



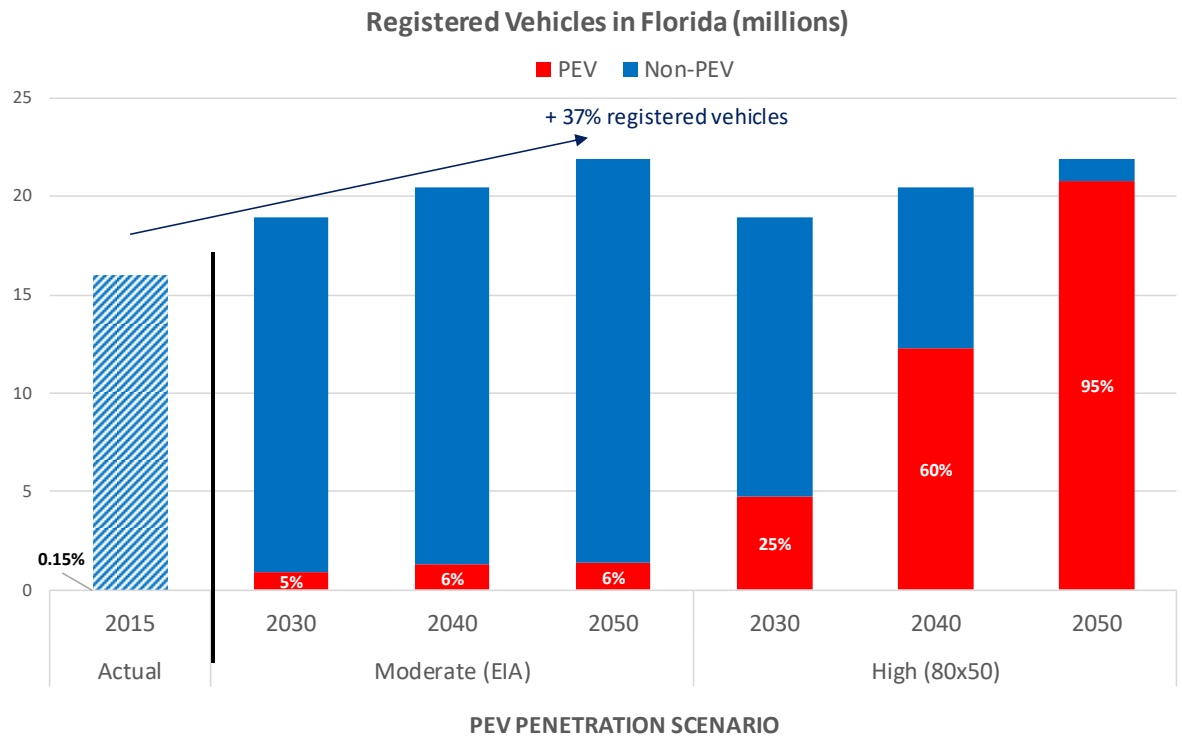
[3] PEVs include battery-electric vehicles (BEV) and plug-in hybrid vehicles (PHEV). This study focused on passenger vehicles and trucks; there are opportunities for electrification of non-road equipment and heavy-duty trucks and buses, but evaluation of these applications was beyond the scope of this study.

Plug-in Electric Vehicles, Electricity Use, and Charging Load

Vehicles and Miles Traveled

The projected number of PEVs and conventional gasoline vehicles in the Florida light duty fleet[4] under each PEV penetration scenario is shown in Figure 4, and the projected annual miles driven by these vehicles is shown in Figure 5. Under the Moderate PEV (EIA) scenario, the number of PEVs registered in Florida would increase from approximately 23,000 today to 931,000 in 2030, 1.25 million in 2040, and 1.36 million in 2050. Under the High PEV (80x50) scenario there would be 4.7 million PEVs in Florida by 2030, rising to 12.3 million in 2040, and 20.8 million in 2050. This equates to 25 percent of in-use light duty vehicles in Florida in 2030, rising to 60 percent in 2040 and 95 percent in 2050. [5]

Figure 4 Projected Florida Light Duty Fleet

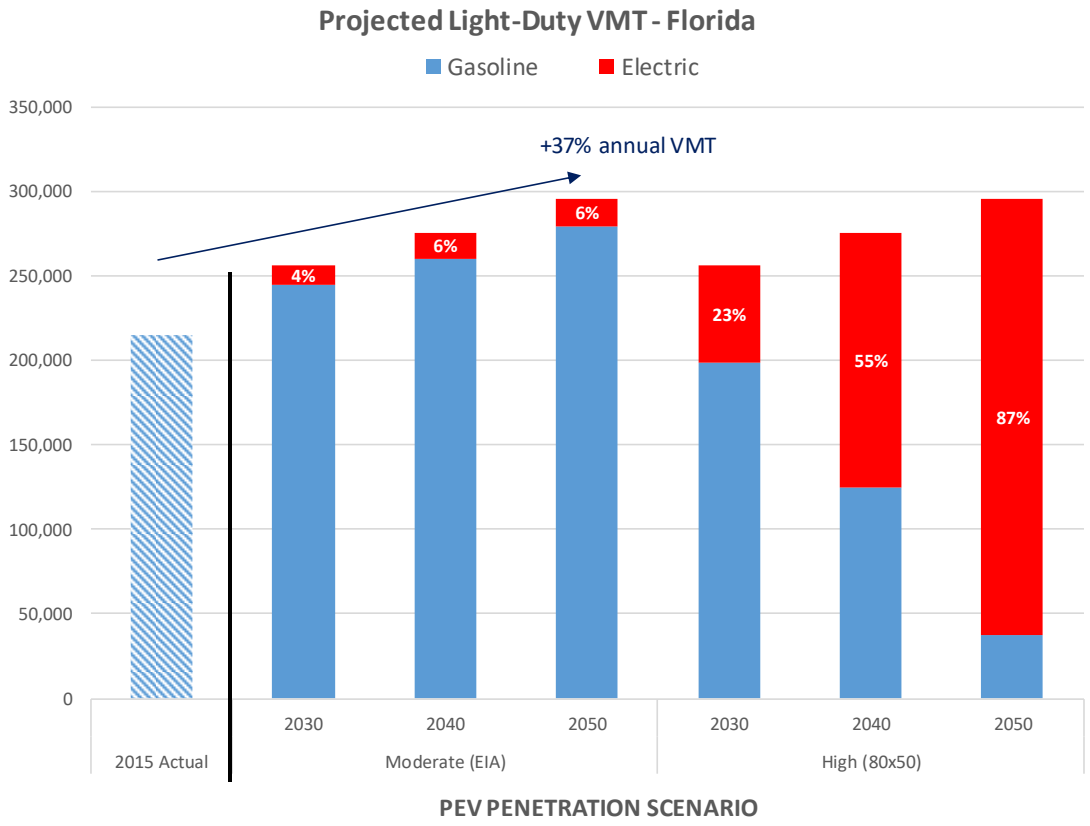


[4] This analysis only includes cars and light trucks. It does not include medium- or heavy-duty trucks and buses.

[5] Note that under both PEV penetration scenarios the percentage of total VMT driven by PEVs on electricity each year is lower than the percentage of PEVs in the fleet. This is because PHEVs are assumed to have a "utility factor" less than one – i.e., due to range restrictions a PHEV cannot convert 100 percent of the miles driven annually by a baseline gasoline vehicle into miles powered by grid electricity. In this analysis PHEVs are assumed to have an average utility factor of 85 percent.

This analysis estimates that under the High PEV (80x50) scenario Florida will reduce light-duty fleet gasoline consumption in 2050 by 69 percent compared to a baseline with no PEVs, due to 87 percent of fleet miles being driven by PEVs on electricity (Figure 5). However, to achieve this level of electric miles, 95 percent of light-duty vehicles will be PEVs, including PHEVs (Figure 4).

Figure 5 Projected Florida Light Duty Fleet Vehicle Miles Traveled (million miles)



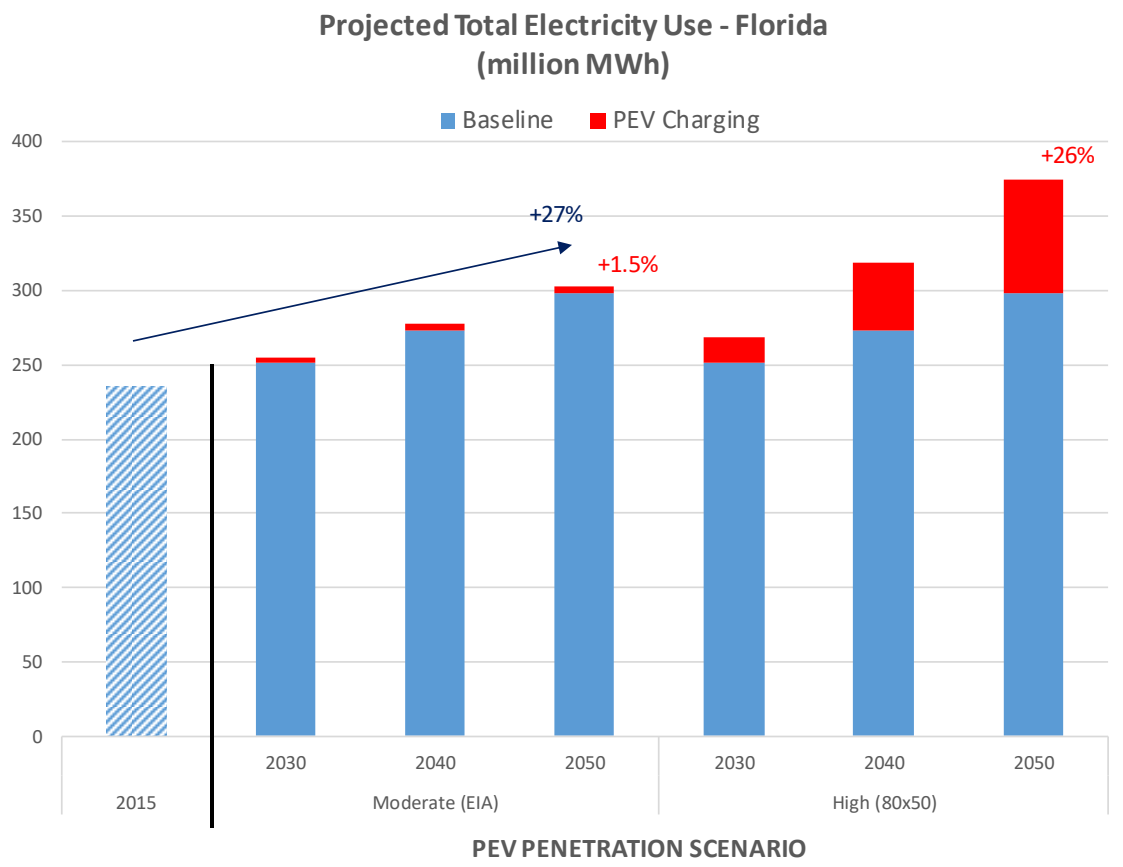
PEV Charging Electricity Use

The estimated total PEV charging electricity used in Florida each year under the PEV penetration scenarios is shown in Figure 6.

In Figure 6, projected baseline electricity use without PEVs is shown in blue and the estimated incremental electricity use for PEV charging is shown in red. State-wide electricity use in Florida is currently 235 million MWh per year. Annual electricity use is projected to increase to 250 million MWh in 2030 and continue to grow after that, reaching 300 million MWh in 2050 (27 percent greater than 2016 levels).

Under the Moderate PEV penetration scenario, electricity used for PEV charging is projected to be 3.5 million MWh in 2030 – an increase of about 1.4 percent over baseline electricity use. By 2050, electricity for PEV charging is projected to grow to 4.5 million MWh – an increase of 1.5 percent over baseline electricity use. Under the High PEV (80x50) scenario electricity used for PEV charging is projected to be 17.3 million MWh in 2030, growing to 76 million MWh and adding 26 percent to baseline electricity use in 2050.

Figure 6 Estimated Total Electricity Use in Florida



PEV Charging Load

This analysis evaluated the effect of PEV charging on the Florida electric grid under two different charging scenarios. Under both scenarios 75 percent of all PEVs are assumed to charge exclusively at home and 25 percent are assumed to charge at locations other than at home (i.e. at work or at other "public" chargers). Under the baseline charging scenario all Florida drivers who charge at home are assumed to plug-in their vehicles and start charging as soon as they arrive at home each day, while under the managed charging scenario a significant portion of PEV owners are assumed to participate in a utility managed charging program to minimize PEV charging load in the late afternoon and early evening when other electricity demand is high.[6]

See Figure 7 (baseline) and Figure 8 (managed) for a comparison of PEV charging load under the baseline and managed charging scenarios, using the 2040 High (80x50) PEV penetration scenario as an example. In each of these figures the 2016 Florida 95th percentile load (MW)[7] by time of day is plotted in orange, and the projected incremental load due to PEV charging is plotted in grey.

[6] Utilities have many policy options to incentivize managed PEV charging. This analysis does not compare the efficacy of different options. For this analysis, managed charging is modeled as 85% of PEV owners that arrive home between noon and 11 pm delaying the start of charging until between Midnight and 2 am. This is only one of many managed charging program options that are available to utilities.

[7] For each hour of the day actual load in 2016 was higher than the value shown on only 5 percent of days (18 days).

Figure 7 2040 Projected Florida PEV Charging Load, Baseline Charging (High PEV [80x50] scenario)

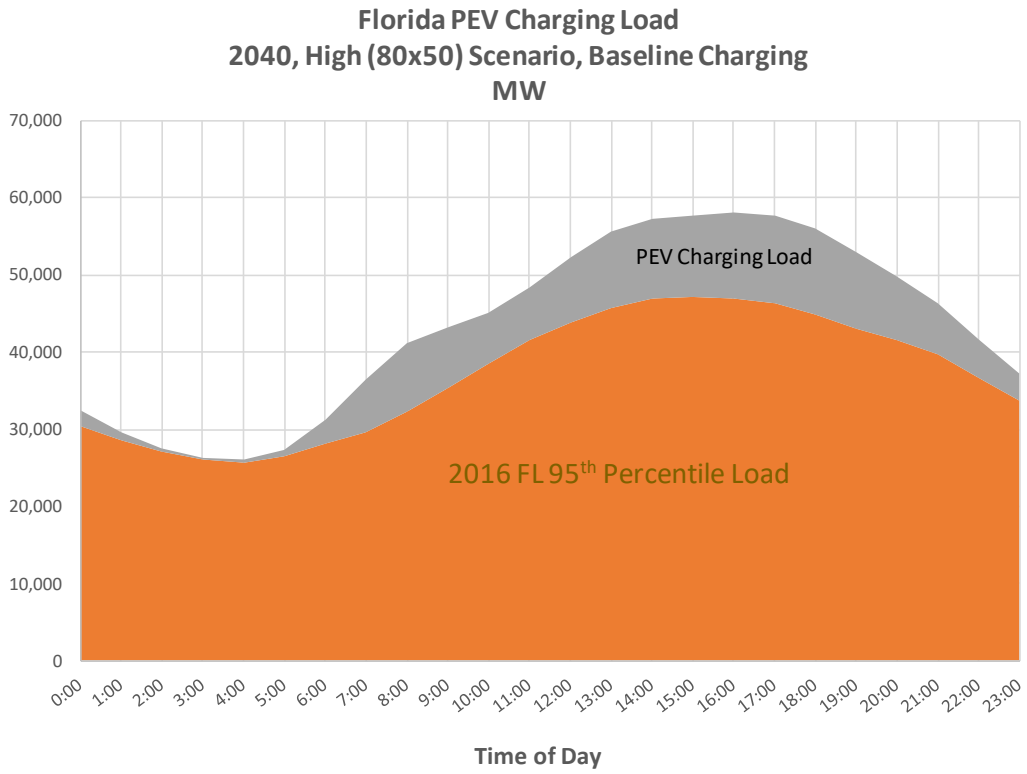
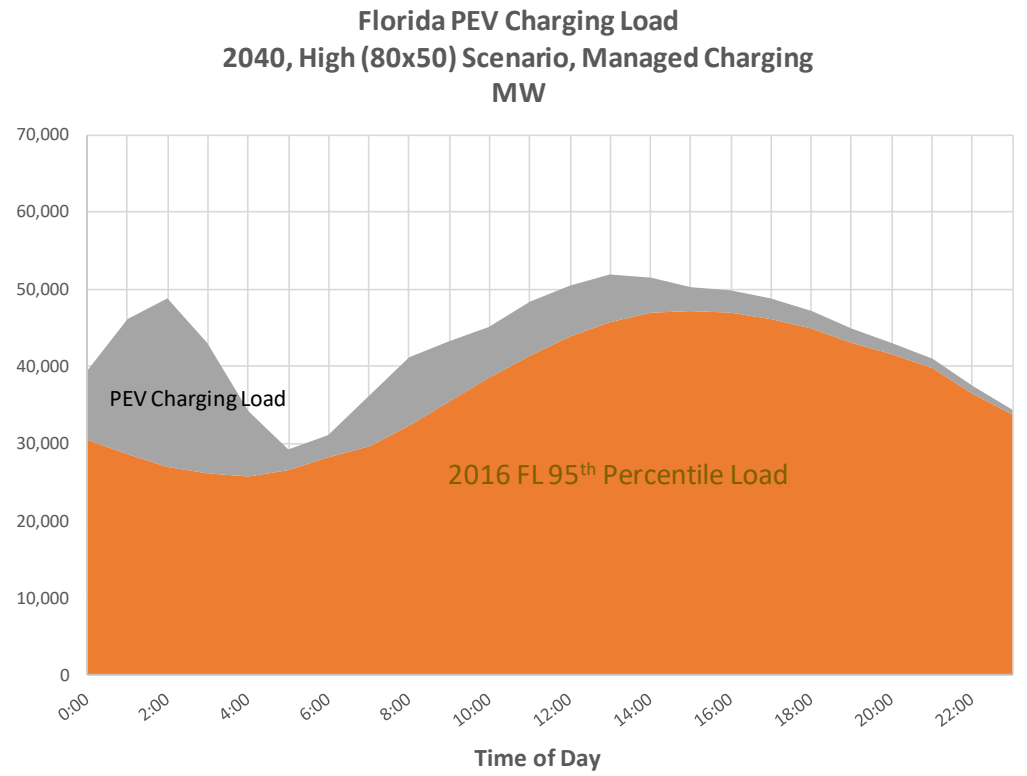


Figure 8 2040 Projected Florida PEV Charging Load, Managed Charging (High PEV [80x50] scenario)



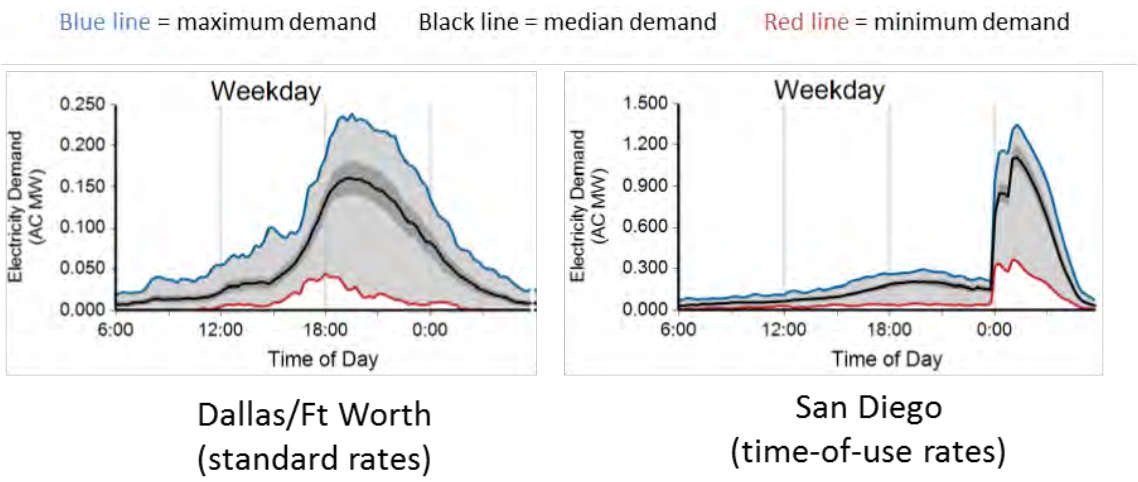
In 2016, daily electric load in Florida was generally less than 30,000 MW from midnight to 5 AM, then ramping up throughout the day to about 47,000 MW between 2 PM and 5 PM, and then falling off through the evening hours.[8]

As shown in Figure 7, baseline PEV charging is projected to add load primarily between 8 AM and 8 PM, as some people charge at work early in the day, but most charge at home in the late afternoon and early evening. Under the baseline charging scenario, the PEV charging peak coincides with the existing afternoon peak load period between 2 PM and 5 PM.

As shown in Figure 8, managed charging significantly reduces the incremental PEV charging load during the afternoon peak load period, but creates a secondary peak in the early morning hours, between midnight and 4 AM. The shape of this early morning peak can potentially be controlled based on the design of managed charging incentives.

These baseline and managed load shapes are consistent with real world PEV charging data collected by the EV Project, as shown in Figure 9. In Figure 9 the graph on the left shows PEV charging load in the Dallas/Ft Worth area where no managed charging incentive was offered to drivers. The graph on the right shows PEV charging load in the San Diego region, where the local utility offered drivers a time-of-use rate with significantly lower costs ($/kWh) for charging during the "super off-peak" period between midnight and 5 a.m. [2]

Figure 9 PEV Charging Load in Dallas/Ft Worth and San Diego areas, EV Project



See Table 1 for a summary of the projected incremental afternoon peak hour load (MW) in Florida, from PEV charging under each penetration and charging scenario. This table also includes a calculation of how much this incremental PEV charging load would add to the 2016 95th percentile peak hour load. Under the Moderate PEV (EIA) penetration scenario, PEV charging would add 875 MW of load during the afternoon peak load period on a typical weekday in 2030, which would increase the 2016 baseline peak load by about 1.9 percent. By 2050, the afternoon incremental PEV charging load would increase to 1,150 MW, adding 2.5 percent to the 2016 baseline afternoon peak. By comparison the afternoon peak hour PEV charging load in 2030 would be only 220 MW for the managed charging scenario, increasing to 306 MW in 2050.

[8] In Figures 7 and 8, 95th Percentile Load is shown for the entire state of Florida across the entire year.

Under the High PEV (80x50) penetration scenario, baseline PEV charging would increase the total 2016 afternoon peak electric load by about 42 percent in 2050, while managed charging would only increase it by about 32 percent.[9]

As discussed below, increased peak hour load increases a utility's cost of providing electricity, and may result in the need to upgrade distribution infrastructure. As such, managed PEV charging can provide additional net benefits to all utility customers, by reducing the cost of providing electricity used to charge PEVs.

Table 1 Projected Incremental Afternoon Peak Hour PEV Charging Load (MW)

		Moderate PEV (EIA)			High PEV (80x50)		
		2030	**2040**	**2050**	**2030**	**2040**	**2050**
Baseline Charging	PEV Charging (MW)	875	1,190	1,156	4,453	11,515	19,543
	Increase relative to 2016 Peak	1.9%	2.5%	2.5%	9.5%	24.5%	41.5%
Managed Charging	PEV Charging (MW)	220	300	306	1,122	2,902	15,240
	Increase relative to 2016 Peak	0.5%	0.6%	0.6%	2.4%	6.2%	32.4%

Utility Customer Benefits

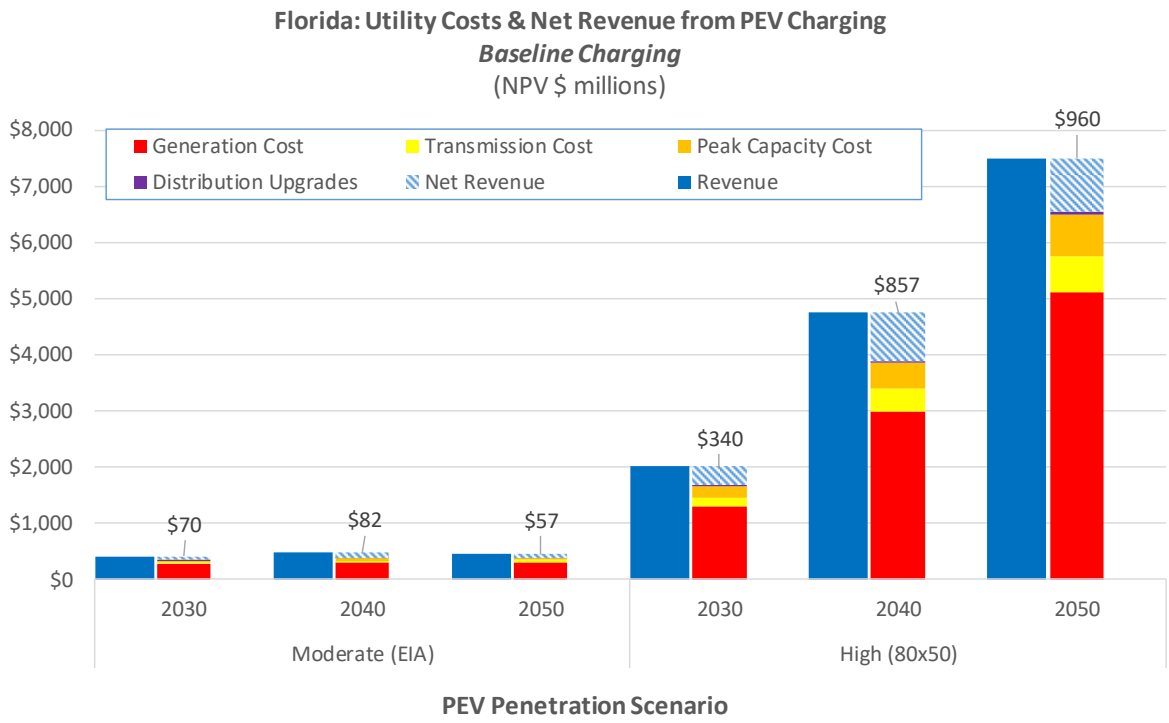
The estimated NPV of annual revenues and costs in 2030, 2040, and 2050, for Florida's electric utilities to supply electricity to charge PEVs under each penetration scenario are shown in Figure 10, assuming the baseline PEV charging scenario.

Under the Moderate PEV penetration scenario, the NPV of annual revenue from electricity sold for PEV charging in Florida is projected to total $408 million in 2030, rising to $444 million in 2050. Under the High PEV (80x50) scenario, the NPV of annual utility revenue from PEV charging is projected to total $2.0 billion in 2030, rising to $7.5 billion in 2050.

In Figure 10, projected annual utility revenue is shown in dark blue. The different elements of incremental annual cost that utilities would incur to purchase and deliver additional electricity to support PEV charging are shown in red (generation), yellow (transmission), orange (peak capacity), and purple (infrastructure upgrade cost). Generation and transmission costs are proportional to the total power (MWh) used for PEV charging, while peak capacity costs are proportional to the incremental peak load (MW) imposed by PEV charging. Infrastructure upgrade costs are costs incurred by the utility to upgrade their distribution infrastructure to handle the increased peak load imposed by PEV charging.

[9] Given projected significant increases in total state-wide electricity use through 2050, baseline peak load (without PEVs) is also likely to be higher in 2050 than 2016 peak load; as such the percentage increase in baseline peak load due to high levels of PEV penetration is likely to be lower than that shown in Table 1. The incremental costs of adding this peak capacity are accounted for in the analysis. As discussed below, even when accounting for these costs there are still net rate-payer benefits from high levels of PEV penetration. As the analysis shows, the net rate-payer benefits are higher with managed charging, because the cost of serving the incremental peak load is lower.

Figure 10 NPV of Projected Annual Utility Revenue and Costs from Baseline PEV Charging

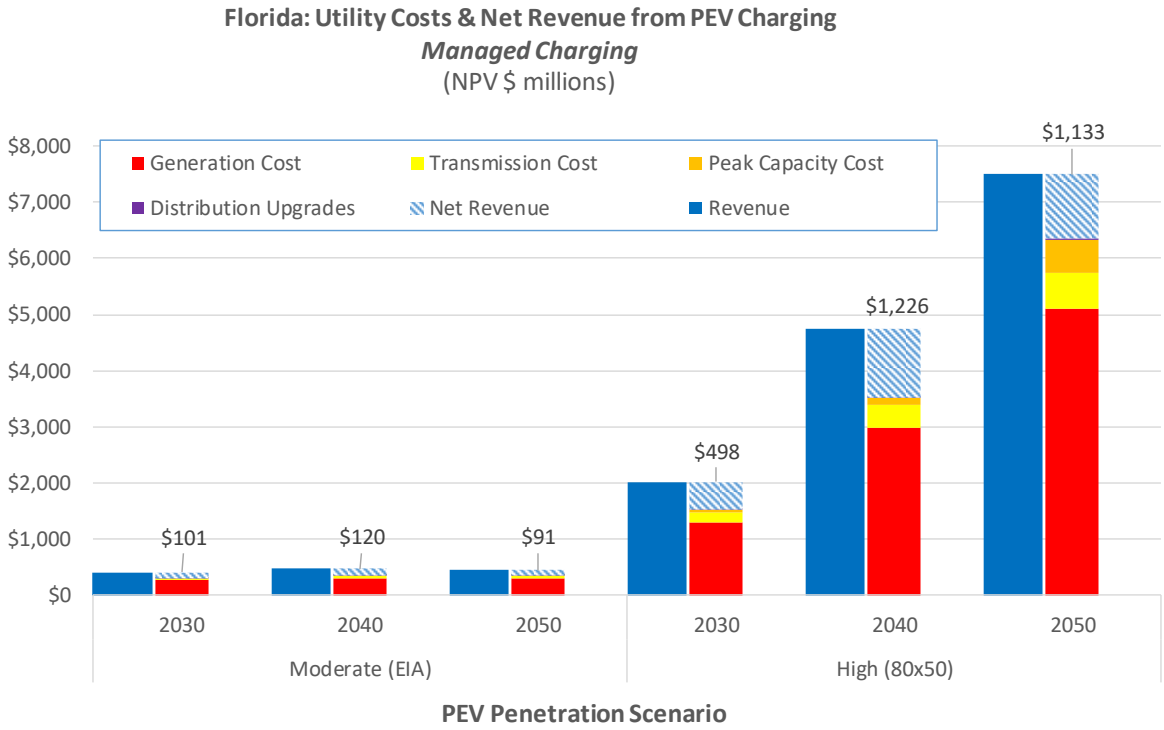


The striped light blue bars in Figure 10 represent the NPV of projected annual "net revenue" (revenue minus costs) that utilities would realize from selling additional electricity for PEV charging under each PEV penetration scenario in these years. Under the Moderate PEV penetration scenario, the NPV of net annual revenue in Florida is projected to total $70 million in 2030 and $57 million in 2050. Under the High PEV (80x50) scenario, the NPV of utility net annual revenue from PEV charging is projected to total $340 million in 2030, rising to $960 million in 2050. The NPV of projected annual utility net revenue averages $74 per PEV in 2030, and $41 - $46 per PEV in 2050.

Figure 11 summarizes the NPV of projected annual utility revenue, costs, and net revenue for managed charging under each PEV penetration scenario. Compared to baseline charging (Figure 10) projected annual revenue, and projected annual generation and transmission costs are the same, but projected annual peak capacity and infrastructure costs are lower due to a smaller incremental peak load (see Table 1).

Compared to baseline charging, managed charging will increase the NPV of annual utility net revenue by $31 million in 2030 and $34 million in 2050 under the Moderate PEV penetration scenario, due to lower costs. Under the High PEV (80x50) scenario, managed charging will increase the NPV of annual utility net revenue by $157 million in 2030 and $173 million in 2050. This analysis estimates that compared to baseline charging, managed charging will increase the NPV of annual utility net revenue by $33 per PEV in 2030 and $8 - $25 per PEV in 2050.

Figure 11 NPV of Projected Annual Utility Revenue and Costs from Managed PEV Charging



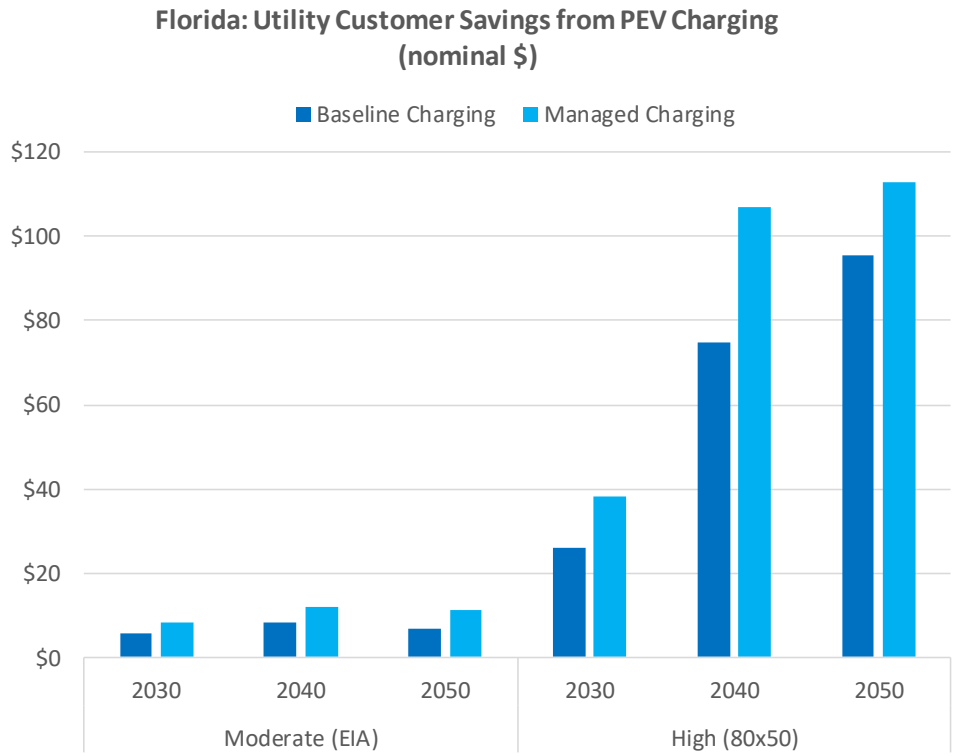
In general, a utility's costs to maintain their distribution infrastructure increase each year with inflation, and these costs are passed on to utility customers in accordance with rules established by the Florida Public Utility Commission (PUC), via periodic increases in residential and commercial electric rates. However, under the PUC rules net revenue from additional electricity sales generally offset the allowable costs that can be passed on via higher rates. As such, the majority of projected utility net revenue from increased electricity sales for PEV charging would in fact be passed on to utility customers in Florida, not retained by the utility companies.

Under current rate structures this net revenue would in effect put downward pressure on future rates, delaying or reducing future rate increases, thereby reducing electric bills for all customers. See Figure 12 for a summary of how the projected utility net revenue from PEV charging could affect average annual residential electricity bills for all Florida electric utility customers.[10] As shown in the figure, under the High PEV (80x50) scenario projected average electric rates in Florida could be reduced up to 3.0 percent in 2050 due to net revenue from PEV charging, resulting in an annual savings of approximately $113 (nominal dollars) per household in Florida.

It must be noted that how this utility net revenue from PEV charging gets distributed is dependent on rate structure. Potential changes to current rates - to specifically incentivize off-peak PEV charging - could shift some or all of this benefit to PEV owners, thus reducing their electricity costs for vehicle charging without reducing costs for non-PEV owners. In either case, rate payers who do not own a PEV will not be harmed by transportation electrification, and may benefit indirectly even if they continue to own gasoline vehicles.

[10] Based on 2016 average electricity use of 13,240 kWh per housing unit in Florida

Figure 12 Potential Effect of PEV Charging Net Revenue on Utility Customer Bills (nominal $)



Florida Driver Benefits

Current PEVs are more expensive to purchase than similar sized gasoline vehicles, but they are eligible for various government purchase incentives, including up to a $7,500 federal tax credit. These incentives are important to spur an early market, but as described below PEVs are projected to provide a lower total cost of ownership than conventional vehicles in Florida by about 2035, even without government purchase subsidies.

The largest contributor to incremental purchase costs for PEVs compared to gasoline vehicles is the cost of batteries. Battery costs for light-duty plug-in vehicles have fallen from over $1,000/kWh to less than $300/kWh in the last six years; many analysts and auto companies project that battery prices will continue to fall – to below $110/kWh by 2025, and below $75/kWh by 2030. [3]

Based on these battery cost projections, this analysis projects that the average annual cost of owning a PEV in Florida will fall below the average cost of owning a gasoline vehicle by 2035, even without government purchase subsidies.[11] See Table 2 which summarizes the average projected annual cost of Florida PEVs and gasoline vehicles under each penetration scenario.

All costs in Table 2 are in nominal dollars, which is the primary reason why costs for both gasoline vehicles and PEVs are higher in 2040 and 2050 than in 2030 (due to inflation). In addition, the penetration scenarios assume that the relative number of PEV cars and higher cost PEV light trucks will change over time; in particular the High PEV (80x50) scenario assumes that there will be a significantly higher percentage of PEV light trucks in the fleet in 2050 than in 2030, which further increases the average PEV purchase cost in 2050 compared to 2030.

[11] The analysis assumes that all battery electric vehicles in-use after 2030 will have 200-mile range per charge and that all plug-in hybrid vehicles will have 50-mile all-electric range.

Table 2 Projected Fleet Average Vehicle Costs to Vehicle Owners (nominal $)

GASOLINE VEHICLE		Moderate (EIA)			High (80x50)		
		2030	2040	2050	2030	2040	2050
Vehicle Purchase	$/yr	$5,296	$5,899	$7,221	$4,488	$6,171	$8,260
Gasoline	$/yr	$1,423	$1,613	$1,933	$1,389	$1,732	$2,232
Maintenance	$/yr	$310	$375	$463	$307	$384	$485
TOTAL ANNUAL COST	**$/yr**	**$7,029**	**$7,888**	**$9,618**	**$6,183**	**$8,288**	**$10,976**

PEV -FL		Moderate (EIA)			High (80x50)		
Baseline Charging/Standard Rate		2030	2040	2050	2030	2040	2050
Vehicle Purchase	$/yr	$5,296	$5,899	$7,221	$5,081	$6,312	$8,472
Electricity	$/yr	$682	$774	$919	$661	$811	$1,014
Gasoline	$/yr	$95	$113	$133	$92	$120	$151
Personal Charger	$/yr	$81	$99	$122	$81	$99	$122
Maintenance	$/yr	$190	$230	$284	$189	$233	$292
TOTAL ANNUAL COST	**$/yr**	**$6,343**	**$7,115**	**$8,678**	**$6,105**	**$7,575**	**$10,051**
Savings per PEV	**$/yr**	**$685**	**$773**	**$939**	**$79**	**$713**	**$925**

As shown in Table 2, under the High PEV Scenario (80x50) even in 2050 average PEV purchase costs are projected to be higher than average purchase costs for gasoline vehicles (with no government subsidies), but the annualized effect of this incremental purchase cost is outweighed by significant fuel cost savings, as well as savings in scheduled maintenance costs. For the Moderate PEV Scenario in 2030, the average Florida PEV owner is projected to have annual operating savings of $685 due to reduced maintenance as well as electricity costs being lower than gasoline[12]. For both scenarios, this annual savings is projected to increase to $925 - $939 per PEV per year by 2050, as projected gasoline prices continue to increase faster than projected electricity prices.

The NPV of total annual cost savings to Florida drivers from greater PEV ownership are projected to be $410 million in 2030 rising to $454 million in 2050 under the moderate PEV penetration scenario. Under the High PEV (80x50) scenario, the NPV of total annual cost savings to Florida drivers from greater PEV ownership are projected to be $239 million in 2030, rising to $6.8 billion in 2050.

[12] Under the moderate PEV (EIA) scenario, this analysis assumes that PEV owners will pay the same net purchase price for gasoline vehicles and PEVs, despite the higher projected purchase price of comparable PEVs. There is evidence that current PEV purchasers are foregoing the purchase of more expensive vehicles to purchase higher-priced PEVs within their target budget. With only modest future PEV penetration this analysis assumes that this behavior will continue. However, for the High PEV scenario net PEV owner benefits reflect the fact that PEV purchasers will pay a higher price for their PEVs than they would have paid for a similar gasoline vehicle.

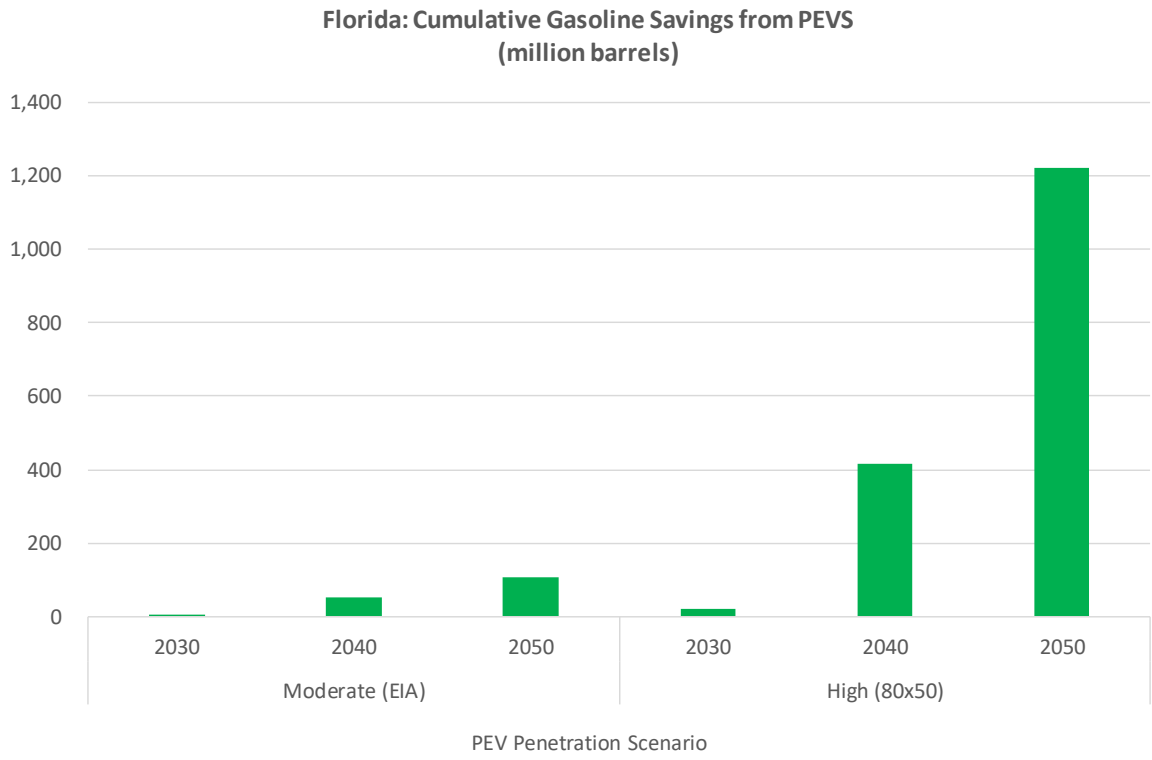
Other Benefits

Energy Security and Emissions Reductions

Along with the financial benefits to electric utility customers and PEV owners described above, light-duty vehicle electrification can provide additional benefits, including significant reductions in gasoline fuel use and transportation sector emissions.

The estimated cumulative fuel savings (barrels of gasoline[13]) from PEV use in Florida under each penetration scenario are shown in Figure 13. Annual fuel savings under the Moderate PEV penetration scenario are projected to total 4.6 million barrels in 2030, with cumulative savings of more than 107 million barrels by 2050. For the High PEV (80x50) scenario, annual fuel savings in 2030 are projected to be 21.9 million barrels, and by 2050 cumulative savings will exceed 1.2 billion barrels.

Figure 13 Cumulative Gasoline Savings from PEVs in Florida



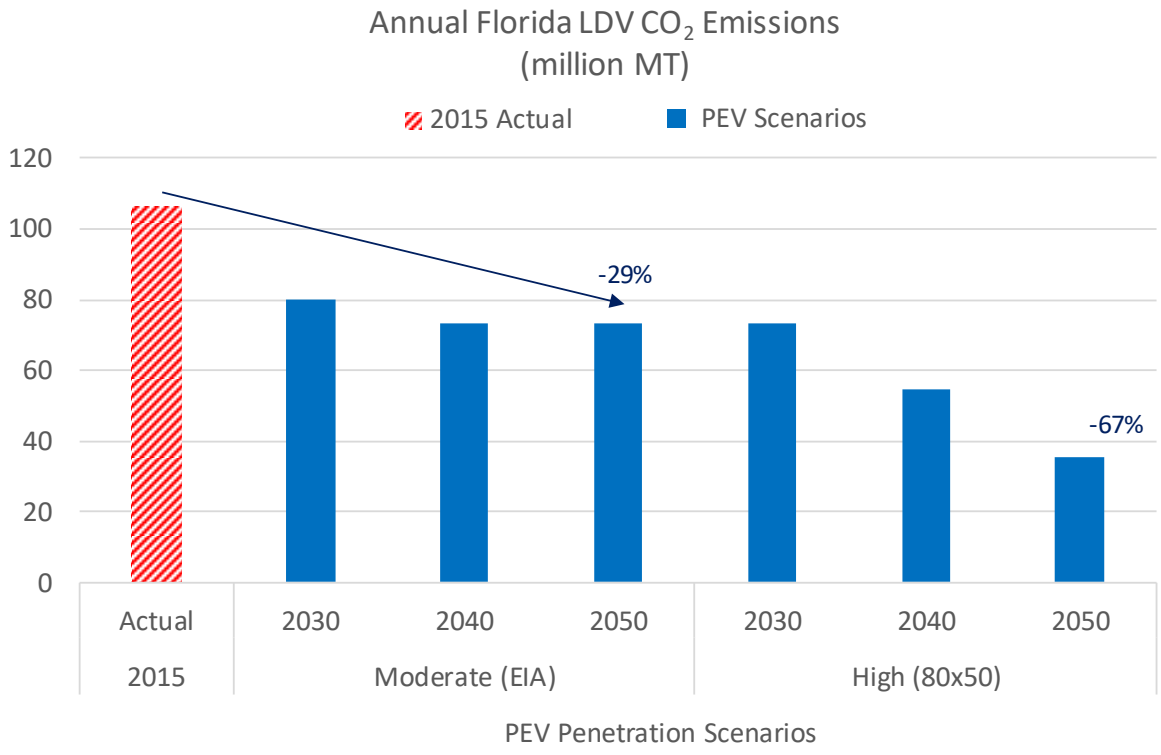
These fuel savings can help put the U.S. on a path toward energy independence, by reducing the need for imported petroleum. In addition, a number of studies have demonstrated that EVs can generate significantly greater local economic impact than gasoline vehicles - including generating additional local jobs - by keeping more of vehicle owners' money in the local economy rather than sending it out of state by purchasing gasoline.

Economic impact analyses for the states of California, Florida, Ohio and Oregon have estimated that for every million dollars in direct PEV owner savings, an additional $0.29 - $0.57 million in secondary economic benefits will be generated within the local economy, depending on PEV adoption scenario. These studies also estimated that between 13 and 25 additional in-state jobs will be generated for every 1,000 PEVs in the fleet. [1]

[13] One barrel of gasoline equals 42 US gallons

The projected annual greenhouse gas (GHG) emissions (million metric tons carbon-dioxide equivalent, CO_2-e million tons) from the Florida light duty fleet under each PEV penetration scenario are shown in Figure 14. In this figure, projected emissions under the PEV scenarios are shown in blue. The values shown represent "wells-to-wheels" emissions, including direct tailpipe emissions and "upstream" emissions from production and transport of gasoline. Estimated emission for the PEV scenarios includes GHG emissions from generating electricity to charge PEVs, as well as GHG emissions from gasoline vehicles in the fleet. Estimated emissions from PEV charging are based on EIA projections of average carbon intensity for the SERC Reliability Corporation /Central electricity market module region, which includes Florida.

Figure 14 Projected GHG Emissions from the Light Duty Fleet in Florida



As shown in Figure 14, GHG emissions from the light duty fleet in Florida were approximately 107 million metric tons in 2015.

Compared to 2015 baseline emissions, in 2050 GHG emissions are projected to be reduced by up to 33.1 million tons under the Moderate PEV penetration scenario and as much as 71 million tons under the High PEV (80x50) scenario. Through 2050, cumulative net GHG emissions are projected to be reduced by nearly 660 million tons under the Moderate PEV penetration scenario and 1.09 billion metric tons under the High PEV (80x50) scenario.

NOx Emissions

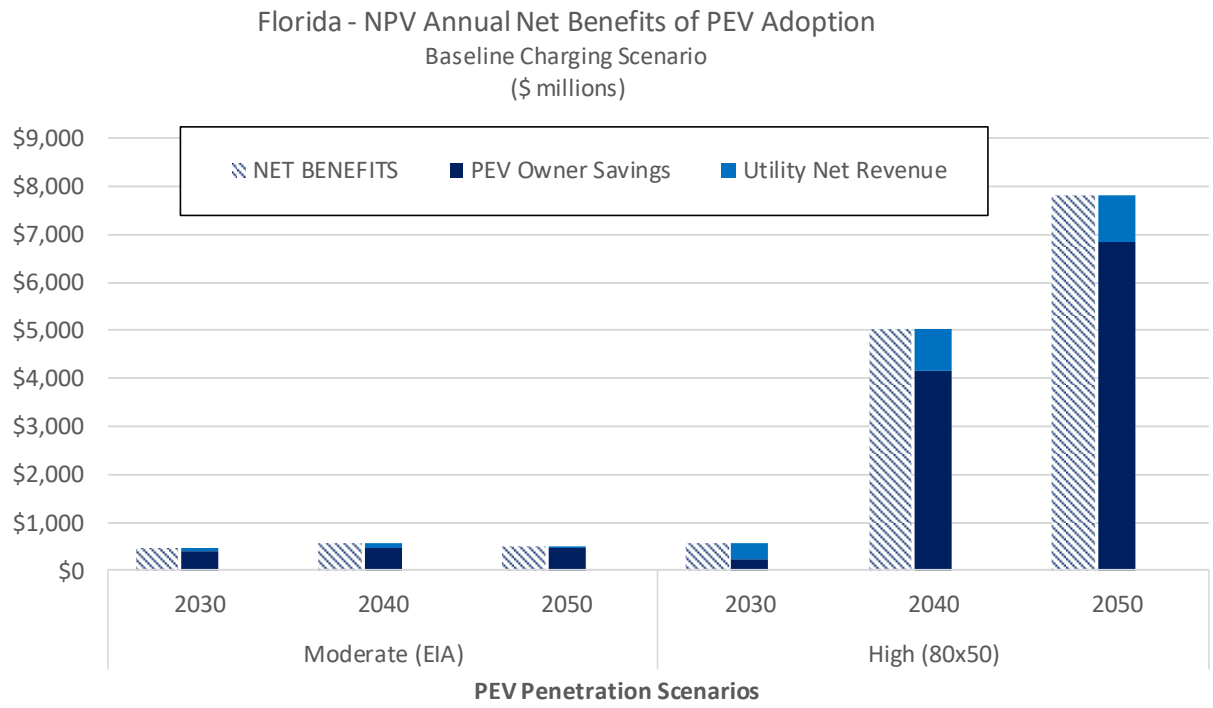
In 2015 the Electric Power Research Institute (EPRI), in conjunction with the Natural Resources Defense Council (NRDC), conducted national-level modeling to estimate GHG and air quality benefits from high levels of transportation electrification [4]. Under their electrification scenario EPRI estimated that NOx would be reduced by 11.4 tons and VOCs would be reduced by 5.5 tons, for every billion vehicle miles traveled[14].

Extrapolating from this data, under the Moderate PEV Scenario (EIA), by 2050 light-duty vehicle electrification in Florida could reduce annual NOx emissions by 1,111 tons and reduce annual VOC emissions by 536 tons. Under the High PEV Scenario (80x50), total NOx reductions in 2050 could reach more than 17,300 tons per year, and total VOC reductions could reach almost 8,350 tons per year.[15]

Total Societal Benefits

The NPV of total annual estimated benefits from increased PEV use in Florida under each PEV penetration scenario are summarized in Figures 15 and 16. These benefits include cost savings to Florida drivers and utility customer savings from reduced electric bills. Figure 15 shows the NPV of annual projected societal benefits if Florida drivers charge in accordance with the baseline charging scenario. Figure 16 shows the NPV of projected annual benefits with managed charging.

Figure 15 Projected NPV of Total Societal Benefits from Greater PEV use in FL – Baseline Charging



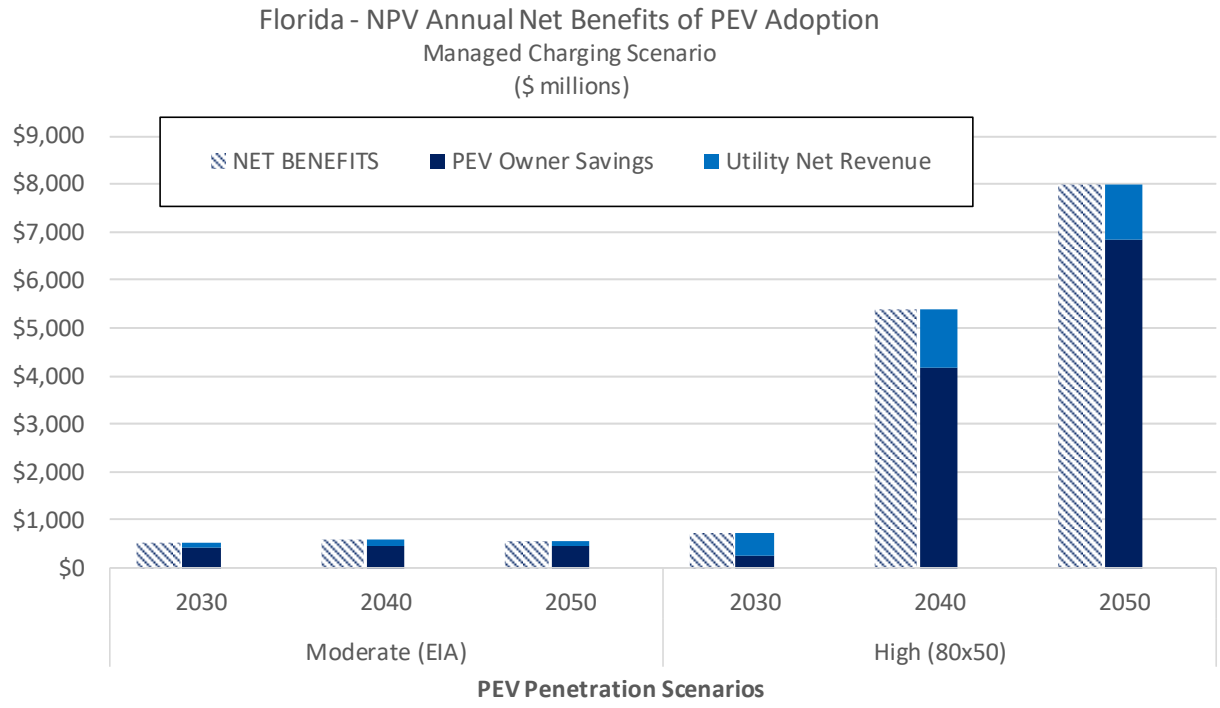
[14] For light-duty vehicles the analysis assumed that by 2030 approximately 17 percent of annual vehicle miles would be powered by grid electricity, using PEVs. Based on current and projected electric sector trends the analysis also assumed that approximately 49 percent of the incremental power required for transportation electrification in 2030 would be produced using solar and wind, with the remainder produced by combined cycle natural gas plants.

[15] Across the entire state, estimated annual light-duty vehicle miles traveled (VMT) totals 2.96 trillion miles in 2050. Of these miles approximately, 6 percent are powered by grid electricity under the EIA penetration scenario, and 87 percent are powered by grid electricity under the 80x50 penetration scenario

As shown in Figure 15, the NPV of annual benefits is projected to be a minimum of $510 million per year in 2050 under the Moderate PEV penetration scenario and $7.8 billion per year in 2050 under the High PEV (80x50) scenario. Approximately 88 percent of these annual benefits will accrue to Florida drivers as a cash savings in vehicle operating costs and 12 percent will accrue to electric utility customers as a reduction in annual electricity bills.

As shown in Figure 16, the NPV of annual benefits in 2050 will increase by $34.1 million under the Moderate PEV (EIA) penetration scenario, and $173 million under the High PEV (80x50) scenario with managed charging. Of these increased benefits, all will accrue to electric utility customers as an additional reduction in their electricity bills.

Figure 16 Projected NPV of Total Societal Benefits from Greater PEV use in FL – Managed Charging



Study Methodology

This section briefly describes the methodology used for this study. For more information on how this study was conducted, including a complete discussion of the assumptions used and their sources, see the report: *Mid-Atlantic and Northeast Plug-in Electric Vehicle Cost-Benefit Analysis, Methodology & Assumptions* (October 2016).[16] This report can be found at:

http://mjbradley.com/sites/default/files/NE_PEV_CB_Analysis_Methodology.pdf

This study evaluated the costs and benefits of two distinct levels of PEV penetration in Florida between 2030 and 2050, based on the range of publicly available PEV adoption estimates from various analysts.

Moderate PEV Scenario –EIA: Based on EIA's current projections for new PEV sales between 2015 and 2050, as contained in the 2017 Annual Energy Outlook (AEO). Under this scenario approximately 4.9 percent of in-use light duty vehicles in Florida will be PEV in 2030, rising to 6.2 percent in 2040 and remaining steady through 2050.

High PEV Scenario – 80x50: PEV penetration levels each year that would put the state on a trajectory to reduce total annual light-duty fleet GHG emissions by 70 – 80 percent from current levels in 2050. Under this scenario 25 percent of in-use vehicles will be PEV in 2030, rising to 60 percent in 2040 and 95 percent in 2050.

Both of these scenarios are compared to a baseline scenario with very little PEV penetration, and continued use of gasoline vehicles. The baseline scenario is based on future annual vehicle miles traveled (VMT) and fleet characteristics (e.g., cars versus light trucks) as projected by the Energy Information Administration in their most recent Annual Energy Outlook (AEO 2017).

Based on assumed future PEV characteristics and usage, the analysis projects annual electricity use for PEV charging at each level of penetration, as well as the average load from PEV charging by time of day. The analysis then projects the total revenue that Florida's electric distribution utilities would realize from sale of this electricity, their costs of providing the electricity to their customers, and the potential net revenue (revenue in excess of costs) that could be used to support maintenance of the distribution system.

The costs of serving PEV load include the cost of electricity generation, the cost of transmission, incremental peak generation capacity costs for the additional peak load resulting from PEV charging, and annual infrastructure upgrade costs for increasing the capacity of the secondary distribution system to handle the additional load.

For each PEV penetration scenario this analysis calculates utility revenue, costs, and net revenue for two different PEV charging scenarios: 1) a baseline scenario in which all PEVs are plugged in and start to charge as soon as they arrive at home each day, and 2) a managed charging scenario in which a significant portion of PEVs that arrive home between noon and 11 PM each day delay the start of charging until after midnight.

Real world experience from the EV Project demonstrates that, without a "nudge", drivers will generally plug in and start charging immediately upon arriving home after work (scenario 1), exacerbating system-wide evening peak demand.[17] However, if given a "nudge" - in the form of a properly designed and marketed financial

[16] This analysis used the same methodology as described in the referenced report, but used different PEV penetration scenarios, as described here. In addition, for this analysis fuel costs and other assumptions taken from the Energy Information Administration (EIA) were updated from EIA's Annual Energy Outlook 2016 to those in the Annual Energy Outlook 2017. Finally, for projections of future PEV costs this analysis used updated July 2017 battery cost projections from Bloomberg New Energy Finance.

[17] The EV Project is a public/private partnership partially funded by the Department of Energy which has collected and analyzed operating and charging data from more than 8,300 enrolled plug-in electric vehicles and approximately 12,000 public and residential charging stations over a two-year period.

incentive - many Florida drivers will choose to delay the start of charging until later times, thus reducing the effect of PEV charging on evening peak electricity demand (scenario 2). [5]

For each PEV penetration scenario, this analysis also calculates the total incremental annual cost of purchase and operation for all PEVs in the state, compared to "baseline" purchase and operation of gasoline cars and light trucks. For both PEVs and baseline vehicles annual costs include the amortized cost of purchasing the vehicle, annual costs for gasoline and electricity, and annual maintenance costs. For the Moderate PEV Scenario, it was assumed that PEV vehicle costs are the same as baseline gasoline vehicles, with the reasoning that consumers have a set budget and will purchase what they can afford, regardless of technology type. For the High PEV Scenario, the same logic could not be applied, as it is assumed that nearly all vehicle purchases will be PEV. For PEVs it also includes the amortized annual cost of the necessary home charger. This analysis is used to estimate average annual financial benefits to Florida drivers.

Finally, for each PEV penetration scenario this analysis calculates annual greenhouse gas (GHG) emissions from electricity generation for PEV charging, and compares that to baseline emissions from operation of gasoline vehicles. For the baseline and PEV penetration scenarios GHG emissions are expressed as carbon dioxide equivalent emissions (CO_2-e) in metric tons (MT). GHG emissions from gasoline vehicles include direct tailpipe emissions as well as "upstream" emissions from production and transport of gasoline.

For each PEV penetration scenario GHG emissions from PEV charging are calculated based on an electricity scenario that is consistent with the latest Energy Information Administration (EIA) projections for future SERC Reliability Corporation / Virginia -Carolina.

Net annual GHG reductions from the use of PEVs are calculated as baseline GHG emissions (emitted by gasoline vehicles) minus GHG emissions from each PEV penetration scenario.

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[5] Idaho National Laboratory, *2013 EV Project Electric Vehicle Charging Infrastructure Summary Report*, January 2013 through December 2013

Acknowledgements

Lead Authors: Dana Lowell, Brian Jones, and David Seamonds

This study was conducted by M.J. Bradley & Associates for Duke Energy. It is one of six state-level analyses that will be conducted of plug-in electric vehicle costs and benefits in the different U.S. states in which Duke operates. These studies are intended to provide input to state policy discussions about actions required to promote further adoption of electric vehicles, as well as to inform internal Duke planning efforts.

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-2, SUB 1197
DOCKET NO. E-7, SUB 1195

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of Application by Duke Energy Progress, LLC, and Duke Energy Carolinas, LLC, for Approval of Proposed Electric Transportation Pilot	))))	PUBLIC STAFF'S COMMENTS

NOW COMES THE PUBLIC STAFF - North Carolina Utilities Commission (Public Staff), by and through its Executive Director, Christopher J. Ayers, pursuant to N.C. Gen. Stat. § 62-140 and other applicable rules of the Commission, and provides the following comments on the unverified application (Application) filed March 29, 2019, by Duke Energy Progress, LLC (DEP) and Duke Energy Carolinas, LLC (DEC) (collectively "Companies"), for approval of their respective Electric Transportation Pilots (ET Pilots).

INTRODUCTION

The Public Staff engaged in a robust investigation of the Companies' application and exhibits. The Public Staff's investigation included reviewing the Companies' responses to numerous data requests and researching electric vehicle (EV) and EV infrastructure activities being undertaken in other states, including pilot programs by DEC and DEP affiliates. The research also included a

review of pilot programs of other electric utilities and available grant programs.[1] Members of the Public Staff conducted conference calls with employees of the Department of Public Instruction regarding school bus purchasing and the North Carolina Department of Environmental Quality (DEQ) regarding the status of the Volkswagen Settlement Environmental Mitigation Trust Funds (VW Trust).[2] The Public Staff also met with employees of the South Carolina Office of Regulatory Staff to learn more about the Companies' pending ET pilot program in South Carolina. Finally, the Public Staff engaged in discussions with the Companies regarding our findings.

As a result of this investigation, the Public Staff concludes that the Companies' overall proposal does not meet the parameters of a pilot in which the Companies would undertake a proof-of-concept through a scalable project. The Companies have failed to demonstrate that spending $76 million over a three-year period is necessary to learn more about serving current and future EV load. The Companies and their affiliates have conducted similar programs both in North Carolina and in other jurisdictions. The Companies have provided no evidence demonstrating that North Carolina customers are sufficiently unique to justify another pilot program or that the results of previous or ongoing pilot projects are insufficient to meet the Companies' needs. There is also a significant amount of

[1] See, e.g., the U.S. Department of Transportation's grant program for transit bus technology at https://www.transit.dot.gov/about/news/FY18-Low-No-Project-Selections.

[2] The Public Staff understands that the DEQ released its VW Trust request for proposals (RFP) in June 2019 from parties seeking funds to mitigate nitrous-oxide emissions from mobile sources (diesel-fueled vehicles). https://deq.nc.gov/news/press-releases/2019/06/17/state-releases-requests-proposals-phase-1-volkswagen-settlement-funds. This would provide funding for purchasing electric school buses and transit buses. A second RFP will provide funding for the installation of fast charging infrastructure.

industry-level data available to help inform the Companies' evaluation and design of EV programs. Finally, the proposal contains no metrics or other standards for evaluating whether the programs are successful and appropriate to expand and implement in the future.

To be clear, the Public Staff is not opposed to transportation electrification. However, though the Companies frame their request as a "pilot" with associated "pilot" tariffs, the Companies are essentially requesting pre-approval of EV infrastructure investments that would be funded by customers. Absent a certification requirement, the Commission generally does not preapprove utility capital investments. Instead, utilities make capital investments in the normal course of business and seek cost recovery in a general rate case. Thus, the Companies' application for preapproval of these programs is misplaced. For this and all of the reasons enumerated above, the Public Staff recommends that the Commission deny the Companies' application.

DESCRIPTION OF THE PROGRAMS

According to the application, the proposed ET Pilots consist of seven individual programs. The programs are as follows:

Residential EV Charging Program

Under the proposed Residential Charging Program, the Companies would provide a rebate of $1,000 per installation for up to 500 DEC and 300 DEP residential customers to install qualifying, level 2, electric vehicle

supply equipment (EVSE). In exchange, the customers would allow the Companies to gather data and have onboard load control capability.[3] The estimated cost of this program is $1.175 million for DEC, and $705,000 for DEP, for a total of $1.88 million.

Fleet EV Charging Program

Under the proposed Fleet EV Charging Program, the Companies would offer a rebate of $2,500[4,5] per installation to install EVSE for commercial and industrial customers that operate fleet vehicles. In this program, up to 500 rebates would be made available to DEC customers and 400 rebates to DEP customers. Customers would be required to be served under a commercial time of use rate, with all EVSE equipment behind a separate meter. The estimated cost of this program is $1.925 million for DEC, and $1.54 million for DEP, for a total of $3.465 million.

EV School Bus Charging Station Program

For the EV School Bus Charging Station Program, the Companies would offer a rebate of $215,000 per bus for school systems to purchase electric school buses and the required EVSE[6] to charge the buses. DEC

[3] The Companies would not begin to utilize load control until the second year of the program.

[4] Customers may qualify for one charging station per electric vehicles, so theoretically one company could apply for, and obtain, all of the rebates.

[5] According to the Companies, commercial EVSE installations are estimated to cost between $2,550 and $6,500 per port.

[6] The Companies have assumed that the cost of each EVSE (including installation) will be $20,000 of the $215,000 per bus total.

would offer rebates to approximately 55 customers, and DEP would offer rebates to approximately 30 customers.[7] The customers would be required to permit access to all vehicle charging data and allow the Companies to perform testing of charging load management and bi-directional charging capabilities. The Companies would own the EVSE as well as the EV bus battery. The Companies contend that they could repurpose the batteries as grid assets at the end of the useful life of the buses.[8] The estimated cost of this program is $11,981,750 for DEC, and $6,535,500 for DEP, for a total cost of $18,517,250.

EV Transit Bus Charging Station Program

Under the EV Transit Bus Charging Station Program, the Companies would install and own 60 EVSE stations in DEC's service territory and 45 EVSE stations in DEP's territory.[9] According to the tariffs attached to the application, the Companies would provide funding of $75,000 per EV transit bus procured within the preceding 24 months.[10] The associated EVSE would be owned by the Companies. To participate, a customer would be required to be on a time-of-use (TOU) rate schedule. The estimated cost

[7] When asked how the Companies arrived at the proposed number of school bus rebates, the Companies indicated that they determined the number based on customer school district interest.

[8] The Companies estimated the useful life of the buses to be at least 12 years. The purchase and maintenance of school buses is governed by State law, including when buses are eligible for replacement. See N.C. Gen. Stat. § 115C-249.

[9] When asked how the Companies arrived at the number of charging stations, the Company indicated that they determined the program size based on discussions with transit agencies regarding current and future interest in EV transit buses.

[10] According to the Companies, the estimated cost for one EVSE station is $75,000, including power upgrades.

of this program is $4,671,000 for DEC and $3,503,250 for DEP, for a total cost of $8,174,250.

Multi-Family Dwelling Charging Station Program

Under the Multi-Family Dwelling Charging Station Program, the Companies would install, own, and operate, level 2 (L2) EVSE at multi-family dwellings. The Companies would charge a fee based on the marginal energy component of the applicable Company's currently approved Small General Service schedule, plus a $0.02/kWh charge to cover network platform and transaction fees. The Companies propose to deploy 100 stations in DEC's service territory, and 60 stations in DEP's service territory. The estimated cost of this program is $1,285,000 for DEC and $771,000 for DEP, for a total cost of $2,056,000.

Public L2 Charging Station Program

The Companies' proposed Public L2 Charging Program would allow them to install L2 EVSE at eligible key public destination locations. Similar to the Multi-Family Dwelling Charging Station Program, the Companies would charge a fee based on the marginal energy component of the Small General Service schedule, plus $0.02/kWh to cover network, platform, and transaction fees. The Companies are proposing to install 100 stations in DEC's service territory, and 60 stations in DEP's service territory.[11] The

[11] When asked how the Companies arrived at these numbers, they indicated that they were based on the number of charging stations already installed in a three-year time period using grants

estimated cost of this program is $1,285,000 for DEC and $771,000 for DEP, for a total cost of $2,056,000.

Fast Charging Program

Under the proposed Fast Charging Program, the Companies would install direct current fast chargers (DCFC) along highway corridors through the Companies' service territories. The Companies would own and operate 70 chargers at approximately 35 locations in DEC's service territory and 50 chargers at approximately 25 locations in DEP's service territory. The estimated cost of this program is $20,107,500 for DEC and $14,362,500 for DEP, for a total cost of $34,470,000, and is by far the most expensive program proposed.

In addition to the seven programs described above, the Companies propose to spend $3,375,000 for education and outreach, and another $2,025,000 for ongoing operations and maintenance.

Notably, according to the Companies in a response to a data request, the estimated costs for all seven programs exceed the estimated total three-year net revenue that would be generated by the charging equipment by approximately $65 million.

provided by the Companies pursuant to their settlement with the U.S. Environmental Protection Agency and others. See https://news.duke-energy.com/releases/duke-energy-project-to-increase-public-ev-charging-stations-in-n-c-by-30-percent (with links); https://www.epa.gov/enforcement/duke-energy-corporation-clean-air-act-caa-settlement.

INFRASTRUCTURE PROGRAMS v. PILOT PROJECTS

Scope of Proposals

As well-intentioned as the Companies' proposals may be, it is inaccurate to call the proposed programs "pilots". The Public Staff conducted a review of EV-related, utility-conducted activities occurring in other states. Our review focused on those activities as of December 31, 2018. Exhibit 1 contains a list of the studies, pilots, and EV programs that were reviewed. While not intended to be an exhaustive or comprehensive list of activities occurring in other jurisdictions, the list is intended to demonstrate that the proposed programs are not new, and, in many cases, mirror activities already underway or that have concluded.

For example, Duke Energy Florida (Item 9 in Exhibit 1) is conducting programs similar to the proposed EVSE programs for multi-unit dwellings, workplaces, public L2, and DCFC installations. In addition, the Companies have pending before the Public Service Commission of South Carolina EV-related programs totaling $14.5 million that are virtually identical to programs proposed in North Carolina (Item 23 in Exhibit 1). The Public Staff also notes that DEC conducted a residential EV-related pilot between 2011 and 2014 in North[12] and South Carolina.[13] The objectives of that pilot were intended to gain a better understanding of customer charging behavior, the impact on demand and

[12] See Docket No. E-7, Sub 969. DEC filed its final report on this pilot on August 19, 2016, identifying the learnings and conclusions the Company drew from the pilot. https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=425ec0c9-01e7-4aad-8b1b-4a6b47c94007.

[13] See Public Service Commission of South Carolina, Docket No. 2011-114-E. https://dms.psc.sc.gov/Web/Dockets/Detail/112410

infrastructure, and the capabilities of the EVSE. DEC provided the EVSE to participants and paid up to $1,000 for the costs of installing the EVSE. While the Public Staff recognizes that EV and EVSE technology is changing, that does not mean that the lessons learned from this pilot are irrelevant or bear repeating in another, much more expensive pilot. Outside of the Companies, Delmarva Power & Light (see item 2 in Exhibit 1), and PEPCO (Item 8 in Exhibit 1) have pilots that are very similar to the ET Pilots.

The Companies' proposed programs in the ET Pilots are designed to obtain infrastructure-related data that is likely already publically available, or will be available within the next 12 to 18 months, from other utilities and jurisdictions. That data includes load patterns related to EV charging, the impact of managed charging, and how managed charging can shape load patterns and customer charging behavior. Additionally, because EV-related loads are not weather-sensitive, load shapes of other utilities (residential and non-residential) should be indicative of the load shapes of North Carolina consumers. For example, it is well known that approximately 80% of residential charging occurs at home in the late afternoon and evening.[14] There is no reason to believe that results of a North Carolina pilot would find otherwise. The Public Staff also believes that any EV-related tariffs developed by other utilities would likely be adaptable in North Carolina. The Companies made it clear in the application and in data responses

[14] Multiple sources reference the same information for residential charging patterns. For example, see page 5-2, "Electric Vehicle Driving, Charging, and Load Shape Analysis," EPRI, 2018 Technical Report (EPRI Study). Furthermore, this analysis provides much more information on the charging behaviors of residential customers and the drivers that could influence that behavior. http://mydocs.epri.com/docs/PublicMeetingMaterials/ee/000000003002013754.pdf.

that they are aware of and are monitoring efforts in other states. There is no reason to duplicate those efforts here by approving the expensive programs proposed by the Companies.

At best, only the Residential EV Charging and Fleet EV Charging programs arguably qualify as pilots, but there are critical omissions from those programs that would support a finding that they are pilots. As a pilot project, the Public Staff would expect to see the Companies piloting various rate designs to evaluate the extent to which various rate designs impact customer usage and promote, or inhibit, managed charging. While the Residential EV Charging program would evaluate active managed charging via onboard load control capabilities in the second year, a robust pilot project should evaluate passive managed charging through experimental rate designs and other mechanisms. As 80% of residential EV owners charge at night, any pilot project should explore the vast array of mechanisms to determine what drives, and does not drive, customer behavior.[15] This information is critical to integrating EV charging customers in an efficient manner. The Fleet EV Charging program is similarly lacking in experimental rate designs. Inclusion of various experimental rate designs and other mechanisms would render these programs more characteristic of a pilot.

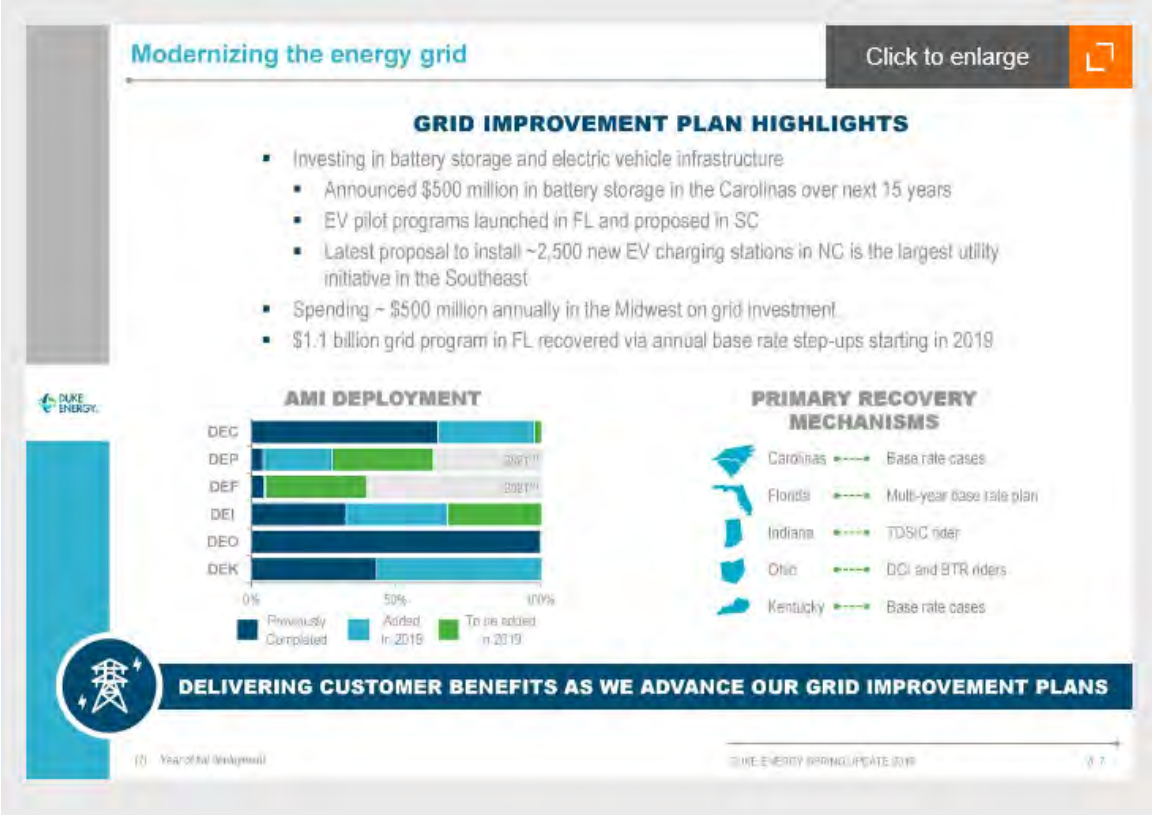
The remainder of the proposed programs cannot be characterized as pilot programs for a variety of reasons. The EV School Bus and EV Transit Bus programs are not reflective of programs that would be offered by the Companies

[15] For example, as North Carolina experiences increased “duck curve” load patterns, a pilot tariff could evaluate customer willingness to charge during times of peak solar production.

in the ordinary course of business, i.e., providing electric service. The Department of Public Instruction, school systems, and municipalities are responsible for purchasing buses for their respective systems; there is no justifiable reason why the Companies would insert themselves into the process. Bus systems have predictable routes and schedules; thus, determining the charging characteristics of buses is easily modeled, if not already available. To the extent the Companies are interested in exploring the use of small scale batteries to provide support to the grid during summers (school buses) or overnight (transit buses), that data can be easily obtained by directly deploying small scale batteries within the Companies' systems.

The various public charging station programs are merely capital projects. The Public Staff is unable to identify any unique learning opportunities arising out of the construction of over 400 public charging stations across the State, especially given the cost. The Companies' proposal is essentially a request to pre-approve infrastructure buildout. A slide presented by the Companies to investors on May 22, 2019 best demonstrates this point:[16]

[16] https://seekingalpha.com/article/4265902-duke-energy-duk-investor-presentation-slideshow



As shown in the slide, the Companies have represented the expenditures to install the charging stations in the proposed ET Pilots to be part of the Companies' Grid Improvement Plan.[17] The Companies' news release on its web site touts the proposal as "the largest investment in electric vehicle (EV) infrastructure ever in the Southeast – a $76 million initiative to spur EV adoption across the state."[18] There was no mention of any "pilot" aspect or lessons hoped to be gained from the proposal. Additionally, on pages 5-6 of the application in this docket, the Companies discussed the increasing deployment of EV charging infrastructure and stated that their proposal would add North Carolina to the growing number of

[17] Grid Improvement Plan is the Companies' current iteration of the original Power/Forward Carolinas initiative.

[18] https://news.duke-energy.com/releases/duke-energy-proposes-76m-electric-transportation-program-in-north-carolina-southeasts-largest-utility-ev-initiative-yet.

states deploying EV infrastructure. The tariffs attached to the application reflect that the proposals are primarily intended to deploy and support EVs and EV infrastructure.[19] In response to a data request, the Companies admitted that the public charging portion of the programs (Multi-Family, Public L2, and DCFC) is intended to provide a foundational level of infrastructure for EV adoption. As shown by the Companies' own admissions and representations, these programs are clearly not "pilots" as that term is generally understood.[20]

Evaluation and Metrics

The value of a pilot project is to allow a utility to test a concept at a smaller scale without incurring significant costs that ultimately would be borne by customers. If a pilot is successful, the program can be deployed system-wide without the risk of program non-viability. If a pilot is unsuccessful, customers would be responsible for a fraction of the costs compared to a system-wide deployment. However, a pilot must have clearly defined objectives and goals that would define success and justify a broader, permanent program.

The Companies' proposal contains no objectives, metrics, goals, or other means of evaluating whether the program is a success or failure. There is no forecasting of how the Companies will determine whether any of the program

[19] See the "Purpose" sections of the Companies' Exhibits C through I.

[20] Webster's online dictionary defines "pilot program" as an "activity planned as a test or trial." https://www.webster-dictionary.org/definition/pilot%20program
See also https://searchcio.techtarget.com/definition/pilot-program-pilot-study "A pilot program, also called a feasibility study or experimental trial, is a small-scale, short-term experiment that helps an organization learn how a large-scale project might work in practice."

components should be expanded beyond the scope of the proposal. In addition, as stated earlier, much of the data likely to be collected by these pilots already exist; and the lack of objectives, metrics, goals, or other means of evaluating successful data collection further muddles what might be learned versus what is already known.

OTHER COMMENTS AND CONCERNS

EV Load Forecasts

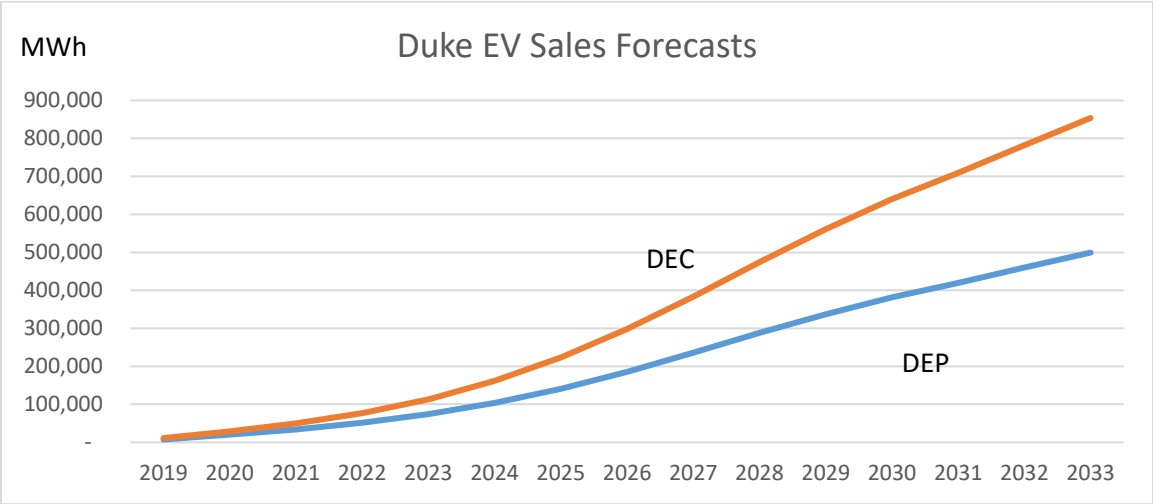
Many of the resources reviewed by the Public Staff regarding the trends in EV sales, and the impact that load will have on the bulk power system, look at perspectives that extend through 2030 to 2040. Those forecasts suggest a very small increase in EV adoption until 2025, after which EV adoption is expected to increase at a greater pace.[21] In fact, the U.S. Energy Information Administration does not project a significant change in the fuel-of-choice for transportation through 2050.[22]

In their integrated resource plans (IRP) filed in 2018 in Docket No. E-100, Sub 157, the Companies included a forecast of EV-related energy sales in their respective Tables C-7. Workpapers associated with Tables C-7 were used to

[21] "Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030," November 2018, EEI Report by Adam Cooper and Kellen Schefter. https://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20EV%20Forecast%20Report_Nov2018.pdf.

[22] "Annual Energy Outlook 2019 with Projections to 2050," US EIA Document AE02019, January 24, 2019, www.eia.gov/aeo , https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf.

develop the chart below, which further identifies a slight increase in EV-related sales, but not until 2024 to 2025.



The Public Staff acknowledges that the EPRI Study suggests two key findings: (1) the EV world is dynamic and (2) charging infrastructure is being deployed and charging speeds are improving. Both of these findings suggest that the rate of EV adoption is likely to increase. However, nothing presented in the EPRI Study, nor any of the forecasts reviewed by the Public Staff, suggests an emergent situation that would warrant additional expenditures to repeat the same type of pilots being conducted across the country, particularly in the next three years. This is particularly true since, as the Public Staff believes, key findings and data from similar pilots around the country will be available for the Companies to use.

The Companies' Cost-Benefit Analysis

The Companies filed, as Exhibit B, a cost-benefit analysis for the ET Pilots (NC Study). The NC Study was similar to other cost-benefit studies conducted by the same author for other utilities in other jurisdictions, including Duke Energy Florida, LLC,[23] and was based on methodology and assumptions used by MJ Bradley & Associates (MJB&A) in another study on the roles of utilities in the EV market.[24] Overall, the Public Staff believes these studies to be reasonable attempts at quantifying the benefits and costs of electric vehicle adoption at various levels in a general sense. However, based upon additional discovery from the Companies, the Public Staff has identified some concerns with how the study estimates the number of EVs in each penetration scenario, and believes that the Commission should give limited weight to the study.

The NC Study developed costs and benefits under two distinct levels of EV adoption: a business-as-usual (BAU) scenario, and a more aggressive scenario (80x50) that is intended to reduce light-duty vehicles' (LDV) greenhouse gas (GHG) emissions by 70%-80% by 2050. The NC Study also acknowledged the more aggressive 80x50 scenario is not likely to occur without much more aggressive policy support by the State.

[23] "Electric Vehicle Cost-Benefit Analysis – Plug-in Electric Vehicle Cost-Benefit Analysis: Florida," MJ Bradley & Associates, January 2019. https://www.mjbradley.com/reports/plug-electric-vehicle-cost-benefit-analysis-florida.

[24] "Mid-Atlantic and Northeast Plug-in Electric Vehicle Cost-Benefit Analysis – Methodology and Assumptions," MJB&A, December 2016. https://mjbradley.com/sites/default/files/NE_PEV_CB_Analysis_Methodology.pdf.

In the 80x50 scenario, the NC Study first sets a GHG reduction goal for LDVs of 80% in 2050. Once this emission reduction is quantified, the NC Study then estimates the number of EVs required to meet this emission reduction goal. This calculation requires an estimate of emission reductions for each EV, which compares typical gasoline LDV emissions per mile to typical EV emissions per mile. While the former is a simple calculation based on typical emissions per gallon of gas and typical miles per gallon, the latter requires an assumption of the typical emissions per kWh of electricity.

This estimate of typical emissions per kWh of electricity requires assumptions to be made about the future makeup of power generation sources. The NC Study uses estimates for the SERC Reliability Corporation/Virginia-Carolinas (VACAR) sub-region from the U.S. Energy Information Administration's (EIA) Annual Energy Outlook 2017. Roughly, these estimates equate to 44% carbon-free electricity in 2015, 49% carbon free electricity in 2030, and 45% carbon-free electricity in 2050.[25] In contrast, the combined 2018 IRPs of DEC and DEP project 60% carbon-free electricity by 2030.[26] Thus, it appears as if the NC Study may be modeling a more carbon-intensive generation portfolio than the Companies anticipate in their combined IRPs. Based upon the Public Staff's understanding of the 80x50 scenario in the NC Study, this could have the result of overestimating the number of EVs that are required to meet the 80x50 emission

[25] See Annual Energy Outlook 2017, "Electricity Generation by Electricity Market Module Region and Source" from the Energy Information Administration. https://www.eia.gov/outlooks/archive/aeo17/, Reference case table "A9", "Electric Power Sector" table, "Electric Generation by Electricity Market Module Region and Source".

[26] See Docket No. E-100, Sub 157: DEC IRP at 8, DEP IRP at 8.

targets. Overestimating the number of EVs would have the effect of overestimating the number of charging stations required and overestimating the amount of revenue from each charging station.[27] The Public Staff is concerned that this "mismatch" between EIA projections and the Companies' IRPs could result in higher costs and lower revenues for the ET Pilots than anticipated.

The NC Study suggests $6.9 billion in benefits by 2050 at a moderate adoption trend that is supported by EIA.[28] Figure 3 of the NC Study provides a graphical illustration of the estimated EV penetration scenarios, suggesting significant differences between the more aggressive GHG scenario and the more moderate EIA scenario by 2050. The Public Staff believes this illustrates a high degree of uncertainty in the projections beyond 2025.

The Public Staff also is concerned that the cost-benefit analysis does not appropriately evaluate the potential impact of EV adoption and the Companies' role in meeting the load obligations associated with that adoption. The Companies indicate that the NC Study was not intended to provide a template for a cost-benefit analysis for each of the individual programs in the ET Pilots, and the Companies have not conducted cost-benefit analyses for the individual programs.[29] The Public

[27] More EVs would require more charging stations. However, if the number of EVs fell short of estimates, the total revenue collected from these charging stations would be lower than anticipated.

[28] Page ii, NC Study.

[29] The Public Staff notes that the charging infrastructure program in Georgia's ET Pilot failed the Rate Impact Measure (RIM) test. See Georgia Power Company's Electric Transportation Pilot and Market Dynamics Driving Electric Vehicles Adoption Evaluation Report, filed August 4, 2017 in Georgia Public Service Commission Docket No. 41373.

Staff believes individual program cost-benefit analyses should be performed to ensure that spending on individual programs is cost beneficial.

Finally, the NC Study suggests that additional revenues realized from EV-related energy sales will exceed the costs of new infrastructure needed to meet the additional loads. According to the study, under current rate structures this could create downward pressure on future rates under all scenarios.[30] The NC Study included the benefits EV owners may realize, such as operational and fuel cost savings. Both groups of benefits are appropriate for purposes of the NC Study. However, additional benefits such as energy security and emission reductions are more related to the use of energy for transportation. These additional benefits are more societal and associated with the removal of fossil-fueled vehicles and may not be appropriate for a cost-benefit study focused on specific programs and aimed at determining whether ratepayers should pay for benefits that would be realized by society as a whole.

CONCLUSIONS AND RECOMMENDATIONS

The Companies' application for approval of the ET Pilots is a request for preapproval of infrastructure spending and not a proof-of-concept pilot program. There are no metrics or standards for determining whether the programs would be successful and should be replicated on a larger scale. Additionally, the ET Pilots are very similar to other pilots currently underway across the country, and are

[30] NC Study at p.9.

virtually identical to the much less costly pilots proposed by the Companies in South Carolina.

The Companies admit the proposals are based on estimated data and are designed to promote EV adoption and install a foundational level of EV infrastructure. Nevertheless, even in the Residential and Fleet EV Charging programs, the Companies proposed no experimental rate designs to evaluate the extent to which various rate designs impact customer charging behavior or facilitate managed charging in a manner to promote EV adoption. Rate designs to manage charging can significantly impact EV adoption, improve service to EVs, mitigate grid impacts, and better enable assignment of full cost of service to those using EV infrastructure.

Based on the foregoing, the Companies have failed to demonstrate that spending $76 million over a three-year period is necessary to learn more about serving current and future EV load in North Carolina. The Public Staff recommends that the Commission deny the Companies' requests for approval of their respective EV pilots.

Respectfully submitted this the 5th day of July, 2019.

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Electronically submitted
/s/ Dianna Downey
Staff Attorney

VERIFICATION

STATE OF NORTH CAROLINA)
)
COUNTY OF WAKE)

I, JACK L. FLOYD, being duly sworn, depose and say:

I am a Utilities Engineer of the Electric Division of the Public Staff of the North Carolina Utilities Commission (Public Staff); I have read the foregoing Public Staff's Comments on the application filed March 29, 2019, by Duke Energy Progress, LLC and Duke Energy Carolinas, LLC, for approval of their respective Electric Transportation Pilots, filed on July 5, 2019, in Docket Nos. E-2, Sub 1197, and E-7, Sub 1195, and know the contents of these Comments.

I believe the information contained in these Comments to be true and correct to the best of my knowledge, information, and belief.

Jack L. Floyd

Sworn to and subscribed before me

This 5th day of July, 2019.

Cleo L Ackerman
NOTARY PUBLIC
WAKE COUNTY, N.C.
My Commission Expires 01-08-2023

Notary Public

My Commission Expires: 1-08-2023

CERTIFICATE OF SERVICE

I certify that a copy of the Public Staff Comments has been served on all parties of record or their attorneys, or both, in accordance with Commission Rule R1-39, by United States Mail, first class or better; by hand delivery; or by means of facsimile or electronic delivery upon agreement of the receiving party.

This the 5th day July, 2019.

Electronically submitted
/s/ Dianna Downey

VOLKSWAGEN
GROUP OF AMERICA

National ZEV Investment Plan: Cycle 1

Public version

April 9, 2017

Contents

1. Executive Summary

As required by Appendix C to the 2.0-Liter Partial Consent Decree entered by the U.S. District Court for the Northern District of California on October 25, 2016, Volkswagen Group of America is investing $1.2 billion over the next 10 years in zero emission vehicle (ZEV) infrastructure, education, and access outside California to support the increased adoption of ZEV technology in the United States, representing the largest commitment of its kind to date. Based on figures from the Council of Economic Advisors and U.S. Department of Transportation related to highway and transit investments, the $1.2 billion being spent here is estimated to support up to 15,000 jobs throughout the United States over the 10 year course of the investment *[Dept. of Transportation, Council of Economic Advisors]*.[1] The first cycle of a separate investment of $800 million in California is the subject of the California ZEV Investment Plan, which was submitted to the California Air Resources Board on March 8.

Volkswagen Group of America has created Electrify America LLC, a wholly-owned subsidiary headquartered in Reston, Virginia, to fulfill its Appendix C commitments.

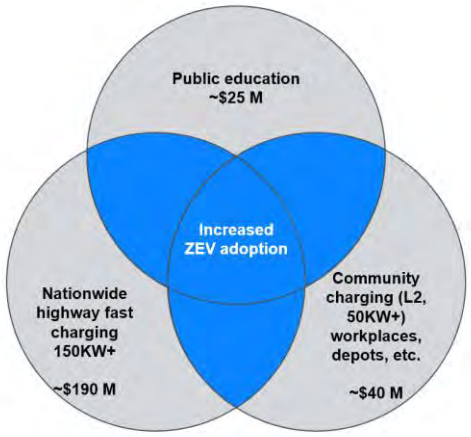
The investment: The $1.2 billion commitment will be spent in $300 million increments over four 30-month cycles. This report describes the $300 million in investments that will be made in the first 30-month cycle, which runs from Q1 2017 through Q2 2019, to meet this goal.

Cycle 1 (Q1 2017 – Q2 2019)	Cycle 2 (Q3 2019 - Q4 2021)	Cycle 3 (Q1 2022 – Q2 2024)	Cycle 4 (Q3 2024 – Q4 2026)	Full 10 years
$300M	**$300M**	**$300M**	**$300M**	**$1,200M**

This investment will make it easier for millions of Americans to charge their electric vehicles. In addition, Electrify America will broadly promote the benefits of ZEVs to consumers through education campaigns.

[1] The Council of Economic Advisors estimates that every $1 billion in federal highway and transit investment would support 13,000 jobs. This total count includes direct, indirect, and induced jobs. Note that the estimate here is for the number of jobs across the entire 10-year, $1.2 billion investment, and not just the first investment cycle, and assumes that spend on charging infrastructure will create a similar number of job-hours per dollar spent as highway and transit investments.

The Cycle 1 plan: In the first ZEV investment cycle, Electrify America will focus on three activities aimed at increasing the use of ZEVs and showing more Americans that going electric is possible and beneficial today. (1) Installing charging infrastructure (approximately $250 million), (2) Public Education initiatives (approximately $25 million), (3) ZEV access initiatives (under development), and an additional approximately $25 million spent on the operational costs of running Electrify America (e.g., personnel, other business expenses).



Overview of Cycle 1 National Investment Plan

INSTALLING CHARGING INFRASTRUCTURE (~$250 million)

Electrify America plans to build charging infrastructure that will primarily consist of (1) community charging and (2) a long distance highway network. In addition, other use cases/technologies are also under consideration including targeted battery storage to manage peak demand and ease grid loads, etc.

A series of guiding principles were applied to identify appropriate infrastructure investments:

- Focus on accessible locations where utilization is expected to be high for ZEV drivers
- Focus on a variety of use cases based on the anticipated charging behaviors of ZEV drivers
- Incorporate anticipated changes in the ZEV industry to maximize usefulness of stations in the medium-to-long term
- Consideration for long term sustainability of the network

Charging stations will be located first in the areas with the highest anticipated ZEV demand; this is based on the forecast penetration rates of ZEVs in each region and the estimated gap between the supply and demand of charging infrastructure in those regions. In aggregate, the Electrify America first cycle investment will aim to establish a network of approximately 2500+ non-proprietary chargers across 450+ individual stations. Note that, in addition to the capital spend numbers shared below, there is an additional approximately $20 million associated with creditable station operating expenses (e.g., fixed costs).

Electrify America stations will be designed to provide access by supporting multiple non-proprietary and interoperable charging technologies to meet different needs. Level 2 AC charging (L2) with universally accepted J1772 connectors will serve charging at long dwell-time locations. 50+ kW Direct Current (DC) fast charging will serve ZEV needs in shorter dwell time situations and along highway corridors, utilizing non-proprietary charging standards (CCS and CHAdeMO). Electrify America will also support open protocols including Open Charge Point Protocol (OCPP) that allow more standardized communication between different chargers and networks.

To simplify the consumer experience, Electrify America will seek access agreements with owners of other charging networks to make it easy for as many ZEV drivers as possible to move more seamlessly between different charging networks.

Community charging (approximately $40 million in capex)

The National Academy of Sciences' 2015 comprehensive report on overcoming barriers to ZEV deployment endorsed a strategy focused on specific geographies, or "beachheads," stating that a strong strategy to increase ZEV adoption "logically would focus on key geographic regions or regional corridors where momentum has already been established; infrastructure is more readily available; [and] word-of-mouth between neighbors, friends, and co-workers can occur more readily" [*NAS, 2015*]. Through the National Outreach Plan process, Electrify America received approximately 50 proposals from cities for concentrated ZEV infrastructure investments in specific metropolitan areas, and many additional recommendations from states, local governments and other stakeholders expressing support for concentrating investment in metropolitan areas.

Electrify America has selected 11 metropolitan areas for Cycle 1 investment: New York City, Washington D.C., Chicago, Portland (OR), Boston, Seattle, Philadelphia, Denver, Houston, Miami, and Raleigh. Government agencies from ten of these metro areas submitted proposals to Electrify America, some of which were the most comprehensive proposals received. Electrify America notes that it was not able to select every metropolitan area that submitted a strong proposal, but it intends to expand its Community Charging investments into metro areas with supportive government policies and strong utility integration in future investment cycles.

Within selected metros, Electrify America plans to build 300+ stations across five major use cases (multi-family homes, workplace, commercial/retail, community, and municipal lots/garages). In order to maximize the effectiveness of the network, it is important to focus on a variety of use cases. According to an NREL report from Jan. 2017, workplace and public charging have both been shown to significantly increase fleet-wide electric vehicle miles traveled *[Wood et al., 2017]*, consistent with the overall goals of Electrify America. A deployment mix of AC L2, DC 50 kW, and DC 150+ kW chargers will be offered across these use

cases to help best meet the anticipated needs of ZEV drivers. Reasoning behind the metro area selection is provided in Section 2.2.1.2.1.

A high-speed highway network (approximately $190 million in capex)

In recent years, a consensus around the value of a national network of extremely high speed ZEV charging equipment along our nation's highways has been emerging. In 2013, western states coordinated with industry to establish the West Coast Electric Highway, which has "successfully enabled significant range extension" for ZEVs and led to "a considerable amount of long distance travel" by ZEV drivers according to Idaho National Laboratory research [*INL 2015b*].

In 2015, Congress required the Federal government to designate national electric vehicle charging corridors and established an aspirational goal of deploying charging infrastructure along the full nationwide network by 2020 [*FAST Act*]. In 2016, the Department of Energy and the Department of Transportation agreed to jointly develop a 2020 vision for that network incorporating DC fast charging at power levels up to 350 kW. Upon designation of the corridors in 2016, 28 states, utilities, vehicle manufactures, and suppliers – such as New York, General Motors, and General Electric – committed to help accelerate ZEV charging infrastructure deployment along these corridors [*Laign*].

The comments, recommendations and proposals submitted to Electrify America through the National Outreach Plan process articulated overwhelming support for investment in a nationwide network of high speed ZEV charging infrastructure along our nation's highways. More than 100 comments and proposals called for investment in DC fast charging corridors, and approximately 20 specifically called for deploying a network with faster, higher-powered charging than is available today. For example, nine states listed DC fast charging corridors as their number one investment priority.

Electrify America will build a long distance high speed highway network consisting of charging stations along high-traffic corridors between metropolitan areas and across the country, with an initial target of approximately 240 highway sites installed or under development by the end of the first cycle, more than 150 of which are expected to be completed. These highway sites will be present in 39 U.S. states with higher anticipated ZEV average annual daily traffic (AADT, a Department of Transportation measure of road traffic density on an annual basis) by 2020. The sites will be located on prominent U.S. interstates and highways, and they have high correlation with the recently-announced EV Charging Corridors [*Alternative Fuels Corridors 2017*]. Sites will be, on average, about 66 miles apart, with no more than 120 miles between stations, meaning many shorter range ZEVs available today will be able to use this network. Also, note that we accounted for existing infrastructure on targeted

highways in our methodology to ensure that the network will supplement, not duplicate, investments already made (see Section 2.2.1.2.2.).

More than 25 comments to Electrify America – especially from ZEV drivers – emphasized the importance of placing stations in locations with sufficient amenities and proper signage. A "user-centric experience" along EV charging corridors is also an aspirational goal established by the Department of Transportation [*FHWA, 2017*]. Electrify America's goal is to locate the charging sites within easy access of the interstate in locations that provide ample parking spaces for charging, ensure customer safety, and offer access to retail and service establishments like restaurants, coffee houses, and retail and convenience stores that provide customers with options during the typical charging time period of up to 30 minutes. The average station will be able to charge five vehicles at once, with station capacity ranging from no less than four and up to ten vehicles charging at a time.

In order to accommodate the call for faster charging reflected in public comments, the chargers deployed will represent state-of-the-art technology with the fastest charging speeds available. Stations will focus on 150 kW and some 320 kW DC fast chargers, which will also be capable of charging 50 kW capable vehicles at a lower power level.[2] Most currently installed non-proprietary DC fast chargers are in the 25-50 kW range; a 50 kW charger can supply about 3 miles of ZEV range per minute of charging. Electrify America's 150 kW DC fast charging stations will provide about 9 miles of ZEV range per minute of charging, while 320 kW DC fast chargers will provide about 19 miles of range per minute. These faster charging speeds are necessary to refuel the next generation of larger battery capacity ZEVs with all-electric ranges above 200 miles. According to Navigant Research projections, these vehicles will represent 84 percent of battery-electric vehicle sales by 2020. By 2025, 39 different models of 200+ mile battery-electric vehicles are projected to represent 87 percent of sales [*Navigant, 2016b*]. Electrify America's network is being designed to charge this next generation of ZEVs.

Industry input received during the Outreach Plan provides Electrify America with confidence that one or more vehicle manufacturers plan to sell 320 kW capable ZEVs by 2020. Electrify America will carefully evaluate the ratio of 150/320 kW chargers at these sites for maximum customer convenience and optimal budgeting, but it plans to "future proof" these investments by designing most stations to be cost-effectively converted from 150 kW to 320 kW charging by the end of the 4th cycle (e.g., by installing appropriately-powered utility connections capable of handling 320 kW chargers), as recommended by Idaho National Lab. Electrify America will also maintain open discussions with OEMs to track progress towards 320

[2] Idaho National Lab, DOE, and DOT refer to power levels of 350 kW because the limit of the standard is currently 350 amps multiplied by 1000 volts, or 350kW. However, comments from OEMs and experts during the Outreach Plan process have led Electrify America to believe that the next generation of vehicles will be designed to go up to 920V, not 1000V. Electrify America refers to 320 kW charging to reflect the result of 350A x 920V."

kW-capable vehicles, understanding that there are still technical, cost, and code and standard setting challenges associated with this new technology [*Carson, 2016*].

Building the infrastructure

In constructing and operating a charging network, Electrify America, which is headquartered in Reston, Virginia, will rely on an extensive group of third-party suppliers and vendors in the charging infrastructure space, most of whom are based in the United States. As such, these partnerships will mean that jobs are created and many existing companies will grow as a result of Electrify America's $250 million Cycle 1 investment across the nation and its additional $120 million investment in California. Electrify America has already begun formal discussions with suppliers, through both a Request for Information (RFI) sent to potential suppliers in December 2016 and through the formal issuance of Requests for Proposals (RFPs), the first of which was issues in March 2017. Over 80% of the suppliers issued the RFI were companies based in the United States.

Preliminary milestones for the network construction progress are shown in Table 1. Site development for the first Electrify America stations will begin in Q2 2017, with development initiated for all stations by Q2 2018. These first stations are expected to be completed and operational for local community charging in Q3 2017 and for highway charging in Q2 2018. Given long lead times in terms of site acquisition and permitting processes, the majority of the stations are expected to be completed near the end of the 30 month cycle, from fewer than approximately 150-200 operational stations in Q2 2018 to 450+ stations by the end of Q2 2019.

	National ZEV infrastructure		
	Pre-site selection	**In development**	**Operational**
Q2 2017	350-400	100-150	0
Q4 2017	150-200	200-250	50-100
Q2 2018	0-50	300-350	150-200
Q4 2018	0	150-200	250-300
Q2 2019	0	0-50	450+

TABLE 1: PRELIMINARY MILESTONES FOR NETWORK CONSTRUCTION FOR THE NATIONAL INFRASTRUCTURE PLAN

Much of this proposed schedule is determined by the lead times associated with various pre-installation tasks, including finding and acquiring sites, permitting, and securing available hardware (especially for new high-speed charging systems), each of which can vary considerably based on local factors. Much of the uncertainty around timelines is associated with (1) the site acquisition and design process, which requires contract negotiations with property owners/developers, customization of engineering drawings for specific sites, and the need to identify approximately five sites for each final location due to uncertainties through the implementation cycle; and (2) the permitting/approval process, which can take anywhere from

3 to 9 months depending on the permits required at the various levels of government (e.g., local vs. state).

BRAND-NEUTRAL PUBLIC EDUCATION AND AWARENESS ACTIVITIES ($25 million)

Electrify America received nearly 150 submissions through the National Outreach Plan process that expressed support for investments that will increase public awareness of ZEVs' attributes and benefits. As one Western state explained, "Without a significant investment in highway corridor charging infrastructure, paired with a dynamic advertising and marketing campaign to spread the awareness of the emerging technology and associated infrastructure available to travelers, the ability of the EV market to expand eastward across the country will be stymied." Likewise, a Northeastern state commented: "A major brand-neutral marketing campaign would have the potential to raise awareness and acceptance of EVs broadly."

In order to inform the public education campaign, Electrify America has performed a segmentation analysis of the general car-buying population to evaluate the penetration of ZEVs in various car-buying population segments and regions, the positioning of zero-emission vehicles relative to competition, the barriers to adoption of ZEVs by population segment, and the key messages to communicate to the general population in order to improve penetration of ZEVs. Based on this analysis and analysis of consumer media consumption habits, Electrify America is developing a comprehensive educational campaign that will simultaneously communicate the benefits of ZEVs (performance, acceleration, quietness, comfort, and the overall enjoyment of the ride) and address barriers to adoption (range anxiety, "golf cart" misperception, charger availability).

Media will be used to put ZEVs on the "big stage" in order to help consumers understand that ZEVs not only meet the majority of their needs today, but even more so as the charging infrastructure network grows. The messaging will be split across traditional advertising channels such as television and targeted digital (including digital radio and social media). In order to quickly maximize messaging presence, a coordinated national/local media strategy was developed. This allows for quick ramp-up across the country, followed by sustained messaging in top, high-potential ZEV markets.

The nearly 150 comments received by Electrify America made it clear that extensive ZEV Education and Outreach efforts are ongoing, and Electrify America intends its investment to leverage and reinforce these ongoing efforts. Through the National Outreach Plan process, we have already begun conversations with a number of potential partners on educational initiatives, including ZEV advocacy organizations, school education curriculum developers, OEMs, and state agencies. We will continue to provide updates on these activities as they develop.

Electrify America's creative agency continues to refine the creative content based on the segmentation analysis (highlighting the most impactful benefits of ZEVs), and creative concepts should be finalized in Q2 of 2017, followed by finalization of media planning by summer. Media will begin towards the end of Q3 of 2017.

ZEV ACCESS INITIATIVES

Numerous government agencies and other stakeholders proposed ZEV access programs in their comments to Electrify America. A program of experiential initiatives like ride-and-drive events are being developed to help increase ZEV access and exposure for as many Americans as possible.[3] The purpose of these activities is to increase the public's awareness of and access to ZEVs and allow them to experience ZEVs without having to purchase a vehicle.

[3] Electrify America will seek written approval for access programs or projects from EPA before Electrify America makes these investments, as required by Appendix C.

1.2 Summary of Public Comments and Other Input

1.2.1. Summary of public comments

As part of the National Outreach Plan, Electrify America solicited proposals and recommendations from outside parties to help substantiate and improve this plan. Electrify America notified stakeholders identified in Appendix C (i.e., states, municipal governments, federally-recognized Indian tribes, and federal agencies) of the proposal submission period, which was open from December 9, 2016 to January 16, 2017. Further detail on outreach efforts can be found in the National Outreach Plan submitted to EPA on November 9, 2016. Electrify America will continue to consider input from stakeholders over the 10-year life of Appendix C.

For the first 30-month investment cycle, Electrify America allowed a 3-week grace period and considered submissions received through February 6, 2017. A total of 484 submissions were received as of February 6, 2017. Figure 1 provides an overview of the proposals by topic and by type of submitter.

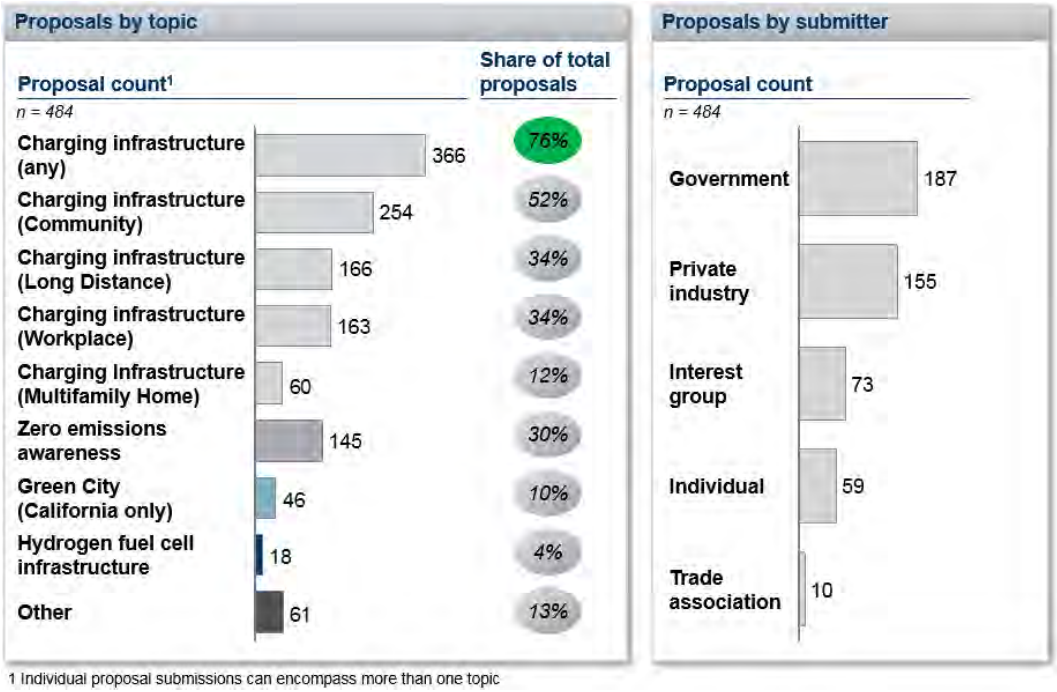


FIGURE 1: SUBMISSIONS BY TOPIC AND SOURCE, OTHER METRICS

Submissions were received from entities in all but four states, and two Native American tribes submitted proposals. The largest number of submissions originated from California (194 submissions), while 49 proposals and recommendations were received from representatives of a city, county, coalition, transit organization or air quality association outside of California.

About 29,000 unique visitors viewed the website, and 121,000 total website hits were recorded by February 6, 2017.

1.2.2. Consideration of comments

Proposals were initially evaluated across a variety of factors including, but not limited to, submission source, speed of implementation, likely charger utilization, and development synergies. Following the initial evaluation, proposals are being categorized based on action-ability and sent for thorough professional review and sorting to the appropriate internal working teams at Electrify America. Starting March 13, working teams began to follow up with proposal and recommendation submitters to clarify submissions, discuss specific ideas, and incorporate some or all of the ideas into Electrify America's plans. There is high likelihood that Electrify America will act on proposals that overlap with or optimize priorities identified by Electrify America in the first cycle. Note that *Electrify America intends to respond to everyone who submitted a proposal*. An overview of this process is shown in Figure 2.

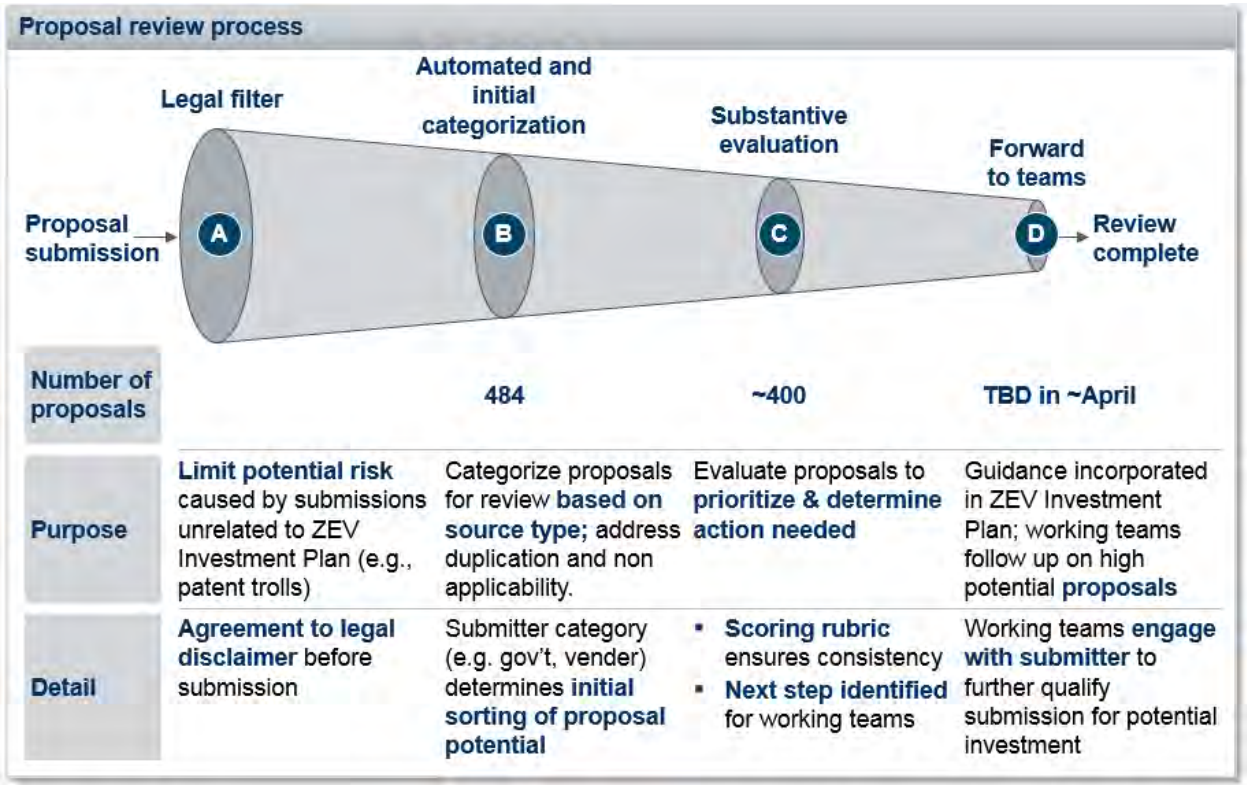


FIGURE 2: OVERVIEW OF PROCESS FOR CONSIDERATION OF PUBLIC COMMENTS

1.2.3. Samples of submitted proposals and recommendations

The submissions provided Electrify America with information on the level of public support for this plan's investment strategies, and it also provided specific project ideas. A selection of submitted recommendations and proposals includes the following:

- **Charging Infrastructure Needs:** The overwhelming majority of comments supported and, in many cases, prioritized, ZEV charging infrastructure deployment investments. This was true across the full spectrum of commenters, from comprehensive proposals from State governments to requests from small towns and 'mom-and-pop' stores for a single charger. Commenters highlighted that charging infrastructure investments meet an identified need and a recognized ZEV deployment barrier. Consistent with this feedback, Electrify America is maximizing infrastructure investment in this plan in ways consistent with the requirements of Appendix C.
- **DC Fast Charging along Highway Corridors:** More than 100 comments and proposals focused on the importance of and execution of a highway network, and nine states and numerous other submissions explicitly urged Electrify America to prioritize investment in highway charging as its highest investment priority. Electrify America intends to focus nearly two-thirds of its national investment in this area, consistent with this recommendation.
- **ZEV charging depots**: Numerous submissions, especially from cities, proposed charging depots in urban centers, consistent with our strategy to incorporate this use case in metro areas. For example, in one Northeastern city, a consortium of parties including the local utility is seeking to install a 100% renewables-powered charging hub in its downtown.
- **Coordinated Planning with State and Regional Government**: Many submissions, especially from state agencies and regional coordinating entities, emphasized the benefits of coordinating infrastructure investments with ongoing state activities. For example, two Western states submitted a consolidated proposal to increase charging infrastructure through workplace charging, park-and-ride transit hub charging, and charging along key interstate corridors. These submissions have highlighted the value of coordinating with state agencies, and Electrify America has already initiated coordination as part of its outreach effort, as described below.
- **Workplace Charging**: Electrify America received more than 150 submissions supporting investment in workplace charging, which is an additional validation of the importance of this use case. Many comments from businesses and government agencies recommended specific sites. Electrify America will closely consider each site identified in a target metro area.

- **Multifamily Dwellings**: More than 50 submissions proposed investment in the multifamily and residential use case, affirming the importance of this use case.
- **Destination Charging**: A small number of commenters suggested that Electrify America invest in destination charging. This use case will receive more consideration from Electrify America given that some proposals had this focus, including some compelling destinations, such as national parks and monuments.
- **Airports**: Submissions from 20 airports and federal agencies proposed charging infrastructure investment at airports. These proposals are being evaluated and may be a further extension of longer dwell time parking applications. The fact that these typically preferentially-located chargers would be seen by non-EV drivers using those airports may help further build charging infrastructure awareness.
- **Experiential Projects**: Electrify America received more than 50 suggestions and proposals to provide experiential access to ZEVs, including ride and drives, ZEV taxis and car sharing, and brand-neutral ZEV showrooms. Electrify America plans to explore some of these concepts in its California Green City.
- **Other Recommendations Out of Scope**: Electrify America also received comments and proposals that it is not able to act upon in Cycle 1, either due to restrictions on investment in Appendix C, or because the investments would be outside of this investment plan's focus on foundational infrastructure to serve ZEV driver needs. For example, some cities and other entities requested that Electrify America supply them with ZEVs of various size classes, which would not qualify as a priority investment at this time. Additional proposals also recommended Electrify America investment in Level 1 charging, bicycle programs, and research and development projects, which are not creditable cost investments under Appendix C. While these submissions did not fit within the scope or timetable of the Cycle 1 ZEV Investment Plan, promising creditable ZEV initiatives will be considered in later investment cycles.

1.2.4. Other Input

Throughout development of this plan, Electrify America consulted knowledgeable experts in the ZEV space with extensive automaker, utility, infrastructure, policy, communications, technology, and consumer advocacy backgrounds.

Electrify America met with a number of utilities and utility groups to explore utility infrastructure investment approaches and synergies. We also spoke with state level officials and their associations to understand state-level infrastructure priorities, charging site opportunities, and potential partnership plans.

Electrify America met with Federal agency experts, who provided detailed information on the Federal government's Smart City effort, their process for designating EV charging

corridors along highways under the FAST Act, lessons learned from the EV Project and the Workplace Charging Challenge, and ongoing work to support deployment of non-proprietary DC fast charging at power levels up to 350 kW.

Additionally, major automotive original equipment manufacturers (OEMs) were consulted to understand their interest and expectations about a new, comprehensive charging network that would best suit future ZEV customers. Consumer, environmental, and EV driver groups were also consulted to gain their public interest viewpoints.

2. National ZEV Investment Plan

2.1. Overview

Over the course of the first 30-month investment cycle, Electrify America will invest $300 million nationwide (excluding California, which is detailed in the California ZEV Investment Plan) across three primary areas:

1. ZEV charging infrastructure
2. ZEV public education campaign
3. ZEV access initiatives (under development)

Approximately $250 million will be spent on charging infrastructure, at least $25 million on public education investments, and the remainder (approximately $25 million) on other operational expenses for Electrify America. Spend related to ZEV access initiatives has not yet been estimated. Note that all numbers and activities referenced in this investment plan refer to National spend (i.e., excludes spend under the California ZEV Investment Plan) unless otherwise indicated.

Figure 3 provides an overview of these planned costs.

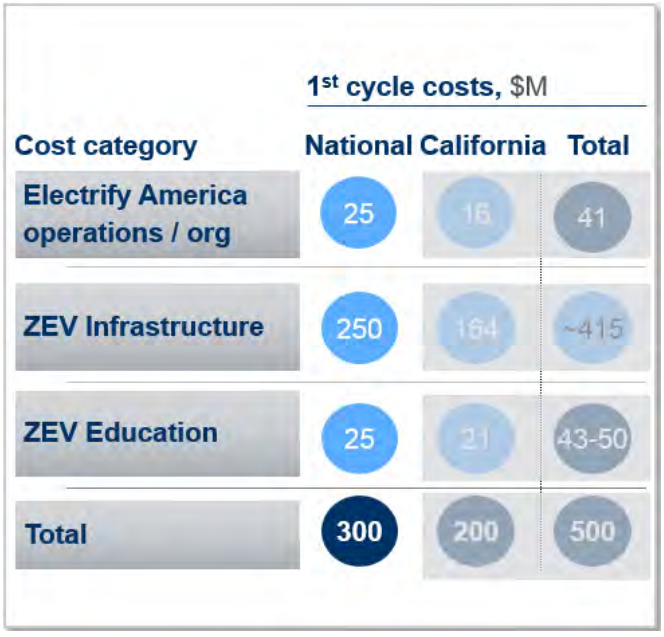


FIGURE 3: OVERVIEW OF COSTS ACROSS CATEGORIES

An overview of the three main investment categories is provided below:

1. **ZEV charging infrastructure**: Electrify America will focus on two primary areas for infrastructure investment: long-distance highway chargers and community-based metropolitan chargers. An overview of these investments is provided in Table 2.

	Long-distance highway network	Community-based metro network
Number of stations	240*	300+
Primary technologies	320 kW and 150 kW	150 kW, 50 kW, and L2
Number of highways/metros	~35 highways across the US	11 metro areas across the US
Approximate spend	$190 million	$40 million

*Stations built or under development.

TABLE 2: OVERVIEW OF LONG-DISTANCE HIGHWAY AND COMMUNITY-BASED LOCAL NETWORKS (EXCLUDING CALIFORNIA)

In developing this plan, we drew on a number of sources from academia, industry, and government (see Section 2.6. Supporting literature) to ensure investments are focused on high-priority areas where there is clear need for investment in ZEV infrastructure and where likelihood of utilization is highest. Details of the station location methodology is described in the following sections of this plan. Note that approximate spend on the highway network is $190 million, the community-based network is $40 million, and there are an additional $15-20 million in creditable expenses associated with station operations (e.g. fixed costs around maintenance and networking).

2. **Public education campaigns**: The purpose of these campaigns is to develop a portfolio of brand-neutral media that increases the number of people aware of and willing to consider ZEVs.
3. **ZEV access initiatives**: Various experiential initiatives like ride and drive events are being considered to further increase ZEV access.

Overhead and other costs are expected to account for approximately $25 million of Electrify America's spend in the first 30-month investment cycle. The majority of this spend (approximately $20 million) will be attributable to operating the business (e.g., personnel).

2.2. Investment types and descriptions

2.2.1. Infrastructure

2.2.1.1. Guiding principles

Electrify America's mission is to establish one of the largest, most technically advanced and customer-friendly charging networks in the U.S. to promote and support the increased adoption of ZEVs. Key guiding principles used to design the network include the following:

- **Focus on locations where access and utilization is expected to be highest**: investments target highways and metropolitan areas with high current and projected concentrations of ZEV drivers to maximize potential network utilization.
- **Focus on a variety of use cases based on anticipated charging behaviors of ZEV drivers**: Electrify America will build chargers to cater to drivers on highways, in public areas (commercial/retail locations, parking garages), in workplaces and multi-family dwellings, and in other viable use cases where appropriate.
- **Incorporate anticipated changes in the ZEV industry by 'future-proofing' stations to maximize their usefulness in the medium-to-long term**: investment will include the latest technology (from L2s up to 320 kW DC fast charging) and operate across different charging standards (CCS and CHAdeMO) to maximize access and help ensure future compatibility in a rapidly evolving industry. Electrify America will also continually look for new technologies, including wireless charging, and work to incorporate them in future investment cycles. Wireless charging will likely occur no earlier than cycle 2 as even the most credible wireless charging proposal we received acknowledged that the bulk of wireless charging investment might not be viable until after 2020. By focusing on open standards and cross-platform compatibility in the first 30-month cycle, Electrify America will be well positioned to adopt new technologies.
- **Focus on a sustainable business model**: the Electrify America network is being designed to ensure that the network is economically viable and can be operated and maintained for the long term.
- **Focus on interoperability and suitable signage**: the Electrify America network will represent an advanced business-to-business (B2B) platform to support other stakeholders who wish to manage the customer relationship themselves as well as business-to-consumer (B2C) capabilities for customer management by Electrify America. Where possible, agreements will be created with the owners/operators of other charging networks to simplify and improve ZEV charging for all drivers on multiple networks. Both Electrify America and available state and federal signage resources will

be used to the extent possible to further resolve consumer lack of awareness of existing charging infrastructure (Figure 4) *[Singer 2016]*.

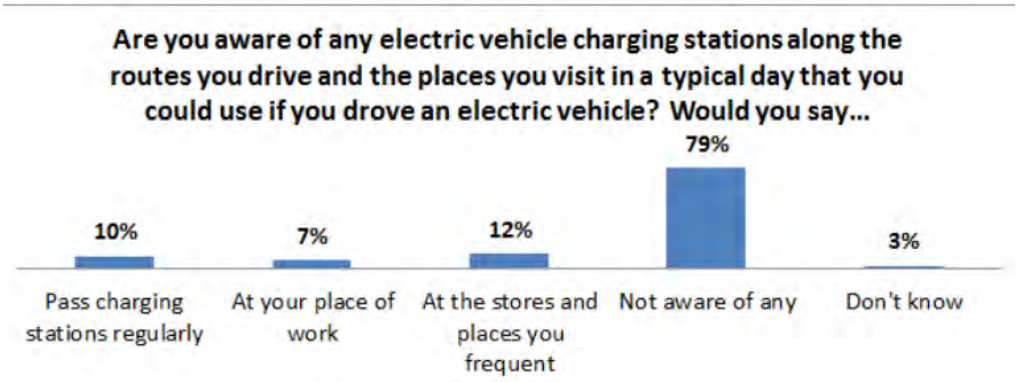


FIGURE 4: CONSUMER VIEWS ON PLUG-IN ELECTRIC VEHICLES

2.2.1.2. Investment selection methodology

The ZEV infrastructure investment plan includes two key components: (1) community-based charging stations in 11 major metropolitan areas and (2) a high-speed nationwide network to facilitate highway travel between major metropolitan areas and across the country with higher and faster DC charging power to reduce waiting times. For both components, the following three factors were used to determine the required investment: (a) locations with the highest ZEV demand; (b) the gap between the existing charging infrastructure supply and projected demand at each location; and (c) the charger count and type needed to meet the excess charging demand at each location. By adopting this methodology, Electrify America is well positioned to install charging stations where they are most needed, as Appendix C requires, and most likely to be used. Note that, throughout this process, Electrify America utilized academic, government, and industry reports on ZEV charging infrastructure investment, advertising, and projections to develop this plan. Electrify America used peer-reviewed reports to the extent they were available. The reports reviewed are reflected in the sources listed at the conclusion of this report.

2.2.1.2.1. Community-based local network investment selection methodology

The first step in the selection process was to determine the list of metropolitan areas to prioritize for investment. An overview of the process can be seen in Figure 5 and comprised two key steps:

1. Narrowing down the list from approximately 100 metropolitan areas to 25 based on key demographic factors and current hybrid and forecast ZEV sales.

2. Further prioritizing this list to 11 metropolitan areas based on the extent of local government interest, incentives, and regulation; local awareness of ZEVs; feedback from utilities and other stakeholders; and quality of fit with the long-distance highway plan.

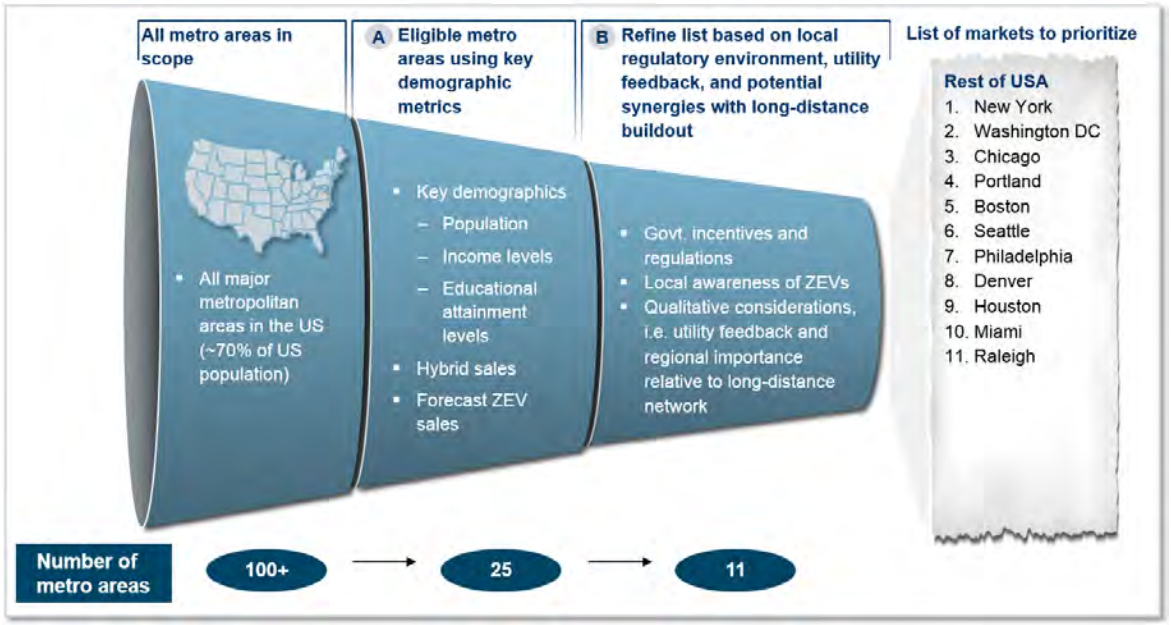


FIGURE 5: OVERVIEW OF METROPOLITAN AREA SELECTION METHODOLOGY

By adopting the methodology shown in Figure 5, a shortlist of priority National metros was developed: New York City, Washington D.C., Chicago, Portland, Boston, Seattle, Philadelphia, Denver, Houston, Miami, and Raleigh. Electrify America notes that it was not able to select every metropolitan area that submitted a strong proposal, but it intends to expand its Community Charging investments into metro areas with supportive government policies and strong utility integration in future investment cycles, and Electrify America will continue to refine its methodology as the industry develops.

Within each priority metro area identified, Electrify America calculated the gap between projected demand for charging power needed from future infrastructure to support projected higher EV market share and the power delivered from infrastructure today. Specifically, infrastructure demand outside the residence was estimated based on a calculation of the projected total ZEV vehicle miles traveled (VMT) in each of the metropolitan areas in 2020. ZEV VMT represents the anticipated ZEV drivers' commuting behavior and is the product of the average commute length [*Kneebone and Holmes*], the number of commuting vehicles, and the ZEV penetration rate [*Navigant Research, 2016*]. Calculated ZEV VMT (in miles) is converted to an expected energy demand using an average energy efficiency of 0.35 kWh/mile. This calculation generates the expected energy demand (in kWh) for charging infrastructure outside the residence within particular metropolitan areas.

Electrify America's approximately $40 million investment in local community-based charging is estimated to fill approximately 10-15% of the projected supply-demand gap in these metropolitan areas through the construction of 300+ stations built in the first 30-month investment cycle. Accordingly, Electrify America investment in infrastructure is only a starting point to closing these considerable charging power gaps; as such, other private and public investment will continue to be needed, especially from utilities who are increasingly acting to provide more charging infrastructure in their service areas.

2.2.1.2.2. Long-distance highway network investment selection methodology

In recent years, consensus around the need for a national network of extremely high speed ZEV charging equipment along our nation's highways has been emerging. In 2015, Congress required the Department of Transportation to designate national electric vehicle charging corridors, and established an aspirational goal of deploying charging infrastructure along the nationwide network by 2020 [*FAST Act*]. In 2016, the Department of Energy and the Department of Transportation agreed to jointly develop a 2020 vision for that network incorporating DC fast charging at power levels up to 350 kW. And when the Department of Transportation designated specific EV charging corridors later that year, a coalition of 28 states, utilities, vehicle manufactures, and other stakeholders committed to help accelerate the deployment of electric vehicle charging infrastructure along the identified routes [*Laign*].

The comments, recommendations, and proposals submitted to Electrify America through the National Outreach Plan also supported investment in a nationwide network of high speed ZEV charging infrastructure along our nation's highways. More than 100 comments and proposals called for investment in fast charging corridors, and approximately 20 specifically called for deploying a network with faster, higher-powered charging than is available today. Commenters – especially EV drivers – also emphasized the importance of placing stations in locations with sufficient amenities and proper signage.

Electrify America has designed a nationwide highway network to place high-speed charging stations along the long-distance routes with the highest estimated ZEV traffic as well as to link prioritized metro areas from the prior section in order to form a cohesive nationwide network. At a high level, ZEV traffic was estimated along every major route in the U.S., and, after taking into account existing charging infrastructure supply along those routes to assure that new investment supplements existing investment, the estimated 'supply-demand gap' for charging stations along each route was calculated using an approach similar to what was used to determine the metropolitan area charging supply-demand gap, but which relied on average annual daily traffic data from the Federal Highway Administration to establish demand. This allowed us to determine which routes have the highest need for new infrastructure investment.

Key sources of data used to complete this analysis include the following: ZEV penetration rates by census bureau statistical area (CBSA) *[Navigant, 2016; Experian]*, number of long-distance trips between metro areas from the FHWA Traveler Analysis Framework [*Federal Highway Administration framework*], and existing charging infrastructure levels *[EERE]*. An overview of targeted highways and estimated station counts is shown in Table 3.

Prioritized highway	Estimated station count
I-95	15+
I-75	10+
I-10	10+
I-80	10+
I-5	10+
I-90	5-9
I-70	5-9
I-40	5-9
I-15	5-9
I-30	5-9
I-85	5-9
I-44	5-9
I-35	5-9
I-65	5-9
I-45	2-4
I-91	2-4
I-84	2-4
I-25	2-4
I-81	2-4
I-20	2-4
I-24	2-4
I-94	2-4
I-87	<2
I-71	<2
I-64	<2
I-17	<2
I-39	<2
I-8	<2
I-26	<2
US-3	<2
US-1	<2
I-12	<2
I-295	<2
I-76	<2
I-55	<2

TABLE 3: OVERVIEW OF NATIONAL HIGHWAYS TARGETED FOR INVESTMENT IN FIRST 30-MONTH CYCLE (ONLY INCLUDING STATIONS EXPECTED TO BE COMPLETED IN FIRST CYCLE)

As described more fully in 2.2.1.3 below, in order to obtain rights to a particular charging site, Electrify America must identify suitable site locations and complete the process of negotiating with landowners, utilities, and other entities before any chargers can be installed.

Given the uncertainty inherent in this process, and the risks of premature disclosure of Electrify America's site selection, Electrify America will provide further detail concerning the location and type of charging infrastructure as those plans are finalized. At this time, Electrify America does not know the precise location of the chargers it will be installing during the first 30-month cycle.

2.2.1.3. Specific description of investments

This section provides an overview of: (1) the quantities and locations of charging stations, (2) the chargers and type/number of connectors per station, (3) the informational basis for calculating charger investment costs, and (4) Electrify America's plan to invest in the existing ZEV infrastructure industry's capabilities and expertise.

2.2.1.3.1. COMMUNITY-BASED LOCAL NETWORK

Five priority use cases will be supported in the local community-based network in the first investment cycle. In future investment cycles, Electrify America may increase the number of use cases supported. An overview of the major use cases and how charging behavior varies between them is shown in Figure 6.

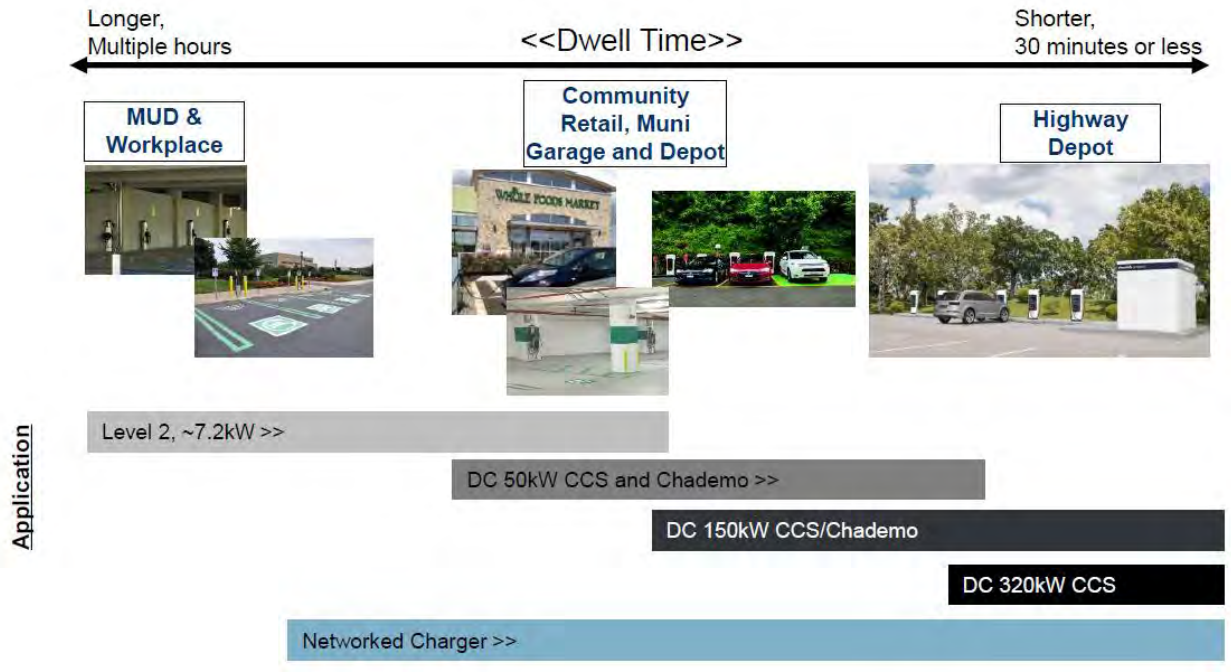


FIGURE 6: OVERVIEW OF MAJOR USE CASES TO BE PRIORITIZED IN FIRST CYCLE

At a high level, use cases with longer expected dwell times (e.g., workplace and multi-family homes), will have a higher ratio of L2 chargers, while use cases with shorter dwell times (e.g., commercial/retail) will have a higher ratio of DC 50+ kW chargers. This is consistent with expected driver behavior across the use cases, where, for example, drivers park their cars at home or work for 6-8+ hours at a time (allowing sufficient time for ~200 miles of charge to be added to the battery with an L2 charger), while drivers park at grocery stores or malls for considerably shorter periods of time (2-4 hours, where a 50 kW DCFC would be needed to add 200 miles of charge in that time period) *[Chehab 2017]*.

Across use cases, a majority of spend will be devoted to public use cases (commercial/retail centers, community depots, and municipal parking lots/garages), approximately one-third to workplaces, and the remainder to multi-family dwellings. However, considerations within individual metros, like corporate campus and multi-unit dwelling density, could alter these ratios. In addition to these use cases, there are other programs/technologies under consideration, including targeted battery storage.

2.2.1.3.2. LONG-DISTANCE HIGHWAY NETWORK

Electrify America will build a long distance high speed highway network consisting of charging stations along high-traffic corridors between metropolitan areas, with an initial target of approximately 240 highway sites installed or under development by the end of the first cycle, more than 150 of which are expected to be completed. Sites will be, on average, about 66 miles apart, with no more than 120 miles between stations, meaning many shorter range ZEVs available today will be able to use this network. An overview of the highway network is shown in Table 3 above.

Electrify America's goal is to locate the charging sites within easy access of the interstate in locations that provide ample parking spaces for charging, ensure customer safety, and offer access to retail and service establishments like restaurants, coffee houses, and retail and convenience stores to provide customers with options during the typical charging time period of up to 30 minutes. The average station will be able to charge five vehicles at once, with station capacity ranging from no less than four and up to ten vehicles charging at a time.

The chargers deployed will represent state-of-the-art technology with the fastest charging speeds available. Stations will focus on 150 kW and some 320 kW DC fast chargers, which will also be capable of charging 50 kW capable vehicles at a lower power level. Most currently installed non-proprietary DC fast chargers are in the 25-50 kW range; a 50 kW charger can supply about 3 miles of ZEV range per minute of charging. Electrify America's 150 kW DC fast charging stations will provide about 9 miles of ZEV range per minute of charging, while 320 kW DC fast chargers will provide about 19 miles of range per minute. These faster charging

speeds are necessary to refuel the next generation of larger battery capacity ZEVs with all-electric ranges above 200 miles.

Precise address locations or GPS coordinates for these highway corridor stations will be developed during our site identification, validation, and acquisition stage that begins in the second quarter 2017. These target locations will be considered confidential business information to ensure optimal lease terms during site negotiations.

2.2.1.3.3. INFRASTRUCTURE INVESTMENT TIMELINE AND MILESTONES

The estimated development schedules for both the highway and local community networks are shown in Table 4. The end-to-end process from site development is a lengthy process with multiple steps and includes the following:

- Ordering equipment
- Development of new property leads
- Signing of lease agreements (or, where appropriate, purchasing property)
- Development of permitting/pre-construction packages
- Filing permits
- Warehousing equipment and Quality Assurance/Quality Control
- Permit approval
- Site preparation
- Equipment delivery to site
- Completion of site construction
- Landscaping
- Utility connection to the grid/inspection and any additional utility preparation including new transformers or upgraded substations
- Commissioning

The length of time needed to complete each step can vary considerably across use cases as well as across geographies (e.g., permit approval timelines can differ substantially from city-to-city and state-to-state). Electrify America has already begun engaging key stakeholders and partners to begin implementation planning. As these relationships develop further, Electrify America will be able to start identifying and acquiring specific locations for chargers.

Development of the first metro community station is expected to begin in Q2 2017, with the first local community and highway charging stations expected to be operational in Q3 2017 and Q2 2018, respectively. The process is expected to take longer for the highway charging stations due to the higher charging power hardware and more complex technical, real estate, and utility requirements involved. Interim milestones for each six month period for the pace of

network construction for both the highway and local community charging stations are shown in Table 4.

	Community-based local network			Long-distance highway network		
	Pre-site selection	In development	Operational	Pre-site selection	In development	Operational
Q2 2017	200-250	50-100	0	100-150	0-50	0
Q4 2017	100-150	150-200	50-100	50-100	50-100	0
Q2 2018	0	150-200	100-150	0-50	150+	0-50
Q4 2018	0	0-50	250-300	0	100-150	0-50
Q2 2019	0	0	300+	0	0-50	150+

TABLE 4: INTERIM INFRASTRUCTURE DEVELOPMENT MILESTONES (NUMBER OF STATIONS) DURING THE FIRST INVESTMENT CYCLE

2.2.1.3.4. CHARGING STATION COST ESTIMATES

To derive an accurate budget estimate for the cost to construct the community-based and long distance charging infrastructure proposed for cycle 1, including all land acquisition, equipment procurement, installation, network and maintenance costs, Electrify America relied on several sources. Published cost estimates, such as those published by the National Academy of Sciences, and competitive benchmarking reports, were reviewed [*NAS, 2015*]. Electrify America drew on previous experience and expertise with currently available charging hardware, network, installation and operating costs, as well as typical vendor costs in procuring sites. Finally, Electrify America engaged in robust dialogue with industry partners (described in section 2.2.1.3.5.) to understand the costs associated with building stations equipped with a new generation of 150 kW and 320 kW DC fast chargers.

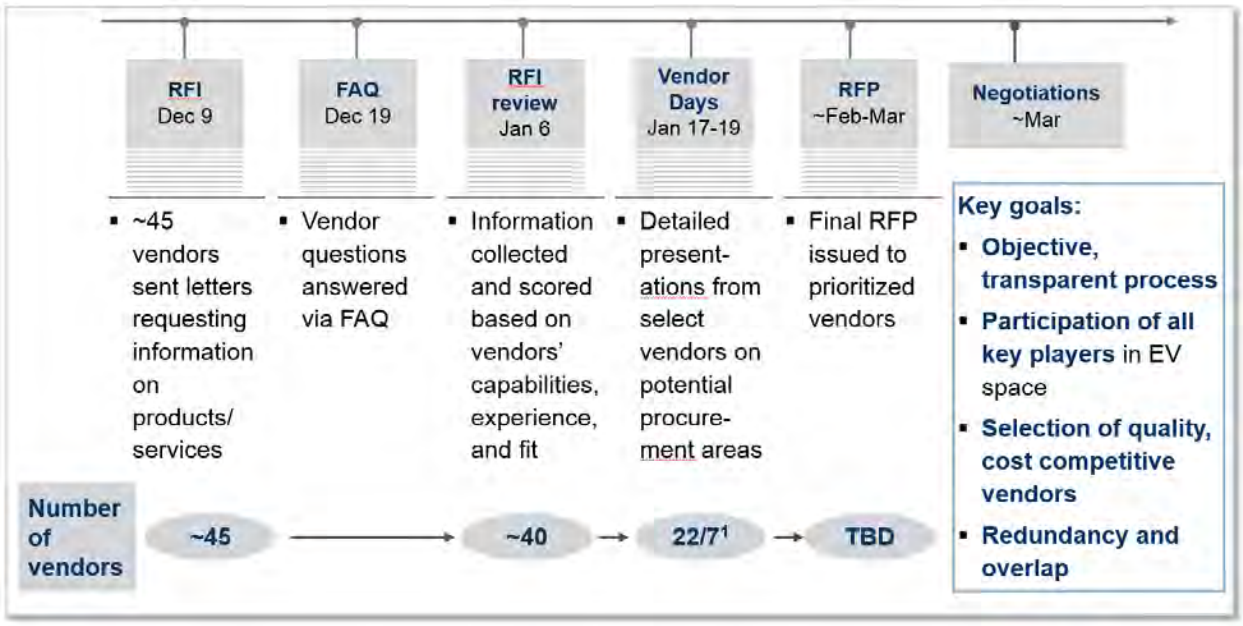
2.2.1.3.5. INDUSTRY PARTNERSHIP ENGAGEMENT

Electrify America will need the help of an extensive group of experienced suppliers in the charging infrastructure space to plan and implement this community and highway network, most of which are expected to be U.S. based firms. As such, Electrify America's $250M investment in infrastructure implementation and maintenance across the nation, and $120M investment in California, is expected to create opportunity for the existing American charging industry and employment in many American communities.

Electrify America has made significant progress in selecting vendors to meet these ambitious infrastructure build-out schedules. To date, Electrify America has solicited cost and technical information through an Request for Information (RFI), it has met with a large number of vendors across the charging space in a series of "Vendor Days," it has received numerous vender proposals through its National Outreach Plan Process, it has prioritized several vendors across key procurement categories from site identification and acquisition to site maintenance,

and it has initiated a series of Requests for Proposals (RFPs). Note that the RFI process is not limiting in that potential partners who did not participate in the RFI process may still be a part of the implementation moving forward when appropriate, and Electrify America will welcome such participation. An overview of the process is shown in Figure 7. Key steps included the following:

- **RFI issuance (Dec. 9th)**: 45+ vendors across the ZEV space (80+ percent U.S. based) sent letters requesting information (capabilities across the value chain, relevant experiences, and product/service offerings).
- **FAQ issuance (Dec. 19th)**: Vendor questions answered to clarify RFI where needed.
- **RFI response review (Jan. 6th)**:Information collected and scored based on vendors' capabilities, experience, and fit with Electrify America's overall mission. This process followed a rigorous, objective scoring methodology to best identify vendors positioned to help Electrify America.
- **Vendor Days (Jan. 17th-19th)**: Detailed presentations were given by approximately 30 vendors across procurement categories to provide qualitative highlights of their capabilities and future plans that Electrify America should consider in its forward planning.
- **RFP issuance (March onwards)**: For priority procurement areas, RFPs began to be issued March 9, beginning with one for site identification, validation and acquisition. The highway network hardware RFP was also issued in March 2017.



1 22 standup meetings during Vendor Days; 7 additional conference calls outside of that.

FIGURE 7: OVERVIEW OF RFI/RFP PROCESS

2.2.1.4. Maintenance plan for ZEV infrastructure

Electrify America will issue RFPs to external vendors to ensure that periodic maintenance will be available across the network for 10 years after the Effective Date to enable the hardware to remain operational over the entire 10 year period. Furthermore, contract terms negotiated after completion of the RFP process will ensure that the charging equipment is marked with a toll-free customer service hotline available 24/7 and that this number will be answered by a live operator if any maintenance issue should arise. Additionally, service response time metrics will be tracked.

2.2.1.5. Interoperability and open access

In order to maximize public access to its charging network, infrastructure built by Electrify America will have the ability to service plug-in ZEVs using a mix of non-proprietary connectors, which can be built by multiple suppliers to a commonly developed specification and can charge electric vehicles produced by multiple automakers. Level 2 AC charging will utilize universally accepted J1772 connectors, while every DC fast charging station will utilize both non-proprietary charging standards (CCS and CHAdeMO) in the first cycle in order to maximize access.

Through the National Outreach Plan process conducted during the development of this plan, Electrify America confirmed that the field of vehicle charging is rapidly evolving, especially regarding charging speed and non-proprietary connectors and protocols. We will continue to evaluate which chargers and non-proprietary connectors should be deployed as the technology and industry evolves.

Electrify America will also support open protocols including Open Charge Point Protocol (OCPP) that allow more standardized communication between different chargers and networks. Electrify America will also work to maintain OCPP compliance and other measures to help maximize interoperability, a term that describes the ease of communication between the charger and the network it is on. A highly interoperable charger network is one that is able to communicate easily with other chargers and networks, much like cellphones that have roaming capabilities today or highway toll transponders that work across multiple toll systems.

Infrastructure will also have the ability to accept multiple payment methods (e.g., subscriptions, mobile pay, RFID, credit cards, and “Plug-and-Charge” standardized in IEC/ISO 15118) to simplify usage as much as possible across a range of buyers. This will be consistent with the Federal Highway Administration’s recent call for a consistent and convenient charging experience along charging corridors, especially with regard to payment methods [*FHWA, 2017*]. In particular, a key part of the business model will be providing true ‘pay-as-you-go’ access to

potential customers, who will be able to use a credit card or other potential payment methods to recharge their vehicles without having a pre-existing relationship with a charging network operator. Note that there is also a disproportionate focus on publicly-accessible infrastructure (e.g., highway chargers, community depots, municipal parking lots and garages) to maximize access as well as promote exposure as broadly as possible.

Through the support of multiple charging standards, the ability to accept multiple payment methods, and a strong focus on publicly-accessible infrastructure, Electrify America will be building a highly interoperable network that provides access to as many consumers as possible. This is consistent with Electrify America's vision to promote 'universal access' as much as possible, well beyond the standards of many current players in the industry.

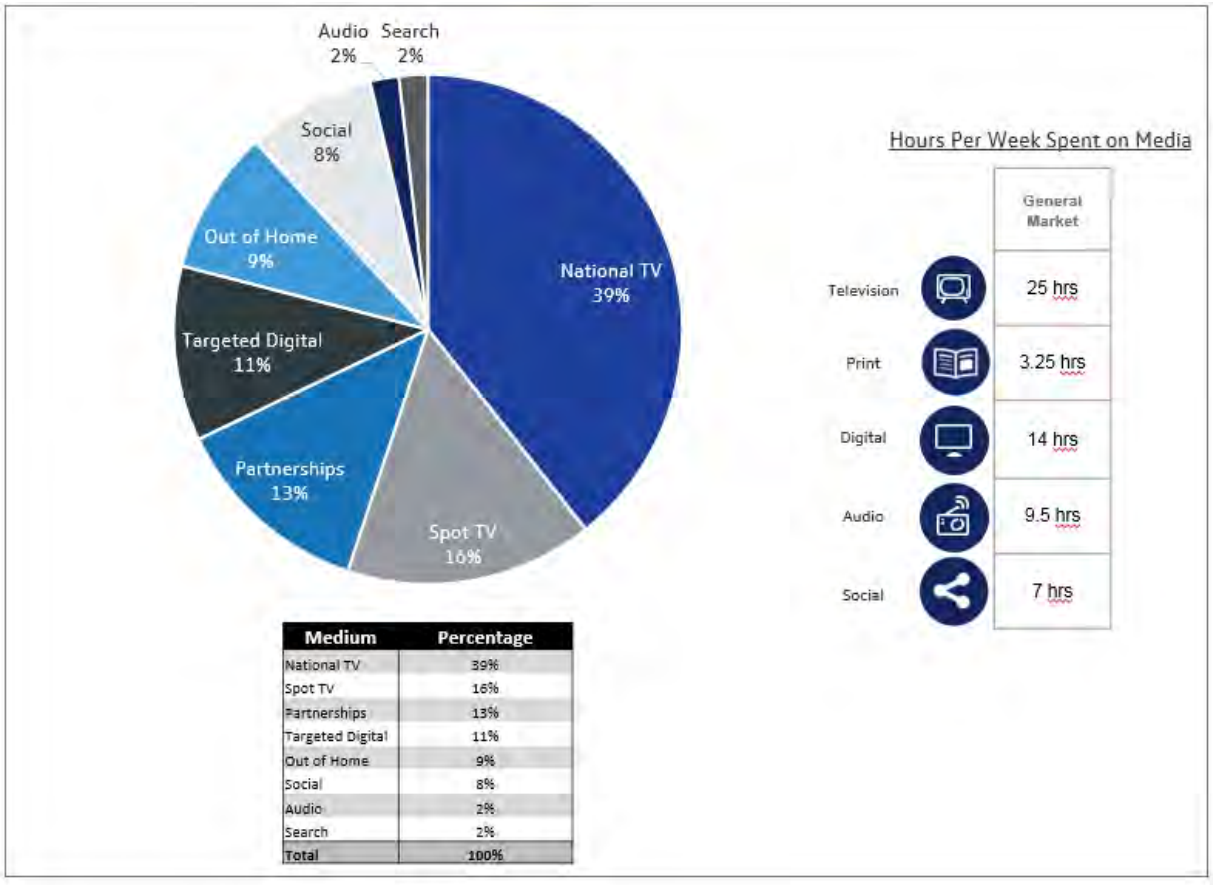
2.2.2. Public education

2.2.2.1. Guiding principles

The National Academy of Sciences' landmark 2013 report, *Overcoming Barriers to Electric Vehicle Deployment*, found that "…most potential PEV customers have little knowledge of PEVs and almost no experience with them. Lack of familiarity with the vehicles and their operation and maintenance creates a substantial barrier to widespread PEV deployment." The principles of the education campaigns, which can help to address the above finding, begin with an understanding of the current adoption rates of ZEVs.

2.2.2.2. Investment selection methodology

Total spend allocation within the first 30-month investment cycle for education will be $43-50 million across the entire United States (with at least $25 million of this spend outside of California). This spend will be allocated across multiple media channels to reach consumers at critical touchpoints based on their consumption habits, as shown in Figure 8.



Medium	Percentage
National TV	39%
Spot TV	16%
Partnerships	13%
Targeted Digital	11%
Out of Home	9%
Social	8%
Audio	2%
Search	2%
Total	100%

FIGURE 8: OVERVIEW OF GENERAL MEDIA CONSUMPTION HABITS

2.2.2.3. Specific description of investments

Based on segmentation analysis and consumer media consumption habits, we have developed a comprehensive plan to deliver messaging about both ZEV benefits and overcoming barriers to ZEV adoption. Media will be used to put ZEVs on the "big stage" in order to help consumers see that ZEVs not only meet the majority of their needs today, but also, as infrastructure networks grow further, adoption barriers continue to be reduced.

A preliminary illustration of this 360 degree messaging is summarized in Figure 9. A more detailed view of this is still under development by the creative and media agencies, but the messaging will be split across traditional advertising channels like TV, targeted digital advertising channels including digital radio, social media, websites, as well as partnerships with various platforms to further spread messaging.

FIGURE 9: PRELIMINARY MULTI-CHANNEL APPROACH TO REACH CONSUMERS AT CRITICAL TOUCHPOINTS[4]

In order to quickly maximize messaging presence, a coordinated National/Local media strategy was developed. This allows for a quick ramp-up across the country, followed by

[4] The experiential programs, if considered access or exposure activities under Appendix C, are subject to written pre-approval by EPA before they may be considered creditable costs.

sustained messaging in top high potential ZEV markets. An overview of these planning principles can be seen in Figure 10.

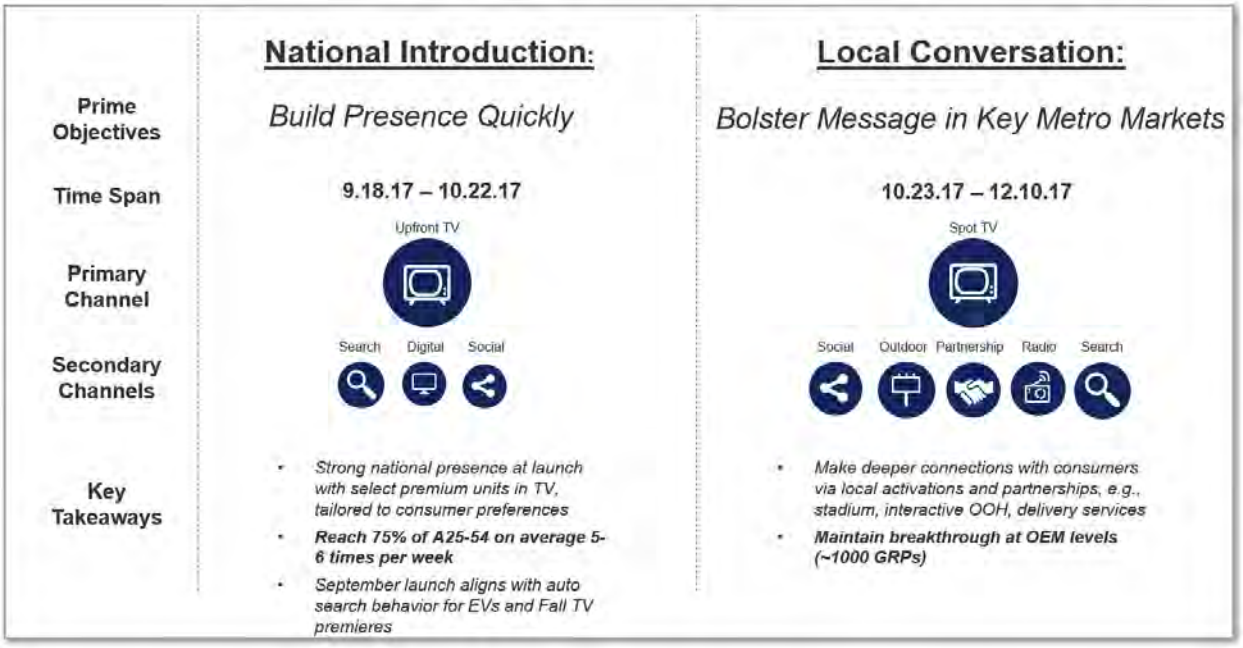


FIGURE 10: PRELIMINARY NATIONAL AND LOCAL MEDIA PLANNING PRINCIPLES

2.2.2.4. Public education timeline and milestones

Electrify America's creative agency continues to refine the creative content based on the segmentation analysis (highlighting the most impactful benefits of ZEVs), and creative concepts should be finalized in the next month, followed by finalization of media planning by summer.

2.2.3. Public access initiatives

Experiential initiatives like ride-and-drive events are being planned to help increase ZEV access and exposure for as many Americans as possible. The purpose of these activities is to increase the public's awareness of and access to ZEVs and allow them to experience ZEVs without having to purchase a vehicle. Options here are currently being explored, and updates will be provided in future reporting cycles. Electrify America will seek written approval for its access program from EPA before making these investments, as required by Appendix C.

2.3. Anticipated Creditable Costs

Creditable costs for the first 30-month investment cycle have been identified across the twelve categories specified in §2.5.3 of Appendix C. The creditable costs reflect Electrify America's current perspective and best estimate of anticipated costs, but are subject to change as the business continues to develop (e.g., vendors identified, full organization hired, office lease signed) and actual costs are incurred. Which costs incurred by Electrify America are creditable costs is determined by the Final Creditable Cost Guidance approved by EPA in March 2017.

Specific creditable costs that fall within the taxes and governmental fees line item have not yet been identified and will be detailed in future Annual ZEV Investment Reports. Services provided through SLAs (Service Level Agreements) between Electrify America and other Volkswagen group companies include finance, tax, treasury, human resources, legal, and purchasing. As the vast majority of creditable costs are driven by goods and services obtained pursuant to third-party contracts, additional detail has been provided for major investment categories (i.e., Infrastructure, Green City, Education/Access, Outreach, other Overhead).

2.4. Advancement of ZEV technology in the United States

The activities described in the National ZEV Investment Plan are designed to promote and support the increased use of ZEVs in a number of ways:

- The ZEV infrastructure plan is designed to **increase the use of ZEVs in the US**. The support of multiple use cases in the local community network and the spatial coverage of the highway network are intended to reduce range anxiety, which is cited as a primary barrier to ZEV adoption by prospective buyers.

- The gap between the current existing energy supplied by charging infrastructure and the projected demand calculated in the ZEV infrastructure investment selection methodology (section 2.2.1.2) illustrates **there is a clearly existing present and projected need for the additional ZEV charging infrastructure** that the Electrify America network will help satisfy.

- Electrify America will build charging stations in the areas of highest ZEV demand (section 2.2.1.2), where there is the **highest likelihood of utilization and provides accessibility/availability where most needed and most likely to be regularly used.**

- The ZEV infrastructure is intended for, and compatible with ZEV technologies **that are not limited to ones supported by VW group brands. Instead, the goal is to promote universal access**. In particular, multiple technologies (L2, DCFC) and **multiple non-proprietary connectors and charging protocols** (e.g., CHAdeMO, CCS) will be offered to maximize public access to Electrify America's charging infrastructure.

- The combination of the above factors will help to **support and/or advance the market penetration of ZEVs in the US and help to build positive awareness of ZEVs**.

2.5. Certification of activities

Electrify America certifies that none of the activities described in the ZEV investment plan described above was/is:

- approved by the Board of Management prior to September 18, 2015

- required by a contract entered prior to the date of lodging of the Consent Decree

- a part of a joint effort with other automobile manufacturers to create ZEV infrastructure

- required to be performed by any federal, state, or local law, or anticipate will be required to perform during the planned 30-month period

2.6. Supporting literature

In developing the methodology for the National ZEV Investment Plan, a number of sources from peer-reviewed academic literature, government, and industry were used. Important data and information from these sources was used to ensure that, in developing our plan, the investments have the highest likelihood of increasing the use of ZEVs in the U.S., address a clearly existing need, have a high likelihood of utilization and provide accessibility where most needed, support the market penetration of ZEVs, and help build positive awareness for ZEVs. For example, in developing our local community-based charger plan, a number of sources providing information on major U.S. metropolitan areas were used to determine the suitability of investment needed across metro areas, allowing us to select metros with the most significant need for investment in ZEV infrastructure.

A selection of key sources used is included below:

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7. Dale Kardos and Associates. EV incentives by state Q2 2016 update.

8. Edison Electric Institute (EEI) (2016). EV market assessment and survey narrative summary.

9. EERE (Office of Energy Efficiency and Renewable Energy). Alternative Fuel Data Center. U.S. Department of Energy. http://www.afdc.energy.gov/

10. Esri street data. Esri GIS mapping software.

11. Experian (estimated 2020 total vehicles by CBSA). http://www.experian.com/automotive/auto-vehicle-data.html

12. Factiva press search or market reports on ZEV incentives / regulations. http://global.factiva.com

13. "FAST Act" or the "Fixing America's Surface Transportation Act.'' Public Law 114-94, enacted December 4, 2015.

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21. Kneebone, Elizabeth, & Holmes, Natalie (2015). The growing distance between people and jobs in metropolitan America. Washington D.C.: Brookings Institute, Metropolitan Policy Program.

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24. Lutsey, Nic; Searle, Stephanie; Chambliss, Sarah; & Bandivadekar, Anup (2015). Assessment of leading electric vehicle promotion activities in United States cities. International Council on Clean Transportation, white paper.

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29. Neubauer, J.S. and Wood, E. (2015). Will your Battery Survive a World with Fast Chargers? http://www.nrel.gov/docs/fy15osti/63531.pdf

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33. Shepard, Scott; Jerram, Lisa; Gartner, John; & Brown, David (2016b). Distribution of BEVs by Range and Class, United States 2016-2025. Boulder: Navigant Research.

34. Singer, Mark (2016). Consumer Views on Plug-In Electric Vehicles, National Benchmark Report. National Renewable Energy Laboratory. http://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark_2nd_ed.pdf

35. Strategic Vision (2016). New Vehicle Experience Survey.

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37. US Census Bureau (population statistics), https://www.census.gov/

38. US Department of Energy (2015). Workplace Charging Challenge – mid-program review: Employees Plug-in. https://energy.gov/sites/prod/files/2015/12/f27/105313-5400-BR-0-EERE%20Charging%20Challenge-FINAL_0.pdf

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2.7. ZEV charging infrastructure glossary

AC Charging

The majority of ZEV charging is done with AC voltage at Level 1 (120 volts or normal household current) or Level 2 (240 volts or an electric dryer power equivalent). AC charging is typically more cost effective for the equipment and installation and takes advantage of longer dwell times to provide lower power to a ZEV over a longer period of time. AC charging is an excellent solution for residential, workplace, multi-unit dwelling and other longer-term parking situations like hotels and municipal or airport parking garages.

DC Fast Charging

Direct current charging for electric vehicles allows for higher charging speeds, as DC current can be supplied directly to the electric vehicle's battery at power levels normally higher than AC charging. The higher the DC power supplied, the faster the electric vehicle can be charged, provided the vehicle is designed to handle such power. A common DC power is 50 kW, which is the upper limit of all the current vehicles which support SAE CCS today, while the CHAdeMO DC standard will accept up to 62.5 kW power. The proprietary Tesla Supercharger technology can charge up to 140 kW and is currently the most powerful charging available. By 2019, it is expected that 150+ kW DC fast charging will be available on a number of vehicles, and speeds of up to 320 kW (at 350 amps of current at 200V to 920V power source) will be available on a limited basis. To illustrate the charging power difference between Level 2 AC and DC fast charging, a Level 2 7.2 kW AC charger will deliver about 27 miles of ZEV range per hour of charging, whereas a 50 kW DC fast charger will deliver well over 100 miles of range per hour.

CHAdeMO

A DC fast charging standard first developed in Japan for the Japanese market and capable in the U.S. of charging the Nissan Leaf, Kia Soul and Mitsubishi iMiEV.

CCS (Combined Charging System)

CCS is a DC fast charging protocol that is SAE certified and featured on vehicles produced by GM, BMW, Volkswagen Group, Ford and a number of other automakers headquartered in Europe and the United States. The "combined" term designates the CCS capability to incorporate the level 2 (J1772 standard) plug and DC fast charging connector into the same larger plug.

Dwell Time

The term for the amount of time a ZEV is parked in a location. The longer the "dwell" time, the longer it is parked.

Higher Power DC Fast Charging

New technology developments will feature 150 kW to 320 kW of charging power, capable of adding electricity to a new generation of longer-range ZEVs at a rate of between 9 and 19 miles per minute. The new chargers designed under CCS protocol will

be available in 2018, utilizing primarily "kiosk" designs, meaning the power electronics and other important components are housed outside the charger itself in an easier-to-service box in a separate location. Not only will these new chargers deliver higher charging power, the 350 amps of current they use will necessitate the use of liquid-cooled charging cables to present an easier-to-handle, thinner cable with which customers will be able to charge their vehicles. The CHAdeMO Association is also working to complete a 150 kW charging protocol by 2017.

OCPP

The Open Charge Alliance (OCA) is a global consortium of public and private electric vehicle (EV) infrastructure leaders that have come together to promote open standards. OCPP is the protocol they have developed to provide powerful, open, and interoperable communication between the different ZEV charging infrastructure companies, hardware and network.

Plug-and-charge

Plug-and-charge is part of the latest revision of the CCS combo standard, featuring the IEC/ISO 15118 standard which prescribes the means by which a charger and network can identify and authenticate a specific vehicle to allow for a charging session automatically, by simply "plugging in", without the need for supplemental membership cards or fobs.

Proprietary/Non-Proprietary Charging Connector and Protocol

A non-proprietary connector is not privately-owned or controlled and is thus easily available as a standard and does not require extensive development to be ready for application. Both CHAdeMO and CCS combo are non-proprietary DC fast charging protocols. A proprietary charging connector is a connector and charging network that is exclusively accessible to one brand of vehicle or type of user.

Zero Emission Vehicle (ZEV)

Under Appendix C, the following three vehicle types are considered Zero Emission Vehicles:

1. An on-road passenger car or light duty vehicle, light duty truck, medium duty vehicle, or heavy duty vehicle that produces zero exhaust emissions of all of the following pollutants: non-methane organic gases, carbon monoxide, particulate matter, carbon dioxide, methane, formaldehyde, oxides of nitrogen, or nitrous oxide, including, but not limited to, battery electric vehicles ("BEV") and fuel cell vehicles ("FEV");
2. An on-road plug-in hybrid electric vehicle ("PHEV") with zero emission range greater than 35 miles as measured on the federal Urban Dynamometer Driving Schedule ("UDDS") in the case of passenger cars, light duty vehicles and light duty trucks, and 10 miles as measured on the federal UDDS in the case of medium- and heavy-duty vehicles; or
3. An on-road heavy-duty vehicle with an electric powered takeoff.

ZEVs do not include: zero emission off-road equipment and vehicles; zero emission light rail; additions to transit bus fleets utilizing existing catenary electric power; or any vehicle not capable of being licensed for use on public roads.

National ZEV Investment Plan: Cycle 2

Public Version – February 4, 2019

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List of Acronyms

Please note – further definition of select terms found in the Glossary in Appendix 4.

BEV	Battery Electric Vehicle
CCS	Combined Charging System
CRM	Customer Relations Management
DCFC	Direct Current Fast Charger
DVMT	Daily Vehicle Miles Traveled
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
ICE	Internal Combustion Engine
kW	Kilowatt
kWh	Kilowatt-hour
L2	Level 2 Charging Station
MSA	Metropolitan Statistical Area
MUD	Multiunit Dwelling
MWh	Megawatt-hour
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
OICP	Open InterCharge Protocol
OOH	Out of Home
PEV	Plug-in Electric Vehicle (BEV or PHEV)
PHEV	Plug-in Hybrid Electric Vehicle
RFI	Request for Information
RFP	Request for Proposal
TNC	Transportation Network Company
VMT	Vehicle Miles Traveled
ZEV	Zero Emission Vehicle

Executive Summary

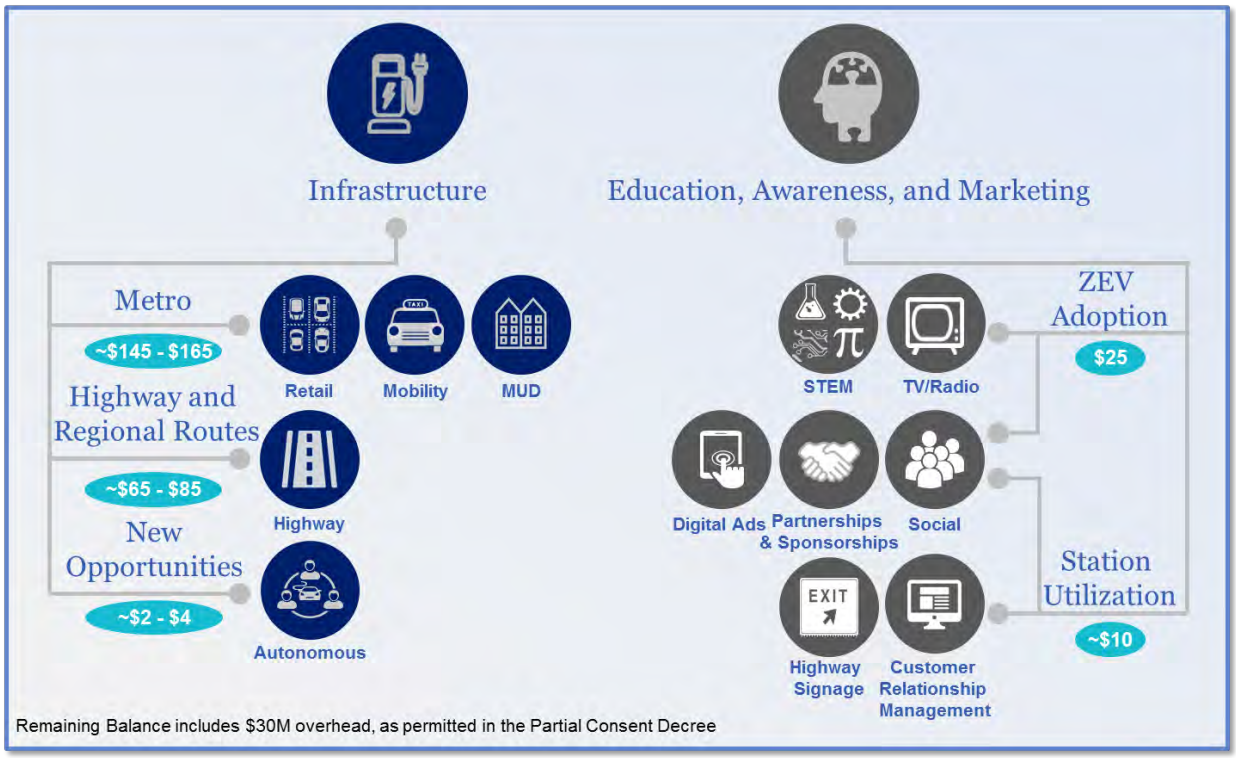
Electrify America is pleased to present this National Zero Emission Vehicle (ZEV) Investment Plan for its second cycle of ZEV infrastructure, education and awareness, and access investments. As required by Appendix C to the 2.0-Liter Partial Consent Decree entered by the U.S. District Court for the Northern District of California on October 25, 2016, Volkswagen Group of America is investing $2 billion over 10 years to support the increased adoption of ZEV technology in the United States. Of this $2 billion investment, $1.2 billion will be spent outside of California. This investment represents the largest commitment of its kind to date. Following conference with the Environmental Protection Agency (EPA), this plan defines the National[1] investments to be made or targeted in Cycle 2, from July 2019 through December 2021.

This ZEV Investment Plan is the culmination of more than a year's worth of research, analysis, and outreach efforts led by a new, dedicated infrastructure planning team. Electrify America has sought to engage stakeholders throughout the ZEV community in defining this plan, through in-person meetings, hundreds of phone calls, community conversations, webinars, and a web-based comment/submission forum. Each touchpoint yielded new ideas and recommendations for the investment, many of which complemented our own internal thinking. Electrify America has thoroughly analyzed each opportunity for its impact on ZEV adoption, and its value as an investment to help Electrify America build toward a sustainable business. The response to our outreach has been inspiring. It demonstrates the real commitment the ZEV community has to our shared mission and this transformational opportunity to drive long-term ZEV adoption. We are deeply grateful to all those who have been a part of this effort.

Electrify America's Cycle 2 investments center on two core areas: ZEV Fueling Infrastructure and ZEV Education, Awareness, and Marketing.

[1] The National ZEV Investment Plan covers investment in the United States, excluding California, pursuant to Section 1.6 of Appendix C of the Partial Consent Decree. Unless noted otherwise, National or Nationally refer to the United States, excluding California pursuant to the aforementioned reference.

Figure 1: Overview of Cycle 2 Investments



Fueling Infrastructure (~$235 million)

In Cycle 2, Electrify America will invest approximately $235 million (Figure 1) in fueling infrastructure for EVs across a broad set of use cases already established in Cycle 1 or newly developed for Cycle 2. Infrastructure cost ranges are Electrify America's best estimates of projected costs, given uncertainties related to hardware, construction, and operations costs at this early stage.

- **Metro Community Charging ($145 - $165 million):** The major focus of infrastructure investment in Cycle 2 is charging within metro areas, where research shows that EV drivers charge most often. Electrify America will invest in metro-based direct current fast charging (DCFC) stations in 18 metro areas. These metro areas are expected to account for more than 50% of expected battery electric vehicles (BEVs) in operation outside California through 2022 (Navigant, 2017). Metro DCFC stations will be placed in retail locations throughout a metro region and are intended to serve EV drivers in their daily fueling needs. Select DCFC stations will also be targeted at customers living in multiunit dwellings (MUDs), expanding access to drivers who reside in such communities. Finally, Electrify America will invest in DCFC stations specifically designed to serve shared mobility drivers (car share, taxis, and transportation network company (TNC) drivers) to ensure that these high mileage drivers and passengers are able to enjoy the benefits of ZEV adoption conveniently and cost effectively. Creditable operating expenses associated with metro charging are forecasted to be approximately $18 million of the total spend in this category.

- **Highways and Regional Routes ($65 – $85 million)**: Cycle 2 investments will build upon Cycle 1 efforts to develop a highway network of ultra-fast DCFC stations. This will include building new sites connecting regional destinations and filling in existing routes as station utilization of the highway network increases. Creditable operating expenses associated with highway charging are forecasted to be approximately $26 million of the total spend in this category.

- **Autonomous Vehicle Charging ($2 - $4 million):** Innovative and disruptive mobility alternatives, specifically driverless/autonomous vehicles, have the potential to bring many benefits to society including significant reductions in traffic congestion and vehicle emissions (Fagnant & Kockelman, 2015; Anderson et al., 2016). However, autonomous zero emission vehicles require unique fueling solutions. To meet the emerging need presented by autonomous ZEVs, Electrify America plans to build one to two commercial autonomous electric vehicle fueling stations.

- **Renewable Generation:** To provide clean and financially sustainable power to stations in Cycle 2, Electrify America will explore investing in renewable generation where cost effective. These costs are related to station infrastructure and as such are included in the aforementioned cost estimates. In aggregate, investments in renewable generation are not expected to exceed $5 million.

Electrify America notes that the estimated budgets represent a good faith estimate of Cycle 2 costs. Given uncertainties regarding both capital and operating costs at this early stage, it is possible that total costs may exceed or fall below targeted levels. In the event that costs fall below targets, Electrify America will deploy additional investments in other Cycle 2 ZEV Investment Plan use cases to meet the Appendix C ZEV Investment Commitment. If costs exceed budget forecasts, the number of infrastructure investments will be reduced by a commensurate amount. In addition, given the early stage of partner discussions, availability of site locations, and/or the technology itself (e.g. autonomous), each new use case involves a level of uncertainty in both cost and operational feasibility. Should investment targets in any new use case be unachievable due to practical considerations, the allocated funds will be redeployed into one or more of the other Cycle 2 ZEV Investment Plan use cases to ensure the total investment fulfills Appendix C requirements.

Table 1: Infrastructure Investment Overview

Use Case	Projected Technology	Estimated Spend ($M)[1]
Metro Community Charging	150 kW DCFC	$145 - $165
Highways and Regional Routes	150 kW / 350 kW DCFC	$65 - $85
Autonomous	TBD	$2 - $4
TOTAL		**~$235**

[1] Costs include creditable operating expenses, on site storage, and up to $5 million in renewable generation where appropriate.

Electrify America believes the investments described in Table 1 address the use cases and locations where ZEV drivers need infrastructure most, while also contributing to a sustainable long-term business for Electrify America and further improvement to air quality in the United States. The investments are projected to roll out along the following timeline in Table 2.

Table 2: Cycle 2 National Preliminary Infrastructure Deployment Schedule – All Sites

Cycle 2 Infrastructure Investments			
Quarter	Pre-site selection	In development	Operational
Q4 2019	150 - 160	20 - 30	40 – 50
Q2 2020	90 - 100	40 - 50	80 - 100
Q4 2020	40 - 50	50 - 60	120 – 140
Q2 2021	0 - 0	50 - 60	160 - 180
Q4 2021	0 - 0	0 - 0	~215

Public Education, Awareness and Marketing Activities

Electrify America will engage in two distinctive and differentiated campaigns, targeting two distinct goals: (1) a brand-neutral campaign to drive ZEV adoption; and (2) a branded media campaign intended to drive station utilization.

Boosting ZEV Adoption through Education and Awareness ($25 million)

Electrify America will invest $25 million in brand-neutral education, awareness, and outreach activities to boost adoption of ZEVs from across the marketplace.

Recent academic research shows that mass-market ZEV adoption has been significantly limited by low awareness. For example, Strategic Vision's 2016 New Vehicle Experience Study found that just 48% of new car buyers in California and 41% of national buyers have ever heard of a ZEV. A UC Davis GreenLight blogpost by Ken Kurani and Scott Hardman entitled, "Automakers and Policymakers May Be on a Path to Electric Vehicles; Consumers Aren't," echoes this finding, showing that consideration of plug-in electric vehicles changed little from 2014 to 2017. During the initial phases of Cycle 2, efforts will primarily focus on increasing awareness and consideration of ZEVs by informing the public of ZEV benefits. This will likely take the form of traditional media advertising, similar to Electrify America's Cycle 1 Jetstones TV/radio campaign, but it will also include other proven awareness building activities, such as partnerships and digital activities. After ZEV awareness has been sufficiently boosted by Electrify America's campaign, awareness initiatives from other organizations (e.g., the Northeast States for Coordinated Air Use Management (NESCAUM)), and the introduction of new ZEV models, Electrify America will shift focus to encouraging customers to research ZEVs and test drive the vehicles. Accordingly, our marketing and media tactics will shift to more targeted digital media interactions such as paid search and web banners, as these tactics traditionally perform well given minimum levels of consumer awareness.

Given the still prevailing lack of ZEV awareness in the United States, the largest portion of the Cycle 2 budget will go toward traditional media, with TV, radio and out of home (e.g., billboards) accounting for approximately $11 million of spending. Digital advertising will account for another approximately $9 million of the budget. To complement these efforts, Electrify America is also planning to spend approximately $4 to $5 million on a range of alternative tactics to provide audiences additional touch points with ZEVs. These tactics may include collaborating with key social media influencers to promote positive aspects of ZEVs; supporting ZEV experience centers with educational materials; and

offering STEM educational programs about ZEVs and charging infrastructure for K-12, vocational schools, professional development, and community colleges. Electrify America will continue to collaborate with organizations that are consumer-oriented and create content/events/test drives to promote ZEV adoption.

To supplement these education and awareness activities, Electrify America will sponsor Learn and Drive events[2] to give consumers an opportunity to experience the thrill of driving a ZEV.

Boosting Station Utilization through Marketing (~$10 million)[3]

Electrify America will also invest in driving utilization of its charging network through branded events, promotions, and marketing. As outlined in Appendix C of the Partial Consent Decree, Electrify America must target sufficient utilization to demonstrate its investments are "addressing an existing need or supporting a reasonably anticipated need." National Renewable Energy Laboratory's 2017 'Consumer Views on Plug-in Electric Vehicles – National Benchmark Report' highlights the challenge, finding that a large majority (~80%) of survey respondents were not aware of any charging stations, including at places they passed regularly, worked at, or frequented. To meet this utilization goal, Electrify America plans to spend approximately $10 million to generate awareness of its ZEV charging infrastructure footprint and drive station utilization. These activities will use Electrify America branding as necessary, but will not feature or favor Volkswagen Group of America vehicles.

Electrify America's marketing efforts will highlight four primary benefits for EV drivers:

- Locations: Convenient charging locations in major metropolitan areas and on national and regional highways;
- Speed: High-powered charging speeds, offering consumers a convenient charging experience (up to 350 kW, providing 200 miles of range in as little as 10 minutes);
- Affordability: Fairly priced and competitive fueling across the network, including subscription plans and charging bundles provided by automotive manufacturers; and
- Customer-centricity: Infrastructure designed considering the consumer experience first, including locations near retail amenities and credit card access at all DCFC stations.

The largest portion (approximately $5 million) of this branded campaign budget will be dedicated to digital advertising. These efforts will be targeted toward those specific groups most likely to be able to utilize the Electrify America charging network, including new and used EV buyers, EV driver club members, and prospective EV buyers/researchers. Electrify America will use digital tools to reach

[2] Under Section 2.5.5 of Appendix C, 'Ride and Drive' events are classified as Access investments. Due to the educational nature of these events, Learn and Drive events are described in this ZEV Investment Plan as supplementing the Education and Awareness activities. However, they will be recorded and tracked as Access investments.

[3] This investment, while a marketing activity, is not classified as 'brand-neutral education and awareness' defined in Section 1.10.2 of Appendix C of the Partial Consent Decree.

these prospects and deliver the right message (e.g., promotion of closest EV charging location) at the right time (e.g., when someone is searching for an EV charger).

The remaining ~$5 million will be used for complementary messaging tactics. These investments may include working with established media outlets to sponsor editorial content about DCFC charging infrastructure; leveraging customer relations management tools to keep current and potential customers informed of new Electrify America charger installations; funding memberships or sponsorships likely to increase awareness and use of Electrify America's stations; supporting key industry events; and supporting signage along roadways to identify Electrify America charging sites.

Conclusion

Electrify America's Cycle 2 planned investments are summarized below (see Table 3). The Cycle 2 budget focuses even more investment on DC fast charging in metro areas, where data demonstrates that the need for investment is extraordinary. The budget also continues to grow the network of highway stations started in Cycle 1. These investments will continue to establish the foundational infrastructure essential to ZEV adoption in the United States.

Table 3: Cycle 2 Budget Breakdown

Category	Estimated Budget ($M)[1]
Infrastructure	**~$235**
Metro Community Charging	**$145 - $165**
Highways and Regional Routes	**$65 - $85**
Autonomous	**$2 - $4**
Brand-Neutral Efforts to Boost ZEV Adoption	**$25**
Electrify America Efforts to Drive Station Utilization	**~$10**
Electrify America Business Operation & Organization[2]	**$30**
TOTAL	**$300**

[1] Costs include creditable operating expenses, on site storage, and up to $5 million in renewable generation where appropriate.
[2] According section 5.1 of Appendix C-1 of the Partial Consent Decree, Electrify America is permitted to spend 10% of the total budget on these costs.

At the end of Cycle 2, Electrify America will have invested its first $600 million in infrastructure, education, awareness, and access initiatives across the country – achieving a key 'half way point' milestone in its 10 year commitment to accelerate ZEV adoption for all drivers. We hope that our investments, as well as outreach and collaboration, serve as a 'rising tide that lifts all boats' for ZEV stakeholders in the public and private sectors, creating benefits for drivers, car companies, utilities, charging infrastructure suppliers, and the construction trades.

We take our planning, development, and deployment work seriously and recognize that the greater supplies and types of zero emission vehicles coming to market from a variety of car companies (established more than 100 years ago or new to market) can only be fully leveraged with commensurate infrastructure and initiatives related to awareness, education, and access. The entire staff at Electrify

America understands that we have an important, unique, and transformational opportunity to bring the United States into the age of electric cars.

The future can be brighter for drivers, air quality, fossil fuel independence, and reduced congestion thanks to zero emission transportation. Electrify America is honored to be a part of this important mission, and we are committed to restoring the public's trust.

1. Introduction

1.1. Background

As agreed to in Appendix C of the 2.0-Liter Partial Consent Decree entered by the U.S. District Court for the Northern District of California on October 25, 2016, Volkswagen Group of America is investing $2 billion over 10 years in zero emission vehicle infrastructure, education and awareness, and access efforts to support the increased adoption of ZEV technology in the United States.

Volkswagen Group of America created Electrify America LLC, a wholly-owned subsidiary headquartered in Reston, Virginia, to fulfill the ZEV Investment Commitment in Appendix C. The company has grown to approximately 70 full-time employees with a diversity of backgrounds in automotive, utilities, EV infrastructure, technology, construction, and state and federal government. All employees share a passion for helping transform and electrify the transportation sector through investments to grow the market for all zero emission drivers and stakeholders.

Of the overall $2 billion commitment, $1.2 billion will be spent Nationally in $300 million increments over four 30-month cycles. This report describes the $300 million of investment that will be made in the second 30-month cycle Nationally. The Cycle 2 period is from Q3 2019 through Q4 2021 (see Table 4).

Table 4: Investment Cycles

	Cycle 1 (Q1 2017 – Q2 2019)	Cycle 2 (Q3 2019 – Q4 2021)	Cycle 3 (Q1 2022 – Q2 2024)	Cycle 4 (Q3 2024 – Q4 2026)	Full 10 years
National Plan	$300M	$300M	$300M	$300M	**$1.2B**

The Partial Consent Decree defines those investments that qualify toward Electrify America's ZEV Investment Commitment. Investments must include "an explanation, taking into account relevant literature from academia, industry, and government, if available, that each National ZEV Investment, to the extent applicable: increases the use of ZEVs in the United States; addresses a clearly existing need or supports a reasonably anticipated need; has a high likelihood of utilization and provides accessibility/availability where most needed and most likely to be regularly used; supports and/or advances the market penetration of ZEVs in the United States; helps build positive awareness of ZEVs; is intended for, and compatible with, ZEV technology brands that are not limited to the Settling Defendants and/or their subsidiaries; and uses non-proprietary or multiple connectors or charging protocols that anticipate technological changes." Infrastructure investments outlined in this plan must meet Appendix C's threshold for qualification, including expectations that infrastructure addresses an existing or reasonably anticipated need.

This document, which is certified by Electrify America leadership consistent with Partial Consent Decree requirements in Appendix 1, outlines Electrify America's plan for the second cycle of investment. Electrify America's mission continues to be:

- Making it easier for millions of drivers to fuel their ZEVs through economically sustainable investments, and
- Promoting sustained ZEV adoption and station utilization through education, awareness, outreach, and access programs

1.2. Investment Plan Overview

This Cycle 2 National ZEV Investment Plan is a comprehensive presentation of Electrify America's Cycle 2 investments, along with supporting documentation as to why each investment meets the Partial Consent Decree's requirements for investment. Chapter 1 contains background information and Electrify America's approach to its Cycle 2 National ZEV Investment Plan. Chapter 2 details Electrify America's outreach efforts to stakeholders throughout the ZEV industry, including specific efforts through the National Outreach website, consistent with the National Outreach Plan. It also includes the key learnings Electrify America has taken from these efforts that have shaped the Cycle 2 National ZEV Investment Plan. Chapter 3 lays out Electrify America's infrastructure investment plan, including the use cases selected, investment methodology, and use case specific details. Chapter 4 addresses investments in education, awareness, and marketing efforts to increase ZEV adoption and boost station utilization. Finally, Chapter 5 highlights Electrify America's impact on our local communities.

Electrify America's Cycle 2 investment represents a continuation of the largest single investment in non-proprietary ZEV fueling and education in U.S. history. The second cycle will dramatically expand ZEV fueling options across the country and support education, awareness, and ultimately, adoption by millions of drivers for years to come. Overall, it presents a substantial step toward transportation electrification, and the associated benefits of clean air and fossil fuel independence.

1.3. Cycle 2 Approach

Electrify America believes each new investment cycle offers the opportunity to evaluate new information, revisit past assumptions, and consider new ideas and feedback in the planning process. As such, three core principles guided the approach to Cycle 2 planning: (1) Start from the fundamentals; (2) Engage external stakeholders; and (3) Emphasize real world inputs (Figure 2).

Figure 2: Cycle 2 Approach

1. ***Start from the fundamentals***
   - *Analyze both business fundamentals of existing investments (e.g., highway and metro) and new business opportunities*
2. ***Engage external stakeholders***
   - *Collaborate with stakeholders throughout planning process to strengthen thinking*
3. ***Emphasize real world inputs***
   - *Leverage operational data and customer-backed research to make data-driven decisions*

Electrify America began its Cycle 2 planning efforts more than a year ago by initiating a re-examination of the fundamentals of ZEV adoption and the ZEV fueling business. This analysis included updated vehicle sales forecasts for battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs), and fuel cell electric vehicles (FCEVs), and reviewing the fueling characteristics of ZEVs scheduled for release up through 2022. This involved an analysis of automotive original equipment manufacturer (OEM) public announcements regarding vehicle types and range, charging connectors, and charging speeds (DC power levels). In addition, Electrify America examined fueling patterns of today's ZEV fleet, with close consideration for the subset of vehicles that more closely reflect the next generation of vehicles coming to market, which are expected to have larger batteries, longer ranges, and faster charging speeds. In conducting this analysis, Electrify America frequently conferred with academic experts at our nation's national laboratories, universities, and research institutions.

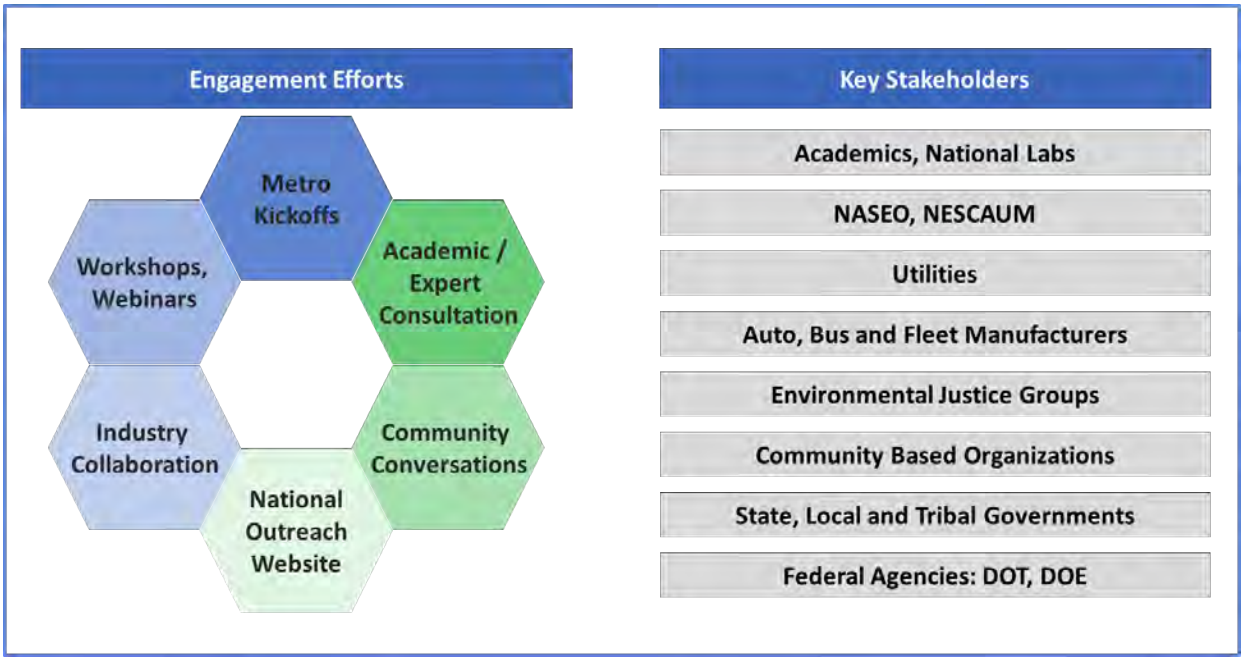
In parallel, Electrify America actively engaged with public and private sector stakeholders throughout the ZEV ecosystem to understand how ZEV investments can have the highest impact on adoption and maximize infrastructure utilization. These hundreds of inputs included conversations with car manufacturers on the technical features of the next generation of vehicles, collaborations with academics on infrastructure siting best practices and recent trends in ZEV awareness, and discussions with advocacy groups and non-profits on how to drive ZEV adoption in local communities. In addition, Electrify America solicited input and feedback from federal agencies; state, local, and tribal governments; and across the industry through its National Outreach website. The guidance from more than 700 inputs submitted online, along with subsequent follow-up conversations by Electrify America staff with submitters, has meaningfully informed and confirmed Electrify America's investment plan and specific strategies for Cycle 2.

As a data driven company, Electrify America has focused on leveraging real-world data and evidence to inform decision-making and improve investment targeting. Information on utilization of existing fueling stations, vehicle sales, local travel patterns, demographics of EV purchasers, and utility rates and programs all guided the selection of Cycle 2 investments. For infrastructure investments, particular emphasis was placed on building a data-backed business case to ensure that all investments are sustainable beyond the end of the Partial Consent Decree. For marketing, education and awareness, and access investments, the focus was on identifying and prioritizing investments with the largest impact on ZEV awareness and adoption. Additional details on the insights and findings pertinent to these investments can be found in Chapter 2: Outreach Efforts and Key Learnings.

2. Outreach Efforts and Key Learnings

Electrify America strongly believes that success in driving ZEV adoption will come from collaboration with the entire landscape of ZEV stakeholders including automotive companies, infrastructure suppliers, utilities, state and local governments, academics, interest groups, and beyond. As such, over the last 12 months our team has spent hundreds of hours and traveled extensively to engage stakeholders in the ZEV community to seek insights on industry trends and customer behaviors, ideas for new business concepts, to understand evolving policies and utility programs, and to collaborate with others on investment opportunities as part of a comprehensive approach laid out in our National Outreach Process. These engagements have taken many forms, including briefings with leaders in our Cycle 1 metropolitan areas, community conversations with local constituencies, workshops, webinars, and consultations with academic experts (Figure 3). Electrify America is grateful to all those who have taken the time to engage with the company in this process.

Figure 3: Stakeholder Engagement Efforts



In addition to the aforementioned efforts, and consistent with Electrify America's commitment to engage in outreach as part of its investment planning process, Electrify America issued a second call for comments, data, and recommendations to inform decisions regarding Cycle 2 investments in ZEV infrastructure, education and awareness, and access programs. The request for input through the National Outreach website launched in January 2018 provided an opportunity for governments, organizations, and others to provide input for Electrify America to update analytical models, evaluate new technology and public policy developments, track evolving consumer expectations, and explore the value of new allowable ZEV Investments. To aid in drafting the Cycle 2 ZEV Investment Plan, Electrify America specifically sought the following types of input:

- Suggestions and Data Relevant to Cycle 2 Investments – Inputs from governments or organizations that are helpful to the decision-making process, including data to help locate

charging stations, ZEV infrastructure plans for individual communities, and information regarding state and local policies designed to increase ZEV adoption;

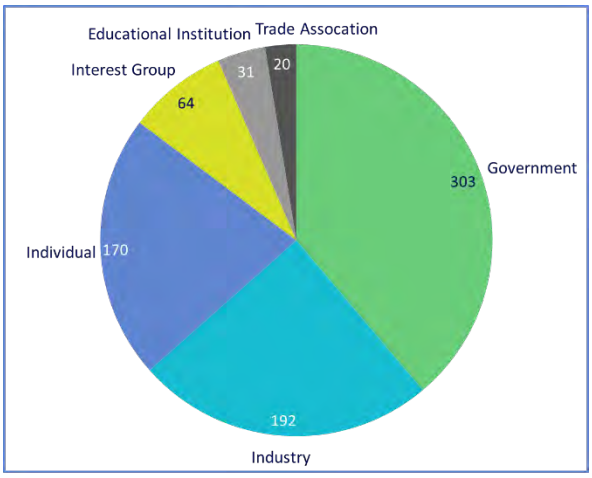
- Education and Access Suggestions – Suggestions on Electrify America's approach to brand-neutral education and access or specific events the company should consider for participation;
- Specific Charging Site Locations – Site locations nominated for consideration in Cycle 2 infrastructure investments;
- Cycle 1 Comments and Feedback – Feedback on the Cycle 1 National and California ZEV Investment Plans, including approaches to metro selection, highways included, evaluation of use cases, and integration of new technology; and
- Other – All other comments or submissions that relate directly to Electrify America's ZEV Investment Commitment.

As a part of this process, Electrify America received nearly 800 submissions, each of which has been carefully reviewed and considered in developing our Cycle 2 plan. The following pages detail our outreach efforts and key learnings and insights from this process.

2.1. Summary of National Outreach Effort

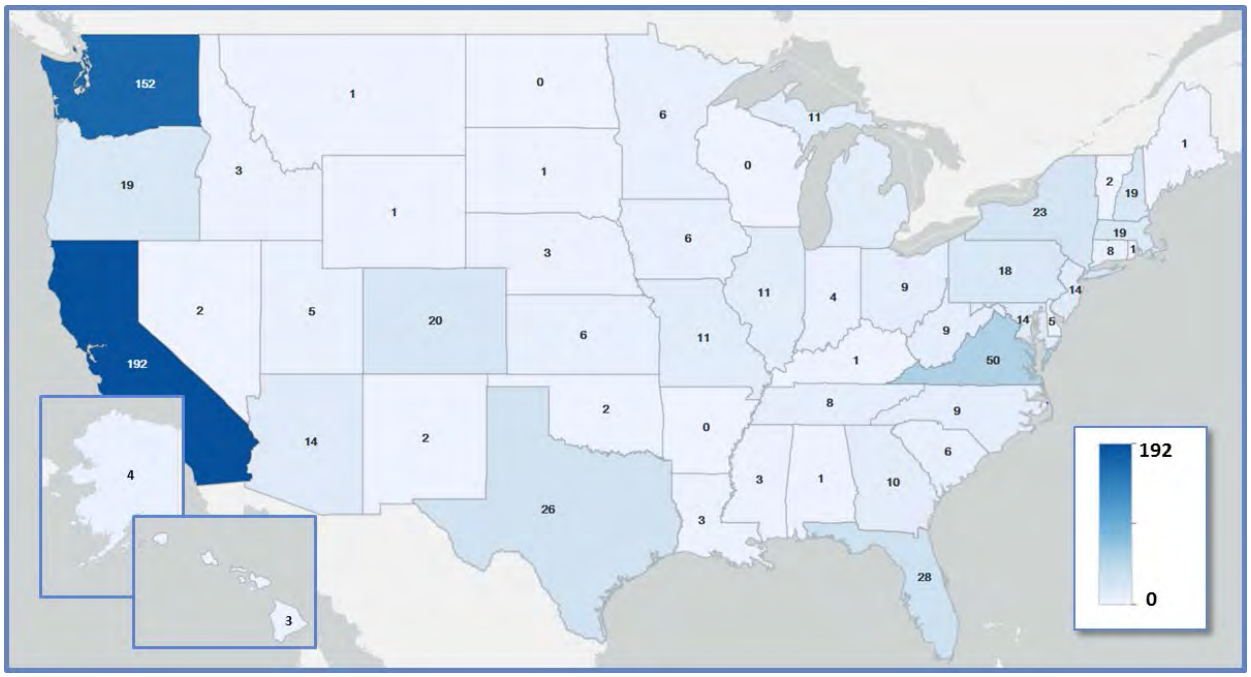
In January 2018, Electrify America launched a page on its website for comments, proposals, data, and recommendations to help define Cycle 2 investments. As of October 14, 2018, 780 submissions were received through the online portal.[4] Government entities made up 39% of submissions (Figure 4). Submissions came in from 47 states and the District of Columbia (see Figure 5), with the largest number of submissions from the states of California (192 submissions) and Washington (152 submissions and more than 970 site suggestions).

Figure 4: Overall Submissions by Institution Category



Electrify America's team reviewed and summarized these submissions and assigned each to internal working teams for a secondary review and follow-up by email or phone call. Electrify America spoke individually with more than 100 submitters, and every submitter was invited to a series of webinars during which findings and lessons learned were shared.

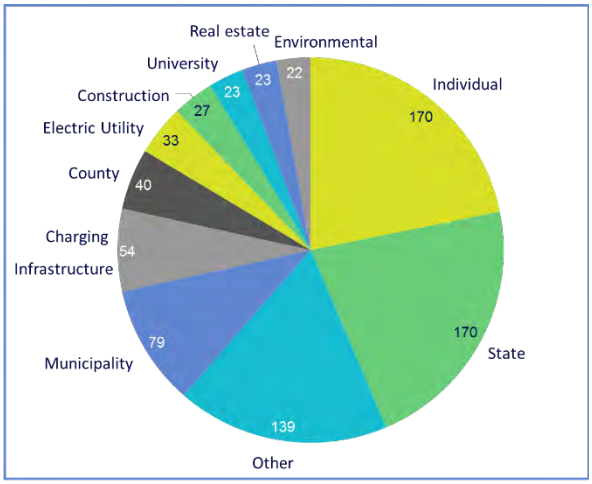
Figure 5: Submissions by State



[4] Electrify America encouraged stakeholders to submit suggestions for the Cycle 2 ZEV Investment Plans between January 15 and March 1, 2018. However, Electrify America has kept the submissions page open and has continued to review the submissions up to the week before this Plan is submitted.

Electrify America received submissions from a variety of stakeholders, including state, county, and local governments, private companies (including electric utilities and charging providers), and individuals (see Figure 6).

Figure 6: Submissions by Stakeholder Category

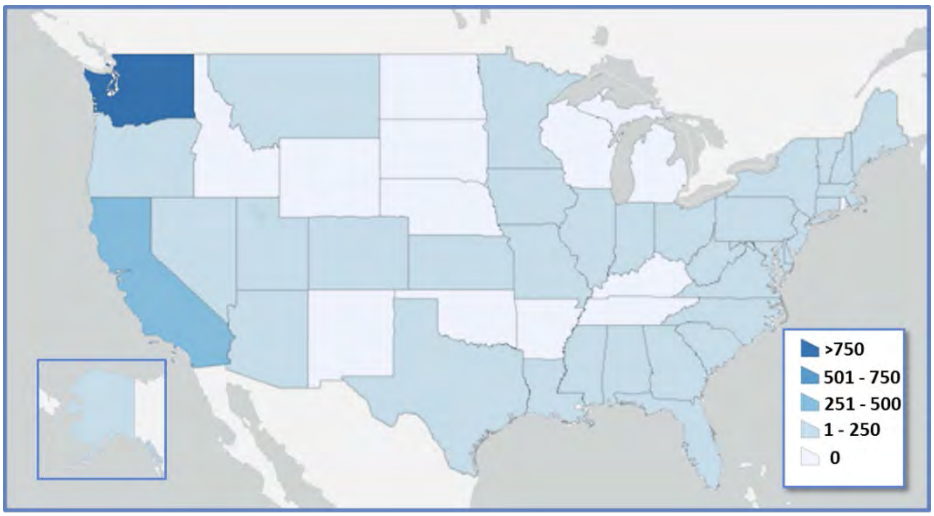


More than 1,900 sites across the United States were suggested through 345 unique submissions (see Figure 7).

Looking across the broad range of submissions, a few major trends were clear (see Figure 8). First, submitters cited a need for more DCFC stations, both in metro areas and on highways. Within metros, they noted a need for strategically placed DCFC infrastructure that can serve multiple use cases, including commuters and people without home charging options. A major American automaker suggested specifically focusing on the needs of DCFC for urban core customers such as taxi/TNC services which require charging near hotels, airports, and convention centers. Submitters commented that highway stations are also essential, suggesting that a highway network will help reduce or eliminate range anxiety. Some, including Denver, Portland, ME, the State of Maryland, and Las Vegas highlighted needs for DCFC infrastructure along key destination corridors. The NESCAUM states noted, "EV adoption in the Northeast Corridor will require robust and reliable charging networks, not only where EV drivers live, but also in nearby states where they travel regularly." The NESCAUM states also cited the importance of connectors to Canada to support both business and pleasure travel.

Nearly 50 submissions noted charging in multiunit dwellings (MUDs) as a priority focus. However, commenters cited divergent strategies to address the MUD market, which suggests there is no single best solution for this use case. Some submissions recommended strategies for L2 installations in MUDs, including focusing on larger MUDs or new buildings to manage costs. New York City, on the other hand, suggested "[f]ast charge hubs overcome the barrier posed by lacking home charging access by establishing highly visible and centralized access points across the city where electric drivers can top up quickly and conveniently…." Similarly, the City of Brookline, MA suggested providing curbside EVSE along a highly traveled thoroughfare in a high-

Figure 7: Site Suggestions by State

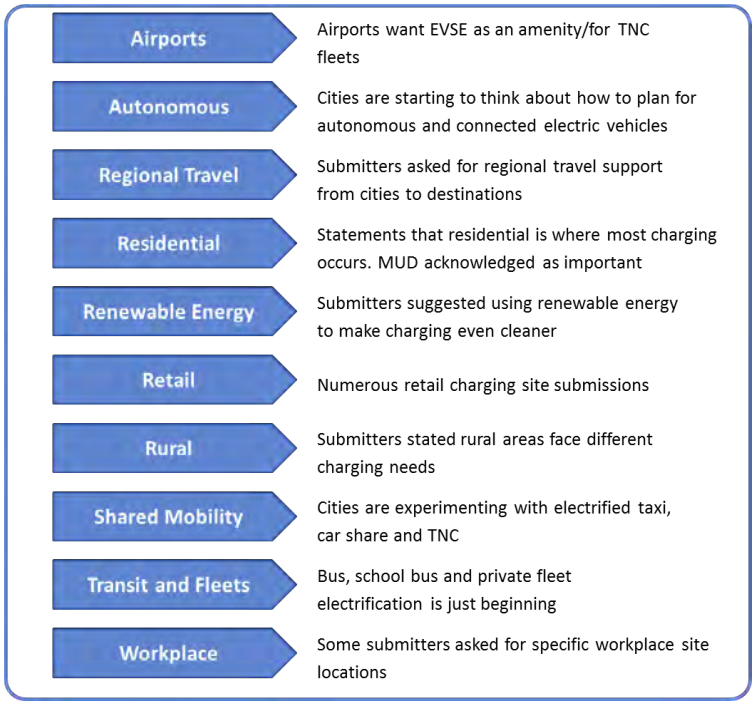


Note: No site suggestions were received from Hawaii

density area to meet the needs of local residents.

Submissions and feedback from governments and industry outside of California prioritized investment in EV charging infrastructure above hydrogen fueling infrastructure. Less than one percent of National submissions (five) recommended investments in hydrogen.

Figure 8: Themes from National Outreach Responses



Finally, nearly 90 submissions discussed ZEV education, awareness, and access initiatives. Many mentioned brand-neutral vehicle showcases and test drives (also known as 'Discover and Drives') as a way to help potential ZEV customers learn about the performance and environmental benefits of ZEVs. Some submissions mentioned using digital media/social media to spur ZEV adoption. For example, ZappyRide offered to collaborate with Electrify America to develop a web platform for prospective EV purchasers aimed at removing the most common obstacles to ZEV adoption. Nearly two dozen submissions mentioned job training or EV curriculum development for both ZEVs and ZEV infrastructure in the form of internships, job training, and career opportunities, particularly for youth. For example, Drive Electric Washington suggested Electrify America "support efforts to design curriculum to serve as a primer about electric cars for secondary students." Similarly, the Mississippi State University Center for Advanced Vehicles Systems suggested educating a broad spectrum of individuals regarding ZEVs "which would include the American public along with specialized education programs developed for secondary, post-secondary, and engineering students."

Overall, Electrify America's National Outreach Process was even more successful than the Cycle 1 experience. It provided a deeper understanding of the infrastructure, education, and access priorities from state and local stakeholders, which have been incorporated alongside other insights captured below to shape the direction and tactics for this Cycle 2 National ZEV Investment Plan.

2.2. Infrastructure Learnings and Insights

Through the outreach process, Electrify America sought to understand three core questions related to ZEV infrastructure:

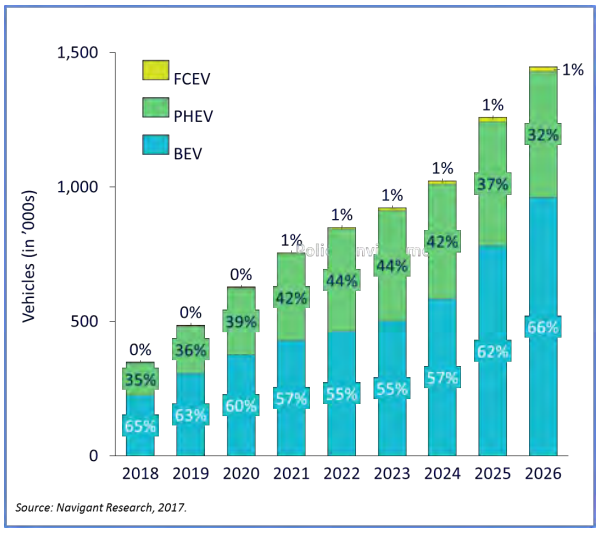
- What types of ZEVs will dominate the future?
- How will these ZEVs be used?
- How will the ZEVs be fueled?

The answer to each of these questions has a major impact on the type and locations of infrastructure required and therefore has been used to guide Electrify America's thinking on its Cycle 2 investments.

What types of ZEVs will dominate the future?

Based on all feedback received and analysis completed through planning Cycle 2, Electrify America believes long-range BEVs will dominate the future ZEV market. As detailed in Figure 9, Navigant Research's 2017 forecast[5] shows the coming decade of ZEV sales to be increasingly represented by BEVs as falling battery prices strengthen the economic advantage of BEVs over their PHEV and ICE counterparts. Complementing this analysis, Bloomberg New Energy Finance (O'Donovan, 2018) forecasts electric car battery prices will fall 54% by 2025 based on technology improvements and scaling associating with increased demand. In contrast to BEVs, Navigant Research forecasts hydrogen fuel cell EVs (FCEVs) will continue to be less than 2% of ZEV sales through 2026, and less than 0.1% of total vehicle sales across the country (Navigant, 2017).

Figure 9: Navigant U.S. ZEV Sales Forecast ('000 vehicles)

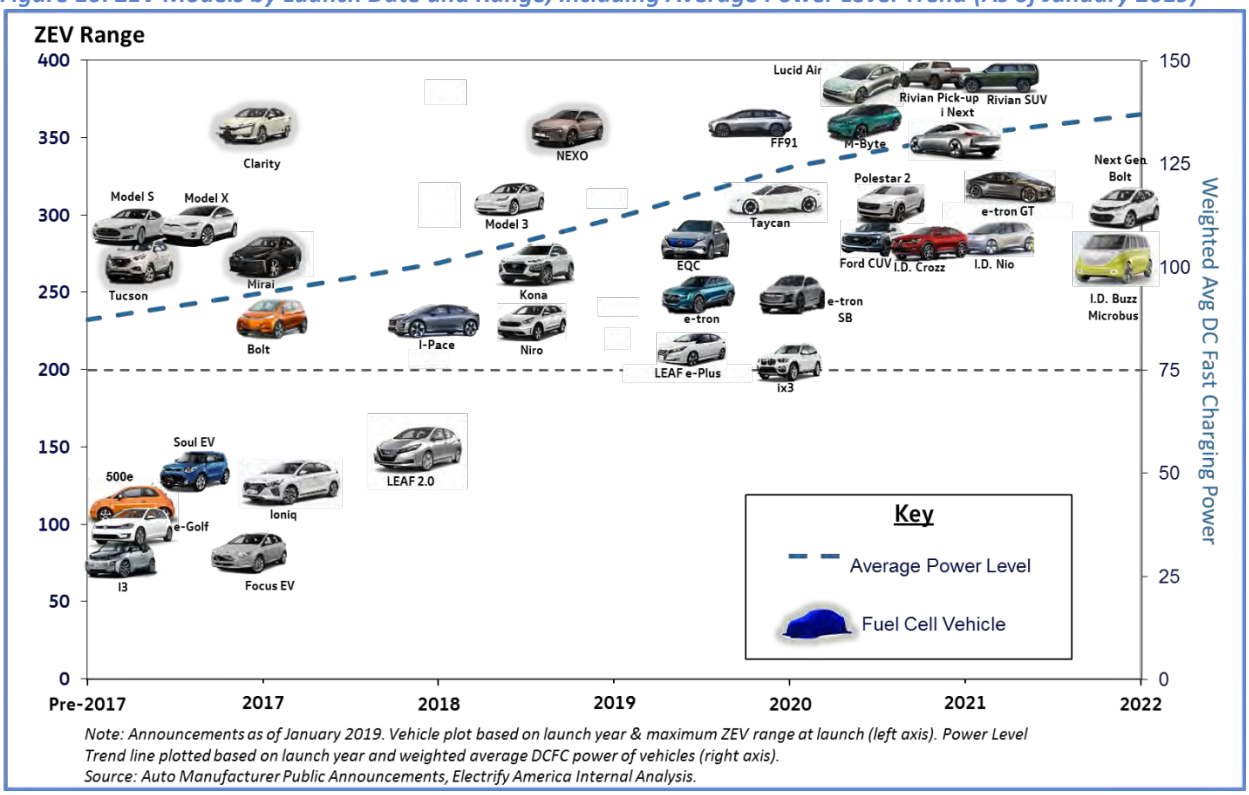


Electrify America's analysis of automotive manufacturer announcements for vehicles slated for release throughout the next five years indicates the clear trend of larger battery, longer range BEVs, with nearly all models planned for over 200 miles of range and some even surpassing 300 miles. These vehicles will also feature higher charging speeds, with most models projected to accept charging speeds of 100 kW and above (see Figure 10). According to Strategic Vision research, "recharging time" is one of the top five reasons for BEV avoidance, and thus increasing power levels and charge speed are very important to ZEV adoption. Finally, a greater diversity of body styles and price points provide more consumer choice. Several new car companies[6] have announced plans to bring all new designs, technologies, and customer experiences to market. And to meet growing demand for SUVs and light duty trucks, a range of new models are planned or already released including (but not limited to) the

[5] Based on Navigant's 2017 Base Case scenario.
[6] Examples include Faraday Future, Lucid, Byton, SF Motors, and Nio.

Hyundai Kona, Jaguar I-Pace, Audi e-tron, Lucid Air, Mercedes EQC, Byton M-Byte, Ford's upcoming all-electric BEV[7], and Rivian RT1.

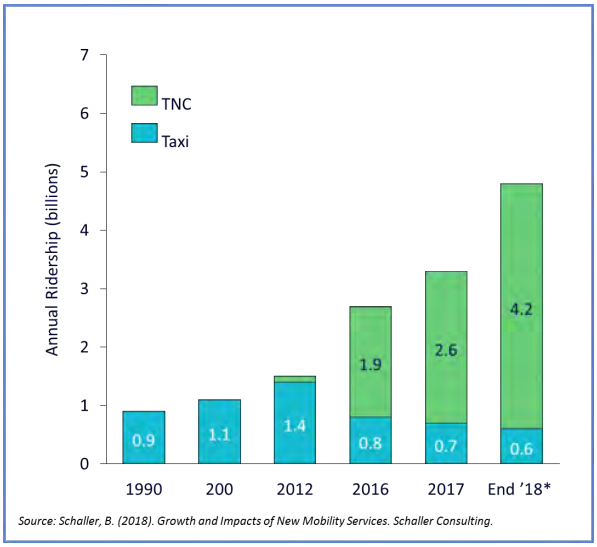
Figure 10: ZEV Models by Launch Date and Range, Including Average Power Level Trend (As of January 2019)



Note: Announcements as of January 2019. Vehicle plot based on launch year & maximum ZEV range at launch (left axis). Power Level Trend line plotted based on launch year and weighted average DCFC power of vehicles (right axis).
Source: Auto Manufacturer Public Announcements, Electrify America Internal Analysis.

In addition to BEV growth in the private use vehicle market, efforts by municipalities, taxi authorities, TNCs, and utilities indicate increased use of ZEVs in shared mobility in the near future. According to Schaller Consulting (Schaller, 2018), annual ridership for ride hail grew ~37% from 2016 to 2017, and is projected to grow ~62% from 2017 to 2018 (see Figure 11). Despite a shrinking portion of ridership for taxis, these combined use cases are seeing dramatic growth and thus the high annual mileage of these vehicles presents a prime opportunity for electrification.

Figure 11: Annual Ridership



Source: Schaller, B. (2018). Growth and Impacts of New Mobility Services. Schaller Consulting.

National Outreach submissions also demonstrated an interest in shared mobility concepts such as ride hailing, ride sharing, and car sharing in more than 30 submissions. Many cities and urban areas, including Atlanta, Chattanooga, Denver, Los Angeles, Nashville, Sacramento, San Jose, Washington, D.C., the Twin Cities, and King County, WA, noted that they are considering or actively pursuing EV car sharing fleets. Some of these

[7] The Ford BEV is unnamed at this time.

communities shared the sentiment of the City of Portland, Oregon which wrote, "[t]he number one barrier to providing electric car share services is the lack of access to electric vehicle chargers," and asked for assistance deploying EVSE that could be partially or fully dedicated to these fleets. King County, WA wrote, "Electrify America can most effectively support ZEV adoption in the [Seattle Metro Area] by collaborating with the Metro to identify strategic locations for charging infrastructure, where high-profile workplace or public on-street charging stations could enable Metro's transition to a ZEV commuter van fleet."

How will these ZEVs be used?

Early data on 200+ mile, long-range BEVs indicates that these vehicles are used by households quite differently than their shorter-range equivalents. First, buyers indicate long-range BEVs are frequently purchased as a replacement vehicle to an existing car in a household fleet (see Figure 12). Whereas short-range BEVs are often additive to a household's fleet and seen solely as a commuter car, the coming 200+ mile BEVs are expected to replace existing household vehicles and perform similar roles as an internal combustion engine (ICE) vehicle does today (New Vehicle Experience Study, 2017).

Similarly, long-range BEVs are used on more 200+ mile trips than their short-range equivalents. Tesla Model S and X vehicles are used for over 60% of household trips that are over 200 miles compared to Nissan Leafs, which are used on fewer than 5% of long trips (see Figure 13) (Nicholas et al., 2017), although new longer range Leaf vehicles will likely reverse this trend. Electrify America expects the "EVs as primary use vehicles" trend to continue as more long-range BEVs become available and as the growing networks of fast charging stations enable this shift.

Figure 12: ZEV Purchase Reasons for Household Fleet

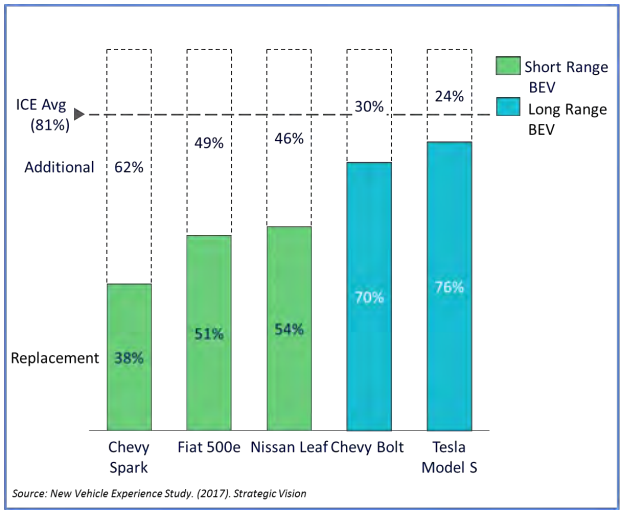
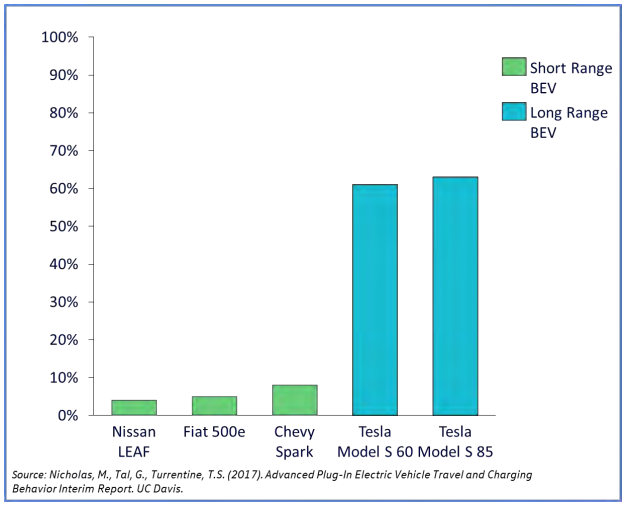


Figure 13: Percentage of Household's 200 Mile Trips Driven in PEV vs. ICE

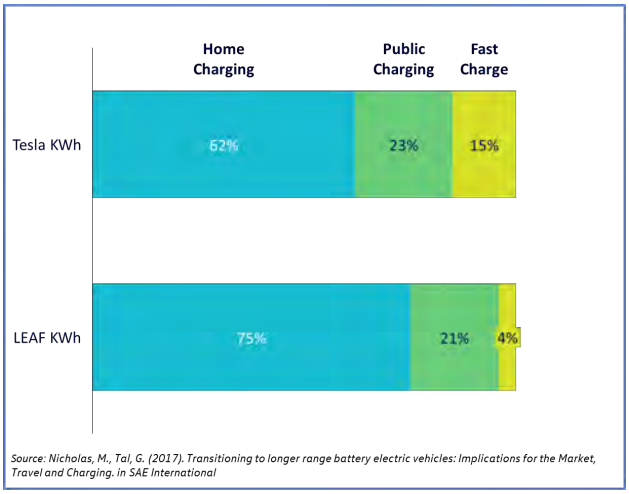


Beyond EV growth in the private use and shared mobility segments, innovations like autonomous vehicles are expected to shift how future electric vehicles will be used. KPMG's Autonomous Vehicles Readiness Index reports autonomous technology will "transform our lives, because it will mean for the first time in history, mobility freedom will be available for everyone, everywhere" (Threlfall et al, 2018). Numerous pilot deployments of autonomous vehicles are already taking place throughout the United States by a variety of technology and automotive companies. In fact, having driven over 10 million miles on public roads in its self-driving minivans, Waymo plans to

make its vehicles available for public use as a ride-hail service in the Phoenix area by the end of 2018 (LeBeau, 2018).

How will ZEVs be fueled?

Figure 14: Charging Location Mix



Source: Nicholas, M., Tal, G. (2017). Transitioning to longer range battery electric vehicles: Implications for the Market, Travel and Charging. in SAE International

According to "Three Revolutions" by Daniel Sperling (2018), "most EV owners depend on overnight charging at home and only secondarily on public and worksite charging." In fact, the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy reports that EV drivers conduct "more than 80% of their charging at home." The next largest segment of charging takes place at workplaces and at public L2s, and then – finally – at public DCFC stations (see Figure 14) (Nicholas & Tal, 2017).

Home charging will support most individuals in single family homes, but multiunit dwellings (MUDs) have traditionally been difficult to outfit with charging infrastructure. According to DeShazo (2017), "MUD residents face a number of obstacles to installing electric vehicle service equipment (EVSE). Foremost is the variable and often high cost of EVSE installation at a MUD site. Additionally, the renter or owner exhibits a low to nonexistent investment motivation." Electrify America anticipates that as EVs gain market share and penetrate larger portions of the overall population, public DCFC will become increasingly important for serving those MUD dwellers.

Electrify America thoroughly investigated how hydrogen fuel cell vehicles are expected to be refueled in Cycle 2, as it explored investment opportunities in this space. Based on stakeholder and expert feedback, Electrify America anticipates that these vehicles will continue to be refueled at public stations, not in home, for the foreseeable future. The Department of Energy continues to support research and development of in-home hydrogen production and refueling. The Department recently awarded a $1 million prize to SimpleFuel for design of what may someday be a new garage appliance (Voelcker, 2017), although current estimates put the price of an in-home station as high as $250,000 for what would be considered a pre-commercial deployment (Blanco, 2017).

2.3. Education and Awareness Learnings and Insights

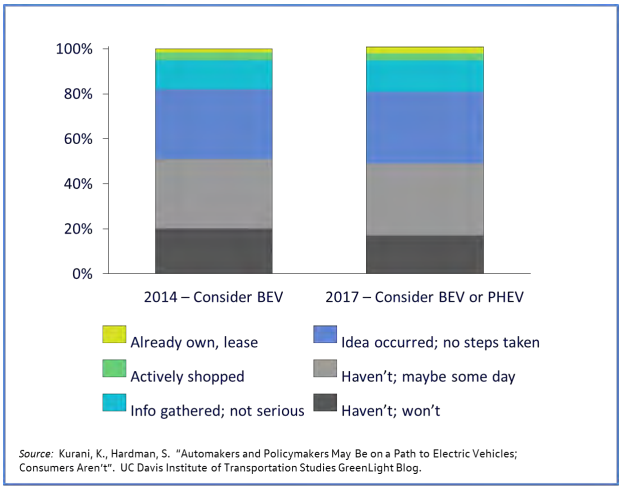
Electrify America also sought to better understand consumer perspectives and behavior to target the Cycle 2 education, awareness, outreach, and marketing efforts. The two primary strategic questions were:

- How are ZEVs perceived today?
- What are the key barriers to EV adoption?

How are ZEVs perceived today?

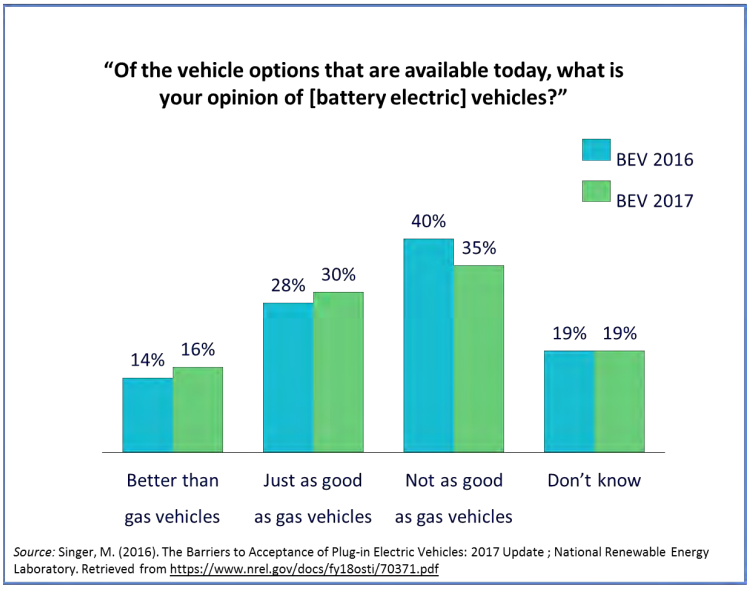
Overall awareness and consideration of electric vehicles today remains low in the United States. According to 2017 research by Ken Kurani and Scott Hardman of UC Davis, consideration of plug-in electric vehicles by Californians has changed little from 2014 to 2017 (see Figure 15). This report, and similar data from Strategic Vision (shared in the Education, Awareness, and Marketing section) are sobering reminders of the limited consideration of ZEVs today and clearly suggest the need for more effective awareness building strategies and solutions.

Figure 15: California BEV Awareness 2014 vs 2017



Source: Kurani, K., Hardman, S. "Automakers and Policymakers May Be on a Path to Electric Vehicles; Consumers Aren't". UC Davis Institute of Transportation Studies GreenLight Blog.

Figure 16: Opinions of BEVs vs Gas Vehicles



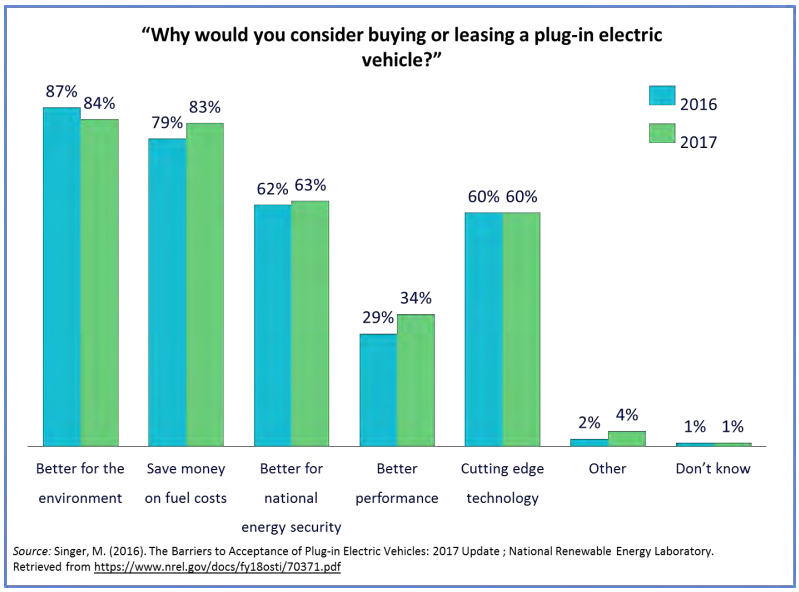
Source: Singer, M. (2016). The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update ; National Renewable Energy Laboratory. Retrieved from https://www.nrel.gov/docs/fy18osti/70371.pdf

However, the 2017 NREL study entitled "The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update" provides a more positive outlook on the market. Over half of consumers view BEVs as either better than, or just as good as, gas vehicles available today, and this number grew year over year compared to 2016 (see Figure 16). A large portion of the population – nearly 20% – answered "don't know" to the question "of the vehicle options that are available today, what is your opinion of [battery electric] vehicles?" which indicates that even more could be persuaded if they were educated about the advantages of ZEVs.

The NREL study also reports that consumers continue to view the primary benefits of electric vehicles as being better for the environment and offering savings on fuel costs (Figure 17). These electric vehicle opinions are correct, of course, but recent studies show that other factors – such as vehicle performance – are more important drivers of purchasing behavior.

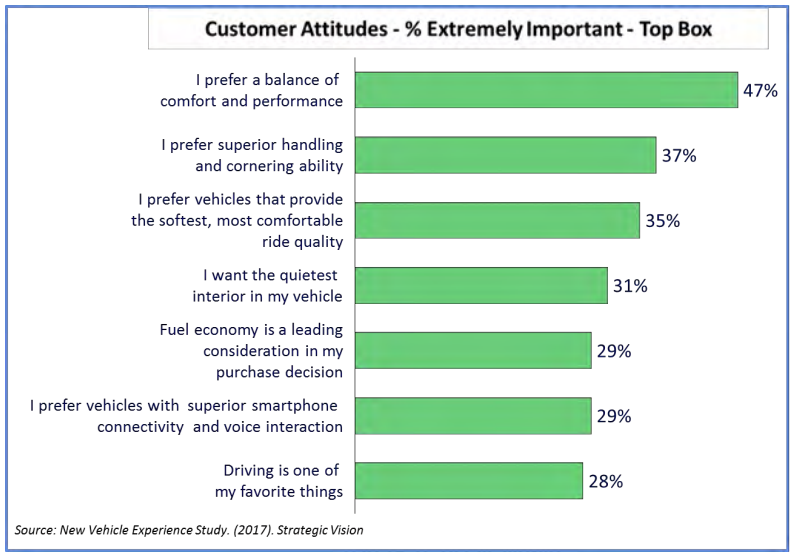
As evidence, recent research from Strategic Vision's New Vehicle Experience Study shows that mainstream car buyers rate comfort and performance as "Extremely Important" (see Figure 18). Fuel economy is also mentioned by respondents, but it ranks 5th, behind a balance of comfort and performance, handling and cornering, soft comfortable ride, and quiet interior. Thus, the primary messaging in promoting the benefits of ZEVs to buyers should focus on performance and handling. Since EVs already possess performance advantages, such as quick acceleration offered by their powerful motors and improved handling thanks to their low center of gravity, this communications approach will be authentic.

Figure 17: Consumer Views on PEVs



Source: Singer, M. (2016). The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update ; National Renewable Energy Laboratory. Retrieved from https://www.nrel.gov/docs/fy18osti/70371.pdf

Figure 18: Consumer Attitudes When Shopping for a Vehicle



Source: New Vehicle Experience Study. (2017). Strategic Vision

What are the key barriers to EV adoption?

Numerous studies including NREL's 2017 "Barriers to Acceptance…," Strategic Vision's 2017 New Vehicle Experience Study, McKinsey & Company's 2017 "Electrifying Insights…," and UBS Evidence Lab's 2016 "What consumers think about electric cars…," highlight a range of barriers to ZEV adoption. While the importance of each barrier varies depending on when and how the study was conducted, five categories typically emerge (ranking is dependent on when and how the studies were conducted):

1) **Range**: Most consumers are not aware that even entry level EVs have a range of 80+ miles per charge, well within most daily commutes. Education is required to show that other models offer up to 300+ miles of range.

2) **Charging Station Availability**: Another barrier is the perception of the lack of charging infrastructure currently available. While ICE drivers can go on long trips secure in the knowledge that they will be able to refuel quickly en route, it is more complex for EV drivers; this same trip requires researching the location of charging stations along the way and setting aside time to charge up.

3) **Cost**: The purchase price of EVs is a deterrent to some buyers. Although EVs are increasingly available at lower price points, they generally remain more expensive than equivalent gasoline vehicles. This financial barrier is overcome in part by federal and state purchase incentives, which can reduce the upfront cost of the vehicle, as well as reduced operating costs (fuel, maintenance), which accumulate over the life of the vehicle. Despite these benefits, further education is necessary to establish awareness regarding these economic advantages. For example, according to NREL's 2017 study "Barriers to Acceptance…," fewer than a quarter of respondents (23%) had heard of PEV tax incentives. Furthermore, EVs typically cost less to operate than gasoline vehicles, including fuel, maintenance, and repairs, and these advantages can become education points as well.

4) **Performance**: Most people have never ridden in or driven an electric car, so the performance compared to non-EVs is one that requires education and experience.

5) **EV Model Selection**: While nearly all vehicle manufacturers already have or are developing electric vehicle models, consumers note the lack of variety in the number of vehicle models available. Currently, most electric cars are small, midsize, or compact, so consumers wanting pickup trucks or SUVs feel they do not have options. Also, many are only available in California and the other states that have adopted the zero emission vehicle mandate.

Electrify America also believes that one additional barrier to adoption, not often noted, is that the majority of people don't think about electric vehicles when they are buying a new car. For the most part, over the last 100 years, vehicles have been purchased and driven in the same way largely because the current driving culture, refueling network, and larger eco-system supporting modern transportation has been developed and well established around fossil fuels and personal use vehicle travel. Consumers typically don't enjoy changing from well-established norms unless there are clear and known advantages to the replacement approach. Fortunately, electric vehicles represent compelling reasons for change for drivers, society at large, air quality, and climate change.

2.4. Ongoing Outreach Efforts

All of the stakeholder engagement efforts detailed above, from the National Outreach website to the hundreds of stakeholder conversations and dozens of academic research papers carefully read, have been instrumental in shaping our understanding of the ZEV marketplace as well as what is most important to driving ZEV adoption.

We will continue ongoing outreach efforts over the course of Cycle 2, with a particular focus on stakeholder outreach specific to the metro areas where Electrify America plans to concentrate Cycle 2 investment.

During Cycle 2, Electrify America plans to conduct a similar process of outreach in order to draft our Cycle 3 ZEV Investment Plans, consistent with the approved National Outreach Plan. This process will include an evaluation of the performance of Cycle 1-2 investments to date, notably utilization statistics at highway and metro stations, and will consider feedback from stakeholders, such as automakers, EV drivers, and governments, regarding where additional station investments are needed.

3. Infrastructure Investments (~$235 million)

Electrify America's infrastructure mission is to drive ZEV adoption by reducing range anxiety and increasing charging convenience. To meet this goal, Electrify America is establishing a ZEV charging network that is comprehensive, technologically-advanced, and customer-centric with the intent of showing ZEV drivers that ZEVs can be used as a primary vehicle. To this end, Electrify America will invest approximately $235 million in Cycle 2 in EV charging infrastructure across multiple use cases at the metropolitan community level and along highways and other regionally significant routes. Estimated budgets for each investment are shown in Table 5 and detailed in the following sections.

Table 5: Estimated Infrastructure Investment Budgets

Category	Estimated Budget ($M)[1]
Infrastructure	**~$235**
Metro Community Charging	**$145 - $165**
Highways and Regional Routes	**$65 - $85**
Autonomous Vehicle Charging	**$2 - $4**

[1] Costs include creditable operating expenses, on-site storage, and up to $5 million in renewable generation where appropriate.

These investments were selected from a much larger set of use cases that were studied, including on-street charging, hotels, transit hubs such as park and rides, fleet charging, and hydrogen fueling stations. While investment in each of these use cases shows potential to drive ZEV adoption, Electrify America was not able to establish a satisfactory business case that would justify investment during Cycle 2. Electrify America will continue to examine data and new information, however, and will potentially shift resources to creditable use cases during Cycle 2 if new opportunities demonstrate these to be good financial investments for the long-term and substantially impactful on ZEV adoption during Cycle 2. Any new investment would reduce the budget dedicated to the above described infrastructure use cases, it should be noted. Electrify America would also inform EPA staff of any reallocation of Cycle 2 funding to new ZEV infrastructure use cases not budgeted for in this Cycle 2 National ZEV Investment Plan.

Guiding Principles

Several key guiding principles were used to select infrastructure investments for Cycle 2. These principles capture Electrify America's short and long-term goals and vision and ensure that each infrastructure investment works towards those goals and vision. The key guiding principles for selecting Cycle 2 investments included:

- **Focus on locations where access and utilization is projected to be highest**: Investments target highways and metropolitan areas with high current and projected concentrations of ZEV drivers. This will maximize potential network utilization, the clearly established goal of and success metric

for the ZEV infrastructure investments established in Appendix C of the Partial Consent Decree. This will also improve both ZEV driver convenience and infrastructure investment economics.

- **Strive to expand ZEV adoption, and meet the needs of drivers in regions:** Investing in adjacent metropolitan areas produces a network effect, where investments to support travel and tourism between cities also support the spread of ZEV adoption geographically across a region.

- **Focus on a variety of use cases based on anticipated charging behaviors of ZEV drivers**: Electrify America will build chargers to serve current and emerging driver needs – including mobility services, corridor travel, and charging in public areas (commercial/retail locations, parking garages) within a metro.

- **Incorporate anticipated changes in the ZEV industry by 'future-proofing' stations to maximize their usefulness in the medium-to-long-term**: Investments will include the latest technology (from L2s up to 350 kW DCFC) and operate across different charging standards (CCS and CHAdeMO) to maximize access and help ensure future compatibility in a rapidly evolving industry. Electrify America will also continually look toward new technologies, including ways to meet the needs of emerging autonomous vehicles, and work to ensure investments are optimized to incorporate these technologies in future investment cycles.

- **Focus on a sustainable business model**: Electrify America is implementing a set of ZEV infrastructure investments designed to be economically sustainable for the long-term.

3.1. Metro Community Charging ($145 - $165 million)

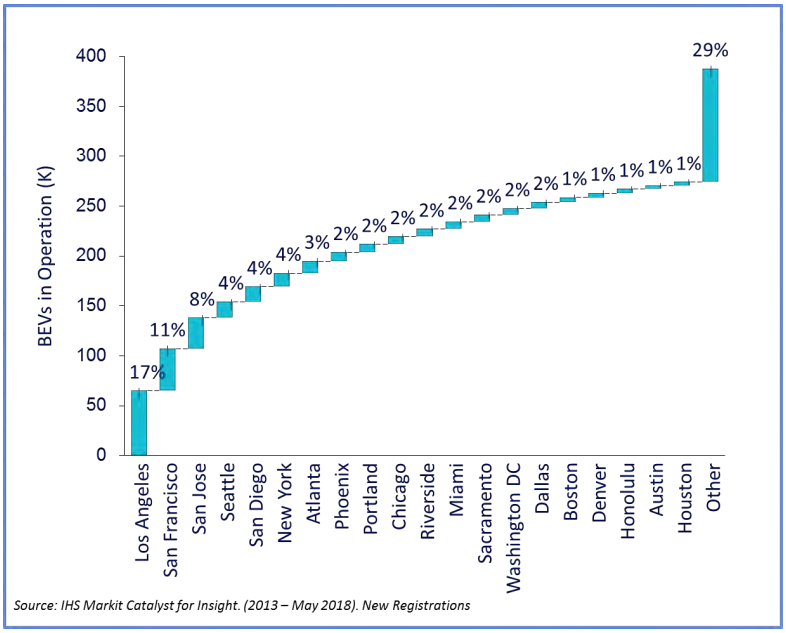
3.1.1. Investment Overview

The largest portion of Electrify America's Cycle 2 investment is dedicated to community charging within metropolitan areas. Electrify America has identified metro charging as the primary use case based on four key market factors:

1. The vast majority of BEVs are projected to be sold in top metro markets;
2. Most miles driven in these BEVs are anticipated to be driven in and around metro areas;
3. Recent research shows that the majority of public charging happens relatively close to home; and
4. New technology is shifting more vehicle miles traveled toward shared mobility options, which will require increasing charging support in and around metros.

Early adoption of BEVs in the U.S. has been concentrated principally within major metro areas, and this trend is projected to continue at least through 2022. In 2018, 71% of the nearly 400,000 BEVs in operation were concentrated in 20 metropolitan areas, and 57% were concentrated within the top 10 metros (IHS Markit Catalyst, 2018). Navigant Research (2017) forecasts this trend will continue through 2022 with over 70% of the projected two million BEVs in operation concentrated in just 20 metro areas. In addition to these forecast findings, Electrify America also considered that the majority of the U.S. population today lives in cities. According to the U.S. Census Bureau (2015), cities are home to 62.7% of the U.S. population. In a 2016 press release discussing the U.S. Census Bureau's American Community Survey, Census Bureau Director John H. Thompson wrote that, "rural areas cover 97 percent of the nation's land area but contain 19.3 percent of the population (about 60 million people)."

Figure 19: BEVs Sold in Top 20 MSAs



Source: IHS Markit Catalyst for Insight. (2013 – May 2018). New Registrations

Electrify America expects that most BEVs, similar to their ICE counterparts, will be driven in and around their metros. According to the Federal Highway Administration's 2017 National Household Travel Survey, 95% of vehicle trips were less than 30 miles from their origin. With most trips occurring close to home, it is not surprising that most DCFC charging sessions also occur close to home. In their 2017 study "Survey and Consumer Motivations to DC Fast Charge," Michael Nicholas and Gil Tal from University of California, Davis showed that a majority of DCFC events for Chevy Bolt drivers were recorded within 8 miles of home. Nicholas and Tal's study "Transitioning to Longer Range Battery

Electric Vehicles" (2017) shows Tesla drivers have similar charging behavior, albeit with a wider driving radius, averaging 29 miles from home for most charging sessions.

Electrify America expects metro charging to become even more important as BEV buyer demographics evolve and a significant number of MUD dwellers and renters purchase BEVs. In today's market, few owners of MUD buildings are willing to install chargers (Sperling, 2018). As NESCAUM described in their submission, "to increase access to EVs for residents of multiunit dwellings (MUDs), Electrify America should pilot innovative solutions for MUDs." Placing DCFCs in sections of metro areas with high MUD density, which has been recommended by UCLA researchers, is an innovative solution to addressing the needs of future BEV drivers that live in MUDs.

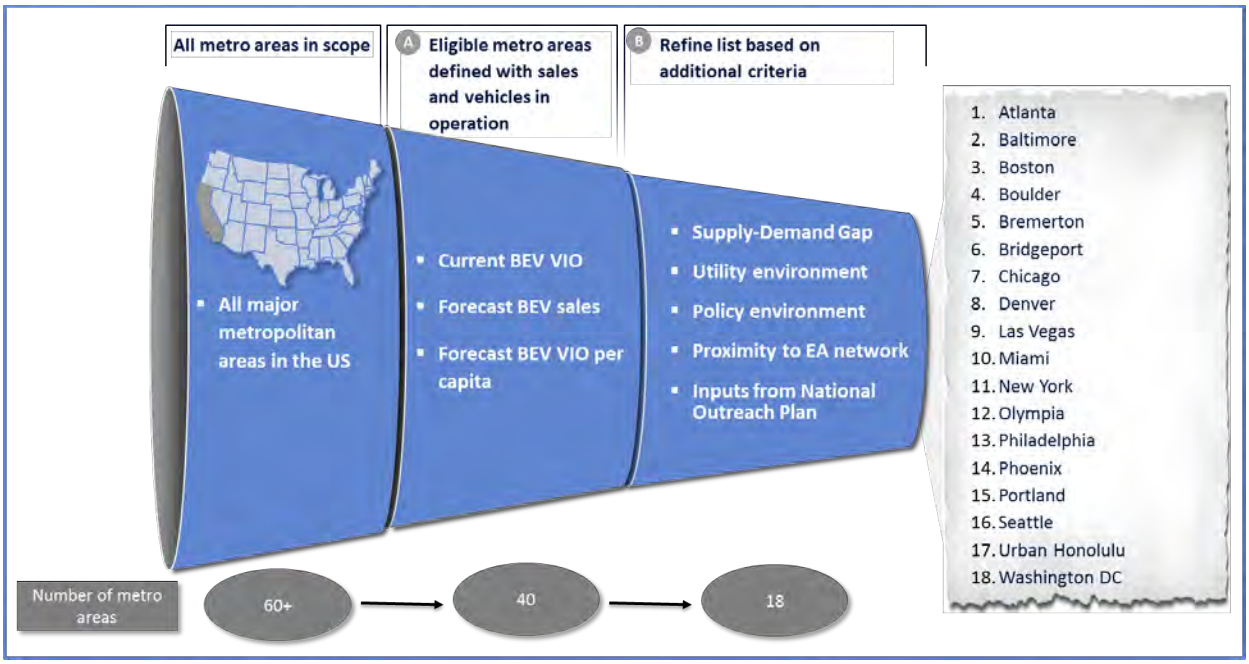
The shared vehicle economy also represents an increasingly important travel component within cities and is an attractive opportunity for early EV adoption by both drivers and passengers. The emergence of ride-sharing companies like Uber and Lyft in New York City increased the vehicle miles traveled (VMT) from shared vehicles, including taxis and black cars, by 25% between 2013 and 2016 (Schaller, 2017). According to the San Francisco County Transportation Authority (2017), in San Francisco, one of the most mature ride-sharing markets in the U.S., 15% of all weekend vehicle trips were completed through transportation network companies in 2016. This growing shared vehicle trend is expected to continue, with the Boston Consulting Group (2017) forecasting that by 2030, 25% of miles driven in the U.S. could be in shared self-driving EVs. These shared vehicles are particularly well-suited for electrification. With high annual mileage, such vehicles enable drivers to realize fuel and maintenance savings even faster than a typical ICE vehicle driver and increase their net income. Electric shared mobility vehicles displace fossil fuel vehicles, reduce household fleet vehicle needs and traffic congestion, and reduce greenhouse gas emissions. However, drivers and communities can only realize these benefits if there is sufficient public charging in the right locations to meet drivers' charging needs.

Considering all of these factors, Electrify America will prioritize metro-based charging investments in Cycle 2. To meet the needs of these drivers, Electrify America will invest in DCFC for three primary use cases within metro areas: retail/community, MUDs, and mobility services. Retail/community stations will target the needs of EV owners as they drive around town on their daily commutes, run errands, or visit friends and relatives. MUD stations will specifically target communities with a high density of MUD dwellers, and will serve as an alternative for those who lack reliable overnight charging at their residence or workplace. Finally, shared mobility stations target the needs of taxi, TNC and car share drivers in their daily travel around a metropolitan area. Electrify America believes that – collectively – these use cases will address the most critical DCFC needs of drivers within selected metropolitan areas.

3.1.2. Investment Selection Methodology

In Cycle 1, Electrify America selected metropolitan areas for investment through a two-step process that featured both quantitative and qualitative filters. Electrify America built upon this two-step approach in Cycle 2, upgrading key metrics to refine the analysis (see Figure 20).

Figure 20: Cycle 2 Metro Selection Process



The two-step process for selecting metro areas in Cycle 2 has been improved and is described below:

1. Starting with the most populous 60 National metro markets, representing over 50% of the U.S. population (excluding California) (ESRI, 2016; U.S. Department of Commerce - Bureau of the Census, 2017), Electrify America assessed each market on their BEV sales today and forecasted for 2022. Sales were analyzed on both a gross and a BEV per capita perspective to not only identify large markets of potential, but to give opportunity to smaller, higher growth potential markets.

   Top scoring metros on the sales metrics were passed on to the second stage of analysis. This yielded 29 metropolitan areas for further evaluation. Electrify America also passed any metropolitan areas to the second step that submitted progressive suggestions in the Cycle 2 National Outreach Process.[8] Combined, this yielded 40 metropolitan areas for further evaluation.

2. The 40 metropolitan areas were then evaluated on their expected needs for charging infrastructure (supply-demand gap, a cornerstone Electrify America methodology established for Cycle 1), the local electric utility costs and collaboration opportunities (utility environment),

[8] Note: Electrify America cannot guarantee that submitters in future cycles will be automatically passed on to the second stage of analysis or other approval processes.

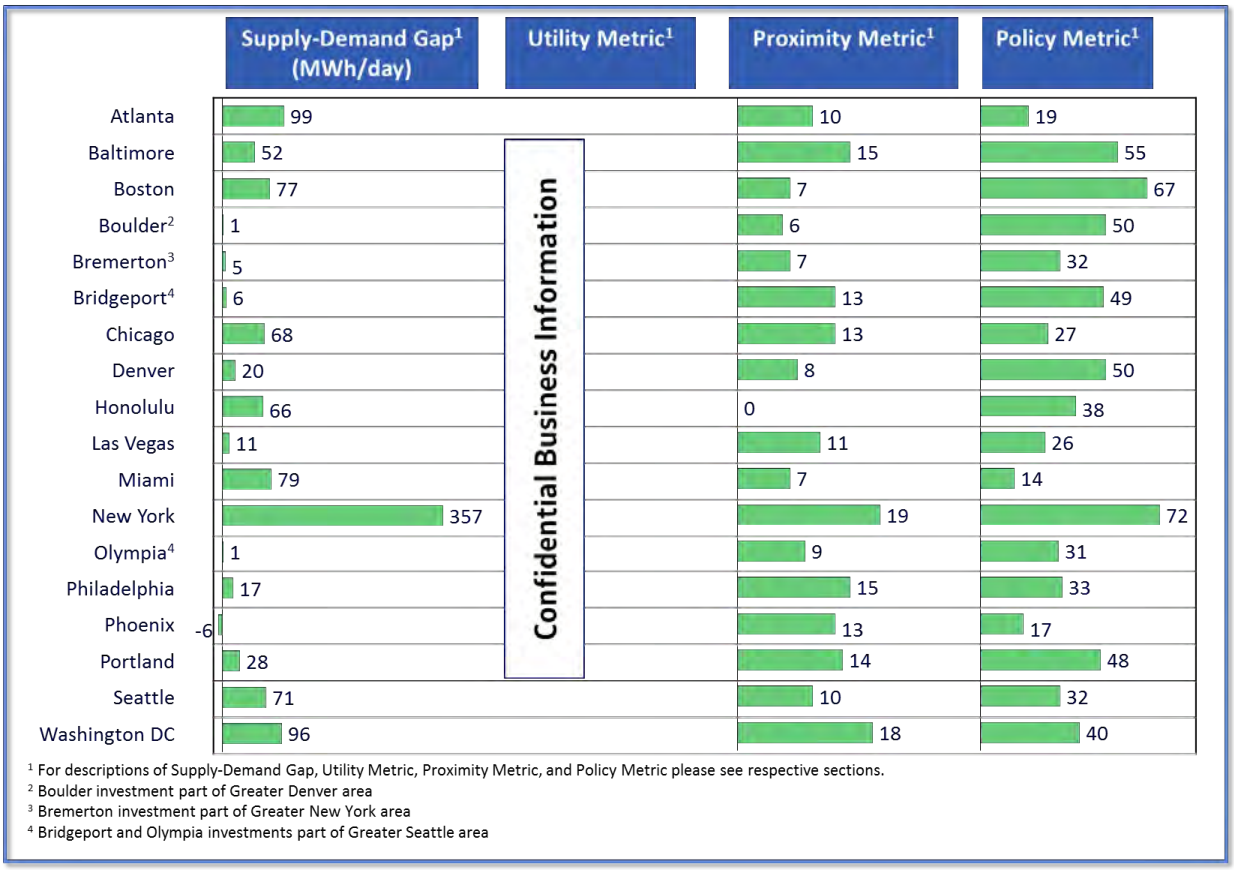
state and local policies impacting EV adoption (policy environment), and the fit of the metro with Electrify America's broader network (proximity to the Electrify America network). For details, see Figure 21 and detailed descriptions of each criteria used below. Electrify America looked across each of the four metrics to determine which metropolitan areas showed the greatest potential for investment in Cycle 2. The Cycle 2 metros for investment are shown in Figure 22.

Through this process, 18 metropolitan areas were selected for metro community charging investments in the Cycle 2 National ZEV Investment Plan. These 18 metropolitan areas currently host approximately 30% of the total population (ESRI, 2016; U.S. Department of Commerce - Bureau of the Census, 2017) and are projected to account for 52% of the BEVs Nationally in 2022 (Navigant, 2017). Electrify America will continue monitoring market conditions, including ZEV sales, utility rates, and policy changes, over the course of Cycle 2. In the event that new market conditions or other information warrant investment in a metro not heretofore selected or additional investment in a selected metro, Electrify America may shift budget to those areas of highest need. Upon making budget shifts, Electrify America will notify EPA staff.[9]

In addition to the 18 metropolitan areas selected, Electrify America will continue to operate and maintain all Cycle 1 metro stations throughout the Electrify America network.

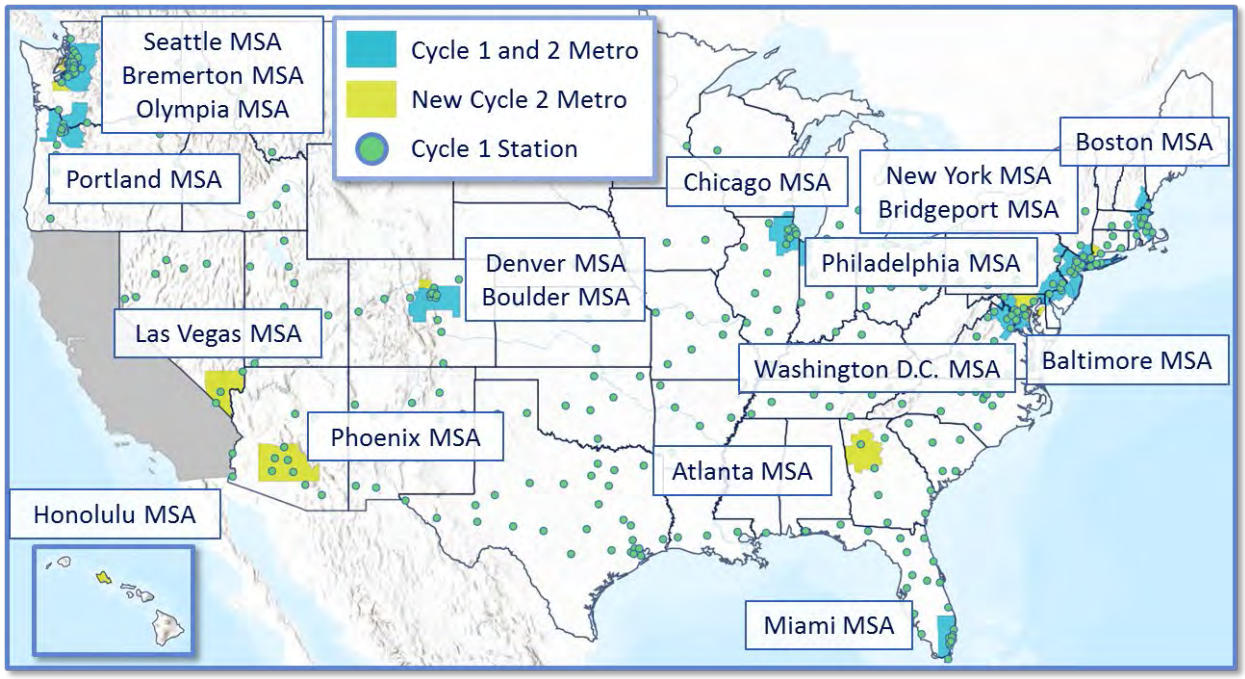
[9] Electrify America is exploring ways to amplify the impact of its investment, including leveraging funding from private and public sources.

Figure 21: Cycle 2 National Metros Selected



[1] For descriptions of Supply-Demand Gap, Utility Metric, Proximity Metric, and Policy Metric please see respective sections.
[2] Boulder investment part of Greater Denver area
[3] Bremerton investment part of Greater New York area
[4] Bridgeport and Olympia investments part of Greater Seattle area

Figure 22: Cycle 2 National Metro Map



Supply-Demand Gap[10]

To ensure investments address a reasonably anticipated need and have a high likelihood of utilization, Electrify America used a supply-demand gap in the metro selection process. The projected gap in supply and demand for BEV charging was determined by: (1) calculating the projected charging power demand (in MWh/day) for public charging in 2022 outside the home; and (2) subtracting the current supply of power delivered by public charging for each metropolitan area. Demand for public charging in a metropolitan area was calculated using the projected number of BEVs in operation by 2022, the average daily vehicle miles traveled as collected by the Federal Highway Administration, the mix of single-family and multiunit homes from the U.S. Census Bureau, and assumptions for vehicle efficiency and the portion of charging occurring at homes. Supply of charging power was estimated using existing charging infrastructure in Recargo's PlugShare database with assumptions made regarding the power level and utilization at each station. Electrify America stations currently under development as part of Cycle 1 were added to the charging supply calculations in each metro to provide a more complete picture of future supply.[11] The resulting Supply-Demand Gap is expressed in MWh/day as the projected unmet energy demand, per day, in each metro area.

Utility Environment

The local utility (or utilities) for each Electrify America metropolitan area plays a major role in the stations' long-term success. To date, utilities across the U.S. have been crucial partners in deploying their distribution systems to bring Electrify America's charging network to drivers. To further optimize Electrify America's infrastructure investments in Cycle 2, this metric identifies the most EV-focused utility environments. An EV-focused utility environment, with utility infrastructure support (such as make-readies), DCFC specific energy rates, and lower or non-existent demand charges, can have a significant impact on the economics of the station. In addition, streamlined utility processes can accelerate site construction and dramatically lower both capital and operating costs. Metro areas where these same conditions are not as positive, especially those with high demand peak charges, can make the economics of owning and operating DCFC stations over the long-term particularly challenging. This metric evaluates both the utility costs to operate DCFC stations within a utility territory, as well as the collaboration potential of the local utility. [12]

[10] In Cycle 1, Electrify America developed a megawatt-hour supply-demand gap analysis methodology to assess the infrastructure needs for any given geographic area. Through the Cycle 2 planning process, Electrify America shared this methodology with academics and researchers across the ZEV space, including teams from UC Davis, UCLA, NREL, Argonne National Laboratory, Idaho National Laboratory, and more. The methodology largely stood up to academic questioning, and thus Electrify America has elected to use this approach again for Cycle 2. However, specific assumptions and data sets have been adjusted based on stakeholder feedback. For example, during a review in October 2017, the UC Davis team noted that our Cycle 1 methodology used commuting data (travel to and from work) to gauge vehicle miles traveled within a city, but that commuting miles represent just a fraction of total miles. As a result, Electrify America has selected a new dataset that provides a more comprehensive set of miles traveled within a metro area.

[11] Proposed/planned stations from other EVSE providers were not included due to the uncertainty of location, quantity, and timing of these stations.

[12] For metro areas with more than one primary utility, Electrify America uses a blend of the two utility scores (e.g., Washington, DC MSA has multiple electric utilities and is largely based on scores from PEPCO and Dominion Energy).

Policy Environment

State and local policies can have a major impact on ZEV adoption, especially as vehicle technologies mature. In Cycle 1, Electrify America captured the impact of such policies on ZEV adoption within a given metropolitan area by counting the number of policies enacted in each metro. However, policies can have varying impact. For example, purchase incentives and vehicle mandates can have a much larger impact than non-binding sales 'targets.' To better address these nuances, Electrify America collaborated with the National Association of State Energy Officials (NASEO) and The Cadmus Group LLC to develop an updated policy metric. NASEO and Cadmus used existing analysis and the input of a panel of ZEV policy experts and practitioners to create a policy tool that ranks and weighs each policy's effectiveness. Policies for each metropolitan area were then aggregated, producing a score which reflects the policy environment in each metro area, and its relative impact on ZEV adoption. For more information on the policy metric, see inset.

Proximity Metric

When considering the purchase of a new vehicle, many buyers look not only at the fueling options within their own metro area, but also on key routes to nearby regional destinations. Over 70% of Tesla drivers cite the existence of the Tesla Supercharger Network as a 'very important' factor in their decision to purchase (Recargo, 2015). Therefore, it is important that Electrify America support not only the local charging needs, but also charging within a reasonable driving radius from home. This metric reflects how many Electrify America highway stations are located within a 120 mile radius of the metropolitan area's borders.

Policy Metric

Electrify America commissioned the National Association of State Energy Officials (NASEO), in partnership with The Cadmus Group LLC, to develop the Plug-In Electric Vehicle Policy Tool to evaluate the impact of state and local policies on plug-in electric vehicle (PEV) adoption in states and cities across the United States. The Tool was designed for Electrify America to use when considering potential metro areas for Cycle 2 investment and allows the user to evaluate the combined strengths and weaknesses of all PEV-related policies in a given metro area on a scale of 1-100 and compare the result with other metro areas.

The Tool provides a unique, evidence-based method to evaluate the ZEV investment climate of a metro area. The Tool's main feature – the Policy Evaluation Rubric – categorizes all PEV policies into six policy categories and 14 policy subcategories. Each policy subcategory is assigned a weight, based on its strength to spur PEV adoption relative to other policies. These weightings were assigned after an exhaustive review of peer-reviewed journal articles, publications from government, non-governmental organizations (NGOs), and the National Academies of Sciences, as well as rounds of expert input from an external Technical Advisory Committee (TAC). Members of the TAC provided input on the project's Policy Tool Methodology and Policy Evaluation Rubric, however, the TAC was not shown the proposed Cycle 1 and Cycle 2 investment jurisdictions and did not partake in reviewing the draft rankings of candidate jurisdictions. TAC members included:

- Jeff Allen, Forth
- Samantha Bingham, Chicago Department of Transportation
- Austin Brown, University of California-Davis
- Tonia Buell, Washington State Department of Transportation
- Stephen Capanna, U.S. Department of Energy
- Gregory Dotson, University of Oregon School of Law
- Robert Jackson, Michigan Energy Office
- Dave Reichmuth, Union of Concerned Scientists
- Michael Samulon, City of Los Angeles
- Christian Williss, Colorado Energy Office

The NASEO team assigned the highest weight to vehicle purchase incentives, followed by PEV deployment targets (including the ZEV mandate) and policies that incentivize EVSE installation and reduce EVSE operational costs. While there is some debate in the literature around the relative effectiveness of these policies, it is the project team's conclusion that these four types of policies represent the most effective policies at advancing PEV adoption.

This Tool was designed for Electrify America in its Cycle 2 investment planning, but may also be used by policymakers at the state and local level to evaluate their jurisdiction's current PEV policy environment. The Tool, as well as a detailed report on the methodology behind it, are available online here: ***https://naseo.org/news-article?NewsID=3321***

3.1.3. Investment Details

Electrify America's metro charging infrastructure investments are forecasted to account for $145 - $165 million of the infrastructure investment budget.

Metro Allocations

To split metro funds between the selected Cycle 2 metros, Electrify America considered a combination of factors to appropriately meet the charging needs of communities and ensure the economic viability of the stations. These factors included the supply-demand gap, policy and utility environment, and the overall connectivity of the metro with other significant BEV markets. Electrify America also weighed operational constraints and challenges including real estate availability in areas where they could be identified. Finally, while the size of the supply-demand gap in the largest metro is more than 10 times the size of the gap in the smaller metro areas selected for investment, Electrify America rebalanced its investment to the smaller, emerging EV markets where necessary to provide sufficient charging services in these markets and to support ZEV growth. Table 6 shows the allocation of the Metro Community Charging investment across the 18 metros.

Table 6: Cycle 2 National Metros

Metro[1]	Estimated New Station Count
Atlanta	8 – 12
Baltimore	3 – 6
Boston	8 – 12
Chicago	8 – 12
Denver – Boulder	8 – 12
Honolulu	3 – 8
Las Vegas	3 – 6
Miami	6 – 10
New York – Bridgeport	12 – 18
Philadelphia	4 – 6
Phoenix	3 – 6
Portland	4 – 6
Seattle – Bremerton – Olympia	12 – 18
Washington, D.C.	12 – 18
Total	**105 – 125**

[1] Electrify America defines a "metro area" as a Metropolitan Statistical Area, except in a limited set of circumstances where Electrify America determines that the MSA arbitrarily excludes a community that is part of the metro area or includes extremely rural areas within its border. In such cases, Electrify America exerted discretion on metro area boundaries.

Cycle 2 Metro Community Charging Use Cases:

Retail/Community

The primary use case for metro community charging in Cycle 2 will be retail/community stations. These stations will be sited to primarily serve drivers around town. Within each metro area, specific site selection and station characteristics require integration of multiple inputs.

First, Electrify America uses a proprietary geospatial model for identifying "target zones" that require DCFC infrastructure. While the specific geospatial and demographic criteria used are confidential, Electrify America's framework is generally consistent with those factors identified by Fitzgerald and Nelder in Rocky Mountain Institute's 'From Gas to Grid' (2017) and includes high-traffic retail areas in locations with strong ZEV adoption potential. In addition, Electrify America takes into consideration the distance between existing Electrify America charging stations to ensure its network meets the needs of ZEV drivers throughout a metro region.

Once target zones have been identified, Electrify America will use a combination of desktop research and on-the-ground resources to identify and screen specific locations within each target zone as leads. Electrify America, like other industry players deploying charging infrastructure, will use site location criteria to optimize charging locations where they are most likely to be highly utilized. While Electrify America's Cycle 2 site location criteria are proprietary and are still being revised, Electrify America anticipates using criteria similar to those used by Pacific Gas and Electric (PG&E) in their "2016 Electric Program Investment Charge" effort, including:

- Minimum siting conditions (e.g., ADA compliance, paved and level, safe and visible);
- Siting to increase EV adoption (e.g., food for purchase, premium spaces, future capacity); and
- Siting to minimize cost (e.g., transformer capacity, distance from transformer, surface materials)

Multiunit Dwelling

As discussed in Section 2.2 Infrastructure Learnings, MUDs present numerous challenges to charging electric vehicles. Electrify America will support drivers living in MUDs in Cycle 2 through placement of DCFC sites within close proximity of groups of MUDs. Many of the same criteria from the retail/community use case will be used to site these stations; however, in addition to these data points, Electrify America will analyze MUD proximity and density to target stations at convenient locations to meet the needs of drivers living in MUDs.

Shared Mobility

As discussed in Section 2.2. Infrastructure Learnings, in some metro areas of the U.S. there is an emerging need for charging of electrified shared mobility vehicles. Approximately 30 submissions received through the National Outreach website discussed the topic. For example, the City of New York, stated, "a rapid expansion of public charging infrastructure can enable an increase in the share of ZEVs in the high-mileage taxi and [for-hire vehicle] fleet." The transition of shared mobility to electric is not only driven by stakeholder support and potential emissions reductions, but also by the potential cost savings realized by drivers and passengers – where an EV deployed for shared mobility can provide a lower total cost of ownership than a comparable ICE vehicle today (Fitzgerald & Nelder, 2017). The benefits of these lower-cost and emission-free vehicles are poised to most directly benefit disadvantaged drivers and passengers, who may not have easy access to cars (Sperling, 2018). While the transition of these vehicles to electric presents numerous benefits, one of the key issues identified when interviewing electric shared mobility drivers is the availability and accessibility of DCFC (House & Fitzgerald, 2018).

Electrify America believes it is crucial that the transition to electric shared mobility comes without compromise to cost or convenience for the driver. To better understand how to conveniently (and economically) serve the needs of these drivers, Electrify America conducted numerous interviews with drivers, discussed challenges and approaches with shared mobility companies and taxi cab commissions, and contributed to focus groups of current and potential electric shared mobility drivers. This collaboration, outreach, and research revealed that these vehicles often require chargers in specific areas of a city not necessarily aligned with considerations for light duty private use EVs, and thus need differentiated site location considerations.

To site stations supporting these drivers, Electrify America will continue to collaborate with the shared mobility industry, including drivers, taxi companies, airport authorities, city governments, regulatory bodies and digital platform providers, such as Lyft and Uber, to select metros for investment in shared mobility targeted infrastructure. Metros will be selected based on a combination of factors designed to identify where the need for these investments is emerging, including local regulations, incentives, and support for electrification of shared mobility vehicles. Many drivers and cities are interested in having their shared mobility vehicles convert to electric, but, the most attractive metros for investment are those where policies or partnerships actually assist, accelerate, or require the conversion of the shared mobility fleet.

Shared mobility vehicle charging stations will be sited using a geospatial model that considers some of the same key factors as retail/community stations, including frequently traveled routes and 24/7 access. However, shared mobility vehicles require locations specifically targeted to their unique routes, including stations near transportation hubs and high traffic areas. As a result, Electrify America will work with shared mobility vehicle entities (e.g., drivers, taxis, TNCs) to optimize charging locations for these drivers. At this time, Electrify America plans to dedicate these sites to shared mobility drivers. Electrify America will aim to maximize ZEV adoption for all and will monitor usage to determine whether to allow for partial or complete public access while maintaining an optimal charging experience for all drivers.

Station Design Details

Stations in metro/community charging use cases will typically employ five ultra-fast EV charging dispensers. In areas with particularly high traffic, willing site hosts, and electrical supply, stations may have up to 10 dispensers; in areas with real estate constraints, sites may be limited to three dispensers. The typical power level of each station will be 150 kW, but DCFC levels will range between 50 kW and 350 kW depending on site constraints (e.g., utility interconnection limitations, available real estate) and expected usage. All public facing fast charging locations will support both CCS and CHAdeMO connectors. Some Electrify America metro stations may include L2 charging where the site host prefers, and where the business case can be justified. The decision to include L2 charging will be made on a case-by-case and site-specific basis.

Table 7 identifies the expected number of stations by use case.

Table 7: Cycle 2 Metro Investments by Use Case

Metro Use Case	Average Ultra-Fast DCFC Charger Count Per Station	Estimated Number of National Stations
Retail/Community	5	105 - 125
MUD	5	8 – 12
Shared Mobility[1]	5	15 – 20
Upgrades to Support Highly Used Locations[2]	5	8 - 12
Total New Stations		**136 – 169**

[1] If Electrify America is unable to identify a sufficient number of metro areas for the total expected shared mobility charging investments, funds will be invested in other metro charging use cases in Cycle 2 metros.
[2] Electrify America will continually monitor the utilization of the existing metro stations and invest a portion of the metro budget towards either adding additional capacity (including additional chargers and/or energy storage) at an existing metro station or adding an additional site nearby to support BEV drivers' needs in Cycle 2. These site decisions will be made based on utilization data from Cycle 1 through the early phase of Cycle 2. This funding may also be used to upgrade stations not originally built by Electrify America.

Select Electrify America sites will also include investments in renewable generation[13] and storage to support long term economic sustainability of the infrastructure investments.

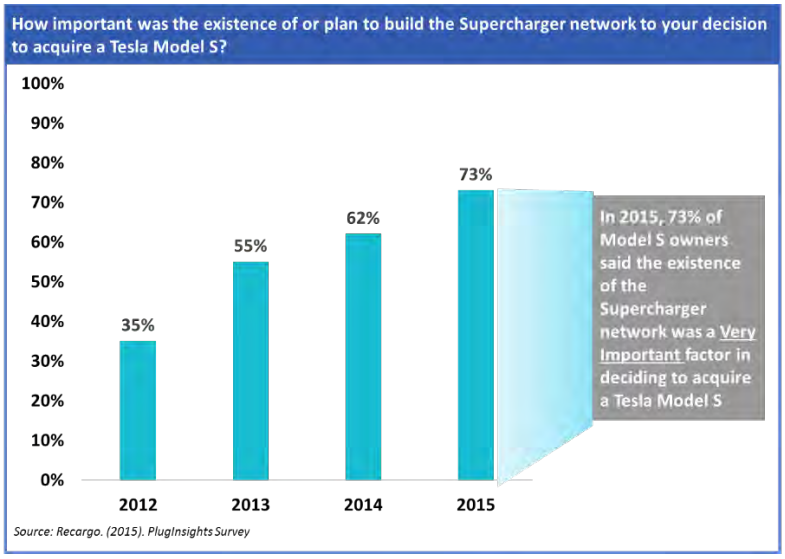
[13] The primary goal of Electrify America's ZEV investments is to support increased adoption of ZEVs in the United States. Fueling BEVs with electricity from renewable sources represents the next step toward zero emissions and would reduce pollution. In addition to providing cleaner fuel, renewables can improve the customer experience (i.e., they can shade customers from the elements when canopies are used) and support the long-term economic sustainability of a charging site. Electricity costs, especially demand charges, can account for over 40% of DCFC operating costs. Ensuring public DCFC is affordable for all consumers is a key to attracting potential buyers and ultimately driving mass adoption. Electrify America plans to invest up to $5 million in renewable generation to power its DCFC stations. Electrify America expects that approximately 1-2 MW of renewable generation will be installed, resulting in approximately 1,600-3,800 MWh of electricity produced annually.

3.2. Regional Routes and Highway Investments ($65 - $85 million)

3.2.1. Investment Overview

Electrify America will also invest in infrastructure on regional routes and highway corridors in Cycle 2. In Cycle 1, Electrify America prioritized the build out of a cross-country network of charging infrastructure focused on highly traveled corridors between major metropolitan areas. As a result, when the Cycle 1 network is complete, approximately 96% of Americans will live within 120 miles of an Electrify America charging station. In Cycle 2, Electrify America will further enhance the highway corridors outlined in the Cycle 1 National ZEV Investment Plan, while also developing new corridors to support the regional travel needs of drivers in top BEV markets.

Figure 23: Importance of Supercharger Network to Tesla Drivers



A key consideration when purchasing a primary household vehicle is whether it will meet the consumer's long-distance travel needs. When surveyed, over 70% of Tesla drivers cited the existence of the Tesla Supercharger Network as a 'very important' factor in their decision to purchase the vehicle (see Figure 23) (Recargo, 2015). Empirical data also shows that vehicle range and supporting infrastructure have an effect on how a vehicle is used – the Tesla Model S is utilized for 63% of household trips over 200 miles, compared to much lower rates for other smaller battery EVs currently available (Advanced Plug-In Electric Vehicle Travel and Charging Behavior Interim Report, 2017). Considering automotive manufacturers' announcements, which indicate that the majority of future BEVs will have ranges greater than 200 miles (according to Electrify America analysis), a suitable long distance network is needed to support adoption.

While a nationwide long distance fueling network is critical for supporting ZEV adoption, regional routes address the more realistic driving habits of most drivers. Federal travel data suggests that over 50% of long distance trips (trips greater than 100 miles) are completed within a 200 mile radius of home, and that nearly 80% of all long distance trips are within 300 miles of home (U.S. Department of Transportation, 2016). Several National Outreach Process submissions also mentioned the importance of placing DCFC stations along regional routes. In Cycle 2, Electrify America will focus on building out new regional routes to support the travel needs of drivers in selected metro areas on more localized corridors.

Finally, Electrify America's Cycle 1 investments were intended to meet ZEV driver needs out into the future. However, in the case that existing stations show higher utilization than originally expected and/or queuing during Cycle 2, Electrify America will add capacity to existing highway routes to ensure sufficient capacity for the growing set of BEV drivers.

3.2.2. Investment Selection Methodology

In Cycle 1, Electrify America proposed a nationwide high-speed DCFC network as a way to drive ZEV adoption. As a first order of business in Cycle 2, Electrify America reviewed the Cycle 1 network and identified routes planned in Cycle 1 but requiring further investment in Cycle 2. These routes were prioritized for build out in Cycle 2.

Next, Electrify America leveraged a data driven approach to select regional routes for new stations and ensure its investments meet the anticipated needs of BEV drivers. Electrify America started by identifying the top BEV markets based on Navigant's BEV forecast. These top markets were prioritized to ensure that investments support the needs of the highest number of existing and future EV drivers possible. Electrify America then used federal and state/local travel data (where available from our National Outreach Process) to analyze the long distance travel patterns of drivers from these metros and to identify the most popular travel destinations.[14] The number of vehicles traveling to each destination was then converted to a forecast of BEV travel using Navigant's forecasted BEV penetration at the origin point (see Figure 24, Figure 25, and Figure 26). Finally, forecasted BEV travel to common destinations from MSAs within a single region (e.g., Portland & Seattle; Boston, New York, Philadelphia, Baltimore and Washington, D.C.) were aggregated to identify the most important routes for EV charging. To finalize the regional routes selected for investment in Cycle 2, destinations were compared to those submitted by states and municipalities in the National Outreach Process to ensure the geospatial analysis matched local needs.

[14] Travel data allowed visualization of trips from county to county. Specific destinations within each county were identified using National Outreach Process submissions and discussions with local experts.

Figure 24: Northeast Top BEV Travel Destinations

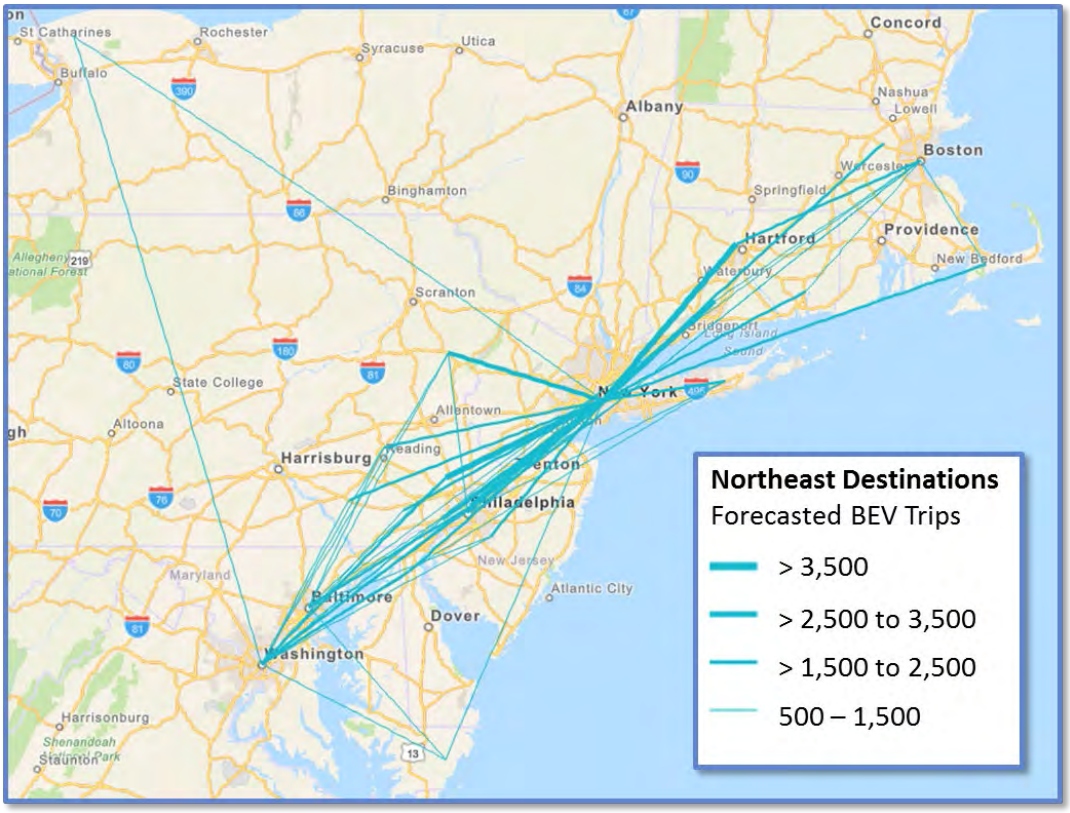


Figure 25: Southeast Top BEV Travel Destinations

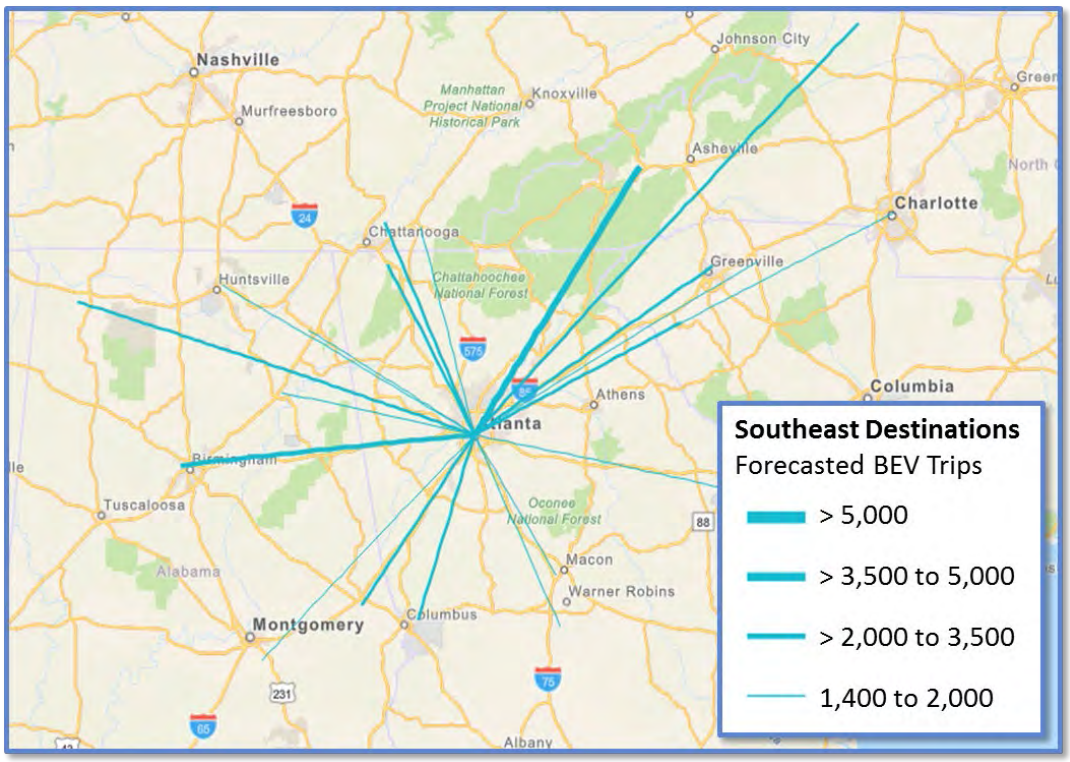
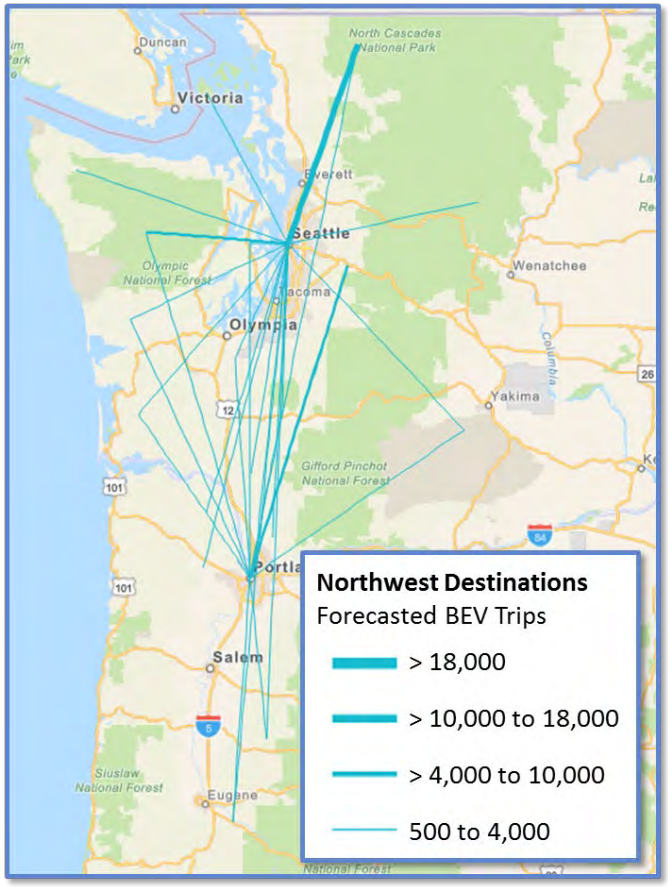


Figure 26: Northwest Top BEV Travel Destinations



Several submissions from the National Outreach website noted the importance of travel to/from Canada. For example, Vermont Public Service suggested placing DCFC on Vermont highway corridors to enable travel to Canada. Similarly, Drive Electric Washington offered specific site locations that include heavy travel to/from Canada. Electrify America also reviewed daily border traffic across numerous major U.S. Canadian borders, and analyzed traffic data at these border crossings. Considering this stakeholder feedback and data supporting heavy travel to/from Canada, Electrify America identified routes to key Canadian border crossings in Washington, Michigan, and Vermont as part of the regional route and highway investments in Cycle 2 (these stations will be placed in the United States).

The regional routes for highway investment are spread throughout the country (see Figure 27, Figure 28, Figure 29, and Figure 30). These include numerous highways in Connecticut, Maryland, New Hampshire, New Jersey, Pennsylvania, and New York in the northeast; several highways in the southern states connecting Atlanta, Birmingham, Mobile, Montgomery, and Nashville; a route to Aberdeen and Port Angeles on the Olympic Peninsula in the northwest; routes connecting Portland with the Oregon coast and to Bend, OR; and a route from Denver to Fort Collins in Colorado. In order to ensure that these investments have the greatest impact on ZEV adoption, Electrify America will continue to analyze long-distance travel data during Cycle 2 and may expand or modify the list of prioritized regional routes to address emerging needs.

In addition to the regional routes being built in Cycle 2, Electrify America will continually monitor the utilization of the existing highway stations and invest a portion of the highway budget towards expanding, or adding, station infrastructure and/or storage/renewable generation where high utilization and optimal conditions are evident.

Figure 27: Northeast Cycle 2 Regional Routes

Figure 28: Southeast Cycle 2 Regional Routes

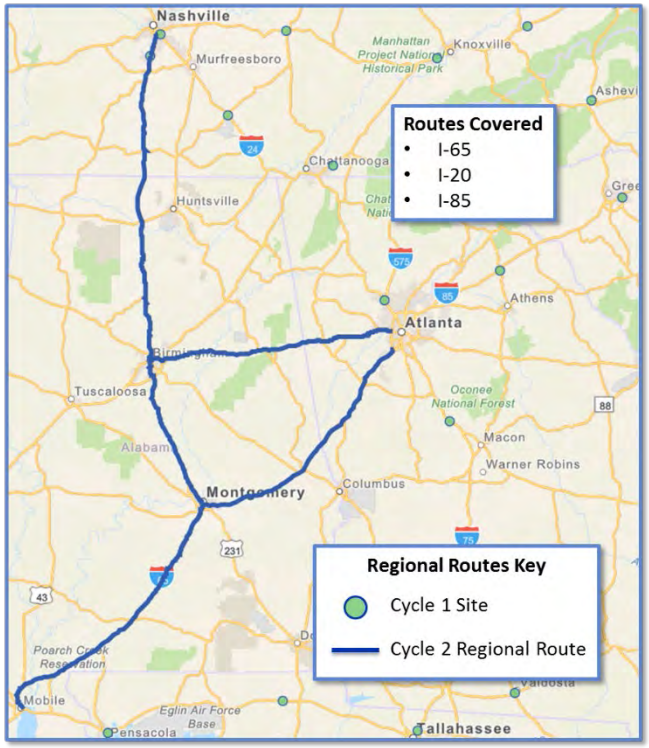
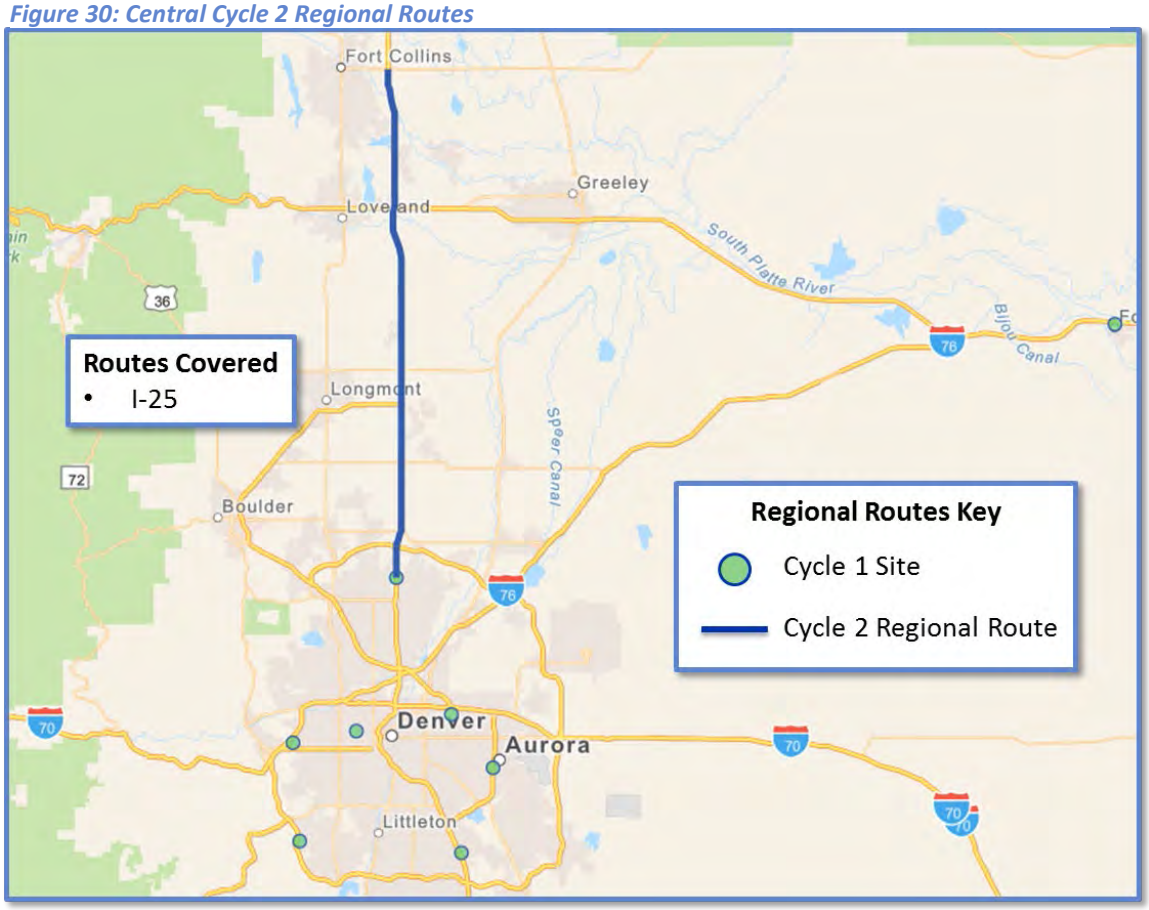


Figure 29: Northwest Cycle 2 Regional Routes

Figure 30: Central Cycle 2 Regional Routes



3.2.3. Investment Details

Electrify America's highway investments, including any generation and storage assets, are projected to account for approximately $65 - $85 million of the infrastructure investment budget. These stations will be designed with light duty vehicle drivers in mind, but much like liquid fueling stations today, some stations may also be able to accommodate the space requirements of medium and heavy duty vehicles.

Enhancing the Cycle 1 Nationwide Highway Network

In Cycle 1, Electrify America laid out a plan to develop a nationwide highway network of high-speed charging stations. The Cycle 1 plan anticipated approximately 90 stations of this network would begin development in Cycle 1, but would be partially funded and completed in Cycle 2. Electrify America has achieved substantial cost efficiencies over the course of Cycle 1 and anticipates being able to fund a significant portion of the 90 stations with the Cycle 1 budget. In Cycle 2, Electrify America is committed to further building its nationwide highway network. As of the drafting of this plan, Electrify America anticipates it will spend $20 million in Cycle 2 and finish up to 28 additional stations for its highway network.

Regional Route Allocations

Funding allocations towards regional routes are based on the number of sites needed to provide travel from Cycle 2 metros to identified destinations. Most sites serving regional routes in Cycle 2 will consist of four chargers, two 150 kW and two 350 kW.[15] The number of sites is determined based on the length of the route, location of existing Electrify America stations, the likely origin of BEVs traveling on the routes, and maintaining a distance of less than 120 miles between stations with consideration for significant changes in elevation.[16] Specific regional routes are identified in Table 8. The total budget for these sites is approximately $20 - $30 million.

Supporting the Highway Network with Additional Investments

Electrify America anticipates some routes in its highway network will demonstrate utilization which requires additional investment to meet driver needs and avoid crowding or queuing. Approximately $7 - $12 million will be dedicated to supporting the existing highway network by either adding additional capacity (including additional chargers and/or energy storage) at an existing highway station or adding an additional site along an existing highway route to support BEV drivers' needs in Cycle 2. These site decisions will be made based on utilization data from Cycle 1 through the early phase of Cycle 2.[17] This funding may also be used to upgrade stations not originally built by Electrify America, consistent with limitations on creditable cost previously established.

[15] The high powered chargers Electrify America is currently deploying are a mix of 350 kW and 320 kW, but Electrify America anticipates being able to increase power levels through upgrades over time. Maximum charging power levels are limited by vehicle capabilities, safety protections, and the charging protocols' technical specifications.

[16] On rare occasion, Electrify America must extend the distance slightly beyond 120 miles to account for significant siting constraints including available real estate, utility connections, etc.

[17] If utilization at stations on Cycle 1 and Cycle 2 routes does not demonstrate sufficient utilization to warrant additional investment, this budget will be reallocated to other Cycle 2 ZEV Investment Plan use cases.

Table 8: Cycle 2 Regional Route and Corridor Investments

Regional Route Highway	Estimated Station Count
I-93 Boston to Concord, NH	1
I-89 Concord to Burlington, VT Border	2
MA-6 Boston to Cape Cod	1
I-84/I-684 New York to Hartford	1
CT-15 New York to New Haven	1
I-476/I-81 Philadelphia to Syracuse	2
I-78 New York to Harrisburg	1
Garden St. Pkwy	2
Canada Connector in Detroit	1
MD-295 D.C. to Baltimore	1
I-20 Atlanta to Birmingham	1
I-85 Atlanta to Montgomery	1
I-65 Nashville to Birmingham	1
I-65 Birmingham to Mobile	2
I-5 Seattle to Canada Border	1
WA-101 Seattle Area to Port Angeles	1
WA-12/8 Seattle Area to Aberdeen	1
OR-26 Portland to Pacific Coast	1
OR-26/97 Portland to Bend	2
I-25 Denver to Fort Collins	1
Stations Supporting Existing High Utilization Routes	8 - 10
Total	**33 - 35**
Enhancing the Cycle 1 Nationwide Highway Network	**~28**

Select Electrify America sites will also include investments in renewable generation and storage necessary to support long term economic sustainability of the infrastructure investments.

3.3. Autonomous Vehicle Charging ($2 - $4 million)

3.3.1. Investment Overview

The automotive industry is in transition as vehicle ownership models are being challenged by disruptive mobility alternatives. The next generation of potential automotive buyers are taking advantage of new mobility services (ride hail, car share, public transit), and the industry is becoming focused on the potential of new mobility choices. These trends can be summarized as Autonomous, Connected, Electrified, Shared (ACES) (INRIX, 2018), or as vehicle electrification, vehicle automation and pooling, and sharing (Sperling, 2018). In addition, recent announcements regarding autonomous vehicle deployments in Phoenix, San Francisco, and Sacramento are examples of how quickly charging for autonomous vehicles could emerge as a new infrastructure need (Rodd, 2018; Knight Foundation, 2018).

Accordingly, in Cycle 2, Electrify America is looking to partner with autonomous vehicle service providers to support their programs with autonomous charging solutions.

3.3.2. Investment Selection Methodology

Electrify America plans to partner with an existing autonomous vehicle company or companies to build an autonomous vehicle charging station(s) in a market where such a station(s) is necessary to serve emerging needs. As the autonomous fleet providers are subject to legal limitations as to where they are able to operate their programs, Electrify America investment in this area will be subject to such location-based limitations.

3.3.3. Investment Details

Electrify America anticipates that two separate stations can be supported by this $2 to $4 million infrastructure investment. Hardware deployed at the station (e.g., robotic arm or other approach) will depend on the available charging technology as well as the OEM vehicle capabilities in the market during Cycle 2.

Please note: if for any reason Electrify America is unable to identify sufficient investments to meet the $2 to $4 million budget by June 2020, or if this emerging need is being met by Electrify America's investment in California, any remaining funds will be redistributed to other Cycle 2 ZEV Investment Plan use cases in order to ensure Electrify America meets the spending requirements of the Partial Consent Decree.

3.4. Infrastructure Investment Timeline and Milestones

Through implementation of the Cycle 1 ZEV Investment Plans, Electrify America has acquired extensive experience deploying DCFC and L2 stations across the country. In Cycle 2, Electrify America will leverage this experience to ensure an efficient and effective roll-out of the infrastructure investments outlined in this plan. Developing any charging site, and especially a high-powered DCFC site with multiple chargers, is an extensive and time intensive process involving numerous steps, processes, and the coordination of multiple parties including real estate owners, hardware vendors, construction contractors, utilities, and permitting agencies. The key steps necessary to deploy each DCFC charging location, once a site has been secured, are outlined below, but are not necessarily in order given variable circumstances:

- Ordering equipment
- Negotiation and signing of lease or license agreements (or, where appropriate, purchasing property)[18]
- Development of permitting/pre-construction packages
- Filing permits
- Warehousing equipment and quality assurance/quality control
- Permit approval
- Site preparation
- Equipment delivery to site
- Completion of site construction
- Landscaping
- Utility connection to the grid/inspection and any additional utility preparation including new transformers or upgraded substations
- Commissioning

The length of time needed to develop a charging location can vary significantly based on available real estate, site characteristics, utility capacity, local permitting agencies, easements, and other geographic and business factors. Electrify America has already established an extensive list of major real estate partners, which will help reduce the overall time necessary to identify charging sites in Cycle 2. In addition, Electrify America has established relationships with many local utilities and permitting agencies, allowing both parties to become more familiar with Electrify America's infrastructure approach, while also improving Electrify America's understanding of local processes. These relationships and learnings can make station development more predictable and streamlined over time.

Considering learnings from Cycle 1, Electrify America has submitted the Cycle 2 National ZEV Investment plan considerably in advance of the beginning of the Cycle. Electrify America will begin development of the first Cycle 2 stations as soon as the Cycle 2 National ZEV Investment Plan is determined to be consistent with the Partial Consent Decree by the EPA. An expeditious determination will enable Electrify America to initiate new RFPs, negotiate contracts, place orders for equipment, secure sites, and begin other key development activities in advance of the beginning of Cycle 2 and

[18] Electrify America's real estate acquisition practices have been developed to ensure that the investment helps the entire EV charging industry grow. For example, Electrify America has not signed exclusive leases that exclude other EV charging companies from building at our sites or working with our partners, and Electrify America also has not signed multiple leases in the same DCFC target zone.

avoid any gap in infrastructure investment. Based on this schedule, by the end of 2019, if not sooner, the first Cycle 2 sites are expected to be online, with many additional Cycle 2 sites well on their way through construction. Table 9 illustrates the preliminary planned rollout of Cycle 2 DCFC infrastructure to support regional routes and highways and metro community charging during Cycle 2.

Table 9: Cycle 2 National Preliminary Infrastructure Deployment Schedule – All Sites

Cycle 2 Infrastructure Investments			
Quarter	Pre-site selection	In development	Operational
Q4 2019	150 - 160	20 - 30	30 - 40
Q2 2020	90 - 100	40 - 50	70 - 80
Q4 2020	40 - 50	50 - 60	110 - 120
Q2 2021	0 - 0	50 - 60	150 - 170
Q4 2021	0 - 0	0 - 0	200 - 230

Electrify America's Cycle 2 DCFC roll-out strategy includes two major phases. In Cycle 1, Electrify America deployed the first UL Certified 150 kW and 350 kW DCFC stations in the United States. These first-of-their-kind stations provide drivers the capability to refuel up to 20 miles of range for every minute charging,[19] along with universal driver access through credit/debit card readers, and a simplified and intuitive charging experience presented by a 15-inch touch screen display. In Phase 1 of the Cycle 2 roll-out, Electrify America will leverage this existing station design to increase the coverage of the Electrify America network. In Phase 2, Electrify America will monitor emerging technology developments and will consider adjusting hardware design and components, taking into account lessons learned, technology improvements, and customer feedback. This two-phase approach will allow Electrify America to rapidly increase the convenience of EV charging, while also allowing lead time to upgrade station designs or accommodate specific site requirements not aligned with current hardware configuration and design.

In Cycle 2, Electrify America will continue to rely upon the capabilities and innovations of an extensive group of experienced suppliers to support the deployment of charging infrastructure. Electrify America will engage in a competitive procurement process to select vendors as necessary to meet the build-out schedules for Phase 1 and Phase 2 of the Cycle 2 schedule. This process will consist of issuing inclusive Requests for Information (RFI) and Requests for Proposals (RFPs) to support activities, such as site identification, site development, and procurement of both current and newly designed charging equipment. This procurement process is expected to begin by Q1 2019 and run through Cycle 2.

[19] Assumes 3.5 miles per kWh.

3.5. Maintenance Plan for Infrastructure

Electrify America's mission to build a comprehensive, technologically-advanced and customer-centric charging network requires that equipment be maintained to industry-leading standards, customer support is available when needed, and stations are repaired in a timely manner when issues occur. Regardless of whether maintenance is performed in house or by a contractor, Electrify America has ensured contractual requirements to reasonably resolve issues with all stations within a maximum of 72 hours.

To meet these expectations, Electrify America conducted a competitive bid process and selected a vendor to provide maintenance for all Electrify America DCFC stations nationwide. This agreement includes routine preventative, campaign, and emergency maintenance for all stations through the contract period. Prior to the conclusion of the contract, or as necessary, Electrify America will solicit competitive bids to ensure no lapses in maintenance coverage for 10 years from the Partial Consent Decree effective date. In addition, all Cycle 2 stations will be marked with a toll-free customer service hotline. Should a customer encounter any issues fueling at an Electrify America station, the 24/7 Customer Contact Center will be available to provide support. Agents and operators have access to real-time station status information and can perform tasks such as reviewing unit performance history, initiating a charge, resetting a charger, or other issue resolution tasks.

3.6. Pricing, Interoperability, and Open Access

Broadly speaking, Electrify America intends to own and operate most of its ZEV infrastructure investments, though some investments may be handled under different ownership/operating structures as required for specific locations and use case needs. At those stations for which Electrify America operates the infrastructure, pricing will be a function of inputs including utility costs, station capital and operating costs, competitor pricing for subscription and rack rate products, and gasoline equivalent prices. Electrify America will set and adjust prices as required to reflect these inputs and drive toward a sustainable business model that always offers fair and reasonable value given our optimal charger utilization targets.

To maximize public access to its network of charging stations, Electrify America stations will continue to have the ability to charge plug-in EVs using a mix of non-proprietary connectors used by multiple automakers. Specifically, public facing DCFC stations will utilize CCS and CHAdeMO non-proprietary charging standards, while any new L2 stations will utilize the universally accepted J1772 connector. Throughout Cycle 2, Electrify America will continue to monitor the developing market of non-proprietary connectors to determine which types of connectors and mix should be deployed as technology and sales evolve.

Electrify America will also support open protocols including Open Charge Point Protocol (OCPP) that allow more standardized communication between different chargers and networks. Electrify America will work to maintain OCPP compliance and other measures to help maximize interoperability, a term that describes the ease of communication between the charger and the network it is on. Electrify America's public DCFC stations are all equipped with credit/debit card readers, and Electrify America believes that true access to charging stations is best guaranteed through credit card readers. In addition, Electrify America's public stations will be equipped with back end systems that can use Open Charge Point Interface (OCPI) 2.1 to communicate with other networks and Open InterCharge Protocol (OICP) to be able to connect to roaming platforms, when a business agreement is secured, in a manner that does not require use of any particular firm's intellectual property. Electrify America's network of ultra-fast chargers will also have the ability to accept multiple payment methods (e.g., subscriptions through our app, mobile pay, RFID, credit and debit cards, and "Plug&Charge" standardized in IEC/ISO 15118) to simplify usage as much as possible across a range of buyers. Through the support of multiple charging standards, the ability to accept multiple payment methods, and a strong focus on publicly-accessible infrastructure, Electrify America will be building a highly interoperable network that provides comprehensive access to all EV drivers.

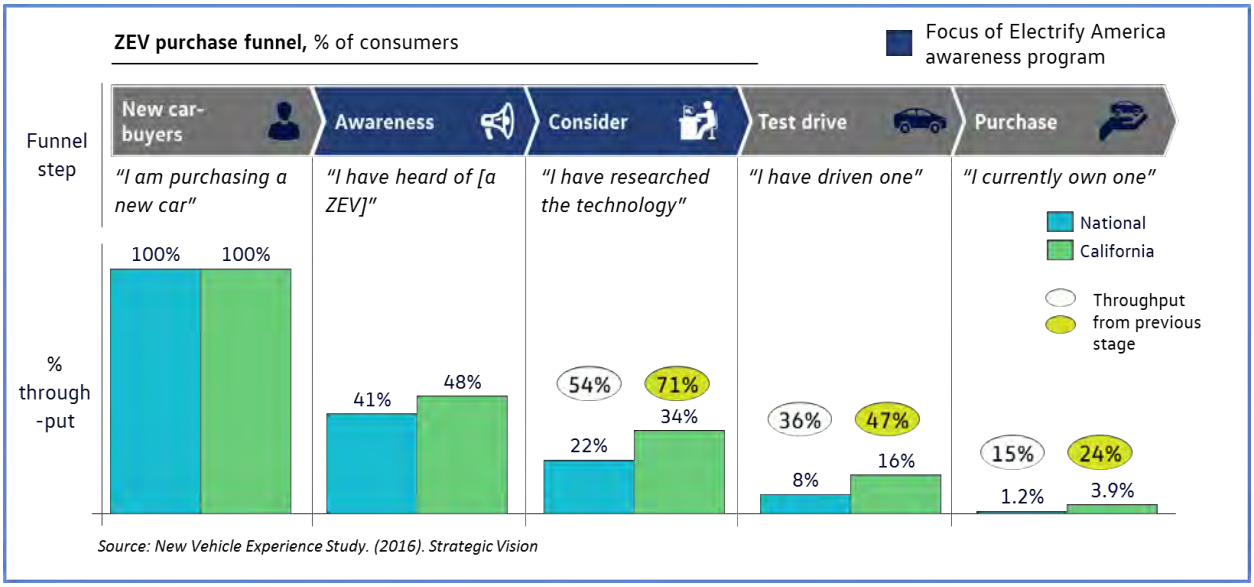
4. Public Education, Awareness, and Marketing Activities

To complement the infrastructure portion of its ZEV investments, Electrify America will also roll out a broad set of education, awareness, and marketing programs in Cycle 2. The effort consists of media and tools from across the marketing spectrum including traditional media (e.g., TV, radio, billboards) as well as more targeted efforts and 'new media,' such as social media messaging and paid search. This effort will include campaigns intended to support two distinct themes of Appendix C of the Partial Consent Decree: increasing the use of zero emission vehicle technology and driving utilization of Electrify America's zero emission infrastructure.

Recent research shows that mass-market ZEV adoption has been significantly limited by low awareness. Strategic Vision's 2016 New Vehicle Experience Study found that just 41% of new car buyers have ever heard of a ZEV (see Figure 31). Similarly, a 2017 Cox Automotive EV consumer study showed that the first electric vehicle that comes to mind for consumers is not actually a battery electric vehicle – it is a Toyota Prius hybrid. And, perhaps not surprisingly, awareness is a major driver of consideration and ultimately of purchasing EVs. As UC Davis' Ken Kurani found in his 2018 State of the Plug-In Electric Vehicle Market: Report 1, "awareness, knowledge, experience, familiarity and assessments of ZEVs" are some of the most powerful predictors of ZEV consideration, far exceeding general socio-economic and demographic statistics.

Stakeholders and academic scholars repeatedly cite education and awareness as a critical input for ZEV adoption. Electrify America's National Outreach website received more than 40 submissions from stakeholders highlighting the importance of these efforts, including many invitations to participate in specific events or programs. A major American auto manufacturer highlighted that "outreach to customers for awareness of products available in the market, convenience of EV driving and the benefits of owning EVs are adoption enablers." Arizona State University identified Education and Marketing as one of the three major elements required to achieve its ZEV adoption goals. The Leadership Counsel for Justice and Accountability strongly supports Electrify America developing "meaningful education and outreach programs," while state level stakeholders at in-person meetings in Portland, Atlanta, and Olympia stressed the importance of combining education and awareness efforts with infrastructure installations.

Figure 31: ZEV Awareness and Consideration



Electrify America also recognizes the importance of driving optimal utilization across its network of stations. Station utilization is a key metric by which our infrastructure investments are judged and will become financially viable, and thus Electrify America's branded marketing funding will be dedicated to building awareness of Electrify America's network, brand, and helping drivers find Electrify America stations.

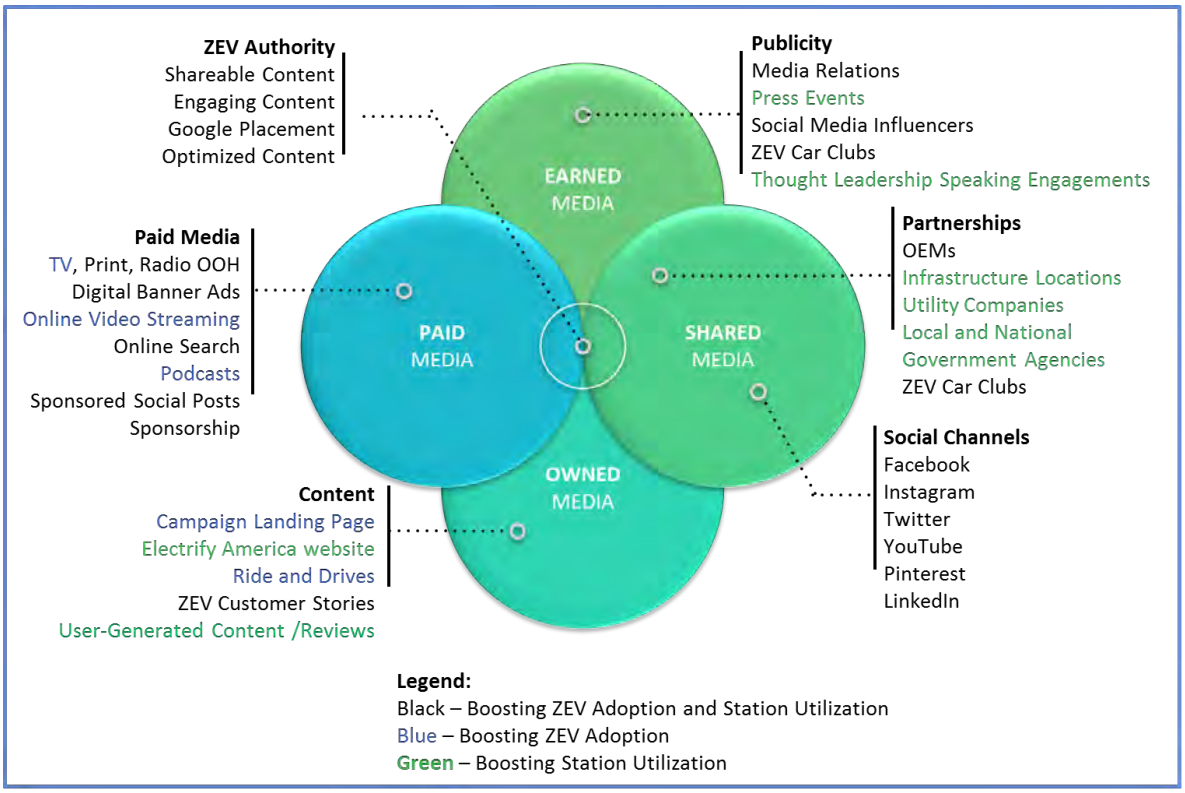
4.1. Public Education, Awareness, and Marketing Framework

Electrify America has developed two holistic marketing campaigns to educate and inspire likely buyers about ZEV technology, vehicle models, financial incentives, and fueling availability. The campaigns together leverage all four corners of the marketing sphere - Paid, Earned, Shared, and Owned (PESO) content (Robinson, 2016) – and are designed to deliver a consistent message across media types.

- Paid Media is content that is distributed based on financial compensation to place the message, and control its distribution, including traditional TV, radio, and out of home (billboard) advertising and sponsored content on social media.
- Earned Media is the published coverage of a company, cause, or person's message by a credible third party, such as a journalist, blogger, trade analyst, or industry influencer. Examples of this include press release content published in newspapers or magazines.
- Shared Media is the practice of distributing content through an entity's own loyal user base or audience. Examples of shared media include posts on Twitter, LinkedIn, and Instagram.
- Owned Media is the aggregation and dissemination of content from loyal customers/followers and then redistributing this content. Examples include customer/employee stories published on a company's website.

Electrify America's efforts to boost ZEV adoption in a brand-neutral manner and to drive Electrify America station utilization will both use this model because it allows for amplifying the message across platforms and targeting spend to the most effective channels. The breakdown of activities, by channel, is shown in Figure 32.

Figure 32: PESO Model Overview

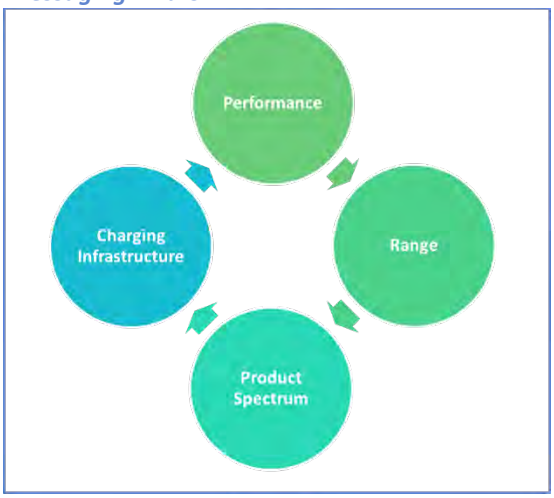


4.2. Boosting ZEV Adoption through Education and Awareness ($25 million)

Electrify America will spend $25 million in Cycle 2 to boost ZEV adoption through informing mainstream car buyers on the key benefits offered by ZEVs in a brand-neutral manner. Of this funding, $24.5 million will be spent on brand-neutral education and awareness funding defined in Section 1.10.2 of Appendix C, while $0.5 million will be spent specifically on Learn and Drive sponsorships, which are categorized as an access program defined in Section 1.10.3 of Appendix C.

In its 2017 New Vehicle Experience Study, Strategic Vision found that drivers identify performance (handling and cornering) and comfort (ride quality and quiet interior) as two of the top four 'Extremely Important' characteristics when shopping for a vehicle. As such, Cycle 2 efforts to drive ZEV adoption will focus on four messaging pillars around ZEVs: performance, range, product spectrum, and charging infrastructure (see Figure 33).

Figure 33: ZEV Education and Awareness Messaging Pillars



Performance messaging will highlight the acceleration, ride quality, and quietness offered by ZEV technology. Range will focus on the fact that the range of today's fleet of ZEVs meet the needs of the overwhelming majority of drivers. Product Spectrum will describe the diversity of ZEV makes and models, from SUVs to sports cars and luxury vehicles. Finally, Charging Infrastructure will help instill range confidence while highlighting the convenience offered by both public charging infrastructure and home charging today.

The majority (~$20 million) of spending on this effort is dedicated to advertising aimed at the top of the 'sales conversion funnel' (see Figure 34). The 'sales conversion funnel' describes a typical customer's journey from complete unawareness of a product, through awareness, consideration, test drive, and ultimate adoption. Figure 35 provides additional details on the contents of each category in the sales conversion funnel.

Figure 34: ZEV Sales Conversion Funnel and Primary Paid Media Categories

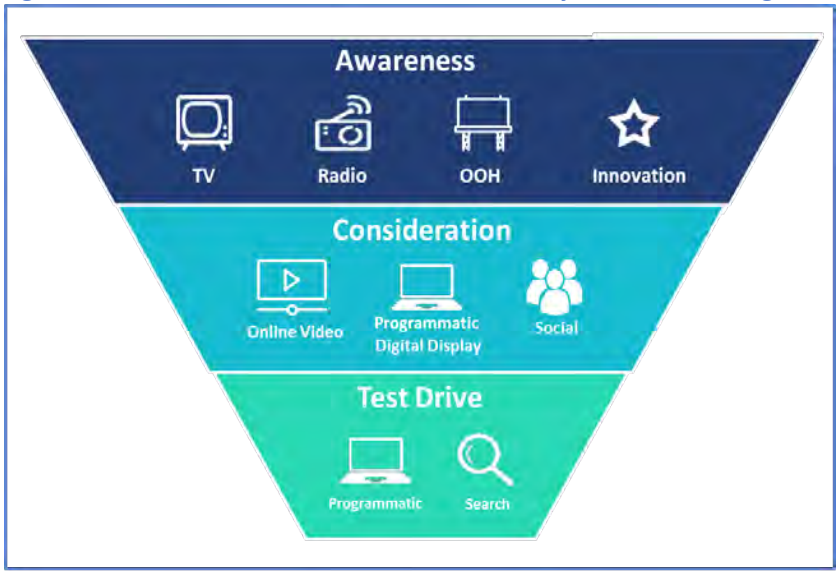
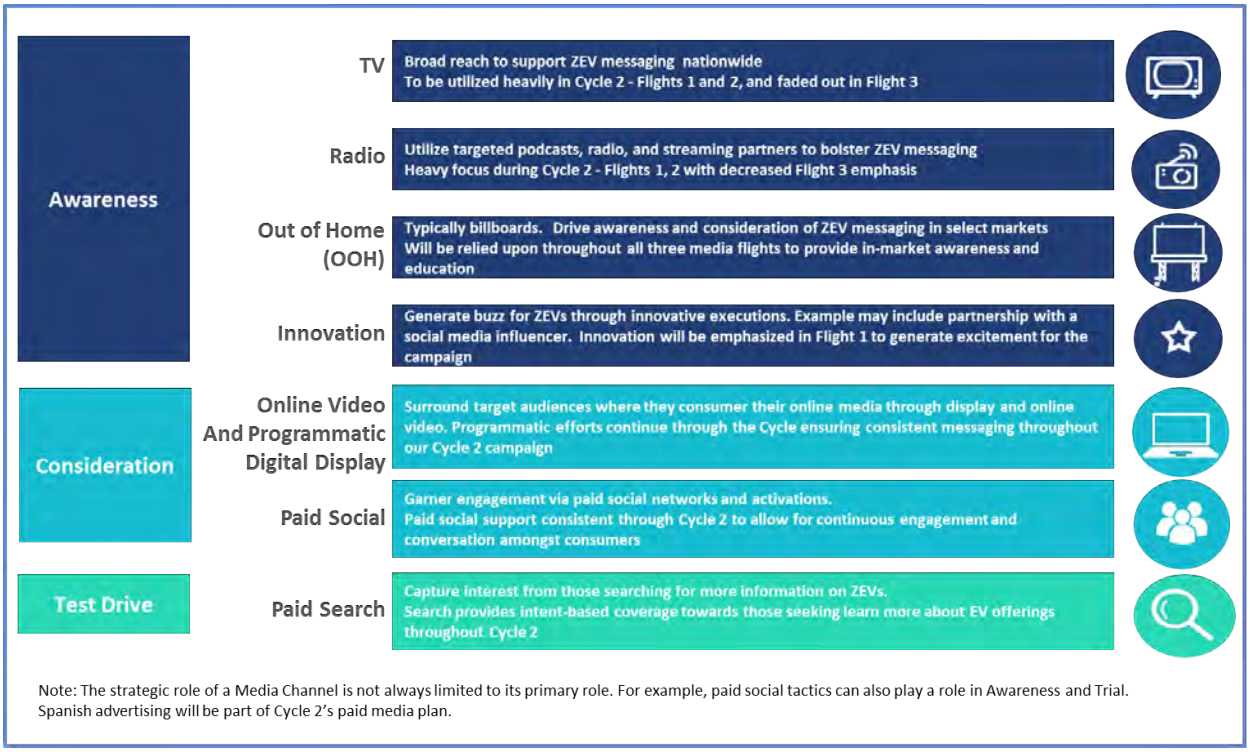


Figure 35: Additional Details on Paid Media Categories

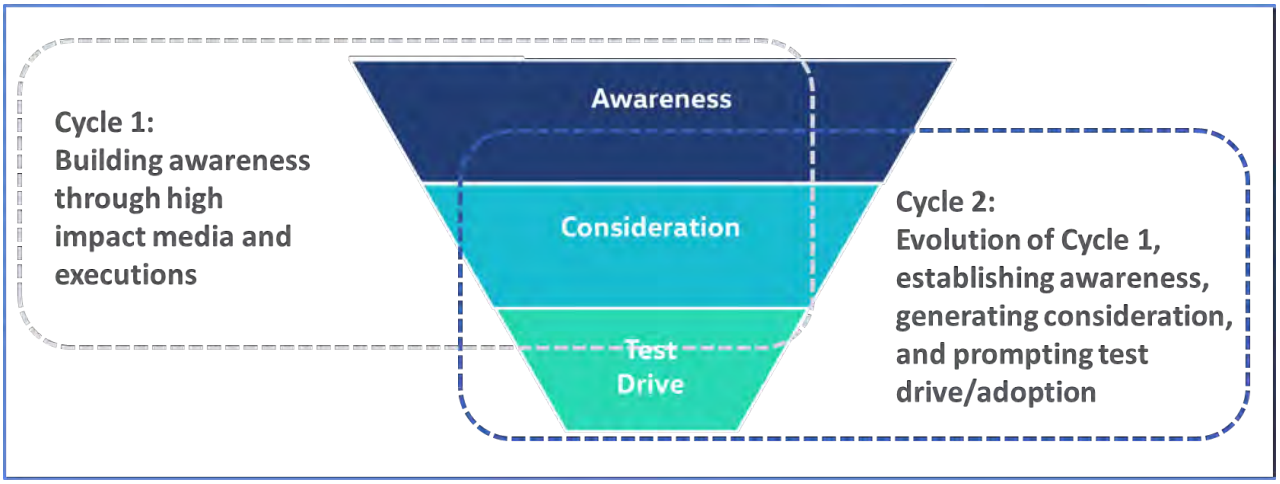


Note: The strategic role of a Media Channel is not always limited to its primary role. For example, paid social tactics can also play a role in Awareness and Trial. Spanish advertising will be part of Cycle 2's paid media plan.

In Cycle 1, Electrify America has focused on building awareness through high impact media executions, with limited emphasis on consideration and test drives. For example, Electrify America created a TV and radio spot called the 'Jetstones' which highlights that ZEVs are available, fun to drive, and more affordable than ever. The spots can be seen and heard at www.plugintothepresent.com.

Over the course of Cycle 2, Electrify America expects consumer awareness to improve as a result of multiple factors. First, Electrify America's hope is that its early efforts, in combination with the activities from many others in the EV community, will boost awareness in the market. In parallel, new EV models will come to market, and Electrify America expects their associated launch campaigns to help drive increased awareness. If successful, these combined efforts should drive a bump in overall market awareness.

Figure 36: Comparison of Cycle 1 vs Cycle 2 Education and Awareness Messages



As awareness improves, Electrify America will shift its focus down the 'sales conversion funnel' to tactics that drive ZEV consideration (see Figure 36).

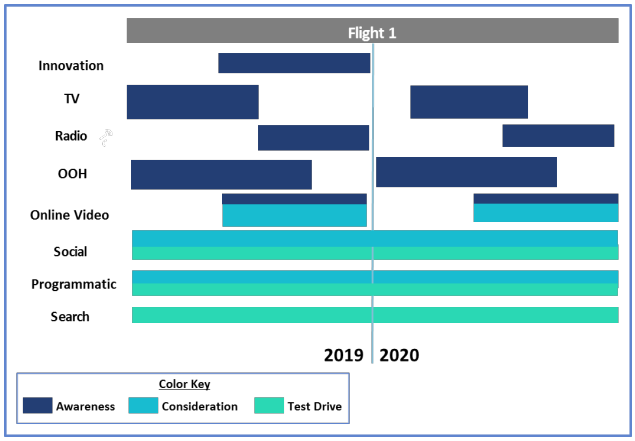
Electrify America's Cycle 2 media strategy will be broken into three flights: Flight 1 will run from July 2019 through mid-2020; Flight 2 will run from mid-2020 through mid-2021; and Flight 3 will run through the end of Cycle 2. The focus of each successive flight will shift further down the sales conversion funnel using those media tactics appropriate for the targeted messaging.

This media plan is subject to informed revision, based on market impacts and evidence of effectiveness. The shift in focus laid out in the plan below from awareness building to consideration and test drives will be evaluated based on learnings, results, market conditions, and evidence of general consumer awareness on an ongoing basis. Electrify America may make adjustments to maximize impact on ZEV adoption as necessary and appropriate during Cycle 2.

Cycle 2 – Flight 1 Paid Media Plan: [20]

Our approach to the Flight 1 media plan is to continue the momentum of Cycle 1 messaging and continue driving overall ZEV awareness. Specifically, Electrify America will focus the bulk of spending on 'upper funnel' media such as TV, radio, and out of home (OOH). Electrify America will leverage the momentum of ZEV vehicle launches in 2019 and 2020 to establish additional awareness among car buyers (see Figure 37).

Figure 37: Proposed Cycle 2 - Flight 1 Paid Media Plan

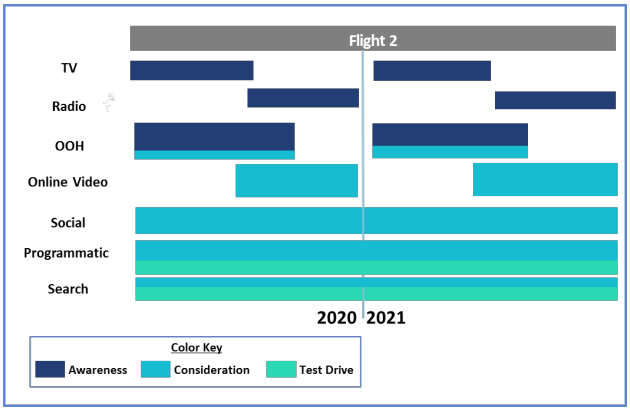


[20] This plan reflects Electrify America's best projection of Cycle 2 media spending at the time of plan drafting. Due to economic, political, and societal shifts in the market, media costs of each component may change, and therefore shift the optimal mix of investments. Electrify America will work with a competitively-selected media agency to optimize media spending for maximum impact on ZEV adoption.

Cycle 2 – Flight 2 Paid Media Plan: [21]

In 2020, ZEV penetration is anticipated to rise and as a result, consumer awareness is expected to be stronger. Flight 2 will evolve by increasing media efforts to drive an already educated audience towards consideration and trial. To capture these audiences, Electrify America will refine our investment[22] towards channels that allow for advanced targeting, such as online video, social, and in-stream audio (see Figure 38).

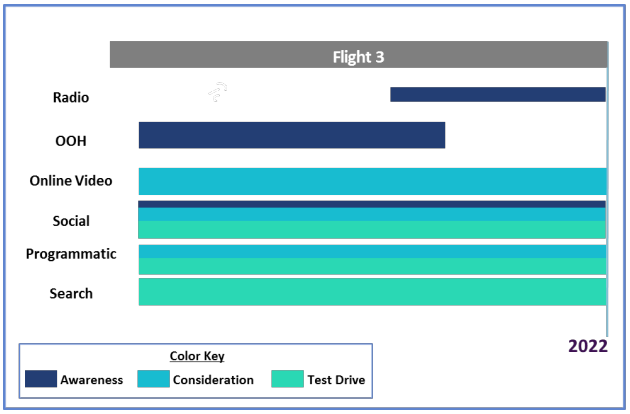
Figure 38: Proposed Cycle 2 - Flight 2 Paid Media Plan



Cycle 2 – Flight 3 Paid Media Plan: [23]

By the latter stage of Cycle 2, Electrify America will focus on driving consumers toward ZEV test drive opportunities at their local dealers and ultimately to purchasing ZEVs. To promote test drives, Electrify America will utilize channels that capture consumer intent, including social, search, and programmatic display (see Figure 39).

Figure 39: Proposed Cycle 2 - Flight 3 Paid Media Plan



Additional Education and Awareness Tactics

In addition to paid media efforts that will be conducted in the three flights described above, Electrify America plans to leverage additional tactics to drive ZEV adoption throughout the cycle. These represent a much smaller slice of the overall Education and Awareness budget, but provide consumers another touch point and unique interaction with ZEVs. These investments are highly dependent on specific projects or opportunities, and thus are difficult to identify in advance. However, some ideas under consideration include:

- Social Influencers: Working with key social media influencers, such as bloggers or tech reviewers, to develop ZEV-related content. Influencers could be provided with a range of ZEV technologies to review, educate, and boost awareness around the "fun to drive" aspect of ZEVs. The goal of this activity will be to promote ZEV awareness in social media channels using trusted influencers to spread positive reviews of living with a ZEV on a regular basis. Electrify America and its media agency will work together to vet possible social media influencers based on multiple criteria including overall ZEV alignment and affinity, frequency of ad posts, location and context, and engagement rates. This digital activity is included within the Digital budget.

[21] See footnote 20.
[22] According to Appendix C, budget items related to education, awareness, access, and marketing are defined as a category of "ZEV investment." Traditional accounting practices categorize these items as spending due to their lack of a forecastable rate of return.
[23] See footnote 20.

- Memberships and Sponsorships: As proposed by numerous submitters to Electrify America's National Outreach Process, including the Sierra Club, Plug In America, and a number of local National Drive Electric Week chapters, establishing partnerships with consumer-oriented organizations to create content/events that promote ZEV adoption.[24]

- Experience Centers: Including refueling infrastructure and education materials at a ZEV experience center with high visibility and public exposure such as Forth's Electric Showcase or the Smart Columbus Experience Center.[25]

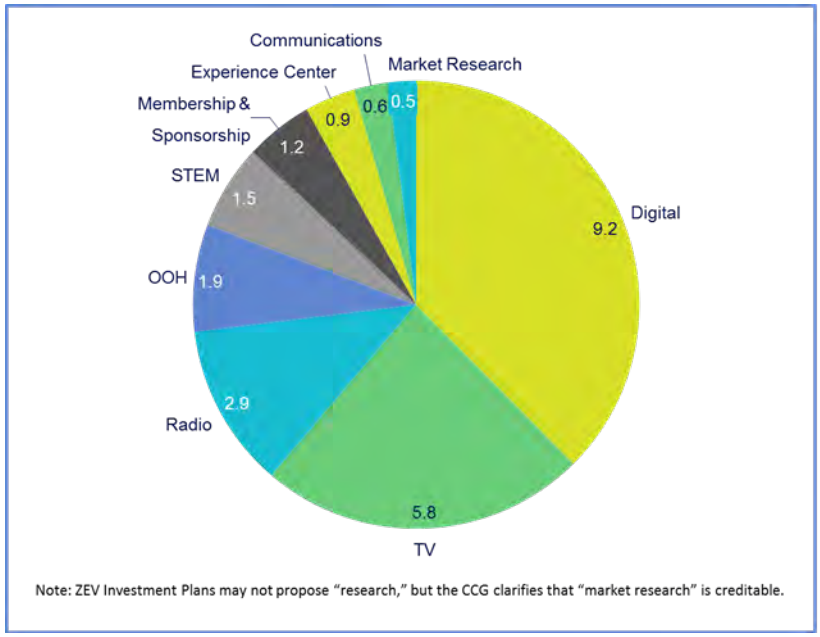
- STEM Education: As referenced in more than 20 National Outreach Process submissions, potential concepts include providing curriculums to Kindergarten through 12th grade classrooms, vocational schools, community colleges, vehicle dealerships, and professional training on ZEVs and charging infrastructure. Other education activities may include sponsoring programs to "certify" qualified dealers that have dedicated and trained staff that are fully versed in ZEVs and their associated purchase considerations (e.g., wall box installation, discounted utility offers, local/state/federal incentives, public charging subscriptions). All STEM education will be specific to ZEVs and/or ZEV infrastructure, and made publically available whenever feasible.

To supplement these brand-neutral education and awareness activities, Electrify America plans to sponsor Learn and Drive activities in Cycle 2. In comments from Plug In America, NESCAUM, and many other organizations, the impact of these activities to increase awareness and ZEV adoption was well demonstrated. These activities, which are classified as an "access" activity under sections 1.10.3 and 2.5.5 of Appendix C of the Partial Consent Decree, will be accomplished by sponsoring the events or programs of other organizations, and the $0.5 million budgeted for this activity in Cycle 2 will not be considered an investment that meets minimum or maximum spending requirements specified in Section 2.5.6 of Appendix C. For detail on this request, see Appendix 3.

The $24.5 million Education and Awareness budget breaks down as shown in Figure 40.

[24] For further details on creditability of memberships and sponsorships, please see Appendix 2.
[25] This budget will not be used to support learn and drive activities at experience centers. All learn and drive activity is categorized as access as defined in Section 1.10.3 of Appendix C.

Figure 40: National Education and Awareness Budget ($ million)



Note: ZEV Investment Plans may not propose "research," but the CCG clarifies that "market research" is creditable.

4.3. Boosting Station Utilization through Branded Marketing (~$10 million)

One of the core metrics by which Electrify America investments are measured is station utilization. Specifically, Electrify America must drive utilization to demonstrate its investments are "addressing an existing need or supporting a reasonably anticipated need," and Electrify America must demonstrate that a charging station "has a high likelihood of utilization and provides accessibility/availability where most needed and most likely to be regularly used," as outlined in the Partial Consent Decree. To address this, Electrify America is targeting $10 million of spending on marketing and will communicate four key pillars:

- Location: Highlighting the locations of Electrify America's chargers to customers and instilling range confidence.
- Speed: Conveying the high-powered speeds at which Electrify America chargers can charge a BEV, offering consumers a more convenient charging experience.
- Affordability: Promoting the affordability of charging offered by Electrify America's network, including subscription plans and charging bundles provided by automotive manufacturers that will be available to customers.
- Customer-centricity: Showcasing that Electrify America's infrastructure is designed with the consumer experience first – stations are located near retail locations and amenities, accept nearly all payment methods, and the charger and app interfaces are user friendly.

Electrify America's messaging goal is to change range anxiety to range confidence by generating awareness of Electrify America charging stations including convenient metro and highway locations, customer-centric charging experience (credit card access/no membership required to access Electrify America chargers), and high-powered offerings of up to 350kW that will allow for 200 miles of charging in as little as 10 minutes (depending upon vehicle capacity to access such fast charging).

The largest portion of Electrify America's activities will be digital advertising targeted at specific groups that are most likely to be able to utilize the Electrify America charging network. Electrify America will use digital tools including online search and programmatic digital display to reach these prospects and deliver the right message (e.g., promotion of closest EV charging location) at the right time (e.g., when someone is searching for a EV charger). Examples of potential targeted audiences include: new and used ZEV buyers, EV driver club members, and prospective ZEV considerers/researchers.

In addition to digital advertising, Electrify America will leverage alternative tactics with a much smaller portion of the overall budget. These tactics include:

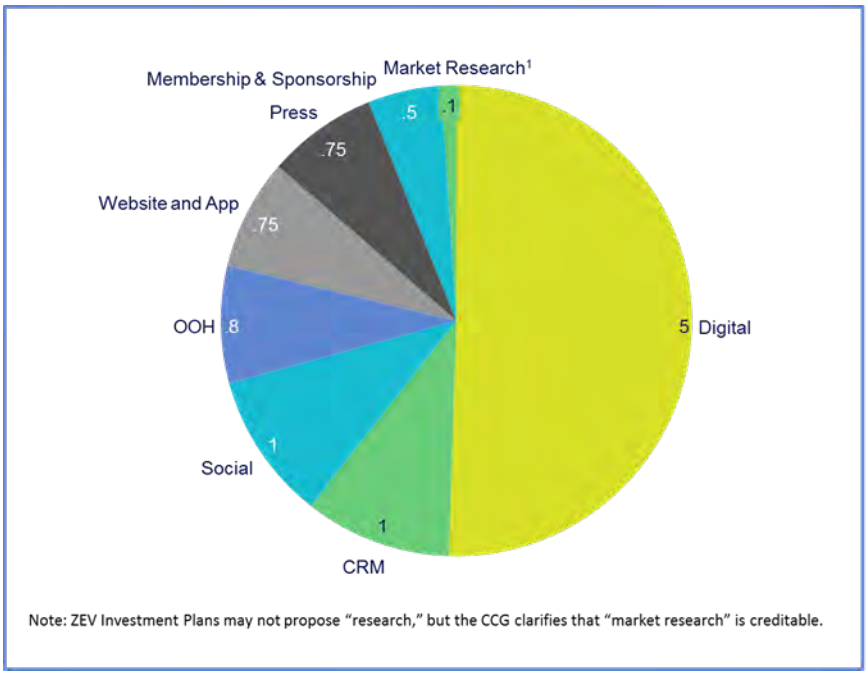
- **Partner Marketing:** Exploring the opportunity to work with OEMs and site hosts to promote Electrify America's ever-expanding network of locations.
- **Social Media:** Monitoring feedback and engaging consumers through social media (e.g., Twitter, Plugshare). Electrify America has found social media to be a valuable tool for listening to the EV community, identifying needs and pain points, and ultimately improving the consumer experience for our drivers.
- **Customer Relations Management (CRM):** As charger utilization increases, it is important to keep customers and prospects informed of the new charger installations. Electrify America will establish

a cadence of electronic communications to keep our customers and prospects informed. Additionally, leveraging online video, Electrify America may create a video series that showcases how to use our DCFC and the customer benefits of charging at our stations.

- **Memberships and Sponsorships:** Support trade groups and conferences promoting the adoption of EV technology. Such membership dues and sponsorship fees would be associated with the Electrify America brand.[26]
- **Events**: Support key industry events by providing promotional charging sessions and branded materials to encourage charging adoption and membership enrollments.
- **Highway Signs**: Brand state and national highway exit signage for Electrify America charging sites.
- **Public Relations**: Conduct media campaigns that are designed to feature Electrify America metro and highway charging stations. For example, press activities can focus on living with a ZEV on a daily basis without access to a dedicated L2 charger using metro DCFC infrastructure and/or conducting a cross country media program that uses the company's highway DCFC locations to highlight that "road trips" to popular destinations in a "one car" ZEV family can be easily managed.

In total, the $10 million budget breaks down as shown below in Figure 41.

Figure 41: National Station Utilization Budget ($ million)



[26] For further details on creditability of memberships and sponsorships, please see Appendix 2.

5. Community Impacts

Electrify America is committed to making a difference through our investments across the United States. The impacts take many forms.

Economic Impacts

The $2 billion ZEV Investment Commitment is already having a big impact on businesses. To date, Electrify America has contracted with more than 100 firms for a total contract value of $380 million. In addition, based on figures from the Council of Economic Advisors and U.S. Department of Transportation related to highway and transit investments, the $300 million being invested Nationally in Cycle 2 is estimated to support up to 2,500 jobs over the 2.5 years of the Cycle.[27]

Recruiting and Hiring Underrepresented Groups

Electrify America believes diversity in backgrounds and experiences within our team is an important part of our cultural fabric and a key to driving ZEV adoption for all Americans. Electrify America has implemented a set of recruiting practices that promote career openings to many traditionally underrepresented groups. Volkswagen Group of America, which provides human resource services to Electrify America, participates in INROADS, an organization that prepares young people from disadvantaged backgrounds for careers in corporate America. We also partner with Out and Equal and exhibit at their conference focused on workplace fairness for the LGBT community. We recently launched a Veterans Employee Resource Group and plan to use this group for outreach and recruiting of veterans. Finally, we plan to partner with WorkplaceDiversity.com to promote Electrify America careers across a range of diversity-focused recruiting sites including HispanicDiversity.com, DisabilityConnect.com, VeteransConnect.com, and AllDiversity.com.

Supporting a Rich Supplier Base

Electrify America is committed to ensuring that investment under its ZEV Investment Commitment reflects the rich and diverse characteristics of the United States and its people. To meet this commitment, Electrify America staff conducts outreach efforts and activities: to ensure potential new suppliers and contractors are aware of Request for Proposal (RFP) opportunities resulting from the ZEV Investment Commitment; to encourage greater participation by underrepresented groups, including certified veteran-, women-, and minority-owned businesses; and to assist applicants in understanding how to participate in the RPF process.

Advancing ZEV Awareness at Public Events

Electrify America executives and staff are frequently asked to speak or participate in dozens of meetings, conferences, and other events regarding electric vehicles, charging technology, and ZEV mobility. Electrify America does not accept most invitations received, in order to focus resources on ZEV infrastructure and investment executions. However, Electrify America attempts to participate in events

[27] The Council of Economic Advisors estimates that every $1 billion in federal highway and transit investment would support 13,000 jobs. This total count includes direct, indirect, and induced jobs. The estimate here is for the number of jobs created by infrastructure investments, and it does not include jobs created through education, awareness, and outreach or Electrify America overhead. The estimate assumes that ZEV investments create a similar number of job-hours per dollar spent as highway and transit investments.

which are specifically focused on ZEV technology, are likely to grow ZEV awareness, or are consistent with Electrify America's obligations and the spirit of the National Outreach Process. These forums have allowed Electrify America to increase general awareness of ZEV technology, to introduce audiences to the ZEV Investment Plans, and to collaborate with the growing movement focused on increasing ZEV adoption.

6. Closing

Electrify America once again thanks the hundreds of stakeholders and EPA staff for providing input, guidance, suggestions, and insights in support of the development of this plan. Building out the largest high-powered, non-propriety ZEV refueling network in the United States is a monumental task. It would not be possible without the support of the ZEV community – from consumers to utilities, suppliers, and government entities. Electrify America looks forward to continued collaboration in pursuit of ZEV adoption across the United States through the ZEV Investment Commitment and beyond. While this investment is ambitious in its size and impact, it is also a pivotal and transformational opportunity to increase the mass-market adoption of ZEVs in America.

We are excited and motivated to continue our ZEV investment commitment into Cycle 2, while complimenting similar investments from the private and public sectors. And we look forward to continuing collaboration with other passionate stakeholders in the ZEV eco-system that are helping achieve this collective vision for ZEV transformation.

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Appendix

1. Certification of Activities

Electrify America certifies that none of the activities described in the ZEV investment plan described above was/is:

- approved by the Board of Management prior to September 18, 2015
- required by a contract entered prior to the date of lodging of the Partial Consent Decree
- a part of a joint effort with other automobile manufacturers to create ZEV infrastructure
- required to be performed by any federal, state, or local law, or anticipate will be required to perform during the planned 30-month period

2. Memberships and Sponsorships

The Settlement documents do not specifically address memberships or sponsorships. There may be occasions where it would be reasonable for Electrify America to further education and awareness of ZEVs or to market Electrify America infrastructure by joining an industry or non-profit organization or by supporting the programs, activities, or events of an industry or non-profit organization. Under some circumstances, it is reasonable for Electrify America to join entities or sponsor their activities as brand-neutral education and awareness activities from the $24.5 million education and awareness budget. Under other circumstances, joining the organization or sponsoring its activities may be considered branded marketing and fall within the $10 million budget for branded marketing. Annual reports to EPA with creditable cost schedules for the given year will include the total cost of memberships and sponsorships.

Brand-neutral education, awareness, and outreach memberships and sponsorships:

Electrify America will follow the criteria in the Creditable Cost Guidance to assess whether a membership or sponsorship may be creditable as a brand-neutral education, awareness, and outreach activity as defined in Section 1.10.2 of Appendix C.

Branded marketing memberships and sponsorships:

Electrify America plans to market charging services and drive station utilization through branded membership and sponsorship, where cost effective. All spending associated with branded marketing memberships and sponsorships will support marketing activities that are directly public facing. In Cycle 2, until Electrify America reaches agreement, in writing, with EPA on the terms and conditions under which intermediary-facing efforts would be creditable, Electrify America will not market its product via memberships and sponsorships that communicate to intermediary audiences (e.g. thought-leaders and industry partners) who, if informed and aware of Electrify America charging services, are likely to be effective at driving station utilization.

Electrify America will follow the criteria in the Creditable Cost Guidance to assess whether a membership or sponsorship may be creditable as branded marketing.

3. Request for Exception to Education and Awareness Requirement

According to Section 2.5.6 of Appendix C, "Unless otherwise agreed to in writing by EPA, Settling Defendants shall spend no less than $25 million and no more than $50 million on such activities during each 30-month investment cycle…." For this Cycle 2 National ZEV Investment Plan, Electrify America formally requests an exception to this clause that would allow $24.5 million to be spent on Education and Awareness activities and $0.5 million to be spent on Learn and Drive events.

Under Section 2.5.5 of Appendix C, 'Ride and Drive' events are classified as Access investments. However, these events are highly educational in nature and are shown to have a high impact on ZEV awareness. As a result, Electrify America requests this amendment to allow for the funding of National Learn and Drive events.

4. ZEV Glossary

AC Charging

The majority of ZEV charging is done with alternating current (AC) Level 1 (120 volts or normal household current) or Level 2 (208-240 volts or an electric dryer power equivalent). AC charging is typically more cost effective for the equipment and installation and takes advantage of longer dwell times to provide lower power to a ZEV over a longer period of time. AC charging is an excellent solution for residential, workplace, multiunit dwelling, and other longer-term parking situations like hotels and municipal or airport parking garages.

DC Fast Charging (DCFC)

Direct current (DC) charging for electric vehicles allows for higher charging speeds, as DC current can be supplied directly to the electric vehicle's battery at power levels normally higher than AC charging. The higher the DC power supplied, the faster the electric vehicle can be charged, provided the vehicle is designed to handle such power. A common DC power level accepted by BEVs on the market today is 50 kW. By 2019, it is expected that 150+ kW DC fast charging will be available on a number of vehicles, and speeds of up to 320 kW (at 350 amps of current at 200V to 920V power source) will be available on a limited basis. To illustrate the charging power difference between Level 2 AC and DC fast charging, a Level 2 7.2 kW AC charger will deliver about 27 miles of ZEV range per hour of charging, whereas a 150 kW or 320 kW DC fast charger can deliver 90 or 200 miles of electric range per 10 minutes respectively.

CHAdeMO

A DC fast charging standard first developed in Japan for the Japanese market and capable in the U.S. of charging several EVs including the Nissan Leaf and Kia Soul.

CCS (Combined Charging System)

CCS is a DC fast charging protocol that is SAE certified and featured on vehicles produced by GM, BMW, Volkswagen Group, Ford, Honda, Hyundai, Proterra and a number of other vehicle manufacturers. The "combined" term designates the CCS capability to incorporate the level 2 (J1772 standard) plug and DC fast charging connector into the same larger plug.

OCPP, OCPI, and OICP

Open Charge Point Protocol (OCPP), Open Charge Point Interface (OCPI), and Open InterCharge Protocol (OICP) are communications standards that have been developed by numerous public and private ZEV infrastructure leaders. OCPP enables standardized communication between charging hardware and the charging station networks that support them, while OCPI enables communication between different charging station networks. OCPP makes it possible to change the network supporting an individual charging station at some future time if desired. OCPI on the other hand is the communications standard that enables commercial entities such as charging networks or automotive OEMs to transfer charging station data between each other such as charger availability or customer information to enable roaming. Finally, OICP is the communication standard for the transfer of data between electric mobility providers and charge point operator systems via a central roaming platform.

Out of Home (OOH) Advertising

In contrast to television advertising, out of home advertising or media refers to advertising that communicates to customers while they are not at home. This type of advertising is intended to reach consumers while they are in public and on the go. Out of home advertising categories can include billboards, street furniture (e.g., bus shelters and benches, or in stores, kiosks, and shopping malls), and transit (buses, metro systems, taxis) to name a few.

"Plug&Charge"

"Plug&Charge" is part of the latest revision of the CCS standard, featuring the IEC/ISO 15118 standard which prescribes the means by which a charger and network can identify and authenticate a specific vehicle to allow for a charging session automatically, by simply "plugging in," without the need for supplemental membership cards or fobs.

Proprietary/Non-Proprietary Charging Connector and Protocol

A non-proprietary connector is not privately-owned or controlled and is thus easily available as a standard and does not require extensive development to be ready for application. Both CHAdeMO and CCS combo are non-proprietary DC fast charging protocols. A proprietary charging connector is a connector and charging network that is exclusively accessible to one brand of vehicle or type of user.

Traditional Media vs. 'New Media'

Historically, advertising to consumers has taken the form of broad messages on television, radio, in print, or messages on physical items such as billboards or street furniture. These platforms are typically referred to as traditional media. Though this method has been generally effective at communicating messages to consumers, these platforms have limited ability to target specific audiences based on their interests and preferences compared to newer media platforms today. In the 21st century and age of the internet, numerous additional platforms for communicating messages have emerged that allow much more direct and effective communication to customers about products and services such as social media advertising and paid search. These are considered 'new media.'

Zero Emission Vehicle (ZEV)

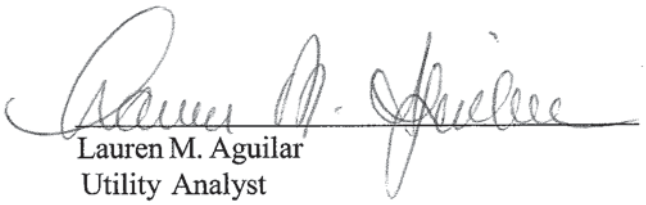
Under Appendix C, the following three vehicle types are considered Zero Emission Vehicles:

1. An on-road passenger car or light duty vehicle, light duty truck, medium duty vehicle, or heavy duty vehicle that produces zero exhaust emissions of all of the following pollutants: non-methane organic gases, carbon monoxide, particulate matter, carbon dioxide, methane, formaldehyde, oxides of nitrogen, or nitrous oxide, including, but not limited to, battery electric vehicles ("BEV") and fuel cell vehicles ("FEV");
2. An on-road plug-in hybrid electric vehicle ("PHEV") with zero emission range greater than 35 miles as measured on the federal Urban Dynamometer Driving Schedule ("UDDS") in the case of passenger cars, light duty vehicles and light duty trucks, and 10 miles as measured on the federal UDDS in the case of medium- and heavy-duty vehicles; or
3. An on-road heavy-duty vehicle with an electric powered takeoff.

ZEVs do not include: zero emission off-road equipment and vehicles; zero emission light rail; additions to transit bus fleets utilizing existing catenary electric power; or any vehicle not capable of being licensed for use on public roads.

AFFIRMATION

I affirm, under the penalties for perjury, that the foregoing representations are true.



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October 30, 2019
Date

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