



Kendrick C. Fentress  
Associate General Counsel

NCRH 20 / P.O. Box 1551  
Raleigh, NC 27602

o: 919.546.6733  
c: 919.546.2694

Kendrick.Fentress@duke-energy.com

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Mar 29 2019

March 29, 2019

**VIA ELECTRONIC FILING**

M. Lynn Jarvis, Chief Clerk  
North Carolina Utilities Commission  
4325 Mail Service Center  
Raleigh, North Carolina 27699-4300

**RE: Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's  
Application for Approval of Proposed Electric Transportation Pilot  
Docket Nos. E-2, Sub 1197 and E-7, Sub 1195**

Dear Ms. Jarvis:

Please find enclosed for filing Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's Application for Approval of Proposed Electric Transportation Pilot in the above-referenced docket.

If you have any questions, please let me know.

Sincerely,

A handwritten signature in black ink that reads 'Kendrick C. Fentress'.

Kendrick C. Fentress

Enclosure

cc: David T. Drooz

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

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

In the Matter of	)	
Application by Duke Energy Carolinas,	)	APPLICATION FOR APPROVAL
LLC and Duke Energy Progress, LLC for	)	OF PROPOSED ELECTRIC
Approval of Proposed Electric	)	TRANSPORTATION PILOT
Transportation Pilot	)	

NOW COME Duke Energy Carolinas, LLC (“DEC”) and Duke Energy Progress, LLC (“DEP”) (collectively, the “Companies”) and, pursuant to N.C. Gen. Stat. § 62-140 and other applicable rules and regulations of the North Carolina Utilities Commission (“Commission”), hereby request approval of the Companies’ proposed electric transportation pilot (the “ET Pilot”) described herein.

**Background**

The adoption of electric vehicles (“EV”) in the United States is growing at a significant pace, and the Companies recognize that they must prepare for and better understand the electrical needs and impacts of this growing population. In 2011, the Commission first approved DEC’s request to conduct a plug-in EV charging station load research study where DEC provided EV charging stations with up to \$1,000 of installation fees to 150 residential customers who bought or leased a plug-in EV in DEC’s service area. *Order Approving Study*, Docket No. E-7, Sub 969, issued March 22, 2011 (“2012 Study Order”). The study commenced in the 2012 time-frame (“2012 Study”).<sup>1</sup> DEC began operating the 2012 Study with the objective of collecting data about its customers’ EV

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<sup>1</sup> DEC owned the charging stations but offered participating customers the ability to purchase the chargers for \$250 after the 2012 Study concluded.

charging behaviors for a two-year period to better understand the impact that charging EVs would have on power demand, transformers, cabling and other infrastructure.<sup>2</sup> By the conclusion of the 2012 Study, DEC had developed a baseline understanding of residential customer light-duty EV charging behavior, average energy consumption of EV charging, and average purchase and installation costs of early market Electric Vehicle Supply Equipment (“EVSE”).

Since the conclusion of the 2012 Study, the EV market has grown and evolved as more EV models have become available. EV adoption has occurred at more than twice the rate of traditional hybrids when they were first released. Moreover, the EV market in North Carolina has increased significantly, with a compound annual growth rate of 39% since 2011. In 2017, 2,055 passenger EVs were registered in North Carolina,<sup>3</sup> and in August 2018, EVs made up 1.1% of North Carolina’s light-duty vehicle market. Additionally, EV technology has advanced significantly since DEC introduced the 2012 Study. EVs contain larger batteries, charge at higher power levels, and have expanded to multiple market segments not previously offered. Forecasts indicate that future adoption of passenger EVs in North Carolina will range from 3%<sup>4</sup> to 8%<sup>5</sup> of light-duty vehicle stock by 2025, depending on several influencing factors including a) vehicle availability, b) infrastructure availability, and c) state and local EV policies:

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<sup>2</sup> 2012 Study Order at 1.

<sup>3</sup> Auto Alliance. Advanced Technology Vehicle Sales Dashboard. <https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard>. Accessed January 7, 2019.

<sup>4</sup> U.S. Energy Information Administration. Annual Energy Outlook 2018. <https://www.eia.gov/outlooks/aeo>.

<sup>5</sup> Fuels Institute. Tomorrow’s Vehicles: An Overview of Vehicle Sales and Fuel Consumption Through 2025. <https://www.fuelsinstitute.org/getattachment/Research/Tomorrows-Vehicles/Tomorrows-Vehicles-An-Overview-of-Vehicle-Sales-and-Fuel-Consumption-Through-2025.pdf>

- Vehicle availability – Simply put, the growth rate in the availability of light-duty passenger EVs since DEC’s 2012 Study has been enormous: as of December 2018, there were over 40 EV models, in a variety of trims, available for purchase in the light-duty passenger vehicle class in the United States, an 800% increase from the mere five EV models that were available in 2011.<sup>6</sup> Coupled with this growth, the light-duty passenger EV market continues to expand with faster charging speeds and longer driving ranges. Additionally, automobile manufacturers are moving into the medium to heavy-duty EV markets to offer electric school and transit buses, as well as electrified cargo and delivery trucks. As of January 2019, about half of all alternatively fueled school and transit bus models available on the market are electric.<sup>7</sup>
- Infrastructure availability – North Carolina’s current pace of EV infrastructure availability cannot support the current and future pace of EV growth, and as EV adoption increases, more investment in EV charging infrastructure is necessary to sustain market growth. Currently there are just 43 public fast charging stations with 86 access plugs in North Carolina.<sup>8</sup>
- State and local policies – Recently, the State of North Carolina has adopted policies related to the advancement of electric vehicles and EVSE in North Carolina because

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<sup>6</sup> U.S. Environmental Protection Agency. <https://www.fueleconomy.gov>. Accessed January 7, 2019.

<sup>7</sup> U.S. Department of Energy, Alternative Fuels Data Center. Alternative Fuel and Advanced Vehicle Search. <https://afdc.energy.gov/vehicles/search>. Accessed January 7, 2019.

<sup>8</sup> U.S. Department of Energy, Alternative Fuels Data Center. Station Locator. <http://www.afdc.energy.gov/stations>. Accessed January 7, 2019. Counts do not include Tesla charging stations, which can only be used by Tesla vehicles.

of their contributions to air quality improvements and climate related carbon reductions.

- In Executive Order 80, North Carolina’s Commitment to Address Climate Change and Transition to a Clean Energy Economy, issued October 29, 2018, Governor Cooper directed that the State of North Carolina will “strive to accomplish” increasing the number of registered, zero-emission vehicles to at least 80,000 by 2025. (Attached hereto as Exhibit A).
- Governor Cooper has designated the North Carolina Department of Environmental Quality (“DEQ”) to manage North Carolina’s share of the Volkswagen Settlement Environmental Mitigation Trust, an agreement between the German automaker and the United States Department of Justice on behalf of the Environmental Protection Agency (“EPA”).<sup>9</sup> DEQ will manage these settlement funds through several programs, including the zero-emission vehicle infrastructure program.
- The DEQ Energy Policy Council recommended that the State adopt measures and implement programs that promote EV adoption and ease the transition to an electrified transportation economy for all

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<sup>9</sup> In 2016, Volkswagen AG agreed to spend up to \$14.7 billion to settle allegations of cheating emissions standards. (“Volkswagen Settlement”) Of that amount, \$2.9 billion was used to establish an Environmental Mitigation Trust that states and territories may use to invest in transportation projects that will reduce NOx emissions. Of that amount, \$92 million was allocated to North Carolina as a beneficiary under the Settlement Trust. In August 2018, DEQ published the State’s Beneficiary Mitigation Plan (“BMP”) under the Settlement Trust for Phase 1 (2018-2020). Eligible mitigation actions under the BMP include replacing diesel school buses and transit buses. In addition, beneficiaries may utilize up to 15% of their total allocation on costs relating to light-duty zero emission vehicle supply equipment.

North Carolinians. The Energy Policy Council further urged consideration by elected officials and regulatory agencies of measures intended to address perceived barriers to EV deployment.<sup>10</sup>

The Companies believe that more investment in EV charging infrastructure will accelerate EV adoption in the State, consistent with the intent of these State policies and the fast-developing EV market.<sup>11</sup> To that end, the Companies have conducted research to demonstrate the potential electric system/customer benefits of increased EV adoption, and the potential for utility-managed charging to enhance those benefits. The Companies designed the proposed ET Pilot to determine best practices for realizing significant potential benefits of increased electric transportation adoption in North Carolina, including the long-term potential for downward rate pressure, retaining fuel cost savings in North Carolina, and reducing vehicle emissions and improving air quality, and have attached a cost-benefit analysis of EV adoption scenarios hereto as Exhibit B.

### **Increasing Deployment of EV Charging Infrastructure**

Around the country, utilities are investing in EV charging infrastructure as new vehicles enter the market and strong sales growth continues nationwide. Since 2013, state utilities commissions have approved over \$1 billion of utility investment in EV programs. Various states around the country have embraced the expansion of electric transportation:

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<sup>10</sup> North Carolina Department of Environmental Quality, Energy Policy Council, Biennial Report, issued May 2018, at p. 77 – 78, available at <https://deq.nc.gov/about/divisions/energy-mineral-land-resources/energy-policy-council> (“Energy Policy Council Report”).

<sup>11</sup> See Energy Policy Council Report at 78 (Explaining that EV adoption will not happen in a vacuum).

- In 2017, the Florida Public Service Commission approved an EV Infrastructure Pilot proposed by Duke Energy Florida, including public Level 2 and DC Fast Charging.
- Since at least 2018, in an ongoing project in New York, ConEdison is supporting the deployment of electric school and transit buses in addition to planned fast charging networks and residential customer charging research.
- In Georgia, Georgia Power has installed 25 public fast charging stations since 2016, facilitating EV adoption across the state of Georgia.
- On January 9, 2019, the Michigan Public Service Commission issued an order approving Consumers Energy Company's request for a three-year pilot program to invest in EV charging infrastructure.<sup>12</sup>
- On January 15, 2019, the Maryland Public Service Commission authorized the electric public utilities operating in that state - BGE, Potomac Electric Power Co., Delmarva Power and Potomac Edison Co. - to move forward with a modified, five-year pilot program of residential, workplace and public charging stations.<sup>13</sup>

The Companies' proposed ET Pilot, if approved, would add North Carolina to the growing chorus of states along the east coast, from Massachusetts to Florida, in deploying EV infrastructure to meet the needs of this growing market. By installing a foundational level

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<sup>12</sup> *In the Matter of the Application of Consumers Energy Company for Authority to Increase Its Rates for the Generation and Distribution of Electricity and for Other Relief, Order, Case No. U-20134, Mich. Pub. Serv. Comm'n., issued Jan. 9, 2019, available at: <https://mi-psc.force.com/s/case/500t0000009fPPSAA2/in-the-matter-of-the-application-of-consumers-energy-company-for-authority-to-increase-its-rates-for-the-generation-and-distribution-of-electricity-and-for-other-relief>.*

<sup>13</sup> *In the Matter of the Petition of the Electric Vehicle Work Group for Implementation of a Statewide Electric Vehicle Portfolio, Order No. 88997, Pub. Serv. Comm'n. of Md., issued Jan. 14, 2019, available at <https://www.psc.state.md.us/wp-content/uploads/Order-No.-88997-Case-No.-9478-EV-Portfolio-Order.pdf>.*

of DC fast charging stations in North Carolina, the ET Pilot would build on a national network to allow EV drivers to travel seamlessly along the crucial interstate corridors.

As electric public utilities, the Companies are well-suited to deploy a foundational level of EV charging infrastructure needed to facilitate rapid EV adoption in North Carolina. As long-term owner-operators of power infrastructure, the Companies are able to ensure assets are used and useful for public benefit throughout the full useful life of the asset, protecting against the risk of stranded assets.<sup>14</sup> The Companies can also ensure that charging infrastructure is integrated safely, reliably and cost-effectively. The Companies are also well-suited to locate chargers in a manner where they are available to all customers rather than only to those of demographics or locations that are early adopters of new technology.

#### **ET Pilot Objective**

The objective of the ET Pilot is to assess different charging load profiles from residential EV, fleet EV, school bus EV, transit bus EV, and DC Fast Charging (“DCFC”) in North Carolina, consistent with the intent of the State policies discussed above. The ET Pilot seeks to establish the extent to which utility-managed charging can shape charging behavior and the value of doing so for these EV segments. Further, the ET Pilot will allow the Companies to investigate the capabilities of electric school buses to provide bi-directional power and resilience benefits as potential mobile backup power sources. A portion of the ET Pilot is designed to complement the goals of the Volkswagen Settlement

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<sup>14</sup> In comparison, the Commission has approved Piedmont Natural Gas Company’s operation of Piedmont-owned compressor stations for selling natural gas to customers seeking to obtain natural gas to fuel their vehicles. See *Order Approving Natural Gas Vehicle Tariffs*, Docket No. G-9, Sub 631, issued Feb. 7, 2017 (approving Rate Schedule 142, Natural Gas Vehicle Fuel, Rate Schedule 143, Experimental Motor Vehicle Fuel Service, Rate Schedule 143, Experimental Motor Vehicle Fuel Service, effective May 1, 2014, Docket No. G-9, Sub 631).



to provide cost sharing to Environmental Mitigation Trust funding and reduce the upfront capital premium of electric transit and school bus deployments.

More specifically, the main goals of the Pilot are to:

- Better understand EV charging behavior and the effects of charging multiple types of EVs on the Companies' bulk electric system;
- Install a foundational level of fast charging infrastructure across the Companies' service territories in North Carolina;
- Support the development of a competitive market for EV charging services and ensure customer choice in EV charging technology;
- Determine procedures to cost-effectively integrate vehicle charging by actively managing charging loads;
- Support public transit electrification and associated cost savings for public agencies in North Carolina;
- Ensure that electrification projects benefit all customers, including those who do not own EVs and low/moderate income customers; and
- Coordinate with DEQ on the Volkswagen Settlement Environmental Mitigation Trust funding, and to the extent practicable, leverage available funding streams for electrification projects.

The Companies propose to report operational data and results from the ET Pilot to the Commission on an annual basis, and to prepare a final report with final findings and conclusions. Concurrent with the final report, the Companies will conduct a stakeholder working group to share results and solicit input for future program design. If the Companies determine that the ET Pilot is ready for wider subscription, they will file a

program for the Commission's approval that would incorporate lessons learned and feedback from the stakeholder working group.

### **ET Pilot Design**

The three customer segments of the ET Pilot are: 1) EV Charging Management; 2) Transit Electrification; and 3) Public Charging Expansion. Within these segments are the following programs set forth for the Commission's approval: 1) the Residential EV Charging Program; 2) the Fleet EV Charging Program; 3) the EV School Bus Charging Program; 4) the EV Transit Bus Charging Program; 5) the Multi-Family Dwelling Charging Station Program; 6) the Public Level 2 Charging Station Program; and 7) the Direct Current Fast Charging Station Program as a three-year pilot.

#### **I. EV Charging Management**

##### **A. Residential EV Charging Program**

The Companies designed the Residential EV Charging Program: (i) to evaluate whether it can encourage EV adoption by providing a rebate to support the installation of EVSE and (ii) to establish procedures to determine the value and viability of utility-managed charging in practice. Based on the cost-benefit analysis attached hereto as Exhibit B, managing EV charging loads may increase net customer benefits of EV charging. The study analyzed historical electric system data from North Carolina along with national average EV charging behavior and found that managed charging may increase the lifetime net revenue benefit by \$400 per EV.

The program will provide a rebate of \$1,000 for up to 500 DEC and 300 DEP residential customers, respectively, in exchange for participation in the program, which will include the transmission of charging load data as well as utility management of home

charging during defined hours. To guarantee customer choice, the Companies will offer multiple options for eligible EVSE hardware along with an option to participate in the program with the telematics capability of selected vehicles rather than a charging station. The proposed tariffs for DEP's and DEC's Residential EV Charging Programs are provided as Exhibit C.

#### **B. Fleet EV Charging Program**

The Fleet EV Charging Program is designed to support the installation of EVSE for public and private entity fleets to encourage use of newer, cleaner EV fleets, and to collect utilization characteristics of EV fleet charging-behavior for a variety of EV types and weight-classes to better understand potential grid and utility impacts of this EV market segment. The Companies believe there is potential for significant operational (fuel and maintenance) cost savings to operators of EV fleet vehicles, as well as emissions reductions and electric system benefits from the adoption of EV fleets. The Companies will offer, on a limited basis, a \$2,500 incentive to commercial and industrial customers that operate fleet vehicles. Participating customers must install all EVSE behind a separate meter taking service on an available commercial Time of Use ("TOU") rate. DEC will offer no more than 500 total EVSE rebates, and DEP will offer no more than 400 total EVSE rebates. The Companies will consider applications for participation in their respective programs on a first-come, first-served basis within limits for participation by a single customer location or parent entity. The proposed tariffs for DEC's and DEP's Fleet EV Charging Program are attached herein as Exhibit D.

## **II. Transit Electrification**

### **A. EV School Bus Charging Station Program**

The Companies designed the EV School Bus Charging Station Program to facilitate the replacement of older diesel school buses with modern, clean, zero-emission school buses in public school transportation systems, install supporting EVSE to facilitate market adoption, and collect utilization and other load characteristics to understand grid and utility impacts and explore the potential for bi-directional power flow from EV school bus (“EVSB”) batteries. The Companies will install and own the EVSE and believe there is potential for significant operational (fuel and maintenance) cost savings to operators of EVSB, diesel emissions reductions benefits and electric system benefits from the adoption of EVSB in North Carolina.

Under this program, DEC seeks to aid in the deployment of approximately 55 electric school buses, and DEP seeks to aid in the deployment of approximately 30 electric school buses by funding up to \$215,000 per bus, on a first-come, first-served basis, to school districts willing to purchase an electric school bus with bi-directional power flow capabilities. The Companies designed the program incentive level to offset the portion of the cost of the bus corresponding to incremental costs associated with the battery. In exchange for this funding, the customer must allow access to all vehicle charging data, and perform testing of charging load management and bi-directional charging capabilities. By testing the bi-directional capabilities of an EVSB, the school bus battery will operate as a grid asset, and the Companies will retain the right to repurpose the EVSB battery after its useful vehicle life as a second-life storage asset. The use of the batteries as grid assets justifies the Companies’ investment level in this Program. The Companies’ load

management or bi-directional power flow testing will not impede in any way the normal duty cycle of the school bus.

Further, the Companies designed the program to complement the anticipated funding available for replacement of legacy diesel school buses per the Volkswagen Settlement Trust. As related to North Carolina's share of the Settlement Trust, DEQ intends to allocate a portion of the Settlement Trust funds to replace older diesel school buses with new diesel, propane or electric school buses. The Companies believe that the availability of funds from the Settlement Trust, combined with their proposed infrastructure investment, would encourage DEQ to replace a limited number of legacy high-emitting school buses with zero-emission, electric school buses. In fact, by adding this utility cost-share to the same level of funding used to purchase a diesel bus (\$81,569), the program would allow DEQ to replace the same number of buses but reduce net annual NOx emissions by an additional 10,400 grams per bus compared to new diesel at no additional cost to the State. Electric school buses can also provide strong operational cost savings currently estimated at approximately \$144,000 annually for a deployment of 20 school buses. The Companies have discussed the proposed program with the North Carolina Department of Public Instruction ("DPI") and several interested county school districts. The proposed tariffs for DEC's and DEP's EV School Bus Battery and Charging Programs are attached herein as Exhibit E.

#### **B. EV Transit Bus Charging Station Program**

The program aims to deploy charging stations for EV transit buses ("EVTB") to support EVTB adoption and collect utilization and other load characteristics to understand potential grid and utility impacts. The Companies believe there are significant potential

operational cost savings and emissions reductions benefits of electric buses, which extend the benefits of transportation electrification to customers who do not drive EVs. Customers such as Greensboro Transit Authority, City of Asheville, and the Raleigh Durham Airport Authority have already deployed or are already planning investments in electric transit buses. The program is designed to complement the Federal Transit Administration funding available for replacement of legacy transit buses, and is available to first-come, first-served non-residential customers that operate transit buses, including transit agencies, universities, airports, and other non-profit/municipal entities. The Companies will install and own qualifying EVSE selected by the transit agency. The Companies propose 60 stations eligible for funding in the DEC service territory and 45 stations eligible for funding in the DEP service territory. DEC's and DEP's proposed tariffs for the EV Transit Bus Charging Program are attached herein as Exhibit F.

### **III. Public Charging Expansion**

#### **A. Multi-Family Dwelling Charging Station Program**

Limited ability to install charging infrastructure at a residence is commonly cited as a barrier for Multi-Family Dwelling (“MFD”) tenants to purchase an EV. Accordingly, the Companies designed the ET Pilot to provide easy access to residential charging for non-homeowners throughout the Companies’ service territories. The Companies will install, own, and operate Level 2 (“L2”) EVSE, and collect a charging fee based on the marginal energy component of the applicable Company’s currently approved Small General Service schedule, plus \$0.02/kWh to cover network platform and transaction fees. The Companies propose to deploy 100 and 60 stations, respectively, in DEC’s and DEP’s territories.

Additionally, in support of the development of a competitive market for EV charging and to maximize site host choice, the Companies will offer multiple brands of EVSE hardware from which the site host can select. DEC and DEP's proposed tariffs for the MFD Program are attached herein as Exhibit G.

### **B. Public L2 Charging Station Program**

Access to reliable public charging is essential to building EV driver confidence. The Companies designed the ET Pilot to provide a base level of destination charging for drivers in the Companies' North Carolina service territories and to ensure that the Companies' Pilot Programs are publicly available to a broad cross-section of customers. The program aims to deploy charging stations at eligible key public destination locations to encourage EV adoption, as well as collect utilization and other load characteristics to understand potential grid and utility impacts. The Companies will install, own, and operate L2 EVSE, and collect a charging fee based on the marginal energy component of the applicable Company's currently approved Small General Service schedule, plus \$0.02/kWh to cover network platform and transaction fees. The Companies propose to deploy 100 stations and 60 stations, respectively, in DEC's and DEP's territories. DEC and DEP's proposed tariffs for the Public Level 2 Charging Station Program are attached herein as Exhibit H.

### **C. Fast Charging Program**

Insufficient charging infrastructure is commonly cited as a barrier to purchasing an EV. Using the EVI-Pro Lite tool developed by the U.S. Department of Energy,<sup>15</sup> the Companies estimate nearly 300 public DCFC plugs will be necessary by 2025 to support

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<sup>15</sup> U.S. Department of Energy. EVI-Pro Lite. <https://afdc.energy.gov/evi-pro-lite>. Accessed January 7, 2019.

the Executive Order 80 goal of 80,000 registered EVs. As of January 2019, there are only 86 open-standard, publicly available DCFC charging plugs in North Carolina.<sup>16</sup>

Currently, a limited number of publicly available fast chargers are available in North Carolina due to the unfavorable revenue potential of the current EV population. The high upfront cost of fast charging installations — particularly at highway corridor locations where they are most needed — results in challenging economics and few commercial installations. As a long-term owner-operator of power infrastructure, a utility is able to ensure assets are used and useful for public benefit throughout the full useful life of the asset and is well-suited to deploy a foundational level of fast charging infrastructure to facilitate long-distance travel throughout the service territory. Without owning the charger, a utility cannot ensure that customer-funded chargers remain well-maintained and useful for the long term.

Further, the Companies believe that a utility can also ensure that fast chargers are located such that they are available to all customers rather than only to those of demographics or locations that are early adopters of new technology. Therefore, DEC intends to install, own, and operate a network of up to 70 fast chargers across approximately 35 individual locations in its service territory, and DEP intends to install, own, and operate a network of up to 50 fast chargers across approximately 25 individual locations in its service territory. Stations will include charging equipment with electrical demand requirements of 100 kW or greater.

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<sup>16</sup> U.S. Department of Energy, Alternative Fuels Data Center. Station Locator. <https://afdc.energy.gov/stations>. Accessed January 7, 2019. Counts do not include Tesla charging stations, which can only be used by Tesla vehicles



The fast charging locations may be located on company-owned or third-party owned property, including, but not limited to, truck stops, gas stations, restaurants, and other retail establishments. Stations will be installed along highway corridor locations throughout the Companies' service territories and made available to DEC and DEP customers and non-customers alike to enable intra- and inter-state EV travel and build driver confidence in EVs.

Currently, the market for public fast charging in North Carolina is limited, with only three commercial operators charging drivers a fee for the service. The Companies want to facilitate the continued growth of fast charging accessibility and realize a customer fee to use the stations must be at a comparable price to other public EV charging options in North Carolina. To charge less would undercut other operators; to charge more would reduce the incentive for drivers to use the Companies' stations. To appropriately address this nuance, the Companies will offer fast charging services in exchange for a Fast Charge Fee consistent with the statewide average for fast charging offered by those stations that charge a fee to the driver and are publicly accessible 24-hours per day. Net revenue from charging would offset total program costs, ensuring that EV drivers pay a greater proportion of program costs than average customers. The Companies would calculate, update, and publish the Fast Charge Fee on a quarterly basis to provide a clear and stable price signal to consumers while also encouraging further market growth from other operators. Nevertheless, the Companies do not expect the Fast Charge Fee to recover the full cost of the charging infrastructure within the term of the ET Pilot. The proposed tariffs for DEC's and DEP's Fast Charging Programs are attached herein as Exhibit I.

### Customer Communications and Information

The Companies will conduct market education and outreach for each program that is like the outreach efforts for existing energy efficiency and demand response programs, including electronic communications, direct mail, social media, public event, and mass market advertising. The Companies will also leverage relationships with agencies and organizations such as North Carolina's Clean Cities coalitions (Centralina Clean Fuels Coalition, Land of Sky Clean Vehicles Coalition, Triangle Clean Cities Coalition), Plug-in NC, and environmental non-governmental organizations that have supported Duke Energy's electric transportation efforts in other jurisdictions.

### Program Costs

The Companies' estimated cost of the North Carolina ET Pilot is approximately \$76 million over the proposed three years. The cost breakdown per program is as follows:

	<b>DEC</b>	<b>DEP</b>
Residential Rebate	\$ 1,175,000	\$ 705,000
C&I Fleet Rebate	\$ 1,925,000	\$ 1,540,000
EV School Bus	\$ 11,981,750	\$ 6,535,500
EV Transit Bus	\$ 4,671,000	\$ 3,503,250
Multi-Family L2	\$ 1,285,000	\$ 771,000
Public L2	\$ 1,285,000	\$ 771,000
DC Fast Charge Network	\$ 20,107,500	\$ 14,362,500
Education and Outreach	\$ 2,025,000	\$ 1,350,000
Ongoing O&M (Project Mgmt., Networking, Charger O&M)	\$ 1,125,000	\$ 900,000
<b>Sub-Total</b>	<b>\$ 45,580,250</b>	<b>\$ 30,438,250</b>
<b>Total</b>		<b>\$ 76,018,500</b>

The Companies intend to recover the costs of their ET Pilot through their respective base rates.

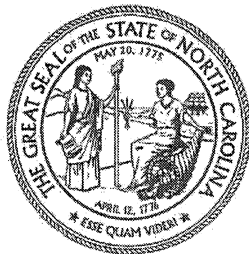
### Request for Approval

The Companies respectfully request approval of the ET Pilot 60 days from the date of filing and an effective date for the ET Pilot 90 days after Commission approval. The Companies also request expedited approval of the ET Pilot to ensure that they can timely advocate to the North Carolina DEQ to commit to funding the replacement of some of the diesel school buses in the State with electric school buses from North Carolina's Volkswagen Settlement Environmental Mitigation Trust. Timely approval of the ET Pilot is critical to putting the Companies' proposed plan in place prior to the opening of the DEQ request for proposal period, currently scheduled for early 2019. The Companies also request that the ET Pilot have an approved duration of three years; if the ET Pilot is successful, the Companies may seek to grow the ET Pilot or seek early termination of the ET Pilot in favor of a full-scale offering to be filed with the Commission for approval.

WHEREFORE, the Companies respectfully request that the Commission issue an Order Approving the ET Pilot including: 1) the Residential EV Charging Program; 2) the Fleet EV Charging Program; 3) the EV School Bus Charging Program; 4) the EV Transit Bus Charging Program; 5) the Multi-Family Dwelling Charging Station Program; 6) the Public L2 Charging Station Program; and 7) the Direct Current Fast Charging Station Program as a three-year pilot, 60 days from the date of this filing to become effective 90 days from the date of Commission approval.



Kendrick C. Fentress  
Associate General Counsel  
Duke Energy Corporation  
P.O. Box 1551/NCRH 20  
Raleigh, North Carolina 27602  
Tel. 919.546.6733  
[Kendrick.Fentress@duke-energy.com](mailto:Kendrick.Fentress@duke-energy.com)



# State of North Carolina

**ROY COOPER**  
GOVERNOR

October 29, 2018

EXECUTIVE ORDER NO. 80

## NORTH CAROLINA'S COMMITMENT TO ADDRESS CLIMATE CHANGE AND TRANSITION TO A CLEAN ENERGY ECONOMY

**WHEREAS**, North Carolina residents deserve to be better educated, healthier, and more financially secure so that they may live purposeful and abundant lives; and

**WHEREAS**, N.C. Const. art. XIV, § 5 requires the conservation, protection, and preservation of state lands and waters in public trust; and

**WHEREAS**, North Carolina is well positioned to take advantage of its technology and research and development sectors, along with its skilled workforce, to promote clean energy technology solutions and a modernized electric grid; and

**WHEREAS**, public-private partnerships in North Carolina foster market innovations and develop clean energy technology solutions that grow the state's economy; and

**WHEREAS**, the effects of more frequent and intense hurricanes, flooding, extreme temperatures, droughts, saltwater intrusion, and beach erosion have already impacted and will continue to impact North Carolina's economy; and

**WHEREAS**, climate-related environmental disruptions pose significant health risks to North Carolinians, including waterborne disease outbreaks, compromised drinking water, increases in disease-spreading organisms, and exposure to air pollution, among other issues; and

**WHEREAS**, to maintain economic growth and development and to provide responsible environmental stewardship, we must build resilient communities and develop strategies to mitigate and prepare for climate-related impacts in North Carolina.

**NOW, THEREFORE**, by the authority vested in me as Governor by the Constitution and the laws of the State of North Carolina, **IT IS ORDERED**:

1. The State of North Carolina will support the 2015 Paris Agreement goals and honor the state's commitments to the United States Climate Alliance.

The State of North Carolina will strive to accomplish the following by 2025:

- a. Reduce statewide greenhouse gas emissions to 40% below 2005 levels;
- b. Increase the number of registered, zero-emission vehicles ("ZEVs"; individually, "ZEV") to at least 80,000;
- c. Reduce energy consumption per square foot in state-owned buildings by at least 40% from fiscal year 2002-2003 levels.

2. Cabinet agencies shall evaluate the impacts of climate change on their programs and operations and integrate climate change mitigation and adaptation practices into their programs and operations. Council of State members, higher education institutions, local governments, private businesses, and other North Carolina entities are encouraged to address climate change and provide input on climate change mitigation and adaptation measures developed through the implementation of this Executive Order. Consistent with applicable law, cabinet agencies shall actively support such actions.
3. The Secretary or designee of each cabinet agency and a representative from the Governor's Office shall serve on the North Carolina Climate Change Interagency Council ("Council"), which is hereby established. The Secretary of the North Carolina Department of Environmental Quality, or the Secretary's designee, shall serve as the Council Chair. The North Carolina Department of Environmental Quality shall lead the Council by providing strategic direction, scheduling and planning Council meetings, determining the prioritization of activities, facilitating stakeholder engagement, and assisting in the implementation of pathways to achieve the goals provided in Section 1 of this Executive Order.

The duties of the Council shall include the following:

- a. Recommend new and updated goals and actions to meaningfully address climate change;
  - b. Develop, implement, and evaluate programs and activities that support statewide climate mitigation and adaptation practices;
  - c. Establish workgroups, as appropriate, to assist the Council in its duties;
  - d. Consider stakeholder input when developing recommendations, programs, and other actions and activities;
  - e. Schedule, monitor, and provide input on the preparation and development of the plans and assessments required by this Executive Order;
  - f. Review and submit to the Governor the plans and assessments required by this Executive Order.
4. The North Carolina Department of Environmental Quality ("DEQ") shall develop a North Carolina Clean Energy Plan ("Clean Energy Plan") that fosters and encourages the utilization of clean energy resources, including energy efficiency, solar, wind, energy storage, and other innovative technologies in the public and private sectors, and the integration of those resources to facilitate the development of a modern and resilient electric grid. DEQ shall collaborate with businesses, industries, power providers, technology developers, North Carolina residents, local governments, and other interested stakeholders to increase the utilization of clean energy technologies, energy efficiency measures, and clean transportation solutions. DEQ shall complete the Clean Energy Plan for the Council to submit to the Governor by October 1, 2019.
  5. The North Carolina Department of Transportation ("DOT"), in coordination with DEQ, shall develop a North Carolina ZEV Plan ("ZEV Plan") designed to increase the number of registered ZEVs in the state to at least 80,000 by 2025. The ZEV Plan shall help establish interstate and intrastate ZEV corridors, coordinate and increase the installation of ZEV infrastructure, and incorporate, where appropriate, additional best practices for increasing ZEV adoption. DOT shall complete the ZEV Plan for the Council to submit to the Governor by October 1, 2019.
  6. The North Carolina Department of Commerce ("DOC") and other cabinet agencies shall take actions supporting the expansion of clean energy businesses and service providers, clean technology investment, and companies with a commitment to procuring renewable energy. In addition, DOC shall develop clean energy and clean transportation workforce assessments for the Council to submit to the Governor by October 1, 2019. These assessments shall evaluate the current and projected workforce demands in North Carolina's clean energy and clean transportation sectors, assess the skills and education required for employment in those sectors, and recommend actions to help North Carolinians develop such skills and education.
  7. Cabinet agencies shall prioritize ZEVs in the purchase or lease of new vehicles and shall use ZEVs for agency business travel when feasible. When ZEV use is not feasible, cabinet agencies shall prioritize cost-effective, low-emission alternatives. To support implementation of this directive, the North Carolina Department of Administration ("DOA") shall develop a North

- Carolina Motor Fleet ZEV Plan (“Motor Fleet ZEV Plan”) that identifies the types of trips for which a ZEV is feasible, recommends infrastructure necessary to support ZEV use, develops procurement options and strategies to increase the purchase and utilization of ZEVs, and addresses other key topics. DOA shall complete the Motor Fleet ZEV Plan and provide an accounting of each agency’s ZEVs and miles driven by vehicle type for the Council to submit to the Governor by October 1, 2019, and annually thereafter.
8. Building on the energy, water, and utility use conservation measures taken pursuant to N.C. Gen. Stat. § 143-64.12(a), DEQ shall update and amend, where applicable, a Comprehensive Energy, Water, and Utility Use Conservation Program (“Comprehensive Program”) by February 1, 2019, and biennially beginning December 1, 2019, to further reduce energy consumption per gross square foot in state buildings consistent with Section 1 of this Executive Order. The Comprehensive Program shall include best practices for state government building energy efficiency, training for agency staff, cost estimation methodologies, financing options, and reporting requirements for cabinet agencies. DEQ and cabinet agencies shall encourage and assist, as requested, higher education institutions, K-12 schools, and local governments in reducing energy consumption. To achieve the required energy consumption reductions:
    - a. By January 15, 2019, each cabinet agency shall designate an Agency Energy Manager, who shall serve as the agency point of contact.
    - b. Each cabinet agency shall develop and submit an Agency Utility Management Plan to DEQ by March 1, 2019, and biennially thereafter, and implement strategies to support the energy consumption reduction goal set forth in Section 1 of this Executive Order. DEQ shall assess the adequacy of these plans and their compliance with this Executive Order.
    - c. By September 1, 2019, and annually thereafter, each cabinet agency shall submit to DEQ an Agency Utility Report detailing its utility consumption, utility costs, and progress in reducing energy consumption.
    - d. DEQ shall develop an annual report that describes the Comprehensive Program and summarizes each cabinet agency’s utility consumption, utility costs, and achieved reductions in energy consumption. DEQ shall complete this report for publication on its website and for the Council to submit to the Governor by February 1, 2019, and annually thereafter beginning December 1, 2019.
  9. Cabinet agencies shall integrate climate adaptation and resiliency planning into their policies, programs, and operations (i) to support communities and sectors of the economy that are vulnerable to the effects of climate change and (ii) to enhance the agencies’ ability to protect human life and health, property, natural and built infrastructure, cultural resources, and other public and private assets of value to North Carolinians.
    - a. DEQ, with the support of cabinet agencies and informed by stakeholder engagement, shall prepare a North Carolina Climate Risk Assessment and Resiliency Plan for the Council to submit to the Governor by March 1, 2020.
    - b. The Council shall support communities that are interested in assessing risks and vulnerabilities to natural and built infrastructure and in developing community-level adaptation and resiliency plans.
  10. DEQ shall prepare and manage a publicly accessible Web-based portal detailing the Council’s actions and the steps taken to address climate-related impacts in North Carolina. Cabinet agencies shall submit data, information, and status reports as specified by the Council to be published on the portal. In addition, DEQ shall develop, publish on the portal, and periodically update an inventory of the state’s greenhouse gas emissions that, among other things, tracks emissions trends statewide by sector and identifies opportunities for additional emissions reductions.
  11. By October 15, 2019, and annually thereafter, the Council shall provide to the Governor a status report on the implementation of this Executive Order.
  12. This Executive Order is consistent with and does not otherwise abrogate existing state law.

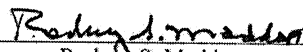
13. This Order is effective October 29, 2018 and shall remain in effect until rescinded or superseded by another applicable Executive Order.

**IN WITNESS WHEREOF**, I have hereunto signed my name and affixed the Great Seal of the State of North Carolina at the Capitol in the City of Raleigh, this the 29<sup>th</sup> day of October, in the year of our Lord two thousand eighteen.



Roy Cooper  
Governor

**ATTEST:**



Rodney S. Maddox  
Chief Deputy Secretary of State



# Electric Vehicle Cost-Benefit Analysis

Plug-in Electric Vehicle Cost-Benefit Analysis: North Carolina



©

MJB & A

June 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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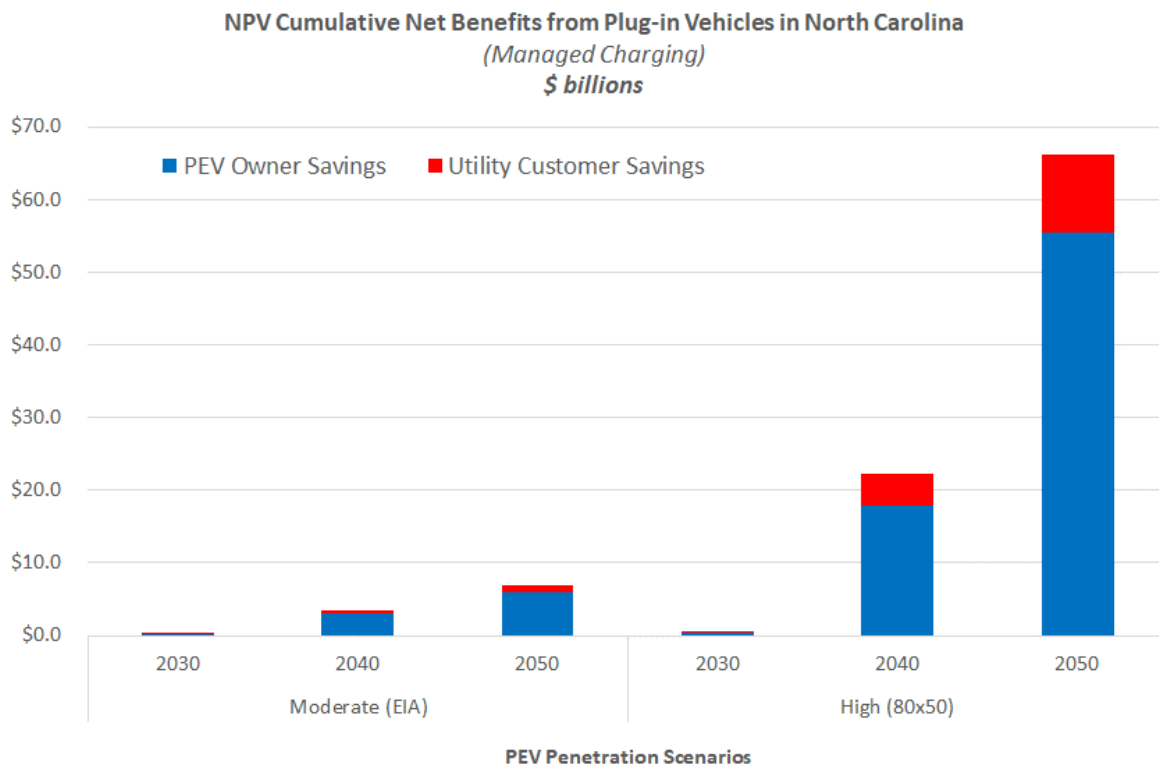
### For questions or comments, please contact:

Dana Lowell  
Senior Vice President  
M.J. Bradley & Associates, LLC  
+1 978 369 5533  
[dlowell@mjbradley.com](mailto:dlowell@mjbradley.com)

## Executive Summary

This study estimated the costs and benefits of increased adoption of plug-in electric vehicles (PEVs) in the state of North Carolina. The study estimated the financial benefits that would accrue to all electric utility customers in North Carolina 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 North Carolina 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 NC 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 North Carolina 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 \$6.9 billion state-wide by 2050.**<sup>1</sup> Of these total net benefits:

<sup>1</sup> Using a 3% discount rate

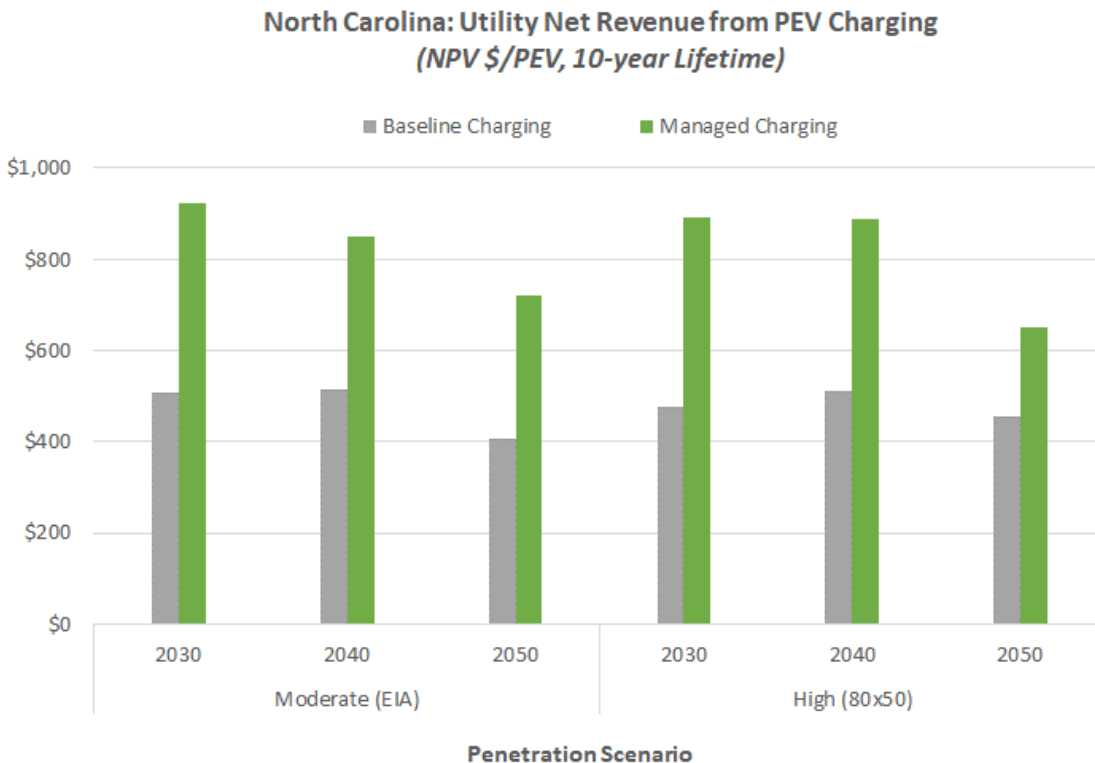
- \$1.0 billion will accrue to electric utility customers in the form of reduced electric bills, and
- \$5.9 billion will accrue directly to North Carolina drivers in the form of reduced annual vehicle operating costs.

Also shown in Figure 1, if PEV sales in North Carolina 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 North Carolina could exceed \$66.1 billion state-wide by 2050**. Of these total net benefits:

- \$10.7 billion would accrue to electric utility customers in the form of reduced electric bills, and
- \$55.4 billion would accrue directly to North Carolina 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 North Carolina in 2030 is projected to increase utility net revenue by about \$920 over its life-time, if charging is managed. PEVs in service in 2050 are projected to increase utility net revenue on average by about \$685 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 \$1,100 per vehicle (nominal \$) in annual operating costs, compared to owning gasoline vehicles. A large portion of this direct financial benefit to North Carolina 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 2.9 billion gallons through 2050 – this cumulative gasoline savings grows to 32.8 billion gallons through 2050 under the high PEV (80x50) scenario. In 2050, annual average gasoline savings will be approximately 213 gallons per PEV under the Moderate PEV (EIA) scenario, while projected savings under the High PEV (80x50) scenario are nearly 263 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 30 million metric tons<sup>2</sup> through 2050 under the moderate PEV scenario, and over 342 million metric tons under the high PEV scenario. The switch from gasoline vehicles to PEVs is also projected to reduce annual NO<sub>x</sub> emissions in the state by over 438 tons in 2050 under the moderate PEV (EIA) scenario, and by over 6,827 tons under the high PEV (80x50) scenario.

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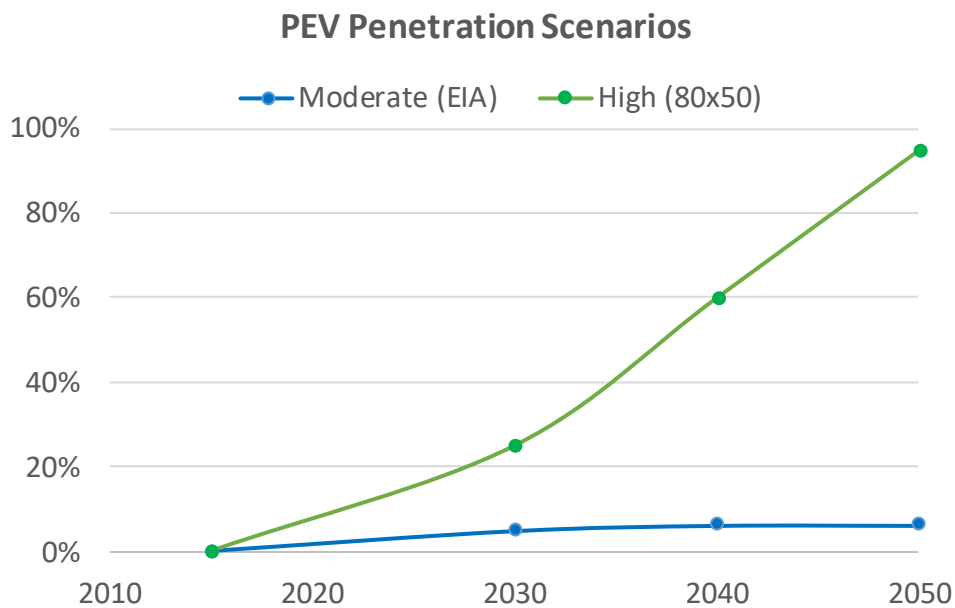
<sup>2</sup> Net of emissions from electricity generation

## 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 North Carolina 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.<sup>3</sup> 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



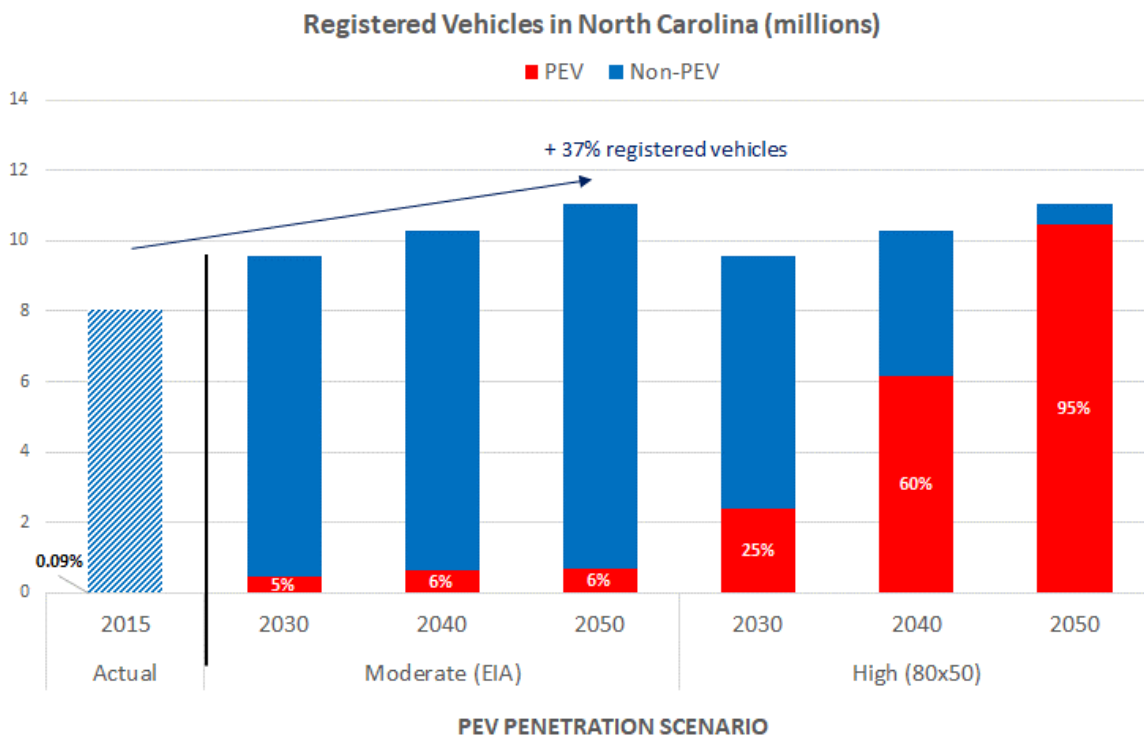
<sup>3</sup> PEVs include battery-electric vehicles (BEV) and plug-in hybrid vehicles (PHEV). This study focused on passenger vehicles and trucks; there are opportunities for electrification of non-road equipment and heavy-duty trucks and buses, but evaluation of these applications was beyond the scope 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 North Carolina light duty fleet<sup>4</sup> 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 North Carolina would increase from approximately 7,000 today to 469,000 in 2030, 638,000 in 2040, and 684,000 in 2050. Under the High PEV (80x50) scenario there would be 2.4 million PEVs in North Carolina by 2030, rising to 6.2 million in 2040, and 10.5 million in 2050. This equates to 25 percent of in-use light duty vehicles in North Carolina in 2030, rising to 60 percent in 2040 and 95 percent in 2050.<sup>5</sup>

Figure 4 Projected North Carolina Light Duty Fleet



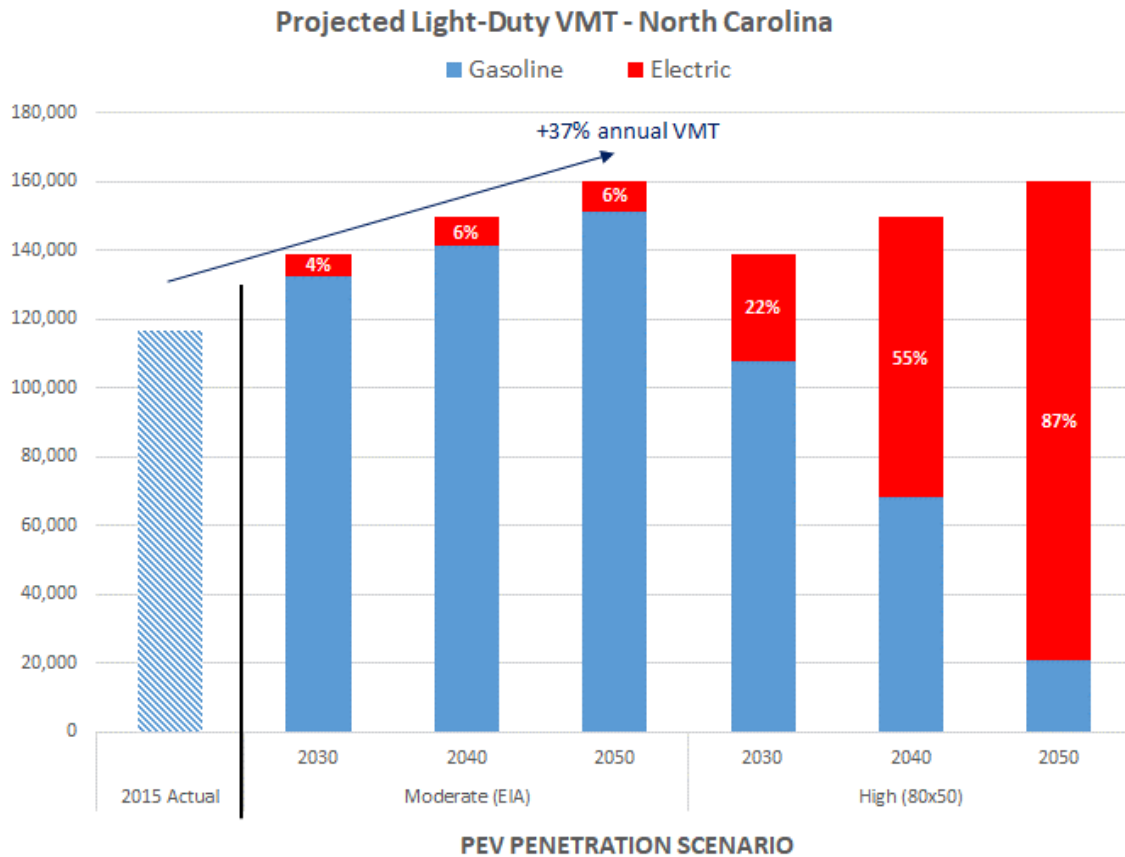
<sup>4</sup> This analysis only includes cars and light trucks. It does not include medium- or heavy-duty trucks and buses.

<sup>5</sup> 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 North Carolina 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 North Carolina Light Duty Fleet Vehicle Miles Traveled (million miles)



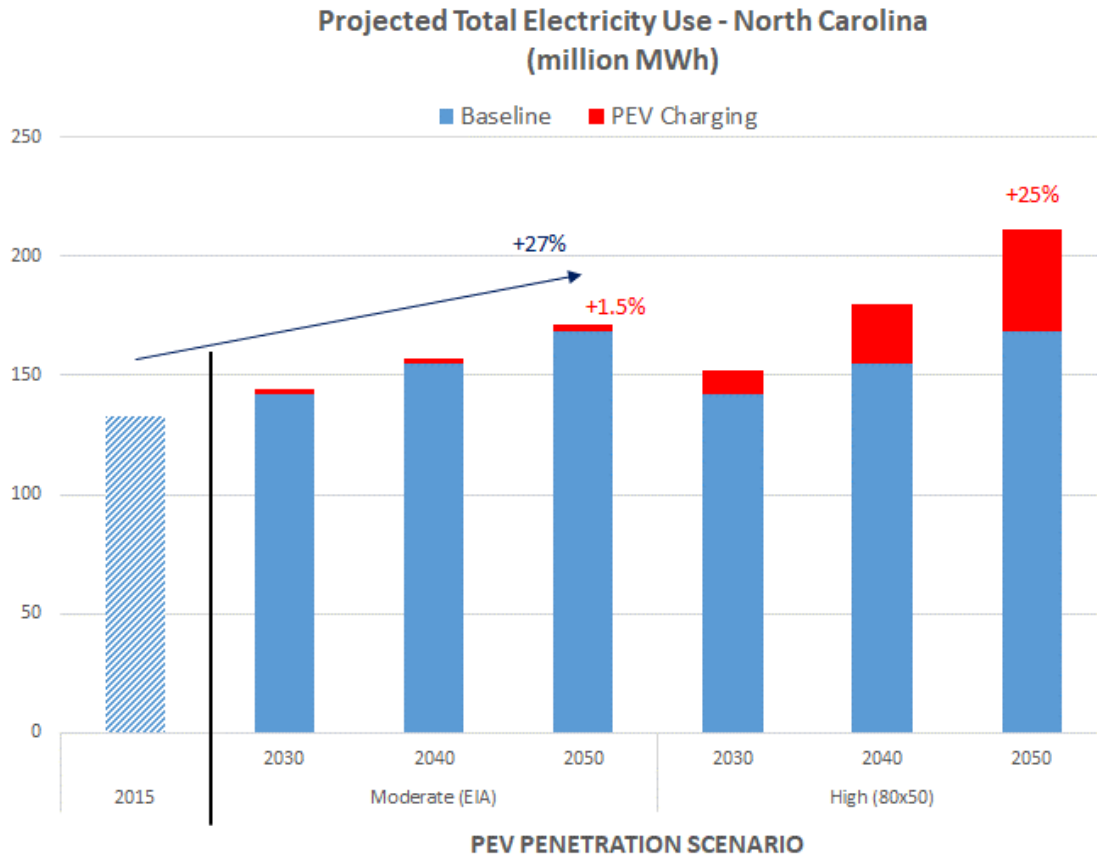
PEV Charging Electricity Use

The estimated total PEV charging electricity used in North Carolina 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 North Carolina is currently 133 million MWh per year. Annual electricity use is projected to increase to 142 million MWh in 2030 and continue to grow after that, reaching 169 million MWh in 2050 (27 percent greater than 2015 levels).

Under the Moderate PEV penetration scenario, electricity used for PEV charging is projected to be 1.95 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 2.5 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 9.6 million MWh in 2030, growing to 42.6 million MWh and adding 25 percent to baseline electricity use in 2050.

Figure 6 Estimated Total Electricity Use in North Carolina



PEV Charging Load

This analysis evaluated the effect of PEV charging on the North Carolina electric grid under two different charging scenarios. Under both scenarios 77 percent of all PEVs are assumed to charge exclusively at home and 23 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 North Carolina 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.<sup>6</sup>

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 North Carolina 95<sup>th</sup> percentile load (MW)<sup>7</sup> by time of day is plotted in orange, and the projected incremental load due to PEV charging is plotted in grey.

<sup>6</sup> 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.

<sup>7</sup> 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 North Carolina PEV Charging Load, Baseline Charging (High PEV [80x50] scenario)

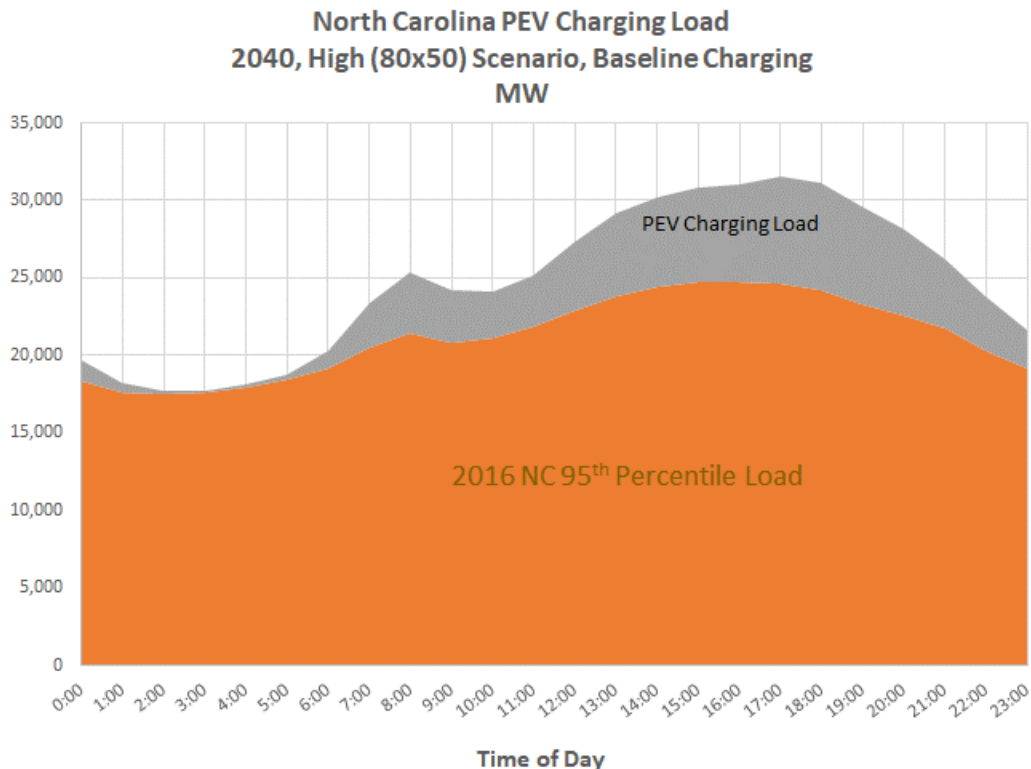
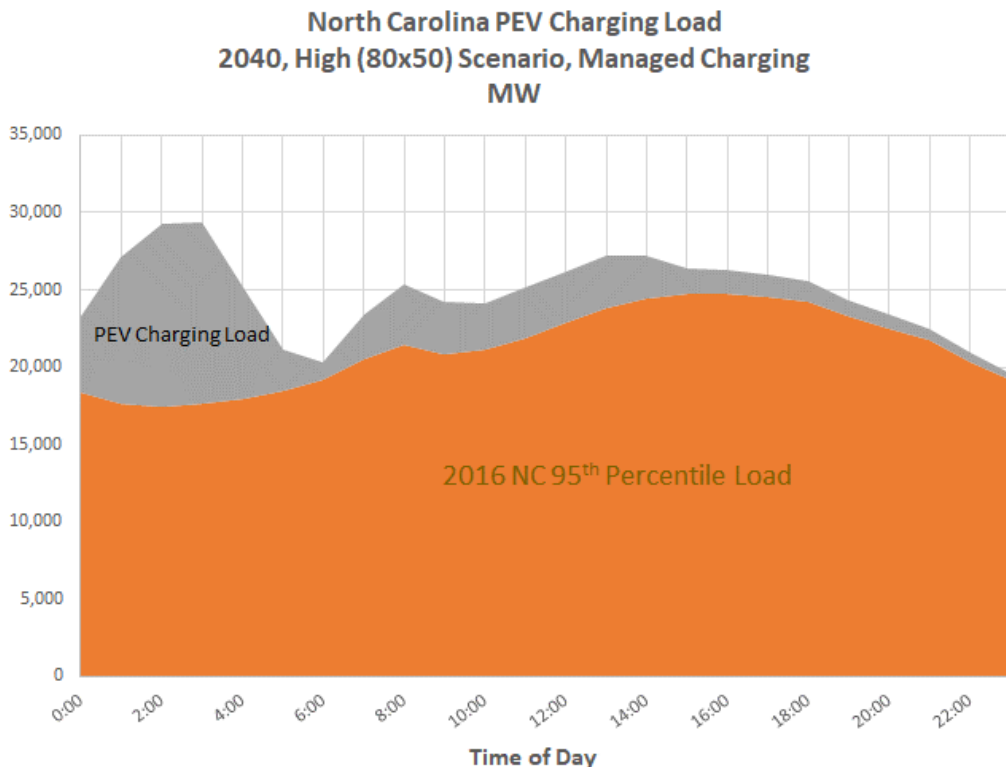


Figure 8 2040 Projected North Carolina PEV Charging Load, Managed Charging (High PEV [80x50] scenario)

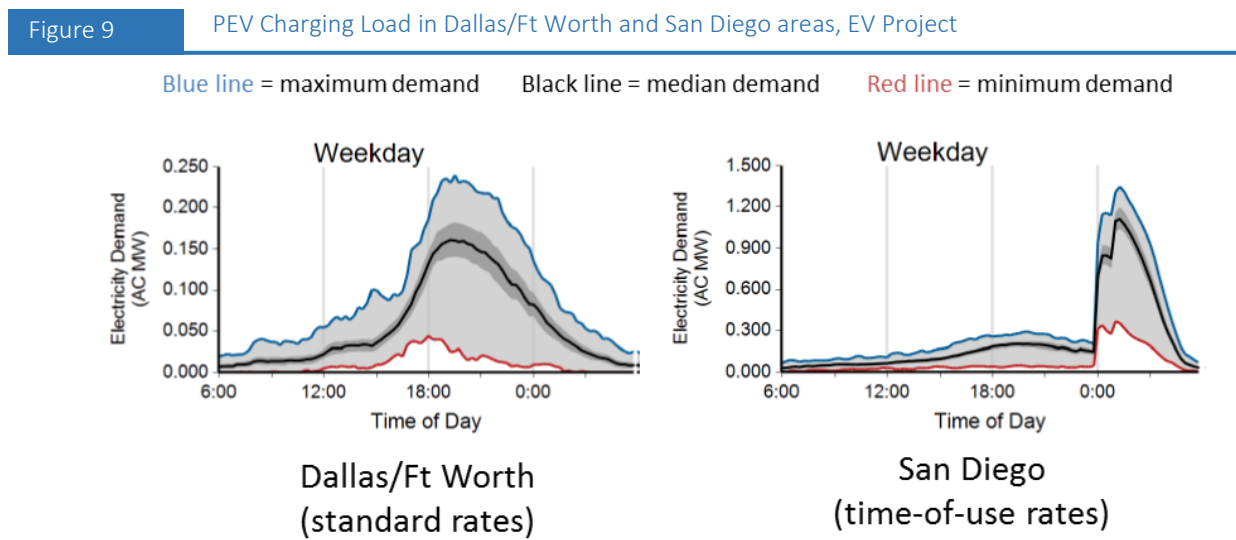


In 2016, daily electric load in North Carolina was generally less than 18,000 MW from midnight to 5 AM, ramping up to about 21,000 MW at 8 or 9 AM (during winter months), falling slightly through late morning and early afternoon, then ramping up again to peak at approximately 24,500 MW between 2 PM and 5 PM (during summer months), and then falling off through the evening hours.<sup>8</sup>

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 summer 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 summer 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]



See Table 1 for a summary of the projected incremental afternoon peak hour load (MW) in North Carolina, 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 95<sup>th</sup> percentile peak hour load. Under the Moderate PEV (EIA) penetration scenario, PEV charging would add 525 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 2.1 percent. By 2050, the afternoon incremental PEV charging load would increase to 692 MW, adding 2.8 percent to the 2016 baseline

<sup>8</sup> In Figures 7 and 8, 95<sup>th</sup> Percentile Load is shown for the entire state of North Carolina across the entire year. The late morning peak shown is more prominent during the winter months, while the late afternoon peak is more prominent in the summer months. Within the Duke Energy service territory, the actual annual peak occurs in the winter months, during the late morning.

afternoon peak. By comparison the afternoon peak hour PEV charging load in 2030 would be only 113 MW for the managed charging scenario, increasing to 154 MW in 2050.

Under the High PEV (80x50) penetration scenario, baseline PEV charging would increase the total 2016 afternoon peak electric load by about 47 percent in 2050, while managed charging would only increase it by about 27 percent.<sup>9</sup>

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
<b>Baseline Charging</b>	PEV Charging (MW)	525	646	692	2,676	6,919	11,742
	<i>Increase relative to 2016 Peak</i>	2.1%	2.6%	2.8%	10.8%	27.9%	47.4%
<b>Managed Charging</b>	PEV Charging (MW)	113	144	154	574	1,484	6,623
	<i>Increase relative to 2016 Peak</i>	0.5%	0.6%	0.6%	2.3%	6.0%	26.7%

### Utility Customer Benefits

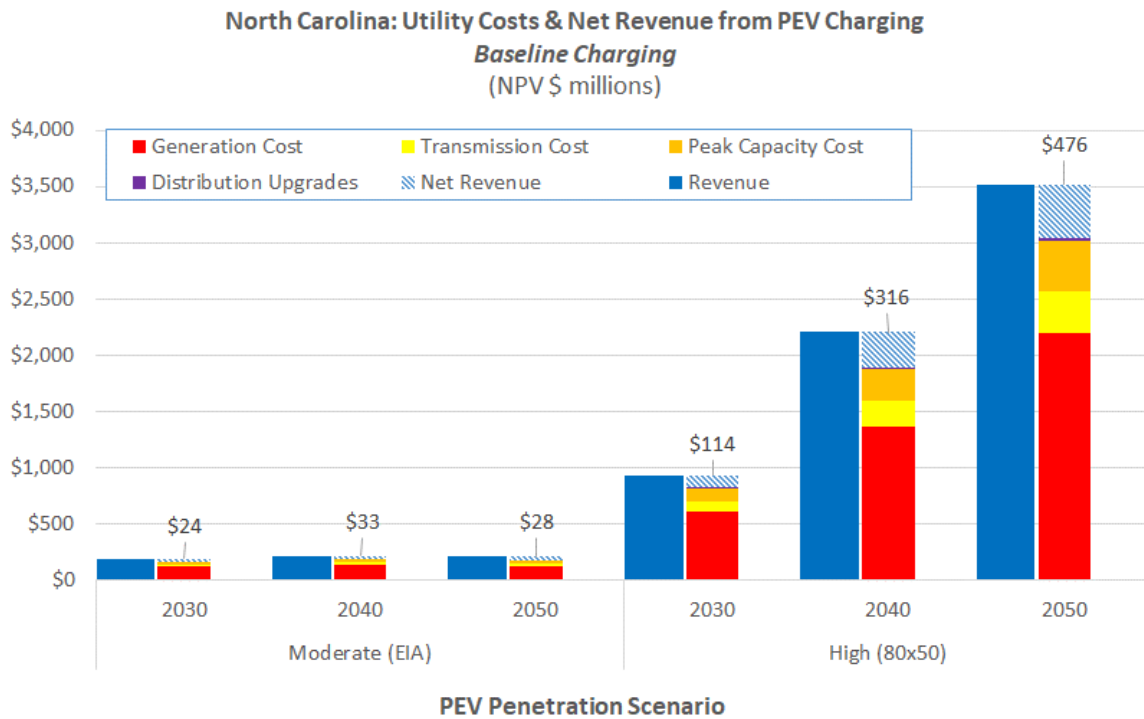
The estimated NPV of annual revenues and costs in 2030, 2040, and 2050, for North Carolina's electric utilities to supply electricity to charge PEVs under each penetration scenario are shown in Figure 10, assuming the baseline PEV charging scenario.

Under the Moderate PEV penetration scenario, the NPV of annual revenue from electricity sold for PEV charging in North Carolina is projected to total \$190 million in 2030, rising to \$206 million in 2050. Under the High PEV (80x50) scenario, the NPV of annual utility revenue from PEV charging is projected to total \$936 million in 2030, rising to \$3.5 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.

<sup>9</sup> 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

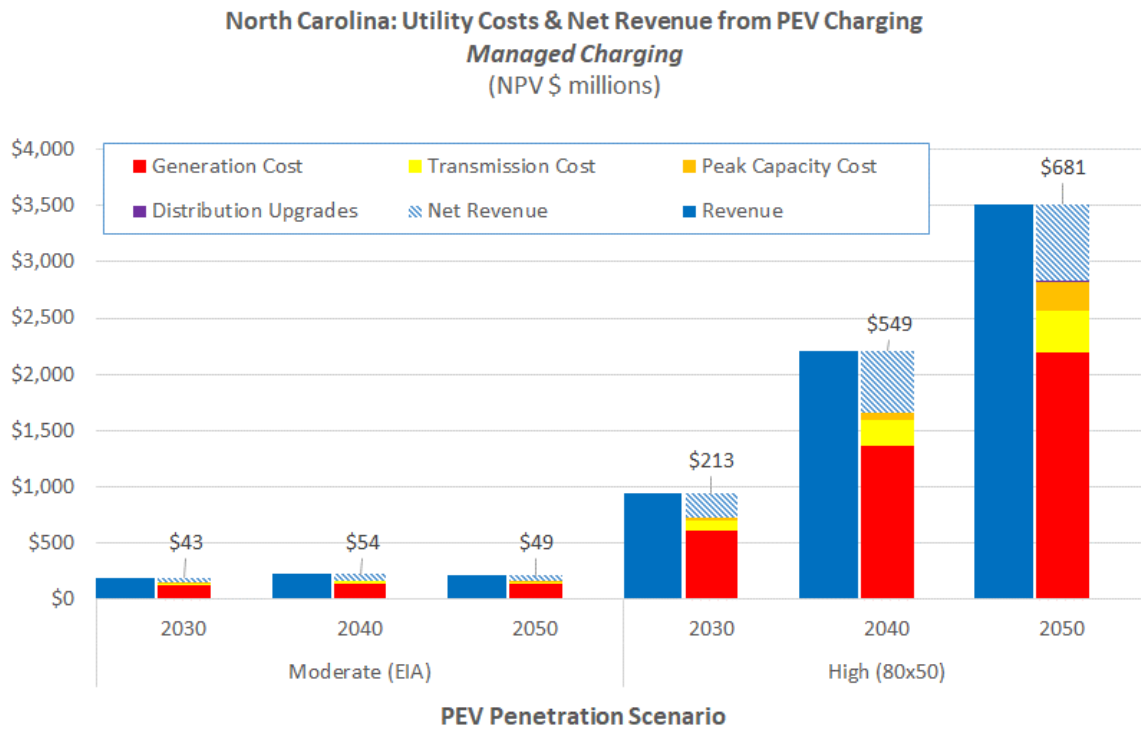


The striped light blue bars in Figure 10 represent the NPV of projected annual “net revenue” (revenue minus costs) that utilities would realize from selling additional electricity for PEV charging under each PEV penetration scenario in these years. Under the Moderate PEV penetration scenario, the NPV of net annual revenue in North Carolina is projected to total \$24 million in 2030 and \$28 million in 2050. Under the High PEV (80x50) scenario, the NPV of utility net annual revenue from PEV charging is projected to total \$114 million in 2030, rising to \$476 million in 2050. The NPV of projected annual utility net revenue averages \$49 per PEV in 2030, and \$41 - \$45 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 \$20 million in 2030 and \$22 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 \$99 million in 2030 and \$205 million in 2050. This analysis estimates that compared to baseline charging, managed charging will increase the NPV of annual utility net revenue by \$42 per PEV in 2030 and \$20 - \$31 per PEV in 2050.

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



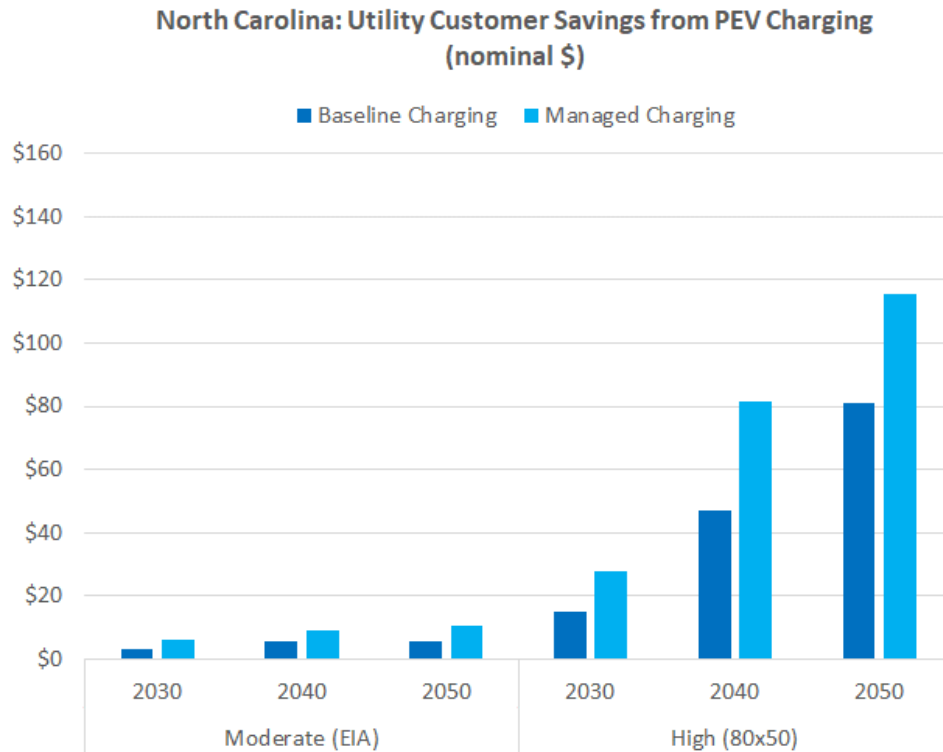
In general, a utility’s costs to maintain their distribution infrastructure increase each year with inflation, and these costs are passed on to utility customers in accordance with rules established by the North Carolina Public Utility Commission (PUC), via periodic increases in residential and commercial 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 North Carolina, 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 North Carolina electric utility customers.<sup>10</sup> As shown in the figure, under the High PEV (80x50) scenario projected average electric rates in North Carolina could be reduced up to 3.9 percent in 2050 due to net revenue from PEV charging, resulting in an annual savings of approximately \$116 (nominal dollars) per household in North Carolina.

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.

<sup>10</sup> Based on 2016 average electricity use of 12,746 kWh per housing unit in North Carolina

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



### North Carolina 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 North Carolina 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 North Carolina will fall below the average cost of owning a gasoline vehicle by 2035, even without government purchase subsidies.<sup>11</sup> See Table 2 which summarizes the average projected annual cost of North Carolina 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

<sup>11</sup> 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.



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.

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	\$5,301	\$5,904	\$7,228	\$4,492	\$6,177	\$8,375
Gasoline	\$/yr	\$1,526	\$1,730	\$2,073	\$1,489	\$1,857	\$2,422
Maintenance	\$/yr	\$332	\$402	\$497	\$329	\$412	\$522
<b>TOTAL ANNUAL COST</b>	<b>\$/yr</b>	<b>\$7,159</b>	<b>\$8,037</b>	<b>\$9,797</b>	<b>\$6,310</b>	<b>\$8,446</b>	<b>\$11,319</b>

PEV - NC Baseline Charging/Standard Rate		Moderate (EIA)			High (80x50)		
		2030	2040	2050	2030	2040	2050
Vehicle Purchase	\$/yr	\$5,301	\$5,904	\$7,228	\$5,086	\$6,318	\$8,581
Electricity	\$/yr	\$629	\$715	\$848	\$610	\$748	\$943
Gasoline	\$/yr	\$101	\$121	\$143	\$99	\$129	\$164
Personal Charger	\$/yr	\$81	\$99	\$122	\$81	\$99	\$122
Maintenance	\$/yr	\$203	\$246	\$304	\$202	\$250	\$314
<b>TOTAL ANNUAL COST</b>	<b>\$/yr</b>	<b>\$6,316</b>	<b>\$7,085</b>	<b>\$8,645</b>	<b>\$6,079</b>	<b>\$7,544</b>	<b>\$10,124</b>

<b>Savings per PEV</b>	<b>\$/yr</b>	<b>\$843</b>	<b>\$951</b>	<b>\$1,153</b>	<b>\$231</b>	<b>\$902</b>	<b>\$1,195</b>
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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 North Carolina PEV owner is projected to have annual operating savings of \$843 due to reduced maintenance as well as electricity costs being lower than gasoline<sup>12</sup>. For both scenarios, this annual savings is projected to increase to \$1,153 - \$1,195 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 North Carolina drivers from greater PEV ownership are projected to be \$395 million in 2030 rising to \$789 million in 2050 under the moderate PEV penetration scenario. Under the High PEV (80x50) scenario, the NPV of total annual cost savings to North Carolina drivers from greater PEV ownership are projected to be \$552 million in 2030, rising to \$12.5 billion in 2050.

<sup>12</sup> 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

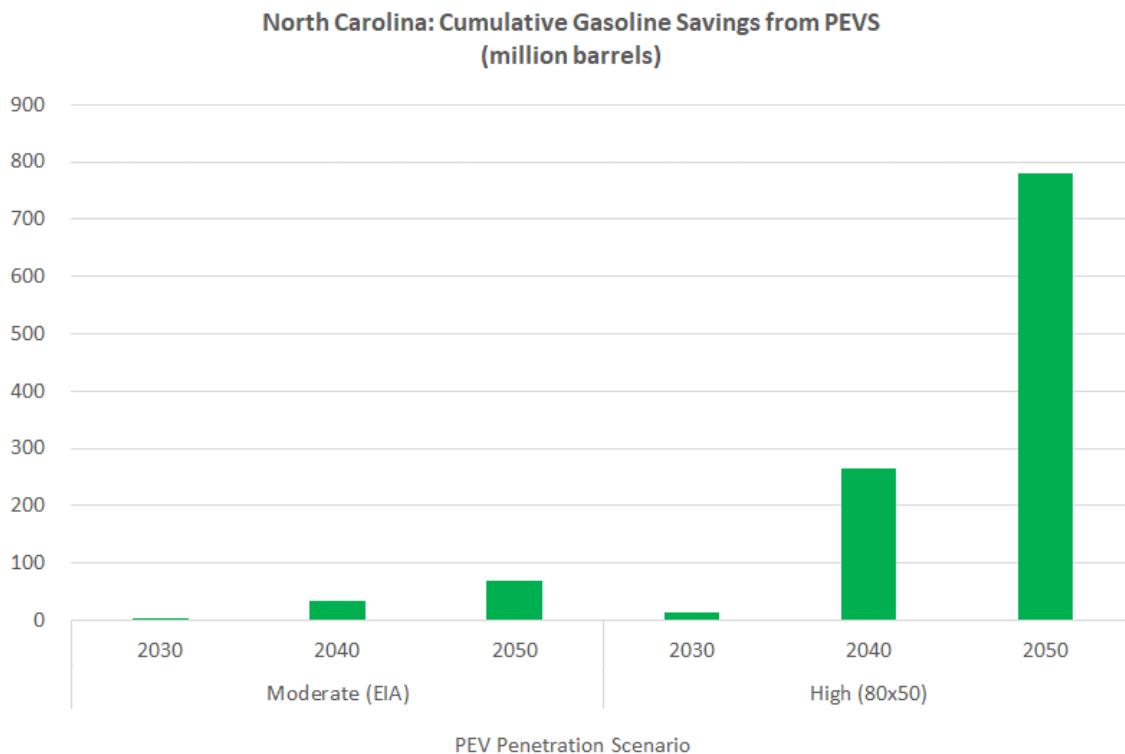
Along with the financial benefits to electric utility customers and PEV owners described above, light-duty vehicle electrification can provide additional benefits, including significant reductions in gasoline fuel use and transportation sector emissions.

The estimated cumulative fuel savings (barrels of gasoline<sup>13</sup>) from PEV use in North Carolina under each penetration scenario are shown in Figure 13. Annual fuel savings under the Moderate PEV penetration scenario are projected to total 2.9 million barrels in 2030, with cumulative savings of more than 68 million barrels by 2050. For the High PEV (80x50) scenario, annual fuel savings in 2030 are projected to be 13.8 million barrels, and by 2050 cumulative savings will exceed 780 million barrels.

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]

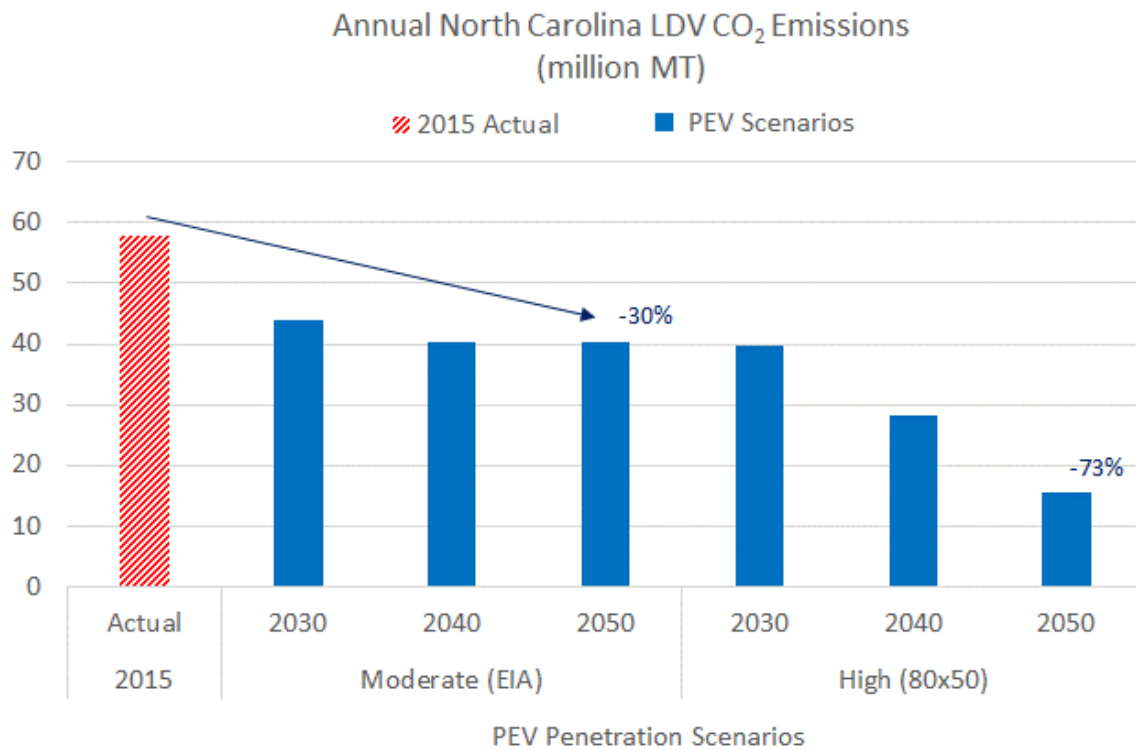
Figure 13 Cumulative Gasoline Savings from PEVs in North Carolina



<sup>13</sup> One barrel of gasoline equals 42 US gallons

The projected annual greenhouse gas (GHG) emissions (million metric tons carbon-dioxide equivalent, CO<sub>2</sub>-e million tons) from the North Carolina 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 /Virginia-Carolina electricity market module region, which includes North Carolina.

Figure 14 Projected GHG Emissions from the Light Duty Fleet in North Carolina



As shown in Figure 14, GHG emissions from the light duty fleet in North Carolina were approximately 58 million metric tons in 2015.

Compared to 2015 baseline emissions, in 2050 GHG emissions are projected to be reduced by up to 17.4 million tons under the Moderate PEV penetration scenario and as much as 42 million tons under the High PEV (80x50) scenario. Through 2050, cumulative net GHG emissions are projected to be reduced by nearly 346 million tons under the Moderate PEV penetration scenario and 627 million metric tons under the High PEV (80x50) scenario.

### NOx Emissions

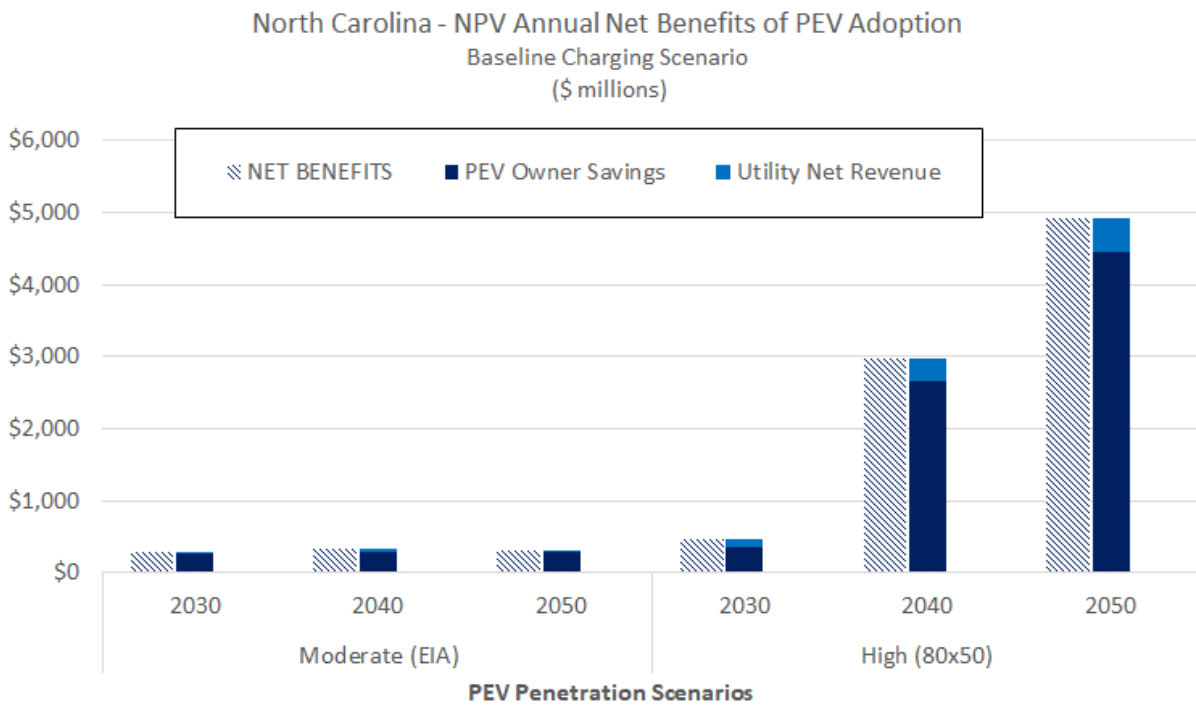
In 2015 the Electric Power Research Institute (EPRI), in conjunction with the Natural Resources Defense Council (NRDC), conducted national-level modeling to estimate GHG and air quality benefits from high levels of transportation electrification [4]. Under their electrification scenario EPRI estimated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

Extrapolating from this data, under the Moderate PEV Scenario (EIA), by 2050 light-duty vehicle electrification in North Carolina could reduce annual NOx emissions by 602 tons and reduce annual VOC emissions by 290 tons. Under the High PEV Scenario (80x50), total NOx reductions in 2050 could reach more than 9,300 tons per year, and total VOC reductions could reach almost 4,500 tons per year.<sup>15</sup>

### Total Societal Benefits

The NPV of total annual estimated benefits from increased PEV use in North Carolina under each PEV penetration scenario are summarized in Figures 15 and 16. These benefits include cost savings to North Carolina drivers and utility customer savings from reduced electric bills. Figure 15 shows the NPV of annual projected societal benefits if North Carolina 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 NC – Baseline Charging



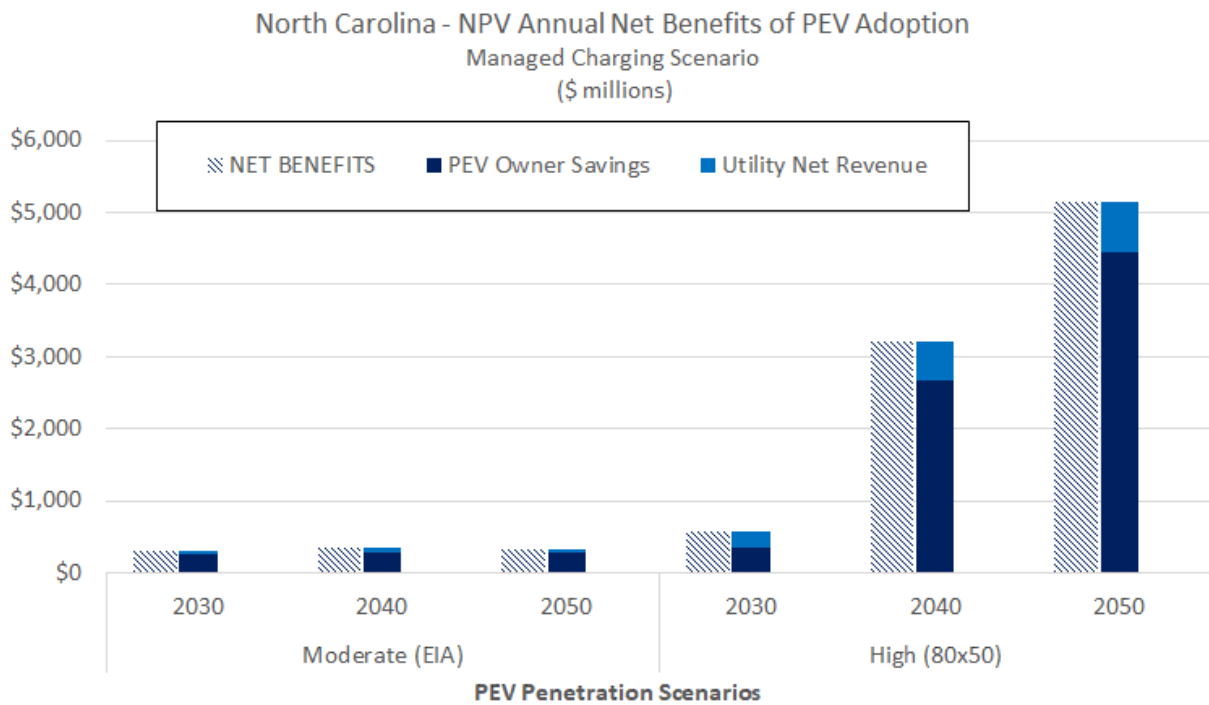
<sup>14</sup> For light-duty vehicles the analysis assumed that by 2030 approximately 17 percent of annual vehicle miles would be powered by grid electricity, using PEVs. Based on current and projected electric sector trends the analysis also assumed that approximately 49 percent of the incremental power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

<sup>15</sup> Across the entire state, estimated annual light-duty vehicle miles traveled (VMT) totals 1.60 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 \$308 million per year in 2050 under the Moderate PEV penetration scenario and \$4.9 billion per year in 2050 under the High PEV (80x50) scenario. Approximately 90 percent of these annual benefits will accrue to North Carolina drivers as a cash savings in vehicle operating costs and 10 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 \$21.6 million under the Moderate PEV (EIA) penetration scenario, and \$205 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 NC – 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).<sup>16</sup> This report can be found at:

[http://mjbradley.com/sites/default/files/NE\\_PEV\\_CB\\_Analysis\\_Methodology.pdf](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 North Carolina 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 North Carolina 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 North Carolina’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.<sup>17</sup> However, if given a “nudge” - in the form of a properly designed and marketed financial

<sup>16</sup> 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.

<sup>17</sup> 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 North Carolina 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 North Carolina 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<sub>2</sub>-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.

### RESIDENTIAL EV CHARGING PROGRAM (NC PILOT)

#### PURPOSE

The purpose of this pilot program is to collect utilization characteristics of electric vehicle (EV) charging behavior, understand potential grid and utility impacts from EV charging, and investigate technological capabilities for controlling residential EV-charging loads.

#### AVAILABILITY

This Program is available on a voluntary basis, at Company’s sole option, to no greater than 500 residential customers receiving electric service from Company. Participants shall submit an Application and must own, lease or otherwise operate on a regular basis a plug-in electric vehicle intended for use on public streets and highways. A plug-in vehicle includes plug-in hybrid and battery electric vehicles. Customer must provide proof of purchase and installation of an approved Level 2 (“L2”) EV Supply Equipment (“EVSE”). This program shall end on and after thirty-six (36) months following the initial effective date of the program. Customer shall maintain and provide the Company access to EVSE connectivity or onboard vehicle telematics platform throughout the 36-month term of the program for purposes of load control during certain defined hours of the day and monitoring of the electrical characteristics of the charging equipment.

#### CHARGING EQUIPMENT

Customers may qualify for one of the following program participation categories:

- a) EVSE-based data collection and load control capability – 250 Customer Limit
- b) Onboard vehicle load control capability – 250 Customer Limit

The Level 2 charging station equipment shall be connected to a dedicated single-phase 208-240 volt circuit with an amperage rating of 20 amps or greater. In the case of selecting a) customer’s EVSE must include revenue-grade metrology with Wi-Fi, Cellular, or other communications to a central server, must be certified under the Open Charge Point Protocol (Version 1.6 or later) and certified as OpenADR 2.0b. Company shall have the right to investigate control capabilities for EV-charging loads. A list of approved EVSE or with appropriate communications and control capabilities will be available from Company or its website.

#### PARTICIPATION INCENTIVE

Applications will be considered on a first-come-first-served basis from the date and time of submittal. Upon acceptance of the Customer’s Application and verification of proper installation of approved L2 EVSE for category (a) applications; or approved L2 EVSE and Open Vehicle-Grid Integration Platform (OVGIP) equipment for category (b) applications, Customer shall receive a one-time rebate of \$1,000 in exchange for data collection and load management participation. Customers are eligible for only one rebate per residence.

During the second and third years of the Pilot, the Company will perform a limited number of load control events (no more than 3 per month) during weekdays between the hours of 6-8am and 4-6pm. Load control events will consist of reduction in charging power up to and including full curtailment for up to 30 minutes. Participants will be notified of events 24h in advance and have the option to opt out of any event.

#### BILLING RATE

EVSE shall be installed on Customer’s side of Company’s meter; therefore, any usage will be billed under the applicable residential schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company’s metering facilities during the current month.

#### CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer’s subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company’s service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company’s service territory or otherwise discontinues use of the Charging Station within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal to the One-Time Rebate pro-rated for the remaining months of the pilot.

#### GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

#### REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

North Carolina Original Leaf No. 260

Effective \_\_\_\_\_

NCUC Docket No. E-7, Sub \_\_\_\_\_, Order Dated \_\_\_\_\_

## RESIDENTIAL ELECTRIC VEHICLE CHARGING PROGRAM EVC-1 (NC PILOT)

### PURPOSE

The purpose of this pilot program is to collect utilization characteristics of electric vehicle (EV) charging behavior, understand potential grid and utility impacts from EV charging, and investigate technological capabilities for controlling residential EV-charging loads.

### AVAILABILITY

This Program is available on a voluntary basis, at Company's sole option, to no greater than 300 residential customers receiving electric service from Company. Participants shall submit an Application and must own, lease or otherwise operate on a regular basis a plug-in electric vehicle intended for use on public streets and highways. A plug-in vehicle includes plug-in hybrid and battery electric vehicles. Customer must provide proof of purchase and installation of an approved Level 2 ("L2") EV Supply Equipment ("EVSE"). This program shall end on and after thirty-six (36) months following the initial effective date of the program. Customer shall maintain and provide the Company access to EVSE connectivity or onboard vehicle telematics platform throughout the 36-month term of the program for purposes of load control during certain defined hours of the day and monitoring of the electrical characteristics of the charging equipment.

### CHARGING EQUIPMENT

Customers may qualify for one of the following program participation categories:

- a) EVSE-based data collection and load control capability – 150 Customer Limit
- b) Onboard vehicle load control capability – 150 Customer Limit

The Level 2 charging station equipment shall be connected to a dedicated single-phase 208-240 volt circuit with an amperage rating of 20 amps or greater. In the case of selecting a) customer's EVSE must include revenue-grade metrology with Wi-Fi, Cellular, or other communications to a central server, must be certified under the Open Charge Point Protocol (Version 1.6 or later) and certified as OpenADR 2.0b. Company shall have the right to investigate control capabilities for EV-charging loads. A list of approved EVSE or with appropriate communications and control capabilities will be available from Company or its website.

### PARTICIPATION INCENTIVE

Applications will be considered on a first-come-first-served basis from the date and time of submittal. Upon acceptance of the Customer's Application and verification of proper installation of approved L2 EVSE for category (a) applications; or approved L2 EVSE and Open Vehicle-Grid Integration Platform (OVGIP) equipment for category (b) applications, Customer shall receive a one-time rebate of \$1,000 in exchange for data collection and load management participation. Customers are eligible for only one rebate per residence.

During the second and third years of the Pilot, the Company will perform a limited number of load control events (no more than 3 per month) during weekdays between the hours of 6-8am and 4-6pm. Load control events will consist of reduction in charging power up to and including full curtailment for up to 30 minutes. Participants will be notified of events 24h in advance and have the option to opt out of any event.

### BILLING RATE

EVSE shall be installed on Customer’s side of Company’s meter; therefore, any usage will be billed under the applicable residential schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company’s metering facilities during the current month.

CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer’s subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company’s service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company’s service territory or otherwise discontinues use of the Charging Station within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal to the One-Time Rebate pro-rated for the remaining months of the pilot.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_\_

EVSE shall be installed on Customer's side of Company's meter; therefore, any usage will be billed under the applicable residential schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

#### CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal to the One-Time Rebate pro-rated for the remaining months of the pilot.

#### GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

#### REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_\_

FLEET EV CHARGING PROGRAM (NC PILOT)

PURPOSE

The purpose of this pilot program is to support installation of electric vehicle supply equipment (EVSE) for public and private entity fleets to support fleet EV adoption, collect utilization characteristics of electric vehicle (EV) fleet charging-behavior for a variety of EV types and weight-classes and better understand potential grid and utility impacts of this EV market segment.

AVAILABILITY

This Program is available on a voluntary basis, at Company's sole option, to no greater than 500 total EVSE rebates during the Pilot term, with a maximum 20 EVSE per customer location, for customers receiving electric service from Company. Customer must own, lease or otherwise operate on a regular basis, one or more plug-in electric vehicles per installed EVSE. A plug-in vehicle includes plug-in hybrid and battery electric vehicles. Customer must provide proof of purchase and proper installation of EVSE. This program shall end on and after thirty-six (36) months following the initial effective date of the program.

CHARGING STATION EQUIPMENT

The Level 2 EVSE shall be connected to a dedicated single-phase 208-240 volt circuit with an amperage rating of 20 amps or greater and will be owned and operated by Customer. Customer must request new service on Schedule OPT-V to separately meter all EVSE funded by the Fleet Rebate. Company shall have the right to assess load characteristics and Customer behavior in connection with the EV charging program.

PARTICIPATION INCENTIVE

Applications will be considered on a first-come-first-served basis from the date and time of submittal. Upon acceptance of Customer's Application and verification of proper installation of all EVSE behind a separate meter, Customer shall receive a one-time rebate for \$2,500 per EVSE.

BILLING RATE

EVSE shall be installed on Customer's side of Company's meter. Customer must elect to receive service under Schedule OPT-V for the duration of the pilot and any usage will be billed under Schedule OPT-V and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the One-Time Program Rebate pro-rated for the number of months remaining in the program.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

## FLEET ELECTRIC VEHICLE CHARGING PROGRAM FEVC-1 (NC PILOT)

### PURPOSE

The purpose of this pilot program is to support installation of electric vehicle supply equipment (EVSE) for public and private entity fleets to support fleet EV adoption, collect utilization characteristics of electric vehicle (EV) fleet charging-behavior for a variety of EV types and weight-classes and better understand potential grid and utility impacts of this EV market segment.

### AVAILABILITY

This Program is available on a voluntary basis, at Company's sole option, to no greater than 400 total EVSE rebates during the Pilot term, with a maximum 20 EVSE per customer location, for customers receiving electric service from Company. Customer must own, lease or otherwise operate on a regular basis, one or more plug-in electric vehicles per installed EVSE. A plug-in vehicle includes plug-in hybrid and battery electric vehicles. Customer must provide proof of purchase and proper installation of EVSE. This program shall end on and after thirty-six (36) months following the initial effective date of the program.

### CHARGING STATION EQUIPMENT

The Level 2 EVSE shall be connected to a dedicated single-phase 208-240 volt circuit with an amperage rating of 20 amps or greater and will be owned and operated by Customer. Customer must request new service on Schedule SGS-TOU to separately meter all EVSE funded by the Fleet Rebate. Company shall have the right to assess load characteristics and Customer behavior in connection with the EV charging program.

### PARTICIPATION INCENTIVE

Applications will be considered on a first-come-first-served basis from the date and time of submittal. Upon acceptance of Customer's Application and verification of proper installation of all EVSE behind a separate meter, Customer shall receive a one-time rebate for \$2,500 per EVSE.

### BILLING RATE

EVSE shall be installed on Customer's side of Company's meter. Customer must elect to receive service under Schedule SGS-TOU for the duration of the pilot and any usage will be billed under Schedule SGS-TOU and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

### CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the One-Time Program Rebate prorated for the number of months remaining in the program.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
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## ELECTRIC VEHICLE SCHOOL BUS CHARGING STATION PROGRAM (NC PILOT)

### PURPOSE

The purpose of this pilot program is to support procurement of Electric Vehicle School Buses (EVSB) by public school transportation systems, install supporting Electric Vehicle Supply Equipment (EVSE) to facilitate market adoption, collect utilization and other load characteristics to understand grid and utility impacts and explore potential for vehicle-to-grid power flow from EVSB batteries.

### AVAILABILITY

This Program is available on a first-come-first-served basis, at Company's sole option, to Customers operating public school transportation systems in Company's North Carolina electric service territory. Participants must utilize one or more electric vehicle school buses and provide transportation services to a public-school system. Incentives are available for no more than 55 buses operated by a single or multiple school systems. Participants must grant Company access to all vehicle charging data throughout the program term and allow implementation of load management capabilities to reduce charging speeds, up to and including full curtailment and Vehicle-to-Grid (V2G) bi-directional power flow, provided such control activities do not impact the necessary duty cycle of the school bus. Prior to participation under this Program, Customer and Company shall execute an Electric Vehicle School Bus Supply Equipment Site Agreement to establish the terms and conditions of EVSE and EVSB battery installation and ownership.

### INCENTIVES

Company shall fund up to \$215,000 per bus for procurement, delivery and installation of EVSB and associated EVSE charging equipment. Company shall retain ownership of the EVSE while Customer shall be responsible for proper operation and maintenance of EVSE according to manufacturer's guidelines. Company shall establish and maintain charging station network connectivity for load control capabilities during full 36-month pilot. Customer will own EVSB and shall operate and maintain all EVSB components for the duration of the pilot. Company will retain ownership rights to EVSB battery and shall be allowed to repurpose or remove EVSB battery at the end of its useful life.

### BILLING RATE

EVSE shall be installed on Customer's side of Company's meter; therefore, any usage will be billed under the applicable general service schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

### CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the EVSE and battery funding amount pro-rated for the number of months remaining in the program.

### CUSTOMER'S RESPONSIBILITIES

Customer shall provide a location on premise for installation of Company's facilities and any necessary access to the work site and shall use reasonable diligence to protect Company's equipment from harm. In the event of damage to Company owned equipment that is caused by the Customer or Customer's agents, Customer agrees to pay all repair or replacement costs associated with the damage. Customer shall grant Company reasonable access rights during times specified by Company to operate and maintain its equipment during the program.

### GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install, at its own expense, additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

### REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

ELECTRIC VEHICLE SCHOOL BUS CHARGING STATION  
PROGRAM EVSB-1 (NC PILOT)

PURPOSE

The purpose of this pilot program is to support procurement of Electric Vehicle School Buses (EVSB) by public school transportation systems, install supporting Electric Vehicle Supply Equipment (EVSE) to facilitate market adoption, collect utilization and other load characteristics to understand grid and utility impacts and explore potential for vehicle-to-grid power flow from EVSB batteries.

AVAILABILITY

This Program is available on a first-come-first-served basis, at Company's sole option, to Customers operating public school transportation systems in Company's North Carolina electric service territory. Participants must utilize one or more electric vehicle school buses and provide transportation services to a public-school system. Incentives are available for no more than 30 buses operated by a single or multiple school systems. Participants must grant Company access to all vehicle charging data throughout the program term and allow implementation of load management capabilities to reduce charging speeds, up to and including full curtailment and Vehicle-to-Grid (V2G) bi-directional power flow, provided such control activities do not impact the necessary duty cycle of the school bus. Prior to participation under this Program, Customer and Company shall execute an Electric Vehicle School Bus Supply Equipment Site Agreement to establish the terms and conditions of EVSE and EVSB battery installation and ownership.

INCENTIVES

Company shall fund up to \$215,000 per bus for procurement, delivery and installation of EVSB and associated EVSE charging equipment. Company shall retain ownership of the EVSE while Customer shall be responsible for proper operation and maintenance of EVSE according to manufacturer's guidelines. Company shall establish and maintain charging station network connectivity for load control capabilities during full 36-month pilot. Customer will own EVSB and shall operate and maintain all EVSB components for the duration of the pilot. Company will retain ownership rights to EVSB battery and shall be allowed to repurpose or remove EVSB battery at the end of its useful life.

BILLING RATE

EVSE shall be installed on Customer's side of Company's meter; therefore, any usage will be billed under the applicable general service schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the EVSE and battery funding amount pro-rated for the number of months remaining in the program.

CUSTOMER'S RESPONSIBILITIES

Customer shall provide a location on premise for installation of Company's facilities and any necessary access to the work site and shall use reasonable diligence to protect Company's equipment from harm. In the event of damage to Company owned equipment that is caused by the Customer or Customer's agents,

Customer agrees to pay all repair or replacement costs associated with the damage. Customer shall grant Company reasonable access rights during times specified by Company to operate and maintain its equipment during the program.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install, at its own expense, additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_\_

ELECTRIC VEHICLE TRANSIT BUS CHARGING STATION PROGRAM (NC PILOT)

PURPOSE

The purpose of this pilot program is to deploy Electric Vehicle Supply Equipment (EVSE) for Electric Vehicle Transit Buses (EVTB) to support EVTB adoption and collect utilization and other load characteristics to understand potential grid and utility impacts.

AVAILABILITY

This Program is available on a first-come-first-served basis, at Company's sole option, to non-residential customers receiving electric service from Company. Participants must operate a commercial transit system utilizing one or more electric vehicle transit buses, including but not limited to transit agencies, universities, airports, and non-profit/municipal entities. Incentives are available for no more than 60 charging stations to support a single or multiple transit systems. Participants shall allow Company to install, own and operate EVSE at the Customer site and measure Customer's electrical charging characteristic on an individual or collective basis and to obtain any other data necessary to determine the operating characteristics of the customer's use of electricity. This program shall end following 36 months from the date of the commissioned installation, unless extended by Company. Prior to participation, Customer and Company shall execute an Electric Vehicle Transit Bus Supply Equipment Site Agreement to establish the terms and conditions of the installation. Electric service to the EVSE must be received under a time-of-use ("TOU") schedule for the duration of the pilot.

INCENTIVES

Company shall fund \$75,000 per EVTB procured within the preceding 24 months for purchase and installation of qualifying EVTB charging equipment at Customer site. Company shall retain ownership of EVSE for the duration of the pilot. Customer shall be responsible for proper operation and maintenance of EVSE according to manufacturer's guidelines.

EVSB and CHARGING EQUIPMENT

Company shall install EVSE on Customer's side of Company's meter. Any usage will be billed under the applicable TOU service schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the EVSE funding amount pro-rated for the number of months remaining in the program.

CUSTOMER'S RESPONSIBILITIES

Customer shall provide a location on premise for installation of Company's facilities and any necessary access to the work site and shall use reasonable diligence to protect Company's equipment from harm. In the event of damage to Company owned equipment that is caused by the Customer or Customer's agents, Customer agrees to pay all repair or replacement costs associated with the damage. Customer shall grant Company reasonable access rights during times specified by Company to operate and maintain its equipment during the program.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install, at its own expense, additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

ELECTRIC VEHICLE TRANSIT BUS CHARGING STATION  
PROGRAM EVTB-1 (NC PILOT)

PURPOSE

The purpose of this pilot program is to deploy Electric Vehicle Supply Equipment (EVSE) for Electric Vehicle Transit Buses (EVTB) to support EVTB adoption and collect utilization and other load characteristics to understand potential grid and utility impacts.

AVAILABILITY

This Program is available on a first-come-first-served basis, at Company's sole option, to non-residential customers receiving electric service from Company. Participants must operate a commercial transit system utilizing one or more electric vehicle transit buses, including but not limited to transit agencies, universities, airports, and non-profit/municipal entities. Incentives are available for no more than 45 charging stations to support a single or multiple transit systems. Participants shall allow Company to install, own and operate EVSE at the Customer site and measure Customer's electrical charging characteristic on an individual or collective basis and to obtain any other data necessary to determine the operating characteristics of the customer's use of electricity. This program shall end following 36 months from the date of the commissioned installation, unless extended by Company. Prior to participation, Customer and Company shall execute an Electric Vehicle Transit Bus Supply Equipment Site Agreement to establish the terms and conditions of the installation. Electric service to the EVSE must be received under an available time-of-use ("TOU") schedule for the duration of the pilot.

INCENTIVES

Company shall fund \$75,000 per EVTB procured within the preceding 24 months for purchase and installation of qualifying EVTB charging equipment at Customer site. Company shall retain ownership of EVSE for the duration of the pilot. Customer shall be responsible for proper operation and maintenance of EVSE according to manufacturer's guidelines.

EVS and CHARGING EQUIPMENT

Company shall install EVSE on Customer's side of Company's meter. Any usage will be billed under the applicable TOU service schedule and other riders, if applicable, for the Billing Demand and kilowatt-hours registered or computed by or from Company's metering facilities during the current month.

CONTRACT TERM AND EARLY TERMINATION

Contract Period shall be 36-months following the initial effective date of the program. Customer's subscription is not transferrable to another party. If Customer transfers their electric service to a different location within Company's service territory, the subscription shall be transferred to the new service location upon re-installation of the Charging Station. If Customer discontinues electric service and relocates outside the Company's service territory or otherwise discontinues use of the Charging Station including but not limited to maintaining connectivity, within twelve (12) months of initial participation, Customer shall remit to Company a Termination Payment equal the EVSE funding amount pro-rated for the number of months remaining in the program.

CUSTOMER'S RESPONSIBILITIES

Customer shall provide a location on premise for installation of Company's facilities and any necessary access to the work site and shall use reasonable diligence to protect Company's equipment from harm. In the event of damage to Company owned equipment that is caused by the Customer or Customer's agents, Customer agrees to pay all repair or replacement costs associated with the damage. Customer shall grant Company reasonable access rights during times specified by Company to operate and maintain its equipment during the program.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install, at its own expense, additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_

MULTI-FAMILY DWELLING CHARGING STATION PROGRAM (NC PILOT)

PURPOSE

The purpose of this pilot program is for the Company to deploy and maintain a network of publicly accessible Multi-Family Dwelling (“MFD”) Level 2 (“L2”) electric vehicle (“EV”) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company’s North Carolina service territory.

AVAILABILITY

Company shall install, own and operate a network of up to 100 MFD L2 stations. Operation and maintenance of L2 stations may be performed by qualified third-party service provider by agreement with Company. Charging stations will be installed at publicly-accessible MFD locations throughout Company’s North Carolina service territory to enable residential charging at MFDs and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company’s electric service customers.

CHARGING STATION EQUIPMENT

The MFD L2 stations shall include charging equipment with electrical demand requirements of up to 10 kW. Each station shall include a minimum of two Level 2 (208/240V) charging outlets capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include smart charging capabilities with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. EVSE must be compatible with OCPP 1.6 or higher. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

BILLING RATES

MFD L2 charging services will be offered in exchange for an L2 Charging Fee consistent with the Kilowatt-Hour Charge of the Company’s first block energy rate of the current Small General Service (SGS) Schedule, plus \$0.02/kWh. Payment shall be made to Company by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The L2 Charging Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure deployment within the term of the pilot.

CONTRACT TERM

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

MULTI-FAMILY DWELLING CHARGING STATION  
PROGRAM MFEV-1 (NC PILOT)

PURPOSE

The purpose of this pilot program is for the Company to deploy and maintain a network of publicly accessible Multi-Family Dwelling (“MFD”) Level 2 (“L2”) electric vehicle (“EV”) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company’s North Carolina service territory.

AVAILABILITY

Company shall install, own and operate a network of up to 60 MFD L2 stations. Operation and maintenance of L2 stations may be performed by qualified third-party service provider by agreement with Company. Charging stations will be installed at publicly-accessible MFD locations throughout Company’s North Carolina service territory to enable residential charging at MFDs and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company’s electric service customers.

CHARGING STATION EQUIPMENT

The MFD L2 stations shall include charging equipment with electrical demand requirements of up to 10 kW. Each station shall include a minimum of two Level 2 (208/240V) charging outlets capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include smart charging capabilities with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. EVSE must be compatible with OCPP 1.6 or higher. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

BILLING RATES

MFD L2 charging services will be offered in exchange for an L2 Charging Fee consistent with the Kilowatt-Hour Charge of the Company’s first block energy rate of the current Small General Service (SGS) Schedule, plus \$0.02/kWh. Payment shall be made to Company by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The L2 Charging Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure deployment within the term of the pilot.

CONTRACT TERM

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.



REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_\_

**PUBLIC LEVEL 2 CHARGING STATION PROGRAM (NC PILOT)**

**PURPOSE**

The purpose of this pilot program is for the Company to develop and maintain a foundational network of publicly accessible Level 2 (“L2”) electric vehicle (“EV”) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company’s North Carolina service territory.

**AVAILABILITY**

Company shall install, own and operate a network of up to 100 L2 stations across approximately 50 individual locations. Operation and maintenance of L2 stations may be performed by a qualified third-party service provider by agreement with Company. Charging stations will be installed at key publicly-accessible locations throughout Company’s North Carolina service territory to enable destination charging in the public sector and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company’s electric service customers.

**CHARGING STATION EQUIPMENT**

The L2 stations shall include charging equipment with electrical demand requirements of up to 10 kW. Each location shall include a minimum of two L2 Electric Vehicle Supply Equipment (“EVSE”) stations capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include smart charging capabilities with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. EVSE must be compatible with OCPP 1.6 or higher. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

**BILLING RATES**

L2 charging services will be offered in exchange for an L2 Charging Fee consistent with the Kilowatt-Hour Charge of the Company’s first block energy rate of the current Small General Service (SGS) Schedule, plus \$0.02/kWh. Payment shall be made to Company by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The L2 Charging Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure deployment within the term of the pilot.

**CONTRACT TERM**

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

**GENERAL**

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

**REGULATORY AUTHORITY**

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

PUBLIC LEVEL 2 CHARGING STATION  
PROGRAM L2EV-1 (NC PILOT)

PURPOSE

The purpose of this pilot program is for the Company to develop and maintain a foundational network of publicly accessible Level 2 (“L2”) electric vehicle (“EV”) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company’s North Carolina service territory.

AVAILABILITY

Company shall install, own and operate a network of up to 100 L2 stations across approximately 50 individual locations. Operation and maintenance of L2 stations may be performed by a qualified third-party service provider by agreement with Company. Charging stations will be installed at key publicly-accessible locations throughout Company’s North Carolina service territory to enable destination charging in the public sector and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company’s electric service customers.

CHARGING STATION EQUIPMENT

The L2 stations shall include charging equipment with electrical demand requirements of up to 10 kW. Each location shall include a minimum of two L2 Electric Vehicle Supply Equipment (“EVSE”) stations capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include smart charging capabilities with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. EVSE must be compatible with OCPP 1.6 or higher. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

BILLING RATES

L2 charging services will be offered in exchange for an L2 Charging Fee consistent with the Kilowatt-Hour Charge of the Company’s first block energy rate of the current Small General Service (SGS) Schedule, plus \$0.02/kWh. Payment shall be made to Company by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The L2 Charging Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure deployment within the term of the pilot.

CONTRACT TERM

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_  
NCUC Docket No. E-2, Sub \_\_\_\_\_

**PUBLIC FAST CHARGING PROGRAM (NC PILOT)**

**PURPOSE**

The purpose of this pilot program is for the Company to develop and maintain a foundational network of publicly accessible Direct Current Fast Charge (DCFC) electric vehicle (EV) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company's North Carolina service territory.

**AVAILABILITY**

Company shall install, own and operate a network of up to 70 DCFC stations across approximately 35 individual locations. Operation and maintenance of DCFC stations may be performed by third-party qualified service provider by agreement with Company. Charging stations will be dispersed at key highway corridor locations throughout Company's North Carolina service territory to enable intra- and inter-state electric vehicle travel and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company's electric service customers.

**CHARGING STATION EQUIPMENT**

The DCFC stations shall include charging equipment with electrical demand requirements of 100 kW or greater. Each location shall include a minimum of 2 DCFC Electric Vehicle Supply Equipment (EVSE) stations capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include revenue-grade metrology with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

**BILLING RATES**

DCFC charging services will be offered in exchange for a Fast Charge Fee consistent with the statewide average for DCFC charging offered by those stations which charge a fee to the driver and are publicly accessible 24-hours per day. Fees may be adjusted throughout the pilot, as needed but no more than once per quarter. Payment shall be made by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The Fast Charge Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure within the term of the pilot.

**CONTRACT TERM**

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

**GENERAL**

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

**REGULATORY AUTHORITY**

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

PUBLIC FAST CHARGING  
PROGRAM FCS-1 (NC PILOT)

PURPOSE

The purpose of this pilot program is for the Company to develop and maintain a foundational network of publicly accessible Direct Current Fast Charge (DCFC) electric vehicle (EV) charging stations to support EV adoption and serve the growing charging needs of Customers across the Company's North Carolina service territory.

AVAILABILITY

Company shall install, own and operate a network of up to 46 DCFC stations across approximately 23 individual locations. Operation and maintenance of DCFC stations may be performed by third-party qualified service provider by agreement with Company. Charging stations will be dispersed at key highway corridor locations throughout Company's North Carolina service territory to enable intra- and inter-state electric vehicle travel and build driver confidence in EVs. Charging services will be available to all electric vehicle owners without preference to Company's electric service customers.

CHARGING STATION EQUIPMENT

The DCFC stations shall include charging equipment with electrical demand requirements of 100 kW or greater. Each location shall include a minimum of 2 DCFC Electric Vehicle Supply Equipment (EVSE) stations capable of charging compatible plug-in electric vehicles intended for use on public streets and highways. Additionally, EVSE shall include revenue-grade metrology with Wi-Fi, cellular, or other communications to a central server along with monitoring and load management/curtailment capabilities. Company may adjust charging capacity to assess load characteristics and grid impacts of electric vehicle charging.

BILLING RATES

DCFC charging services will be offered in exchange for a Fast Charge Fee consistent with the statewide average for DCFC charging offered by those stations which charge a fee to the driver and are publicly accessible 24-hours per day. Fees may be adjusted throughout the pilot, as needed but no more than once per quarter. Payment shall be made by Smart Phone App, Radio-frequency identification (RFID) Card or by Credit Card swipe at the site. The Fast Charge Fee is intended to recover, at a minimum, the cost of electric service plus transaction and network service costs, but is not anticipated to recover the full cost of the charging infrastructure within the term of the pilot.

CONTRACT TERM

Contract Period shall be 36-months following the initial effective date of the program. At the end of the 36-month pilot, Company may seek regulatory approval to continue to own and operate the stations or to sell the stations with any proceeds being credited to program costs.

GENERAL

In addition to the usage recording capabilities of the charging station equipment, Company shall have the right to install at its own expense additional metering and load research devices as it deems appropriate to collect the usage characteristics of the electric vehicle charging station equipment.

REGULATORY AUTHORITY

Services rendered under this Agreement are subject to the authority of the North Carolina Utilities Commission and any changes or other modifications lawfully made thereto.

Effective for services rendered on and after \_\_\_\_\_

NCUC Docket No. E-2, Sub \_\_\_\_\_

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Progress, LLC and Duke Energy Carolinas, LLC's Application for Approval of Proposed Electric Transportation Pilot, in Docket Nos. E-2, Sub 1197 and E-7, Sub 1195, has been served by electronic mail, hand delivery, or by depositing a copy in the United States Mail, 1<sup>st</sup> Class Postage Prepaid, properly addressed to parties of record.

This the 29<sup>th</sup> day of March, 2019.



Kendrick C. Fentress  
Associate General Counsel  
Duke Energy Corporation  
P.O. Box 1551 / NCRH 20  
Raleigh, NC 27602  
Tel 919.546.6733  
Fax 919.546.2694  
[Kendrick.Fentress@duke-energy.com](mailto:Kendrick.Fentress@duke-energy.com)