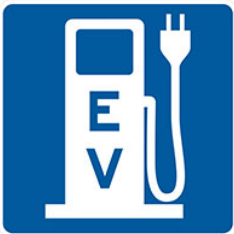


NORTH CAROLINA ZEV PLAN

A Strategic Plan for Accelerating
Electric Vehicle Adoption in
North Carolina



OCTOBER 1, 2019

VERSION 1.0

*Prepared by the North Carolina Department of Transportation
for the North Carolina Climate Change Interagency Council*

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- Southern Environmental Law Center
- Tesla

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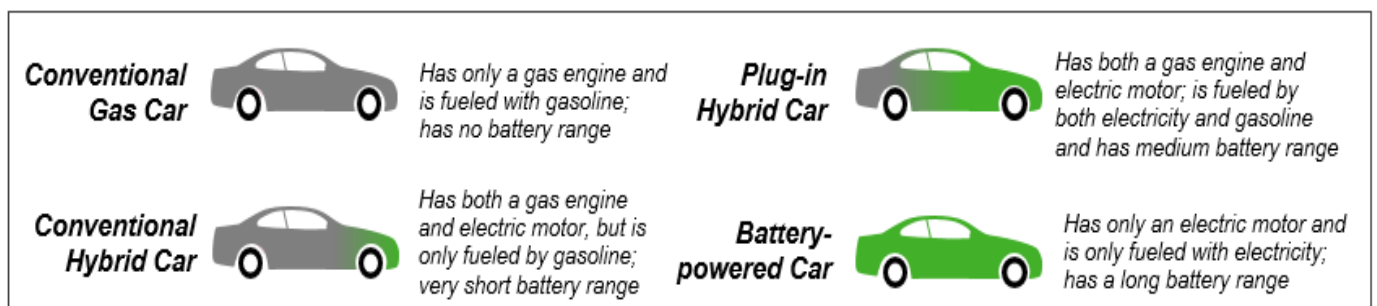
Glossary

Zero Emission Vehicle ('ZEV')	Includes both fully electric plug-in as well as plug-in-hybrid electric vehicles (see definitions below); other forms of zero emissions vehicle will be considered as technology becomes more widespread and readily adopted
Electric Vehicle ('BEV')	A vehicle powered solely through a battery and electric powertrain that is capable of highway speeds (i.e., not golf carts or personal recreational vehicles)
Plug-in-Hybrid Vehicle ('PHEV')	A vehicle that combines a conventional gasoline powered engine with a battery that can be recharged allowing it to operate as an electric vehicle
Greenhouse Gas ('GHG')	A gas that contributes to the "greenhouse effect" through the absorption and emission of radiant energy in the thermal infrared range
Alternative Fuel Vehicle ('AFV')	Includes any vehicle fueled with an input other than gasoline or diesel
Original Equipment Manufacturer ('OEM')	A company that produces parts and equipment that may be marketed by another manufacturer (e.g., brake pads installed in a car)
Internal Combustion Engine ('ICE')	An engine that fuels a vehicle via combustion of a power source, using inputs such as gasoline, diesel, biofuels, propane or natural gas
DC Fast Charge ('DCFC')	Direct current fast charging stations offer significantly faster charging time compared to Level 1 or Level 2 charging stations. DC fast charging output is available at 50, 150 or 350 kilowatts

1. Executive Summary

On Aug. 15, 2019, the National Oceanic and Atmospheric Administration (NOAA) announced that globally, July 2019 was the hottest month ever recorded on Earth. Climate scientists conclude that the emissions resulting from the burning of fossil fuels contribute to the increase in global temperature. On Oct. 29, 2018, Governor Roy Cooper signed *Executive Order No. 80, North Carolina's Commitment to Address Greenhouse Gas Emissions and Transition to a Clean Energy Economy* (EO 80). EO 80 calls for a 40% reduction in statewide greenhouse gas emissions from 2005 by 2050. In addition, the order sets a goal of at least 80,000 registered zero emission vehicles (ZEVs) in North Carolina by 2025. North Carolina's transportation sector contributed 32% of the states total greenhouse gas emissions in 2017, so achieving this ZEV goal is an important step in lowering overall greenhouse gas emissions. ZEVs are not only a cleaner more efficient means of moving passengers, they also connect with North Carolina's ambition of creating and supporting clean energy jobs. When EO 80 was signed, less than 10,000 electric vehicles were registered in North Carolina.

EO 80 charged the North Carolina Department of Transportation – in coordination with the North Carolina Department of Environmental Quality – with developing a NC ZEV Plan to guide ZEV adoption in North Carolina. Per EO 80, the ZEV Plan should establish interstate and intrastate zero emissions vehicle corridors, increase the installation of zero emission vehicle infrastructure, and outline best practices for increasing zero emission vehicle adoption in North Carolina. This NC ZEV Plan focuses on both fully electric vehicles and plug-in-hybrids. Over 80% of respondents to NCDOT's online survey report driving fewer than 50 miles per day. This is similar to national data, which indicate that the average driver covers between 30-35 miles daily.¹ Because most cost-effective plug-in hybrids generally achieve ranges near 30² miles before the gas engine kicks in, the majority of them would function similar to a fully electric vehicle in many daily driving scenarios. Therefore, this plan treats both as ZEVs.



¹ US DOT/FHWA Traffic Volume Trends; US Bureau of Labor Statistics

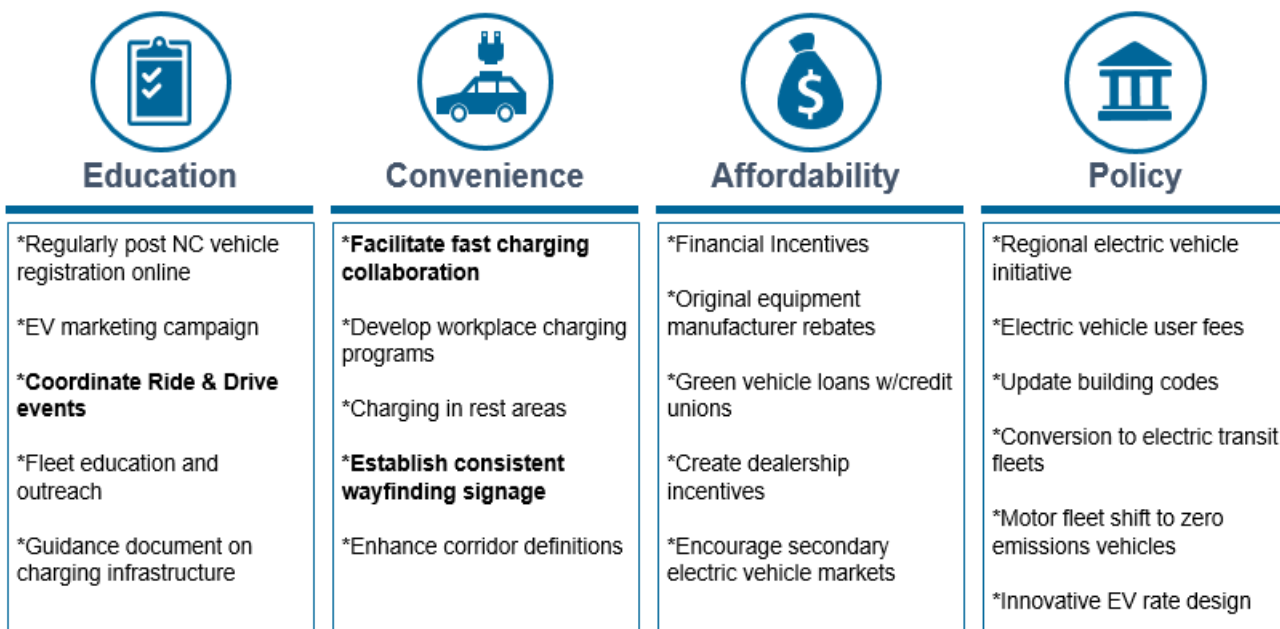
² EVAdoption.com – current available PHEV models

This plan is the result of stakeholder outreach within North Carolina, research into successful practices in other states, assessment of what will be needed from industry partners to help adoption and defining efforts to drive broader acceptance of these zero emission vehicles in the general public.

Over 1,200 stakeholders representing the general public as well as industry members, universities, environmental groups, local government, and other North Carolina state agencies took part in a comprehensive series of engagement meetings, workshops, and surveys. From this input, this ZEV Plan identifies four action areas to support ZEV adoption:

- **Education** – Educate across a variety of topics such as pricing and affordability; vehicle range per charge; charging costs and options; and availability of vehicles and charging. Education and marketing for the public, as well as potentially for dealerships and fleet owner/operators.
- **Convenience** – Increase ease of charging and comfort in the overall electric vehicle network to alleviate concerns regarding range per charge and replacement of traditional internal combustion engines.
- **Affordability** – Reduce upfront costs through potential financial incentives, as well as helping develop a used-car market to provide a more appealing range of vehicle types at more prices.
- **Policy** – Establish policies that promote electric vehicle adoption and revise or remove those that inhibit adoption. State alliances and coalitions may also encourage continued investment.

For each area, the NC ZEV Plan recommends strategies, lead actors, key stakeholders, and an implementation timeline. The figure below provides a summary of these strategies.



Bold Text indicates work already started

While this plan is the culmination of many months of work, it represents only one step in North Carolina's progress toward the emission reduction goals outlined in EO 80. Implementation is critical to increasing ZEV adoption in the state and all parties involved will need to remain flexible to accommodate the ongoing transformations in the transportation sector. Technology advancement, policy drivers, market forces, consumer preferences, and developments in other transportation trends (e.g., automation, ride sharing, and connected infrastructure) will all impact the future of vehicle electrification.

2. North Carolina's Vision

Through Executive Order No. 80, the State of North Carolina is demonstrating its commitment to reduce fossil fuel emissions and transition to cleaner energy sources. The order contains a wide variety of objectives, including resiliency planning and adaptation to climate change, as well as the expansion of clean-energy businesses and service providers; however, the primary goal is to reduce statewide greenhouse gas emissions to 40% below 2005 levels by 2025. A key step to achieving this goal is to reduce transportation emissions and continue to grow North Carolina's clean transportation economy by registering at least 80,000 zero emissions vehicles in the state by 2025.

ZEV Plan's Primary Goal:

The primary purpose of this NC ZEV Plan is to increase the number of registered zero-emission vehicles in North Carolina to at least 80,000 by 2025.

EO 80 specifies that the NC ZEV Plan should provide for the following:

- Establishing state-wide vehicle corridors
- Installing charging stations and other needed infrastructure
- Incorporating best practices for increasing electric vehicle adoption

In addition to transportation-focused objectives, this plan furthers environmental and economic objectives consistent with EO 80.

Environmental Objectives:

- Reduce greenhouse gas emissions
- Improve air quality
- Enhance public health

Economic Objectives:

- Minimize the cost of owning an electric vehicle
- Support improvements to electricity markets
- Grow state and local economies and job opportunities
- Provide equitable access to clean transportation technologies and their benefits

Electric Vehicle Ownership and Consideration

The transportation sector is moving toward electric vehicles (EVs) because of their numerous benefits. At the same time, while EV technology is rapidly changing, it is not a perfect fit for every use case. As a result, potential EV customers, policy makers, fleet managers, and others should be aware of important considerations regarding EVs.

Benefits of EV Adoption

A primary benefit of EVs over internal combustion engine (ICE) vehicles is lower lifecycle costs, which can reduce transportation costs for households or businesses. EVs have fewer moving parts than an ICE vehicle. They also tend to have a longer lifecycle. Both these factors lead to increased cost savings over the life of the vehicle. Lower operation and maintenance costs can make up for the initial higher purchase price. EV drivers report enhanced vehicle performance given their quick acceleration and quiet ride. EV owners also value the convenience of charging at home or work, rather than making special trips to a gas station.

EVs reduce emissions of greenhouse gases and other air pollutants that threaten public health and exacerbate climate change. Most EVs charge from the electricity grid, which means as the power sector shifts to clean energy, EVs will get even cleaner over time. ICE vehicles, by contrast, become dirtier over time as engines get older and less efficient. EVs can support the electric grid by providing additional electric capacity and by charging during off-peak hours. Increased penetration of EVs can enhance resilience of the transportation sector by diversifying the types of vehicles on the road. EVs also promote energy independence by not relying on imported fuel or the global oil market. In terms of economic development, the transition to a cleaner transportation sector creates opportunities for business innovation and economic growth.

Access to affordable EVs and charging infrastructure can benefit vulnerable communities by providing additional transportation options, lowering household transportation costs, and improving local air quality. Policies and programs that lower EV purchase prices and expand access to charging options at or near multi-family housing or public housing can be helpful. For businesses in middle- and low-income areas, the presence of charging infrastructure can help travelers, visitors, and customers that drive EVs to and through those areas.

Considerations for EV Adoption

EVs are not a viable option in all cases, and the shift to transportation electrification requires careful consideration of impacts and trade-offs. A higher purchase price can put vehicles out of reach for potential buyers, even if they would save money over the life of the vehicle. Vehicle range is a consideration for those that commute long distances or have limited access to charging infrastructure. Those living in multi-family housing may depend upon public charging stations if they do not have access to charging where they live. Most of today's EVs are

passenger vehicles. Those needing medium- or heavy- duty vehicles may not find a suitable electric model. Manufacturers are beginning to fill this gap by developing electric versions of pick-up trucks, vans, delivery vehicles, and long-haul trucks.

Equitable access to charging infrastructure is important as we bring technology to all communities of North Carolina. Electric cooperatives have already deployed 39 cooperative-owned charging stations to serve rural communities and intend on investing another \$1 million in 2019-2020. Multiple cooperatives also offer special EV time-of-use rates and other EV-related bill credits for the purchase of an EV or the installation of a home charging station. It is also critical to understand and be able to access the varying types of charging stations, which come in several versions, seen in the figure below.

The shift to electric vehicles can have important implications for the state’s workforce and rural communities. In recognition of the impacts that changes in the transportation sector may have for North Carolina’s work force, the N.C. Department of Commerce has developed the 2019 report “Clean Energy & Clean Transportation in NC: A Workforce Assessment.” The assessment finds that North Carolina has a large and diverse clean economy workforce and is meeting current clean economy workforce needs overall. It also identifies opportunities to prepare North Carolina’s workforce for growth of the clean economy.

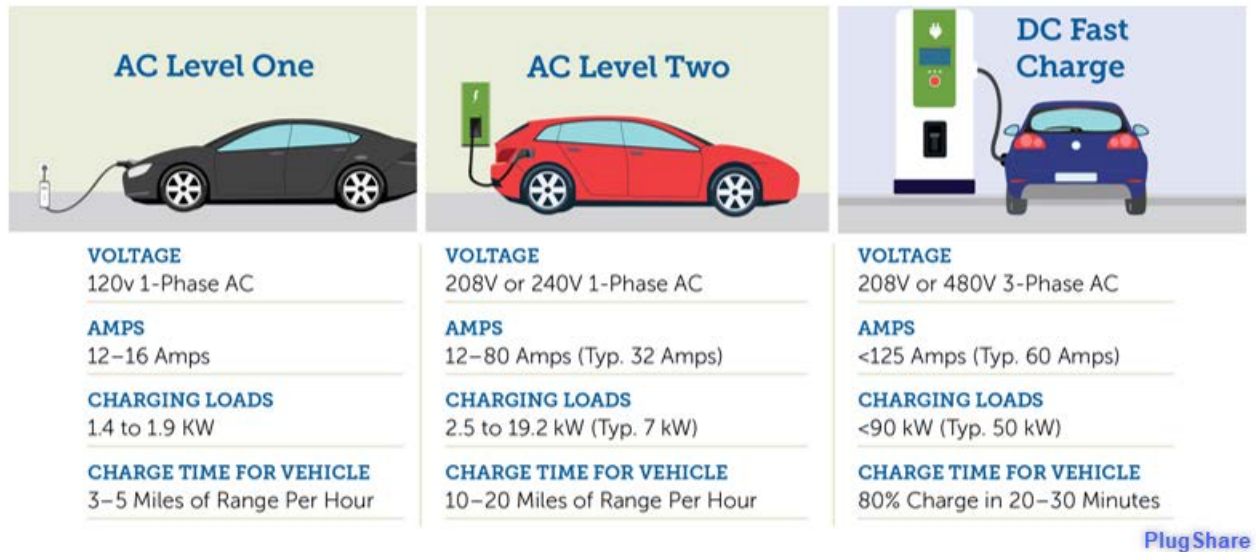


Figure 1. Electric Vehicle Charging Station Speed Comparison

The Electric Vehicle Market

Electric cars are making significant inroads across the globe. Vehicle electrification is occurring at varying rates as specific market, technological, infrastructure, and political factors allow. However, there is a broad movement toward electrification that is unlikely to slow in the near-term and is likely to accelerate. Figure 2 highlights the large variation in EV passenger vehicle sales that exists globally, with smaller and more aggressively subsidized nations such as Norway generating almost half of their overall sales from electric vehicles. China’s passenger

car sales are representative of this strong shift toward electrification, with electric vehicles accounting for over 4% of its overall passenger car sales in 2018. By contrast, nations such as the US and UK fall in the 2%-3% range, with an expectation that improving economics around cost of ownership will eventually drive the market toward greater electrification.

In the United States, this longer-term cost advantage is only beginning to be understood by drivers. Plug-in NC estimates that over a year, driving 12,000 miles, the cost of operating a standard gasoline vehicle would be about \$1,250 as compared to \$400 for an electric vehicle.³

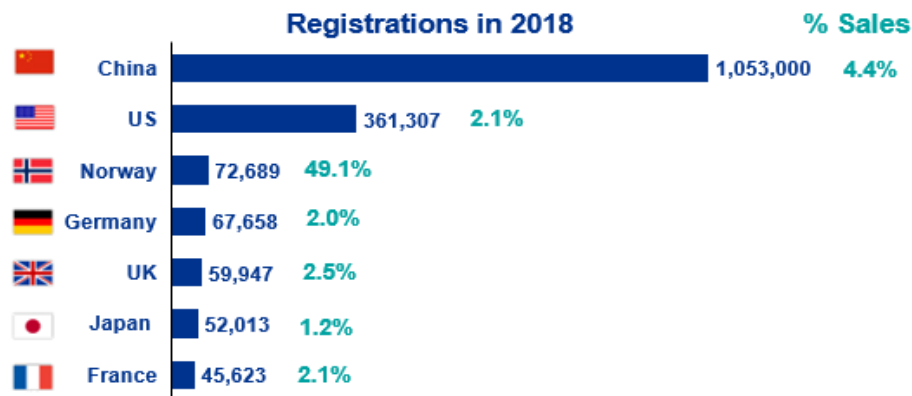


Figure 2. Large Market Share of Plug-in EV Passenger Car Sales, 2018

Increasingly, even when comparing upfront costs there are already several price competitive EVs on the market. The mileage range for a single charge is also improving (Figure 3).

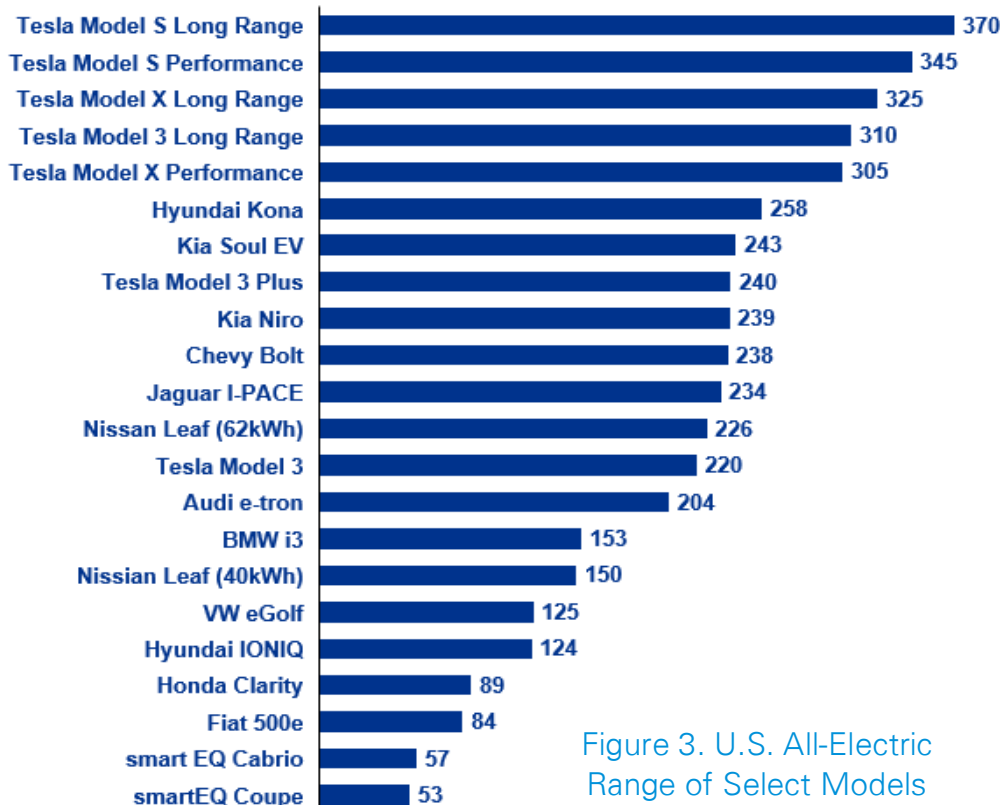


Figure 3. U.S. All-Electric Range of Select Models

³ <http://www.pluginncc.com/>

North Carolina EV Readiness

North Carolina has already made progress toward electric vehicle adoption. As of August 31, 2019, 9,614 all-electric cars were registered in the state. In 2012 and 2013, several North Carolina Metropolitan Planning Organizations and associated organizations (Greater Asheville⁴, Greater Charlotte⁵, Piedmont Triad⁶, the Greater Triangle⁷ and City of Raleigh⁸) developed electric vehicle readiness plans that helped spur charging station installation. Currently there are over 1,440 charging outlets across the state (Figure 4).

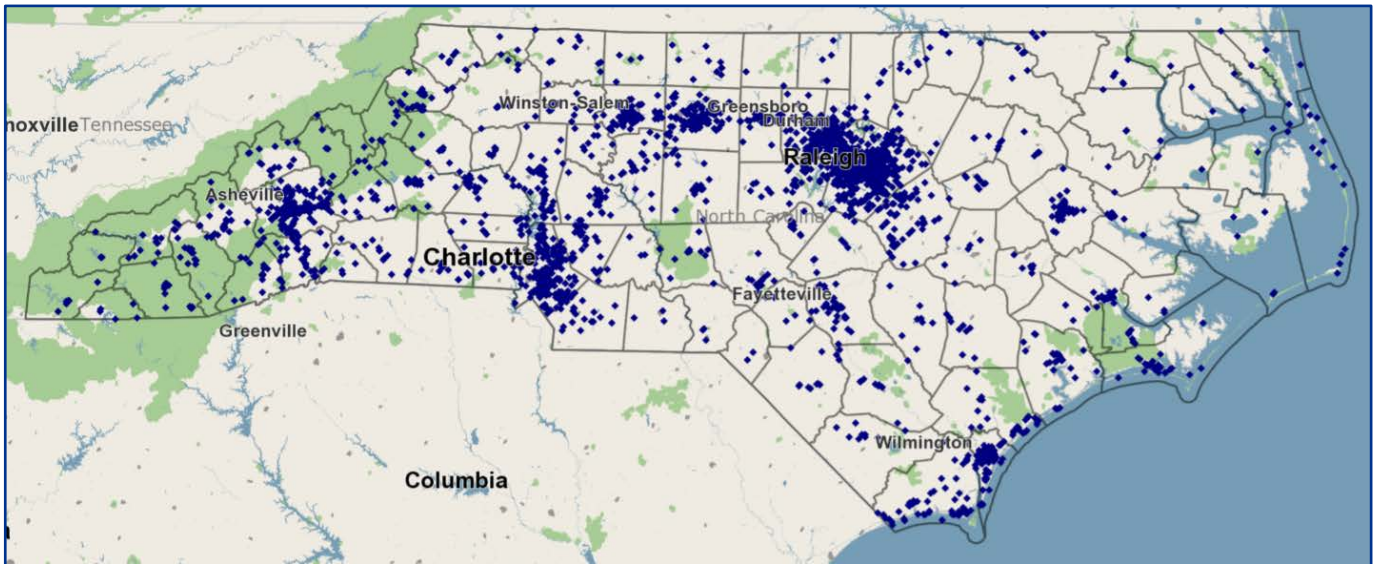


Figure 4. Level II and DC Fast Charge locations across North Carolina

Charging infrastructure has received increased attention recently because of North Carolina's \$92 million share of the Volkswagen Settlement, an agreement between the German automaker and the U.S. Department of Justice on behalf of the U.S. Environmental Protection Agency (EPA). Governor Cooper designated the N.C. Department of Environmental Quality (DEQ) to manage North Carolina's share of the settlement.

North Carolina's plan to distribute the settlement money is structured in three phases, so DEQ can seek additional input and make changes as needed along the way. In Phase 1 (2018 - 2020), DEQ plans to invest 33% of the overall funds (\$30.68 million). DEQ will manage the VW settlement funds through five programs, one of which is the Zero Emission Vehicle DC Fast Charge Infrastructure Program. This program is designed to expand the state's ZEV charging infrastructure network along priority designated corridors. North Carolina has committed to spending the maximum allowed for ZEV infrastructure, approximately \$4.6 million in Phase 1.

Work toward planning the optimal placement of DC Fast Charge (DCFC) Infrastructure has

⁴ <http://cleanvehiclescoalition.org/pdfs/GreaterAshevillePEVReadinessPlan-Version1.1-February2013.pdf>

⁵ <http://www.pluginnc.com/resource/greater-charlotte-plug-in-electric-vehicle-readiness-plan/>

⁶ <http://www.pluginnc.com/resource/piedmont-triad-plug-in-electric-vehicle-readiness-plan/>

⁷ <http://www.pluginnc.com/resource/greater-triangle-plug-in-electric-vehicle-readiness-plan/>

⁸ <https://www.raleighnc.gov/content/AdminServSustain/Documents/EVInfrastructureWrapup.pdf>

already begun with NCDOT’s work on the Federal Highway Association’s (FHWA) Alternative Fuel Corridors program. FHWA is helping establish a national network of alternative fueling and charging infrastructure along national highway system corridors. FHWA intends to support the expansion of this national network to encourage multi-state and regional cooperation and collaboration as well as bring together a consortium of stakeholders including state agencies, Clean Cities, utilities, and car manufacturers.

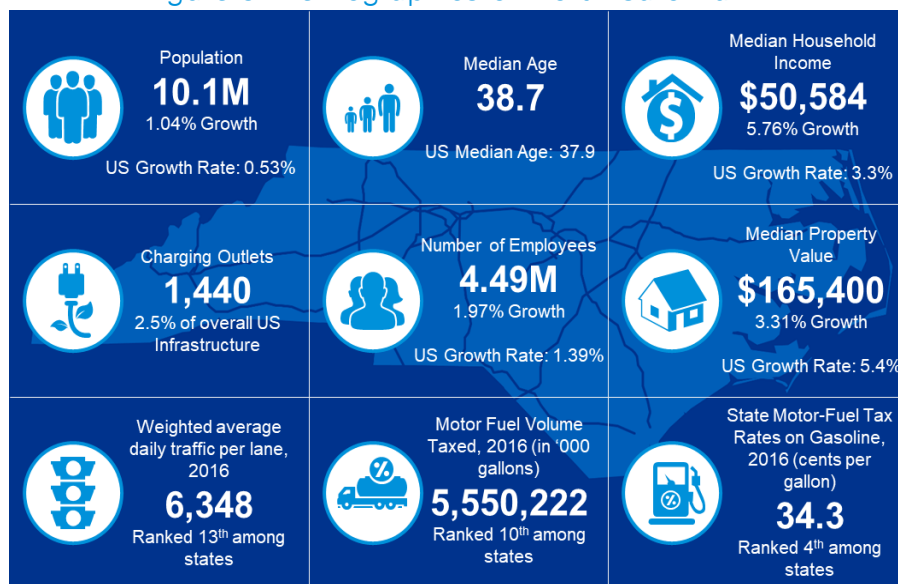
Data from North Carolina have also been incorporated into a multi-state Infrastructure Location Identification Tool.⁹ The tool was developed by the Georgetown Climate Center and M.J. Bradley & Associates. It allows the user to assess potential charging locations using key metrics for DCFC infrastructure including proximity to existing utilities, commercial activity, and demographic data. The tool is designed so a user may generate and visualize rankings of locations that reflect the relative suitability of those locations for charging station deployment based on regional- or state-level priorities. The tool is focused on publicly accessible DCFC infrastructure along over 11,000 miles of key EV corridors in the 12-state Transportation and Climate Initiative region (Virginia to Maine, including D.C.), and North Carolina.

The cities of Greensboro and Asheville are currently operating fully electric buses in their transit fleets. Chapel Hill Transit and GoRaleigh, the City of Raleigh’s bus service, will also have electric buses in service by the winter of 2020.

Demographics and Growth Potential

North Carolina’s growth trends create a positive environment for ZEV adoption. As shown in Figure 5, North Carolina’s population and median household income are growing much faster than the national average. These trends indicate that more North Carolinian’s will be interested

Figure 5. Demographics of North Carolina

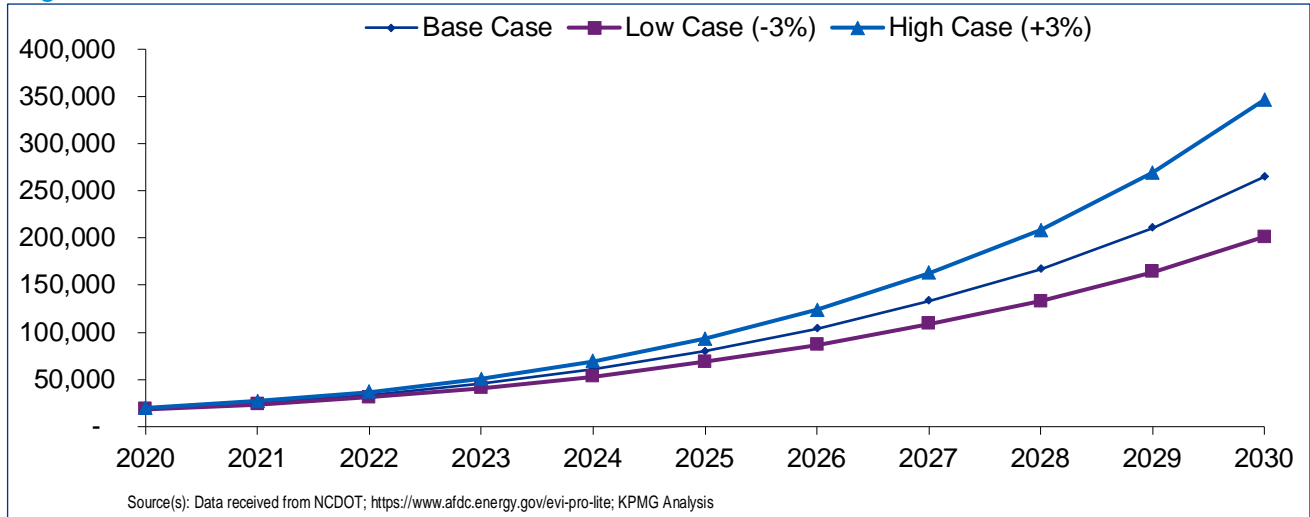


⁹ <https://www.georgetownclimate.org/articles/ev-corridor-analysis-tool-for-northeast-and-mid-atlantic-states.html>

in and able to purchase ZEVs. While economic and population growth may be most pronounced in North Carolina’s urban centers, rural communities and electric member cooperatives have an important stake in transportation electrification.

Recent forecasts using Bloomberg’s Electric Vehicle Outlook¹⁰ indicate the total number of electric vehicles in North Carolina could top 250,000 by 2030. As an emerging technology, the electric vehicle adoption rate depends upon supporting infrastructure, public policies, public awareness, technology improvements and other factors. This plan seeks to foster the supporting infrastructure and promote electric vehicle benefits.

Figure 6: North Carolina Electric Vehicle Forecast



NCDOT Electric Vehicle Survey Results

In addition to looking at the external environment and high-level factors related to adoption, the NCDOT deployed a survey to gain insights into personal views on electric vehicles.

Over 1,000 people, representing 76 North Carolina counties, participated in an online MetroQuest® survey capturing attitudes on the vehicles themselves as well as other related issues that might affect the decision to eventually purchase an electric vehicle. More than 90% of those surveyed indicated they had at least some level of concern about the effects of climate change on their daily lives (see Figure 7).

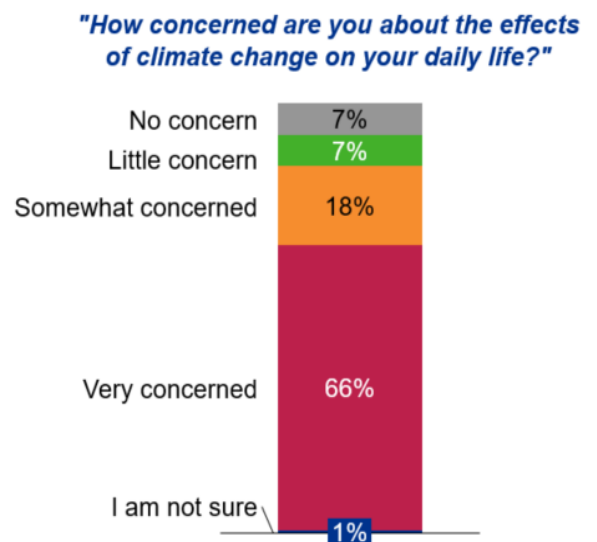


Figure 7: Survey – Level of Climate Change Concern

¹⁰ https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf

When asked to rank the factors that would contribute to their purchase of a zero emissions vehicle, financial incentives were the highest followed by technical concerns, such as range per charge (see Figure 8). In other findings, few respondents would find it difficult to fit an electric vehicle into their daily routines (see Figure 9). Over 80% of respondents reported daily travel of less than 50 miles, a range that is achievable by nearly every electric vehicle model. Models offered by Nissan, Chevy, Hyundai, Kia, Tesla, and others offer ranges of over 150 miles per charge.

Figure 8: Survey – Key Purchase Factors

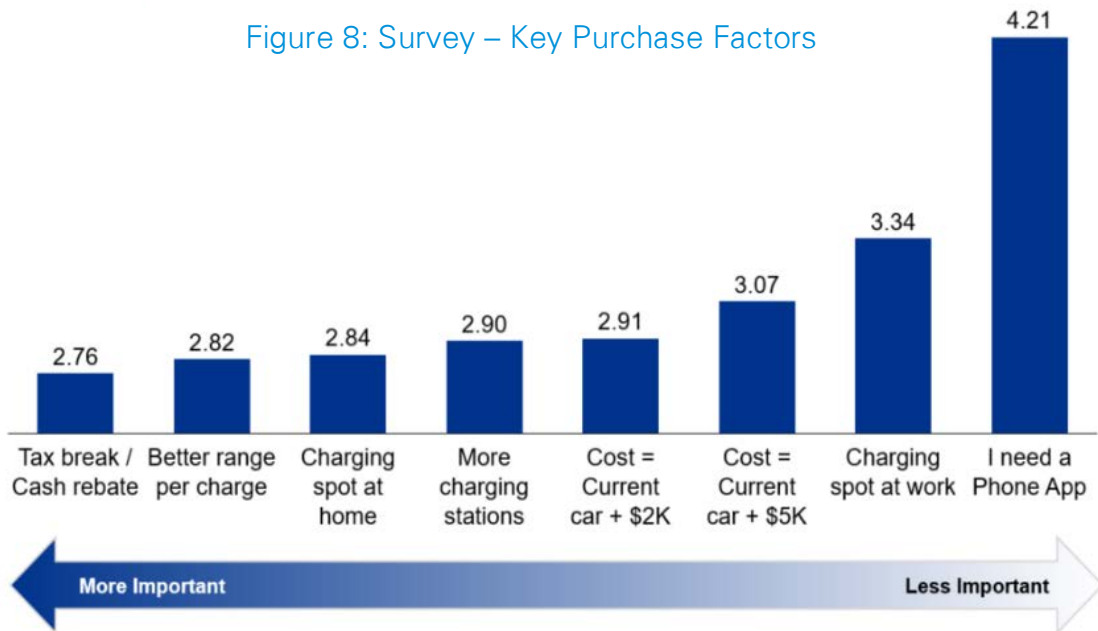


Figure 9: Survey – Daily Mileage

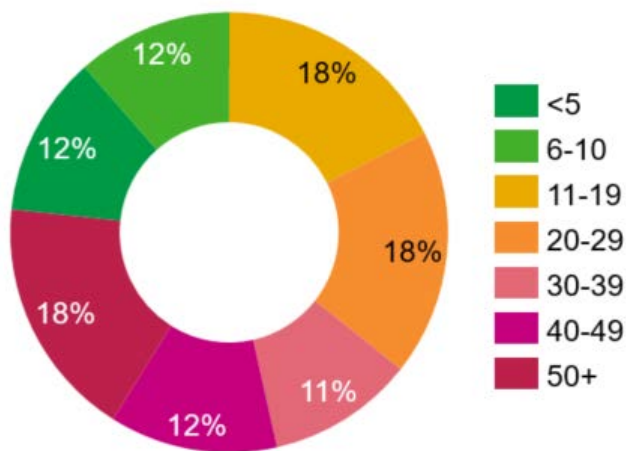
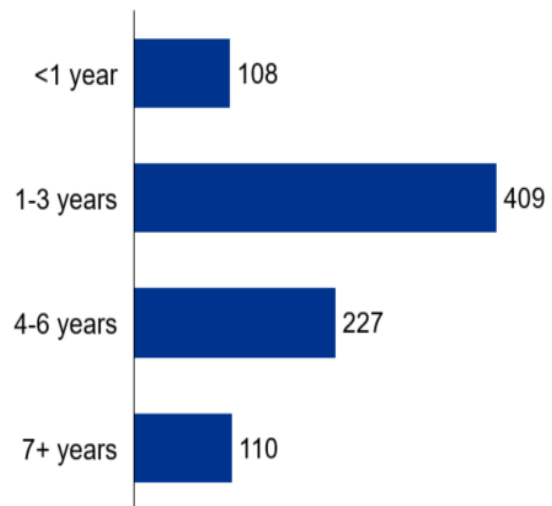


Figure 10: Survey – Vehicle Replacement



In addition, 6 in 10 respondents plan to buy a new car within the next three years, meaning that an electric vehicle – properly positioned – could be seriously considered in their purchasing decision (see Figure 10).

Respondents were also asked for input on charging station locations across the state that would enhance connectivity by providing access to charging sites other than just work and home, such as shopping centers and recreation facilities (see Figure 11).

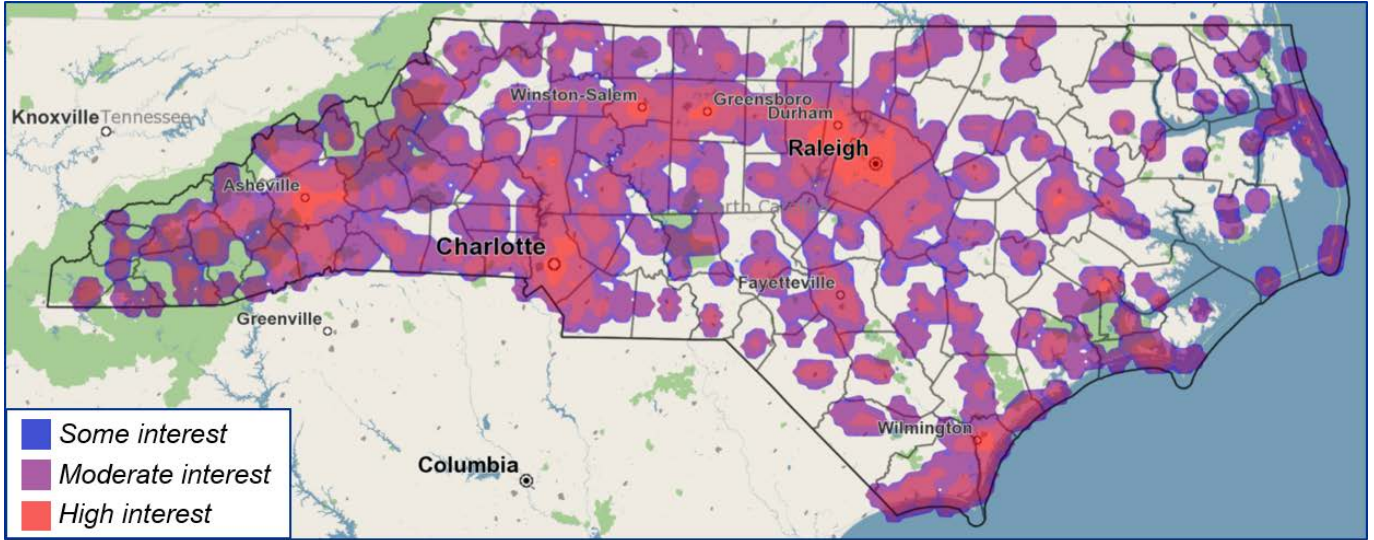


Figure 11: Locations of Interest for Charge Station Deployment

Timeline for Adoption Initiatives

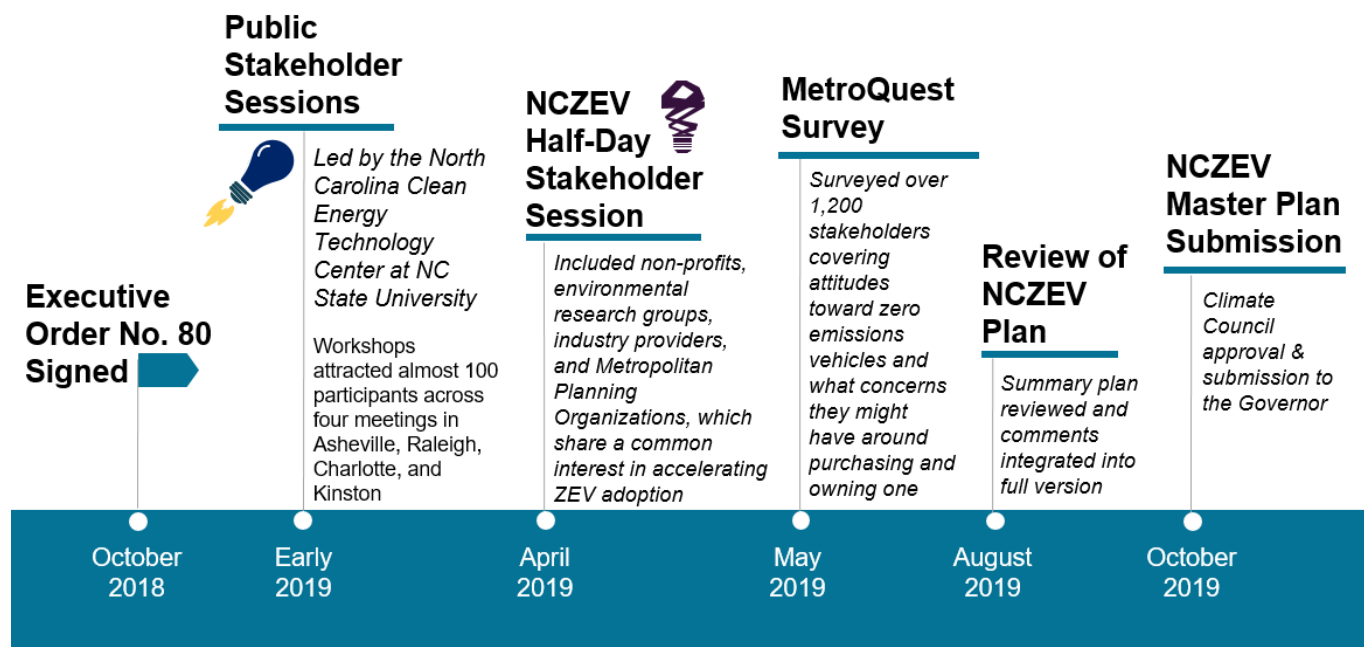
The timeline graphic below provides the anticipated timeframes for the implementation and achievement of the short-, medium-, and long-term strategies laid out in this plan. This plan is not intended to be fixed and the rapidly shifting nature of many of the underlying factors that are being addressed will need to be monitored to ensure that the plan remains relevant and on schedule. A standard cadence of updates and strong program tracking will provide this input, allowing course-corrections over time.



3. Strategies to Accelerate Adoption

Timeline of Activities

Following the signing of Executive Order No. 80 in October 2018, the following activities were completed to help ensure that aspects of the plan would receive adequate consideration and that appropriate stakeholder input would be included.



Key Takeaways from Stakeholder Engagement

To help develop strategies to achieve at least 80,000 ZEVs by 2025, the NCDOT working group brought together a diverse set of viewpoints from parties included in the plan. The North Carolina Clean Energy Technology Center at North Carolina State University held a series of public sessions in early 2019. These workshops attracted almost 100 participants across four meetings in Asheville, Raleigh, Charlotte and Kinston. In addition to these public meetings, the NCDOT’s working group and consultants held a half-day session with several stakeholders to share information and collaborate on how to promote electric vehicle use in North Carolina. The stakeholders represented multiple organizations of auto manufacturers, environmental non-profits, community organizations, businesses, Metropolitan Planning Organizations, and universities.

In addition, the NCDOT’s working group reviewed studies done in North Carolina and other states, including the Greater Charlotte Plug-in Electric Vehicle Readiness plan (2012), Greater

Asheville Plug-in Readiness Plan (2013), Piedmont Triad Plug-in Electric Vehicle Readiness plan (2013), and the Greater Triangle Plug-in Electric Vehicle Readiness plan (2013). From all these sources, a list of initiatives was developed and ranked on several criteria.

The resulting four major initiative categories shown below were developed based on this work and represent collections of initiatives that – when combined into a single effort – could have greater impact than deployed individually.

It is also important to note that these categories are only starting points: they represent a convenient means of describing the diversity of input provided to the NCDOT by the various parties with an interest in achieving the goals of Executive Order No. 80. Each of these categories include actions that require detailed planning to ensure that they align with the interests of North Carolina and the many stakeholders throughout the state.

Education	Convenience	Affordability	Policy
<ul style="list-style-type: none"> *Regularly post NC vehicle registration online *EV marketing campaign *Coordinate Ride & Drive events *Fleet education and outreach *Guidance document on charging infrastructure 	<ul style="list-style-type: none"> *Facilitate fast charging collaboration *Develop workplace charging programs *Charging in rest areas *Establish consistent wayfinding signage *Enhance corridor definitions 	<ul style="list-style-type: none"> *Financial Incentives *Original equipment manufacturer rebates *Green vehicle loans w/credit unions *Create dealership incentives *Encourage secondary electric vehicle markets 	<ul style="list-style-type: none"> *Regional electric vehicle initiative *Electric vehicle user fees *Update building codes *Conversion to electric transit fleets *Motor fleet shift to zero emissions vehicles *Innovative EV rate design

Bold Text indicates work already started

Leading Practices for State-wide Adoption



Education

One of the most significant barriers to EV adoption is a basic lack of awareness of the benefits of EV ownership. As recently as 2017, half of all US consumers were unfamiliar with electric vehicles and related technology.¹¹ Many consumers lack an understanding of available models, vehicle performance, cost effectiveness, vehicle range per charge, and opportunities to charge.

Now that the market is starting to mature in some states, EVs are being showcased through mainstream outlets such as television commercials, online ads, and other traditional marketing avenues, creating a broader understanding of the technology across a variety of demographics. Consumer awareness tends to improve through marketing campaigns, direct conversations with EV owners and first-hand experience driving an EV.

Increasing consumer education about electric vehicles will require a coordinated effort by North Carolina's Department of Transportation and other state agencies, OEMs, auto dealers, and electric utilities, and other stakeholders to develop a comprehensive marketing and outreach program. This section recommends strategies for increasing consumer familiarity and comfort with electric vehicles.

Regularly Post NC Vehicle Registration Data Online [Short-term]

Strategy: Make vehicle registration data available on-line.

Lead Actors: NCDOT

Key Stakeholders: Municipal and local governments, businesses, NGO's, general public.

As a first order level of transparency of the progress towards the EO 80 goal of 80, 000 electric vehicles by 2025, NCDOT will post vehicle registration data. The number of registered electric vehicles, plug-in hybrid vehicles, hybrids, and conventional ICE vehicles will be listed by county and by zip code. This data will not only document the progress of EV adoption in the state, but also provide a valuable reference by which almost all the strategies proposed here can be monitored and, if necessary, adjusted. Similarly, local governments, businesses, and NGO's will have This data available to help guide their efforts to siting charging infrastructure, applying for grants, or otherwise targeting their endeavors.

EV Marketing Campaign [Short-term]

Strategy: Establish a multi-stakeholder marketing campaign directed at consumer segments

¹¹<https://www.mckinsey.com/~media/mckinsey/industries/automotive%20and%20assembly/our%20insights/electrifying%20insights%20how%20automakers%20can%20drive%20electrified%20vehicle%20sales%20and%20profitability/how%20automakers%20can%20drive%20electrified%20vehicle%20sales%20and%20profitability/mck.ashx>

mostly likely to purchase EVs.

Lead Actors: NCDEQ, NCDOT

Key Stakeholders: Electric utilities, local dealerships, OEMs, NGOs, community EV groups

Increasing consumer education about EVs will benefit from a coordinated effort by state agencies, local governments, original equipment manufacturers (OEMs), auto dealers, and electric utilities, and other stakeholders. A statewide marketing campaign should be developed that incorporates all aspects of electric vehicle adoption establishing a consistent message linking all the strategies proposed here.

Coordinate Ride & Drive Events [Short-term]

Strategy: Identify opportunities for drivers to benefit from organizational partnerships with local dealerships to allow the public to drive in the newest and most popular electric vehicles.

Lead Actors: NC Clean Energy and Technology Center, electric utilities.

Key Stakeholders: Local dealerships, NCDOT, state agencies, municipal and county governments, businesses.

Many consumers are interested in owning an EV yet are hesitant to purchase. Ride & Drive events provide consumers an opportunity to learn about and test drive EVs. Ride & Drive events occur periodically across the state. The City of Charlotte, for example, conducted an extensive Ride & Drive event as part of 2019 National Drive Electric Week with the Nissan Leaf as the executive automotive sponsor. The event promotion shown below captures many of the elements that will motivate a consumer to attend.

In addition to traditional Ride & Drive events, consumers can benefit from a modified, extended EV demo option. Under this approach, consumers can borrow an EV for up to one week, which allows them to get a better sense for the technology and how such a vehicle could integrate into their daily lives. For example, many stakeholder organizations observed that extended Ride & Drives provide consumers with first-hand experience of EV performance during a typical work week.

“Come join the party! We are throwing a party for National Drive Electric Week 2019. Join us for music, food from electric food trucks, ride-n-drives, and a display of the latest electric vehicles on the market...our community partners will be on the scene talking about clean air initiatives and there will be games and giveaways for kids. Bring the whole family to see why you should switch to electric!”

- Charlotte National Drive Electric Week

Fleet Education and Outreach [Short-term]

Strategy: Promote conversion to electric vehicle fleets with key private and government fleet managers.

Lead Actors: NC Clean Energy Technology Center

Key Stakeholders: Private fleet operators, state and local government fleet operators, NCDOT, NCDOA, electric utilities.

Compared to personally owned vehicles, fleets hold potential for quicker, broader electric vehicle adoption. This is because fleet buyers base purchasing decisions off the total cost of vehicle ownership, a metric for which electric vehicles offer several potential benefits.

- 1. Operating Costs:** Typically, the fuel cost per mile is significantly less for electricity compared to gasoline or diesel. Additionally, maintenance costs are significantly lower due to electric motors having fewer moving parts and requiring less overall servicing.
- 2. Useful Life (miles driven):** Given that the upfront cost of a vehicle is fixed over its useful life, the total cost of ownership becomes more favorable the longer the vehicle remains in use. With fewer moving parts, electric vehicles tend to last longer than vehicles with combustion engines.
- 3. Battery Costs:** Batteries typically make 30-40% of manufacturing cost. However, costs are falling quickly, with year-on-year reductions of almost 20% so far and 12% reductions through 2025

It is likely that the fleet buyer will favor electric vehicles when total cost of ownership becomes favorable compared to gasoline vehicles, even if the upfront cost of an electric vehicle are higher.¹² For commercially focused fleet managers a small reduction in total cost of ownership per vehicle can amount to a very large sum across their entire fleet.

Guidance Document on Charging Infrastructure Installation & Management [Short-term]

Strategy: Establish and regularly update guidance documents to assist government and private sector entities with installation and management of charging infrastructure.

Lead Actors: NC Clean Energy Technology Center, Department of Insurance

Key Stakeholders: DOA, state agencies, local governments, businesses, NGOs.

Segments of state and local governments as well as businesses are installing more and more charging stations for the public and their employees each year. When installing charging stations, questions often arise around requirements and best practices for installation and operation. A guidance document addressing these questions will facilitate increased

¹² OVO Energy (2017). Electric cars top list of most-coveted technology amongst Brits for 2017. [online] Available at: <https://www.ovenergy.com/ovo-newsroom/press-releases/2017/august/electric-cars-top-list-of-most-coveted-technology-amongst-brits-for-2017.html> [Accessed 6 Jun. 2018].

deployment of charging infrastructure. Such a document should address topics such as appropriate charging rates, recommended specifications and functionality of charging stations, access to and management of charging data, and treatment of ICE vehicles that park in EV-designated spaces. In addition, guidance should provide clarity to local governments, developers, property owners, and EV infrastructure companies by identifying a realistic pathway for installing EV charging stations in compliance with requirements of the Americans with Disabilities Act.



Convenience

Adoption of electric vehicles is contingent on a positive consumer experience. Ensuring that electric vehicles are not only affordable, but also functional, attractive, and meet the everyday needs of drivers is critical to EV adoption. The initiatives described below are designed to make it easier for drivers to integrate EVs into their daily schedules by making charging opportunities outside the home more available.

Facilitate Fast Charging Collaboration [Medium-term]

Strategy: Continue to support existing Fast Charging Corridor efforts and collaborate directly on planning and rollout of fast charging networks with industry partners.

Lead Actors: NCDEQ

Key Stakeholders: NCDOT, electric utilities, businesses, and N.C. Utilities Commission.

Fast charging refers to EV charging stations of at least 50kW capacity that allows EV drivers to receive a full charge in a matter of minutes, not hours. Current charging technology provides up to 250kW charges, which provides about 250-miles of range in about 30 minutes. Some consumers have concerns that EVs do not allow them to drive far enough with a fully charged battery, a concern referred to as “range anxiety.” Range is a major purchase consideration for consumers considering electric vehicles, and consumers who perceive a lack of sufficient charging infrastructure will be less likely to purchase an electric vehicle.

Fast charging allows EV owners to charge in a reasonable amount of time when on trips or if needed for driving around town. Targets for fast charging collaboration efforts include retail centers, rest areas, grocery stores, public parking lots, and gas stations. It is important to build fast charging networks for travel between important destinations, such as cities and tourist attractions, and conscientious siting of charging infrastructure can provide equitable access in low-income and rural areas. Funding to expand the state’s charging infrastructure network under the Volkswagen Settlement administered by NCDEQ gives priority to projects proposed along designated Fast Charging Corridors.

Develop Workplace Charging Programs [Medium-term]

Strategy: Launch workplace charging programs or pilot programs at large employers, such as government and businesses.

Lead Actors: NC Clean Energy Technology Center

Key Stakeholders: Corporations, Industry partners, utilities, municipalities.

Workplace charging programs can provide convenience and assurance to employees with limited charging access at their homes. Municipalities in North Carolina are ideal candidates for workplace charging programs given their influence over early - often expensive and time-consuming - steps in deploying these programs, such as working through design and permitting, as well as administering any incentives. Workplace charging programs can facilitate electric vehicle adoption among employees by providing charging stations in facility parking lots, dedicated EV spaces, and on-street parking.

US DOE Workplace Charging Challenge has partnered with over 600 workplaces to install over 5,500 charging stations accessible to over one million employees.

US DOE surveyed many of these partner workplaces and found that participants were much more likely to purchase and drive an electric vehicle. In addition, North Carolina can look to take advantage of US DOE federal grants to jumpstart its initial workplace charging pilot program.

Employees with access to workplace charging are SIX times more likely to drive a PEV than the average worker

- Department of Energy Workplace Charging Challenge Mid-Program Review: Employees Plug In

Charging in Rest Areas [Long-term]

Strategy: Continue to investigate the feasibility of options to provide DC Fast Charging at Interstate rest areas, reconciling legislative issues as necessary.

Lead Actor: NCDOT

Key Stakeholders: NCDOT, FHWA, utilities, NC General Assembly

Located off major interstates and with attractive amenities, North Carolina's rest areas are well-positioned as potential locations for DC Fast Chargers to enhance North Carolina's EV corridors. However, there are several hurdles that must first be overcome:

1. **Revenue Generation on Federal Right of Way:** Federal law prohibits revenue generation at rest areas unless it is used to defray cost of the service provided.
2. **Distribution of Power:** To distribute power, a FHWA approved State Utility Accommodation Policy (UAP) must be in place; North Carolina does not have a UAP.
3. **Session Law 2012-186:** State law states that NCDOT may operate an electric vehicle charging station at State-owned rest areas only if the following conditions are met:

- i) The electric vehicle charging state is accessible by the public
 - ii) A mechanism is developed to charge the user a fee to recover the costs of electricity consumed, processing the user fee, and operation and maintenance.
4. **Electrical Infrastructure:** Fast Charging requires 3-phase power services. North Carolina rest areas do not have 3-phase power and estimates to install the infrastructure to provide 3-phase power can be costly.

Even as 3-phase power infrastructure becomes more prevalent throughout the state, there will still be a need to reconcile conflicting North Carolina and Federal laws.

Establish Consistent Wayfinding Signage [Short-term]

Strategy: Increase deployment of clear, uniform road signage to indicate public charging stations and identify critical areas throughout the state for placement.

Lead Actor: NCDOT

Key Stakeholders: Metropolitan Planning Organizations, local governments, businesses.

North Carolina already has over 1,440 EV charging stations but lacks comprehensive signage for directing residents to public charging stations. Consistent charging signage across all electric vehicle corridors in North Carolina will increase public awareness of charging station availability and may contribute to reduced concerns regarding range.

Recent research has shown that universal electric vehicle charging signage is associated with increased consumer interest. North Carolina can adopt the Federal Highway Administration (FHWA) design for uniform charging station signage as seen in Figure 12 as well as continue to gather input into optimal signage placement.



Figure 12: FHWA Approved Wayfinding Signage Designs¹³

Enhance Corridor Definitions [Short-term]

Strategy: Refine definitions of current FHWA alternative fuel corridors to be more EV focused to encourage investment of charging infrastructure along designated corridors.

Lead Actors: NCDOT, FHWA

¹³ https://afdc.energy.gov/fuels/electricity_charging_station_signage.html

Key Stakeholders: State government agencies, Metropolitan/Rural Planning Organizations

In 2016 and 2017, North Carolina designated portions of I-85, I-40, I-26, I-77 and I-95 as Alternative Fuel Corridors as part of the FHWA Alternative Fuels Corridors program (Figure 13). Designation through this program is based on location of currently available infrastructure. An enhanced corridor definition will allow the state to determine the focus on where to develop future charging infrastructure. For instance, I-85 corridor shown in Figure 13 has one of the highest AADT in the region and has already been identified by the North Carolina Division of Air Quality as a priority corridor to receive funding for DC Fast charging through the VW settlement.

Figure 13: Designated Electric Vehicle Corridors



To define these enhanced corridors, NCDOT will need to take into consideration factors such as proximity to employment, availability of power, modal connections, right of way ownership, and others. Obtaining public input on locations of charging infrastructure (as shown previously on Figure 11) indicates that while there is a general desire for charging across the state, the need to develop corridors such as US 74, US 70, US 64, and US 17, to ensure access to tourist locations and evacuation routes that may not be identified by other siting criteria. Finally, identifying corridors based on travel behavior indicators such as annual average daily traffic (AADT) and EV ownership per capita, will present strong reasoning for charging stations to be funded, planned, and constructed in a manner that provides optimal charging coverage.

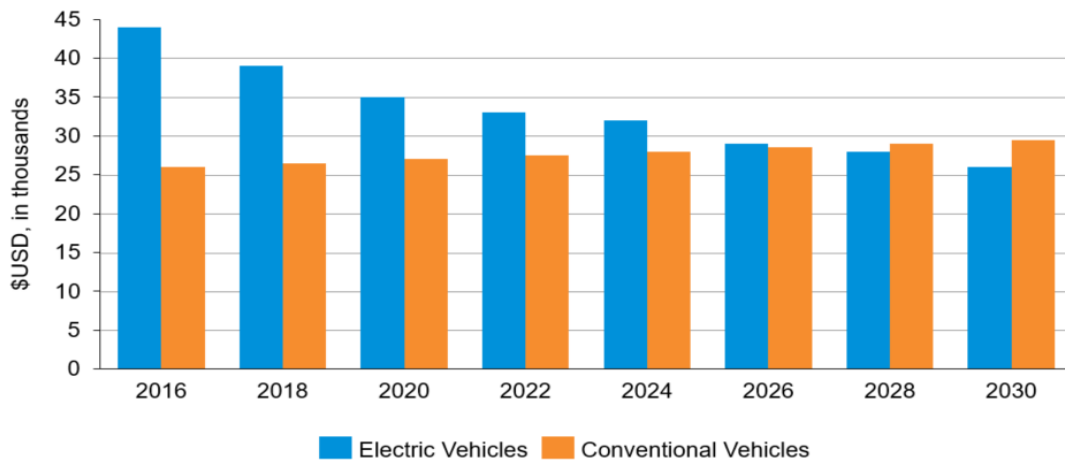
Establishing these corridors will enable the legislature to more easily provide public funding that will ultimately encourage private investment in fast charging along designated corridors. An increase in EV trips combined with a decrease of ICE vehicle trips could reduce emission hot spots along these corridors, which often affect disadvantaged populations.



Affordability

Among the most impactful strategies for increasing EV adoption are those that reduce the purchase price. While the purchase price of many EVs is higher than those of ICE vehicles, EVs generally are less expensive to own (lower fuel costs, no oil changes, fewer mechanical linkages, etc.). This makes EVs an attractive option for many consumers, including those in low- and middle-income households. However, the shared vehicle market may rapidly close this gap. As Figure 14 shows below, the gap between the average price of EVs and ICE vehicles is set to close over the next several years.

Figure 14: Forecasted Price of Electric vs. Conventional Vehicles



Source: BloombergNEF

Financial Incentives [Long-term]

Strategy: Provide a state tax credit and other financial incentives to drive EV purchases by reducing up-front costs.

Lead Actors: NC General Assembly, research institutions

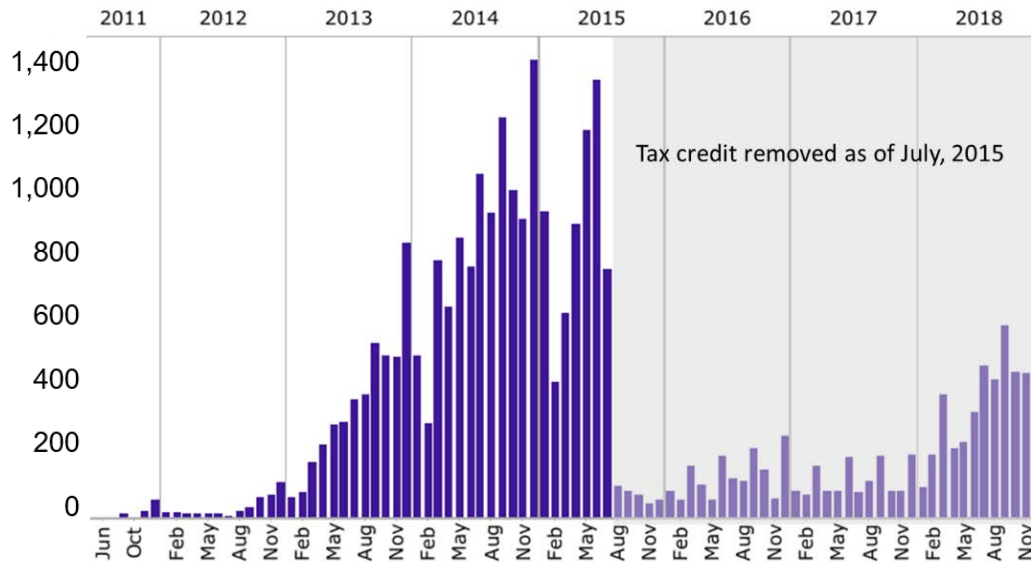
Key Stakeholders: NC General Assembly, NCDOT, dealerships, NGOs, electric utilities.

The \$7,500 federal tax credit for EV purchases has improved EV affordability and helped drive adoption over the past several years. That incentive is beginning to phase out for popular models, and there is some discussion about eliminating the federal tax credit altogether. Elimination of the federal tax credit would leave a significant gap in funding, as the average upfront price of an electric vehicle is unlikely to reach parity with comparable gasoline models until approximately 2025.

In addition to federal tax credits, state tax credits have proven effective at driving EV adoption. Georgia's \$5,000 state tax credit led to a surge in EV adoption in 2014-2015, and sales plummeted once it was removed in 2015 (Figure 15). Representatives in Georgia's state legislature have recently proposed HB 732 which would restore the credit at a more moderate

level of \$2,500 with a hard end date of 2023.¹⁴ Commissioned studies have highlighted that the credit and adjustments to fees could create almost 1,000 full-time jobs in the state and grow Georgia’s state GDP by \$100 million over the next five years.¹⁵ Georgia’s experience indicates that a critical element for driving sustained EV adoption is a well-timed implementation and predictable phase-out schedule.

Figure 15. EV sales in Georgia



Alliance of Automobile Manufacturers (2019). Advanced Technology Vehicle Sales Dashboard.

To inform discussions on state tax credits and other financial incentives (e.g., point-of-sale rebate, rebate or credit for installation of charging infrastructure), university researchers and stakeholders could conduct analysis on the impacts of various policy designs. Policy design topics include the level of state tax credit and other financial incentives, qualifying vehicles and owners, duration of the financial incentive, and presence and length of a phase-out period. Important impacts include the effects on vehicle adoption rates, equitable access to incentives, and the costs of providing the incentive.

Original Equipment Manufacturer (OEM) Rebates [Long-term]

Strategy: Original manufacturers offer and publicize rebates at the point of sale for an electric vehicle

Lead Actors: Auto manufacturers

Key Stakeholders: Dealerships, EV associations

To increase affordability of EVs, manufacturers such as Nissan offer customer rebates on EV purchases. Nissan offers a \$3,500 rebate for electric coop members in NC for the purchase of a Nissan LEAF and a \$3,000 rebate for members of Plug-In NC. Rebates from additional

¹⁴ CleanTechnica – Bill Introduced to Reinstate Georgia EV Tax Credit

¹⁵ PlugInAmerica – Economic Opportunities of Electric Vehicles in Georgia

manufacturers can increase interest in EVs and their affordability for a larger segment of consumers, including low- and middle-income buyers in rural and urban communities. Manufacturer rebates apply in addition to tax credits and other financial incentives. For example, a Nissan LEAF with an MSRP of \$35,000 would effectively cost \$24,000 after a \$3,500 rebate and \$7,500 federal tax credit. In addition to the reduced purchase price, the vehicle owner would benefit from ongoing savings through reduced operation and maintenance costs.

Green Vehicle Loans with Credit Unions [Short-term]

Strategy: Credit unions and commercial banks provide low-interest financing for customers who purchase electric vehicles.

Lead Actors: Credit unions, commercial banks

Key Stakeholders: Local dealerships.

Although EVs are affordable for many consumers today and are declining in cost, they are still out of reach for some consumers. Currently, there are loan programs in North Carolina that exist for electric vehicles and can be used as a baseline to scale a green vehicle loan initiative. ElecTel Cooperative Federal Credit Union, for example, offers special low-interest loans for the purchase of electric vehicles.

“Green loans are likely to appeal to millennials – those drivers who are now in their teens to late 20s and tend to be more environmentally conscious than previous generations”

- Jeffrey Stoltman, professor of marketing at Wayne State University in Detroit

To maximize the effectiveness of these loans, partnerships can work directly with participating car dealerships. Similar to conventional loans, participating dealerships would be able to process a customer’s green vehicle loan application on the lot and determine eligibility.

Create Dealership Incentives [Short-term]

Strategy: Outline and evaluate potential incentives to local dealerships to ensure electric vehicle models are displayed on showrooms and charged for test drives.

Lead Actors: NC Clean Energy Technology Center

Key Stakeholders: Local dealerships, NGOs, universities.

Dealerships are a key part of electric vehicle adoption. Dealerships without electric vehicle models displayed and ready for test drives will almost always affect the consumer’s purchase decision. In addition, many dealerships have high employee turnover within the sales force, making it more difficult to establish and coordinate long-term plans.

More research is needed to identify the most effective and sustainable mechanisms to encourage local dealerships to sell electric vehicles. Given that dealerships take on debt to

cover inventory, the decision to keep electric vehicles on the lot requires confidence in the local market.

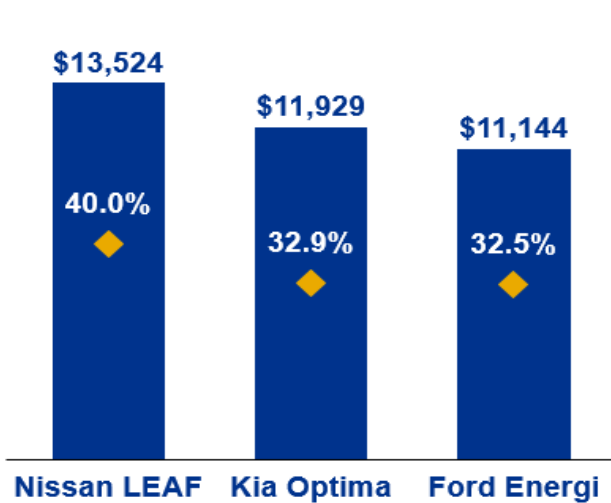
Encourage Secondary Electric Vehicle Markets [Medium-term]

Strategy: Identify ways to drive a larger and healthier secondary market for electric vehicles, coordinating with manufacturers to develop a pipeline of used vehicles into North Carolina.

Lead Actors: NCDOT, NC Clean Energy Technology Center, Climate Alliance members

Key Stakeholders: State credit unions and local dealerships.

The used market for electric vehicles represents a small but growing portion of overall transactions. Recent studies have highlighted savings that can be realized by opting for a used instead of a new vehicle. A used Nissan LEAF, for example, can be bought for approximately 40% less than new models. These numbers will moderate over time as the market and



technologies mature but are an increasingly viable way to get and keep electric vehicles on the road. Increased access to used EVs is an opportunity for low- and middle-income populations to participate in and benefit from transportation electrification.

Encouraging used electric vehicle purchases will require significant enabling efforts around educating consumers about their options as well as how electric vehicles as a powertrain are fundamentally different. Warranties, while still

three years for most major areas of the car, are federally mandated at eight years or 80,000 miles for the battery. In addition, states that have opted into the Zero Emissions Vehicle Memorandum of Understanding (“ZEV States”) this battery coverage is extended to 15 years and 150,000 miles.



Policy

Adoption of electric vehicles is contingent on adapting or creating the right policies. State alliances and coalitions can encourage private industry investment and ensure that efforts do not stop at state borders.

Regional Electric Vehicle Initiative [Short-term]

Strategy: To establish a regional collaboration that is mutually beneficial to residents and businesses in participating states to promote a seamless cross-state driving experience, increase public awareness of EVs, and facilitate the sharing of best practices for policy development and program implementation.

Lead Actors: Governor's Office, NCDOT, NCDEQ

Key Stakeholders: EV industry, federal government, local governments, electric utilities

State alliances and coalitions can encourage private industry investment and interstate coordination. The Southeast is home to a strong automotive sector that includes a robust supply chain and manufacturing plants for several major automotive companies that are increasing their investments in electric vehicles. A regional initiative in the Southeast would signal to the auto industry and other players in the EV industry that the region wants to increase EV adoption and capture associated economic and job opportunities. In addition, a regional initiative could facilitate installation of charging infrastructure to support the tourism and recreation sectors. It could also facilitate access to charging infrastructure and electric vehicles in small towns and rural or underserved communities.

Electric Vehicle User Fees [Long-term]

Strategy: Establish and maintain a fair fee structure for electric vehicles, which may include road usage charges, mileage-based user fees or other mechanisms

Lead Actors: NC FIRST Commission, NCDOT, NC General Assembly

Key Stakeholders: NC residents, universities

The NC FIRST commission was created by Transportation Secretary Jim Trogdon in March 2019. It is tasked with evaluating North Carolina's current and future transportation investment needs and providing recommendations to ensure that critical financial resources are available in the future. The NC First Commission will consider fee structures such as vehicle registration fees, road use charges, and mileage-based user fees to maintain equity of electric vehicle drivers that use roads and infrastructure but do not pay federal and state taxes "at the pump" like conventional vehicles. A fee structure affecting EVs should be established with consideration of implications for EV adoption, revenue generation, environmental consequences, and disadvantaged communities and should not be set at levels that discourage EV adoption. The Commission will send recommendations to the NCDOT Secretary for evaluation and presentation to the General Assembly.

Update Building Codes [Medium-term]

Strategy: Modify building policies and practices, such as building codes, the state construction manual, and applicable statutes, to help enable EV charging installation.

Lead Actors: NC Building Code Council, Department of Administration or Insurance

Key Stakeholders: NC General Assembly, metropolitan planning organizations, non-profit organizations, trade associations.

Adopting EV-ready building codes is a top priority for North Carolina, given it is much more expensive to retrofit existing buildings for EV accessibility and usage. Outfitting buildings with

parking spaces, complete with wiring and appropriate safety equipment can be approximately 65% less expensive¹⁶ than installing these features to the same specifications after full construction. North Carolina will need analyses of existing policies to identify specific changes to the building code and other policies that affect residential (including multi-family residences), commercial, industrial, and government buildings. These changes should balance the interests of increasing availability of charging infrastructure with home affordability and long-term housing and transportation trends.

Conversion to Electric Transit Fleets [Medium-term]

Strategy: Establish a taskforce to study conversion to electric transit fleets in North Carolina and issue a report that recommends numeric goals and strategies for electrifying transit fleets.

Lead Actor: NCDOT

Key Stakeholders: NCDOT, transit fleet managers, OEMs

Shifting to electric transit fleets in North Carolina can lower transit costs, reduce greenhouse gas emissions, benefit air quality, and improve rider experiences. Increased use of electric buses and other transit vehicles can yield meaningful reductions in transportation sector emissions and move the state toward a 40% reduction in statewide GHG emissions by 2025.

The taskforce's report should include numeric goals for electric transit fleet adoption, such as a number or percentage of conversion by 2025, 2030, and 2040. In addition, the report should include information and recommended strategies for adoption, including a comparison of life-cycle costs among transit vehicle technologies, sources of funding, technical considerations, and best practices.

Today there are 939 full-size buses and 2,451 light-transit vehicles in North Carolina, which are powered by a mix of diesel, electric power, compressed natural gas, and hybrid power. Conversion of this entire fleet to all electric power could significantly improve life-cycle vehicle costs associated with fleet operations, reduce GHG emissions, and reduce air pollution in urban areas. Fleet and bus electrification provide riders multiple benefits, including a quieter ride and easier entry because of a lower floor design. Shifts in these fleets also provide an opportunity to reduce emissions in low-income communities that have been disproportionately exposed to harmful pollutants.

North Carolina is already seeing progress with bus electrification. The City of Greensboro plans to have 16 electric buses the city's fleet by 2020 and expects to save over \$300,000 per bus over the life of the vehicle due to reduced maintenance and operating cost. Asheville (five electric buses) and Raleigh Durham International Airport (four electric buses) also have taken the first steps to electrify their bus fleets. The cities of Chapel Hill and Raleigh will have electric buses in service by the winter of 2020.

There are a number of grant opportunities available for electric bus and charging equipment

¹⁶ Energy Solutions – Plug-in Vehicle Infrastructure Cost-Effectiveness Report

funding. The NCDOT and other agencies can play a role in communicating grant availability and details to applicable agencies. In addition, agencies can utilize, when able, flexibility in grant making criteria to consider the economic, health, and social impacts on disadvantaged communities.

In March of 2019 the Federal Transit Authority (FTA) announced the availability of “Low-No or No Emission” (Low-No) funding for fleet and bus infrastructure. The Low-No program provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required support facilities.

The Low-No program is unique in its support of the deployment of advanced technology vehicles. Through April 11, 2019, about \$84 million in grant selections funded the deployment of transit buses and infrastructure that use advanced propulsion technologies. Fifty-two projects in 41 states will receive a share of the funding including projects in Greensboro, Chapel Hill, and Raleigh.

Motor Fleet Shift to Zero Emission Vehicles [Short-term]

Strategy: Implement the directive in EO 80 that cabinet agencies prioritize ZEVs in the purchase and lease of new vehicles and use those vehicles when feasible.

Lead Actors: NCDOA, state cabinet agencies

Key Stakeholders: State and local governments

Section 7 of EO 80 directs cabinet agencies to “prioritize ZEVs in the purchase or lease of new vehicles and shall use ZEVs for agency business travel when feasible.” It then directs the Department of Administration to develop a NC Motor Fleet ZEV Plan (and update it annually) that defines feasibility and includes strategies related to infrastructure, procurement, and other key topics for increasing ZEV use in the state motor fleet. NCDOT is in a unique position to assist NCDOA with its statewide fueling and maintenance facilities. The feasibility of placing charging stations at these facilities will be investigated.

Ongoing implementation of this provision in the executive order will not only shift the state fleet, it will also increase state employees’ familiarity with ZEVs and increase the visibility of ZEVs on public roads. State purchasing contracts for ZEVs and charging infrastructure allow local governments and public institutions of higher education to purchase those items at lower cost than they can negotiate individually. As implementation of section 7 proceeds, the state will lead by example, showing that public and private fleets across the state also can shift to ZEVs.

Innovative EV Rate Design [Medium-term]

Strategy: Offer innovative electricity rates that support EV adoption and encourage vehicle charging when it is beneficial for the grid

Lead Actors: North Carolina Utilities Commission, public utilities, electric cooperatives, municipal electric utilities

Key Stakeholders: Ratepayers, NCDEQ, NC Public Staff

As described in the 2019 N.C. Clean Energy Plan, rate design can effectively encourage drivers to charge EVs at times of the day when it is advantageous to the electric grid. A super-off-peak rate during overnight hours, for example, can entice drivers to program their vehicles to charge during the middle of the night and avoid contributing to peak electricity demand in the early evening. Rate design also can strategically encourage workplace charging. Beyond supporting the electric grid, these policies can increase the cost-effectiveness of EVs for residential and commercial uses. Current rate design for commercial EV charging site hosts and EV fleet managers can be cost prohibitive. Some state utilities commissions have begun evaluating innovative rate designs for EVs, and different rate designs could support the electric grid and EV adoption in North Carolina as well.

4. Conclusion

North Carolina is well-positioned for the adoption of electric vehicles to reduce emissions, but additional action on public education, financial incentives, and a coordinated implementation program are required for success. It is critical to note that this is not an effort that will be taken on by NCDOT alone, or any single agency.

In fact, the most effective way to keep up to date on progress across everyone coordinating on these initiatives is to visit the web portal for the N.C. Climate Change Interagency Council.¹⁷ This is the most efficient way to get the latest news and information about each of the specific directives, as well as updates on major milestones for the program as a whole. Continue to check back frequently to see what is new and how you can participate in the many exciting efforts that are underway across North Carolina.

¹⁷ <https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy>