

# Alternative Fuel Vehicle Infrastructure and Resiliency

Planning for Storm Response in the Carolinas

# A Carolinas Alternative Fuels Resiliency Plan

## *Core Plan Formation Team*



# Planning for resiliency = Planning to avoid the worst possible outcome

- ▶ Extreme weather events are inevitable.
- ▶ Increased use of alternative fuel vehicles during extreme weather events evacuation and response is also inevitable.
- ▶ Planning for both is necessary and will make the difference between tragedy or not.
- ▶ Goal of this project: Plan for the use of alternative fuel vehicles by evacuees and responders during these inevitable weather events

# Why evacuees?

- ▶ Smooth evacuation of areas that are projected to be in danger is critical to preservation of life and property during extreme weather events
- ▶ Currently in NC and SC, three fuel types are most commonly used in vehicles by the general public: gasoline, diesel, and electricity.
- ▶ Both states have prior experience with and existing plans for petroleum use during evacuations and storm response.
- ▶ Our planning focused on the missing fuel: electricity
- ▶ Both states are seeing rapid growth in EVs among residents and visitors and additional planning is needed.

# Why responders?

- ▶ First & second responders are critical during & after in natural disasters.
- ▶ First responders= Police, fire, ambulance, National Guard
- ▶ Second responders = utilities, refuse haulers, DOT
- ▶ Gasoline, diesel, electricity, natural gas, and propane currently used by first/second responders.
- ▶ Both need reliable fuel supplies, no matter what fuel type they are using.

# NC & SC FEMA Disaster Declarations

- ▶ **HURRICANE DORIAN**

- ▶ Incident Period: August 31, 2019 - September 9, 2019

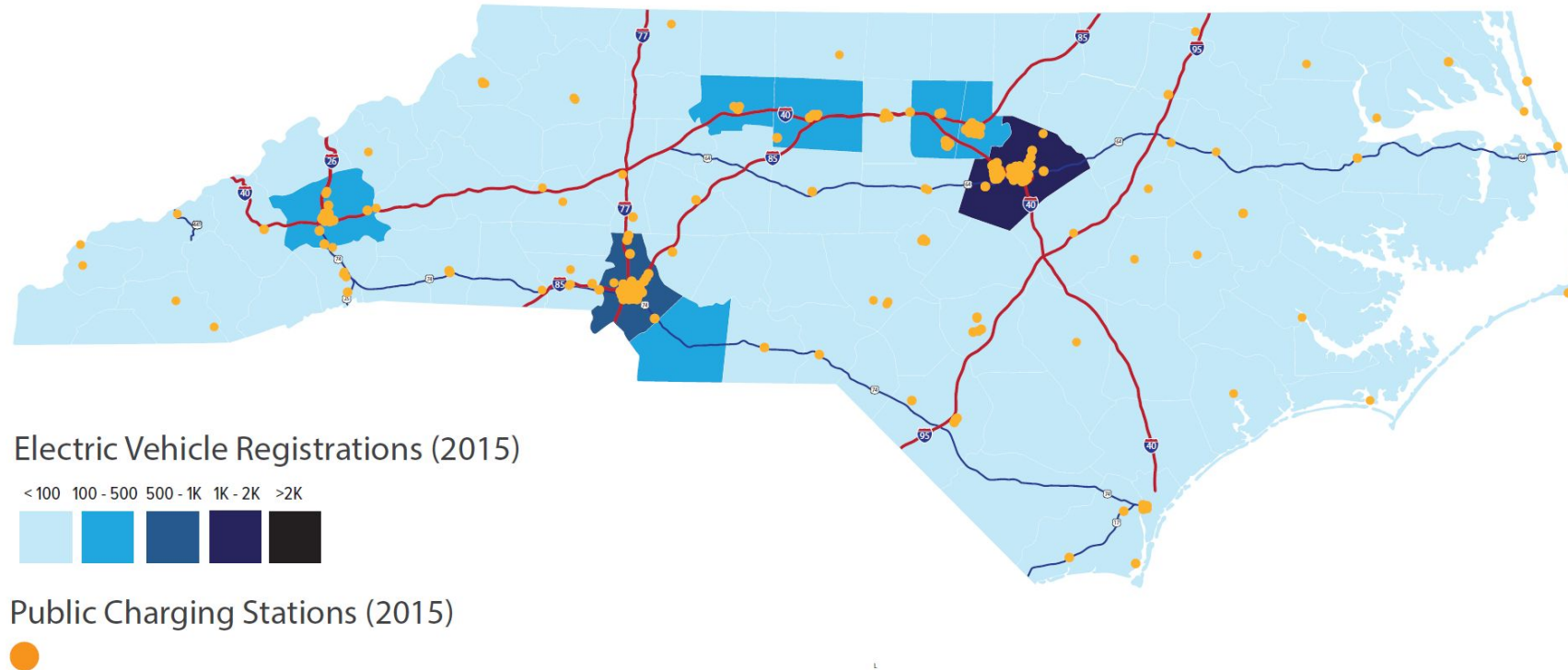
- ▶ **HURRICANE FLORENCE**

- ▶ Incident Period: September 7, 2018 - October 8, 2018

- ▶ **HURRICANE MATTHEW - SPOTLIGHTED IN PLAN**

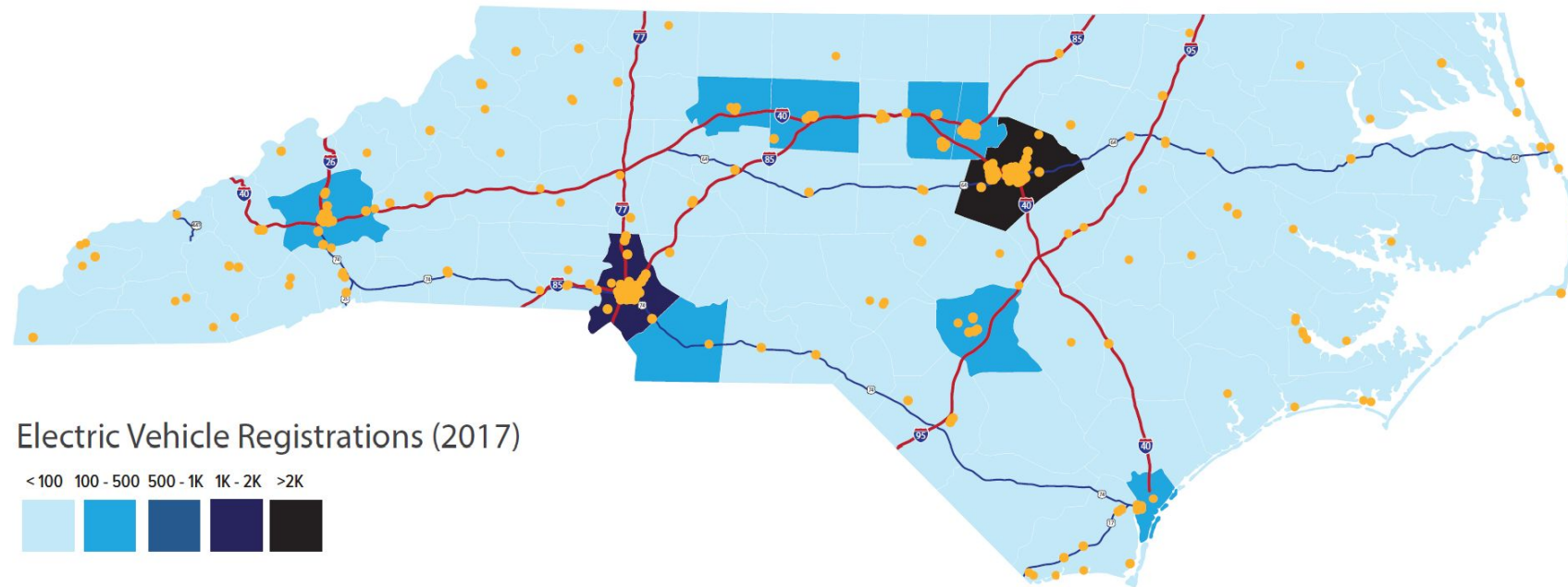
- ▶ Incident Period: October 4, 2016 - October 30, 2016

# EV and Charging Growth in NC



Source: Plug-in NC

# EV and Charging Growth in NC



Electric Vehicle Registrations (2017)

<100 100 - 500 500 - 1K 1K - 2K >2K



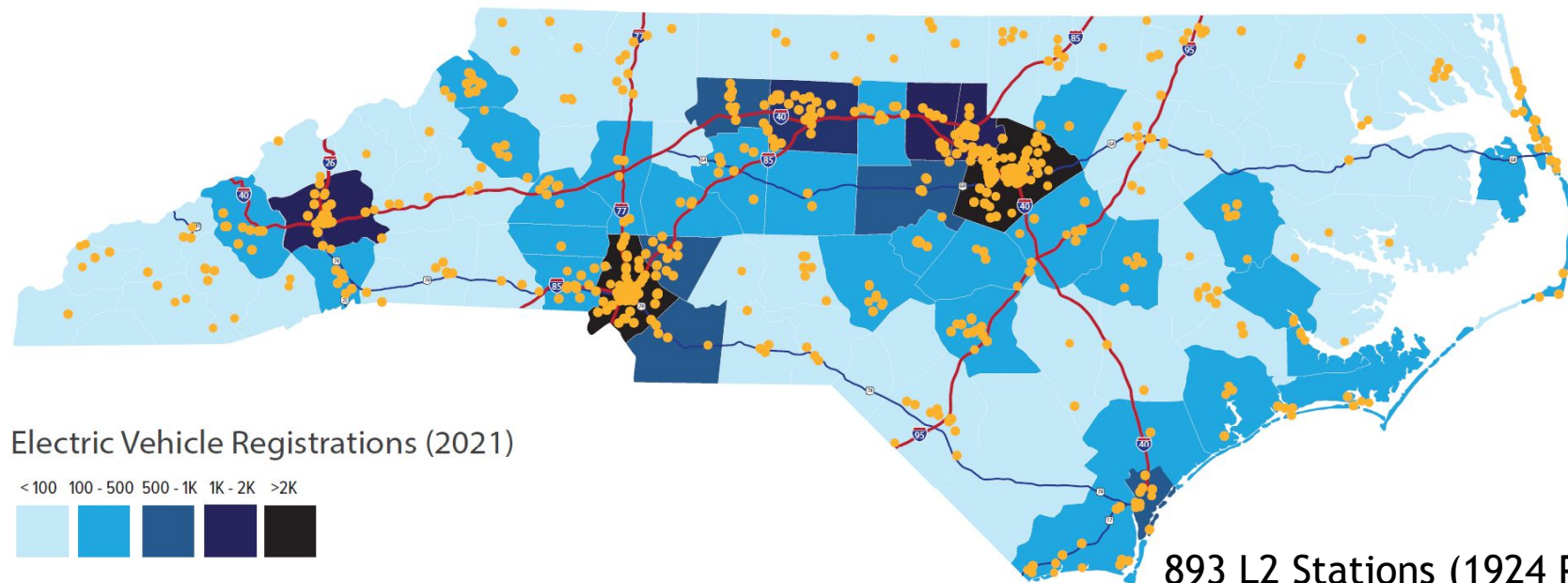
Public Charging Stations (2017)



Source: Plug-in NC



# EV and Charging Growth in NC



Electric Vehicle Registrations (2021)

<100 100 - 500 500 - 1K 1K - 2K >2K



Public Charging Stations (2021)



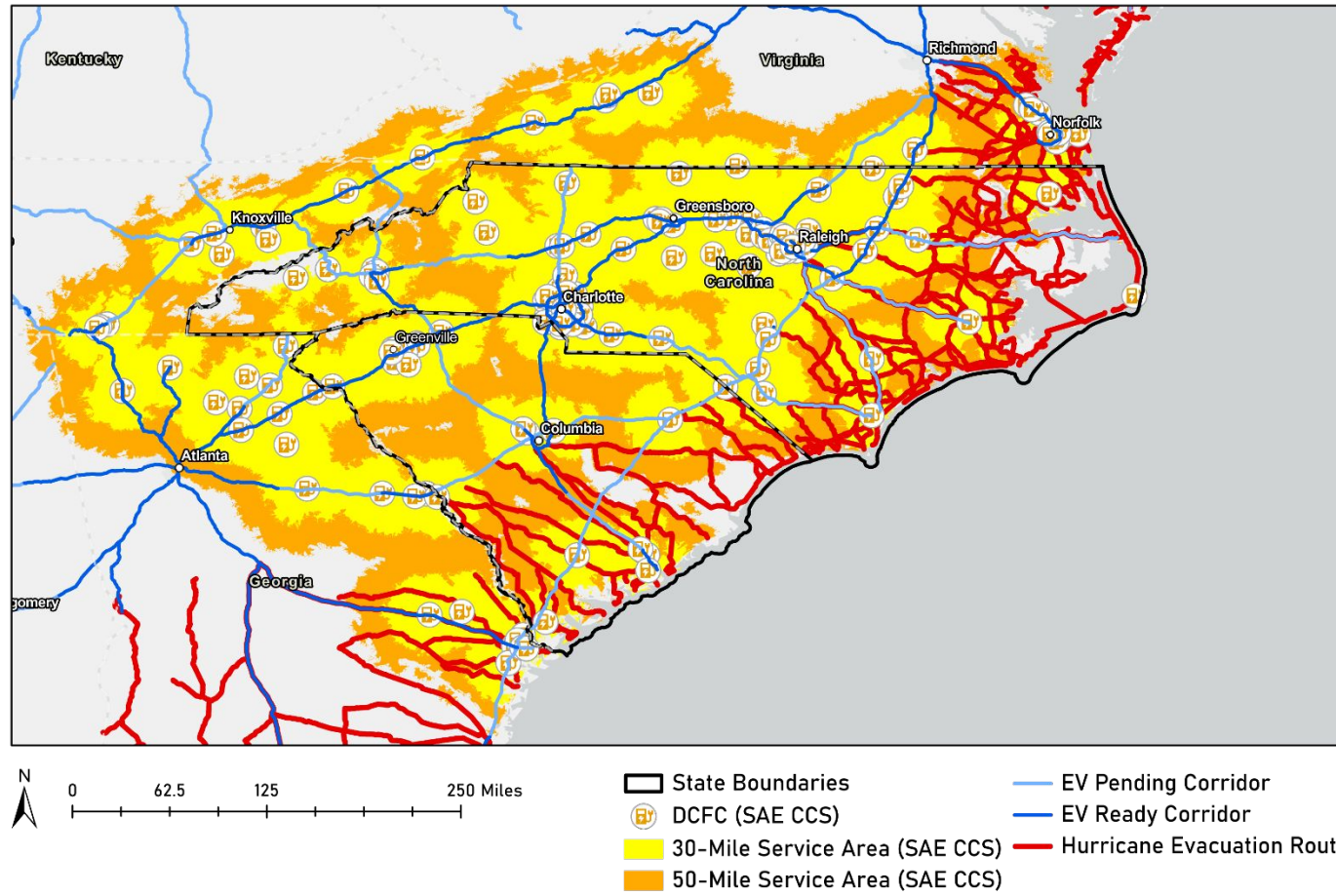
893 L2 Stations (1924 Plugs)  
149 DCFC Stations (557 Plugs)

Source: Plug-in NC

# What to Expect?

Today	2025	2030
38,727 EVs	80,000 EVs	1.25M EVs 50% New Vehicle Sales
893 L2 Stations (1924 Plugs) 149 DCFC Stations (557 Plugs)	*Executive Order #80 called for 80,000 by 2025*	*Executive Order #246*

# Supporting Emergency Evacuation



Source: Alexander Yoshizumi, NC State University

# Model Inputs



## Vehicle (Agent)

- BEV Penetration (% electric)
  - Can vary across space
- BEV Composition
  - Battery Capacity (kWh)
  - Efficiency (kWh/mi)
  - Acceptance Rate (kW)
  - Market Share (%)
- Risk Tolerance
- Origin & Destination
- Trip Start Time
- Starting State-of-Charge
- Speed-Efficiency Relationship



## Exits (Nodes)

- EVSE Station Presence
- Number of Level 2 Plugs
- Number of Level 3 Plugs (DCFC)
- Level 2 Power Rating (kW)
- Level 3 Power Rating (kW)



## Evacuation Type

- Planned, Semi-urgent, Urgent



## Roads (Lines)

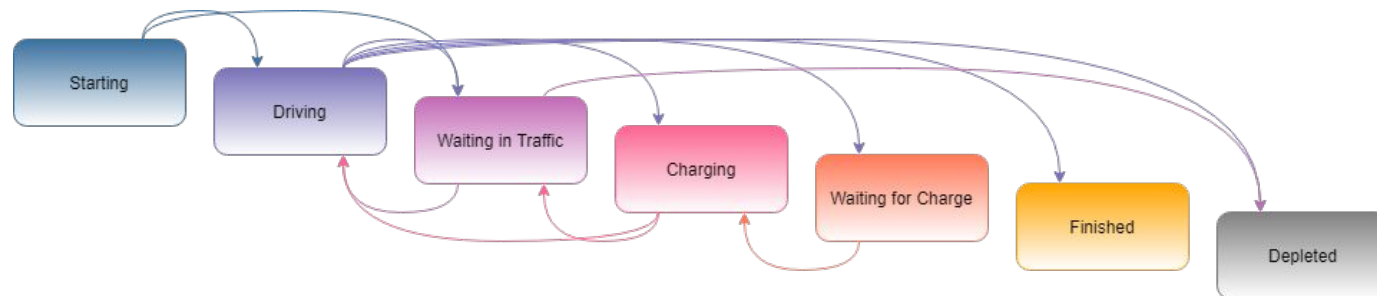
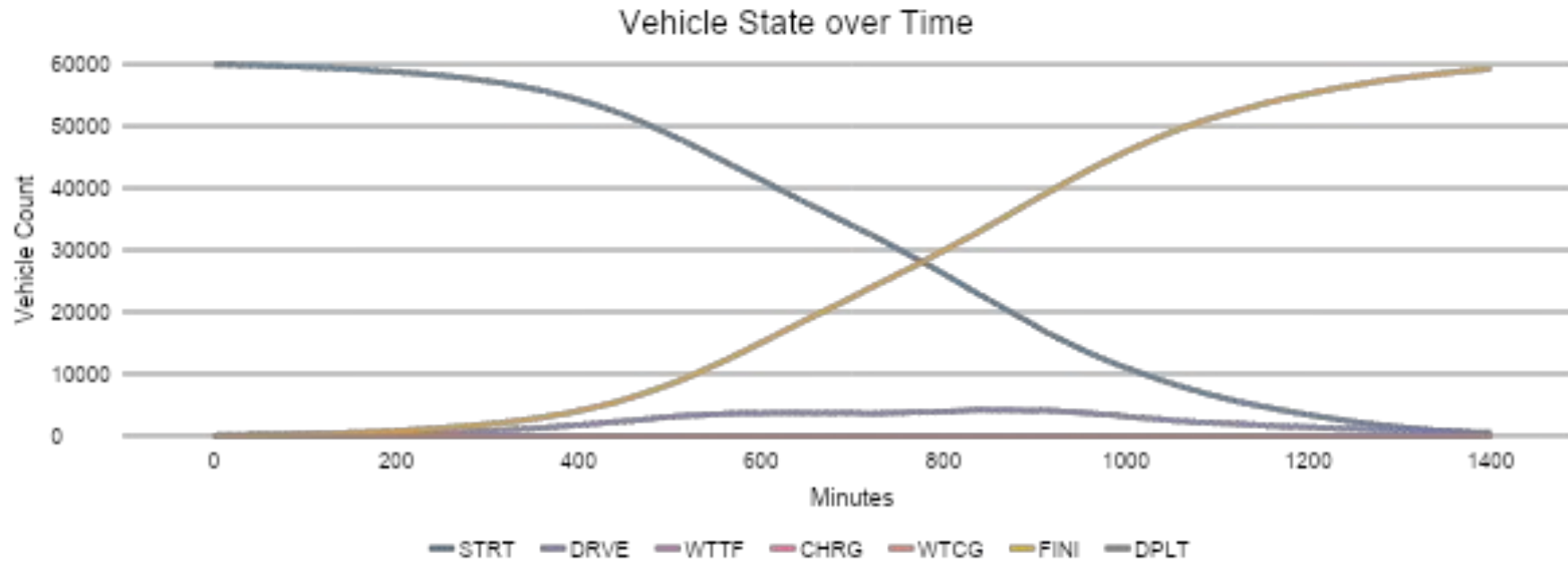
- Line Length
- Number of Lanes



## Traffic Flow

- Speed-Density Relationship
  - Greenshield, 4PL, 5PL

# Model Operation



# Preliminary Model Outputs



Source: Alexander Yoshizumi, NC State University

# Best Practices: Redundancy and Resilience of Fueling Infrastructure

- ▶ All fuel types can face shortages or interruptions
- ▶ Additionally, electrical outages can cause compressors to not function, affecting other fuel types
- ▶ Two primary solutions for electrical backup:
  - ▶ Generators
  - ▶ Energy storage, such as battery storage
- ▶ On-site fuel storage can help crucial fleets through temporary shortages.
- ▶ Generators can be dual-fuel and be designed to use alternative fuels in addition to (or in place of) gasoline or diesel

# Recommendations and next steps

- ▶ Two categories of recommendations:
  - ▶ Recommendations aimed at ensuring safe and efficient evacuations
  - ▶ Recommendations aimed at increasing the resilience of crucial fleets (first responders, second responders, emergency management, local government, hospitals)
- ▶ Audiences:
  - ▶ Who will carry out these recommendations?
  - ▶ State agencies, local governments, utilities
- ▶ Interested in learning more? Join one of our webinars this Fall! Contact Heather Brutz ([hmbritz@ncsu.edu](mailto:hmbritz@ncsu.edu)) or Bonnie Loomis ([bonnieloomis@e4carolinas.org](mailto:bonnieloomis@e4carolinas.org)) to be put on invite list.



# Contact us!

- ▶ Bonnie Loomis, E4 Carolinas, [bonnieloomis@e4carolinas.org](mailto:bonnieloomis@e4carolinas.org)
- ▶ Heather Brutz, NC State University, [hmbrutz@ncsu.edu](mailto:hmbrutz@ncsu.edu)