

# **Carolina Alternative Fuel Infrastructure for Storm Resilience**

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# Project Overview

## Timeline: 10/1/19-12/31/2022

- ❖ Start Date: 10/1/19
- ❖ End Date: 12/31/22
- ❖ Completion: ~ 40%

Budget Period No.	Start Date	End Date	Federal Share minus FFRDC	Federal Share %	Non-Federal Share	Non-Federal Share %	FFRDC Share	Total Estimated Cost
1	10/1/2019	12/31/2020	\$186,940	35.4%	\$265,762	50.4%	\$75,000	\$527,702
2	1/1/2021	12/31/2021	\$194,686	34.4%	\$295,638	52.3%	\$75,000	\$565,324
3	1/1/2022	12/31/2022	\$219,943	37.3%	\$295,060	50.0%	\$75,000	\$590,003
Total Project			\$601,569	35.7%	\$856,460	50.9%	\$225,000	\$1,683,029

## Barriers:

- ❖ EV inventory among emergency responders; and
- ❖ Limited availability of EV charging stations along evacuation routes.

## Partners:

### Grant Recipients

- ❖ E4 Carolinas
- ❖ Savannah River National Laboratory
- ❖ Southeast Alliance for Clean Energy (SACE)
- ❖ NC State University Clean Energy Technology Center
- ❖ Centralina Clean Fuels
- ❖ Triangle Clean Cities

### Local Cost Share

- ❖ ONEH2
- ❖ Dominion Energy South Carolina
- ❖ Duke Energy Piedmont Natural Gas
- ❖ North Carolina Department of Environmental Quality (NCDEQ)
- ❖ Electric Cooperatives of South Carolina
- ❖ Advanced Energy

# Statement of Project Objectives

Objective	Goals	Impact
<p>To develop and implement the Carolina Alternative Fuel Infrastructure for Storm Resilience plan, enhancing the Carolina alternative fuel vehicles fleet and fueling facility disaster preparedness, recovery planning, and resiliency by increasing alternate fuel diversity, and specifically the use of alternative fuels for emergency response fleets that provide critical post-infrastructure disruption transportation, clean-up, utility restoration, and recovery operation services.</p>	<ul style="list-style-type: none"> <li>❖ Complete research and compile inventories necessary for the project’s planning phase;</li> <li>❖ Complete assessments and create a draft plan; and</li> <li>❖ Implement the plan through testing, validation, distribution, training, education and rehearsals.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Create inventory of AFV infrastructure and fleets across North and South Carolina;</li> <li>❖ Develop best practices during an emergency response;</li> <li>❖ Data collection of AFV inventory and;</li> <li>❖ Post disaster emergency response plan that will impact infrastructure disruption, transportation, clean up, utility restoration and recovery operations.</li> </ul>

## Project Approach

Budget Period 1 (2020): Complete research and compile inventories necessary for the project's planning phase.

Budget Period 2 (2021): Complete assessments and create a draft plan.

Budget Period 3 (2022): Implement the plan through testing, validation, distribution, training, education and rehearsals.

# Project Milestones

## Budget Period 1: 10/19/2019-12/31/2020

Documentation of alternative fuel vehicle infrastructure, vehicles and fleets.	Technical	Alternative Fuel Vehicle infrastructure, suppliers, alternative fuel vehicles and fleets used by first responders are identified.	Completed
Inventory of alternative fuel vehicle, utility and petroleum distribution infrastructure.	Technical	An inventory of alternative fuel vehicle, utility, petroleum distribution infrastructure subject to disruption and requiring vehicle response is identified.	Completed
Inventory of alternative fuel vehicle infrastructure, fleets and vehicles.	Technical	An inventory of alternative fuel infrastructure, existing and planned alternative fuel vehicle fleets and conventional petroleum fuel resources is identified.	Completed
All data resources have been recorded.	Go/No Go	Data resources are recorded in an industry standard format for the data type and used by all stakeholders. Inventories of Carolina storm impacts, alternative fuel vehicle fleets and vehicle fuel infrastructure will be created which did not previously exist.	Completed

# Project Milestones

## Budget Period 2: 1/1/2021-12/31/2021

Assess existing alternative fuel vehicle fleets.	Technical	Coverage, adequacy, and state of the existing alternative fuel vehicle fleets employed in infrastructure disruption response and the alternative fuel infrastructure supporting these fleets.	2 <sup>nd</sup> Quarter 2021 completion and Subtask 2.1 is on target to complete task.
Best Practices for resilience or recovery practices surveyed.	Technical	Review of reliable alternative fuel vehicle and fuel diversity alignment with identified infrastructure disruption recovery needs during adverse, system disrupted conditions.	3 <sup>rd</sup> Quarter 2021 completion and Subtask 2.2.1 is on target to complete task.
Draft Plan developed and distributed.	Technical	Solutions incorporated into a plan and socialized with appropriate stakeholders.	4 <sup>th</sup> Quarter 2021 completion and Subtask 2.2.1 is on target to complete task.
Carolina Alternative Fuel Infrastructure for Storm Resilience Plan drafted.	Go/No Go	The draft Carolina Alternative Fuel Vehicle Infrastructure for Storm Resilience is complete and distributed to all stakeholders.	4 <sup>th</sup> Quarter 2021 completion and Subtask 2.2.2 is on target to complete task.

Any proposed future work is subject to change based on funding levels.

# Project Milestones

## Budget Period 3: 1/1/2022-12/31/2022

Plan Component Tests	Technical	Testing of the select plan components.	Completion in 2022
Stakeholders trained and plan adopted.	Technical	Government agencies, utilities, and alternative fuel providers adopt the plan.	Completion in 2022
Stakeholder dress rehearsal.	Technical	Stakeholder training of optimum alternative fuel vehicle use is complete and dress rehearsal conducted.	Completion in 2022
Final Assessment and Summary of existing alternative fuel vehicle fleets completed.	Technical	Coverage, adequacy, and state of the existing alternative fuel vehicle fleets employed in infrastructure disruption response and the alternative fuel infrastructure supporting these fleets assessment.	Completion in 2022
Final Disaster Plan Distribution including a Training and Education Summary and Impact Report.	Technical	Final Resiliency Plan. Training and Best Practices awareness activities with Stakeholders. Summary Report of all training and outreach contacts and initiatives.	Completion in 2022

Any proposed future work is subject to change based on funding levels.

## Task 1.1 – Infrastructure Disruption Research (2/1 – 7/31/20):

Subtask 1.1.1 – Storm Disruption Research: Research and document the incidence of damaging Carolina storms to identify when, where and the duration of Storm-caused disruption of infrastructure affecting petroleum and alternative fuels, including the fuel distribution and utility networks and Storm-caused damage requiring response involving vehicles.

- **Carolina Utility Infrastructure Storm Disruption Information** – This Subtask was substantially completed in the Budget Period 1 fourth quarter (see Subtask 1.2 described further below). The Project Partners continue to examine how utility infrastructure disruption extent and frequency can best be quantified and are collaborating with the utilities during the Budget Period 2 first quarter to enhance this data set.
- **Transportation Infrastructure Information** – During the Budget Period 1 fourth quarter the North Carolina Department of Transportation provided information for the Project’s GIS data base. The South Carolina Department of Transportation was subsequently responsive during the Budget Period 2 first quarter.
- **Communications Infrastructure** – Limited data was publicly available for this data set.
- **Emergency Preparedness** – The data set is substantially complete. The North Carolina and South Carolina Emergency Preparedness Offices provided each State’s Emergency Preparedness Plan.
- **Water Infrastructure** – This data set was substantially complete during the Budget Period 1 fourth quarter. The most significant outstanding data is for South Carolina coastal zone flooding which is being revised by the National Oceanographic and Atmospheric Administration.
- **Storm Frequency & Intensity** – This data set was substantially complete during the Budget Period 1 fourth quarter



## Project Accomplishments and Progress

**Subtask 1.1.2** – This Subtask deals with the identification fossil fuel delivery infrastructure and the frequency and extent to which it is disrupted for any reason.

- **American Petroleum Council** – Information on oil and natural gas production in the Carolinas (none) was determined, along with GIS information for the main petroleum product pipelines and distribution terminals. The extent and frequency of truck-based petroleum product deliveries will be completed during the Budget Period 2 first quarter.
- **Propane Gas Associations** – This data set was substantially completed during the Budget Period 1 fourth quarter
- **Petroleum Trade Associations** – These associations were able to provide little meaningful publicly available information on retail gasoline distribution. The USDOE Energy Information Administration will be examined for appropriate data during the Budget Period 2 first quarter.
- **Utility Commissions** – The North Carolina Utility Commission and the South Carolina Public Service Commission that it maintains no publicly available data on utility infrastructure.
- **U.S. Department of Transportation** - GIS data for the principal U.S. highways in the Carolinas was added to the inventory during the Budget Period 1 fourth quarter.

**Subtask 1.1.3** – The Subtask deals with the alternative fuel vehicle and fueling infrastructure. North Carolina State University has taken the lead in organizing a working group with has been meeting via an online, interactive platform.

- **Alternative fuel infrastructure** – This data set was substantially complete during the budget Period 1 fourth quarter with the exception of an alternative vehicles fleet inventory being conducted by a coalition of Project Partners. Response rates were extremely slow, if at all. Additional effort is planned for the Budget Period 2 first quarter to enhance data from this survey.

**A. Subtasks 1.2 – Inventory Creation:** The Project Partners created a GIS work group to organize the data collected, establish a common format for all, publish documentation of the format standards, create a central data repository accessible to all and meet weekly to provide Project guidance as the inventory is completed. This task was substantially completed during the Budget Period 1 fourth quarter. A listing of all data sets gathered appears in the table below. Further below is the description of a task created to “quality assess” the data base to ensure that it is sufficient for Budget Period 2 planning needs. Items highlighted in pink are those presently thought to require data enhancement.

## Project Accomplishments and Progress

### Task 1.2 – Inventory Creation (8/1 – 11/30/20):

**Subtask 1.2.1 – Infrastructure Disruption:** Organize an inventory depicting alternative fuel vehicle, utility and petroleum distribution infrastructure subject to disruption and requiring vehicle response.

**Subtask 1.2.2 – Alternative Fuel Vehicle Infrastructure:** Organize an inventory depicting the Carolinas’ alternative fuel infrastructure, existing and planned alternative fuel vehicle fleets and conventional petroleum fuel resources.

- **Alternative Fuel**

- ❖ Types of Vehicles
- ❖ Infrastructure Requirements
- ❖ Current vehicle and fleet distribution/ownership (e.g. Emergency Resources)
- ❖ Distribution and Dispensing

	BEV	HFC	NG	Propane	Biodiesel	Total
North Carolina						<b>2,243</b>
<i>Public</i>	1,610	0	27	66	6	
<i>Private</i>	312	0	15	9	108	
South Carolina						<b>812</b>
<i>Public</i>	568	1	8	53	0	
<i>Private</i>	84	0	5	6	34	

Source: <https://afdc.energy.gov/>

## Project Accomplishments and Progress

### Task 2.1 – Assessment:

**Subtask 2.1.1 Potential for Conventional Fuel, Vehicle and Utility Infrastructure Disruption:** A subtask working group, headed by Bonnie Loomis of E4 Carolinas, was organized in January 2021 consisting of various Project Partners. Specific Project Partner assignments under this Subtask consist of:

- **Electric and natural gas utility** - Dominion Energy South Carolina, Duke Energy/Piedmont Natural Gas, Electric Cooperatives of South Carolina, ElectriCities, NCEMC and E4 Carolinas
- **Electric vehicle charging** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky and all utility companies
- **Alternative fuel (hydrogen, natural gas, propane, bio-fuel, etc.) fueling** - ONEH2 and Savannah River National Laboratory
- **Gasoline, Fuel Oil and Propane fueling distribution** - NCDEQ, SCORS, E4 Carolinas
- **Highways** - NC/SC DOT, NCDEQ, SCDHEC and SACE
- **Communications** - NC/SC DOT, NCDEQ, SCDHEC and SACE
- **Water (fresh and waste/drainage)** - NC/SC DOT, NCDEQ, SCDHEC and SACE



**Subtask 2.1.2 Assessment of Alternative Fuel and Vehicle Adequacy During Disruption:** A subtask working group, headed by Jacob Bolin of Advanced Energy and Mike Riley of Piedmont Natural Gas, was organized in January 2021 consisting of various Project Partners. Specific Project Partner assignments under this Subtask consist of:

- **Employing the existing fleet inventory information and other resources, identify where utilities and first responders are now employing alternative fuel vehicles** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.
- **Quantify the number of alternative fuel vehicles in personal use, their general location and how they may “migrate” or evacuate during times of infrastructure disruption. Consider potential highway “outage” scenarios. Consider how alternative fuel vehicles (personal, transit system, school buses, etc.) may be creatively used to facilitate evacuation or recovery** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.
- **Project the number of alternative fuel vehicles five and ten years in the future and how fleet growth may influence aspects of the Plan** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.
- **Quantify the “pros” and “cons” and cost/financing of alternative fuel vehicles (by type of vehicles and type of disruption) to support a conclusion of the value in using alternative fuel vehicles during disruptions** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.
- **For instances demonstrating value, assess the adequacy of the existing fleet versus the potential disruption (this could become a measure of resilience** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.
- **Recommend where alternative fuel vehicles 1) could be used, 2) should be used and 3) should not be used to provide resilience against or recovery from infrastructure disruption and why** - NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONE H2, Savannah River National Lab, Duke Energy Piedmont Natural Gas and Dominion Energy South Carolina.

## Task 2.2 – Plan Creation:

**Subtask 2.2.1 Opportunity Prioritization and Solutions:** A subtask working group, headed by Heather Brutz of the North Carolina Clean Energy Technology Center, was organized in January 2021 consisting of various Project Partners. Specific Project Partner assignments under this Subtask consist of:

- **Identifies other areas in the United States or World with similar circumstances/conditions as the Carolinas which will make good “parallel” case studies, if these other areas have good solutions** - Petroleum Supplies – NCDEQ, SCORS, E4 Carolinas
- **Examine instances within the United States (or the world) of disruptions involving at least the following infrastructures and how alternative fuel vehicles (electric, natural gas, hydrogen, propane, bio-fuel, etc.) were/are employed to enhance resilience or accelerate recovery** - Propane and Bio-fuels – E4 Carolinas
  - **Electric and natural gas utilities** - Hydrogen Fuel Vehicles and Infrastructure – ONEH2 and Savannah River National Laboratory
  - **Electric vehicle charging** - Transportation, Communications and Water Infrastructure Disruption – NC/SC DOT, NCDEQ, SCDHEC, SACE and E4 Carolinas
  - **Alternative fuel (hydrogen, natural gas, propane, bio-fuel, etc.) fueling** - ONEH2 and Savannah River National Laboratory
  - **Gasoline and Fuel Oil fueling** - E4 Carolinas
  - **Highways** - NC/SC DOT, NCDEQ, SCDHEC, SACE and E4 Carolinas
  - **Communications** - NC/SC DOT, NCDEQ, SCDHEC, SACE and E4 Carolinas
  - **Water (fresh and waste/drainage)** - NC/SC DOT, NCDEQ, SCDHEC, SACE and E4 Carolinas
- **Determine whether various “best practices” are application to the Carolinas and, if so, create a “solution” for the Carolina “problem” identified using a “best practice” and providing a high level cost/benefit analysis** - Dominion Energy South Carolina, Duke Energy/Piedmont Natural Gas, Electric Cooperatives of South Carolina, **ElectriCities**, NCEMC, NC State, Advanced Energy, SACE, Triangle J, Palmetto Clean Fuels, Land of Sky, ONEH2, Savannah River National Lab, NC/SC DOT, NCDEQ, SCDHEC and E4 Carolinas.

**Subtask 2.2.2 Plan Formation:** This Subtask headed by Jason Wager and Caitlin Rose is planned to initiate on 7/1/2021.

A discussion of what was accomplished under these goals and objectives established for this reporting period, including major activities, significant results, major findings or conclusions, key outcomes, or other achievements.

### **Significant accomplishments for this project:**

- Determine the needs of the GIS Mapping inventory for project years two and three
- Identify and quantify inventory deficiencies which will include at least:
  - Alternative Fuel Fleet inventory
  - Alternative Fuel Vehicles Fueling Infrastructure inventory
  - South Carolina Flood Zone information
  - Coastal and Water Management information from NEMAC
  - NOAA Updates
  - Propane and retail gasoline distribution and disruption potential
  - Storm evacuation routes
  - Transit system alternative fuel vehicles
  - Electric Cooperatives of South Carolina alternative fleet inventory survey
  - Hydrogen fuel and fleet infrastructure to augment ONEH2 documentation
  - Natural Gas, Electricity and Petroleum Pipeline distribution infrastructure detail
- Assign and confirm inventory completion tasks among all Project Partners and manage completion of inventory by Subtask end; and
- Oversee and complete inventory narrative.

## Project Approach

The Statement of Project objective is to develop and implement the Carolina Alternative Fuel Infrastructure for Storm Resilience plan to enhance Carolina alternative fuel vehicles fleet and fueling facility disaster preparedness, recovery planning, and resiliency by increasing alternate fuel diversity, and specifically the use of alternative fuels for emergency response fleets that provide critical post-infrastructure disruption transportation, clean-up, utility restoration, and recovery operation services.

E4 Carolinas, Inc. along with Savannah River National Lab and a host of partners in North and South Carolina have worked together to complete the work assigned in each Subtask for the project. Despite challenges due to Covid-19 and work from home requirements Project Partners have continued to meet to complete the assigned tasks under each of the Subtasks. This project is unique with the partners who have committed to working towards the final project.

Additional organizations have led their support by providing information and data to achieve the overall end product which will be a comprehensive, data driven plan that has thoroughly studied alternative fuel vehicles fleet and fueling facility disaster preparedness, recovery planning, and resiliency by increasing alternate fuel diversity, and specifically the use of alternative fuels for emergency response fleets that provide critical post-infrastructure disruption transportation, clean-up, utility restoration, and recovery operation services. The Carolina Alternative Fuel Infrastructure for Storm Resilience Plan will be distributed to stakeholders with new data contained in the Plan. Stakeholders will be presented with potential alternative fuel value or fleet economics and will be connected with resources which can support them in exploring their opportunity. Dress rehearsals for stakeholders will be conducted to ensure their knowledge of alternative fuel infrastructures and operation.

## Collaboration and Coordination Among Project Team

- ❖ Monthly Subtask Leader/Co-Leader Meeting
- ❖ Monthly Subtask Working Group Meetings
- ❖ Bi-Monthly GIS Meetings
- ❖ Quarterly Progress Reports
- ❖ Yearly Project Meeting
- ❖ DropBox Fileshare





## Overall Impact:



### **Achievements to Date:**

- ❖ Produced alternative fuel vehicle inventory and creation of GIS database to store data;
- ❖ Transfer of knowledge and information between all Subtask Working Groups; and
- ❖ Strong collaborative relationships among all partners and stakeholders.

### **Upcoming:**

- ❖ Collecting data and information regarding infrastructure disruption; and
- ❖ Working towards the plan creation among the Subtask Working Groups.

\*Any proposed future work is subject to change based on funding levels.

# Summary

## Objectives

To develop and implement the Carolina Alternative Fuel Infrastructure for Storm Resilience plan, enhancing the Carolina alternative fuel vehicles fleet and fueling facility disaster preparedness, recovery planning, and resiliency by increasing alternate fuel diversity, and specifically the use of alternative fuels for emergency response fleets that provide critical post-infrastructure disruption transportation, clean-up, utility restoration, and recovery operation services.

## Approach

The Statement of Project objective is to develop and implement the Carolina Alternative Fuel Infrastructure for Storm Resilience plan to enhance Carolina alternative fuel vehicles fleet and fueling facility disaster preparedness, recovery planning, and resiliency by increasing alternate fuel diversity, and specifically the use of alternative fuels for emergency response fleets that provide critical post-infrastructure disruption transportation, clean-up, utility restoration, and recovery operation services.

## Accomplishments

- ❖ Produced alternative fuel vehicle inventory and creation of GIS database to store data;
- ❖ Transfer of knowledge and information between all Subtask Working Groups; and
- ❖ Strong collaborative relationships among all partners and stakeholders.

## Up Next

- ❖ Complete assessments and create a draft plan; and
- ❖ Implement the plan through testing, validation, distribution, training, education and rehearsals.

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