# Planning an Affordable, Resilient, and Sustainable Electric Grid in North Carolina 2nd Stakeholder Meeting

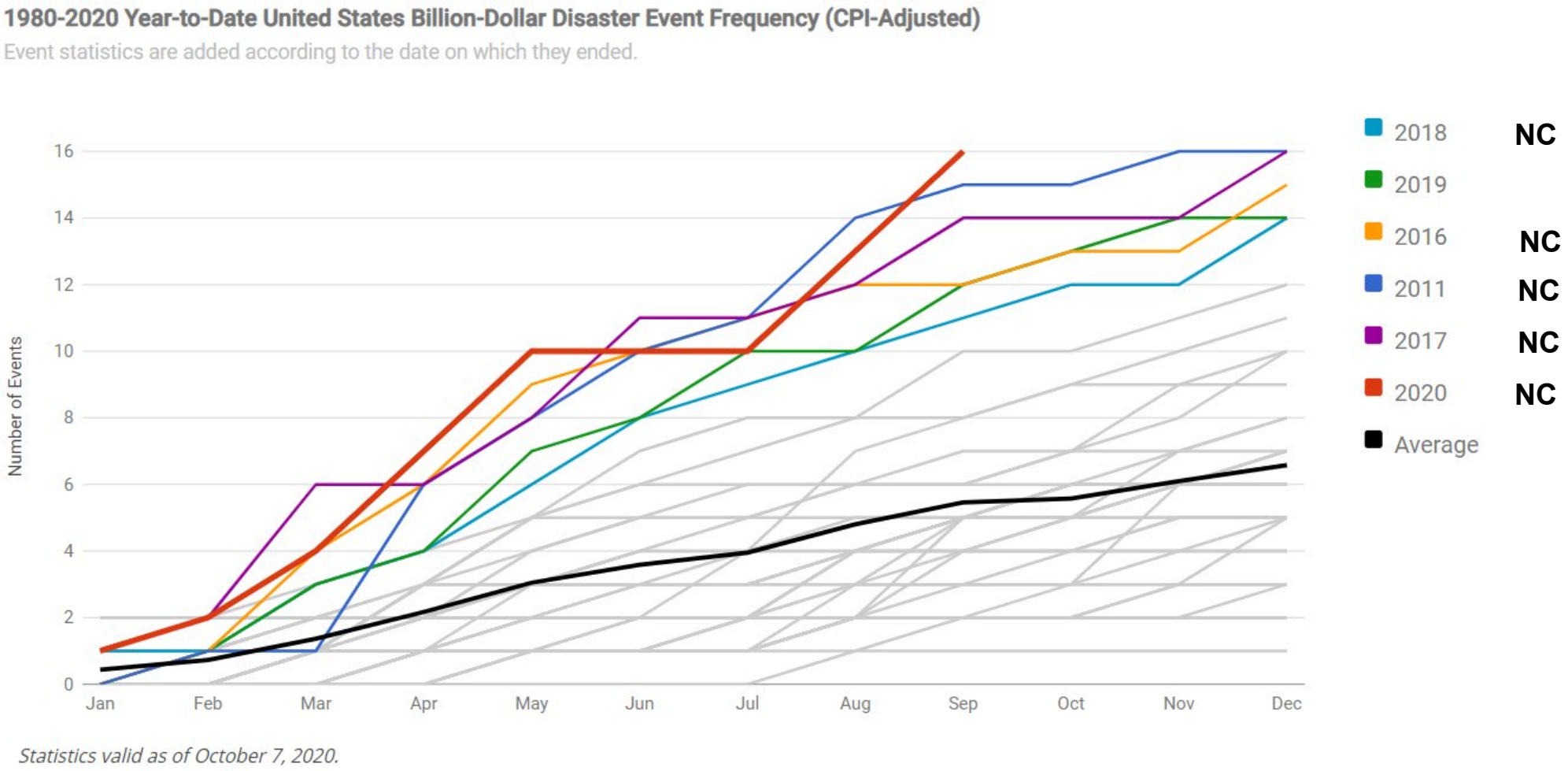
December 3, 2020 12:30-4:30*

**Following slides contain presentations given by :**

- Sushma Masemore, Deputy Assistant Secretary for Environment, State Energy Director, NC Department of Environmental Quality
- Robert Cox, Associate Director, UNC Charlotte EPIC

**Event Agenda is linked HERE*

# *Frequency of Billion-Dollar Disaster Events in the U.S.*




Source: National Oceanic and Atmospheric Administration, https://www.ncdc.noaa.gov/billions/

# *Hurricane Florence Impacts*


## Transmission Summary

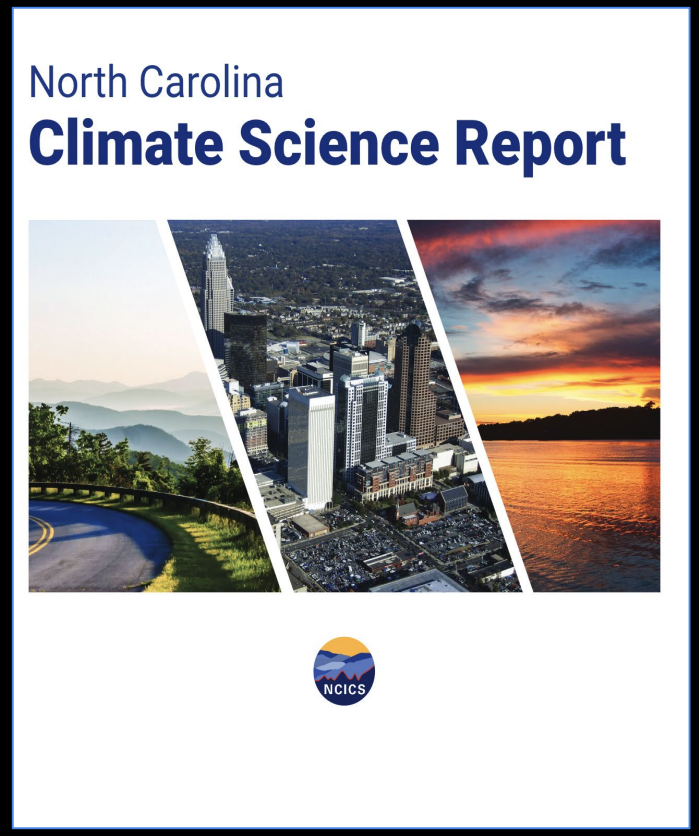
| DEP System Outage Information | Lines | Substations | Wholesale PODs |
|---|---|---|---|
| Peak Storm (183) | 45 | 90 | 48 |

## Distribution Summary

| Restored | Events | Outages |
|---|---|---|
| NC | 22,604 | 1,643,762 |
| SC | 3,806 | 177,984 |
| **Total** | 26,410 | 1,821,746 |
| | | |
| DEC | 5,569 | 387,791 |
| DEP | 21,878 | 1,448,718 |
| **Total** | 27,447 | 1,836,509 |

- Florence was the largest mobilization in Duke Energy storm history.
- Flooding and wind damage were unprecedented than any storm to hit Duke Energy.
- 9 substations flooded

# NC Climate Science Report




- ☑ **Global State of the Science**
- ☑ **Historical Changes in NC**
- ☑ **Projections for NC**

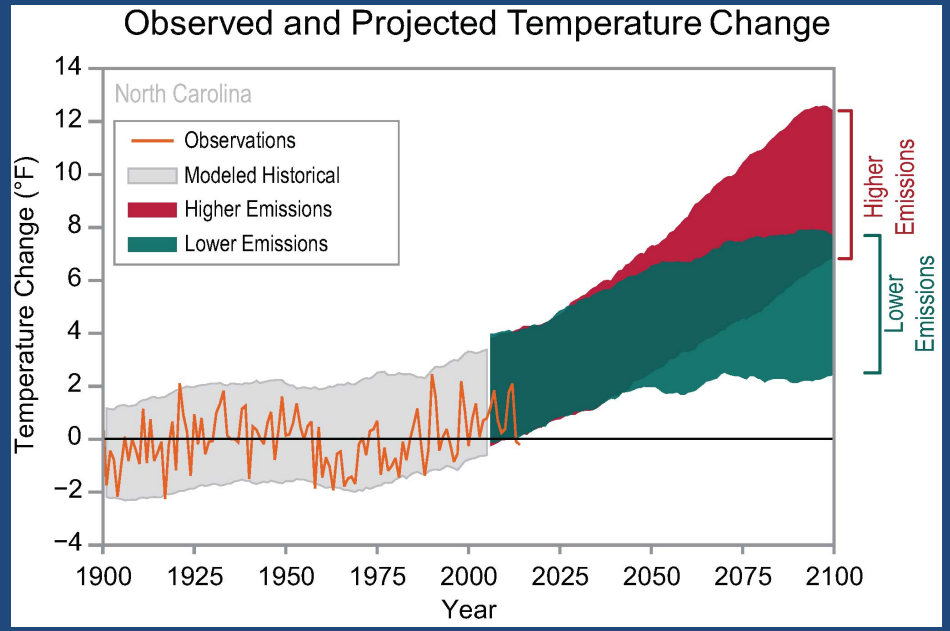
Source: North Carolina Climate Science Report, https://ncics.org/nccsr

"Large changes in **North Carolina's climate**

— much larger than at any time in the state's history —

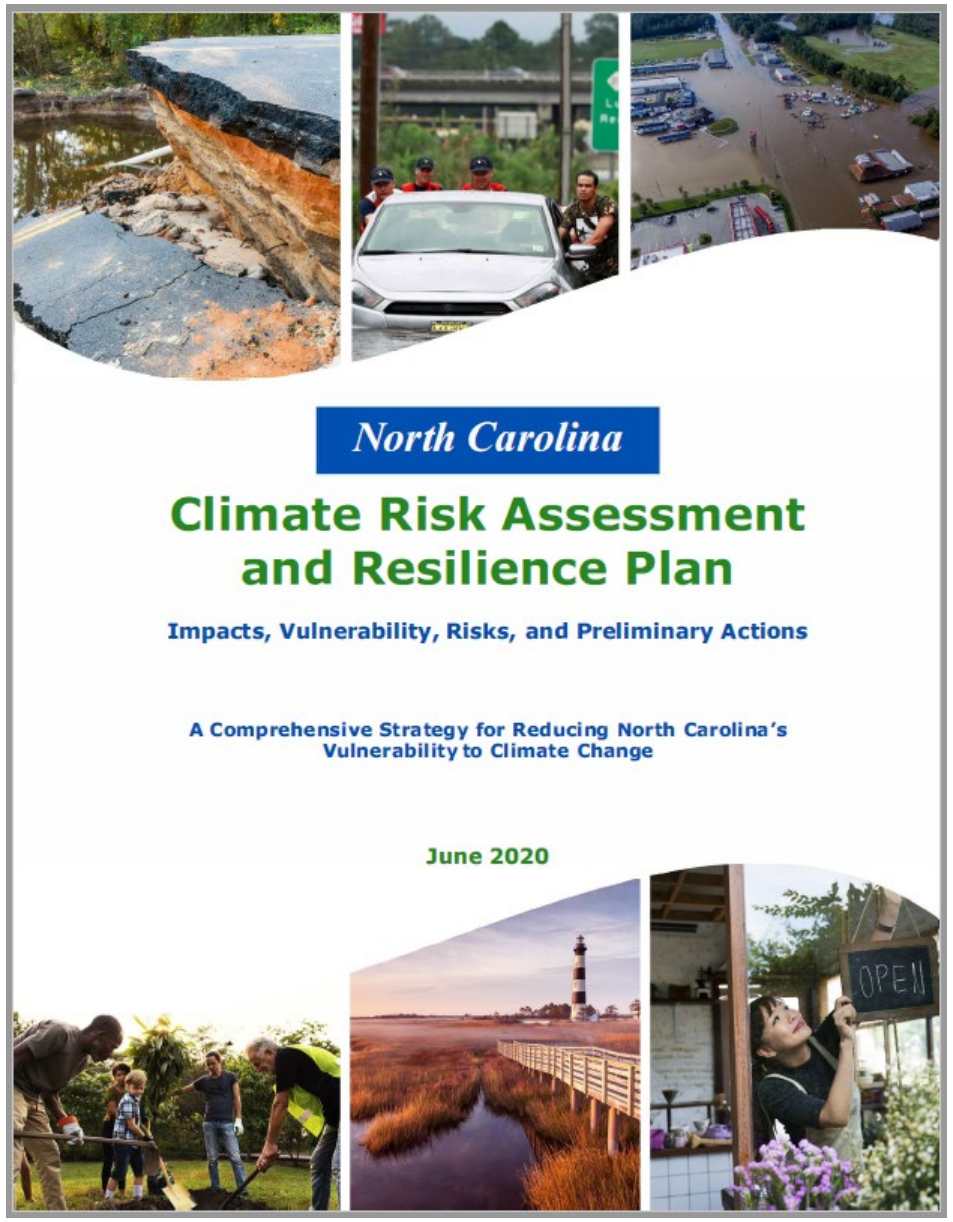
are ***very likely*** by the end of this century under both the lower and higher scenarios."

| | |
|---|---|
| *Very likely* | 90–100% probability of outcome |




https://statesummaries.ncics.org/

# North Carolina Resilience Plan





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

# *Hazards Affecting the Energy System*


## Non-Climate Stressors

- ***Population Growth***
- ***Aging Infrastructure***
- ***Socioeconomic disparity***
- ***Physical Attacks, Cyber Security, and other manmade disasters***
- ***Rural-Urban Divide***
- ***Public Health Threats/ Pandemics***

## Climate Stressors

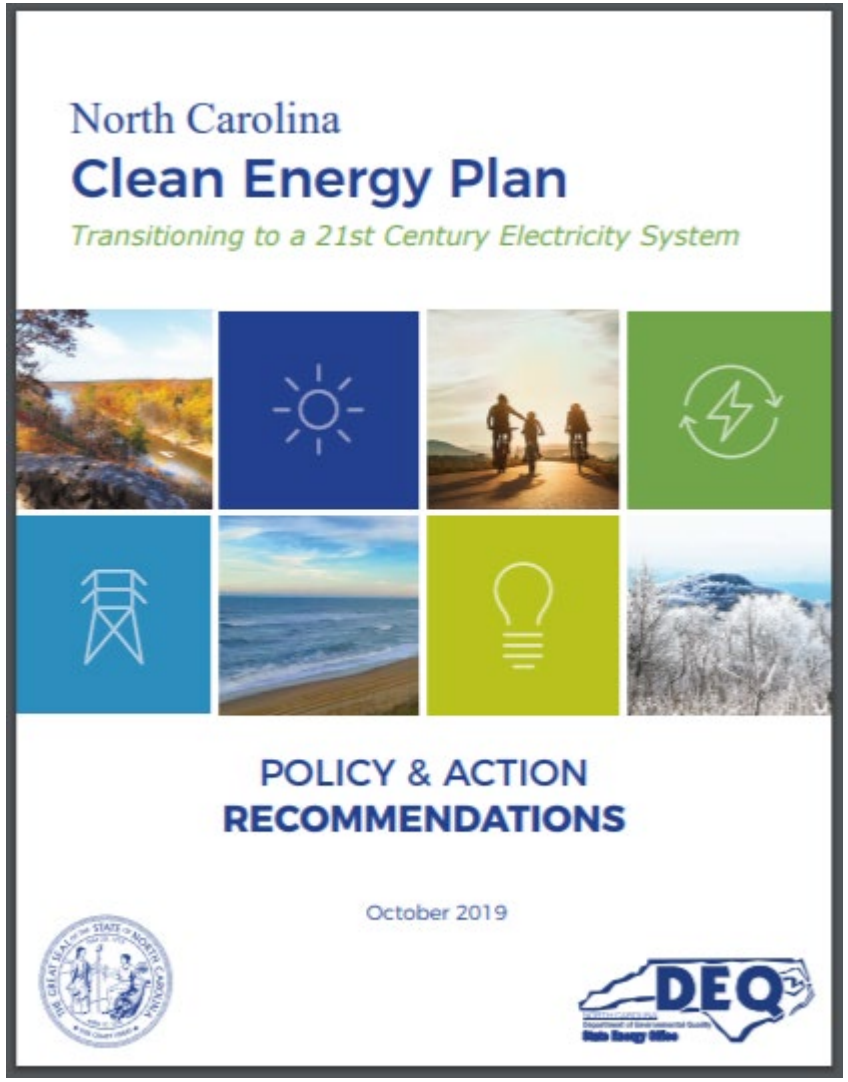
(Projected by the end of this century under both the lower and higher emissions scenarios)

| | | |
|---|---|---|
| ***Virtually Certain*** Sea Level will continue to rise | ***Very Likely*** Summer Heat Index Values will increase | ***Likely*** Annual Total precipitation will increase |
| ***Likely*** Hurricane intensity will increase | ***Likely*** Severe droughts will become more intense | ***Likely*** Increase in precipitation will lead to an increase in inland flooding |

***Virtually Certain***= 99-100% probability of outcome
***Very Likely***= 90-100% probability of outcome
***Likely***= 66-100% probability of outcome
***About as Likely as Not*** = 33-66% probability of outcome
***Unlikely***= 0-33% probability of outcome
***Very Unlikely***= 0-10% probability of outcome
***Exceptionally Unlikely***= 0-1% probability of outcome

Source: North Carolina Climate Science Report, https://ncics.org/nccsr

# *North Carolina Clean Energy Plan*
# *Focus on Resilience*




https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy-16

**Key Recommendation:**

Modernize the grid to support clean energy resource adoption, resilience, and other public interest outcomes.

- Utilities to develop projects focused on DERs, community solutions, and microgrids at state facilities and critical infrastructure locations to enhance resilience.

- Coordinate resilience planning with disaster recovery operations center and require NC Emergency Management's Recovery Support Functions to address cybersecurity concerns in conjunction with energy resiliency issues.

- Develop a method to quantify the human costs of power outages, and integrate these costs when evaluating grid modernization plan components related to resiliency.

# *Planning an Affordable, Resilient, and Sustainable Grid for North Carolina*

**Overview:**

| | |
|---|---|
| **Funded by State Energy Program, Department of Environmental Quality under a U. S. DOE grant** | **Partners:** University of North Carolina at Charlotte, EPIC, North Carolina State University's Solar Energy Center, and Duke Energy |

**Project Goals:**

- Conduct a power-system analysis to assess storm impacts of three (3) scenarios, including a baseline, improved, and advanced scenario for deployment of DERs.
- Produce a cost-benefit analysis of implementing each of three (3) scenarios.
- Convene a comprehensive stakeholder engagement process to improve state energy planning processes.

**Impact:**

The project will inform the development of new metrics (e.g., economic losses experienced by customers from outages due to hurricanes) to help the state, utilities, and stakeholders evaluate resiliency options.

# *Framework for Energy System Resiliency Planning*


**Resilience Analysis Process**
**(Sandia National Laboratory)**

## Risk Based Framework

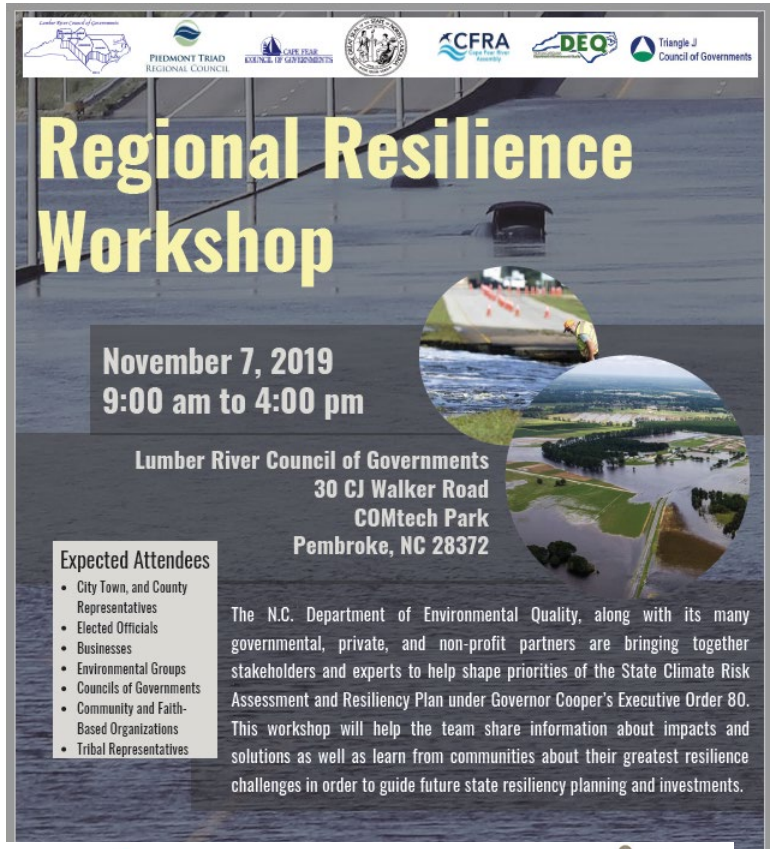
- Walks through defining:
  - hazards,
  - consequences, and
  - goals.

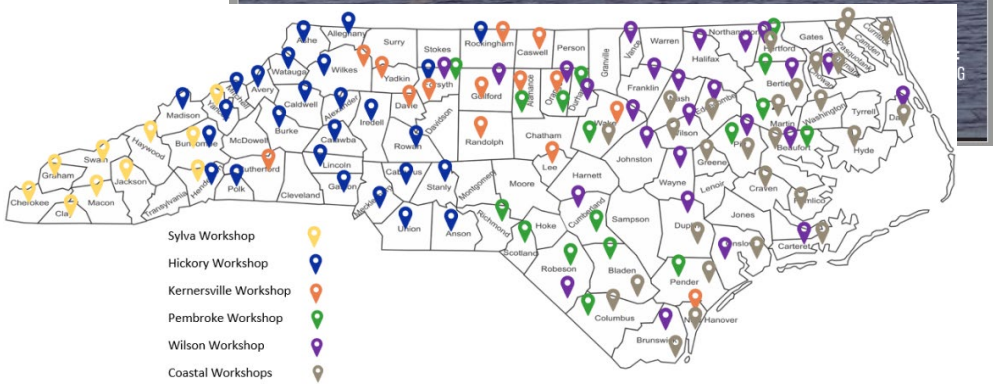
## Valuing Resiliency

| Consequence Category | Resilience Metric |
|---|---|
| **Direct** | |
| **Electrical service** | • Cumulative customer hours of outages<br>• Cumulative customer energy demand not served<br>• Average number (or percentage) of customers experience an outage during a specified time period |
| **Critical electrical service** | • Cumulative customer hours of outages<br>• Cumulative customer energy demand not served<br>• Average number (or percentage) of critical loads that experience an outage |
| **Restoration** | • Time to recovery<br>• Cost to recovery |
| **Monetary** | • Loss of utility revenue<br>• Cost of grid damages (e.g., repair or replace lines, transformers)<br>• Cost of recovery<br>• Avoided outage cost |
| **Indirect** | |
| **Community function** | • Critical services without power (hospitals, fire stations, police stations)<br>• Critical services without power for more and N hours (e.g., N>hours or backup fuel requirement) |
| **Monetary** | • Loss of assets and perishables<br>• Business interruption costs<br>• Impact on Gross Municipal Product, Gross Regional Product |
| **Other Critical Assets** | • Key production facilities without power<br>• Key military facilities without power |

# Different ways energy resilience metrics can be used.

1. **Build resilience through the modernization of the energy supply and delivery infrastructure**.
   - Utilities, regulators, policy makers, energy planners, and emergency planners can use metrics to quantify human and economic costs of power outages and make investment decisions related to energy infrastructure planning and operations.
2. **Serve as a performance incentive metrics to:** (1) incentivize the delivery of utility performance targets or (2) track which metric is useful in measuring a defined resiliency outcome.
3. **Inform integrated system planning processes**, particularly distribution system planning options



# *NC Resilience Plan: Path Forward*

# PARSG Project Review: 12/3/2020

Robert Cox

December 3, 2020

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*Energy Production and Infrastructure Center*

# Agenda

- 12:50 – Project Review
- 1:50 – Breakout Session Overview
- 2:00 – Breakout Session 1
- 2:45 – Stretch Break
- 3:00 – Breakout Group Report Out
- 3:45 – Breakout Session 2
- 4:15 – Wrap-up & Next Steps

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# Today's Stakeholder Session

- Goals:
  - Present current project status & approach
  - Meet in small groups to discuss community goals
- Four groups identified:
  - Asheville / Henderson (Mountains)
  - New Bern (Coastal)
  - Triad
  - Large urban center

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# Project Background

- U.S. Dept. of Energy, State Energy Program Award
  - 2-year project began in June 2019
- Building on & contributing to resilience related efforts in NC & U.S.
  - 2023 Duke Energy (DE) Integrated Resource Plan, DE Grid Improvement Plan;
  - NCDEQ Clean Energy Plan & 2023 NC Hazard Mitigation Plan,
  - NARUC, NASEO,U.S. DOE Comprehensive Electricity Planning Task Force (through Feb 2021).
- Team

U.S. DEPARTMENT OF ENERGY

NORTH CAROLINA DEQ Department of Environmental Quality

NC CLEAN ENERGY TECHNOLOGY CENTER

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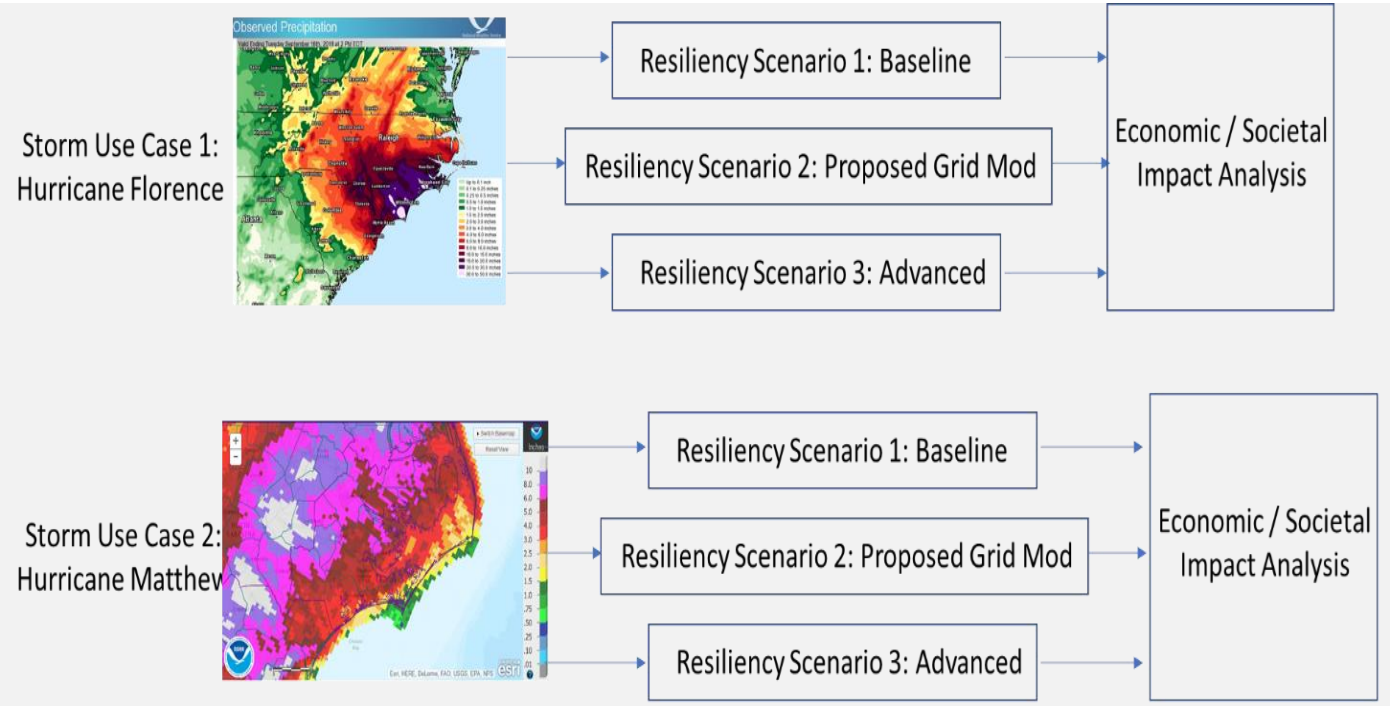
# Project Overview (As Proposed)

- Proposed when Power Forward was still on the table
- Defined three scenarios

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# PARSG Project Review: 12/3/2020

Robert Cox and Beth Schrader

December 3, 2020

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# Understanding Resilience

- Reliability:
  - Associated with everyday operation of the grid
  - Well defined metrics exist
- Resiliency:
  - Associated with major events (i.e. hurricanes, ice storms, etc.)

| Jurisdiction | Date Range | Without MEDs | | With MEDs | |
|---|---|---|---|---|---|
| | | SAIFI | SAIDI | SAIFI | SAIDI |
| South Carolina Duke Energy Carolinas | 12 Months Ending 3/31/19 | 1.23 | 241 | 1.77 | 654 |
| South Carolina Duke Energy Progress | 12 Months Ending 3/31/19 | 1.30 | 143 | 2.41 | 1,479 |

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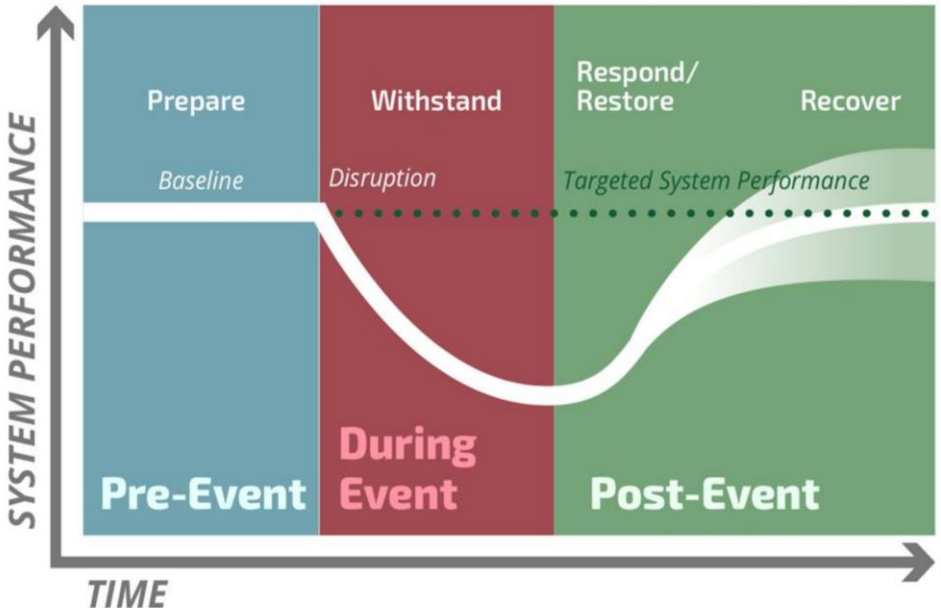
# Understanding Resilience

- 'Resilience' means the ability to prepare for and adapt to changing conditions and ***withstand and recover rapidly*** from disruptions.
- Resilience is contextual: Defined in terms of threats or hazards
  - Resilient to hurricane may not be resilient to earthquake
- Hazards have low probability but potential for high consequence

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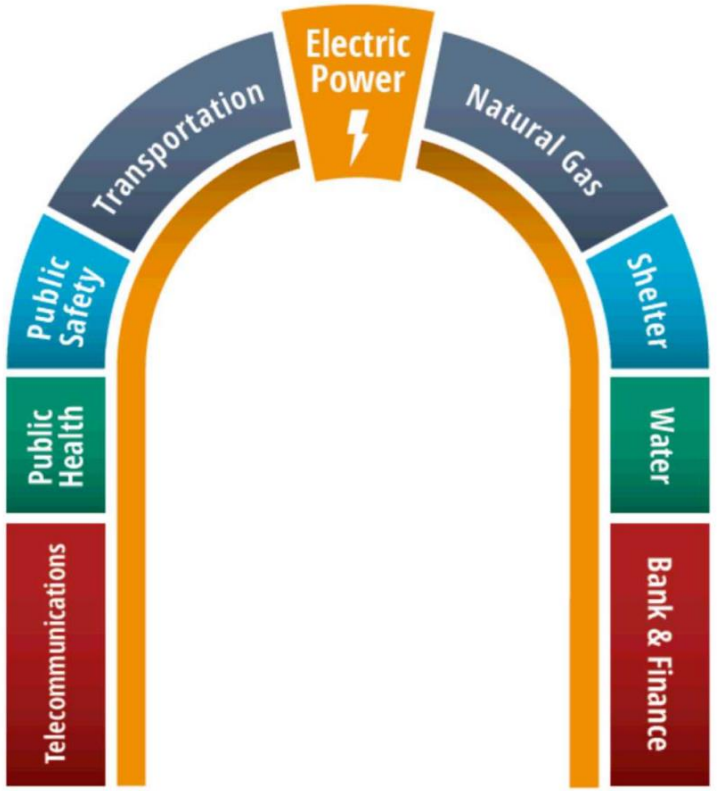
# But Electric Power Can't Be Considered in Isolation…

- Electric power is foundational to so many of the services that a community requires
- Resilience thus requires looking beyond simply the grid, but what the grid enables
- Utilities and communities/governments may see resilience differently

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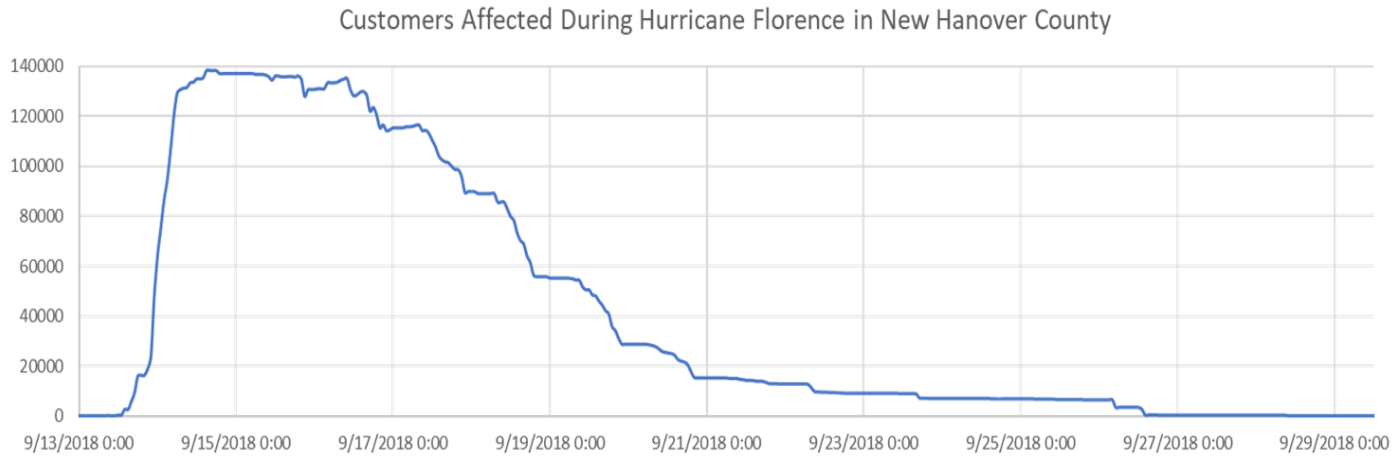
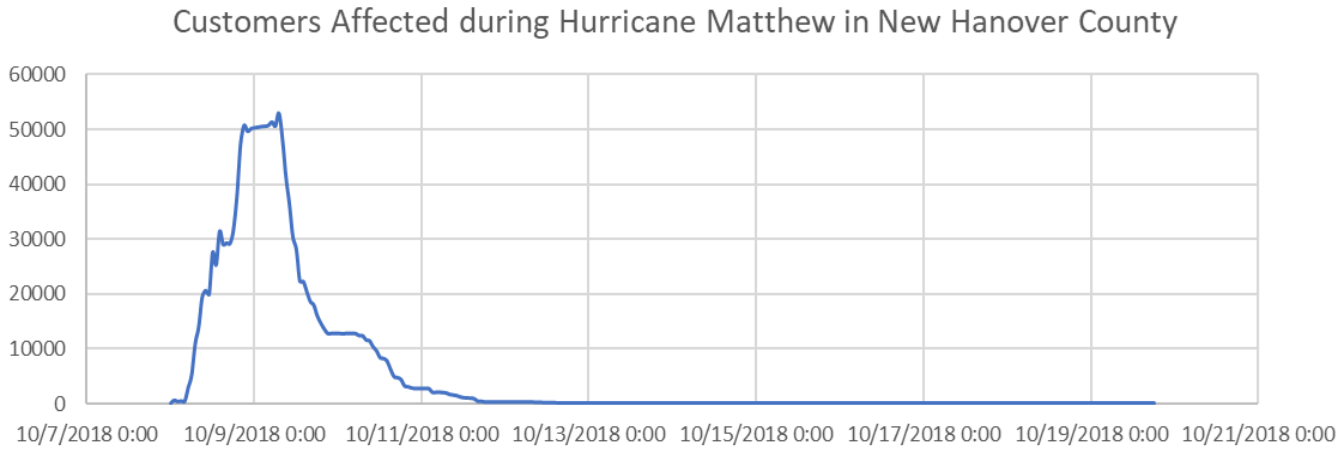
# Issues Framing the Analysis

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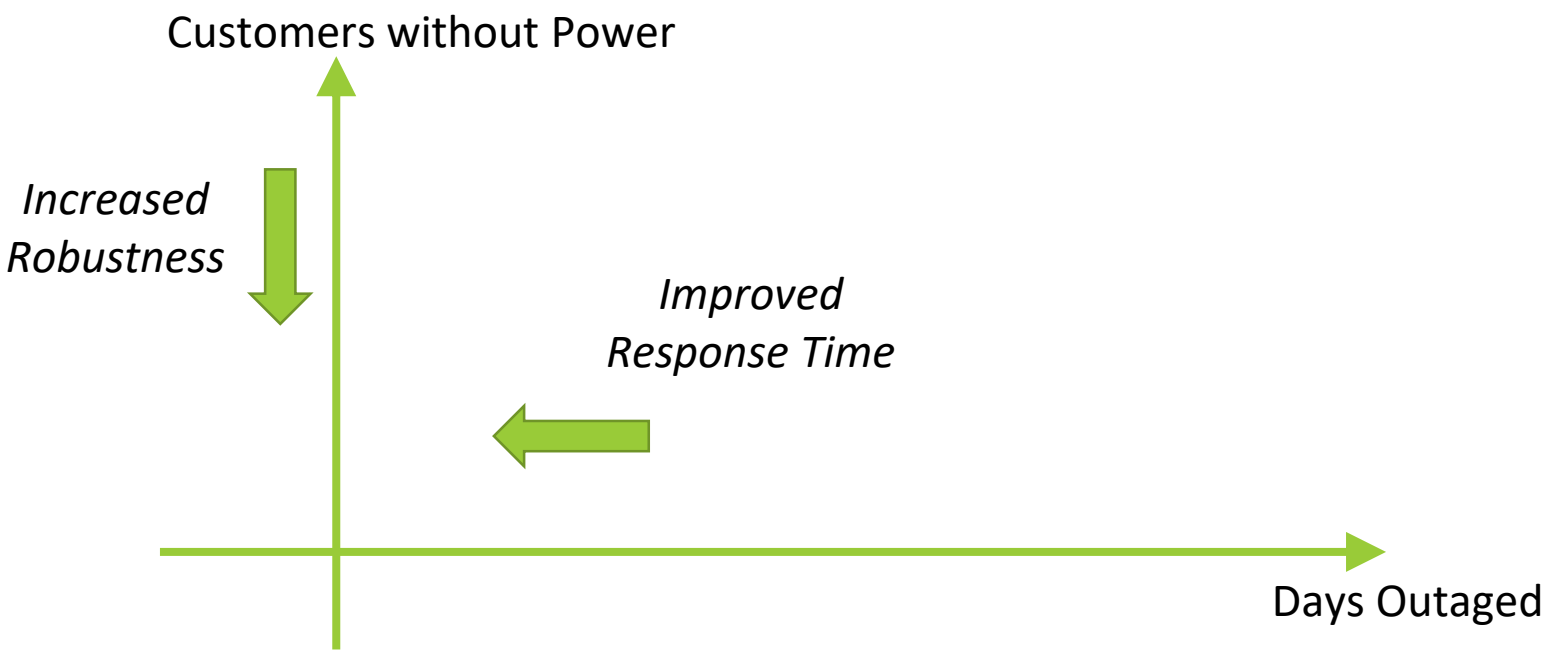
# Defining Resilience

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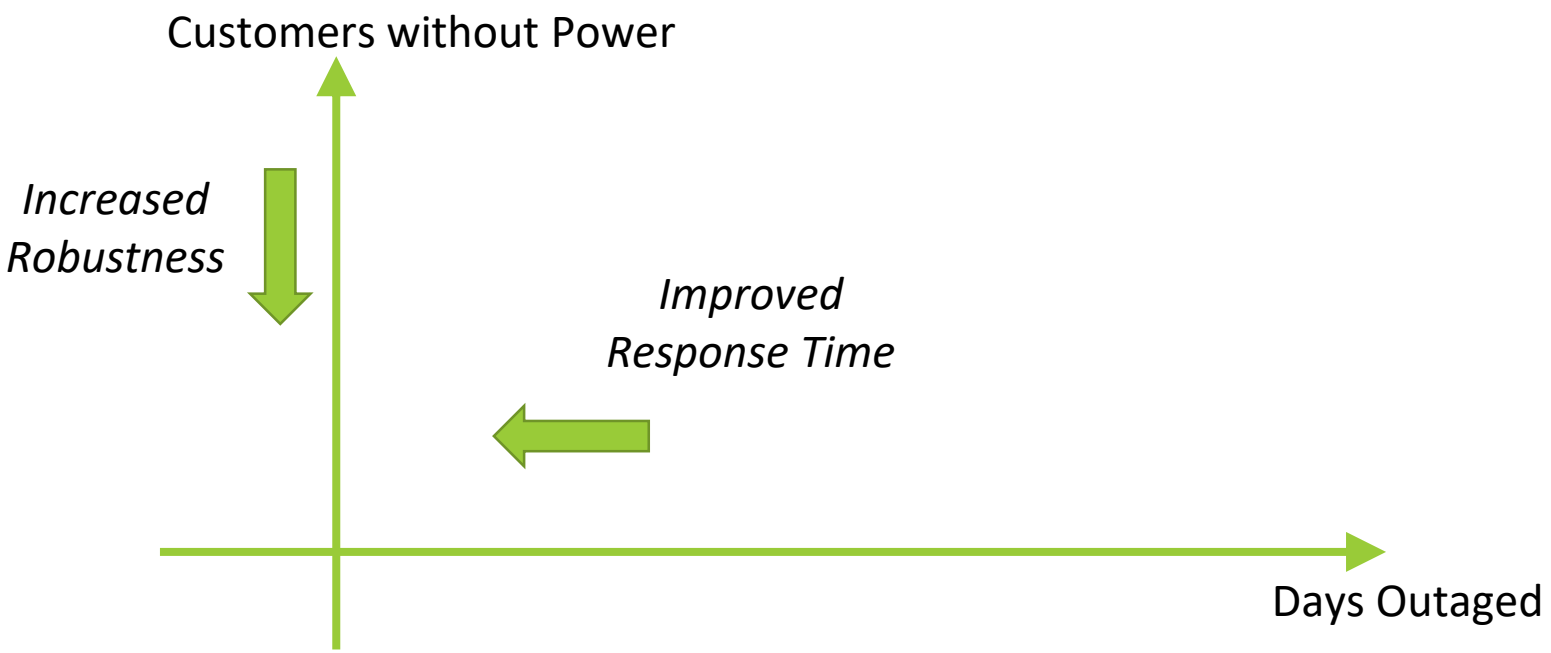


This is clearly beneficial, and can be summarized in several potential metrics

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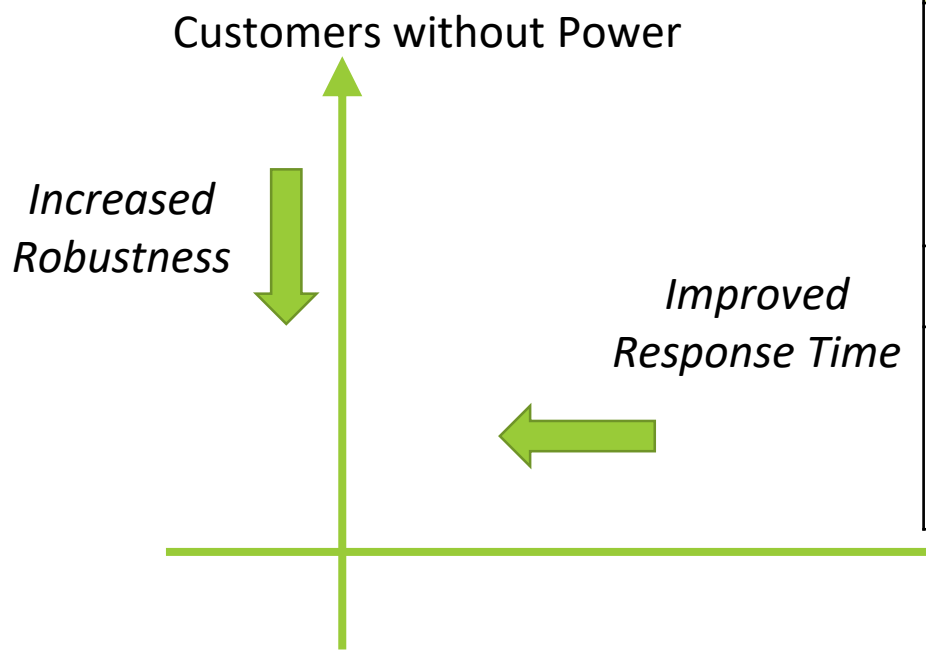


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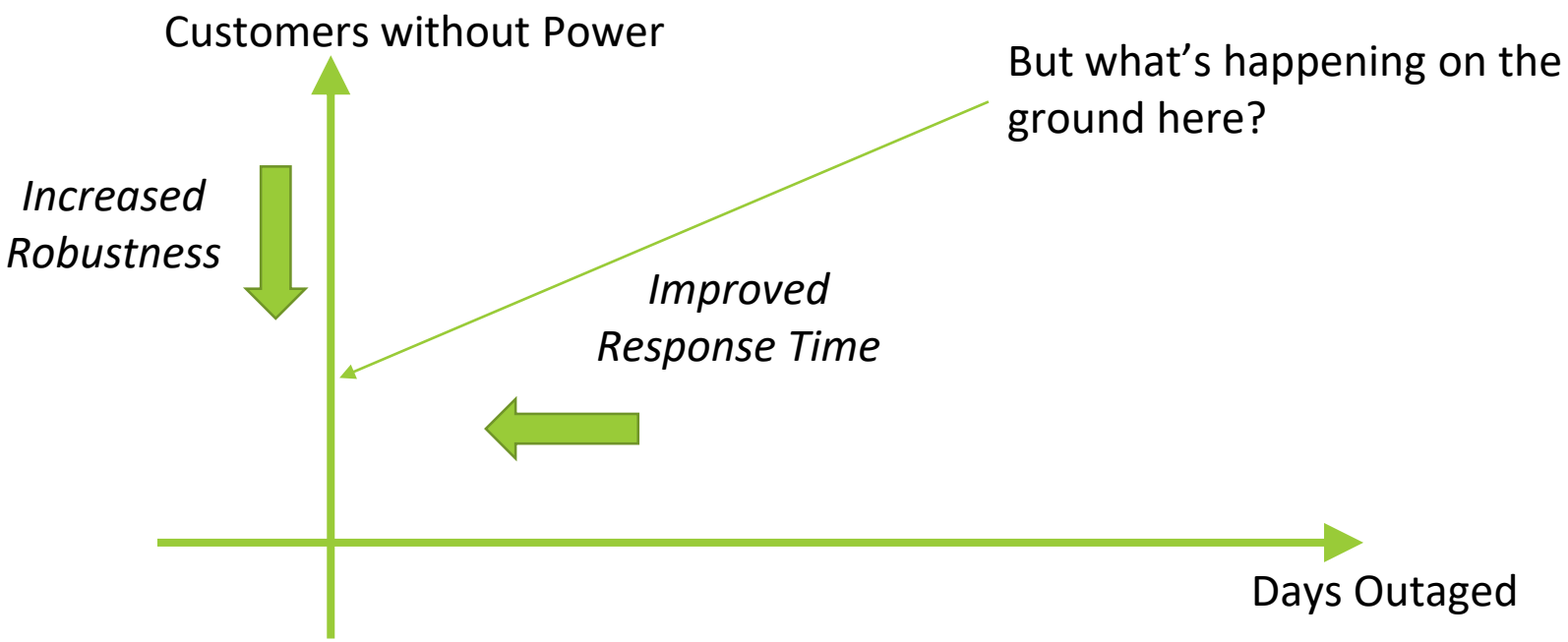


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# Defining Resilience

| Consequence Category | Resilience Metric |
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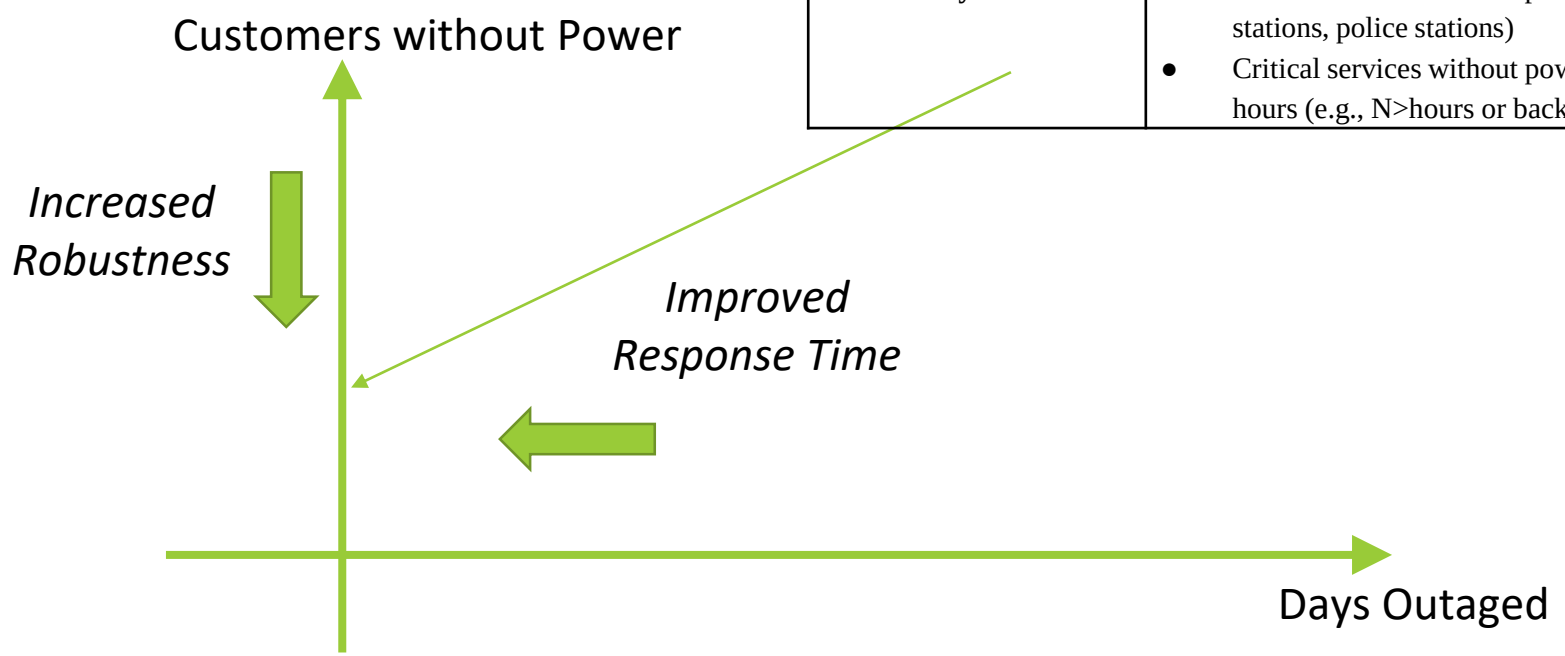


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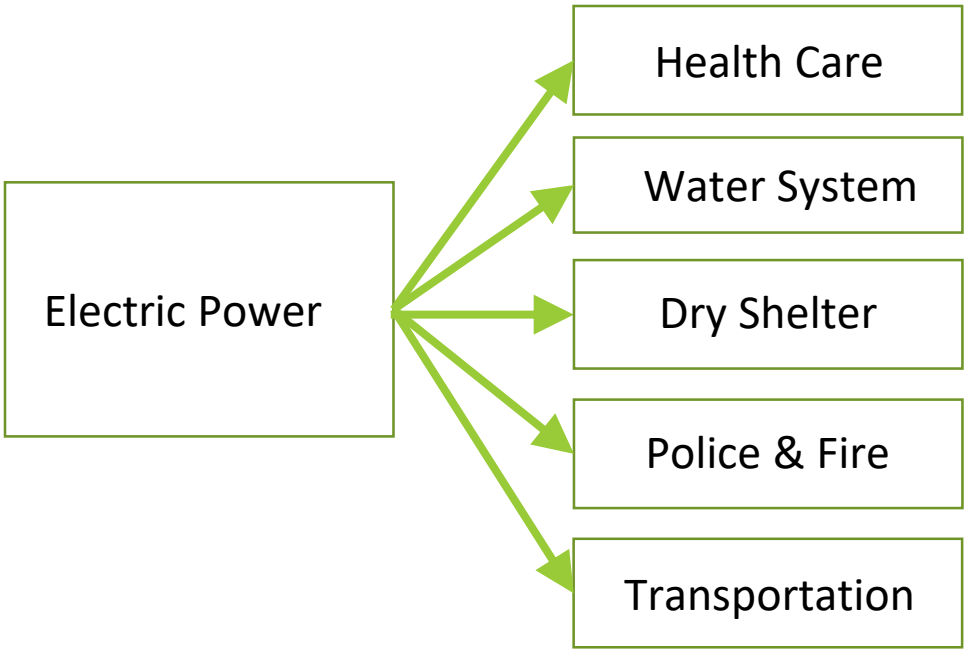
# The Interdependencies in Our Systems

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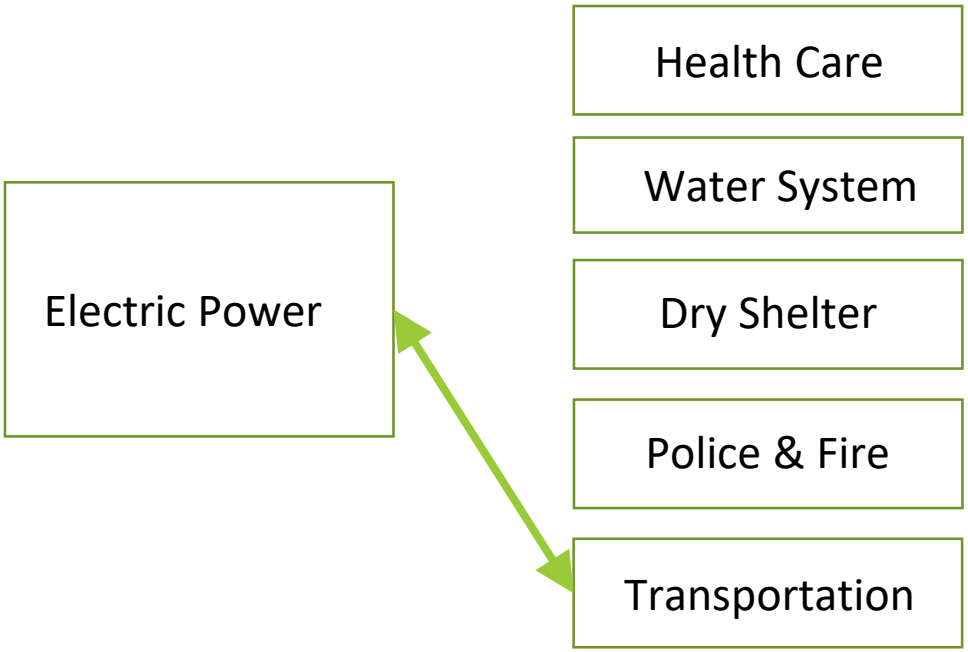
# But What About Backup Diesel?

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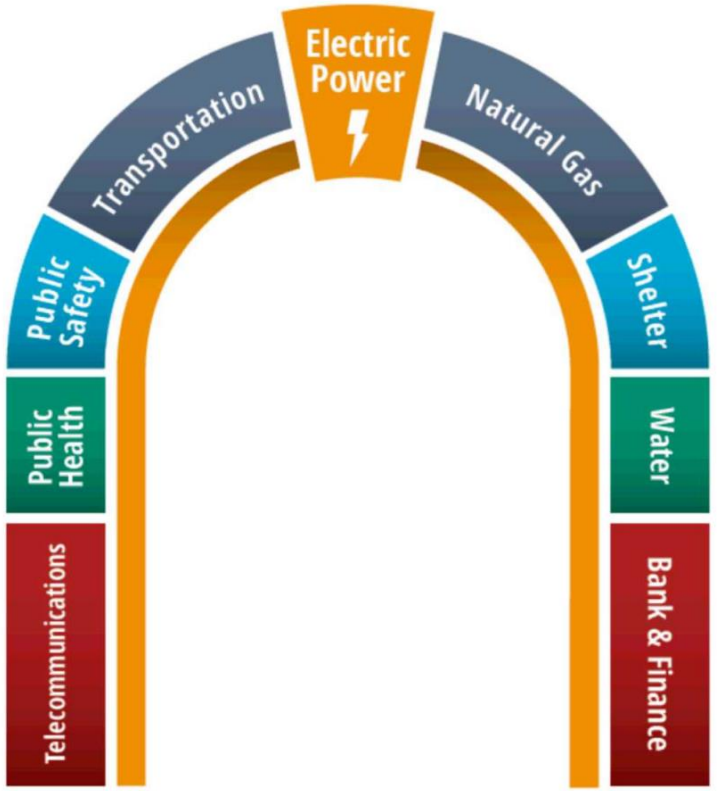
# The Bottom Line

- Electric power is the lifeblood of our society, including the function of the economy after an event
- Resilience analysis must include an understanding of this impact

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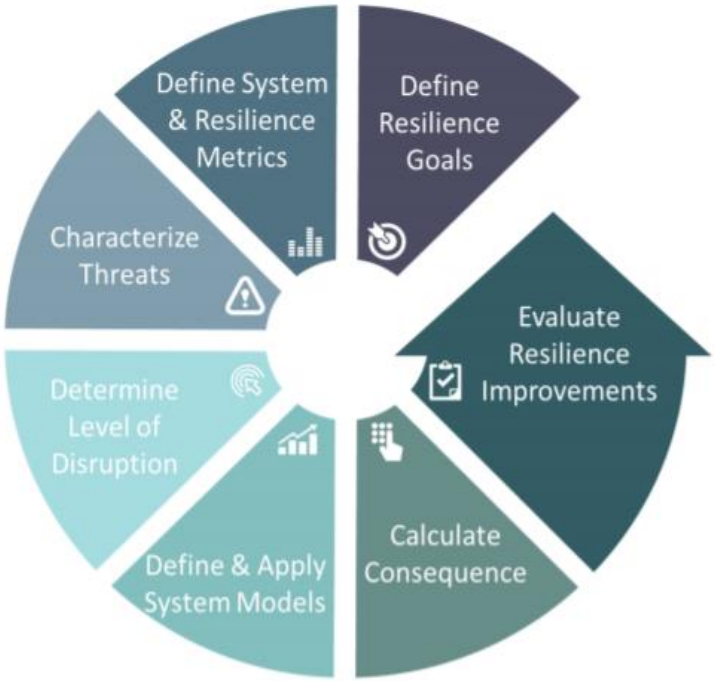
# Resilience Analysis Process

- First proposed as part of the 2015 Quadrennial Energy Review
- Walks through defining:
  - Hazards
  - Consequences
  - Goals

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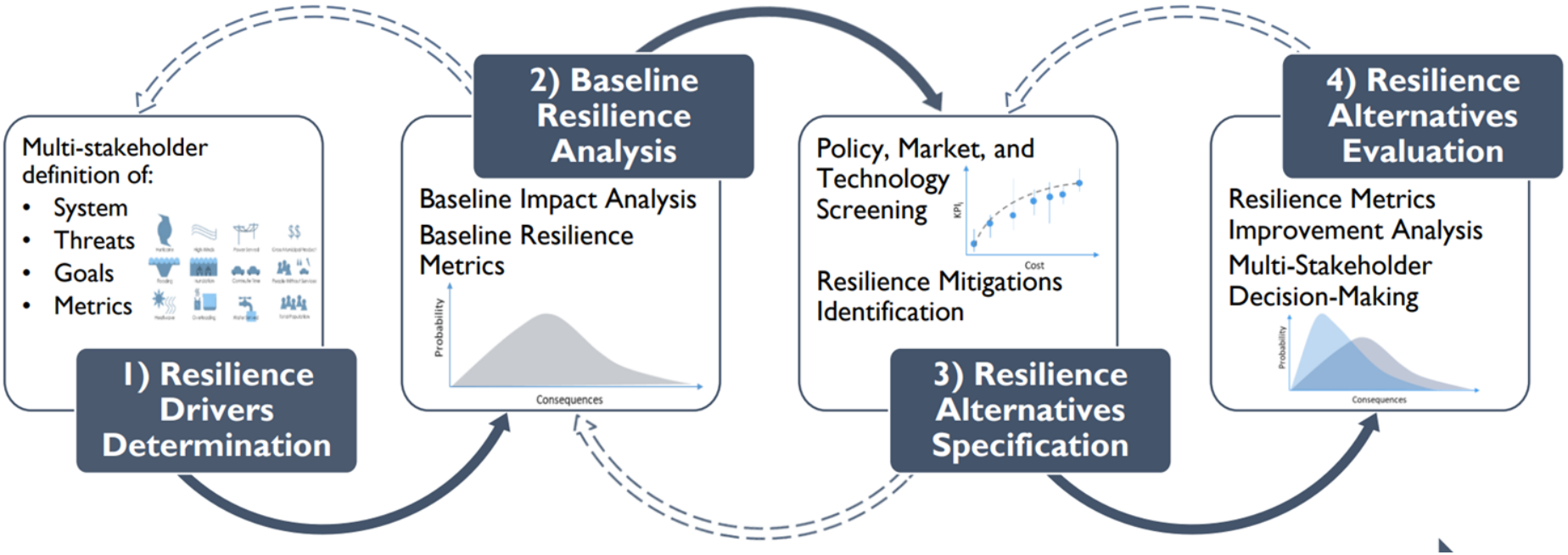


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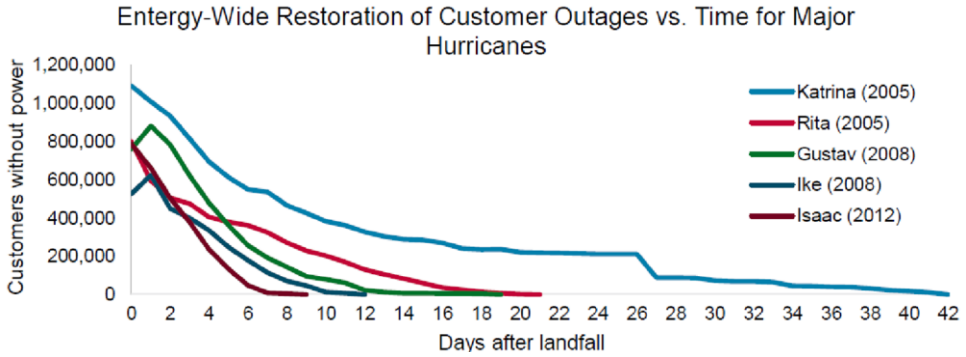
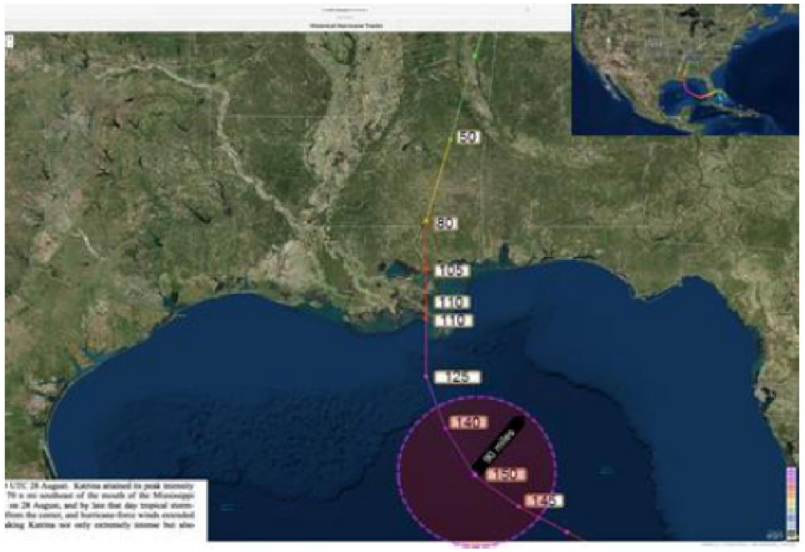
# Example: City of New Orleans

- City concerned about providing citizens with access to infrastructure services as quickly as possible
- Process:
  - What is the worst-case storm event likely to hit the city?
  - How did the city perform in past cases similar to the worst-case scenario?
  - Deploy grid modernization solutions to ensure *sustained and equitable* access to services provided by the grid



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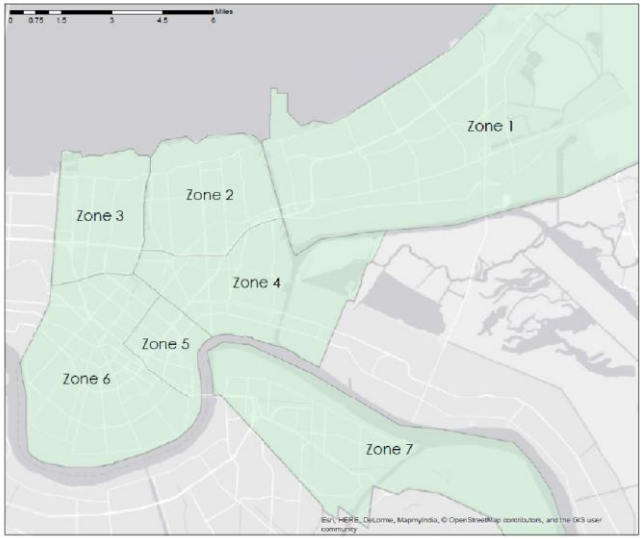
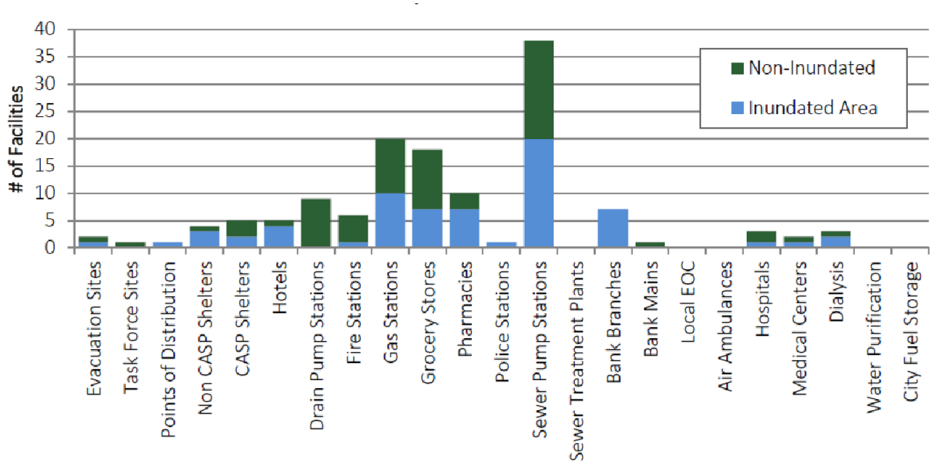
# Example: City of New Orleans

- Goal: Provide sustained and equitable access to key services
- Metric: % of infrastructure assets with reliable backup power for at least 7 days, and 12-14 if costs allow

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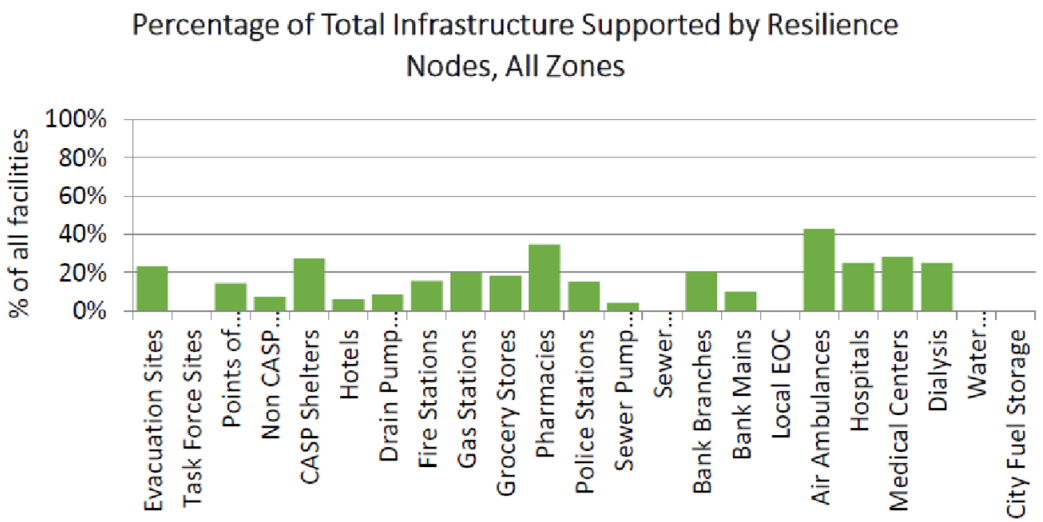
# Example: City of New Orleans

Identify “resilience nodes”

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# Our Analysis Approach

- Our project focuses on historic analysis looking at impact of recent storms on DEC and DEP


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# Duke Data

- DEC & DEP outage information, with a focus on MEDs
  - From 2015-2018
- Extensive information about GIP programs impacting New Hanover County
  - Self-Optimizing Grid
  - Targeted Undergrounding
- Feeder models for New Hanover County
- Understanding of transmission vs. distribution outages in major events

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# How Does This Impact North Carolina

- North Carolina has a complex patchwork of models for power delivery:
  - IOUs
  - Munis
  - Co-ops
- To begin to understand this, we started with New Hanover County, the largest urban area in the state with significant hurricane threats

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# Stakeholder Process

- Direct conversations with stakeholders in the region
  - City of Wilmington
  - Office of Emergency Management (New Hanover County)
  - CFPUA
  - UNC Wilmington
  - Local school district
  - Hospital system

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# What Do We Hear in Stakeholder Conversations?

- From City and County staff: Extremely impressed with response from Duke Energy during Florence
- CFPUA:
  - Southside Plant: Released 5.25 million gallons of partially treated wastewater
  - Difficulty getting diesel to other locations nearly resulted in loss of potable water
- Emergency Management:
  - Fuel could not be delivered; Fuel contract needed to be developed during the storm
  - Shelters were overwhelmed
- UNCW
  - Significant loss of refrigerated food and research
  - Unable to provide support to surrounding community
- Community:
  - A number of comments have reflected a *perception* of inequity in the restoration

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# Outcomes

- Emergency response and management is particularly difficult
- ***Can sites be identified throughout the County at which power can be provided in the immediate aftermath of the storm?***
- What role can grid modernization efforts play and to what extent does a microgrid or other solution become the necessary solution?

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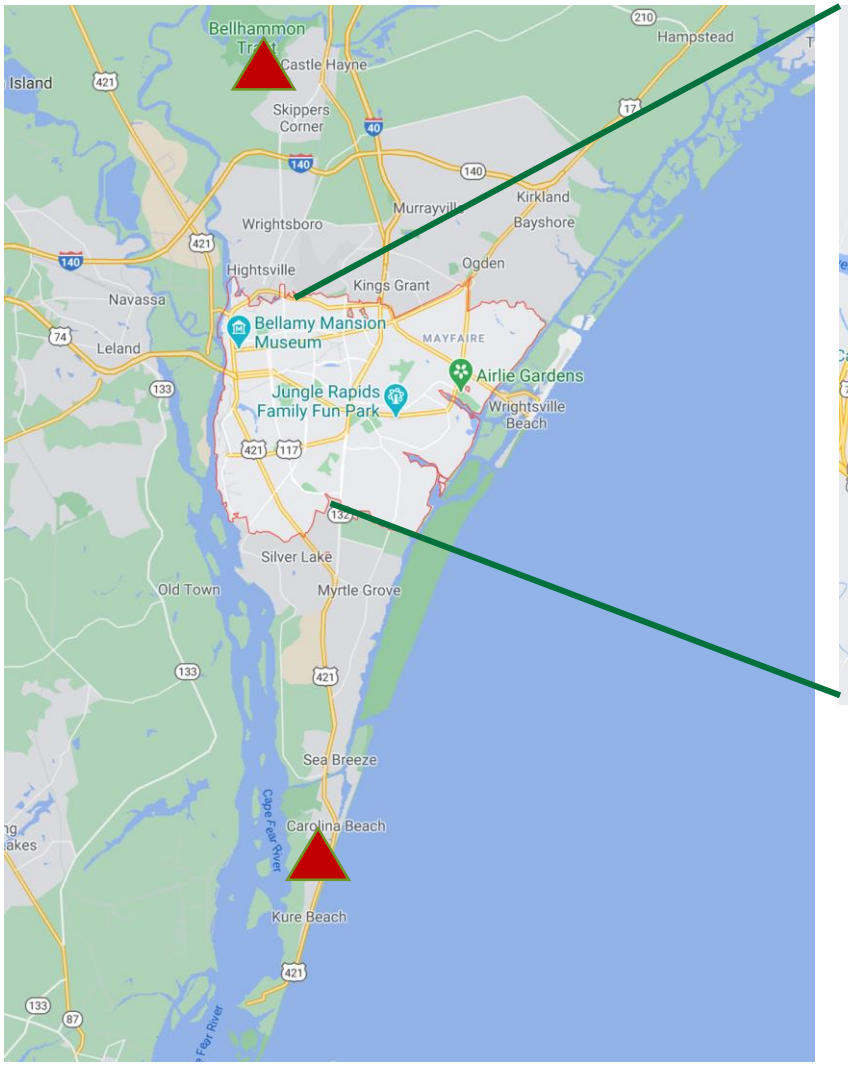
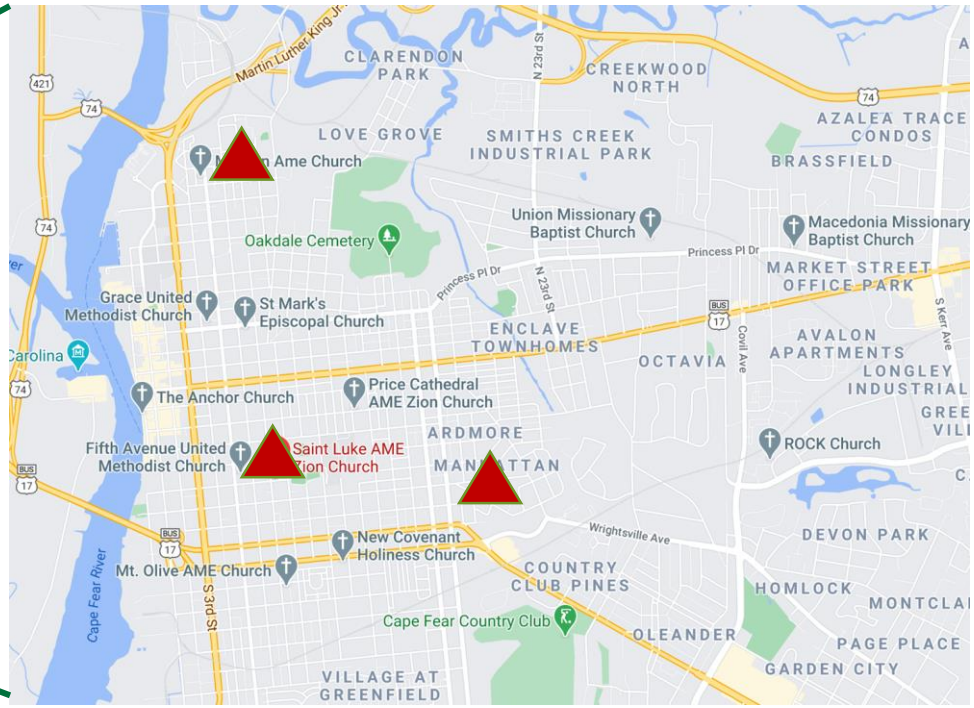
# Key Areas Where Community Function is Essential

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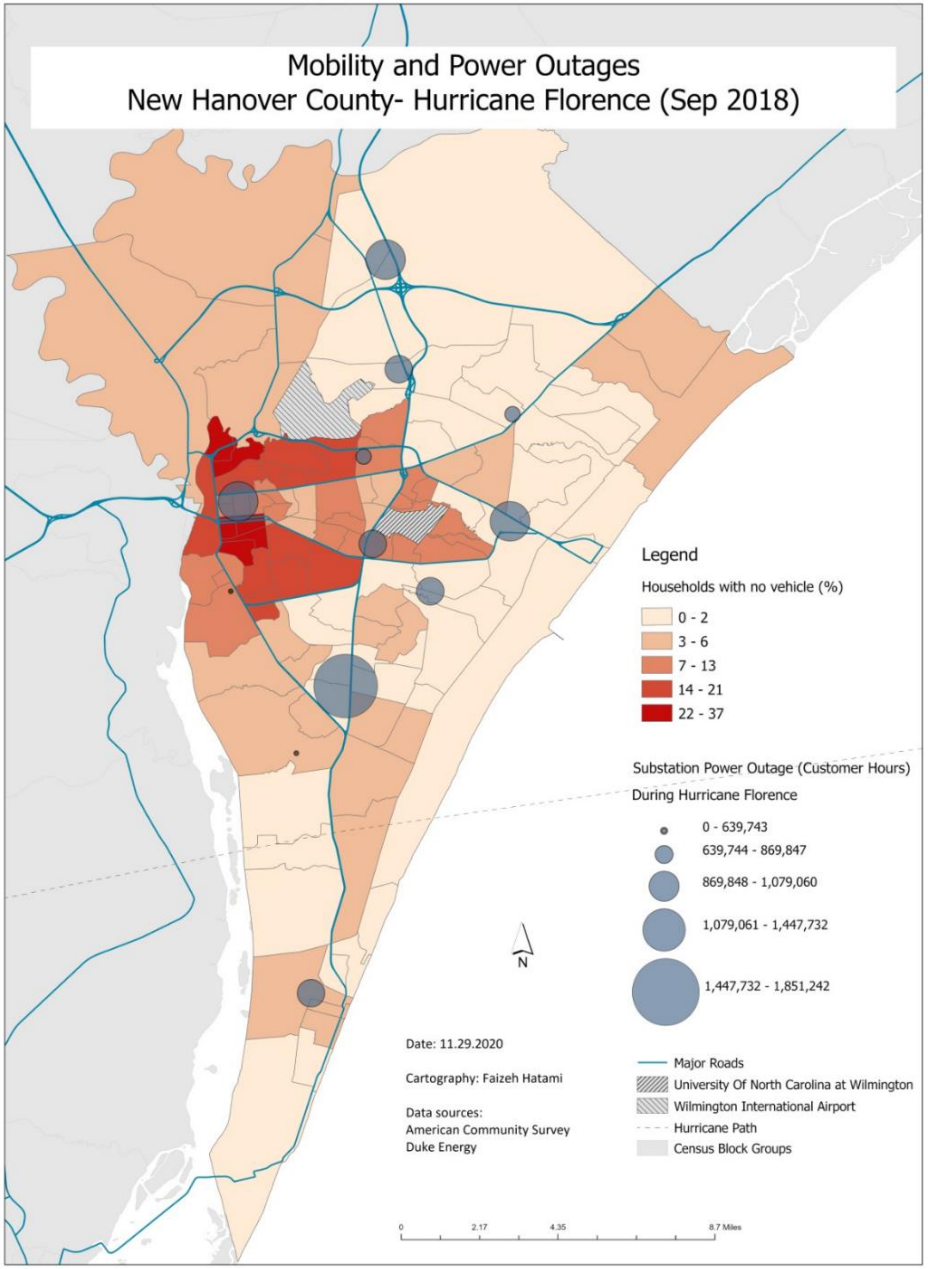
# Understanding Community Challenges

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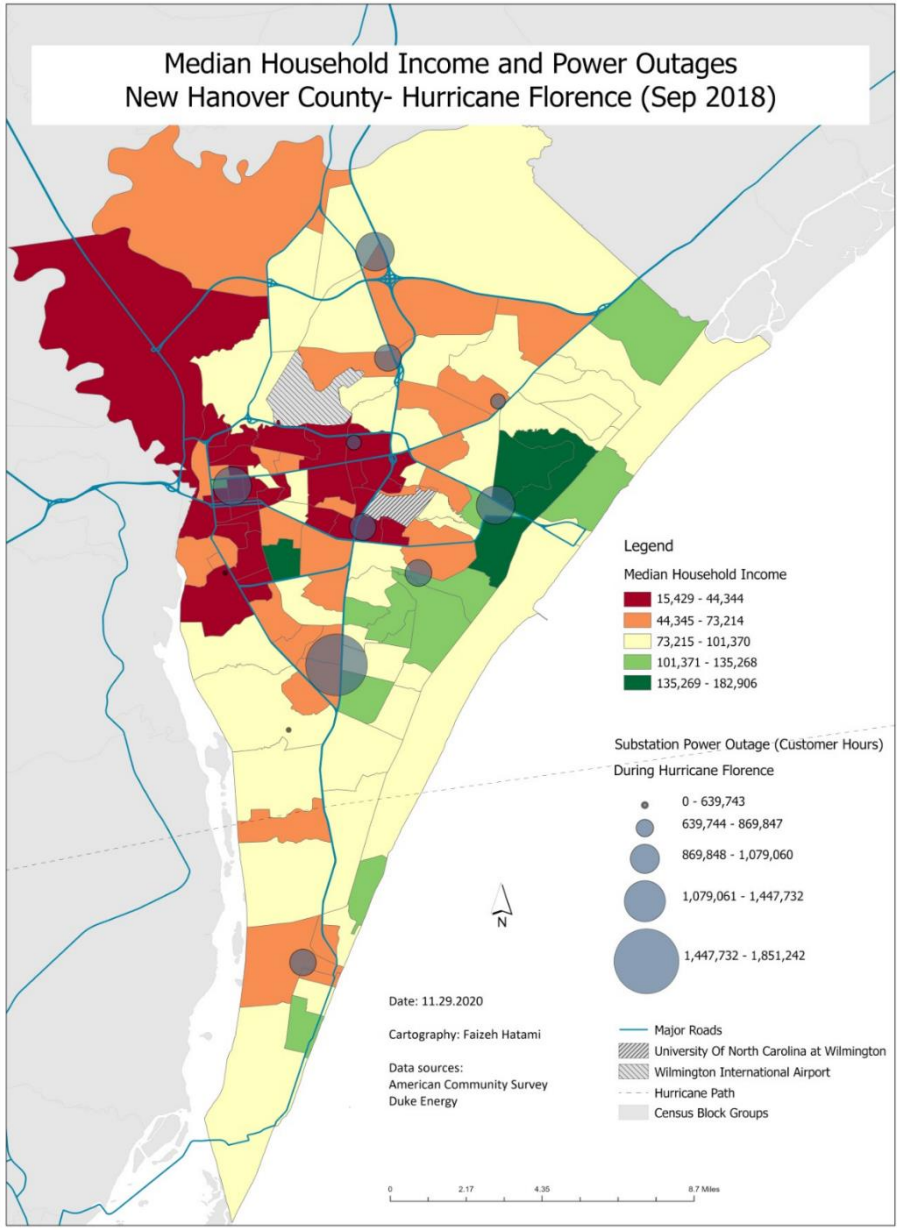


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# Potential Locations

- Northside
  - Local Church: Last mile point-of-distribution center; can allow community WiFi access for applications
- Southside
  - Local Church: Point of distribution, mass feeding
  - Community center: Point of distribution, mass feeding
  - Shopping center with grocery store and pharmacy: Located near public housing developments. Located in area where residents are less mobile.

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# Potential Locations

- Castle Hayne:
  - Shopping center with grocery store and pharmacy: Serves a rural community
- Carolina Beach / Kure Beach:
  - Shopping center with grocery store, pharmacy, library: Serves a community that tends to be isolated during storms

# What Next?

- How can we create metrics to evaluate potential solutions that meet these goals?
- Understand history of power outages in these regions

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# Example Community Metrics

- Number of critical assets without power for more than *N* hours in a given region (# of assets)
  - *N* may be set as 0 hours or greater than the number of hours back up fuel is available
- Type of critical assets without power (hospital, fire station, police station, evacuation shelters, community food supply distribution center, production facility, military sites)
- Critical asset energy demand not served (cumulative kWh)
- Critical asset time to recovery (Average hrs)

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# Breakout Session Overview

Robert Cox

December 3, 2020

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*Energy Production and Infrastructure Center*

# Agenda

- 12:50 – Project Review
- 1:50 – Breakout Session Overview
- 2:00 – Breakout Session 1
- 2:45 – Stretch Break
- 3:00 – Breakout Group Report Out
- 3:45 – Breakout Session 2
- 4:15 – Wrap-up & Next Steps

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# Today's Stakeholder Session

- Goals:
  - Present current project status & approach
  - Meet in small groups to discuss community goals
- Four groups identified:
  - Asheville / Henderson (Mountains)
  - New Bern (Coastal)
  - Triad
  - Large urban center

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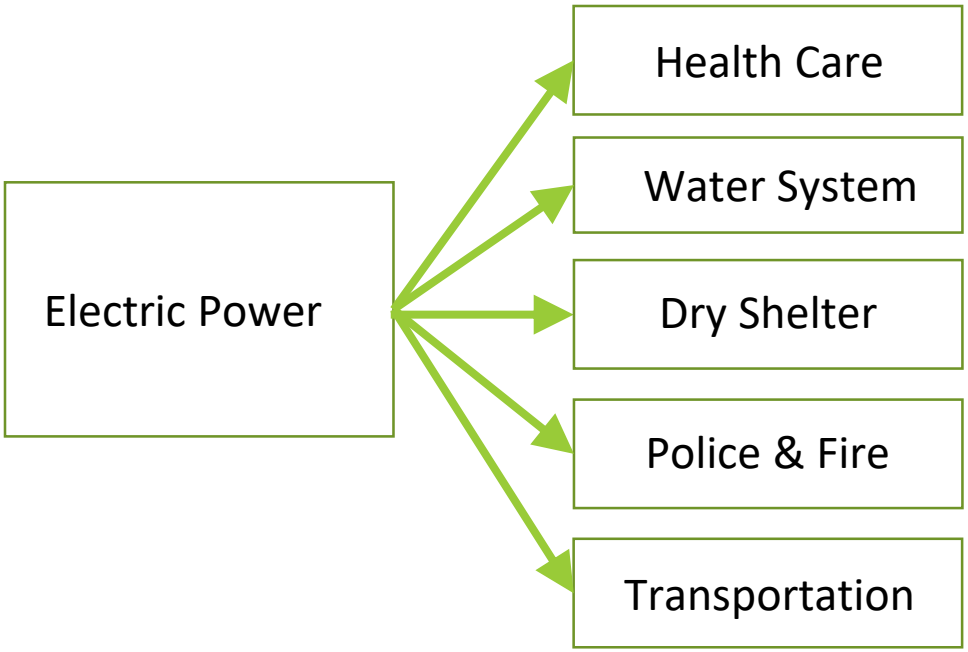
# The Interdependencies in Our Systems

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# The Dimensions of Resilience

**POPULATION AND DEMOGRAPHICS**
Composition, Distribution, Socio-Economic status, etc.

**ENVIRONMENTAL/ECOSYSTEM**
Air quality, Soil, Biomass, Biodiversity, etc.

**ORGANIZED GOVERNMENTAL SERVICES**
Legal and security services, Health services, etc.

**PHYSICAL INFRASTRUCTURE**
Facilities, Lifelines, etc.

**LIFESTYLE AND COMMUNITY COMPETENCE**
Quality of Life, etc.

**ECONOMIC DEVELOPMENT**
Financial, Production, Employment distribution, etc.

**SOCIAL-CULTURAL CAPITAL**
Education services, Child and elderly care services, etc.

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# Our Approach

| Dimension | Community Vulnerability | Power System Vulnerability |
|---|---|---|
| Population and Demographics | 1. What is the social vulnerability of the population, and how does this impact your response to disasters?<br><br>2. Are there vulnerabilities associated with the ability of your population to bounce back? For example, historically disenfranchised groups can be more negatively impacted by disasters because of a more general feeling of hopelessness. | 1. Are there large demographic groups that remain after storms that need power for essential services? For example, shelters, child care, etc.<br>2. Will a loss of power impact your ability to provide medical services, or will restoration exacerbate demographic issues? |
| Environmental and Ecosystem | 1) Are there particular threats to the environment that impact your community (i.e. threats to agriculture from storms, wastewater runoff, etc.) | 1) Is there a strong relationship between power and the ability to protect the environment (i.e. wastewater treatment facilities). Are there vulnerabilities to providing diesel for backup at key locations? |

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# Our Approach

| | | |
|---|---|---|
| Organized Governmental Services | 1) Are there vulnerabilities to your ability to provide emergency services following a disaster?<br><br>2) Are there vulnerabilities associated with services such as medical treatment, social services, elderly care, etc.? | 1) Is there a specific concern about getting diesel for back up generators, for instance? Do you not have adequate backup?<br>2) How does a loss of electric power impact essential social services? |
| Physical Infrastructure | 1) Are there particular infrastructure vulnerabilities that your community faces (i.e. impacts from flooded roads, limited redundancy in electric power infrastructure, etc.) | 1) Are there specific threats to your power infrastructure or your ability to get fuel for long periods? |
| Economic Activity | 1) Are there specific vulnerabilities to your economy, i.e. do you have a high dependence on | 1) Without electric power, is your economy threatened in some way? |

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# Our Approach

- Quick introduction
- Quick introduction:
  - Name
  - Organization
  - Resilience dimension most important to you
- Deep dive on the top 3 dimensions

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