Resilience for Regulators #1

Climate Resilience Frameworks to Improve Risk Management: Exploring Lessons Learned from North Carolina

NARUC
National Association of Regulatory Utility Commissioners

January 26, 2022

NARUC Center for Partnerships & Innovation

Welcome & Agenda

1. Opening remarks & Introductions (Commissioner Kimberley Duffley)
2. Panelist Presentations
3. Q&A(all participants)
4. Closing Remarks & Next Resilience for Regulators Webinar

Opening Remarks & Introductions

Moderator: Hon. Kimberly Duffley

Commissioner, North Carolina Public Utilities Commission

Panelists:

Jim Fox, Senior Resilience Associate, NEMAC+Fernleaf, US Climate Resilience Toolkit Team

Sushma Masemore, Assistant Secretary for the Environment, North Carolina Department of Environmental Quality

Robert Cox, Associate Director, University of North Carolina Charlotte's Energy Production & Infrastructure Center (EPIC)

Nelson Peeler, Senior Vice-President of Transmission, Fuels Strategy, and Policy, Duke Energy

Climate Resilience Frameworks to Improve risk management – Lessons learned from North Carolina

January 26, 2022

NARUC
National Association of Regulatory Utility Commissioners

DEQ NORTH CAROLINA

UNC CHARLOTTE EPIC

U.S. Climate Resilience Toolkit

CPO CLIMATE PROGRAM OFFICE
ADVANCING SCIENTIFIC UNDERSTANDING OF CLIMATE, IMPROVING SOCIETY'S ABILITY TO PLAN AND RESPOND

UNC ASHEVILLE NEMAC+FernLeaf

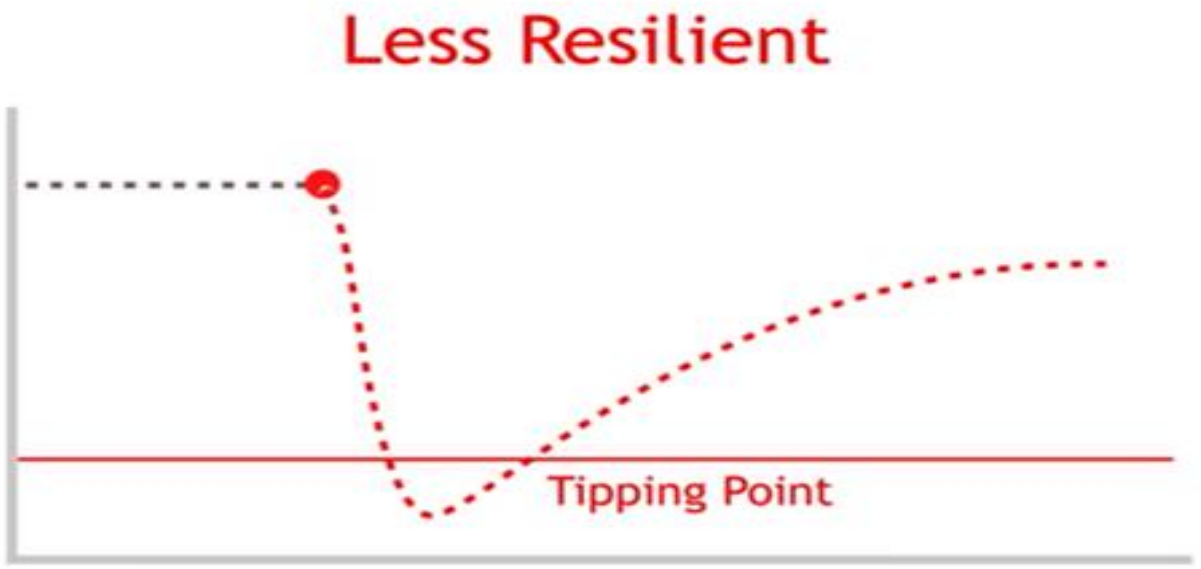
DUKE ENERGY®

Speaker Slide

- Jim Fox jfox@nemacfernleaf.com, Ned Gardiner ned.gardiner@noaa.gov

Changes in flooding, wildfire, heat, power, population, and other realities are stressing our communities, landscapes, and livelihoods

What is resilience?



IPCC – “Resilience is the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identify and structure, while also mainlining the capacity of adaptation, learning and transformation.”

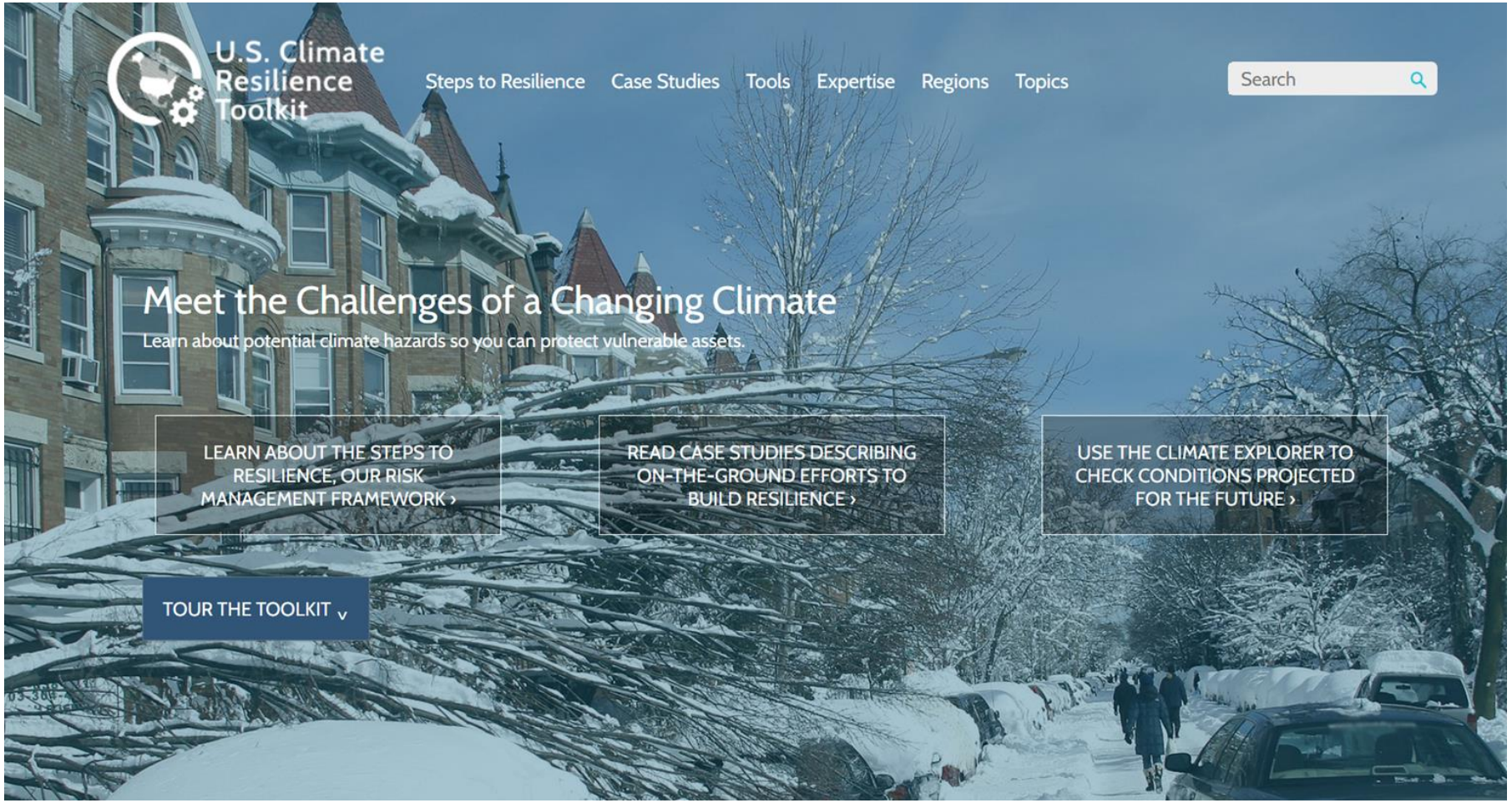
NC EO80 Directives

Department of Environmental Quality & Designees

- **N.C. Climate Risk Assessment and Resiliency Plan -** provide a scientific assessment of current and projected climate impacts on North Carolina and prioritize effective resilience strategies.

All Cabinet Agencies - Assess and Address Climate Change

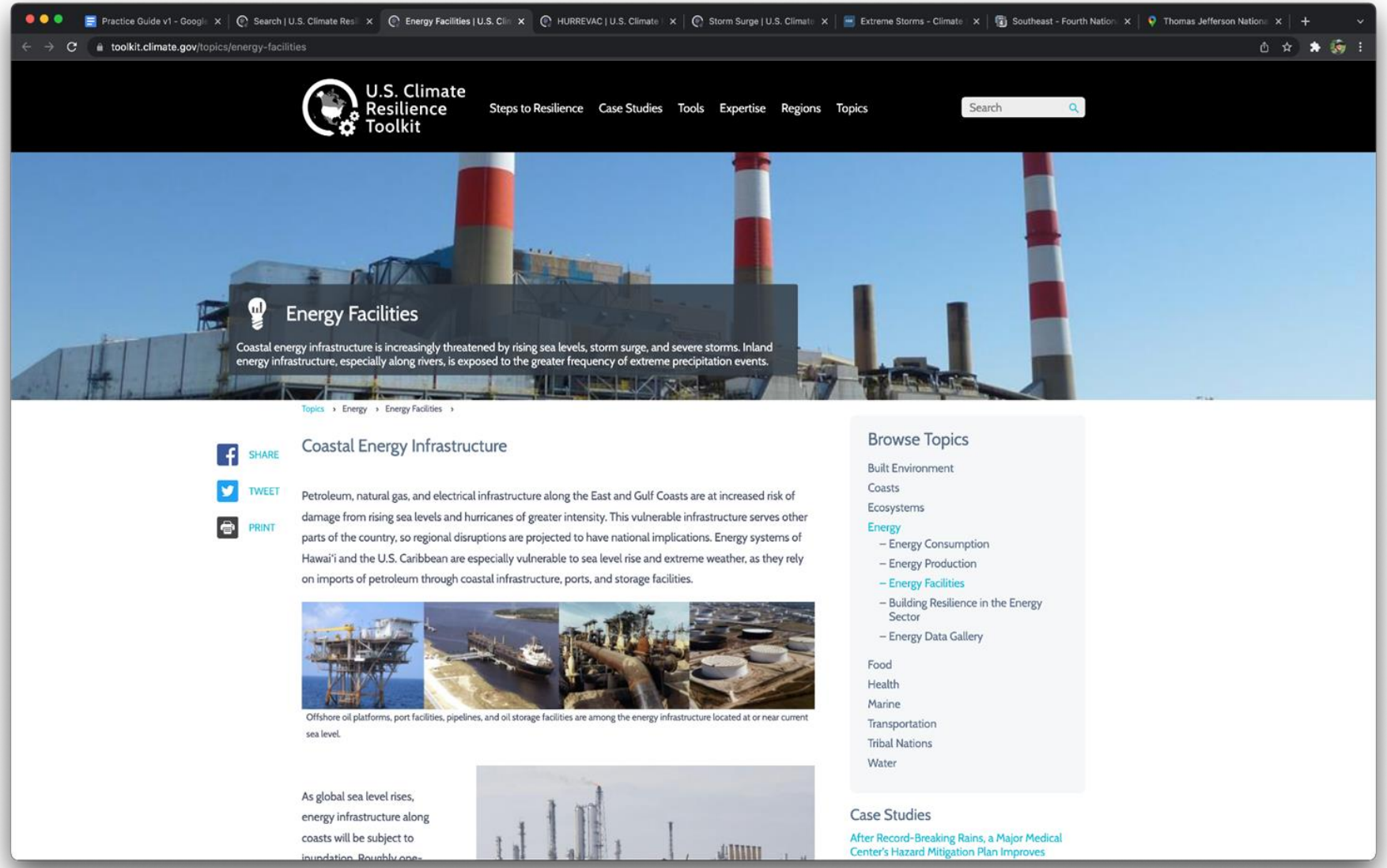
- Evaluate the impacts of climate change on agency programs and operations
- Integrate climate change mitigation and adaptation practices into agency programs and operations
- Support communities and sectors vulnerable to climate change impacts



- US Climate Resilience Toolkit launched in 2014
- Assist decision makers in building resilience

toolkit.climate.gov

U.S. Climate Resilience Toolkit



Did you know?

- Sectors (Energy, others)
- Case Studies
- Regional Data
- Hundreds of Tools
- Links to experts

toolkit.climate.gov

U.S. Climate Resilience Toolkit

Climate Explorer

- Historical temperature and precipitation observations at hundreds of climate stations,
- Interactive graphs and maps showing climate projections and observations for any county in the contiguous United States.

toolkit.climate.gov

U.S. Climate Resilience Toolkit

Steps to Resilience

- ✓ Risk framework
- ✓ Transparent and defensible priorities
- ✓ Comparable to other communities nationwide
- ✓ Moves from the data to decisions - from “Did you know?” to “What can we do about it?”
- ✓ Scalable to handle small communities, large metro areas, and states

US Dept of Energy VARP

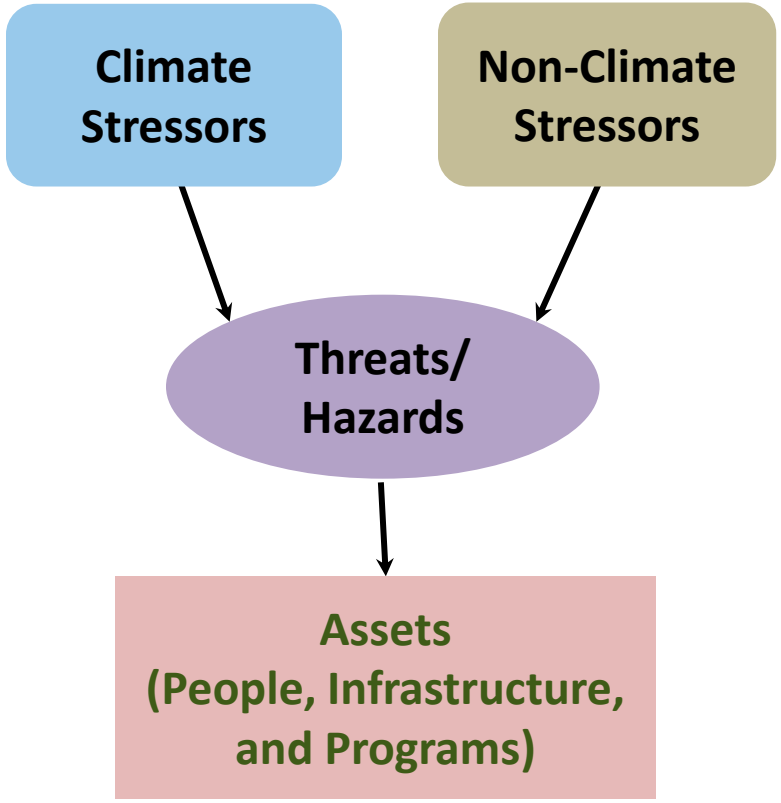
1. Identify VARP planning team
2. Identify Critical Assets and Infrastructure
3. Characterize Climate Trends and Events
4. Characterize Likelihood of Climate Change Hazards
5. Characterize Current and Projected Impacts
6. Characterize Vulnerabilities with a Risk Matrix
7. Identify and Assess Resilience Solutions
8. Develop and Implement a Portfolio of Solutions
9. Monitor, evaluate, and reassess the Resilience Plan

Steps to Resilience

U.S. Climate Resilience Toolkit
toolkit.climate.gov

1. Explore Hazards
2. Assess Vulnerability & Risk
3. Investigate Options
4. Prioritize & Plan
5. Take Action

NC Climate Risk Assessment Using the Steps to Resilience From Data to Decisions



- Temperature Variability and Change
- Extreme Precipitation
- Sea Level Rise and Tidal Effects

- Development
- Impervious surfaces
- Population growth
- Energy and water demand

- Flooding (Riverine, Coastal, Other)
- Water shortage due to drought
- Wildfire
- Extreme Heat

- People
- Programs
- Property
- Infrastructure

NC Climate Risk Assessment Using the Steps to Resilience
From Data to Decisions

Framing comments

- Energy reality is rapidly changing, this provides an opportunity to build resilience as we are modernizing the infrastructure to handle 21st century fuel and power needs.
- Energy drives commerce, transportation, housing sectors and therefore solutions must be integrated across these sectors

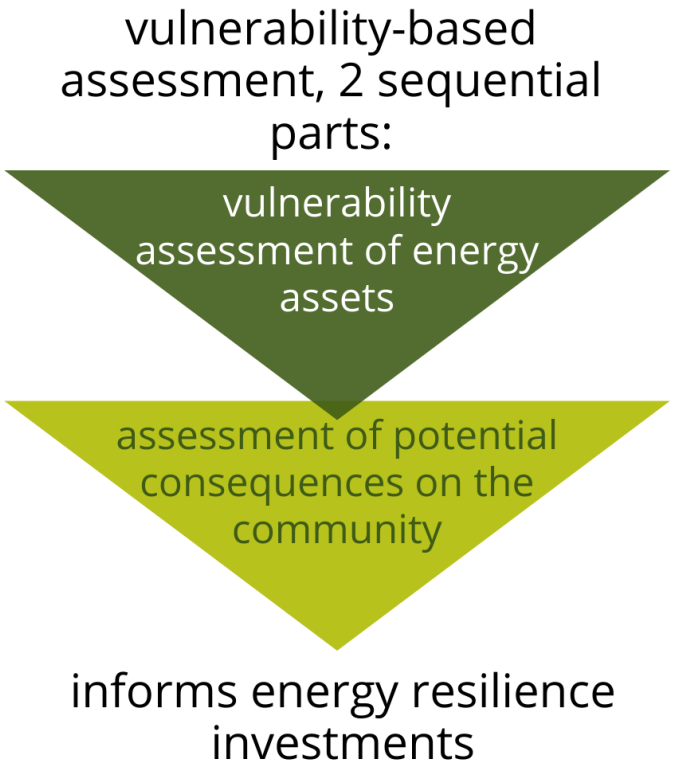
Critical Impacts and Potential Options

- Electric Grid/Increased Storm Intensity causes power outages and related disruptions cascade through the local and state economy
- Power Plant Cooling/Water shortage due to drought puts stress on water quantity and quality
- Fuel supply chain disruption/increased storm intensity affects evacuation routes and critical infrastructure

NC Energy Pilot Project Summary

Develop a systematic vulnerability-based approach to assess needs for equitable energy resilience investments across the state of North Carolina

- **using New Hanover County as a case study**
- **and New Bern as a test case for replicability of the analytical approach.**



DEQ NORTH CAROLINA

UNC ASHEVILLE NEMAC+FernLeaf

Energy Resilience with an Equity Lens

- Who is being most impacted?
- How is that impact being experienced?
- What unique vulnerabilities, risks, assets and barriers exist?
- What additional resources are necessary?

Energy System

Reduce the number of customers impacted and duration of outages

Emergency Mgmt

Efficiently address immediate life safety concerns

Reduce future losses, risks and vulnerabilities to life and property

Increase speed to recovery

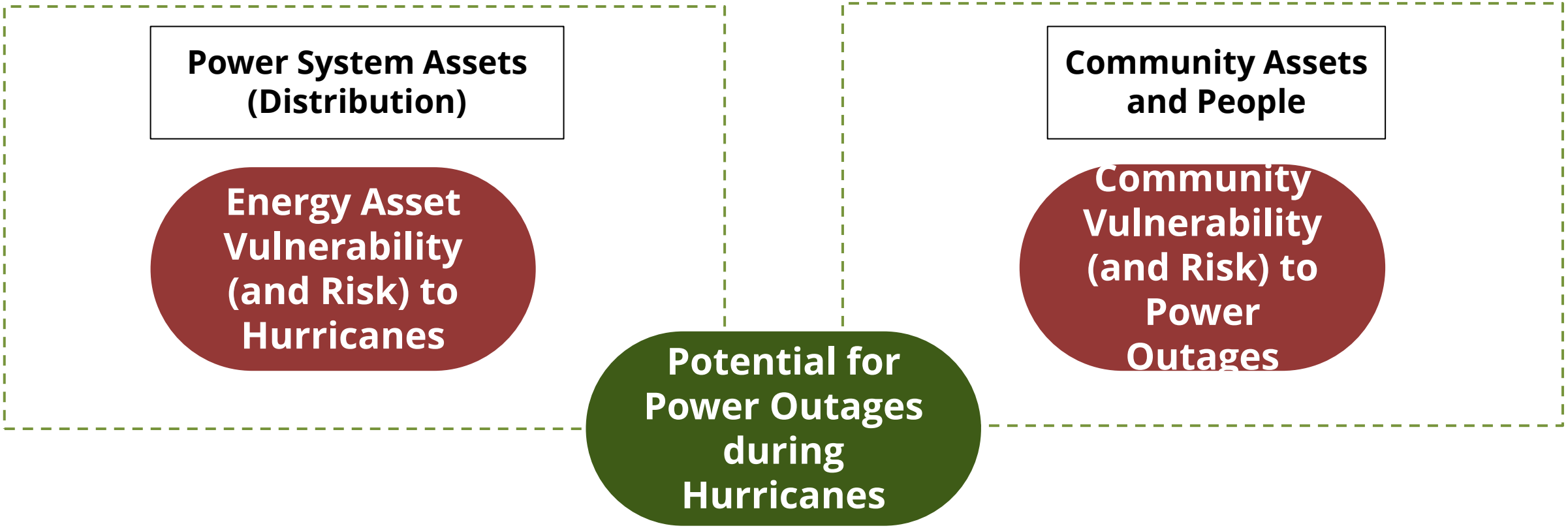
Community Resilience

Trust, transparency, community input, and context

Improved health, economic and social well-being outcomes

Full participation, equitable access, availability, and benefit

Vulnerability analysis framework for the pilot project

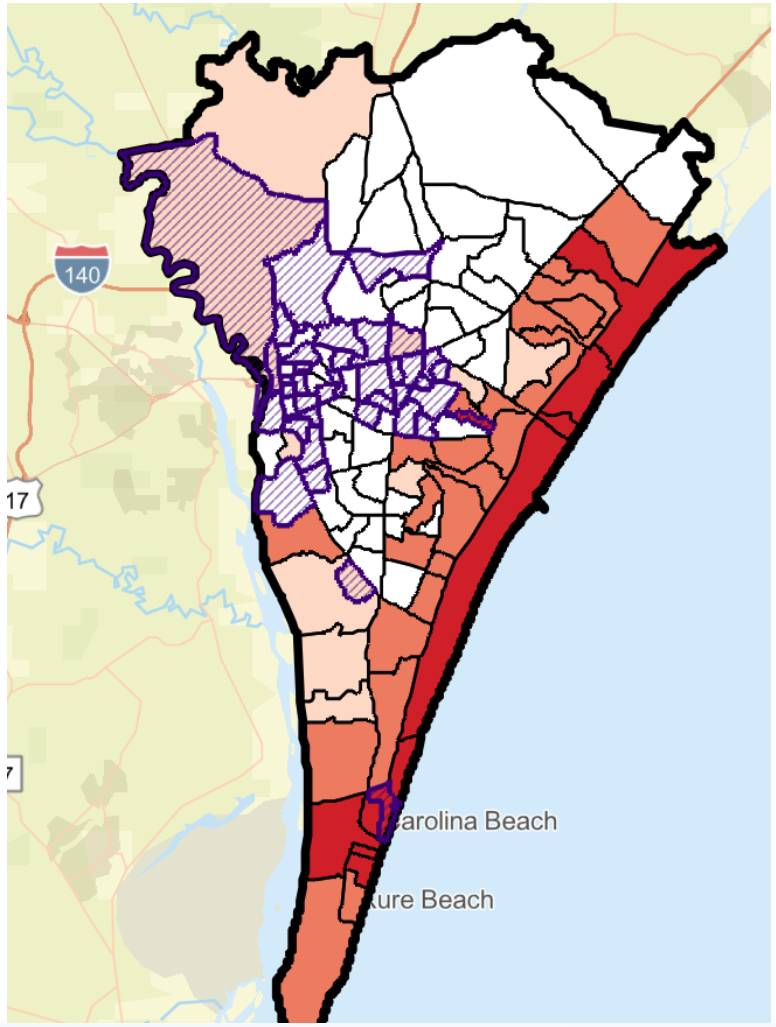


DEQ NORTH CAROLINA

UNC ASHEVILLE NEMAC+FernLeaf

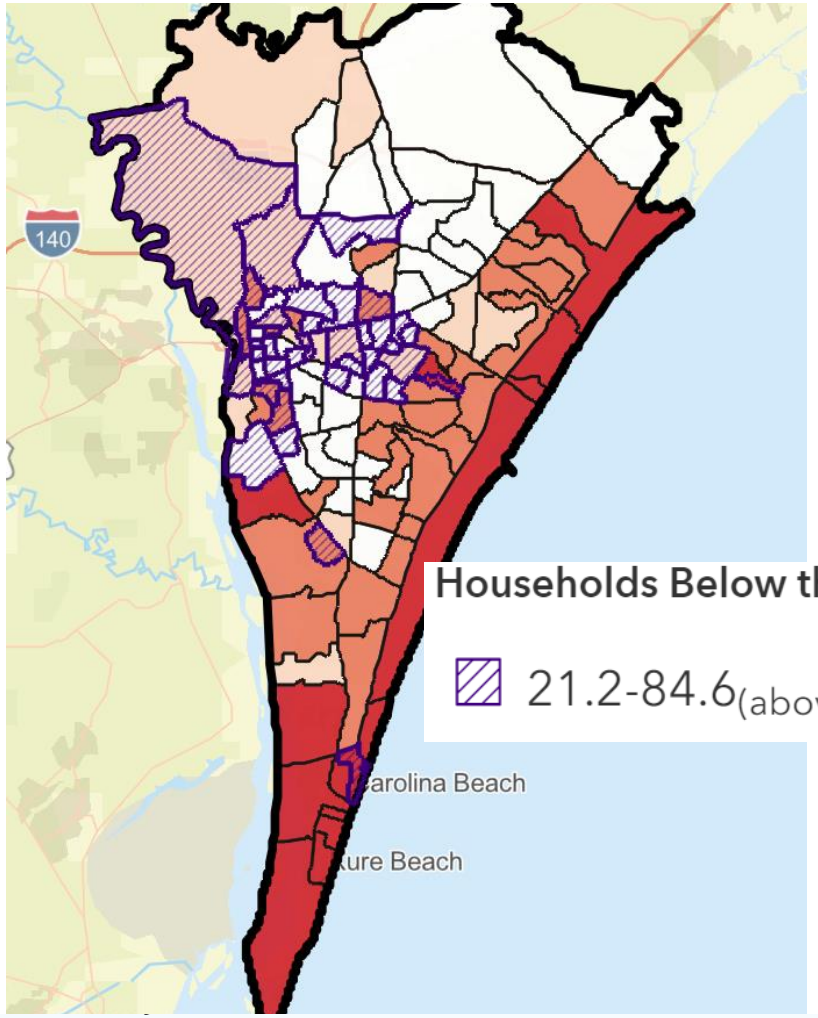
Vulnerability of Residential Properties to Flooding

Moderate Storm Surge (Cat 1-2)



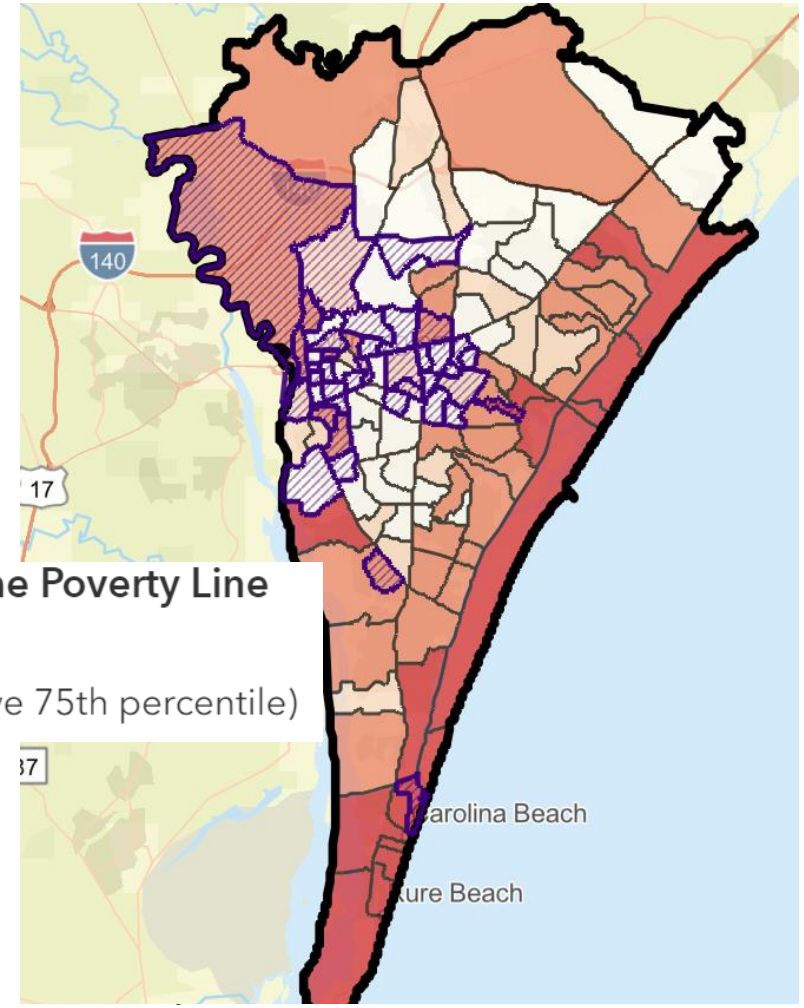
0.11-1.46 | 1.47-11.6 | 11.7-56.8

Extreme Storm Surge (Cat 3-5)



0.11-1.64 | 1.65-26.8 | 26.9-90.3

FEMA Floodplain Inundation



0.09-0.67 | 0.671-11.2 | 11.3-60.4

Households Below the Poverty Line

21.2-84.6 (above 75th percentile)

Resilience for Regulators

Climate Resilience Frameworks to Improve Risk Management

Collaborative Efforts and Lessons Learned

January 26, 2022

Sushma Masemore, P.E.
Assistant Secretary for Environment

Problem Statement

North Carolina experiences frequent extreme weather events that disrupt essential operations, energy infrastructure, and threatens the health and safety of citizens.

What are we trying to prevent?

Carolina's Grid Disturbance types
Source: Advanced Energy

- Florence was the largest mobilization in Duke Energy storm history.
- Flooding and wind damage were unprecedented.
- Generator failures at a WWTP released partially-treated water into the Cape Fear River.
- 9 Duke Energy substations were flooded.

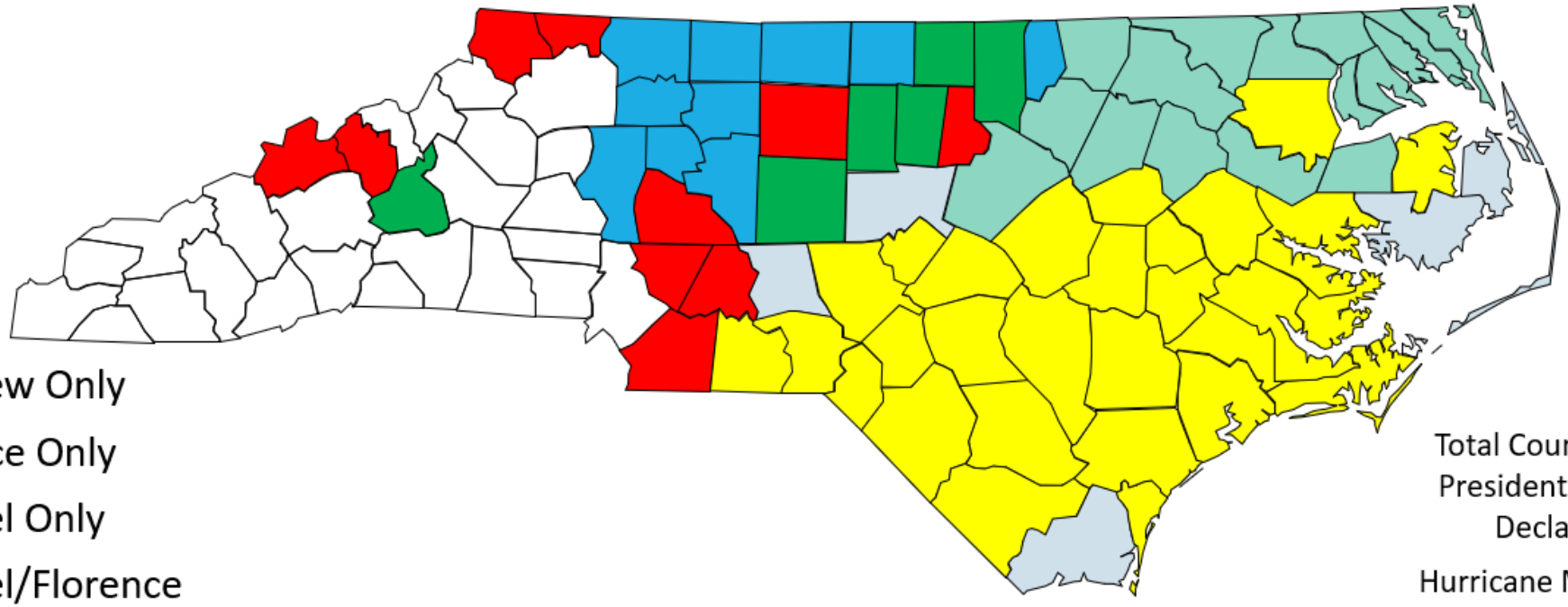
Distribution Summary

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

Transmission Summary

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

Widespread impacts: Matthew, Michael, Florence



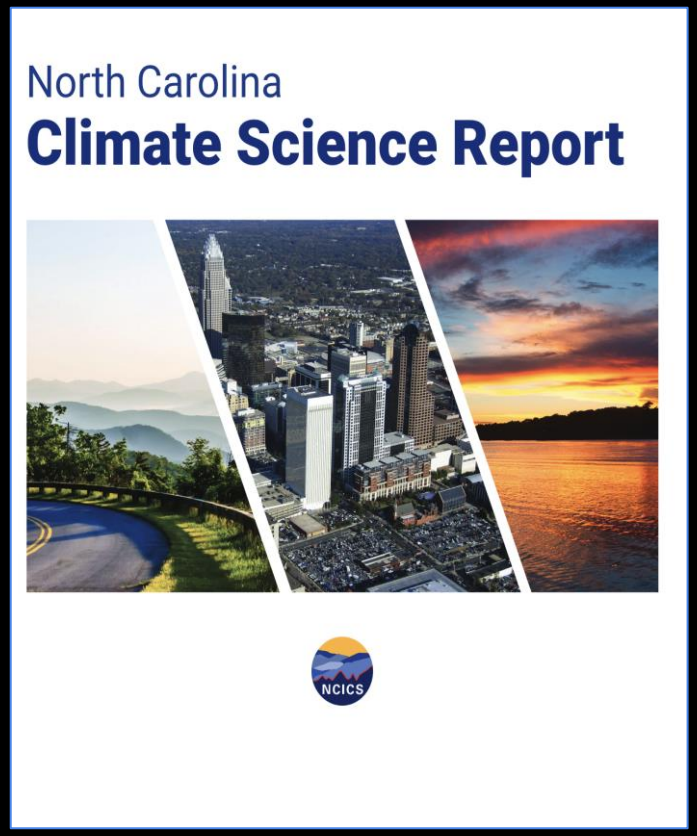
- Matthew Only
- Florence Only
- Michael Only
- Michael/Florence
- Matthew/Florence
- Matthew/Michael/Florence

Total Counties Under Presidential Disaster Declaration:

Hurricane Matthew: 50
Hurricane Florence: 52
Tropical Storm Michael: 21

77 of 100 Counties impacted between 2016-2018

NC Climate Science Report



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

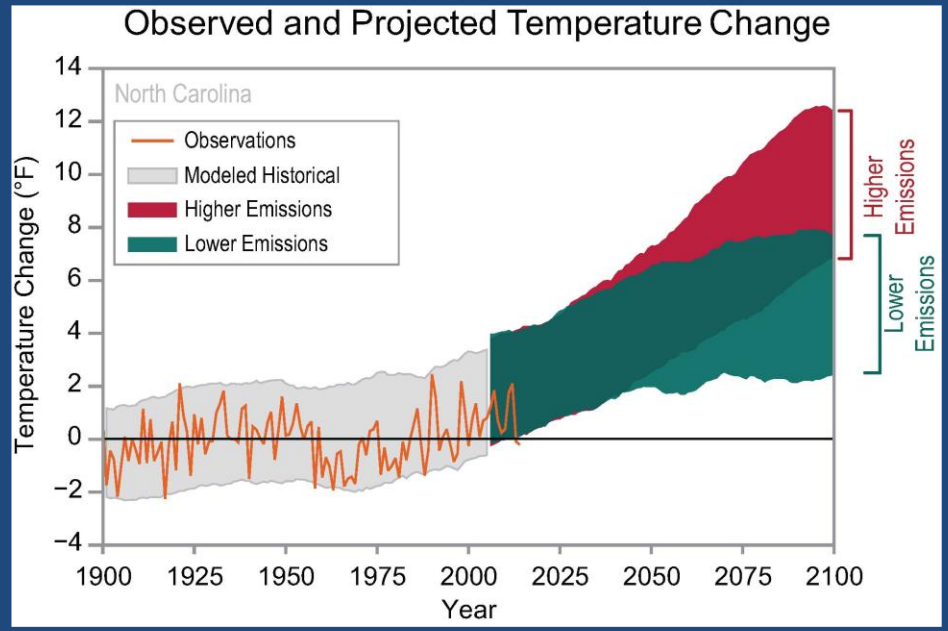
Source: North Carolina Climate Science Report, https://ncics.org/nccsr

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

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

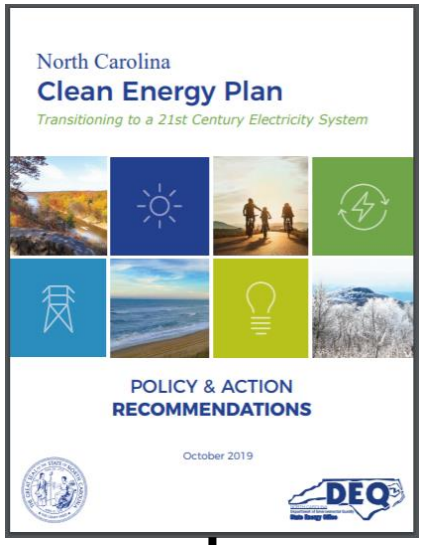
are ***very likely*** by the end of this century under both the lower and higher scenarios."

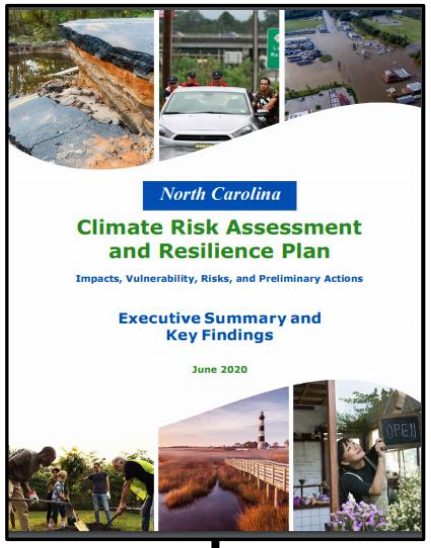
Very likely	90–100% probability of outcome



https://statesummaries.ncics.org/

Crosscutting Priorities



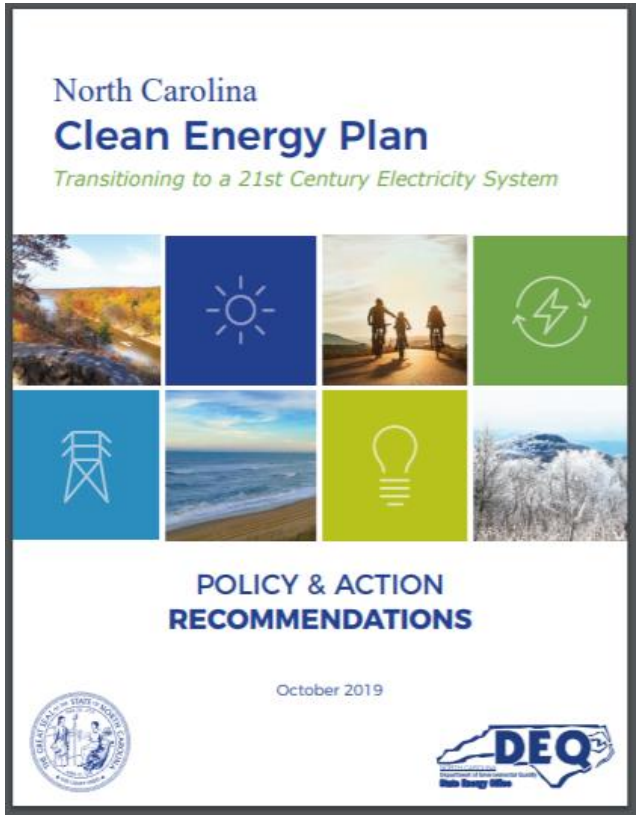


Energy Resilience & Equity

Vulnerable Sectors & Nature Based Solutions

Distributed Energy Resources, Community Solutions, and Microgrids

NC Clean Energy Plan Recommendations



1. Require comprehensive utility system planning
   - Establish planning processes that connects generation, transmission, and distribution planning in a holistic, iterative, and transparent process

2. Modernize the grid to support clean energy resources
   - **Create accountability by requiring transparency, setting targets, timelines and metrics of progress made toward grid modernization goals.**

3. Strengthen the resilience and flexibility of the grid
   - Require utilities to develop projects focused on DERs, community solutions, and microgrids at state facilities and critical infrastructure locations to enhance resilience.
   - Develop a method to quantify the human costs of power outages and integrate these costs when evaluating grid modernization plan components related to resiliency.

How does resilient distribution planning align with transmission and resource planning?

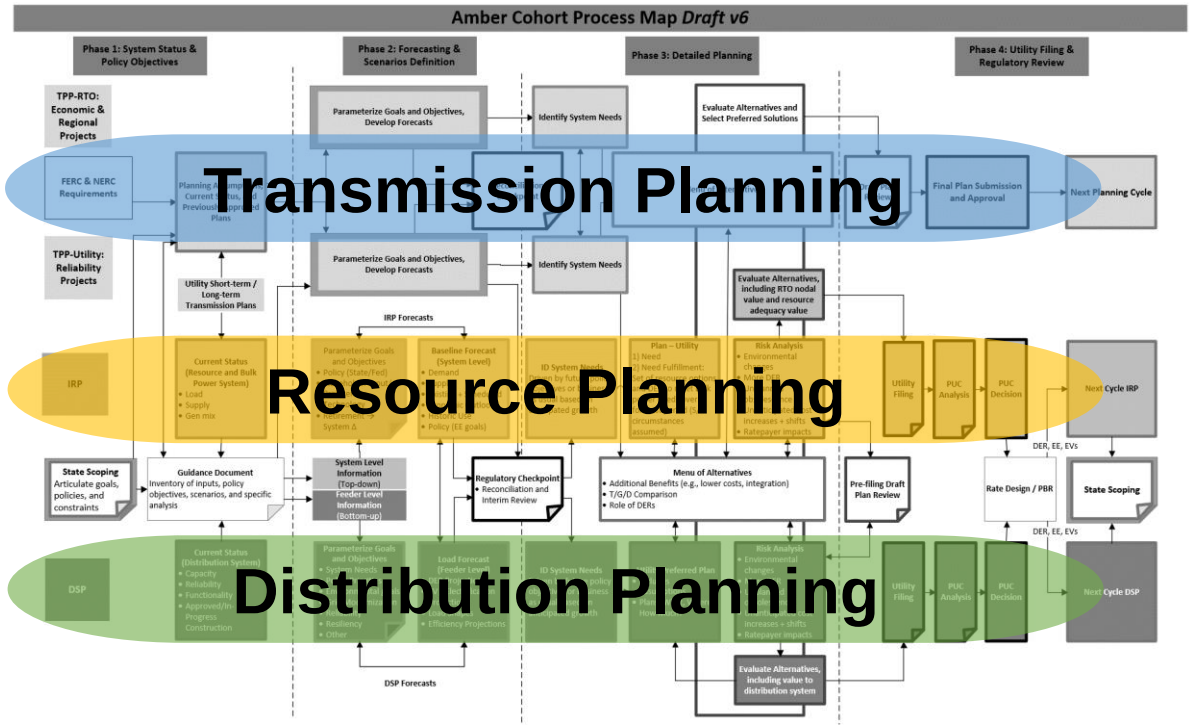
Do “T”, “D”, and “G” planning integrate resilience independently?

Or is it better to address resilient planning as an overlay across “T”, “D” and “G”?

Resilient T Planning

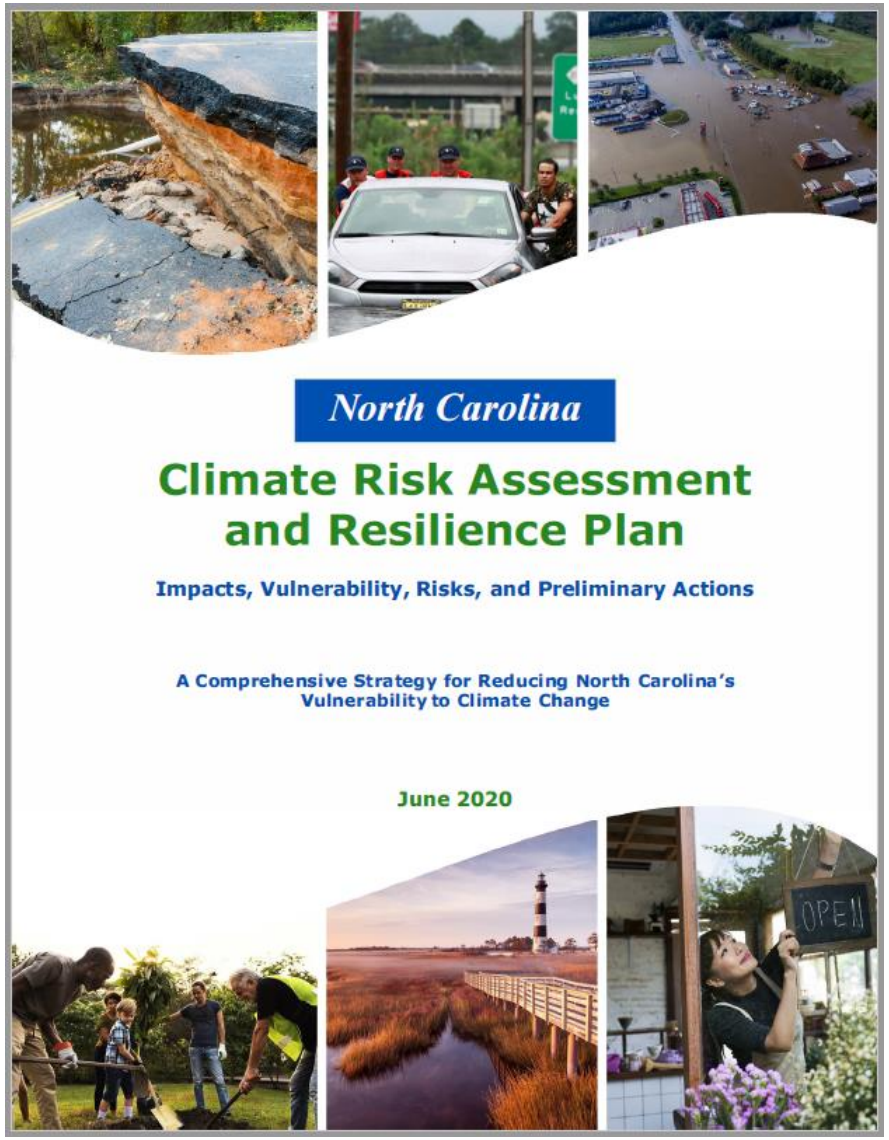
Resilient R Planning

Resilient D Planning



Resilient G/T/D Planning

North Carolina Resilience Plan



Sector Strategy Developers: 200+

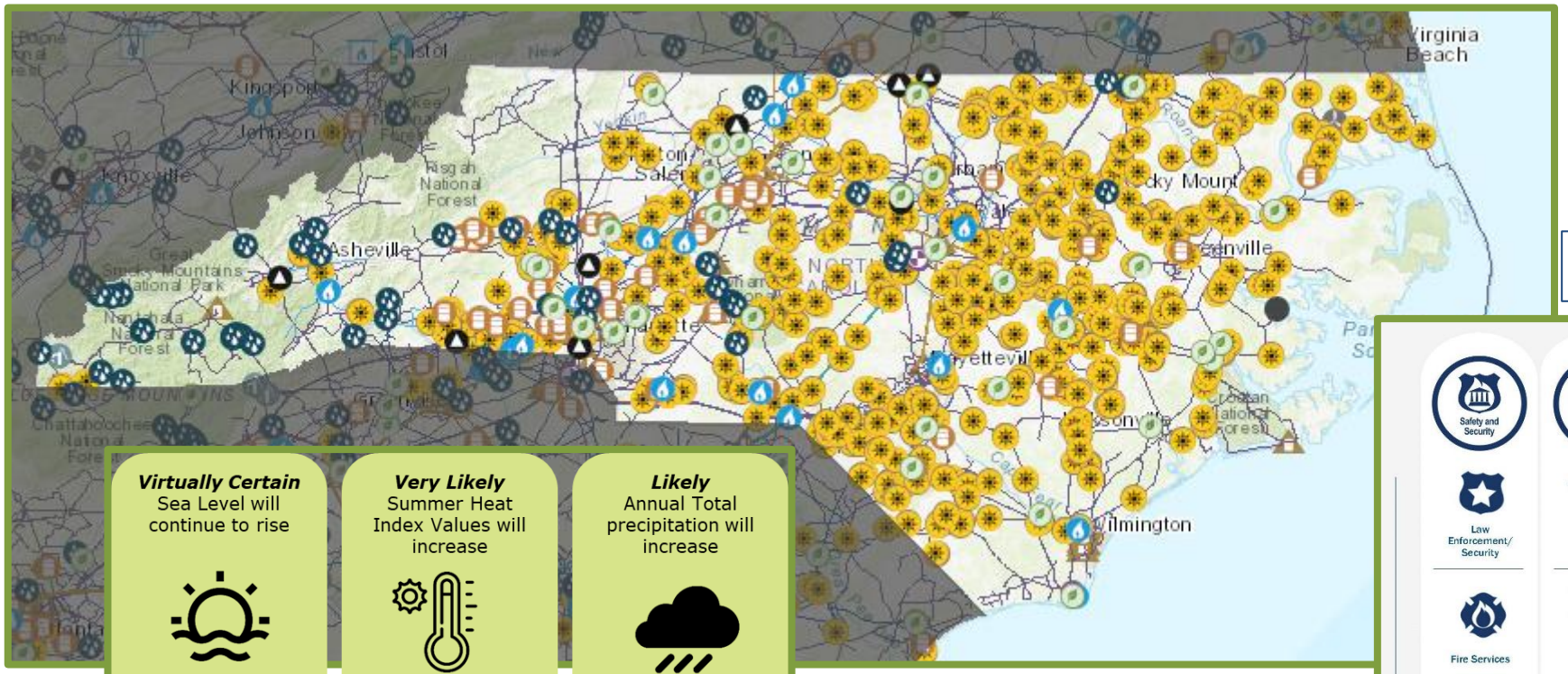
Community Workshops Participants: 300+

Stakeholders: 100+

Vision of Resilience

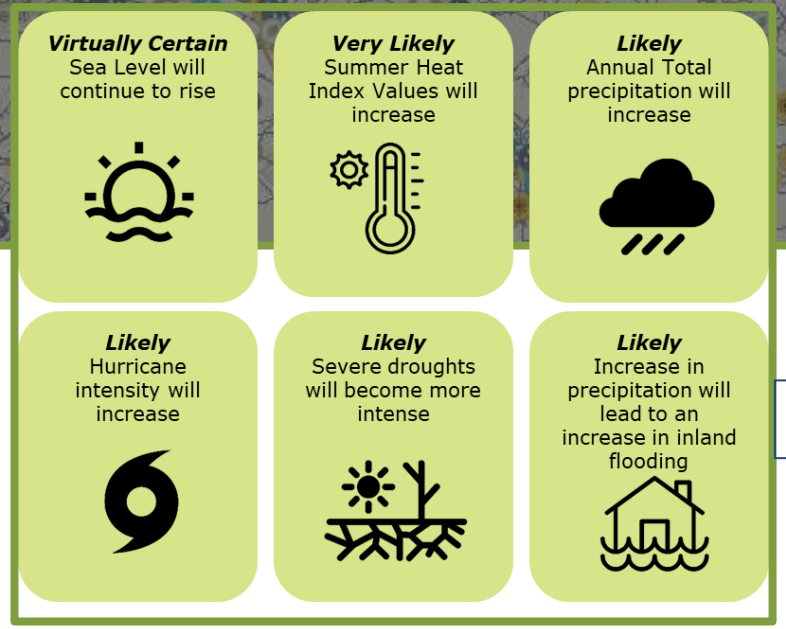
- *A resilient North Carolina is a state where our communities, economies, and ecosystems are better able to rebound, positively adapt to, and thrive amid changing conditions and challenges, including disasters and climate change; to maintain and improve quality of life, healthy growth, and durable systems; and to conserve resources for present and future generations.*

Community Energy Resiliency Planning



Energy assets

Community critical infrastructure



Climate threats

https://www.eia.gov/state/?sid=NC

DEQ Current Energy Resilience Projects

1. Planning an Affordable, Resilient, and Sustainable Grid (PARSG)

Partners: UNCC EPIC, NC CETC, Duke Energy, New Hanover County, NC DEQ SEO

Benefit: New metrics (e.g., economic losses experienced by customers from outages due to hurricanes) to help the state, utilities, and stakeholders evaluate resiliency options.

2. Community Energy Resilience Planning in New Hanover County (FEMA BRIC)

Partners: New Hanover County, NC DEQ SEO, UNCC EPIC. Duke Energy, EPRI. NCUC Public Staff

Benefit: Engage community/businesses/government to mitigate risk, increase resiliency, and promote a culture of preparedness via energy infrastructure, EE measures, and distributed energy resilience solutions.

3. New Hanover Community Vulnerability and Resilience Mapping

Partners: UNC-Asheville NEMAC, FernLeaf Interactive, New Hanover County, NC DEQ SEO

Benefit: Novel systematic method to identify resilience solutions for community assets in disadvantaged communities at risk of extreme flooding and heat events.

DEQ Current Energy Resilience Projects

4. Community Microgrids

Partners: UNCC, Duke Energy, NCEMC, NREL, Quanta Technology, Southern Methodist University, Clemson University, NC CETC, NC DEQ SEO

Benefit: First-of-the-kind assessment of advanced algorithms compared to a baseline of control algorithms in fielded utility scale community microgrids.

5. Alternative Fuels Corridor Planning

Partners: E4Carolinas, Savannah River National Lab, SACE, NCCETC, Centralina Clean Fuels, Triangle Clean Cities, Duke Energy Piedmont Natural Gas, Advanced Energy, Electric Cooperatives of SC, ONEH2, NC DEQ SEO

Benefit: Post disaster emergency response plan/roadmap that will reduce the impact to infrastructure disruption, transportation, utility restoration and recovery operations.

6. Securing Government Buildings and Critical Infrastructure

Partners: State agencies, NCORR, USCA, NASEO, USDOE, utility providers, NC DEQ SEO

Benefit: Cohesive strategy for incorporating key state-owned infrastructure into broader vulnerability, energy efficiency, and resilience planning processes.

What's Ahead

In Electricity System Resilience

- Divisions in DEQ are working with community, government, and business partners to plan and implement actions that can be taken to increase resilience
- Muni & Coop electricity providers are looking at resilience as well
- Significant questions:
    1. How the current regulatory process is able to adapt to this new concept of system community energy planning?
    2. Could investments in new infrastructure include some of these community benefits?

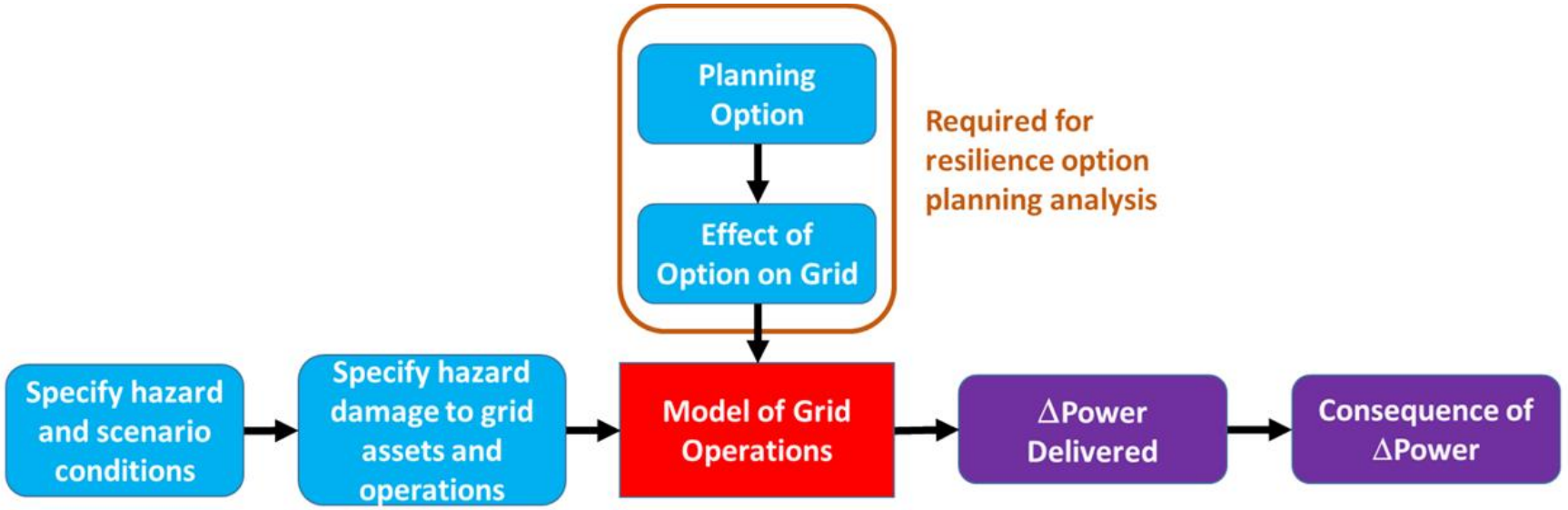
Planning an Affordable, Resilient, and Sustainable Grid in North Carolina

Dr. Robert Cox

Associate Director, Energy Production and Infrastructure Center
Professor of Electrical and Computer Engineering
UNC Charlotte

Project Approach

- Project was developed following two major events
  - Difficulty with a major $13B grid modernization effort in NC
  - Impact of Hurricane Florence
- Guiding questions:
  - What are the ***consequences*** of recent and expected events?
  - How do we view both traditional and advanced investments through the lens of mitigating those consequences

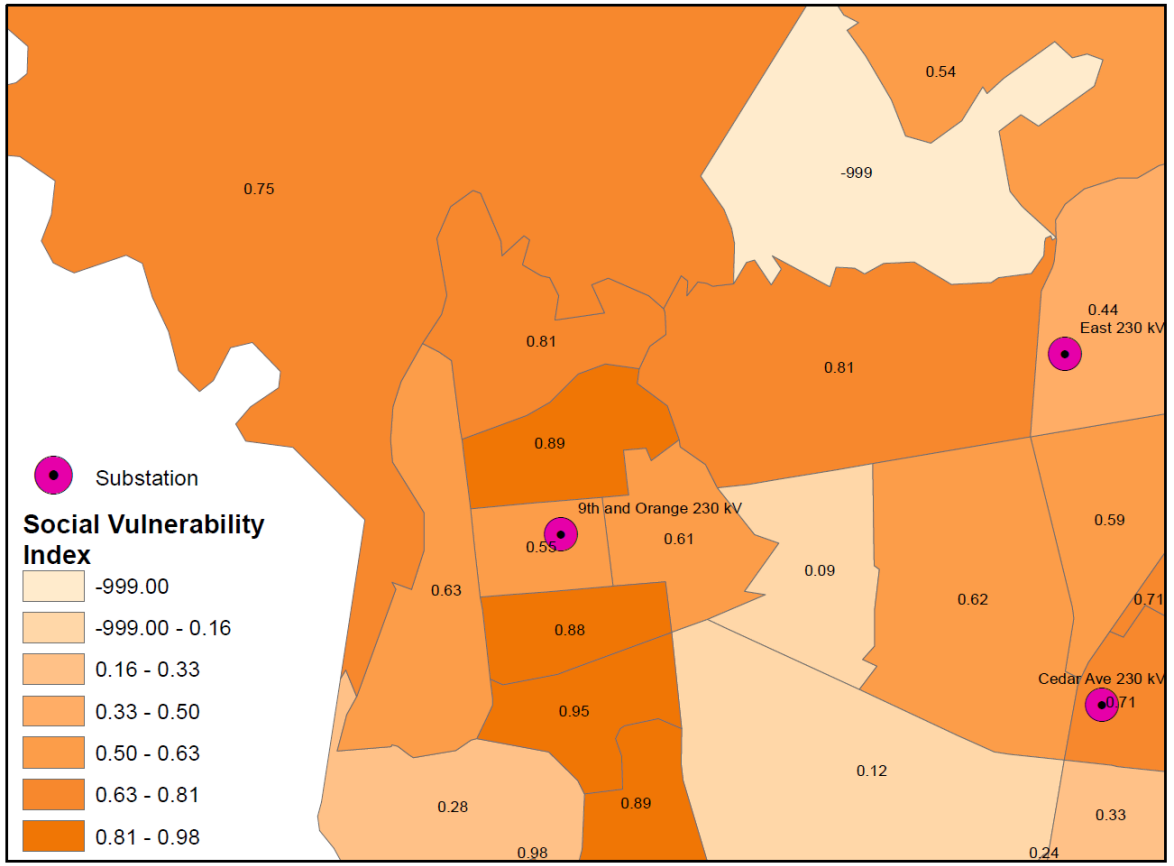


Key Findings

- ***Finding #1:*** Significant past storm impacts occur on the distribution system, often because of issues outside of expected utility control
- ***Finding #2:*** Need for greater engagement between local stakeholders & utilities
- ***Finding #3:*** Need for new metrics that recognize the shared need for hardening & DERs:
  - Must value the necessity of hardening to enable greater penetration of DERs
  - Must find a way to rate-base and/or cost-share resilient back-up power, considering the full stacked benefits

Holistic Benefits of Grid Resilience

- Many impacts to critical infrastructure discussed in project
- One common impact is the effect on customers in areas with high Social Vulnerability Index



Wilmington, NC

Holistic Benefits of Grid Resilience

- Example:
  - Food contents damaged (D-SNAP) benefits
  - Sheltering costs
- Assumptions:
  - Outpost can protect 100 customers with an average family of 4
  - Outpost can provide ice
  - Outpost can keep residents in home
  - 2-day outage, 1x per year

Benefits of Shelter With Resilient Power
2 Day Use, 1X per year

Cost Category	Cost
Food damage	$64,000 / event
Sheltering cost	$23,800 / event
Self food preparation	$4,800 / event
Total Annual Benefit	$92,680 / event
20-Year Benefit	$1.85M

NARUC Panel Discussion

Climate Resilience Frameworks to Improve Risk Management: Exploring Lessons Learned from North Carolina





DUKE ENERGY®

BUILDING A **SMARTER** ENERGY FUTURE®

Nelson Peeler, Duke Energy - SVP,
Transmission and Fuels Strategy and Policy

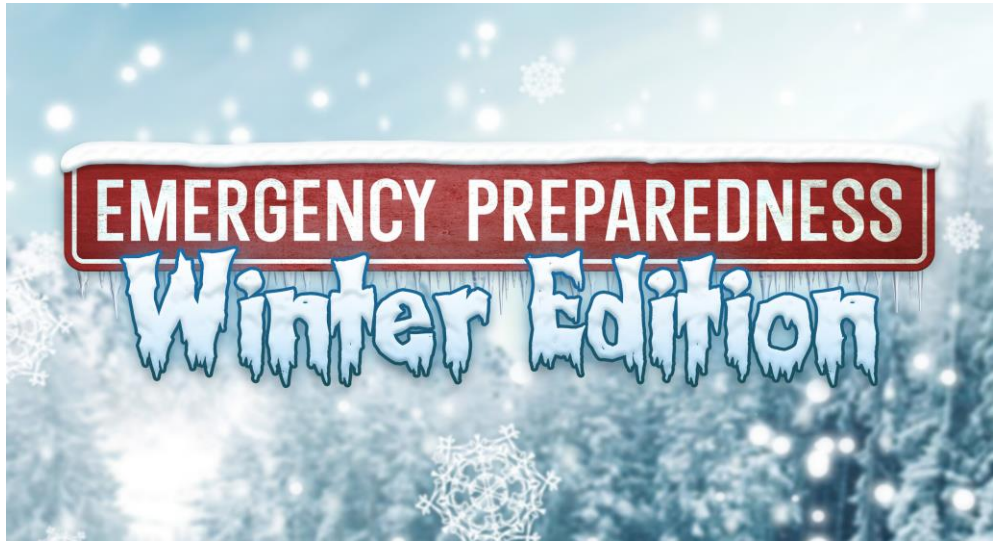
Assessment Key Findings

Extreme weather events, including extended durations of colder than normal weather, pose a risk to the uninterrupted power delivery

Natural gas supply disruptions in infrastructure-limited areas can affect winter reliability

Continuing drought in the west can cause low hydro conditions for the upcoming winter and reduce the available supply of electricity

Generator Owners are facing challenges to obtain fuels as many supply chains are stressed



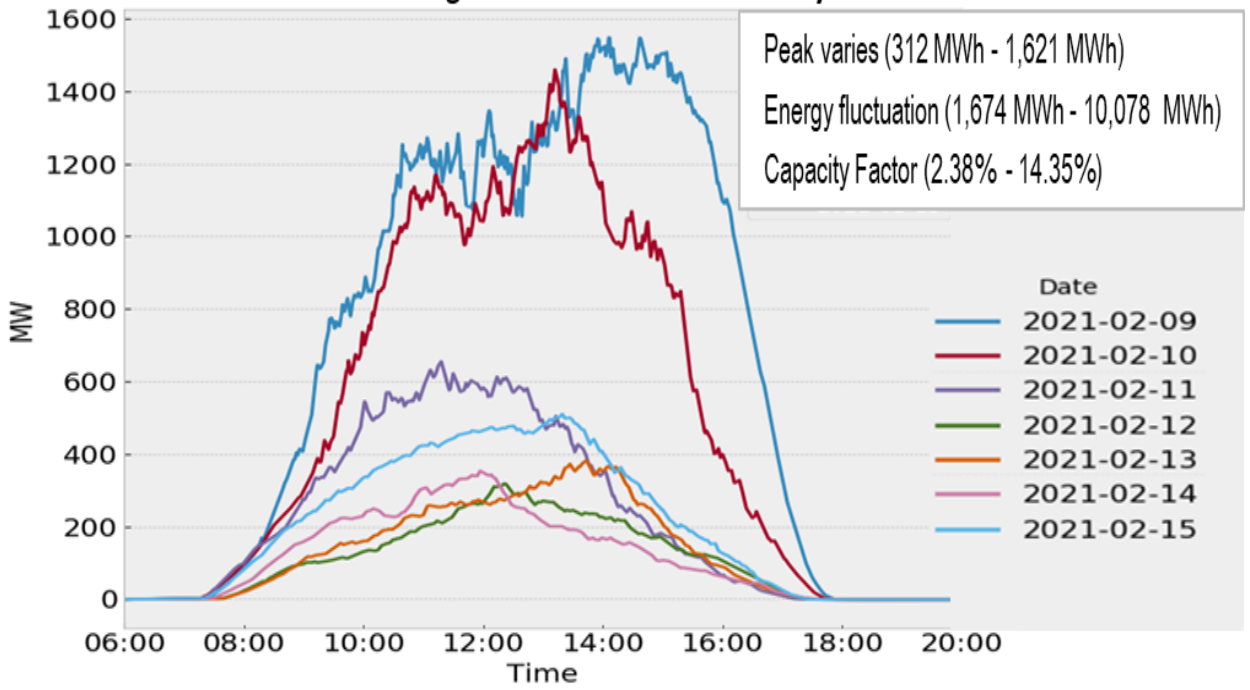
Responses to NERC's Level 2 Alert — Cold Weather Preparations for Extreme Weather Events

- Indicate that operating plans for winter are in place, but
- Generator resource availability could again suffer as a result of
  - equipment failure or lack of fuel under severe winter conditions

Duke Energy Actions for Extreme Weather Resiliency

- Winter and Summer Preparedness Reviews
  - Effective weatherization practices
  - Coordinated generation planning
- On-site fuel backup, dual fuel capability
- Integrated gas and electric coordination
- Culture of self-criticality and lessons learned
  - Root cause analysis and learning from events
  - Evaluation of events across industry, all regions
- <u>Vertical integration</u> provides benefit for Duke Energy customers:
  - Enhances resiliency as distribution, transmission and generation can easily coordinate respective operations
  - Supports resiliency needed with the introduction of significant levels of renewable energy

Figure 1: Solar Real Time 7-Day Profile



Large daily variation in renewable energy output during winter months highlights need to advance system resiliency

Transmission Grid Modernization Programs

- System Intelligence
  - Smart field devices and infrastructure to improve grid operator system awareness
  - Remotely sectionalize circuits
  - Locate system faults
- Substation Hardening & Resiliency
  - Flood mitigation
  - Replacing oil filled circuit breakers
- Line Hardening & Resiliency
  - Rebuilding vulnerable line segments to reduce threats: high winds, lightning and vegetation
- Cyber and Physical Security
  - Electronic detection
  - Fences and Intrusion Detection

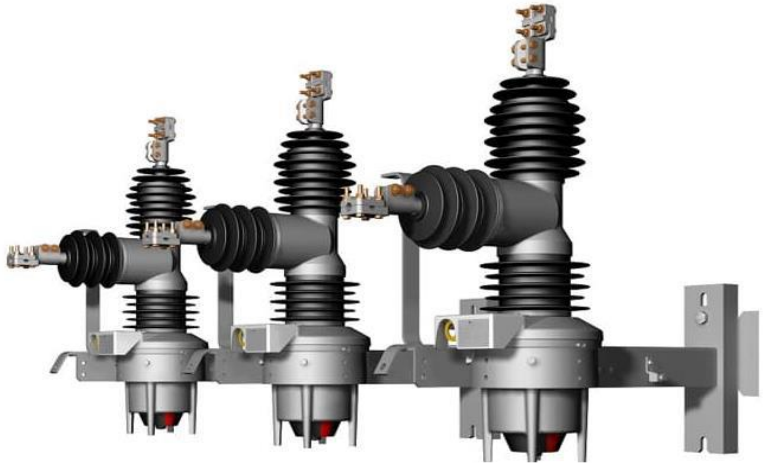
Grifton Station after Hurricane Mathew 2016

Grifton Station with Tiger Dam Before Hurricane Florence 2018

Grifton Station Flood Wall 2020

Distribution Grid Modernization Programs

- Self-Optimizing Grid
  - Ability to automatically reroute power
  - Rapidly dispatch line crews directly to the source of the outage
- Targeted Underground
  - Underground most outage prone overhead power line sections
- Long Duration Outage/High Impact Sites
  - Radial feeds to entire communities or large groups of customers
  - Inaccessible line segments
- Integrated Volt-Var Control (IVVC)
  - Optimize voltage and reactive power



Electronic Reclosers

Capacitor and Voltage Regulator Controls