Planning an Affordable, Resilient & Sustainable Power Grid

Stakeholder Meeting

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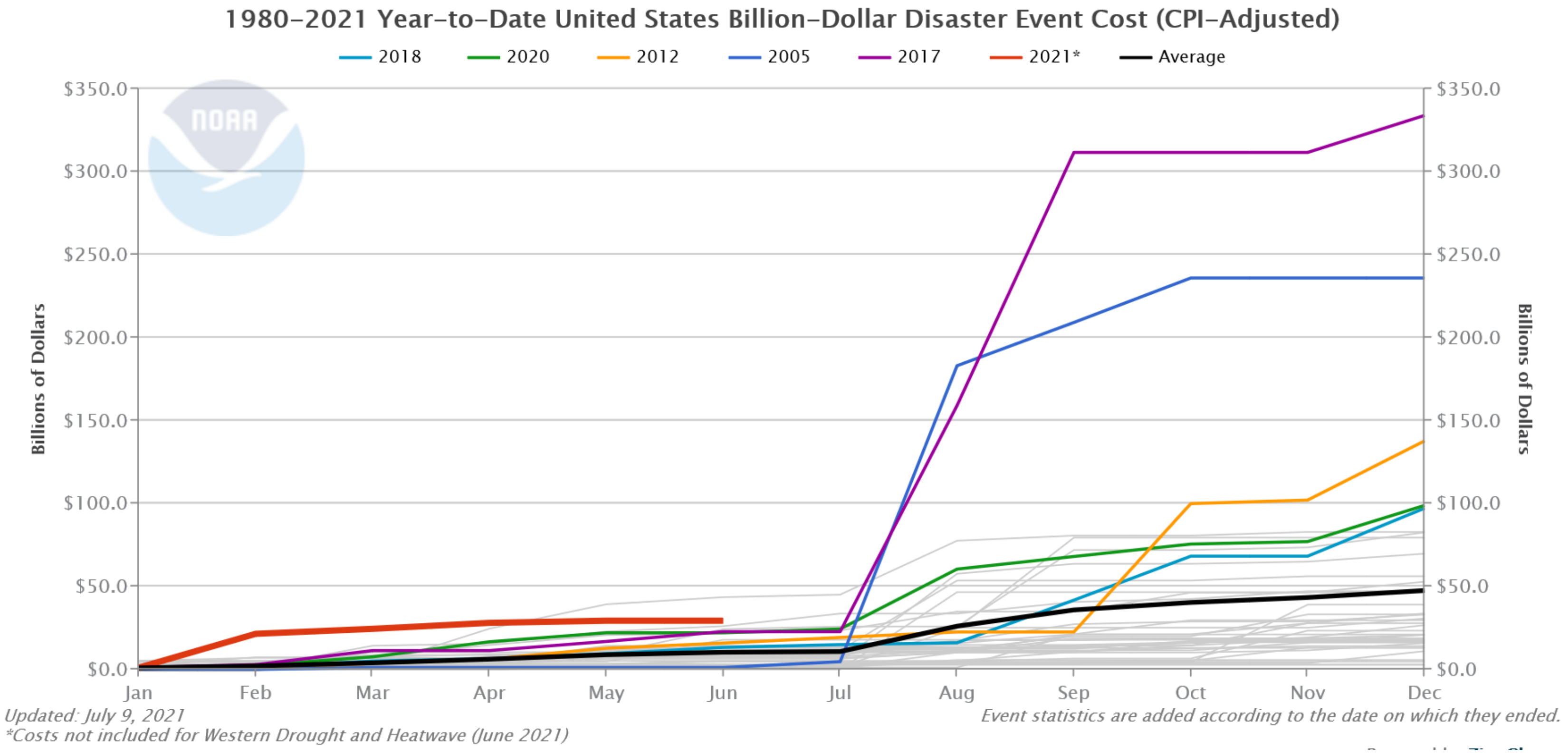
Assistant Secretary, NC Department of Environmental Quality
October 7, 2021

Frequency and Cost of Billion-Dollar Disaster Events in North Carolina



Decade	Total Cost (billions)
1980 - 1990	**$5 -$10**
1990 - 2000	**$10 -$20**
2000 - 2010	**$5 -$10**
2010 – 2020	**$20 - $50**

(dollars are CPI-adjusted)

Most of cost incurred in 2018 from Florence and Michael

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

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2018 Hurricane Florence Impacts

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

Duke spokesperson Randy Wheeless

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

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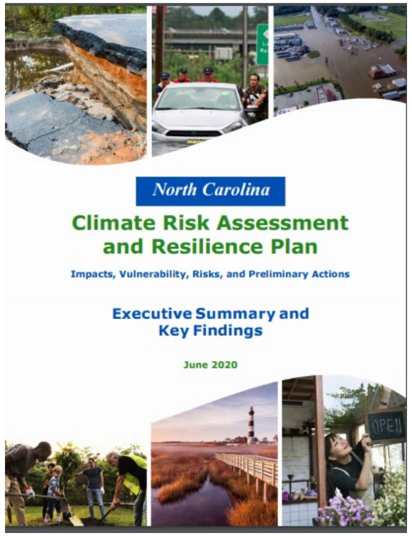
2020 NC Climate Risk Assessment and Resilience Plan



Summary & Key Findings

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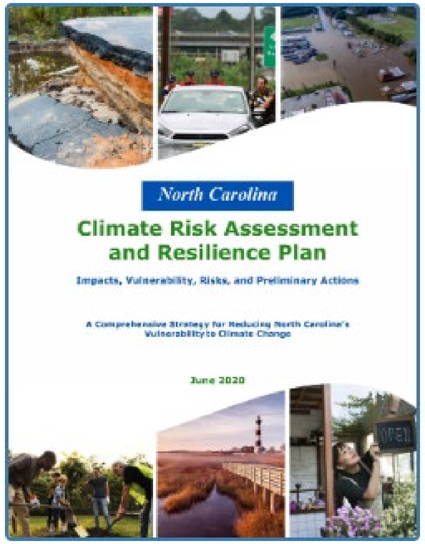

Main Report

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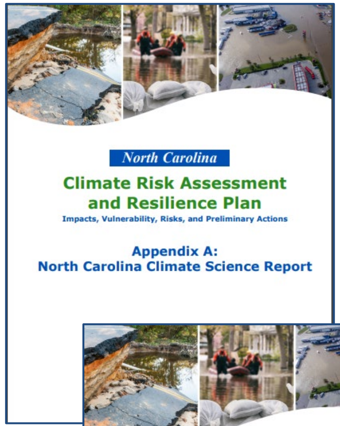

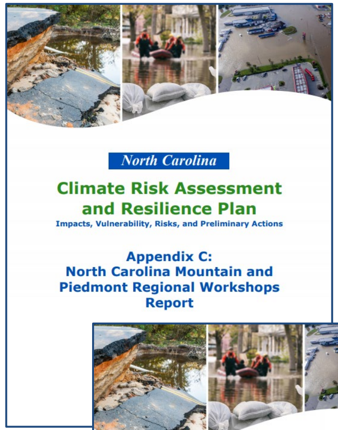

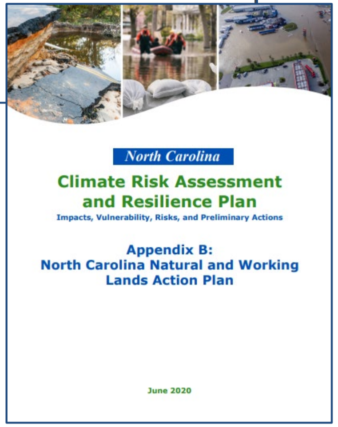

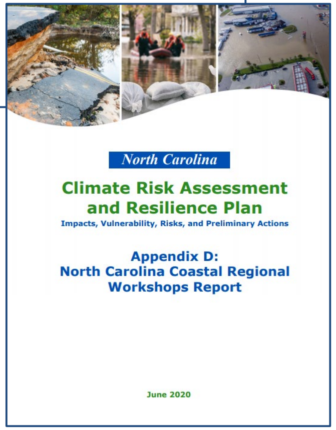

Appendix A: Climate Science Report
Appendix B: Natural and Working Lands Action Plan
Appendix C: Mountains and Piedmont Regional Workshop
Appendix D: Coastal Regional Workshop

NC Climate Risk Assessment and Resilience Plan

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

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Climate Science Report:
NC Institute for Climate Studies (NCICS)

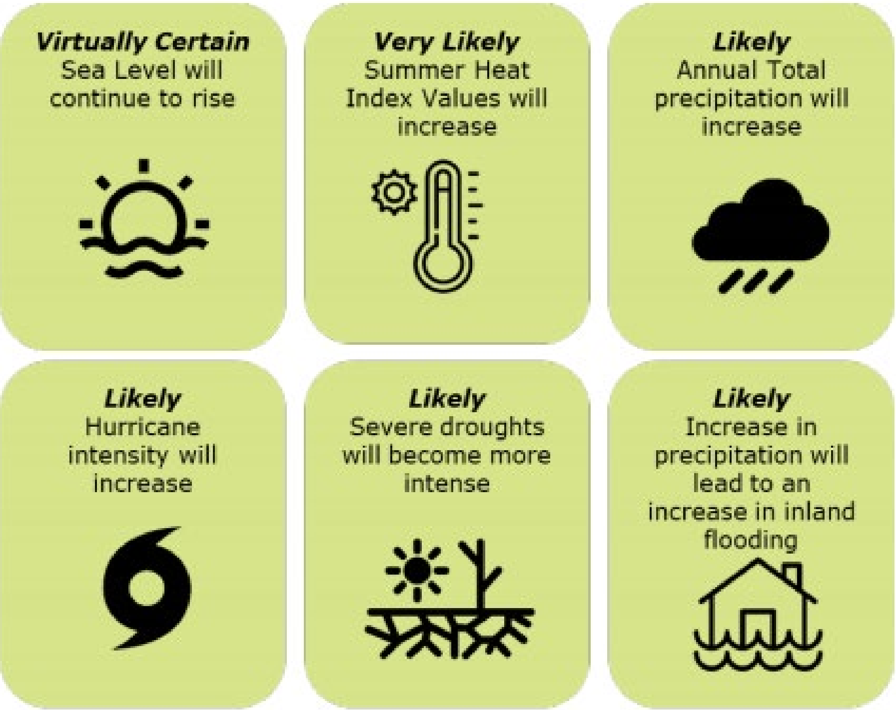
North Carolina
Climate Science Report

- ✓ 15 federal and state experts involved
- ✓ Global state of the science
- ✓ Historical changes in NC
- ✓ Projections for NC under high/low GHG scenarios out to 2100
- ✓ Report quantifies meteorological variables over 3 regions
- ✓ Transparent, peer-reviewed study

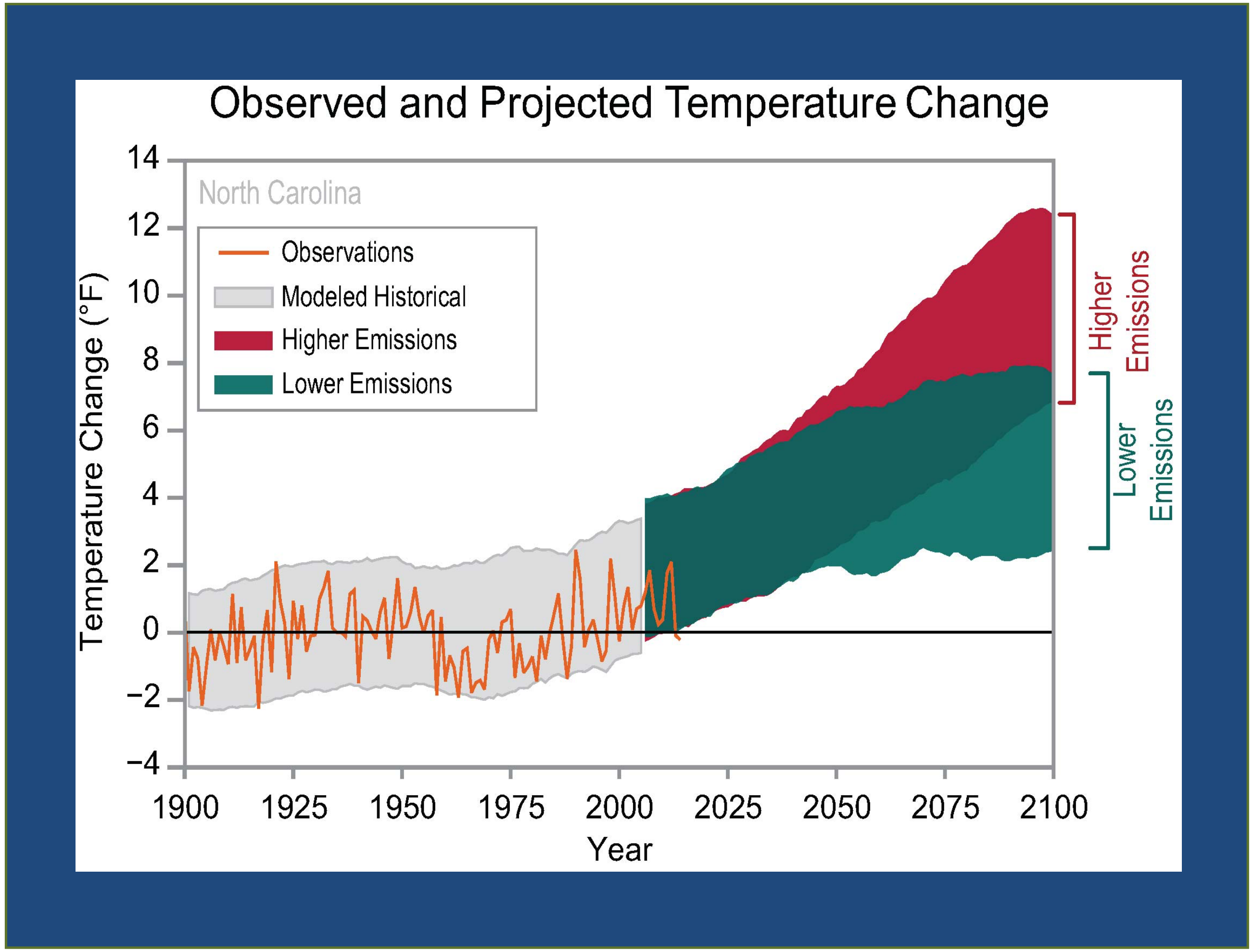
https://ncics.org/nccsr
https://statesummaries.ncics.org/

"our scientific understanding of the climate system strongly supports the conclusion that large changes in North Carolina's climate, much larger than at any time in the state's history, are very likely (90-100% probability) by the end of this century..."

Climate Change Hazards



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



DEQ RARP: Exploring Hazards

Climate Change Hazards

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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

Non-Climate Stressors

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

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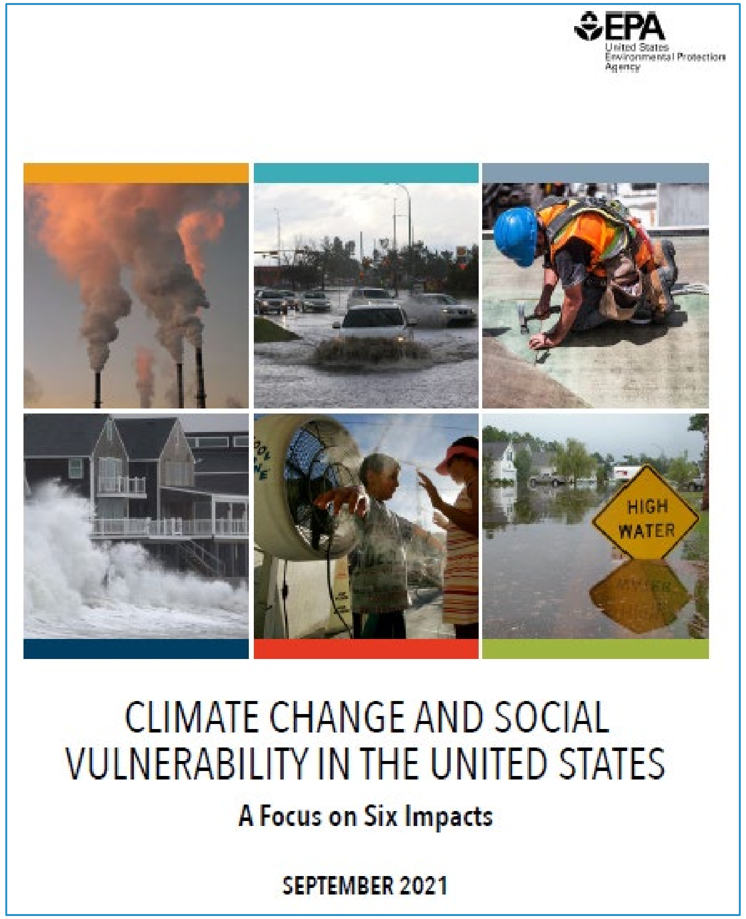
DEQ RARP: Vulnerability and Risk



According to EPA's Fourth National Climate Assessment:

- **Impacts** of climate change will **not be equally distributed** across the U.S. population.
- **Vulnerable populations,** based on a range of social, economic, historical and political factors, have a **lower capacity to prepare for, cope with, and recover from climate change impacts**.

People are at risk of experiencing climate change impacts when they are both **exposed** and **vulnerable** to **climate hazards.**

This report focuses on whether those who are **socially vulnerable** are **disproportionately exposed** to projected **climate hazards.**

DEQ RARP Energy Resilience - Key Observations

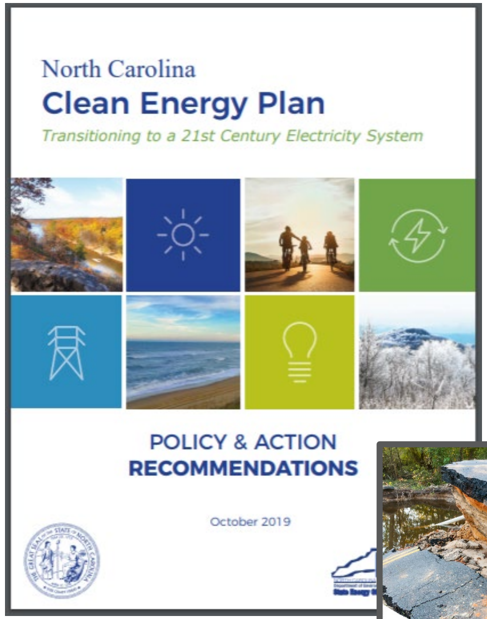
Energy solutions to climate change must be integrated across economic sectors.

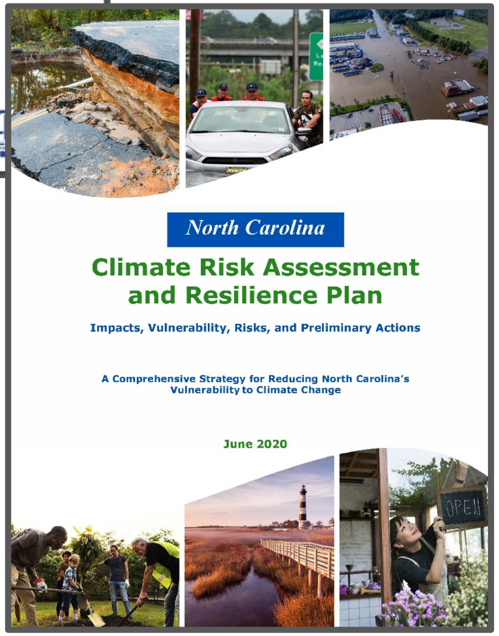
Rapid changes in energy/electricity create opportunities to build resilience via modernization of energy supply and delivery infrastructure.

Resilience metrics can quantify human/economic costs of power outages.

Risk-based framework can accelerate decisions related to energy infrastructure planning and operations.

Energy Resiliency addressed in both DEQ Plans



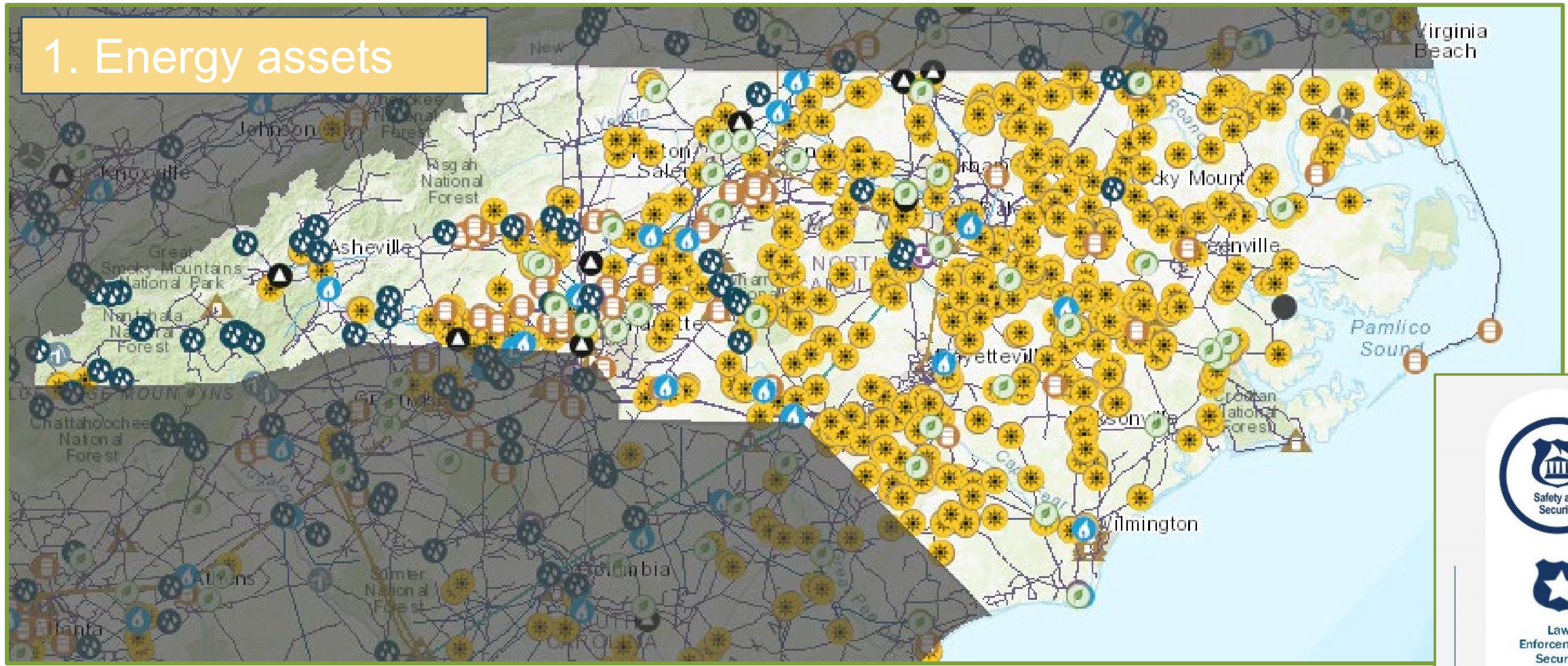


Key Recommendation:
Modernize the grid to support clean energy resource adoption, **resilience**, and other public interest outcomes.

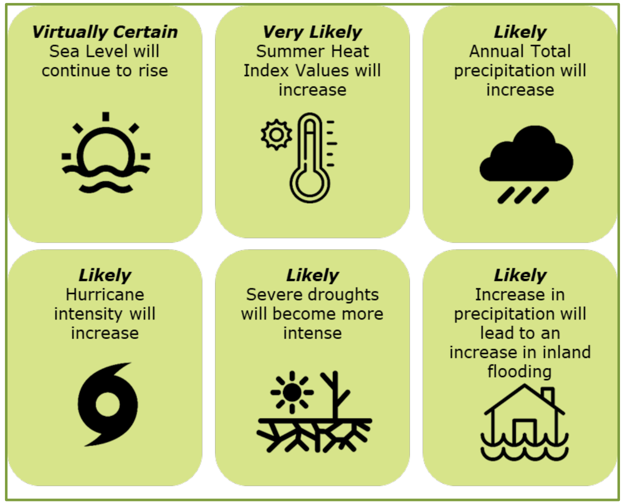
- Focus **on distributed energy resources, community solutions, and microgrids**
- **Coordinate resilience planning** with disaster recovery operations center
- Address cybersecurity and other concerns in conjunction with energy resiliency
- Develop a method to **quantify the human costs of power outages** and integrate these costs when evaluating grid modernization plan components related to resiliency.

Community Energy Resiliency Planning

1. Energy assets



2. Community critical infrastructure

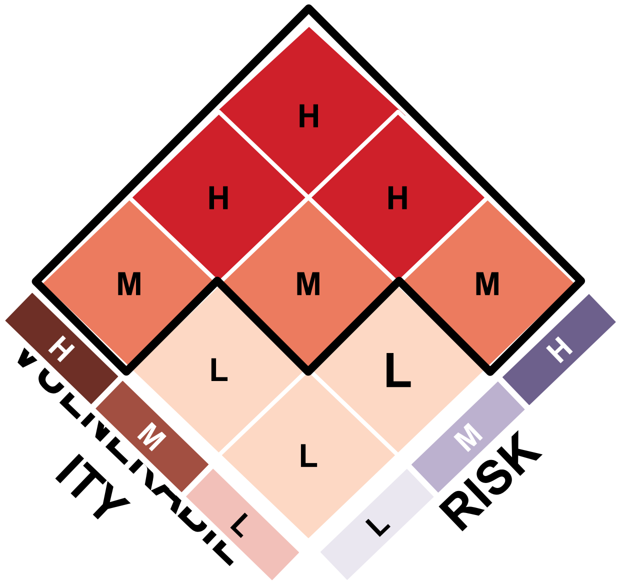


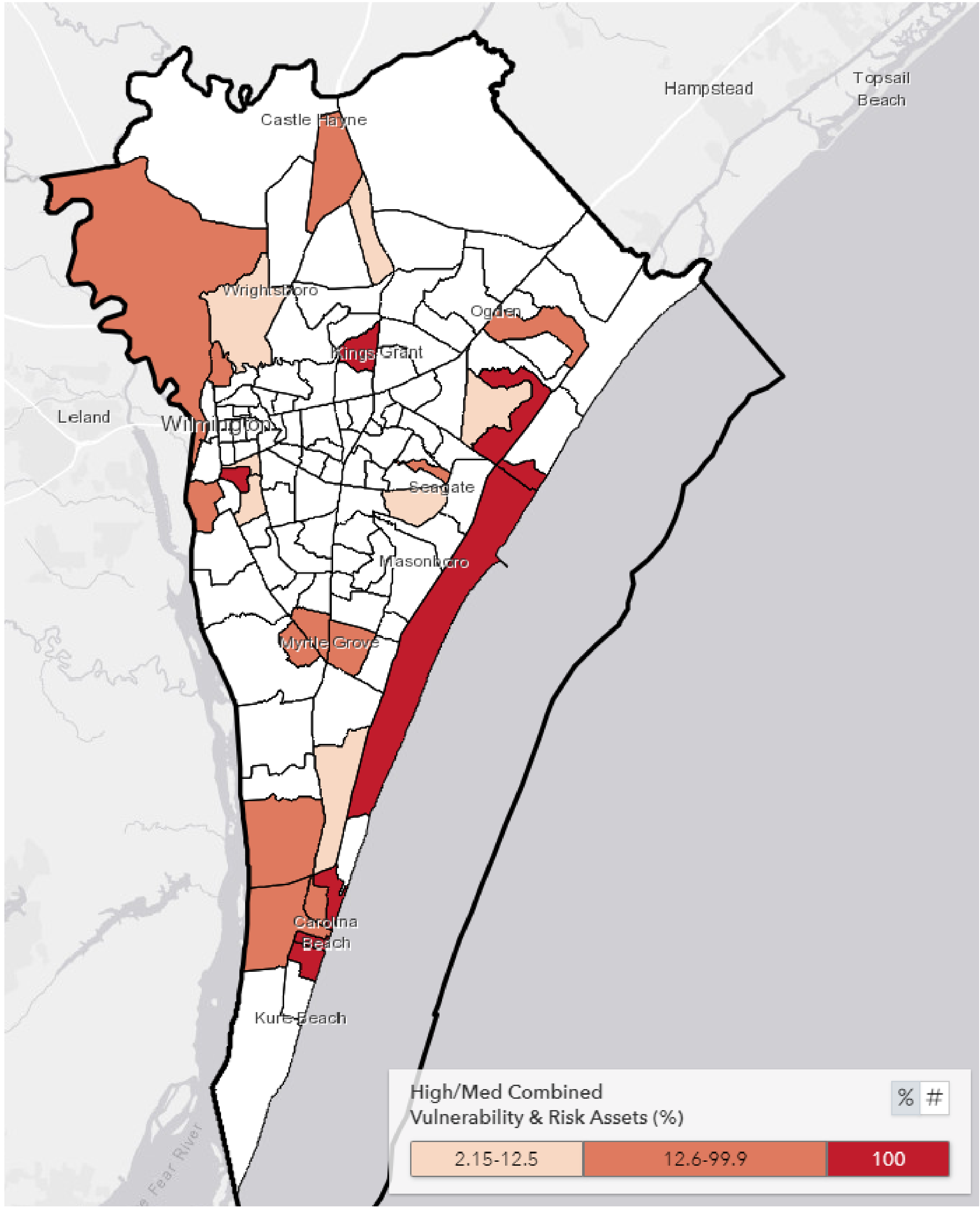
3. Climate threats

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

Approach
Planning-level

COMBINED VULNERABILITY & RISK





UNC Asheville's NEMAC
National Environmental
Modeling and Analysis Center

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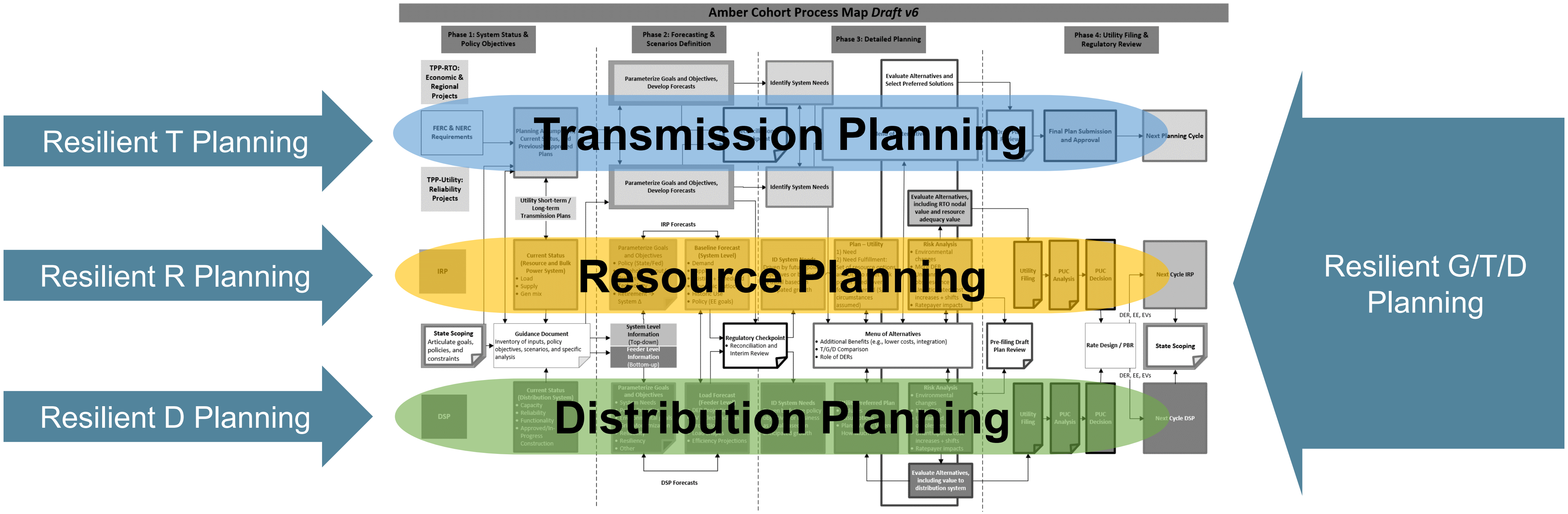
How does resilient distribution planning align with transmission and resource planning?

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?



Resilience Criteria & Metrics are needed for Planning & Solutions

Valuing Resiliency

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

Metrics can be used to quantify human and economic costs of power outages and to make investment decisions on infrastructure.

Grid Investments and Resilience Metrics

Outcome: Resilience

Preferred metrics:

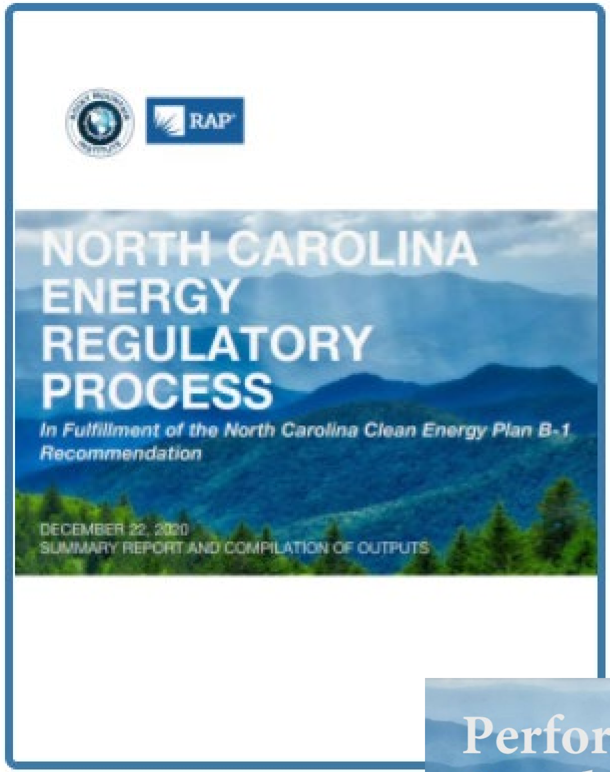
- Number of critical assets (see note below) without power for more than N hours in a given region (# of assets), N may be set as 0 hours or greater than the number of hours backup fuel is available
- Critical asset energy demand not served (cumulative kW)
- Critical asset time to recovery (average hrs)

Alternative metric:

- Cumulative critical customer hours of outages (hrs)

Notes:

- Recommended metrics revolve around impacts on critical community assets since that is the framework used in the PARSG (Planning an Affordable, Resilient and Sustainable Grid) project and in the state Resilience Plan. This approach is also being integrated into the NARUC-NASEO comprehensive system action plan that the NC delegation is considering.
- Critical assets may include hospitals, fire stations, police stations, evacuation shelters, community food supply distribution centers, production facilities, military sites, etc.
- Since resilience study is very much a work in progress in North Carolina, it is recommended that these initially be tracked metrics, with no incentive attached.
- Efforts to develop resilience metrics are currently underway across organizations such as the DOE, FERC, EPRI and multiple state public utility commissions. The industry is lacking agreed-upon performance criteria for measuring resilience, as well as a formal industry or government initiative to develop consensus agreement.[27] As such, there are currently no standardized metrics to measure resilience efforts or to quantify the extent or likelihood of damage created by a catastrophic event. Resilience is addressed state-by-state, and oftentimes event-by-event. If different metrics, benchmarks, rewards or incentives are identified and developed for reliability and resilience,[28] there is a need to properly distinguish each, take into account the benefits for each, and differentiate how to separately determine the benefits, rewards and penalties for each.[29]
- The metrics identified above are based on community impact driven resilience needs for critical infrastructure. It is based on current North Carolina state and local government led application of energy vulnerability and risk analysis framework that uses the Resilience Analysis Process (RAP) developed by the Sandia National Lab, which includes prioritization of grid-modernization initiatives that could achieve a desired set of resiliency goals for the community.



https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy-20

Thank you!