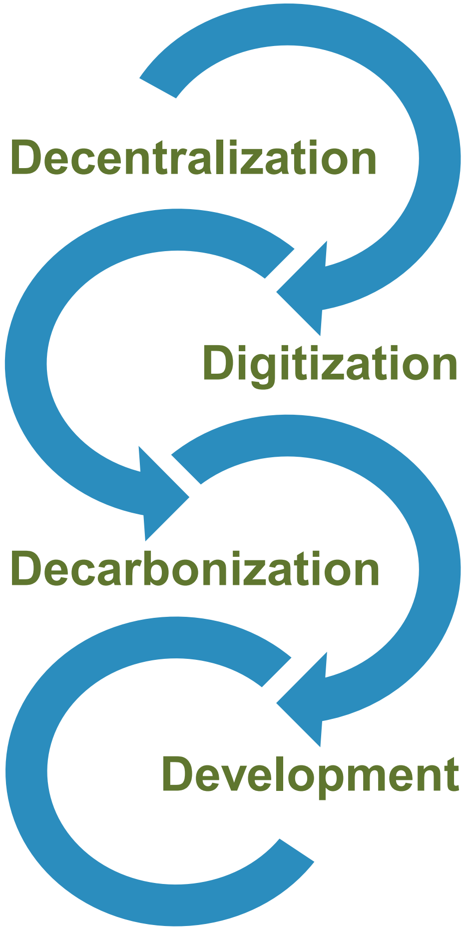
Energy System Planning for North Carolina

NC Utilities Commission Technical Conference (E-100, SUB 165)

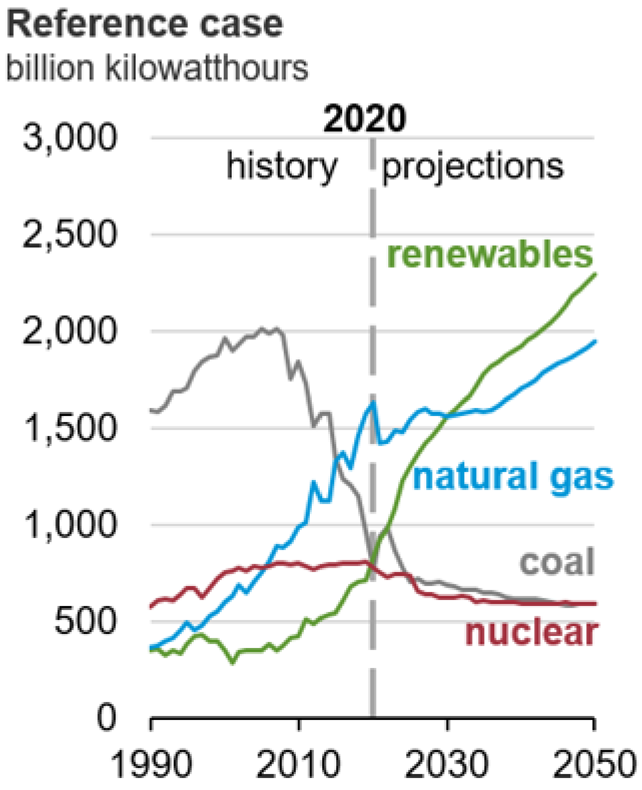
March 9, 2021

Sushma Masemore, P.E.
State Energy Office

Drivers of Power Sector Transformation



U.S. Electricity Generation Forecast, AEO 2021

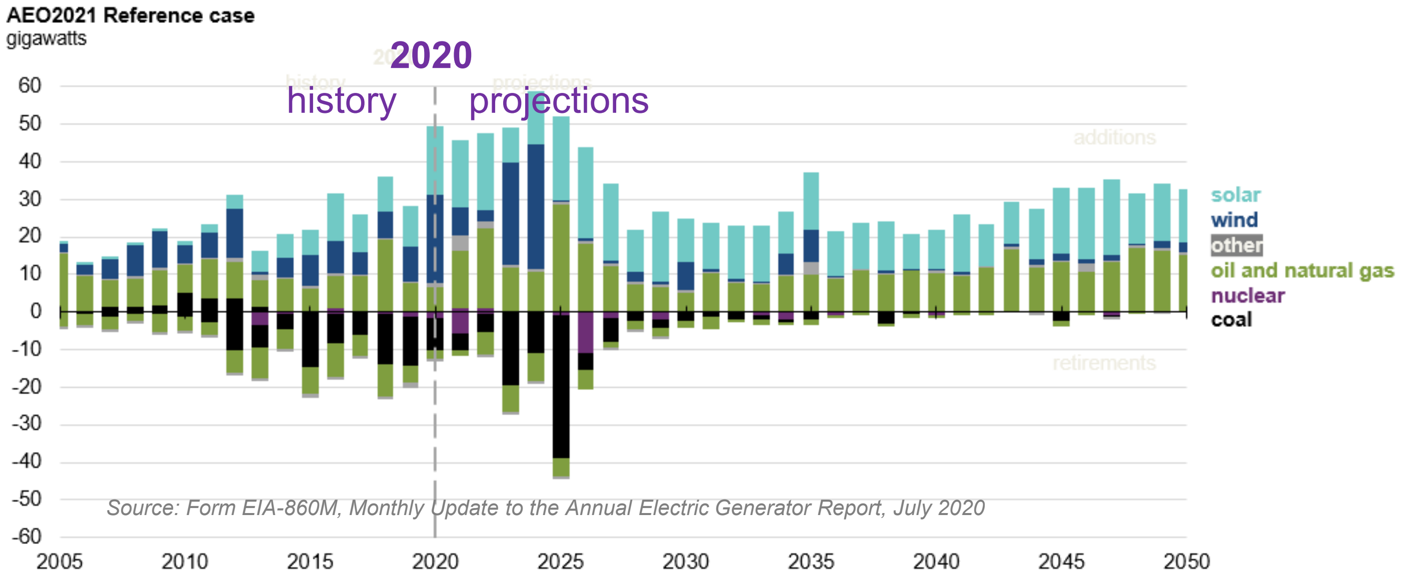


“Electricity generation increases by a third; natural gas prices influence competition with renewables”

Grid Transformation in NC

- Technology evolution and declining costs
- Fuel prices and other cost uncertainties
- Shifting consumer preferences/practices
- Public interest goals related to sustainability and decarbonization
- Natural and physical threats challenging system reliability and resiliency
- State and federal policies

Record Amount of Capacity Additions and Retirements



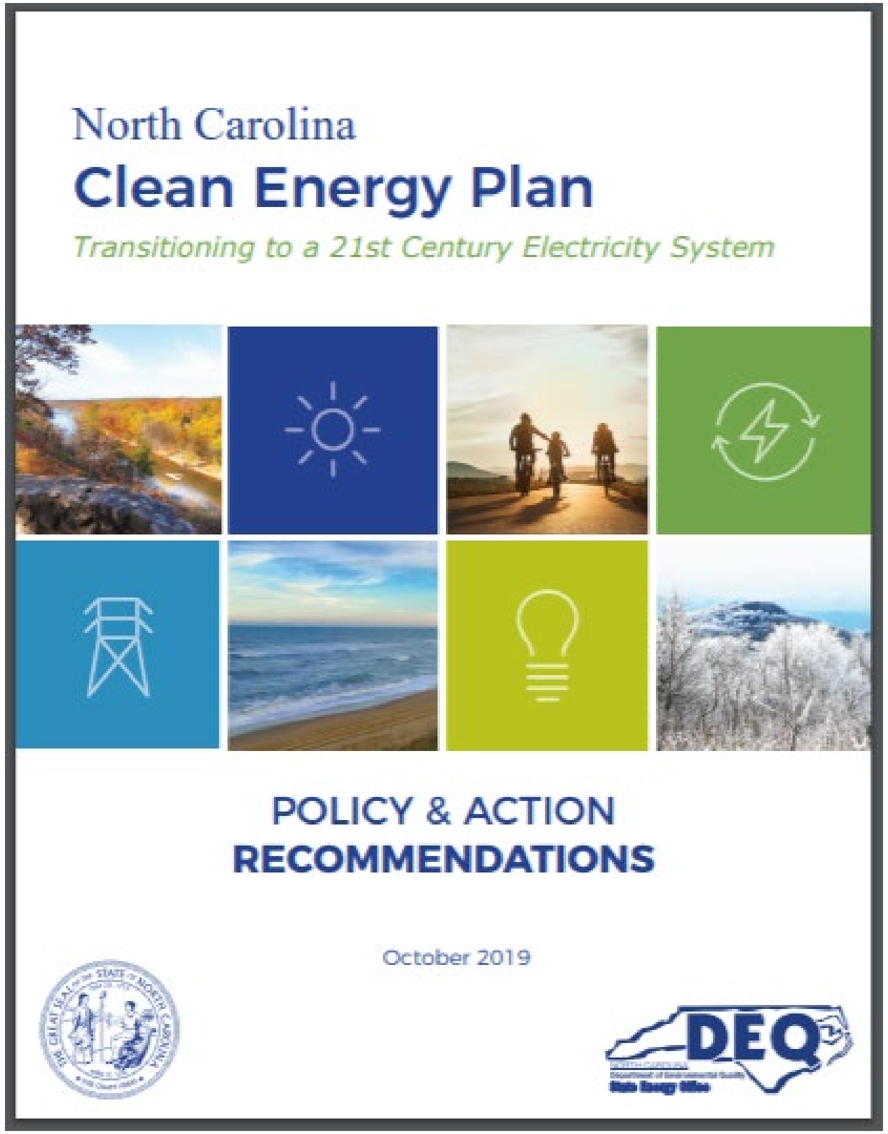
With greater alignment of transmission, resource, and distribution planning, states and electric utilities could:

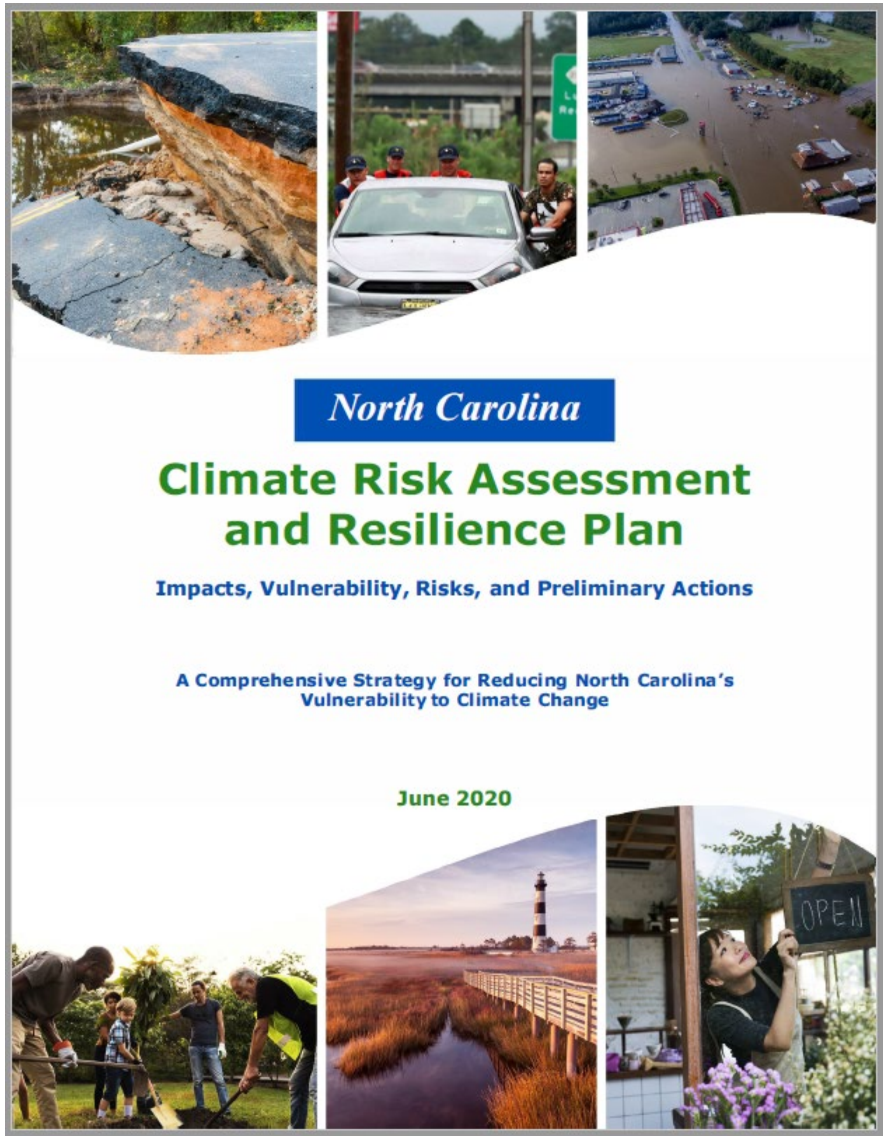
- Improve grid reliability and resilience
- Optimize use of distributed and existing energy resources
- Avoid unnecessary costs to ratepayers
- Support state policy priorities
- Increase the transparency of grid-related investment decisions

Method:

- Create a forum for a transparent decision-making process.
- Bring the right players to the conversation to examine the system as a whole amongst IOUs, cooperatives and municipal utility providers.
- Plan ahead – it will be a long and iterative process
- 21st century grid will need to be smart, flexible and modern – solutions and options could outpace system design and planning processes.

North Carolina Plans





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

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

Utility Incentives & Comprehensive System Planning

C. Comprehensive utility system planning

Establish comprehensive utility system planning process that connects generation, transmission, and distribution planning in a holistic, iterative and transparent process that involves stakeholder input throughout, starting with a Commission-led investigation into desired elements of utility distribution system plans.

Process towards a more holistic electricity sector planning process

- Begin an investigation into the desired elements of an Integrated Distribution Plan (IDP). The links between IDP, IRP, and transmission planning could be explored throughout this investigation.
- Move towards an Integrated System Operations Plan (ISOP) approach, which combines resource, transmission, and distribution planning.
  - Include regularly scheduled plan submissions to allow for stakeholder intervention
  - Utilize existing analytical tools, improved data and modeling access for industry and stakeholders.
- Create guidelines for future comprehensive system planning, initially focusing on distribution planning.
  - Outputs feed into existing processes, such as NCUC's IRP proceedings, Duke's ISOP efforts, and NCTPC efforts.

Grid Modernization and Resilience

D. Grid modernization to support clean energy resources

Use comprehensive utility planning processes to determine the sequence, needed functionality, and costs and benefits of grid modernization investments. Create accountability by requiring transparency, setting targets, timelines and metrics of progress made toward grid modernization goals.

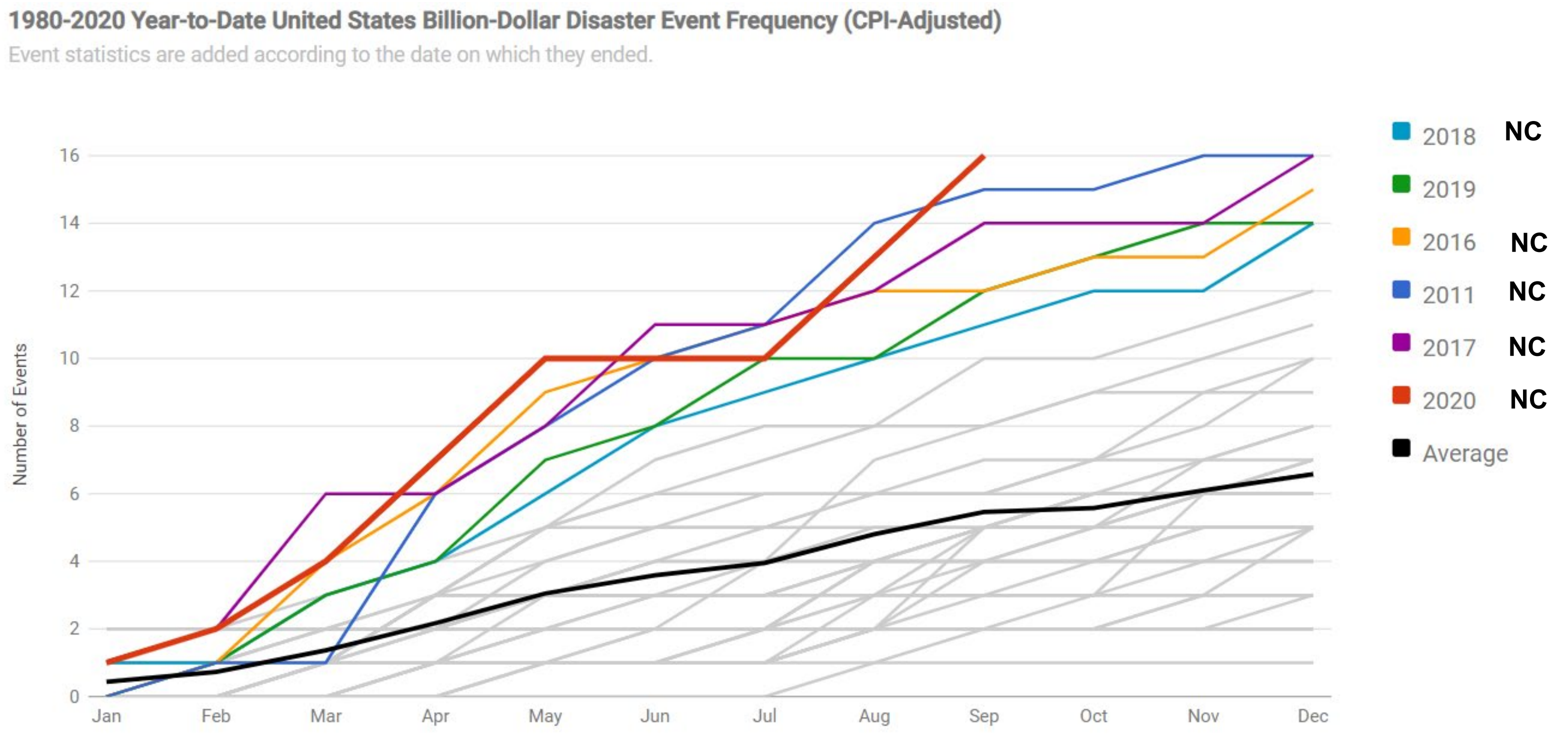
Establishing formal procedures and requirements for grid modernization plans to achieve a more streamlined and transparent process.

- Providing a set of planning requirements prior to the submission of a grid modernization plan will ensure that technologies are deployed strategically and on an as-needed basis.
- Grid modernization should be directly linked to and informed by the more holistic planning process and should include needed improvements to both the distribution and transmission systems.
- Directing utilities to include detailed and clear analysis of cost and benefits in planning processes will ensure approved investments are net beneficial.
- Establishing performance metrics, targets, and accompanying timelines, will allow regulators to ensure that new investments are delivering expected benefits in a timely manner.

Grid Modernization and Resilience

E. Grid resilience and flexibility

- 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.



Statistics valid as of October 7, 2020.

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

Carolina's Grid Disturbance types

Source: Advanced Energy

Hurricane Florence Impacts

Megatrends

	GIP PROGRAMS	I - Phys & Cyber Threats	II - Adv Tech (Solar/Battery)	III - Environmental Policy	IV - Weather	V - Grid Improvement Techn	VI - Concentrated Growth	VII - Customer Expectation	NC - DEC Total ($M)	NC - DEP Total ($M)	NC TOTAL ($M)	
Protect	Physical Security	x	x			x		x	$58.0	$64.7	$122.7	
	Cyber Security	x	x			x		x	$7.0	$4.0	$11.0	
Optimize	Self-Optimizing Grid	x	x	x	x	x	x	x	$420.0	$302.0	$722.5	1st
	Integrated Volt/VAR Control	x	x	x	x	x	x	x	$207.0	$10.0	$217.0	2nd
	Harden &Resiliency [T]		x	x	x			x	$102.4	$31.3	$133.7	
	Targeted Underground				x			x	$59.8	$54.7	$114.5	
	Energy Storage*		x	x	x		x	x	$56.5	$72.5	$129.0	
	Transformer Retrofit [D]				x			x	$8.3	$109.7	$118.0	
	Long Duration Interruptions				x			x	$11.3	$15.8	$27.1	
	Transformer Bank Repl [T]		x	x				x	$33.6	$82.7	$116.3	
	Oil Breaker Rpl [T]			x		x		x	$101.6	$42.8	$144.4	
	Oil Breaker Rpl [D]			x		x		x	$13.9	$42.0	$55.9	
Modernize	Enterprise Communications	x	x	x	x	x	x	x	$103.8	$108.0	$211.8	3rd
	Distribution Automation		x	x	x	x		x	$118.4	$70.9	$189.3	4th
	System Intelligence [T]		x	x		x		x	$62.7	$23.7	$86.4	
	Enterprise Applications		x	x		x		x	$17.0	$10.8	$27.8	
	ISOP		x	x		x	x	x	$4.1	$2.5	$6.6	
	DER Dispatch		x	x		x		x	$4.5	$2.9	$7.4	
	Electic Transportation*		x	x					$38.2	$25.2	$63.4	
	Power Electronics		x	x		x		x	$0.7	$1.1	$1.8	
											$2,314.2	

Duke Energy Grid Improvement Plan

Transmission Summary

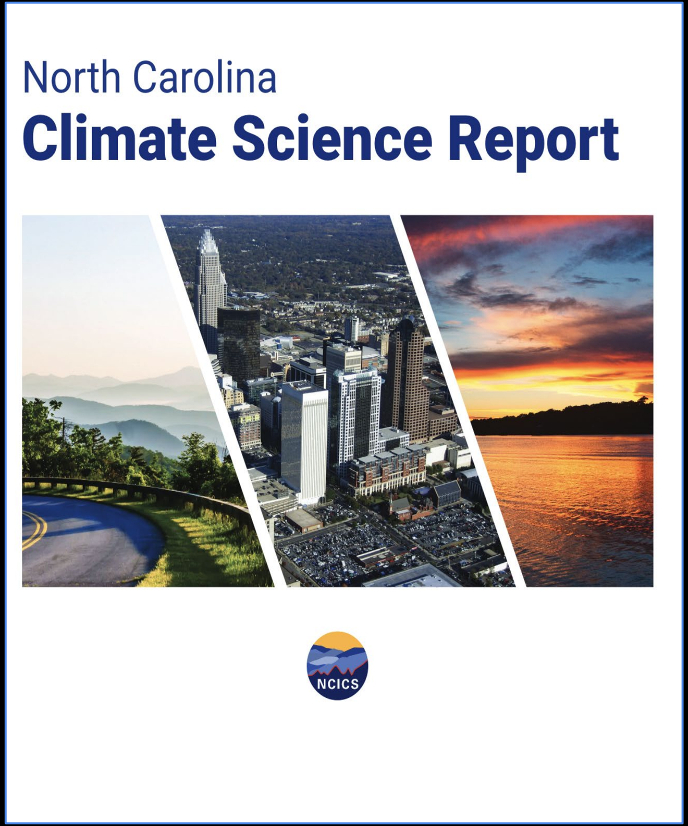
DEP System Outage Information	Lines	Substations	Wholesale POIs
Peak Storm (183)	45	90	48

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**

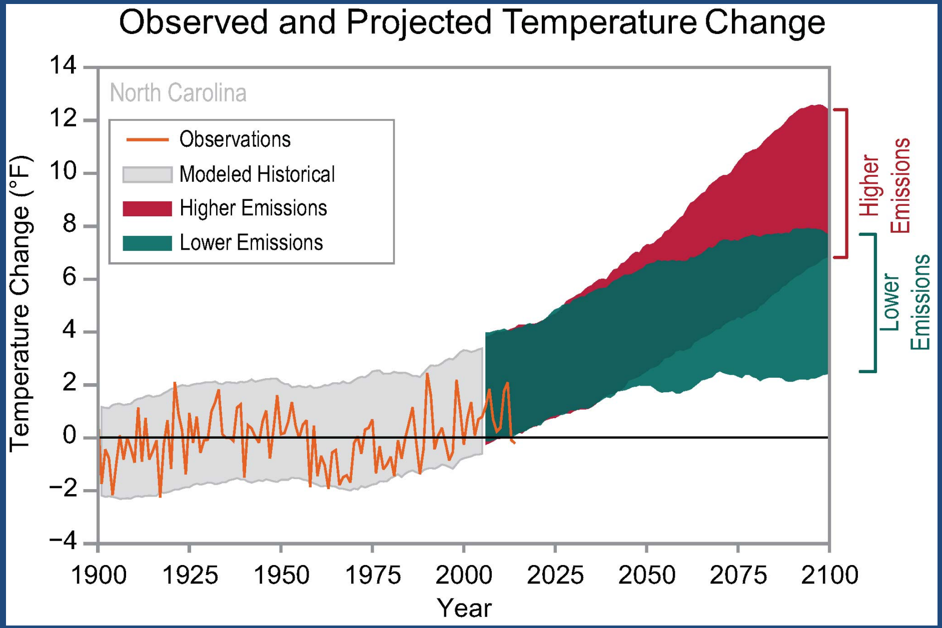
Source: North Carolina Climate Science Report, https://ncics.org/nccsr

"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/

Reliability & Resiliency

- **Reliability:**
  - Associated with everyday operation of the grid
  - Well defined metrics exist
- **Resiliency:**
  - Associated with major events
  - Defined in terms of threats or hazards

- No uniform methodology or best practice for incorporation of resiliency into regulated utility planning processes
- No state utilizes a resilience metric in regulated utility planning processes such as IRP, IDP, ISOP
- NARUC Report found that in regulatory proceedings, resilience values for DER's have only been used qualitatively for decision making

Source: UNC Charlotte Energy Production and Infrastructure Center

Energy System Resiliency Planning

Risk Based Framework

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

Metrics can be used to quantify human and economic costs of power outages and make investment decisions related to energy infrastructure planning and operations.

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

Summary

- Many drivers are rapidly transforming the electricity system.
- The grid is becoming more dynamic, with two-way power flows demanding better data, modeling techniques, and decision support tools.
- North Carolina will need to explore beyond the traditional generation, transmission and distribution planning and operating processes.
- Evolution in utility planning processes are needed to consider the system from a holistic perspective, requiring
  - Input from stakeholders,
  - Regulatory solutions, and
  - Policy actions.
- This conference is a necessary next step in understanding and charting a path forward for NC.