

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

U.S. Department of Energy

North Carolina Department of Environmental Quality

University of North Carolina Charlotte, EPIC

NC Clean Energy Technology Center



Project Team

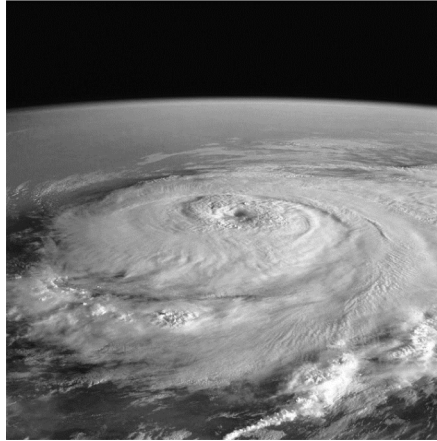
- North Carolina Department of Environmental Quality State Energy Program (NCDEQ)
- University of North Carolina Charlotte, Energy Production Infrastructure Center (EPIC)
- NC Clean Energy Technology Center/ NC State University (NCCETC)



Project Background & Motivation

- 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).
- DOE's interest in developing metrics that can evaluate the societal and economic impact of inflation-adjusted cost of weather-related power outages estimated to be \$25 to \$70 billion annually in the U.S.





Project Goals

- Develop an Affordable, Resilient & Sustainable Grid Roadmap to inform key energy planning processes:
 - EPIC will utilize Duke Energy's 2015-2018 outage data to conduct power system and cost benefit analyses to assess storm impacts in 3 grid scenarios
 - NCCETC will lead stakeholder process to share results & gather input on advanced grid scenario to inform state energy planning processes.
 - NCDEQ will incorporate findings into State Risk Assessment and Resiliency Plan and coordinate with other agencies developing State Hazard Mitigation Plans.



Timeline Highlights

- Define 3 weather related 'use cases' for analysis & report on severity & duration of outages & establish current grid baseline (scenario #1) system performance report (Q2)
- Hold 2 subject matter expert (SME) meetings to review & validate Duke Energy's Grid Improvement Plan for resiliency scenario #2 and scenario #3 including advancements in micro and mini grid opportunities (Q3 &Q4)
 - Synchronize with economic (lost wages) modeling
- Develop matrices including probability distributions , technical & economic consequences
 - Generate valuation of resiliency measures & grid resiliency scenario #3
- Conduct 2-3 stakeholder meetings & develop roadmap (Q3-7)
 - Review & validate list of resiliency advancements in grid scenarios 2 & 3
 - Vet final roadmap before publication



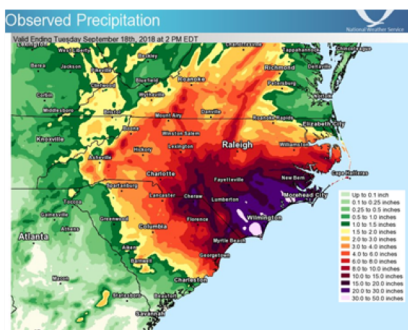
Grid Resilience Modeling

- Challenge: Investing in a resilient grid does not fit the traditional regulatory framework
- Traditional focus: Reliability – Investing to maintain day-to-day operations
 - Many metrics exist and are commonly used by regulators nationwide
- New problem: Resiliency: Investing to prepare for and adapt to changing conditions, and to withstand and recover rapidly from disruptions
 - Widely accepted metrics do not exist
- Approach:
 - Examine impact of recent hurricanes in North Carolina
 - Consider impacts in three scenarios:
 - **Scenario 1:** Current grid
 - **Scenario 2:** Proposed grid improvement plan
 - **Scenario 3:** More resilient technologies; i.e. increased distributed generation, microgrids, mini-grids, etc.



Resilience Modeling Methodology

Storm Use Case 1:
Hurricane Florence



Resiliency Scenario 1: Baseline

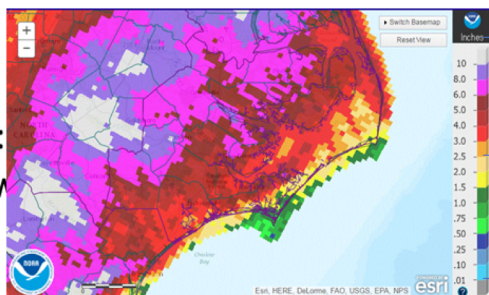
Resiliency Scenario 2: Proposed Grid Mod

Resiliency Scenario 3: Advanced

Economic / Societal
Impact Analysis

*How do the proposed
measures affect the
community & local
economy?*

Storm Use Case 2:
Hurricane Matthew



Resiliency Scenario 1: Baseline

Resiliency Scenario 2: Proposed Grid Mod

Resiliency Scenario 3: Advanced

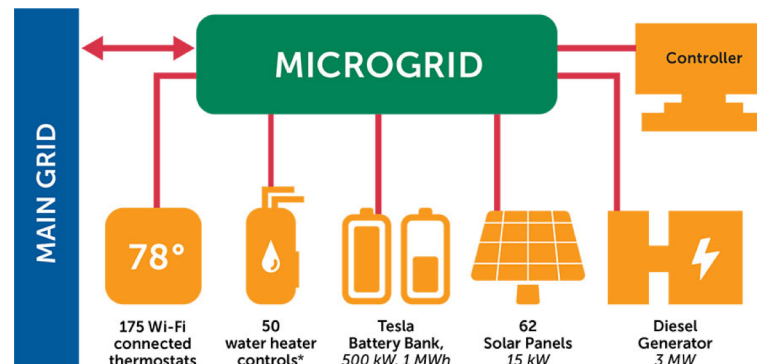
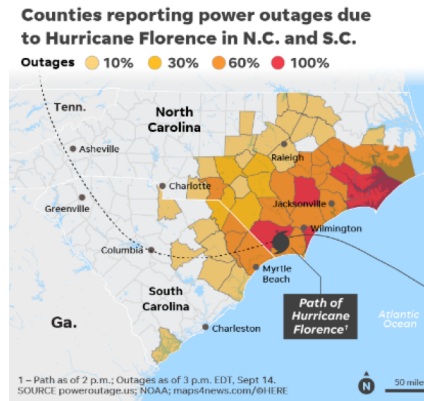
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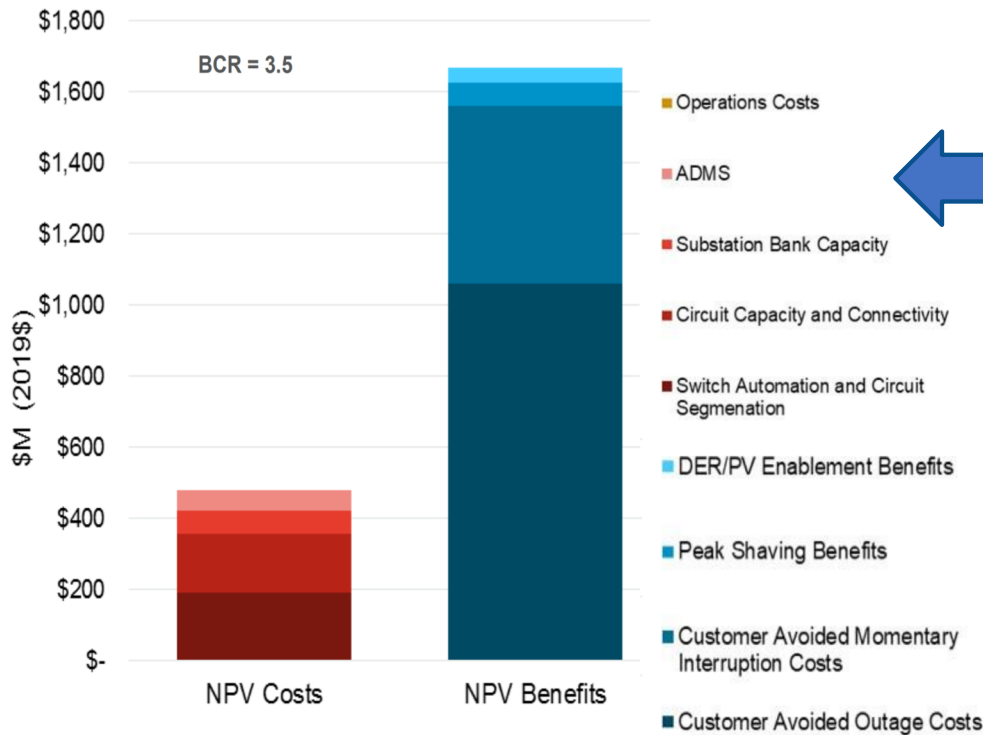


Resilience Modeling Methodology

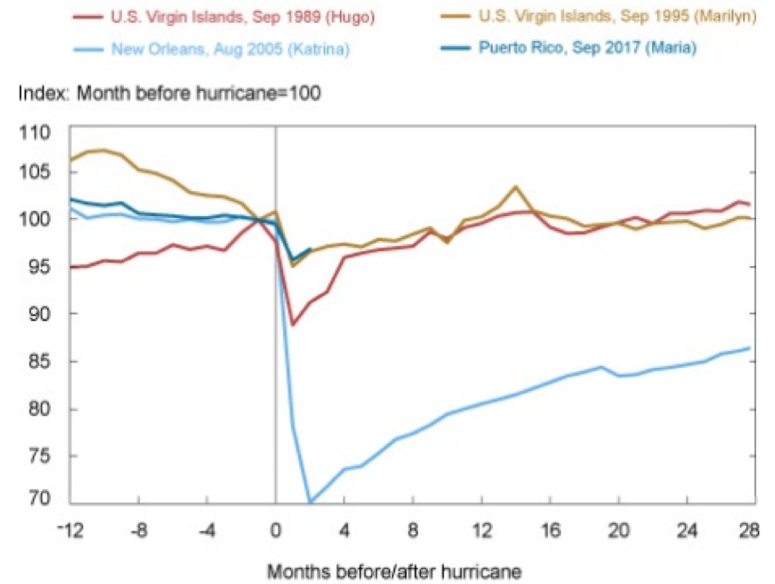
- Scenario 1:
 - Where did outages occur in recent major storms?
 - What were the indirect impacts on the community and economy?
- Scenario 2:
 - How would impacts have changed under the Grid Improvement Plan?
- Scenario 3:
 - How would impacts have changed with a more flexible grid with more DERs and microgrids?



Combining Traditional Analysis With New Impacts Focused on Economic and Community Impacts



Total Employment Before and After Selected Hurricanes



Source: Authors' calculations; U.S. Bureau of Labor Statistics data, accessed through Haver Analytics.

Can we value the costs borne by the community?



Resilience Metrics

- Analysis related to work elsewhere:
 - DOE Grid Modernization Laboratory Consortium, National Academy of Sciences, NARUC, etc.
- Metrics focused on indirect impacts of major storms:
 - Loss of assets, lost wages and jobs, impact on critical infrastructure
- Calculations performed using accepted tools, including DOE's Interruption Cost Estimate (ICE) Calculator and IMPLAN
- Determine potential power-system impacts from the improvements in each scenario; how do these impact the various indirect metrics?
- Analysis will include data such as local GDP and payroll data



Examples

- Number of critical community assets that remain powered during an extended outage:
 - Hospitals, police/fire stations, wastewater treatment facilities, etc.
- Is the recovery cost borne by the community – not the utility – reduced:
 - Monetary losses from businesses
 - Cumulative customer outage days occurred following a major storm
 - Lost wages during outage period
- ***Bottom line: How do we reflect community costs in our investment decisions?***



Stakeholder Engagement

- Description of Stakeholder groups
 - SMEs- utility related & public staff technical experts
 - Local & state govt., advocacy & environmental, energy trade groups, utilities (IOUs, EMCs, Munis) large energy users, consulting, project developers, technology providers, academics
- Role in the project
 - Provide guidance and input on what is important to consider for resilience in the 3rd scenario
 - Review modeling efforts and provide feedback
 - Validate work through engagement
 - Provide diverse set of voices, background, and resources to ensure as many considerations can be included accurately in modeling



Stakeholder Workshops

- 1st (Apr/May 2020*)
 - Present the project
 - Educate stakeholders on topic and value
 - Provide framework for 3rd scenario and complete activity to obtain input
 - Get feedback on methodology, results, metrics, etc.
- 2nd (Sept/Oct 2020*)
 - Present initial findings – including 3rd scenario prelim results
 - Continue discussion/review on methodology, results, metrics, etc.
- 3rd (Mar/Apr 2021*)
 - Present findings of the overall project, get feedback and input
 - How can the findings be useful to project goals and applied

* Tentative dates



Review Timeline & Deliverables

- Q1: Define use cases
 - Prepare summary memo
- Q2: Analysis under baseline scenario for each use case
 - Prepare summary report and data for use in economic/societal analysis
- Q3:
 - Finalize proposed grid-modernization developments for Scenario 2
 - Analysis under Scenario 2
 - Prepare summary report and data for use in economic/societal analysis
- Q4: Define initial scenario 3
 - First stakeholder meeting in this Quarter
- Q5: Analysis under scenario 3
 - Prepare summary report and data for use in economic/societal analysis
- Q6-Q7: Refinement of scenarios based on economic societal impacts



Project Impacts

- Fill specific data and information gaps on value of resiliency
- Help inform state policy, utility models and filings, regulators, and other states
- The road map will provide metrics and illustrative impacts (3 scenarios) with these metrics to educate and inform stakeholders & future decision making

Questions?

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