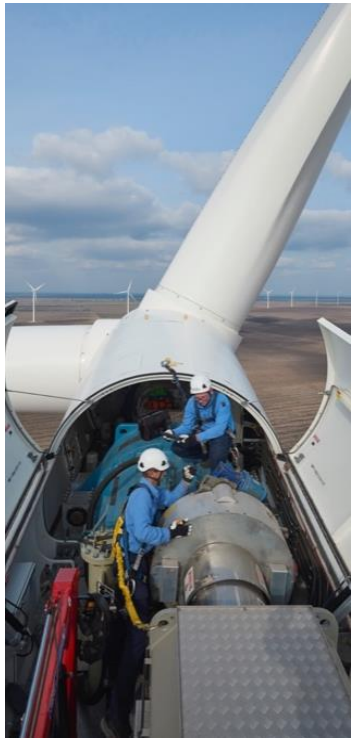
Duke Energy Integrated System and Operations Planning (ISOP)

NCEP Annual Meeting, Tuesday, September 14, 2021







DUKE ENERGY®

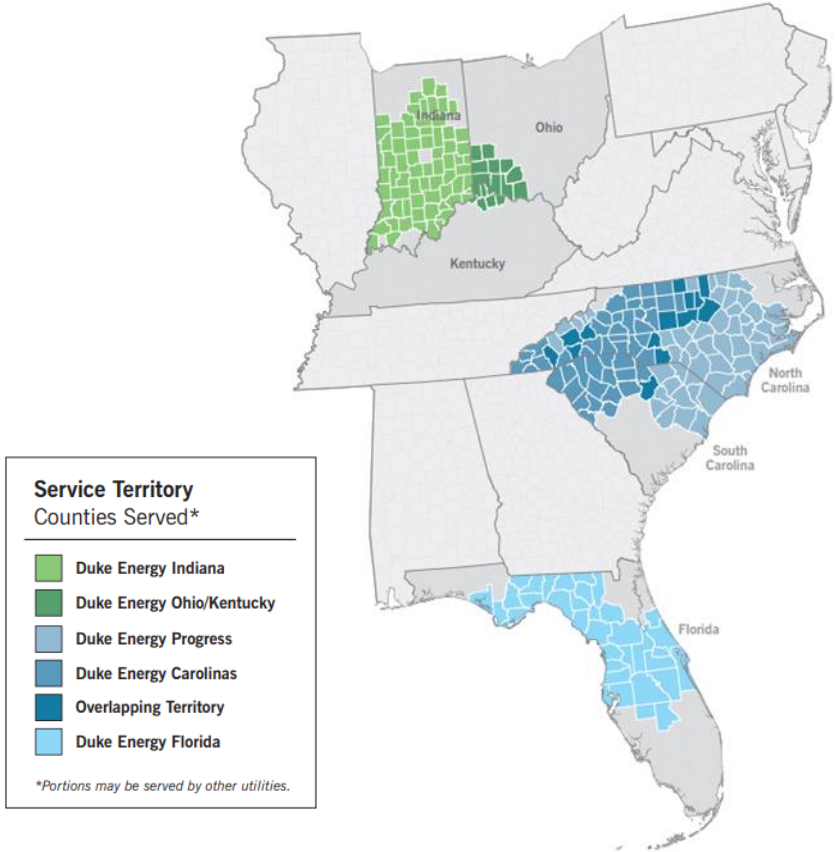
Duke Overview

Regulated Electric Utilities

- Serve 7.8 million residential, commercial and industrial customers
- Serving customers in 6 states
- 51,144 MW generation
- Approximately 280,000 miles of distribution lines
- Approximately 31,000 miles of transmission lines

Commercial Renewables

- Over 5,100 MW generation
  (wind, solar, fuel cell & battery)
- Serving 19 states

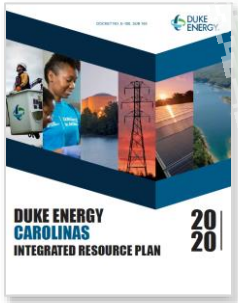


ISOP Origins & Purpose

2020 Climate & Sustainability Reports

Clean Energy Vision

Net Zero Carbon by 2050



Integrated Resource Plan (IRP)

Growth and Integration of DERs

Pathways to Net Zero

Integrated System and Operations Planning (ISOP) is integrating our long-term planning efforts to define future system needs

NTS/Storage Potential

- Storage needs and potential on the system
- Storage use cases for energy network support
- Opening up to new non-traditional solutions (NTS)

Pumped Storage Hydro

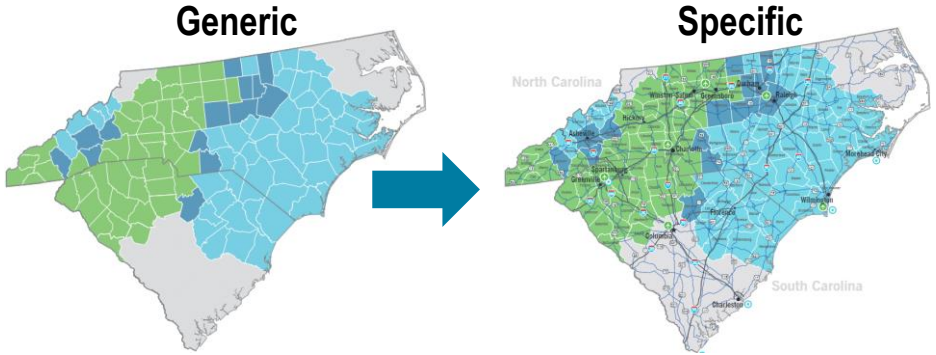
Lithium-Ion BESS

Grid Implications

- Informed view of distributed resources and capabilities operating on the system
- Grid configurations and capabilities needed to support envisioned fleet transition and future operations

Incorporating Grid Implications

Analytical Challenges and Complexity

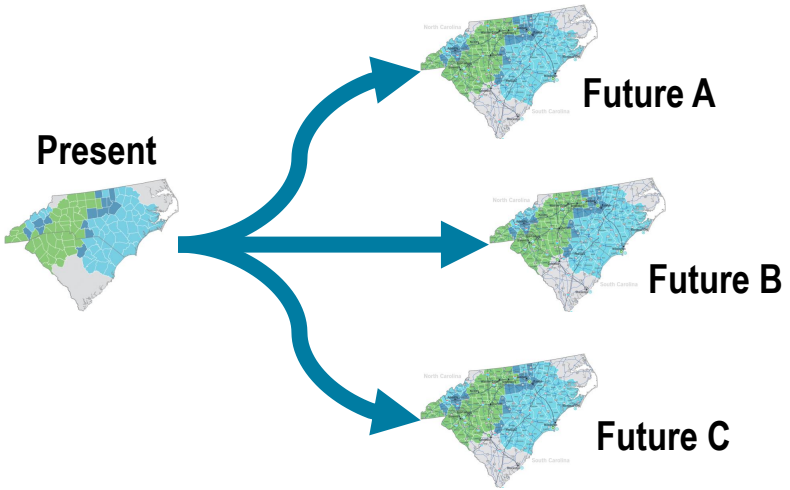


Analytical complexity increases substantially

- Location matters for grid analysis
- Transmission models identify issues, not solutions
- Generation is just one factor influencing grid analysis

Scenario analysis compounds the challenge

- Seemingly minor differences in generation portfolios may result in significantly different grid impacts



Assessing Grid Implications of Clean Energy Portfolios

Make holistic analysis manageable …

- Limit total number of scenarios
- Aim for scenario consistency over time

while covering the range of plausible futures

- Construct framework around key themes
- Focus on critical thresholds/inflection points

Pathways in 2020 Carolinas IRPs

Pathway A: Base Without Carbon Policy

Pathway C: Earliest Practicable Coal Retirements

Pathway B: Base With Carbon Policy

Pathway E: 70% CO_2 Reduction: High SMR

Pathway D: 70% CO_2 Reduction: High Wind

Pathway F: No New Gas

Centralized Generation Mix ⟷ **Highly Distributed Generation Mix**

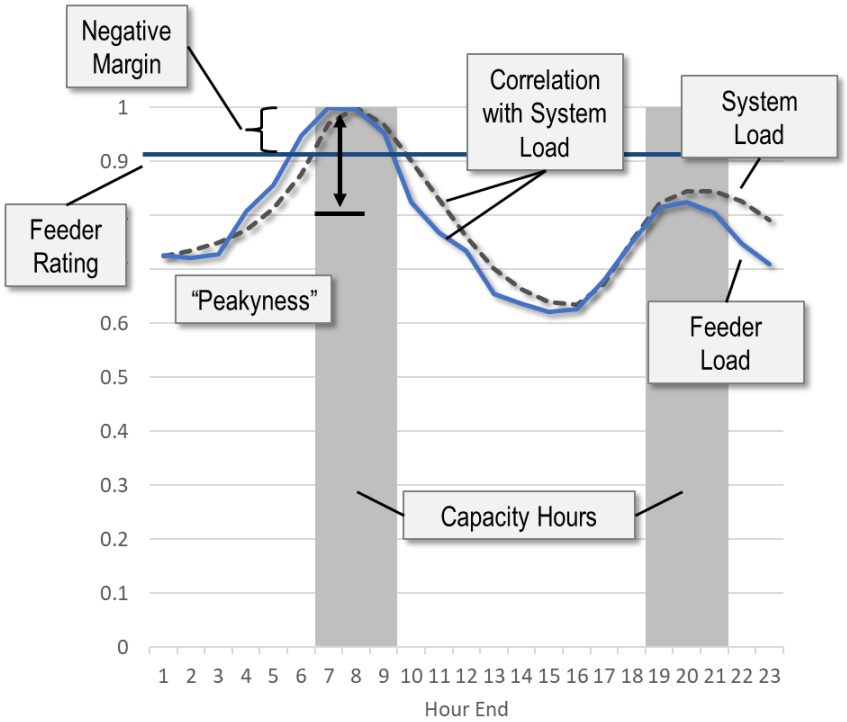
Potential Scenarios Connecting Generation to Grid Planning

Low Grid Impact Scenario	Moderate Grid Impact Scenario	Higher Grid Impact Scenario

Evaluating Non-Traditional Solutions

NTS Screening for Distribution Storage Opportunities

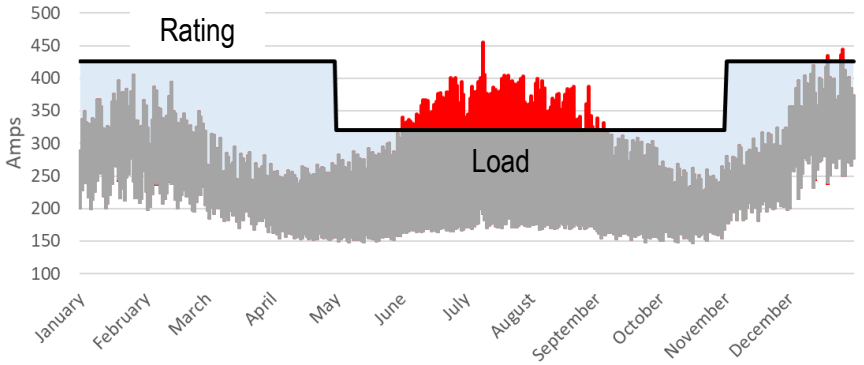
Normalized System and Feeder Load Shapes (Winter)



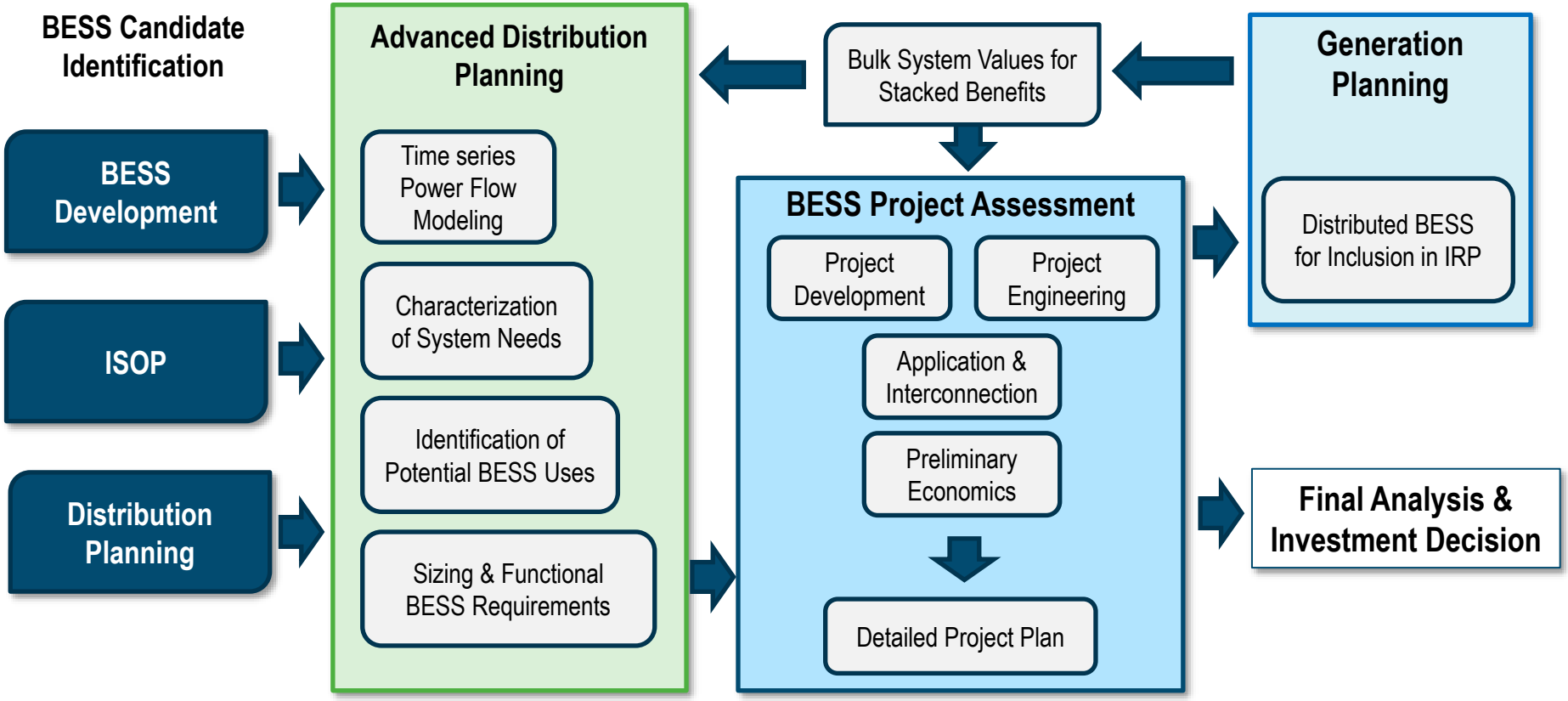
Additional Screening Criteria

- Load Growth
- Paired Feeder + Bank Overloads
- Connected PV

Seasonal Equipment Rating and 8760 Load



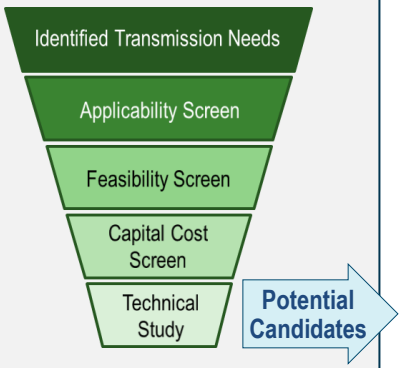
Screening and Evaluation of Storage Solutions for Distribution



NTS Screening for Transmission Storage Opportunities

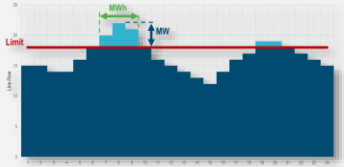
❶ NTS Screening

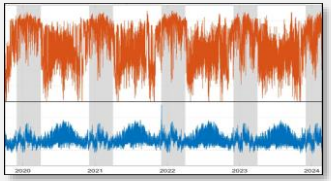
Screen for potential NTS alternatives to traditional projects being considered

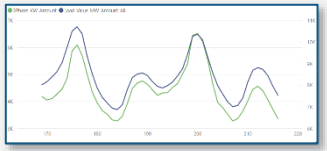


❷ Technical Feasibility (Phase 1)

- Model power flows to identify alternatives, BESS requirements and potential locations
- Evaluate BESS opportunity for potential additional energy and ancillary service value
- Evaluate BESS application for system capacity value







❸ Economics (Phase 1)

- Preliminary economic analysis of alternatives

- Transmission planning review of system needs and priorities

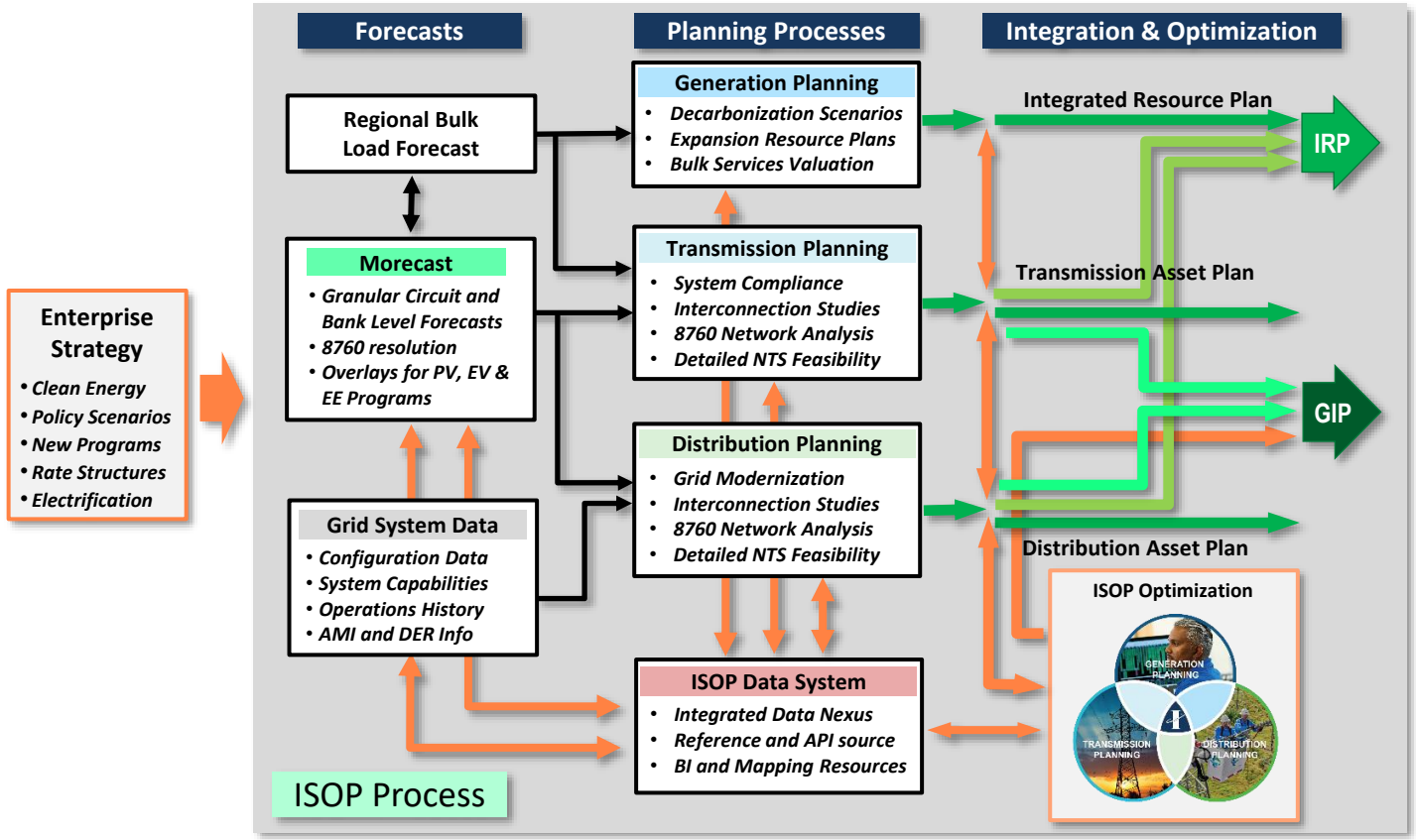
❹ Next Steps (Phase 2)

- Detailed feasibility review

Advanced Transmission Planning applications are being used to assess dynamic grid operations and storage potential

Collaboration and Alignment

ISOP Overview: Aligning and Linking Process, Tools, and Data



ISOP = Collaboration

Key Investments Required:

- Grid connectivity data
- Grid system data quality
- Data infrastructure to support integration
- Tools for time series systems analyses
- Tools for screening & visualization
- Process automation

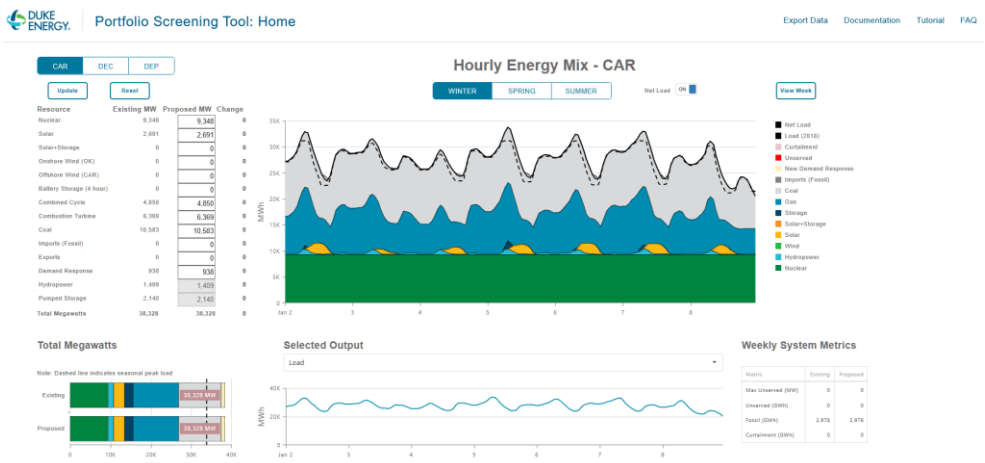
Development & Integration

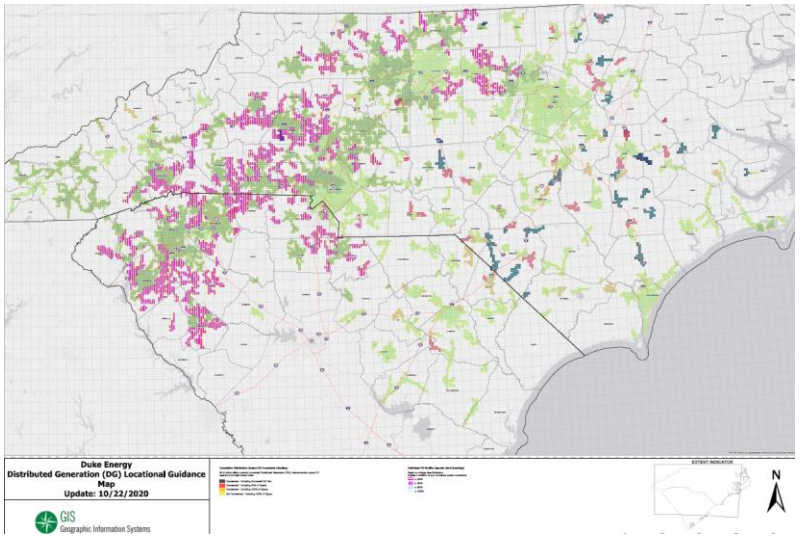
- Tabletop Learning Processes
- Flexibility for scenario analysis

Engaging with Stakeholders

Approach

- Virtual forums to discuss objectives, provide progress updates, and solicit feedback
- Technical conferences focused on specific topics and tools
- Collaboration with stakeholder groups in several focus areas





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