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Energy's Role in Climate Resilience: A Q Methodology Study of Governance and Community Priorities in North Carolina

Tristen Best, MPP Candidate | Energy Policy
University of North Carolina at Chapel Hill, tristenbest6@gmail.com |
https://publicpolicy.unc.edu/person/best-tristen

Master's Capstone Committee
Alex Seeskin, Graduate Capstone Advisor
Alex Hopkins, Interim Director of the UNC Energy Transition Initiative (ETI)
Daniel Gitterman, Professor of Public Policy at UNC Chapel-Hill

Visit the Energy Transition Initiative (ETI) at: https://ie.unc.edu/centers/eti

Abstract
This project uses Q methodology to investigate how diverse stakeholders across North Carolina conceptualize and prioritize climate and energy resilience in the face of intensifying climate impacts and rising energy demands. While resilience research has explored disaster response and energy transitions separately, few studies have examined how subjective stakeholder perspectives shape policy preferences at the intersection of these domains. By analyzing 50 opinion statements sorted by local officials, utility representatives, community leaders, and policy professionals, the study reveals distinct narratives around equity, governance, technology, and risk. These findings build on frameworks from resilience theory, energy justice, and adaptive governance, advocating for the importance of inclusive planning that reflects localized needs and trade-offs. The study contributes insights for policymakers and institutions, including the UNC Energy Transition Initiative working to implement community-centered strategies for resilient, low-carbon development in North Carolina and similar contexts.

Keywords
climate resilience, energy transition, stakeholder engagement, Q methodology, North Carolina, disaster adaptation, energy justice

Disciplines
Environmental Policy, Energy Systems, Climate Adaptation, Public Policy Analysis

UNC Office of Human Research Ethics
Exemption Category: 2. Survey, interview, public observation, 3. Benign Behavioral intervention
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Executive Summary

North Carolina faces escalating climate resilience challenges in the face of stronger storms, rising seas, and a rapidly growing population. In 2024, Hurricane Helene devastated the state, leaving over one million residents without power and causing an estimated $1.4 billion in damage to the electric grid, plus an additional $13 billion in economic losses due to business interruptions (North Carolina Office of State Budget and Management [OSBM], 2024). This disaster exposed deep vulnerabilities in North Carolina's aging energy infrastructure and highlighted the urgent need for long-term resilience planning. At the same time, North Carolina's population has surpassed 11 million (U.S. Census Bureau, 2024). Projections suggest nearly four million more residents by 2030 (WRAL News, 2024), which will significantly increase energy demand across the state. This combination of more extreme weather and rising demand poses a challenging question: How do we build a reliable, climate-resilient energy system while accommodating growth?

This capstone addresses these challenges by exploring how different stakeholders in North Carolina that range from policymakers, utility officials, local leaders, and community advocates prioritize strategies for energy and climate resilience. It uses Q methodology, a research approach designed to reveal shared and conflicting perspectives by having participants rank opinion statements on a spectrum of agreement (Brown, 1980). The Q-set used in this study included fifty statements developed through a review of relevant literature, analysis of state energy policy debates, and consultation with the UNC Energy Transition Initiative (ETI). Themes represented in the statements included state versus local authority, trust in institutions, infrastructure investment, energy equity, climate risk, and the role of the private sector. The study was conducted in partnership with ETI, which helped guide the research design and connect with a diverse pool of stakeholders across sectors and regions of the state.

Nine stakeholders completed Q-sorts, and factor analysis using principal components with varimax rotation revealed two dominant perspectives. The first factor, Justice-Oriented Clean Energy Pragmatists, emphasizes equity, public investment, and the importance of government mandates and planning to protect vulnerable communities and drive climate resilience. Participants holding this view strongly supported regulatory action, targeted funding for marginalized areas, and inclusive decision-making. Their priorities align with emerging frameworks in energy justice and climate equity that argue resilience efforts must actively confront historic inequities and redistribute benefits (Basseches et al., 2022; European Environment Agency, 2023; Earth System Governance Project, 2021). The second factor, Technocratic Resilience Modernizers, favors data-driven planning, infrastructure modernization, and trust in technical experts and established institutions. Participants in this group prioritized federal subsidies, cost-benefit analysis, and grid upgrades while expressing caution toward politicized framing and top-down mandates. Their perspective aligns with ecological modernization theory and reflects a depoliticized approach that emphasizes efficiency and reliability over systemic change (Schulz & Siriwardane, 2015; Spaargaren & Mol, 1992).

Despite these differences, there were areas of consensus. Both groups rejected individual action and market-based solutions as sufficient responses to climate risk. They supported collaborative governance, public investment, and cross-sector partnerships. These commonalities suggest that while resilience visions may differ, there is shared recognition that institutions must take a leadership role. Key points of divergence also emerged. The Justice-Oriented group favored the creation of a statewide resilience task force, stronger mandates, and increased public accountability. In contrast, the Technocratic group was more skeptical of new bureaucratic structures and preferred incremental changes through existing institutions. Perspectives were influenced by professional roles and geographic contexts. Factor 1 participants more often came from nonprofit and advocacy organizations, often based in eastern and central North Carolina. Factor 2 participants tended to work in technical or utility sectors and were more commonly based in the western part of the state.

These findings have clear policy implications. As North Carolina implements House Bill 951 and other energy transition goals, it must recognize that stakeholders hold distinct but not mutually exclusive visions. Policymakers should draw on both perspectives. The Justice-Oriented view offers legitimacy and social alignment, while the Technocratic view offers practicality and technical focus. A combined strategy would balance investment in grid modernization with targeted community engagement, ensure equity in resilience spending, and create mechanisms that bring both experts and communities to the table. Moreover, the study suggests that Q methodology can be a valuable tool for participatory policy design, helping to surface areas of agreement and highlight stakeholder concerns before major decisions are made.

Future research can build on this study by conducting similar Q-sorts in other regions or states, comparing patterns across time, or expanding the range of participants to capture even broader perspectives. As climate impacts intensify and energy systems are tested by rising demand and natural disasters, understanding how stakeholders frame resilience will be essential. This capstone contributes to that understanding by identifying meaningful differences and shared values in North Carolina’s energy transition landscape and offering concrete insights into how resilience policy can be designed to work across diverse priorities.

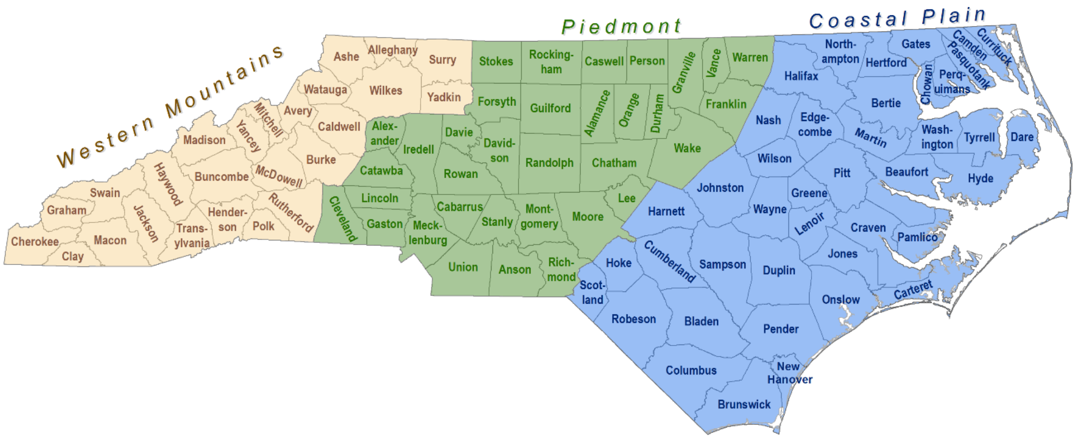
Introduction

North Carolina is on the front lines of climate change, confronting increasingly severe weather events and the imperative to adapt its infrastructure and communities. As one of the fastest-growing states in the United States, with a population now exceeding 11 million (U.S. Census Bureau, 2024), North Carolina faces unique vulnerabilities to climate-related disasters, including hurricanes, flooding, and extreme heat. These hazards pose significant risks to the state's communities, critical infrastructure, and economy, making climate resilience a rising priority for policymakers, planners, and residents. Recent climate events are constant reminders of the scale of the challenge. In September 2024, Hurricane Helene struck North Carolina as one of the most devastating storms in the state's history. The hurricane left more than one million people without power and caused approximately $1.4 billion in damage to the electrical grid, with business interruptions pushing the total economic losses above $13 billion (North Carolina Office of State Budget and Management [OSBM], 2024). Beyond the immediate outages, Helene's aftermath revealed deep vulnerabilities in the energy infrastructure, from downed transmission lines to prolonged rural outages and the costly recovery facing storm-damaged communities (OSBM, 2024). These impacts reinforce the urgent need to strengthen North Carolina's energy systems before the next crisis hits.

Geographic Diversity and Climate Risks

North Carolina's diverse geography, as illustrated by its three distinct regions the Coastal Plain, Piedmont, and Western Mountains, complicates resilience planning. Each region faces different climate risks and socio-economic contexts that influence how communities perceive and respond to threats. The low-lying Coastal Plain is especially susceptible to hurricanes, storm surge, and sea level rise. In northeastern counties, relative sea level is rising nearly twice as fast as it is along the southeastern coast, threatening infrastructure and homes with chronic flooding (North Carolina Institute for Climate Studies [NCICS], 2020). Coastal cities such as Wilmington are projected to experience over 50 tidal flood days per year by 2050 under moderate sea level rise scenarios (NCICS, 2020).

Figure 1



Note: North Carolina's three major geographic regions: the Coastal Plain, Piedmont, and Western Mountains. Adapted from North Carolina Climate Science Report, by North Carolina Institute for Climate Studies (NCICS), [2020]. Retrieved from https://ncics.org/programs/nccsr/.

The Piedmont, home to major urban centers like Raleigh, Charlotte, and Greensboro, faces different climate threats. Rapid urbanization has increased impervious surfaces, which heightens flood risks and urban heat island effects (Cutter, Ash, & Emrich, 2014). Meanwhile, the Western Mountains region is vulnerable to warming temperatures that threaten water supplies and increase wildfire risks in high-elevation forests (Cutter et al., 2016). During Hurricane Helene, mountain counties such as Buncombe and Madison experienced landslides, power outages, and transportation disruptions, showing that no part of the state is immune to climate extremes (Mehta, 2024).

These geographic risks intersect with persistent social and economic vulnerabilities. Rural and low-income communities often bear the greatest impact during disasters due to outdated housing, energy poverty, and limited access to emergency resources. For instance, families in energy poverty face higher health risks from heat and cold, have fewer options for recovery, and are often excluded from clean energy upgrades (Riva et al., 2023). Counties with high social vulnerability tend to recover more slowly and face higher rates of post-disaster displacement (Cutter et al., 2014). Studies of North Carolina's Appalachian counties show that they rank among the least resilient regions in terms of disaster recovery and institutional capacity (Cutter et al., 2016). These disparities emphasize why equity, and inclusion must be central to any climate resilience strategy.

Rising Energy Demand and Energy Transition Pressure

At the same time, North Carolina's rapidly growing population and industry are putting pressure on its electricity system. Projections show that the state will gain nearly four million new residents by 2030, with increased energy needs driven by expanding data centers, electric vehicle infrastructure, and new manufacturing facilities (WRAL News, 2024). These trends present challenges for maintaining grid reliability while meeting the state's decarbonization goals, including a mandated 70% reduction in power sector carbon emissions by 2030 under House Bill 951 (WRAL News, 2024).

Utilities like Duke Energy have warned of a 2-gigawatt increase in load within the next few years, roughly equivalent to the demand of a million new homes. Meeting this demand with intermittent renewables and aging grid infrastructure may require new investments in storage and transmission, which has triggered policy debates about balancing long-term sustainability with short-term reliability (Burke & Stephens, 2018). In regions hit hard by recent storms, the need for resilient and flexible energy systems is especially urgent.

Study Rationale

Understanding how to improve North Carolina’s resilience requires more than just technical solutions. It also demands insight into how different stakeholders perceive the problem and prioritize responses. Research shows that competing values, political ideologies, and economic interests shape climate adaptation decisions at every level of governance (Sovacool, 2019; Davidson, 2010). For instance, while some actors advocate for top-down state planning, others emphasize local control, market innovation, or equity-focused interventions. Without understanding these diverse perspectives, policy interventions may fail to gain support or fall short in addressing community needs.

This study uses Q methodology to surface and analyze these perspectives. Q methodology allows participants to rank opinion statements, about topics like resilience planning, energy affordability, infrastructure investment, and governance based on their own priorities (Brown, 1980; Parkins, 2022). Through statistical factor analysis, the method reveals shared viewpoints and clusters of agreement or disagreement among participants. This provides a deeper, evidence-based map of how North Carolinians think about the convergence of energy resilience.

The results are designed to support the work of UNC’s Energy Transition Initiative (ETI) and other state actors involved in building a climate-ready energy system. By identifying areas of consensus and tension, the findings can inform tailored strategies for resilience that align with stakeholder values and are more likely to succeed in implementation.

Capstone Partner: UNC Energy Transition Initiative

This capstone project was conducted in collaboration with the UNC Energy Transition Initiative (ETI), housed within the UNC Institute for the Environment. ETI was established to enhance UNC’s role in shaping North Carolina’s clean energy future and serves as a central hub for research, policy analysis, and stakeholder engagement.

As the capstone partner for this research, ETI provided guidance, feedback, and critical connections throughout the project. The initiative’s leadership, Interim Director Alex Hopkins, offered insight on the Q methodology study and helped ensure that the Q-set statements reflected the diversity of energy-related policy discourse in North Carolina. ETI also helped refine the stakeholder recruitment strategy by opening its statewide network of policy professionals, energy practitioners, and nonprofit partners, enabling the study to reach a broad and balanced participant sample.

Literature Review

Resilience, in the context of climate adaptation and disaster risk management, is broadly defined as the ability of a system or community to withstand and recover from hazards while maintaining essential functions (UNDRR, 2024). This concept has evolved to emphasize not only the biophysical aspects of climate threats but also social, economic, and governance dimensions that shape how impacts are absorbed and responded to (Folke, 2016; IPCC, 2022). Modern resilience thinking teaches that resilience is a process rather than a static end-state because it involves continual adaptation and learning in the face of changing conditions (IPCC, 2022; Tiwari et al., 2022). The interplay between hazard exposure, underlying vulnerabilities, and adaptive capacity is crucial for determining outcomes after disruptive events (Siders, 2019; Cutter & Derakhshan, 2020). Communities with greater access to resources, robust social networks, and inclusive governance structures tend to adapt more effectively, whereas those facing economic or informational constraints often have lower resilience (Matin et al., 2018; Guo et al., 2025). For example, systematic analyses find that social capital, described as the trust and cohesion within a community can significantly enhance collective action during crises and speed recovery (Guo et al., 2025). Conversely, structural inequalities such as poverty or marginalization and power imbalances can hinder a community's capacity to adapt, leading calls for more equitable and inclusive approaches to resilience-building (Matin et al., 2018; Meerow et al., 2019).

Considering these factors, scholars have reiterated the need for flexible governance arrangements that empower local stakeholders and integrate diverse knowledge systems into resilience efforts (Djenontin & Meadow, 2018). This perspective is reflected in policy as well. For instance, North Carolina's statewide Climate Risk Assessment and Resilience Plan explicitly mentions cross-sector collaboration, community engagement, and attention to vulnerable populations as central to building resilience (NC DEQ, 2020). Resilience research also tackles the challenge of operationalizing and measuring this multifaceted concept. Efforts to quantify community resilience have produced indices combining social, economic, infrastructural, and institutional indicators to benchmark how well different regions can prepare for and bounce back from disasters (Cutter & Derakhshan, 2020). Studies applying these metrics reveal uneven resilience across geographies; for example, rural and low-income areas often score lower due to persistent disadvantages in resources and institutional support (Cutter & Derakhshan, 2020; Siders, 2019). At the same time, longitudinal studies suggest that resilience is not fixed but rather it can improve over time with targeted interventions through investments in infrastructure or social programs, or erode under chronic stresses (Cutter & Derakhshan, 2020). This view supports the understanding that building resilience requires an ongoing, iterative process of learning and adjustment, rather than a one-time effort (IPCC, 2022; Tiwari et al., 2022). Climate change has further complicated these efforts by introducing evolving and more intense hazards, from extreme storms to prolonged heatwaves, pushing communities beyond historical experience. To address emerging threats, researchers advocate interdisciplinary frameworks that integrate climate science, engineering, and social measures. For instance, an energy “services” approach to resilience considers not just physical assets but the ability of systems to meet community needs during disruptions (Tiwari et al., 2022). These approaches move beyond traditional risk and vulnerability assessments because the goal is to capture how well critical services like power, water, and healthcare can be maintained when crises strike (Tiwari et al., 2022). Overall, the literature points towards enhancing climate resilience demands through a holistic understanding of communities as complex systems. Here strengthening human, social, and economic capital is as important as fortifying physical infrastructure (Folke, 2016; Guo et al., 2025).

I. Community Resilience in Disaster and Energy Contexts

In the United States and globally, recent disasters have demonstrated firsthand how community resilience hinges on both hard infrastructure and softer social factors. For example, coastal communities prone to hurricanes show varied recovery outcomes that correlate with differences in local organization, resource access, and governance capacity (Siders, 2019). Case studies find that when residents, civic groups, and authorities coordinate effectively, sharing information and resources, communities can respond and rebuild faster after events like floods or storms (Guo et al., 2025). Strong collaborative networks and social trust act as force multipliers by facilitating collective action and problem-solving in crises (Guo et al., 2025). Ensuring that resilience strategies are locally appropriate and just is increasingly viewed as essential to “leaving no one behind” in adaptation efforts (Matin et al., 2018; IPCC, 2022). Energy systems have emerged as a critical focal point in community resilience research, given the central role of energy in disaster response and recovery.

The concept of energy resilience refers to the capacity of energy infrastructure and services to endure, adapt, and quickly recover from shocks, whether due to extreme weather, supply disruptions, or surges in demand (Hamborg et al., 2020). Recent years have seen interdisciplinary efforts to frame energy resilience in holistic terms, recognizing technical, economic, and social dimensions (Dias et al., 2023). For instance, a cross-epistemic framework by Hamborg et al. (2020) connects engineering and social science perspectives to evaluate how power grids can remain functional during crises while also considering institutional decision-making and community needs. A key takeaway is that highly centralized energy systems, while efficient under normal conditions, may be brittle when faced with localized disasters that can knock out large portions of the grid. As a result, policymakers and scholars are increasingly interested in decentralized solutions, such as microgrids, distributed solar with battery storage, and other localized generation that can isolate from the main grid and keep critical services powered during emergencies (Dias et al., 2023; Parkins, 2022). Decentralized energy infrastructures allow for greater flexibility and local control, which in turn can enhance community-level resilience by reducing dependence on distant, vulnerable transmission networks (Hamborg et al., 2020). Empirical research supports these benefits as communities that have invested in renewable energy microgrids or backup systems have shown quicker recovery of electricity after extreme events, minimizing disruptions to emergency response and economic activity (Dias et al., 2023).

However, the transition to a more resilient, distributed energy approach is not devoid of challenges. Institutional and regulatory barriers often impede the deployment of community energy projects, and financing such upgrades remains a concern for resource-constrained areas (Burke & Stephens, 2018). Moreover, a high penetration of renewable energy introduces variability (e.g. solar and wind intermittency) that must be managed with storage or smart-grid technologies to ensure reliability (Dias et al., 2023). These challenges are a high-level example that achieving energy resilience is as much a governance and planning issue as it is a technical one. Researchers emphasize the importance of inclusive energy planning, involving local stakeholders in decision-making to identify acceptable trade-offs and to harness community knowledge in designing energy systems (Burke & Stephens, 2018; Parkins, 2022). Studies suggest that when communities participate in energy transitions, for example, through public forums or energy cooperatives, the outcomes tend to enjoy greater public support and better address local priorities, thereby improving both the sustainability and resilience of the energy supply (Parkins, 2022; Carley & Konisky, 2020).

Ensuring that transitions are also equitable is vital since new energy investments should prioritize historically underserved communities to reduce, rather than exacerbate, existing disparities in who is most impacted by outages or fuel disruptions (Carley & Konisky, 2020; Dias et al., 2023). The literature converges on the view that strengthening climate resilience requires integrating energy security considerations with broader social and governance strategies. Community resilience is highest when infrastructure improvements go hand in hand with capacity-building at the local level, such as fostering social networks, diversifying energy sources, and empowering community organizations to take part in resilience planning (Guo et al., 2025; NC DEQ, 2020).

II. Q-Methodology as a Tool for Understanding Resilience and Energy Policy

To bridge the gap between top-down policy discourse and the diverse perspectives of stakeholders on the ground, researchers have increasingly turned to Q-methodology. Q-methodology is a mixed-method technique designed to systematically study subjective viewpoints by having participants rank a set of statements and then using factor analysis to identify patterns in those rankings. This approach is well-suited for exploring the complex attitudes and beliefs that different people or groups hold about issues like climate resilience and energy transitions, which often involve value trade-offs and uncertainties. By capturing nuanced viewpoints in a structured way, Q-studies can reveal distinct discourses or narratives that might otherwise be overlooked in traditional surveys or public meetings. Recent applications of Q-methodology in environmental policy have demonstrated its value in unpacking contentious debates and informing more inclusive decision-making. For example, a Q-method study in western Canada identified several competing discourses on energy development ranging from strong support for renewable energy to preferences for maintaining the fossil fuel status quo, which is the tip of the iceberg when looking at the ideological divides that policymakers must navigate (Parkins, 2022). In another study, Rittelmeyer (2020) applied Q-methodology in California's Sacramento San Joaquin Delta to understand stakeholders' perceptions of flood risk management. The analysis uncovered divergent viewpoints among farmers, residents, and planners regarding levee improvements and land use, thus providing insight into points of consensus and contention in flood resilience planning. These examples illustrate Q-methodology's ability to surface unrealized perspectives that may not emerge through conventional stakeholder engagement methods, which gives voice to a broader range of concerns and priorities.

In the context of climate adaptation and energy policy, Q-methodology is a powerful way to incorporate community and stakeholder input into the policy process. Studies using Q have revealed how different groups conceptualize "resilience" and what strategies they favor. Ultimately, this can provide information that is invaluable for crafting policies that are sensitive to local values (Parkins, 2022; Djenontin & Meadow, 2018). For instance, one community might prioritize hard infrastructure solutions like grid hardening, while another might emphasize social programs and green infrastructure. A Q-study can empirically identify these preference patterns and go a step further to probe into the rationales behind them. Research has noted that Q-methodology can even facilitate a form of stakeholder dialogue by clarifying where shared priorities exist across otherwise divergent groups. In practice, the insights from Q-studies have been used to inform participatory planning exercises, ensuring that resilience and energy transition strategies align more closely with stakeholder values and concerns. For example, by identifying a set of core viewpoints on community solar projects and emergency preparedness, a Q-method analysis can guide regional planners to develop adaptation initiatives that most stakeholders find acceptable, thereby improving implementation success (Burke & Stephens, 2018). Moreover, Q-methodology has proven useful in contested policy arenas, such as debates over carbon pricing, nuclear energy, or large-scale renewable installations where polarized positions can stall progress. By revealing subtler differences of opinion and highlighting underlying points of agreement, Q studies provide a more nuanced map of the stakeholder landscape, which decision-makers can use to design more strategic and inclusive policies.

Q Methodology

To understand how diverse stakeholders in North Carolina prioritize energy and climate resilience strategies, this study uses Q methodology, described best previously a research technique designed to systematically capture subjective viewpoints and reveal shared patterns in attitudes or values (Brown, 1980; Parkins, 2022). Figure 2 outlines the steps that were used for this study, which are documented in more detail.

Participants complete a Q-sort, where they rank a set of statements along a forced quasi-normal distribution grid, from "most agree" to "most disagree." Each participant's sort is then analyzed via factor analysis to reveal clusters of similar sorting patterns, referred to as factors, which represent distinct viewpoints within the population (Watts &

Stenner, 2012). Q methodology does not aim to generalize findings to an entire population through large samples but instead seeks to identify and describe the range of discursive positions that exist on a given issue (Dryzek & Berejikian, 1993). This approach is ideal for complex governance problems, where success depends not only on technical feasibility but also on stakeholder perceptions and engagement (Djenontin & Meadow, 2018; Carley & Konisky, 2020).

Figure 2: Q Methodology Research Process Flow

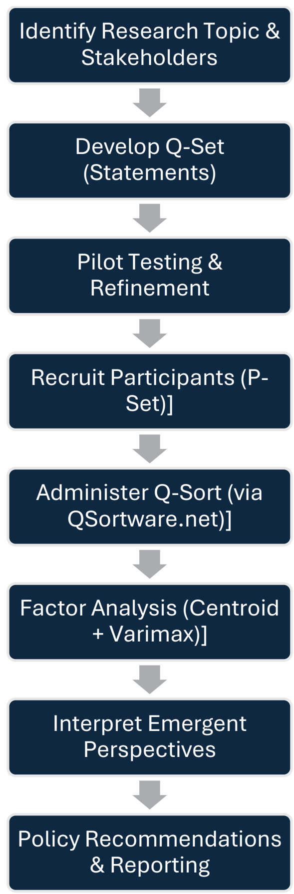


Figure 2. Q methodology research design used to explore energy and climate resilience perspectives in North Carolina. Adapted from Watts & Stenner (2012).

This study uses Q methodology to explore how stakeholders in North Carolina across local governments, state agencies, utilities, advocacy groups, and academic institutions understand and prioritize energy resilience. The approach provides insight into the values that guide their decision-making, from technical preferences to social justice concerns, and reveals areas of consensus and tension. By surfacing these perspectives, the analysis can help design policies that are better aligned with stakeholder priorities, increasing the likelihood of support and effectiveness.

I. Q-Set Development and Themes

The success of Q methodology depends on the development of a robust Q-set, which refers to the statements participant's sort. This study's Q-set comprises 50 carefully curated statements drawn from academic literature, government and NGO reports, transcripts from energy resilience planning meetings (including 2025 Clean Tech Summit panels), policy briefs, and public commentary. The selection process was primarily informed by guidance from Brown (1980), Watts and Stenner (2012), and Parkins (2022), which emphasize the need for a concourse that reflects the full range of relevant discourses on the topic. To ensure comprehensive coverage, the list of 50 statements (*Appendix A*) were organized into eight thematic categories, each representing a major area of debate or interest in energy and climate resilience policy. Table 1 outlines the number of statements that correspond to each theme,

Table 1: Thematic Clusters of Q-Set Statements

Theme	Statement Numbers	Key Focus Area
Governance & Policy	1-9	Role of state vs. local government, mandates, regulation
Economic Trade-offs	10-15	Affordability, jobs, ratepayer fairness
Private Sector & Market Solutions	16-21	Innovation, competition
Community Engagement & Equity	22-31	Participation, marginalized voices, trust
Technical Infrastructure	32-35	Energy sources, reliability, efficiency
Climate Risk & Perception	36-40	Urgency, skepticism, communication
Sociopolitical Dynamics	41-45	Ideology, public opinion, activism
Implementation & Strategy	46-50	Multi-sector planning, enforcement, hybrid energy mixes

1. Governance and Policy Approaches

This theme includes statements addressing which levels of government (local, state, federal) should lead resilience planning, whether mandates or voluntary frameworks are appropriate, and how authorities should be distributed. These questions have emerged in U.S. adaptation policy, where the balance between top-down mandates and local autonomy is often contested (Siders, 2019). For example, one statement in the Q-set claims that "climate resilience planning should be mandatory for all municipalities," reflecting debates about uniformity versus flexibility. Other expresses concern that "local communities should have the final say," referencing literature on decentralization and community-driven adaptation (Meerow et al., 2019; Djenontin & Meadow, 2018).

2. Costs, Incentives, and Economic Trade-Offs

These statements focus on who should bear the financial burden of resilience upgrades and clean energy transitions. Prior research shows that affordability concerns often shape public and political support for climate policy, particularly in rural or low-income areas (Carley & Konisky, 2020). Sample statements include: "Raising utility rates to fund renewable energy projects is unfair to low-income households," and "Green energy projects create more job opportunities than fossil fuel industries." The inclusion of competing views allows for exploration of economic justice, job creation narratives, and cost-benefit perceptions (Tiwari et al., 2022; Riva et al., 2023).

3. Private Sector and Market-Based Solutions

This theme captures attitudes toward the role of corporations, utility companies, and market mechanisms in driving resilience. For example, one statement claims, "Tech companies have the best tools to drive climate resilience," while another critiques monopolistic structures: "Utility monopolies hinder market innovation." These reflect tensions in energy governance between public responsibility and private innovation (Hamborg et al., 2020; Burke & Stephens, 2018). Prior Q studies have shown that stakeholders often diverge on whether market forces can deliver equitable, reliable outcomes in climate planning (Parkins, 2022).

4. Community Engagement and Equity

One of the most widely discussed themes in the literature is whether climate resilience policies serve all populations equitably (Matin et al., 2018; Meerow et al., 2019). Statements under this theme address racial, geographic, and economic equity, e.g., "We need targeted programs to ensure that minority communities are not left behind in the clean energy transition," and "Urban areas are getting too much funding compared to rural regions." These also probe whether communities trust that their voices are heard, and whether resilience planning is transparent and participatory (Djenontin & Meadow, 2018; Carley & Konisky, 2020).

5. Technical and Infrastructural Solutions

Statements in this category reflect views on the role of specific technologies or engineering strategies for improving resilience. These include traditional energy sources (e.g., "Nuclear power is a reliable, low-carbon source"), emerging solutions (e.g., "Offshore wind is promising for energy resilience"), and debates over energy reliability during storms (e.g., solar intermittency). Tiwari et al. (2022) argue for a services-based approach, where the ultimate goal is maintaining end-user needs, not simply energy production. Including these views allows the Q analysis to reveal preferences around energy system design and modernization.

6. Perceptions of Risk and Urgency

This theme gauges how participants perceive the severity and immediacy of climate threats, a key variable in climate behavior and support for adaptation (Siders, 2019). Statements range from urgent warnings (e.g., “Hurricane Helene proves the need for robust resilience”) to skeptical positions (e.g., “Overemphasizing climate threats creates panic”). Studies have found that stakeholders’ sense of risk influences their policy preferences and tolerance for regulatory intervention (IPCC, 2022; Davidson, 2010).

7. Sociopolitical Context

These statements probe how political identity, trust, and ideology shape attitudes toward resilience. For example: “Climate resilience cannot succeed unless it is separated from partisan agendas,” or “Environmental activism is out of touch with ordinary citizens.” These statements draw on research showing that resilience efforts often become politicized, and that cultural values may determine acceptance or resistance to certain solutions (Sovacool, 2019; Matin et al., 2018).

8. Implementation and Strategy

Finally, statements in this theme address how resilience strategies should be implemented: who should lead, what tools should be used, and how outcomes should be monitored. Sample items include: “Long-term partnerships between schools, businesses, and governments will sustain resilience,” and “A statewide resilience task force would streamline decision-making.” These reflect debates over adaptive governance, institutional capacity, and long-term planning (Parkins, 2022).

Pilot Testing

To ensure clarity, relevance, and thematic balance, the Q-set was pilot-tested with two stakeholders. Feedback led to the refinement of several statements for neutrality and readability. The set was then reviewed by the UNC Energy Transition Initiative, ensuring alignment with real-world discourse and North Carolina’s unique policy environment. Following best practices (Brown, 1980; Watts & Stenner, 2012), the 50 statements were randomized and uploaded into QSortware.net, the platform used to administer the digital sorting activity. This platform enables an intuitive, user-friendly interface for remote sorting, making the Q-sort accessible to participants across geographic and institutional contexts.

II. Participant Recruitment and Q-Sort Implementation

A central strength of Q methodology is in its ability to uncover structured patterns of subjectivity across a diverse and strategically selected group of participants, which is referred to as the P-set (Brown, 1980; Watts & Stenner, 2012). The aim is not to generalize to a larger population, but rather to capture the range of existing perspectives on a given topic. This study purposefully recruited individuals representing a broad cross-section of stakeholders involved in or affected by energy and climate resilience policy in North Carolina. This included local and state government officials, utility representatives, energy professionals, planners, nonprofit leaders, academic researchers, and community advocates.

Participants were selected using purposive and snowball sampling techniques, with initial outreach supported by the UNC Energy Transition Initiative (ETI). ETI's statewide network facilitated access to individuals with experience and institutional knowledge in resilience planning and clean energy transitions. The participant pool was intentionally diverse in terms of geography and professional background. While Q methodology does not require large samples, it does require coverage of all relevant discourse communities (Parkins, 2022). The final sample for this study included 9 participants, a robust number for Q research that allows for multiple viewpoints to emerge through factor analysis but lower than targeted due to time constraints.

Participants were invited to complete the Q-sort digitally using QSortware.net, a secure, web-based platform designed specifically for Q methodology research. The platform was chosen for its free cost, accessibility, and ease of use, especially given the geographically distant nature of the P-set that made in-person sorting unfeasible. Each participant received a personalized link to access the sorting activity, along with a background guide explaining the purpose of the study, and instructions on how to complete the sort were embedded in the software. The consent process was integrated directly into the QSortware interface.

Participants first reviewed the full set of 50 statements (*Appendix A*) in an initial sort and categorized them into three piles agree, neutral, and disagree as a preliminary step and to practice the process of sorting. This mimicked the two-step Q-sorting process recommended in Q literature to help participants reflect before ranking (Brown, 1980; Watts & Stenner, 2012). They then placed each statement into a forced-choice distribution grid shaped like a quasi-normal curve, ranging from +4 (most agree) to −4 (most disagree). QSortware's drag-and-drop interface allowed participants to adjust their rankings as needed before submitting their final sort.

Figure 3: 9-point Q-Sort Grid Used by Participants

Rank / Score	Label Sort	# of statements
+4	Most Agree	2
+3	Strongly Agree	4
+2	Agree	6
+1	Slightly Agree	8
0	Neutral / Unsure	10
-1	Slightly Disagree	8
-2	Disagree	6
-3	Strongly Disagree	4
-4	Most Disagree	2

Figure 3. Quasi-normal distribution grid used by participants on

QSortware.net to rank 50 statements from most agree to most disagree.

One of the key advantages of using QSortware.net was that it enabled participants to sort the statements remotely and asynchronously, reducing scheduling constraints and improving accessibility for those who work primarily in other regions of the state. The platform automatically saved each participant's sort data in a format suitable for statistical analysis and simplifying data export. In addition to numerical rankings, QSortware enabled participants to leave qualitative comments explaining their reasoning for statements placed at the extremes (±4, ±3). These comments added interpretive depth to the factor analysis and can be combined with follow-up interviews.

Although initially planned, short follow-up interviews were not conducted with a subset of participants from each factor group after the sorting due to time constraints. However, future semi-structured interviews offer an opportunity to clarify ambiguities, gather feedback on the Q-sort experience, and probe additional reasoning behind participants' rankings. QSortware enabled participation across a geographically and professionally diverse P-set. The combination of using an online accessible format and methodological approach that emphasizes depth is a growing trend in Q methodology research, where web platforms are increasingly used to expand engagement without sacrificing data quality (Duenas et al., 2021).

III. Analysis and Discussion

This study used Q methodology to identify shared stakeholder perspectives on energy resilience in North Carolina. Through principal components analysis and varimax rotation in RStudio, a two-factor solution was selected as the most statistically and conceptually robust. The final two factors accounted for 62.76 percent of the total variance across Q sorts, with Factor 1 defined by six participants and Factor 2 by three. Both factors demonstrated high composite reliability, 0.96 and 0.92, respectively and low standard errors. A third factor was initially identified but excluded from the final model due to weak statistical support. It was defined by only one participant and associated with a high standard error, making it more likely to reflect an individual rather than shared viewpoint.

In the energy and climate literature, two contrasting perspectives consistently emerge that reflect the factor perspectives identified in this study. The first is a justice-oriented, policy-driven perspective emphasizing equity, government intervention, and community empowerment. The second is more technocratic, modernization-focused prioritizing technical solutions, expert management, and depoliticized planning (Basseches et al., 2022; Schulz & Siriwardane, 2015). These distinctions mirror the climate justice versus technocratic resilience frameworks widely recognized in the field (Amegavi et al., 2024).

Factor 1: Justice-Oriented Clean Energy Pragmatists

This factor aligns closely with climate justice and "just resilience" approaches. Participants strongly endorsed strict government regulation of greenhouse gases, mandates on renewables, and targeted investments in disadvantaged communities. These priorities push forward principles of fairness and inclusion in adaptation, where public policy actively prevents the marginalization of vulnerable groups (Climate-ADAPT, 2021; Schulz & Siriwardane, 2015). Renewal of state mandates and economic development through clean energy were additional priorities aligned with equity-based outcomes. Participants firmly rejected voluntary or market-only approaches, consistent with critiques of the limitations and inequities arising from unregulated systems (Amegavi et al., 2024). Given their emphases revealed through sorting, the label "Justice-Oriented Clean Energy Pragmatists" is assigned to this factor. This group combines transformative justice aims with pragmatic, policy-based tools such as mandates and public funding (Climate-ADAPT, 2021).

Factor 2: Technocratic Resilience Modernizers

This factor is described more as an "engineering resilience" or ecological modernization perspective that emphasizes data-driven, expert-led, and depoliticized approaches to resilience (Schulz & Siriwardane, 2015; Bailey et al., 2011). Participants prioritized infrastructure upgrades, federal subsidies, and energy efficiency retrofits, especially in response to severe weather. They expressed skepticism toward politically charged narratives, suggesting a preference for decisions rooted in technical analysis over moral appeals or what can be interpreted as alarmism. This aligns with critiques of conventional adaptation efforts as overly technocratic and politically detached, where efficacy often trumps justice considerations (Ameyali et al., 2024; Bailey et al., 2011). The unique label "Technocratic Resilience Modernizers" is used to capture their trust in expertise and modernization as the primary vehicles for resilience.

Areas of Consensus

Despite distinct orientations and factors that are given original names, both factors converge on several critical points. All participants supported public investment in green infrastructure, community trust-building, and long-term partnerships, which consistently reflects literature that cross-sector collaboration and collective planning are important (ICLEI, 2021; Amegavi et al., 2024). Both groups also rejected laissez-faire or voluntary-only approaches, aligning with evidence that market solutions alone are insufficient for equitable climate resilience (Amegavi et al., 2024).

Key Points of Divergence

Notable differences include attitudes toward centralized governance and power structures. For example, Factor 1 strongly endorsed a statewide resilience task force, while Factor 2 opposed the idea, which may suggest a split between justice-oriented oversight and technocratic efficiency. Similarly, Factor 1 critiqued utility monopolies as innovation barriers, whereas Factor 2 was comparatively neutral, showing divergence in how people perceive institutional authority. These differences match up with broader scholarly observations on how professional context and power dynamics influence resilience framing (Basseches et al., 2022; Bailey et al., 2011).

Stakeholder Patterns

This study's ability to analyze demographic variation was limited due to a smaller-than-expected sample size. However, initial results show that "Justice Pragmatists" tended to represent advocacy, nonprofit, or policy roles, often from central or eastern regions of North Carolina, consistent with equity-focused mindsets emerging from community-based professional environments. Technocratic Modernizers were more likely to come from engineering, utility, or technical backgrounds, reflecting an expertise-driven worldview (Amegavi et al., 2024; Schulz & Siriwardane, 2015).

Toward an Integrated Approach

These two worldview perspectives are complementary rather than mutually exclusive. Literature increasingly advocates integration, combining justice-driven principles like "no one left behind" with evidence-based infrastructure modernization and stakeholder coordination (Climate-ADAPT, 2021; ICLEI, 2021). By embracing both justice and technical expertise, North Carolina can develop resilience strategies that are efficient, equitable, and broadly supported.

Conclusion & Policy Implications

This study was designed and implemented to understand how stakeholders in North Carolina view and prioritize energy resilience in a time of growing climate risk. Motivated by the need for policies that are not only technically effective but also socially equitable, the research used Q methodology to identify shared and divergent perspectives among a diverse sample of energy, policy, and community professionals.

Through a digital structured sorting activity and principal components analysis with varimax rotation, two distinct and uniquely named factors emerged in the form of "Justice-Oriented Clean Energy Pragmatists" and "Technocratic Resilience Modernizers". Pragmatists emphasize equity, community voice, and government action, while the Technocrats prioritize technical solutions, institutional efficiency, and depoliticized planning. While their philosophies differ, both groups agree on key principles of public investment are necessary, market-based solutions alone are insufficient, and coordinated planning is critical. These findings show that resilience is not just a technical challenge but also a political and social one. The values, professions, and institutional roles of stakeholders shape how resilience is understood and pursued. Rather than treating these views as mutually exclusive, policymakers need to draw on both to design strategies that are both just and effective.

For policymakers, the results underscore the importance of designing resilience strategies that integrate both community-driven equity goals and data-driven technical planning. State and local governments may benefit from creating resilience frameworks that include both grassroots representation and expert advisory input. Policies that invest in infrastructure upgrades, while also addressing affordability and community trust, are more likely to gain broad support and be sustained over time.

This capstone project was conducted under time constraints and without monetary resources, which limited the scope and sample size. Future research can build on this study by further expanding the participant pool, incorporating more diverse sectors and regions, and integrating interviews to provide contextual insight into deliberation of statements. It would be especially valuable to see how these stakeholder perspectives shift with broader engagement or evolve in response to policy changes. Adaptations of this methodology could also be applied at more local levels to reflect unique community circumstances and governance dynamics. Additional Q studies or mixed-method approaches could further explore how these framings shape public engagement, institutional priorities, and policy implementation. As the energy transition accelerates, understanding how stakeholders define resilience and what outcomes they prioritize will be essential for building bipartisan coalitions and advancing effective energy projects in North Carolina.

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Appendix A: List of Q-Set Statements by Thematic Category

1. Governance & Policy Approaches

1. Local governments should have the primary responsibility for funding climate resilience projects in their communities.
2. State-level mandates are essential to ensure North Carolina transitions quickly to renewable energy sources.
3. Federal subsidies are crucial for the energy market and real innovation in climate resilience.
4. County-level resilience plans are more effective than statewide approaches for addressing local needs.
5. Stricter government regulations on greenhouse gas emissions are necessary to protect communities from climate impacts.
6. Climate resilience planning should be mandatory for all municipalities in North Carolina.
7. Reducing government oversight will allow free-market competition to spur better energy solutions.
8. Public investment in green infrastructure is the best way to ensure equitable climate resilience.
9. Local communities should have the final say on whether to approve new energy projects.

2. Costs & Economic Trade-Offs

10. Raising utility rates to fund renewable energy projects is unfair to low-income households.
11. Green energy projects create more job opportunities than traditional fossil fuel industries.
12. Private investors, not taxpayers, should bear the costs of large-scale renewable energy developments.
13. North Carolina's economy will grow faster if it leads the Southeast in clean energy innovation.
14. Financial incentives for homeowners to install solar panels are vital to expand energy resilience.
15. Local businesses cannot afford the high initial costs of transitioning to renewable energy.

3. Private Sector & Market Solutions

16. Tech companies have the best tools to drive climate resilience through advanced energy solutions.
17. Utility monopolies hinder market innovation for energy resilience.
18. Electric cooperatives are better equipped than investor-owned utilities to address local resilience needs.
19. Oil and gas companies can lead the transition by investing more in renewables.
20. Competition among private firms will lower the cost of clean energy technologies.
21. Mandatory corporate sustainability reporting will accelerate energy resilience efforts.

4. Community Engagement & Equity

22. Rural communities deserve more state funding to build resilient energy infrastructures.
23. Community-led energy cooperatives strengthen local resilience against climate impacts.
24. We need targeted programs to ensure that minority communities are not left behind in the clean energy transition.
25. Urban areas are getting too much attention and funding for resilience projects compared to rural regions.
26. Residents, not politicians, should set the priorities for local resilience spending.
27. Voluntary action by citizens is enough to achieve energy resilience without government mandates.
28. Renters have fewer opportunities to invest in clean energy, which undermines equitable resilience.
29. Community input is often ignored in climate resilience decision-making.
30. Energy access and affordability should be a key focus of resilience efforts.
31. Building community trust is more important than scientific data for successful resilience initiatives.

5. Technical & Infrastructural Solutions

32. Offshore wind farms are a promising option for boosting North Carolina’s energy resilience.
33. Solar energy is unreliable during hurricane seasons and can’t fully address resilience needs.
34. Nuclear power is a reliable, low-carbon energy source that enhances resilience.
35. Retrofitting existing buildings for energy efficiency is a top priority for climate resilience.

6. Risk Perception & Climate Urgency

36. Severe hurricanes, like Helene, prove the urgent need for robust energy resilience measures.
37. Overemphasizing climate threats only creates panic and hinders rational policymaking.
38. Frequent flooding events highlight the failure of current resilience strategies.
39. Climate projections are too uncertain to justify massive investments in renewable energy.
40. Public awareness campaigns on climate risks are more effective than punitive regulations.

7. Sociopolitical Context

41. Climate resilience cannot succeed unless it is separated from partisan agendas.
42. Environmental activism in North Carolina is often disconnected from the concerns of everyday citizens.
43. Rural voters oppose renewable energy mandates because they fear it will harm traditional industries.

44. Ignoring climate resilience planning will damage North Carolina’s reputation as a business-friendly state.
45. Grassroots movements are more influential than legislative action in driving climate resilience.

8. Implementation & Strategy

46. Voluntary corporate pledges on clean energy have little impact without enforcement.
47. A statewide resilience task force, representing all counties, would streamline decision-making.
48. Expanding natural gas infrastructure is a necessary bridge to a cleaner energy future.
49. Having multiple energy sources is better for resilience than relying solely on renewables.
50. Long-term partnerships between schools, businesses, and government agencies will sustain climate resilience efforts.