U.S. DEPARTMENT of ENERGY | Office of Cybersecurity, Energy Security, and Emergency Response

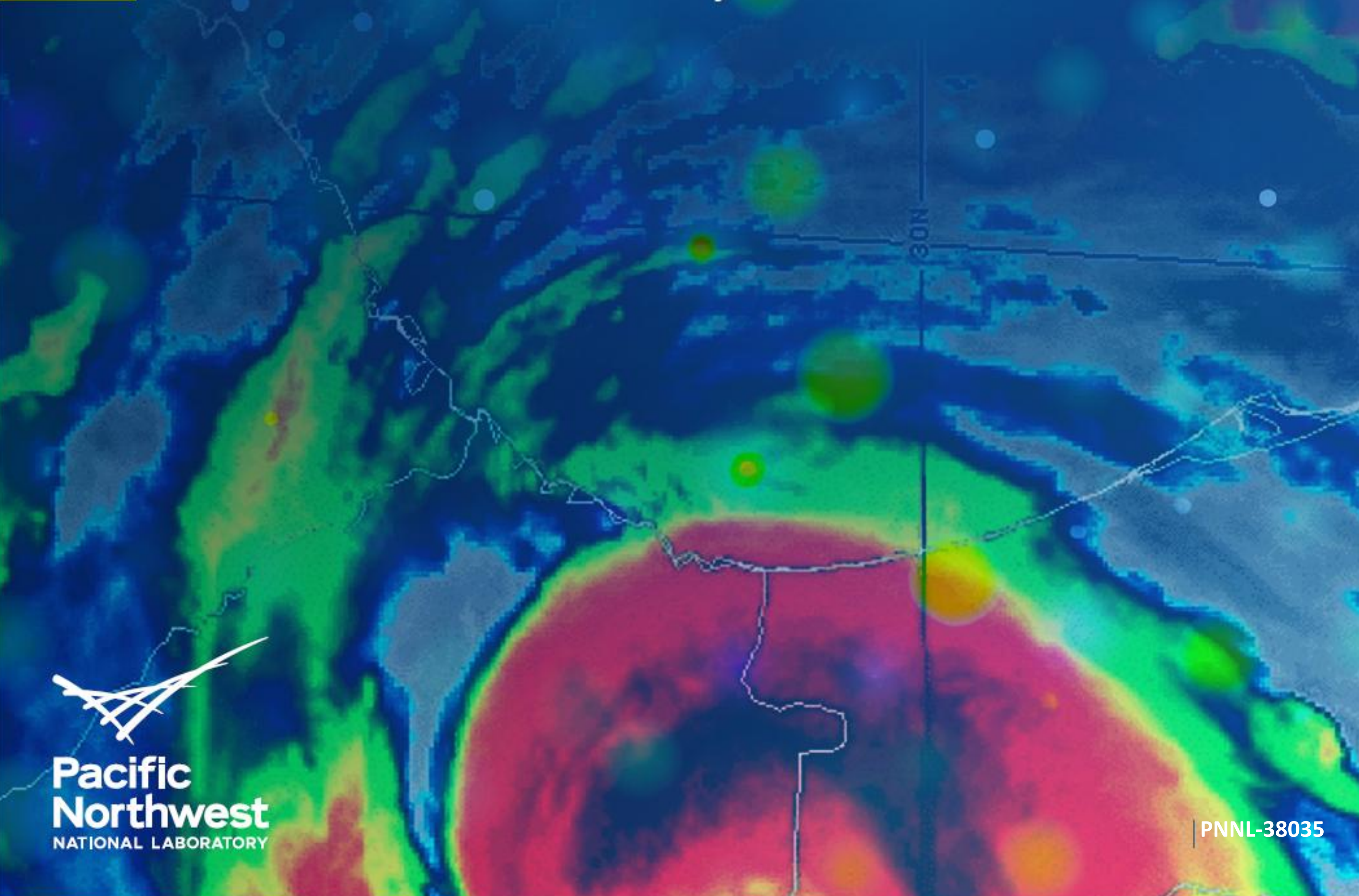
APRIL 2026

Hurricane Helene
Energy Systems Impact and Situational Insights in East Tennessee

Tennessee Department of Environment and Conservation

Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response

Pacific Northwest National Laboratory



Pacific Northwest NATIONAL LABORATORY

PNNL-38035

ACKNOWLEDGEMENTS

Many federal and state partners contributed to the development of the *Hurricane Helene Energy Systems Impact and Situational Insights in East Tennessee* report and participated in interviews, data validation, and scenario walkthroughs that shaped the final report. This work was sponsored by the U.S. Department of Energy's Office of Cybersecurity, Energy Security, and Emergency Response (CESER). We would like to acknowledge the following individuals and organizations for their contributions.

Project Sponsor: Megan Levy with U.S. Department of Energy, Office of Cybersecurity, Energy Security, and Emergency Response (DOE CESER)
Project Manager: Rebecca O'Neil and Irena Netik with Pacific Northwest National Laboratory (PNNL)
Report Writers: Jen Yoshimura, Geoffrey Whittle-Walls, and Joshua Brown with PNNL
Interview Lead: Joshua Brown and Geoffrey Whittle-Walls with PNNL

Special Recognition: Special recognition goes to Ben Bolton with Tennessee Department of Environment and Conservation (TDEC) Office of Energy Programs (OEP), who played a central role in coordinating agency engagement across state and federal entities. His early insights helped frame the vulnerability pathways explored in this assessment, and his continued collaboration ensured the technical accuracy of water-energy interdependencies presented in this report.

Special Thanks:
Thank you to Darrell Guinn, James Everett, Benjamin Heath, and Tom Zimmerman at Tennessee Valley Authority (TVA) River Forecast Center, and Will Pride with the TDEC Division of Water Resources, for walking the project team through hydrologic operations and outage management timelines. Their willingness to provide detailed operational insights and cross-reference outage patterns with reservoir levels significantly strengthened the report's analysis. The team also extends appreciation to Matt Heckard of the Tennessee Emergency Management Agency (TEMA) for his review and feedback, which provided valuable perspective on emergency management operations in Tennessee.

PURPOSE AND USE OF THIS REPORT

This report provides a situational review of the energy-related impacts and system-level dynamics observed in East Tennessee following Hurricane Helene. This report is not intended to serve as a formal After-Action Report, nor does it evaluate the performance of any specific agency or actors involved in the response. Rather, through publicly available data and limited interviews with key state government actors, the Hurricane Helene Energy System Impact Report identifies cross-sector dynamics, interdependencies, and opportunities to inform future preparedness planning for energy security for the State of Tennessee.

Intended Audience:

This report is intended for use by state and local emergency management agencies, energy providers, emergency response planners, and federal partners.

Distribution:

This report may be shared publicly but should be cited in full context. As this document draws primarily on publicly available sources and limited interviews, interpretations should be considered preliminary.

Limitations:

Findings presented herein are based on available data at the time of publication and may not reflect real-time conditions or the full operational context. Observations are system-level and do not reflect internal evaluations conducted by responding agencies.

Points of Contact:
Ben Bolton
Tennessee Department of Environment and Conservation (TDEC)
Office of Energy Programs (OEP)
ben.bolton@tn.gov

Megan Levy
Department of Energy (DOE)
Office of Cybersecurity, Energy Security, and Emergency Response (CESER)
megan.levy@hq.doe.gov

Rebecca O'Neil
Pacific Northwest National Laboratory (PNNL)
rebecca.oneil@pnnl.gov

TABLE OF CONTENTS

TABLE OF FIGURES

Acronym List

Acronym	Description
AI	Artificial Intelligence
CESER	Office of Cybersecurity, Energy Security, and Emergency Response (DOE)
COA	Course of Action
DOE	U.S. Department of Energy
DWR	Division of Water Resources (TDEC)
ETF	East Tennessee Foundation
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
INL	Idaho National Laboratory
ITDRC	Information Technology Disaster Resource Center
LNG / LPG	Liquefied Natural Gas / Liquefied Petroleum Gas
MEC	Mountain Electric Cooperative
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OEP	Office of Emergency Programs (TDEC)
ORNL	Oak Ridge National Laboratory
PNNL	Pacific Northwest National Laboratory
RFC	River Forecast Center (TVA)
SMS	Short Message Service
TDOT	Tennessee Department of Transportation
TDEC	Tennessee Department of Environment and Conservation
TECA	Tennessee Electric Cooperative Association
TEMA	Tennessee Emergency Management Agency
TNGIC	Tennessee Geographic Information Council
TNVOAD	Tennessee Voluntary Organizations Active in Disaster
TVA	Tennessee Valley Authority

EXECUTIVE SUMMARY

The response of energy systems under compound and cascading stressors is increasingly central to disaster preparedness and recovery. Hurricane Helene's inland impact on East Tennessee, though generally perceived as secondary in media and public attention to coastal damage incurred, revealed critical lessons about energy interdependencies, localized infrastructure vulnerabilities, and the thresholds at which systems fail. Though Helene made initial landfall in Florida's Big Bend as a Category 4 storm, its inland trajectory brought record rainfall and widespread disruptions across the American South, including East Tennessee. As such, this was not a high-wind-driven electric grid crisis, but rather a flood-driven cascade of interdependent system failures, particularly affecting rural communities with limited access points and infrastructural redundancy.

This situational report focuses specifically on energy system performance and interdependencies associated with Hurricane Helene's impacts across East Tennessee. It does not attempt to identify root causes, evaluate broader emergency response structures, or assess agency effectiveness. Rather, it aims to illuminate how energy disruptions intersected with other lifeline services, particularly water, transportation, and communications, and identify the infrastructural and logistical conditions that shaped those outcomes. Where possible, this report seeks to highlight both constraints and successful practices that emerged during the event.

The analysis on which this report is based draws findings from multiple data sources, including public infrastructure and disaster records, geospatial overlays of critical assets and flood zones, and a limited number of interviews with local government representatives. Due to the limitations in direct agency access during the assessment period, these findings represent a snapshot of observed system effects and community-level outcomes, not a comprehensive review of emergency response coordination efforts.

This report seeks to better understand and document the following key aspects:

- How interdependencies between power, fuel, water, and transportation systems affected emergency service continuity;
- The effectiveness of generator deployment and fuel supply logistics in sustaining critical services;
- Data gaps and coordination constraints between federal, state, and local actors; and
- The role of rural utilities and the operational differences between investor-owned utilities, electric cooperatives, and municipal systems.

Due to data access limitations and the availability of only two state-level agency interviews, the findings presented here are preliminary. However, they offer a starting point for further planning, partnership development, and resilience-building efforts across Tennessee's energy and emergency management sectors.

INTRODUCTION

The State of Tennessee carries the enduring moniker of the "Volunteer State," a title earned during the War of 1812 when an outsized number of Tennesseans volunteered to serve under General Andrew Jackson. This legacy of service continues to define the state's identity today, reflected not only in the branding of institutions like the University of Tennessee but also in the values embedded within communities across the state. Nowhere was the volunteer spirit more evident than in the days and weeks following Hurricane Helene, as communities and emergency response organizations mobilized to support one another and begin the long road to recovery.

Hurricane Helene made landfall on Florida's Gulf Coast in late September 2024 as a Category 4 storm. While much of the national focus remained on coastal devastation at the time, the storm's inland trajectory brought significant and compounding disruptions to the Southern Appalachian region. As Helene tracked through Georgia and into Western North Carolina and East Tennessee, the storm system transitioned from a wind-driven hazard to a widespread flooding event. The Appalachian Mountains running along the border of North Carolina and Tennessee and historically regarded as a natural buffer against tropical storms, instead funneled heavy precipitation into narrow valleys and low-lying corridors, overwhelming rivers, inundating infrastructure, and isolating communities.

In East Tennessee, the federally declared disaster zone included eight counties: Carter, Cocke, Greene, Hamblen, Hawkins, Johnson, Unicoi, and Washington. Together, these counties form a diverse infrastructural and geographic profile, ranging from rugged, sparsely populated highlands to growing urban centers with more robust utilities.

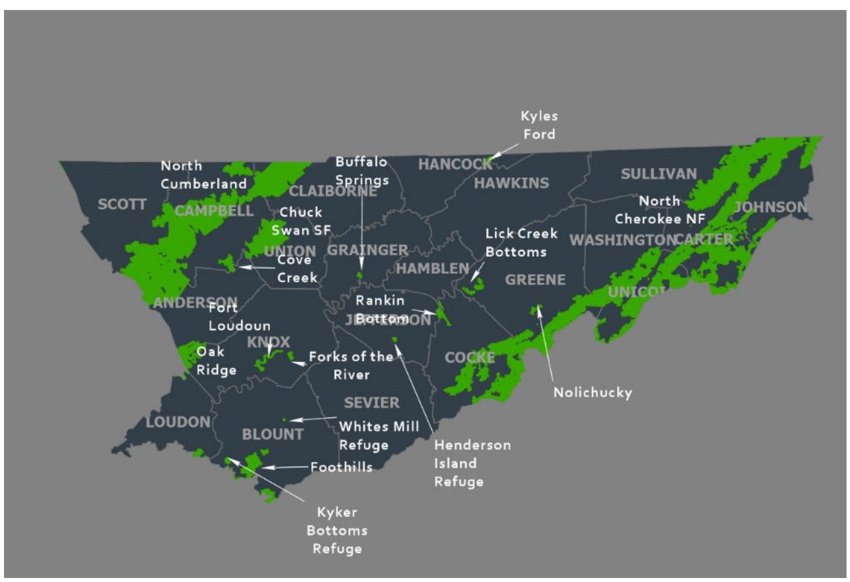


Figure 1: Geographic and Ecological Features of the Federally Declared Disaster Zone in East Tennessee

Source: Tennessee Department of Environment and Conservation, 2024

As shown in **Figure 1**, the disaster-affected counties intersect with major conservation lands and river systems. This ecological complexity, especially in mountainous counties like Johnson, Unicoi, and Carter, intensified flood impacts, disrupted access routes, and prolonged isolation for remote communities.

These areas rely heavily on decentralized infrastructure such as electric cooperatives for power, private wells for water, diesel fuel for backup generation, and single-access roads for ingress and egress. Conversely, Greene and Hawkins counties present mixed profiles, with aging infrastructure spread across both rural tracts and small urbanized nodes. Hamblen and Washington counties include the regional cities of Morristown and Johnson City, which benefit from centralized services and greater utility redundancy, though their outlying communities remain vulnerable to access and restoration delays. The rural-urban divide shaped how Helene's disruptions unfolded. In mountainous areas, service restoration was constrained by road washouts, blocked passes, and communication failures. Electric cooperative utilities serving these regions faced greater logistical burdens in accessing downed distribution lines and damaged electrical infrastructure. In contrast, cities like Morristown and Johnson City experienced faster recovery, supported by municipal utilities with a relatively greater backup capacity. Still, many residential areas outside city limits, particularly those dependent on private wells for water and propane for heating and cooking fuel, faced prolonged outages and water access disruptions. The regional patchwork of service delivery models amplified disparities, with vulnerable populations in low-density areas suffering the longest delays in recovery.

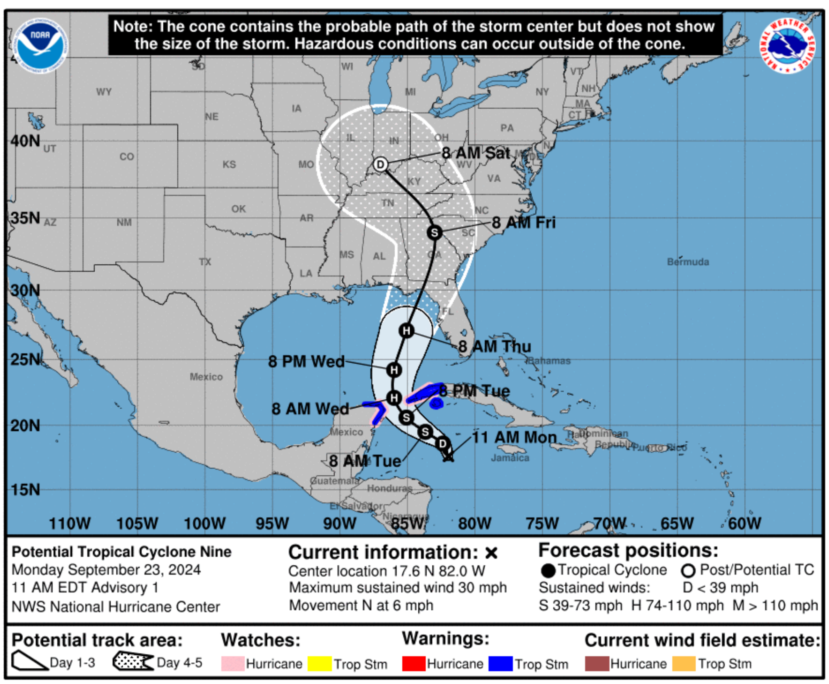


Figure 2: September 26-30, 2024, Hurricane Helene Pathway

Source: National Oceanic and Atmospheric Administration, 2024

As floodwaters rose and rainfall exceeded historical levels, infrastructure systems began to fail, not directly because of wind or structural collapse, but because the disruption of one system quickly cascaded into others, exposing the tight coupling between energy, water, and access services in vulnerable areas. At peak impact, more than 128,000 Tennesseans were without power. Backup generators, particularly in hospitals and long-term care centers, became critical lifelines, but refueling logistics were hampered by submerged roadways and degraded coordination. The interdependence between power, water, and fuel emerged as the defining vulnerability. With well pumps offline and water treatment systems overwhelmed, clean water access became one of the most urgent and persistent challenges across the region. The failure of a single system often triggered additional service breakdowns, which in turn compounded risks for emergency response and public health.

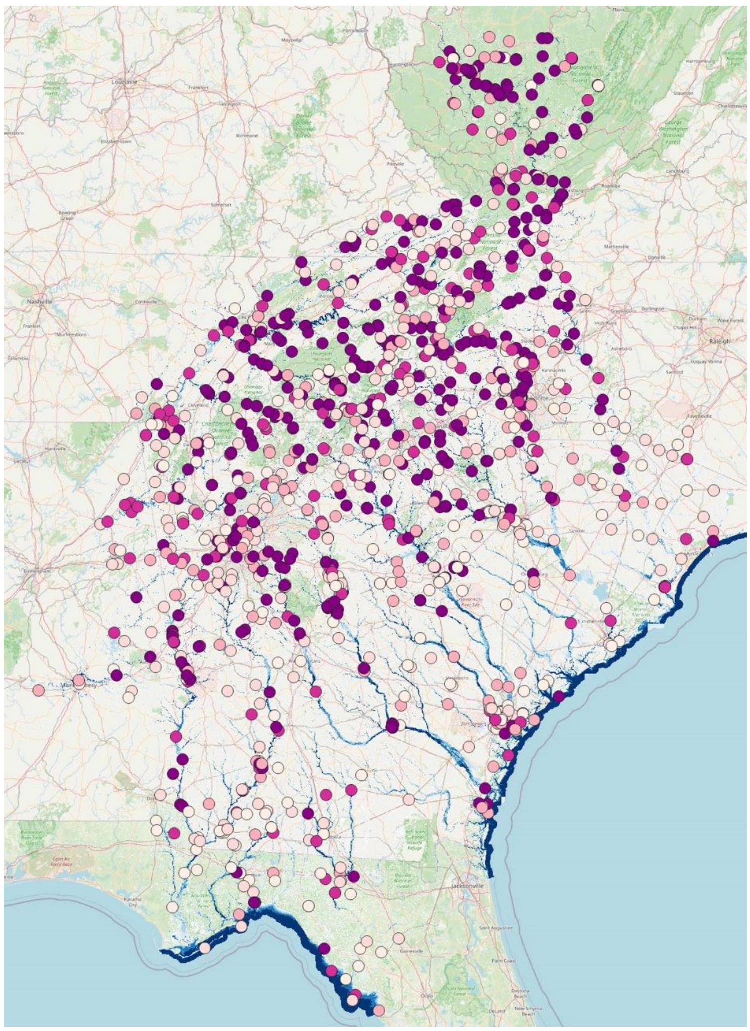


Figure 3: Critical Infrastructure System Assets that Experienced 4' or Greater Flood Depth due to Flooding Caused by Hurricane Helene

Source: PNNL

Formal response efforts began on September 30th, when the State of Tennessee activated its Emergency Management Plan. A federal-level Major Disaster Declaration followed shortly thereafter, making the state eligible to request Individual and Public Assistance. Emergency power deployments, transitional housing support, and debris removal operations subsequently began in the following weeks. However, the breadth of the storm's inland footprint, coupled with limited redundancy across rural infrastructure, created uneven restoration timelines.

By late December, over $24.4 million in disaster assistance had been distributed through a combination of federal, state, and partner-supported programs; in early 2025, an additional $9.6 million was allocated to the Tennessee Department of Transportation for large-scale debris clearance. In late January 2025, the Tennessee General Assembly convened a special legislative session and approved a bipartisan disaster relief package totaling more than $210 million designed to ease recovery burdens for local governments and residents. This included a $110 million Hurricane Helene Interest Payment Fund, $100 million in a new Governor's Response and Recovery Fund, and property tax relief provisions for affected homeowners[a]. These timelines underscore both the scale of the event and the systemic fragilities it exposed.

While TEMA was on the ground locally and the larger formal responses were still mobilizing, much of the initial relief came from local communities within the state itself, true to Tennessee's longstanding identity as the "Volunteer State." Local nonprofits, volunteer organizations, and mutual aid groups responded swiftly, filling operational gaps left by logistical barriers and delayed external support. These community-led responses were not merely supplemental, they were essential. In many areas, they were the first to deliver aid, provide wellness checks, and help restore a sense of stability and trust within affected neighborhoods.

As energy systems become increasingly interdependent with water, communications, transportation, and health services, planning for resilience must account for the full spectrum of rural and urban vulnerabilities. Hurricane Helene did not produce a catastrophic grid failure; instead, it revealed the critical points where aging infrastructure, logistical constraints, and limited service redundancies intersect with shifting climate patterns.

The lessons learned from East Tennessee are not just local: they are regional signals for how preparedness, investment, and system design must evolve to meet a new era of compound threats.

[a] "Tennessee Lawmakers Approve Helene Disaster Aid Package," January 30, 2025. https://tennesseelookout.com/2025/01/30/tennessee-lawmakers-approve-helene-disaster-aid-package. Accessed August 6, 2025.

OBSERVED SYSTEM DYNAMICS

The following observations are drawn from a structured assessment of energy-related impacts during Hurricane Helene in East Tennessee. They are not evaluations of agency performance but are instead system-level insights intended to inform future planning, coordination, and investment decisions across the energy and emergency response sectors.

The purpose of these observations is to identify specific pressure points where operational delays, logistical bottlenecks, or coordination challenges seemed to have emerged. They reflect conditions that disrupted or constrained energy system performance, directly or through critical interdependencies with transportation, water, fuel, and communications networks.

These insights were developed using a layered methodology that included public documentation research, geospatial mapping of critical infrastructure, and direct input from utility and water sector professionals. While the analysis was limited by the availability of formal after-action data, the triangulation of sources enabled the identification of consistent, observational patterns relevant to resilience planning.

These observations are summarized in the table below, which presents each by reference number, title, and a brief synopsis of the core issue. This table provides a structured overview of the energy-related challenges and system dynamics examined in the pages that follow.

Table 1: Key Observations and Situational Synopses

Observation	Title	Situational Synopsis
OBS-1	**Energy Infrastructure**	*Hurricane Helene resulted in widespread power outages across East Tennessee, particularly in rural areas where storm-related damage and access constraints influenced restoration timelines.*
OBS-2	**Critical Facilities and Backup Systems**	*Backup power systems played a key role in supporting critical infrastructure during the storm. Availability and use varied by location, with rural facilities in particular adapting to generator operational needs based on staffing and fuel access.*
OBS-3	**Propane Supply Chains**	*Propane served as a vital energy source in rural communities and distribution timelines were influenced by transportation conditions and demand surges.*

Observation	Title	Situational Synopsis
OBS-4	**Energy System Interdependencies**	*The event illustrated how electricity, water systems, communications systems, fuel supply, and transportation are closely connected.*
OBS-5	**Interdependent Coordination Systems and Emergency Response**	*Coordination between state, federal, and local partners played an important role in response operations. Field observations reflected how varying levels of connectivity and communication shaped the timing and alignment of interagency activities.*

The observations that follow are not meant to convey conclusive findings but rather represent working insights. They are offered to help decision-makers and energy stakeholders across Tennessee anticipate future stress scenarios, adapt response protocols, and strengthen the resilience of the interconnected systems that communities rely on most.

OBS-1: Energy Infrastructure

Tennessee's electrical infrastructure is anchored by a diverse generation portfolio and a highly decentralized utility distribution model. Tennessee's primary electrical provider, the Tennessee Valley Authority (TVA), operates as a public power company and sells electricity from a number of generation assets to 153 local power companies for distribution. As of March 2025, the state generated electricity through a balanced mix of sources: nuclear power contributed the largest share at 33.1%, followed by natural gas (25.5%), coal (24.7%), and renewables (16.5%). Petroleum-fired generation remained negligible at 0.2%, slightly below the national average (0.3%). While delivering nearly 60% carbon-free electricity, this generation portfolio reflects a state-level divergence from national trends in Tennessee's heavier reliance on nuclear and coal, and comparatively lower use of natural gas and renewables (see **Figure 4**).

Utility-Scale Net Electricity Generation (share of total)	Tennessee	U.S. Average	Difference
Petroleum-Fired	0.2%	0.4%	-0.2%
Natural Gas-Fired	23.1%	39.3%	-16.2%
Coal-Fired	29.4%	14.2%	15.2%
Nuclear	32.3%	18.1%	14.2%
Hydroelectric (pumped storage)	13.8% (-1%)	7% (-0.1%)	6.8%
Solar	1.6%	9%	-7.4%
Biomass	0.7%	1.1%	-0.4%
Other Renewables	0%	11%	-11%

Figure 4: Utility-Scale Net Electricity Generation by Source – Tennessee vs. U.S. Average, May 2025

Source: U.S. Energy Information Administration (EIA)

TVA's power production supports over three million residences and over 140,000 businesses statewide. There are over ten million customers in TVA's full service territory, which includes nearly the whole state (99.7%) and parts of six surrounding states, most significantly Mississippi and Kentucky.

Electricity distribution, by contrast, is handled by a decentralized network of 153 power companies comprised of local, municipal, and cooperative utilities (see **Figure 5**). These local utilities are collectively represented by several organizations, including the Tennessee Electric Cooperative Association (TECA) – which coordinates mutual aid and advocacy in particularly rural and disaster-vulnerable regions – and the Tennessee Valley Public Power Association (TVPPA), which represents all 153 municipal and cooperative power companies in the TVA service territory – colloquially referred to as “The Valley”.[b]

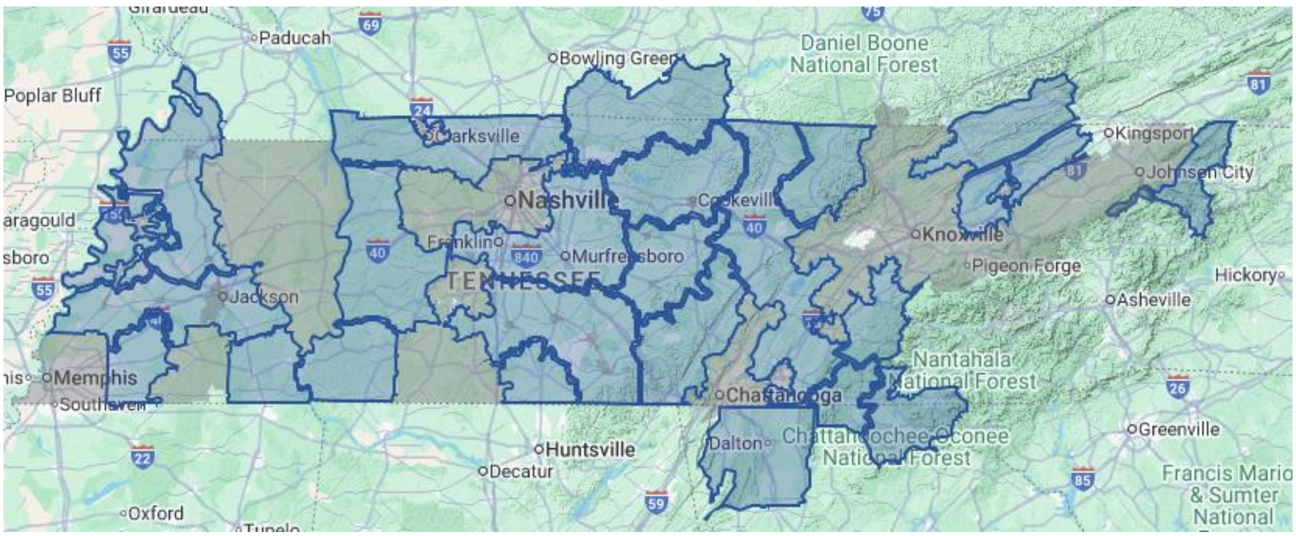


Figure 5: TECA Member Electric Utility Service Territories in Tennessee

Source: Tennessee Electric Cooperative Association

This decentralized delivery model mirrors Tennessee’s mixed rural-urban geography and offers a more localized responsiveness than more traditional large public or investor-owned utilities are able to provide. However, during large-scale disruptions such as Hurricane Helene, it can also create coordination challenges in outage reporting, resource allocation, and restoration sequencing due to the patchwork of smaller entities involved.

Regional Vulnerability to Severe Weather

Tennessee’s power infrastructure is notably sensitive to weather-related disruptions, particularly regarding the impacts associated with severe thunderstorms, flooding, and tornados. Although geographically included in FEMA Region 4, the region with the highest average annual property damage from hurricanes in the United States totaling approximately $1.2 billion, Tennessee is generally spared the immediate impacts associated with hurricanes. Instead, the state often deals with the

[b] “Co-Op Facts and Figures – Tennessee Electric Cooperative Association.” Accessed June 13, 2025. https://www.tnelectric.org/about/co-op-facts-and-figures/.

downstream impacts of tropical systems that move northward, bringing intense rainfall, flooding, high winds and storm-driven debris.

From 2008 to 2017, the leading cause of electric outages in Tennessee was weather or falling trees, disrupting service to an average of 252,400 customers each year. These outages typically peak in May, which is the state's wettest month and when tornado activity increases as cold and warm fronts collide, mirroring national patterns of seasonal storm vulnerability.

In 2018, the average Tennessee customer experienced 1.8 interruptions, each lasting approximately 3.3 hours, for a total of around 6 hours of outage time per year. This is relatively low compared to neighboring Kentucky – where average outage durations can exceed 7 to 8 hours per event – and substantially less than during major-storm years in states like South Carolina, which saw average customer outage durations jump to over 20 hours in the wake of Hurricane Matthew.

While Tennessee's typical outage durations appear moderate, their very brevity may discourage investment in backup generation, leaving both residential and commercial customers more vulnerable to the cascading impacts of rare but prolonged service disruptions across essential interconnected systems like water, telecommunications, and fuel supply.

System Performance and Recovery Trends

System-wide power performance during Hurricane Helene reflected the expected resilience of Tennessee's centralized generation and transmission infrastructure. However, it also revealed uneven conditions at the distribution level, particularly in the state's easternmost regions, the East division. While no catastrophic failures were reported across bulk power systems, outage patterns and recovery timelines demonstrate how localized constraints can shape the public's experience of power stability in the aftermath of severe weather events.

Several smaller public utilities in the rural and mountainous northeastern corner of the state had significant outages to work through, such as Mountain Electric Cooperative with 25,000 customers, Appalachian Electric Cooperative with 11,900, Holston Electric Cooperative with another 11,900, and Powell Valley Electric Cooperative with 11,200 customers without power on the September 27th peak of the impact from Helene[c].

[c] "Helene Impacts Tennessee Co-ops," September 27, 2024. https://tnelectric.org/2024/09/27/helene-impacts-tennessee-co-ops. Accessed August 6, 2025.

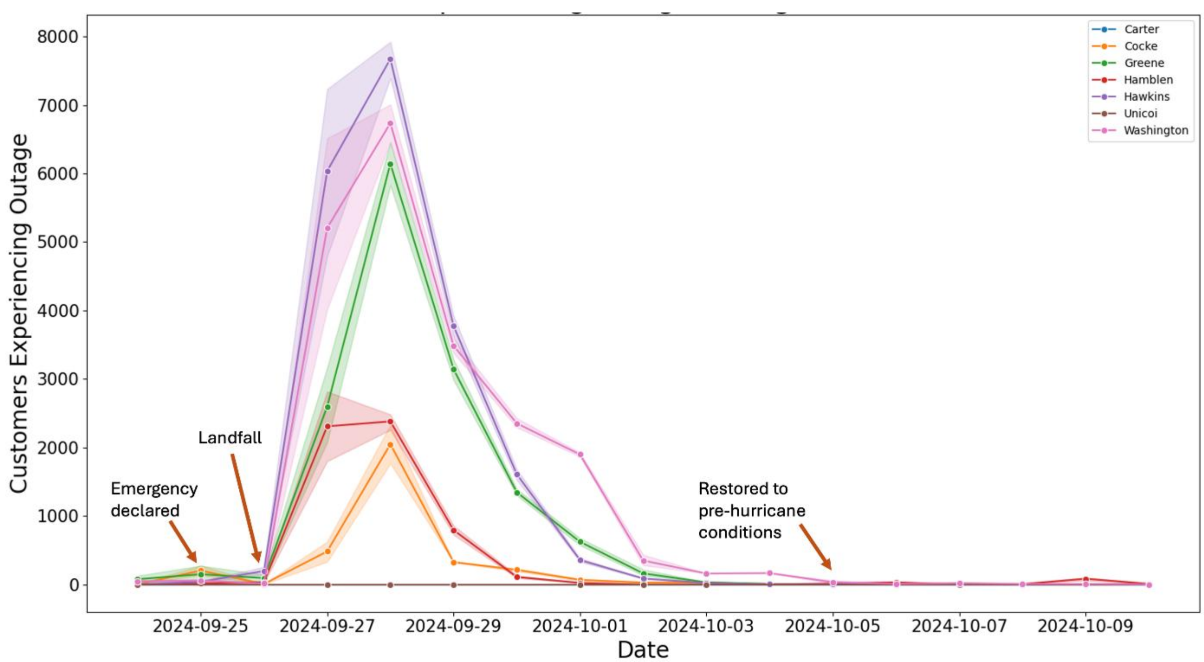


Figure 6: Outages by Number of Customers during Hurricane Helene, by Affected TN Counties

PNNL Analysis with Outage Data Sourced through Oak Ridge National Laboratory EAGLE-I

According to U.S. Department of Energy reports, Tennessee electric customer outages peaked at 105,932 on September 27th and declined to 10,628 by September 30th, suggesting a strong statewide response coordination. However, they obscure more protracted recovery trajectories in rural, mountainous areas such as the service territory of Mountain Electric Cooperative where outages persisted well into mid-October. As shown in **Figure 7,** the city of Newland (NC) reported 1,850 customers without power on October 13th, and by October 17th, only partial restoration had occurred, with 750 customers still without service. Similar patterns were observed in the Tennessee cities of Mountain City and Roan Mountain, though total outage counts were smaller.

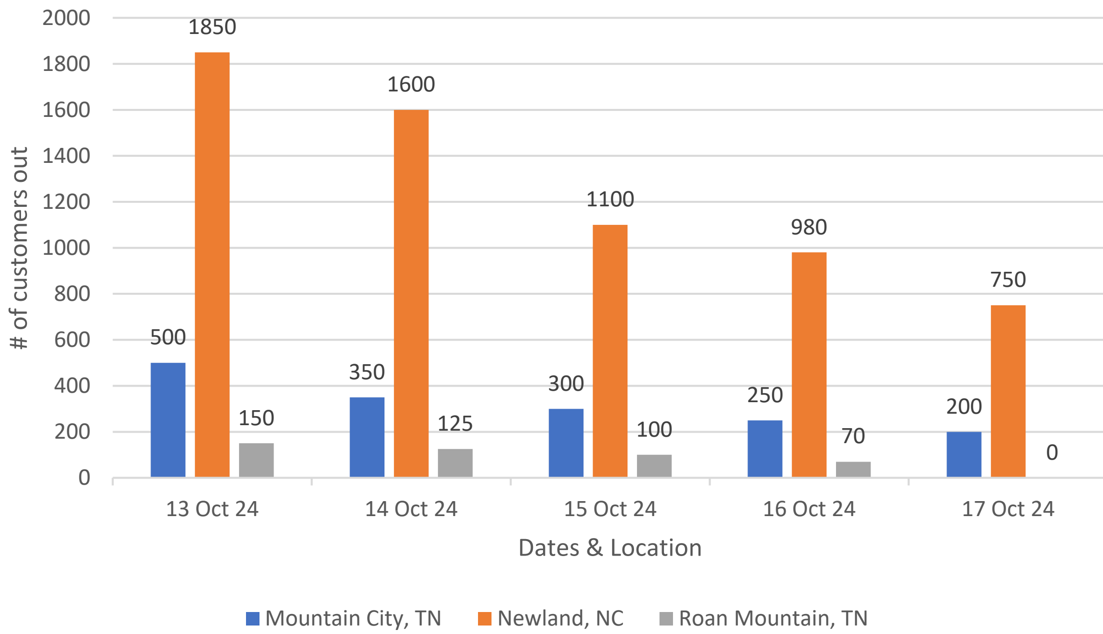


Figure 7: Mountain Electric Cooperative Outage Reports, October 13–17, 2024

Source: Mountain Electric Cooperative

These persistent outages occurred within the broader context of East Tennessee, a zone comprising 26 counties that span from small unincorporated communities to growing metro areas including Johnson City, Bristol, and Knoxville.

While the region benefits from a coordinated emergency management structure that includes both state-level support and locally led emergency management functions, Hurricane Helene highlighted how existing administrative systems cannot always compensate for underlying physical and operational vulnerabilities.

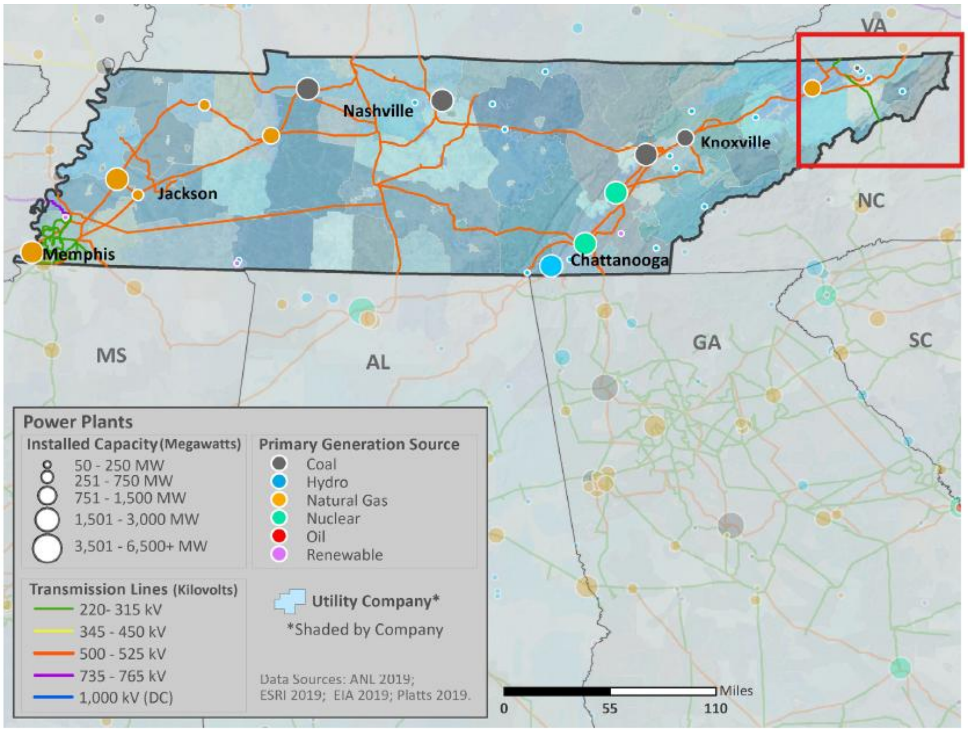


Figure 8: Tennessee Power Infrastructure by Generation Source and Transmission Capacity

Sources: ANL 2019; ESRI 2019; EIA 2019; Platts 2019

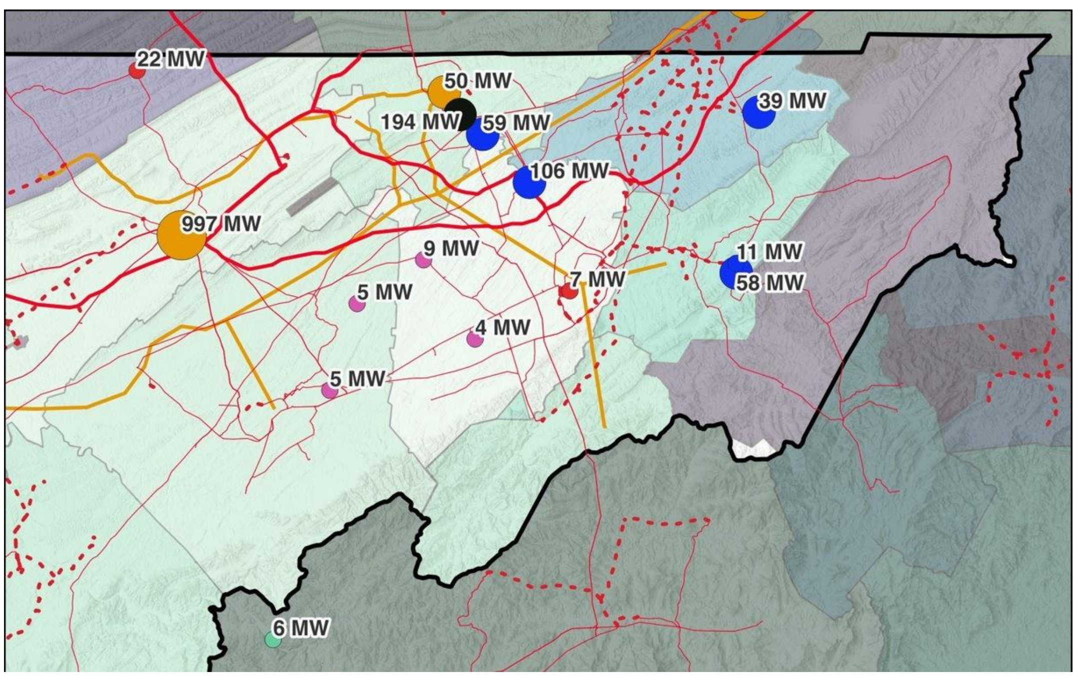


Figure 9: East Tennessee Power Infrastructure with Generation Capacity

Source: PNNL

As seen in **Figures 8 and 9** the farthest northeastern region of Tennessee, including some of the hardest-hit areas during Hurricane Helene, contains comparatively lower installed generation capacity with a number of hydropower facilities along the border with North Carolina. While this region does include some generation assets, such as the John Sevier Combined Cycle Plant (natural gas and steam) on its western edge, it lacks the large-capacity facilities found elsewhere in Tennessee. This makes the region heavily reliant on long-distance transmission and more susceptible to distribution-level outages during extreme weather.

Operational visibility varied across service providers. Several cooperatives, including Holston Electric and Powell Valley Electric, maintained real-time public dashboards throughout the event. Others, including Mountain Electric Cooperative, began with static updates to TVA and TDEC, potentially limiting early situational awareness. Roughly two weeks into the response, they started publishing daily restoration updates on their company website.

TECA mobilized over 185 line workers statewide and facilitated the deployment of additional crews to neighboring states, including Georgia, North Carolina, and South Carolina.[d] Support also came from cooperatives in Virginia, Maryland, and Delaware. Early crew placements seem to have accelerated recovery operations for higher-density or more accessible regions. However, for smaller and more remote cooperatives in East Tennessee, like Mountain Electric Cooperative, it appears that they may have faced longer waits, not due to oversight, but due simply to logistical complexity and other interdependencies.

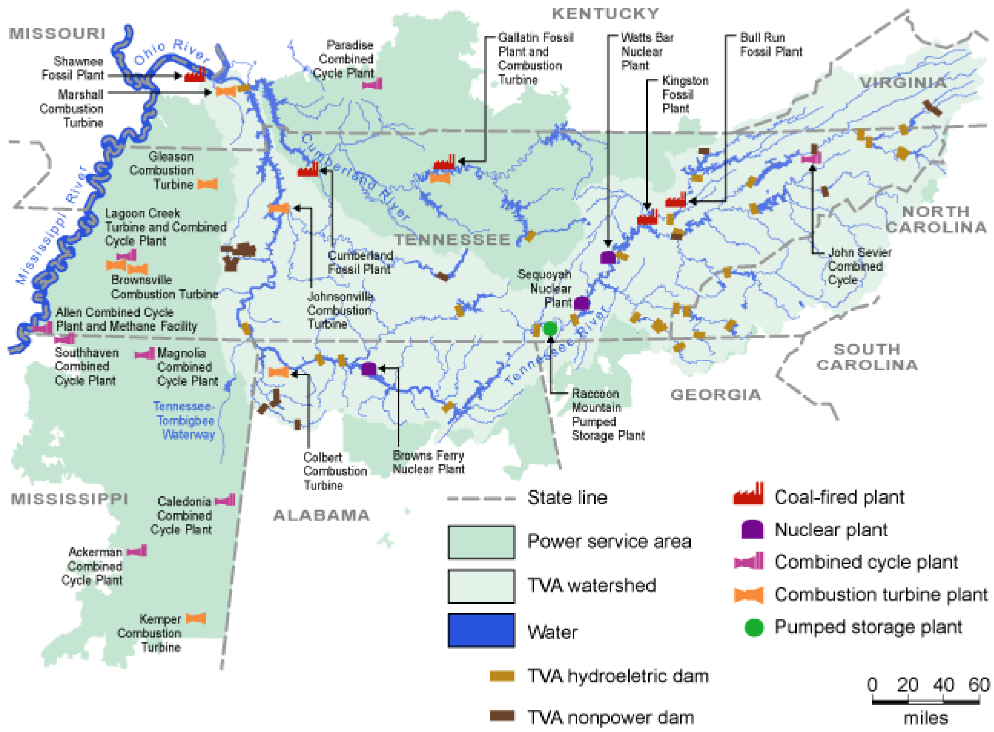
These infrastructure and coordination challenges occurred within a region already characterized by high-risk assets and hazards. East Tennessee is home to multiple nuclear energy and research facilities, as well as recurring threats including flooding, forest fires, hazardous materials transport, and seismic activity. These co-occurring risks heighten the consequences of delayed restoration and underscore the need for enhanced system redundancy, field access planning, and outage tracking capability in the region. Although no root cause analysis was available at the time of this review, the consistent alignment of outage persistence with geographic and infrastructural constraints allows for plausible inference. Helene did not introduce new risks, but rather it exposed and exponentially activated those already embedded in East Tennessee's energy system. The bulk power system, including TVA's generation and transmission network, remained largely stable and continued delivering power to local providers. However, resilience challenges were concentrated at the distribution level[e], where rugged terrain, limited operational visibility, and the fragmented structure of local utilities contributed to prolonged outages and restoration delays.

---

[d] "More than 50 People Stranded on Roof of Unicoi County Hospital," September 27, 2024. https://web.archive.org/web/20240927190701/https:/wcyb.com/news/local/patients-and-staff-stranded-on-roof-of-unicoi-county-hospital. Accessed July 29, 2025.

[e] TEMA Situation Report #1, 2024. Mission #183: Statewide Impacts from Helene. Not publicly available.

From a generation standpoint however, TVA's portfolio demonstrated resilience despite two of its nuclear facilities, Browns Ferry (AL) and Sequoyah, being offline for scheduled maintenance, the Watts Bar Nuclear Plant operated continuously at full capacity throughout the event.[f]



Source: Tennessee Valley Authority (TVA). | GAO-23-105375

Figure 10: Tennessee Valley Authority (TVA) Service Area and Key Electricity Generating Assets

Source: TVA

The primary constraints during Hurricane Helene were not due to shortfalls in electricity supply, but rather the structural challenges of restoring service in isolated, lower-capacity distribution systems, particularly in areas served by smaller and more remote utilities such as Mountain Electric Cooperative. TVA's generation and transmission systems remained stable throughout the event, with upstream reliability ensuring that power was available for distribution. TVA compensated for reduced nuclear output by ramping up hydroelectric generation, supported by increased rainfall, along with fossil fuel and natural gas resources.

[f] Micek et al., "Hurricane Helene causes over 4.7 million power outages across Southeast US".

OBS-2: Critical Facilities and Backup Systems

Critical facilities are essential structures that support public safety, emergency response, and core societal functions during and after disasters. These include shelters, emergency operations centers, public health systems, and vital utilities such as drinking water, sewer, and wastewater facilities, where continuity of service is crucial for effective disaster recovery. In Tennessee, these assets are managed during disaster response efforts through coordination among the Tennessee Emergency Management Agency (TEMA), other state agencies and local governments, with inventories ultimately maintained at the county level. Tennessee's mixed urban-rural geography presents unique challenges in protecting and resourcing these facilities, especially in rural counties where infrastructure is limited and emergency services are often volunteer-based.

To mitigate the impact of power loss at critical sites, Tennessee utilizes a tiered backup power planning model. TDEC's Office of Energy Programs (OEP) collaborates with utilities and local governments to assess energy needs and deploy emergency generation. Diesel-based generators are the most common backup systems, but they depend heavily on fuel availability and accessible transport routes, conditions often compromised during extreme weather events.

Hospitals and Medical Facilities

Across the eight counties most affected by Hurricane Helene – Carter, Cocke, Greene, Hamblen, Hawkins, Johnson, Unicoi, and Washington – hospital capacity appeared to be unevenly distributed. Carter County maintains one full-service hospital with backup generation in place, though public data on fuel redundancy or duration capacity is limited. Cocke and Greene Counties rely on regional hospitals in Newport and Greeneville, respectively, with reported but undocumented use of generator support during the storm. Hamblen County, which includes Morristown, benefits from two hospitals and higher infrastructure redundancy, serving as a support hub for surrounding rural areas. In contrast, Johnson and Unicoi Counties are served by small, critical-access hospitals with minimal backup capacity.

Water and Wastewater Systems

Water treatment and wastewater facilities throughout the region vary widely in scale and resilience. Carter and Washington Counties benefit from more robust urban infrastructure, with multiple public utilities equipped with fixed backup power. In contrast, Hawkins and Johnson Counties rely on smaller, more dispersed systems that have limited generator coverage.

In Greene County, the Greeneville Water Commission plays a critical role by supplying water to five other utilities: Cross Anchor Utility District, Glen Hills Utility District, Mosheim Utility District, North

Greene Utilities, and Old Knoxville Highway Utility District.[g] During the storm, Greeneville Water's raw water intake became inoperable and required major repairs. Temporary pumps were deployed to maintain supply to the treatment facility, but the disruption cascaded across dependent downstream systems, ultimately affecting tens of thousands of additional customers.

Emergency Operations Centers (EOCs)

EOC functionality across the region reflects county-level capacity. Carter County maintains a joint municipal EOC with known generator backup, while Cocke and Greene Counties operate county-level centers with limited public information on backup systems. Hamblen County, given its regional role, has a centralized EOC with confirmed power redundancy. Smaller counties such as Johnson and Hawkins share coordination responsibilities with neighboring jurisdictions and depend on intermittent generator support.

Dams and Flood Control Infrastructure

TVA operates 29 hydroelectric dams across the Tennessee River watershed, along with another 17 for flood control and/or recreational purposes. While the hydroelectric dams' primary purpose is power generation, they all also serve as critical components of Tennessee's flood mitigation strategy. Their strategic placement in East Tennessee takes advantage of the steeper terrain for hydrologic flow increases while also enabling large-scale water management during extreme precipitation events.

Figure 11: TVA Dam Infrastructure Across the Tennessee River Watershed

Source: TVA

Impact of Hurricane Helene

Hurricane Helene's inland surge brought historic flooding to East Tennessee's mountainous terrain, placing immense stress on critical infrastructure systems. The most consequential impacts emerged

---

[g] "Boil Advisory Lifted For Greeneville Water And Greene County Utilities," October 15, 2024. https://wgrv.com/2024/10/15/boil-advisory-lifted-for-greeneville-water-and-greene-county-utilities/. Accessed August 6, 2025.

from intense and sustained rainfall across the Nolichucky, French Broad, and Pigeon Rivers. These waterways, which pass through narrow valleys and population centers, experienced rapid and extreme rises in water levels, overwhelming communities and infrastructure alike. In locations where TVA-operated dams were present, these structures served as frontline assets, absorbing stormwater inflows, regulating river flow, and mitigating flood damage.

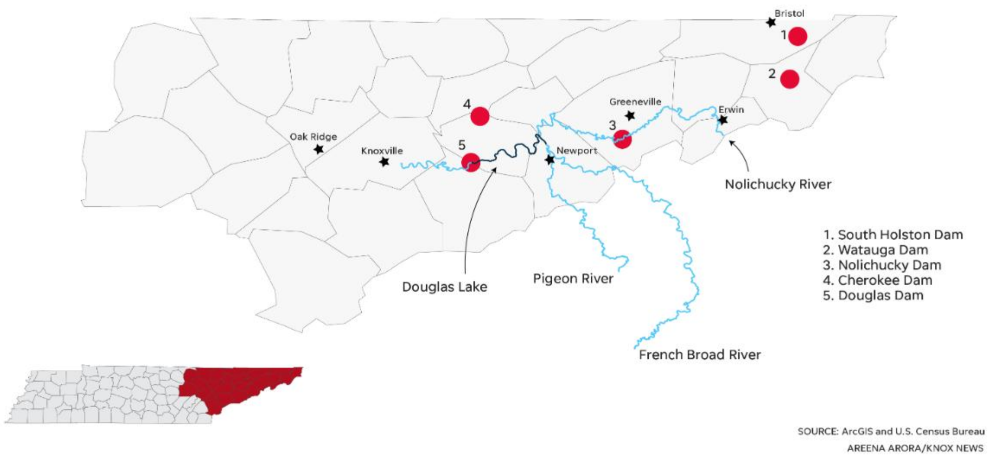


Figure 12: Key East Tennessee Rivers and Dams Affected by Hurricane Helene Flooding

Sources: ArcGIS and U.S. Census Bureau (via Knox News)

Five major dams – South Holston, Watauga, Nolichucky (non-power), Cherokee, and Douglas – were directly impacted by floodwaters. These facilities span counties including Sullivan, Washington, Greene, Jefferson, and Cocke, with downstream effects reaching into Knox County. TVA estimated that operations at Nolichucky Dam alone prevented over $400 million in downstream damages by processing more than 400 billion gallons of stormwater. At the height of flooding, the dam withstood flows reaching 1.3 million gallons per second, which is nearly twice the volume of Niagara Falls.

However, the event also exposed operational stress points. On September 28th, TVA issued a "Condition Red" alert due to elevated flood levels and structural concerns at the Nolichucky Dam, prompting precautionary evacuations in Greene County. Although the dam ultimately held, its performance under extreme conditions underscored the critical role of hydrologic infrastructure in disaster containment.

Outside these regulated systems, flood impacts were more severe. Long stretches of the Nolichucky and French Broad Rivers without upstream dam control experienced extensive damage. Smaller dams and culverts failed, and numerous bridges and roads were washed out, which disrupted access and prolonged emergency response times. According to TDEC, concentrated damage occurred along unregulated waterways and smaller tributaries, particularly in Greene, Unicoi, and Cocke counties. In

January 2025, TEMA published a progress update on waterway restoration, noting significant debris cleanup in these waterways.[h]

The storm's cascading effects extended to healthcare and utility systems. In Unicoi County, floodwaters forced the rooftop evacuation of fifty-four individuals from the hospital after sustained power loss, and a nearby medical facility in Erwin was destroyed. Ballad Health deployed a mobile medical unit at Unicoi County High School;[i] however, at the time of writing, no formal documentation could be located regarding its operational duration or capacity. Similar disruptions occurred across other impacted counties, where hospitals, emergency operations centers, and water treatment plants were heavily dependent on diesel-powered backup generators.

Fuel supply chains were disrupted by landslides and road closures, particularly along Interstate 40, delaying critical deliveries to backup power systems. While TDEC OEP coordinated emergency fuel shipments with TEMA and private-sector partners, facility-level details were not made public.

Efforts to deploy portable generators also faced significant barriers. Although more than 100 units were available during the early response, stakeholder input indicated that distribution was, in some cases, influenced by concerns that residents may not have had the knowledge to safely install and operate the generators, which could limit their effective use.

These challenges were compounded by regional competition for resources, as neighboring states like North Carolina and South Carolina were also managing significant impacts from the same storm system. Widespread demand across the southeastern U.S. further strained availability of critical emergency assets.

Restoration timelines varied significantly. Knoxville and surrounding metro areas saw electricity return within 7 to 10 days. In contrast, more rural and heavily affected counties like Carter, Johnson, and Unicoi faced prolonged outages, compounding the challenges faced by critical facilities[j]. Restoration efforts were carried out by local power companies in accordance with their own operational protocols and system conditions, resulting in variation in prioritization and restoration timelines across service territories.

Overall, Hurricane Helene underscored that Tennessee's dam infrastructure is not secondary but foundational. Performance gaps during the event were not limited to diesel fuel access or generator placement, as they also reflected the burden placed on stressed hydroelectric assets amidst compounding storms. At Douglas Reservoir, TVA led debris removal operations following the storm. In addition, TVA also received a FEMA Mission Assignment to support TDEC's debris management efforts,

---

[h] "Efforts to Remove Debris from Tennessee Waterways Underway." Accessed March 30, 2026. https://www.tn.gov/tema/news/2025/1/9/efforts-to-remove-debris-from-tennessee-waterways-underway.html

[i] "Medical Response Tent Opens in Erwin | Ballad Health." Accessed June 13, 2025. https://www.balladhealth.org/news/medical-response-tent-erwin.

[jj] "More than 50 People Stranded on Roof of Unicoi County Hospital," September 27, 2024. https://web.archive.org/web/20240927190701/https:/wcyb.com/news/local/patients-and-staff-stranded-on-roof-of-unicoi-county-hospital.

aligning federal support with TVA's existing operational responsibilities and regional presence. TVA deployed a one-mile-wide floating boom to intercept a massive debris field and removed thousands of cubic yards across complex shoreline terrain. The debris cleanup, coordinated with TEMA, FEMA, TDEC, EPA, USACE, and other agencies, illustrated how TVA's institutional capacity enabled it to serve as both infrastructure guardian and emergency response leader[k,l,m]. These timelines underscore both the scale of the event and the systemic fragilities it exposed.

[k] "Joint Efforts Underway to Remove Debris for Douglas Lake Following Tropical Storm Helene," November 7, 2024. https://www.tn.gov/tema/news/2024/11/7/joint-efforts-underway-to-remove-debris-for-douglas-lake-following-tropical-storm-helene.html. Accessed August 6, 2025.

[l] "Douglas Lake Waterway Debris Removal Fact Sheet," November 15, 2024. https://www.tn.gov/content/dam/tn/tema/documents/disasters/hurricane-helene/20241115_factsheet_douglas_debris.pdf. Accessed August 6, 2025.

[m] "Team Up to Clean Up," February 19, 2025. https://www.tva.com/the-powerhouse/stories/team-up-to-clean-up. Accessed August 6, 2025.

OBS-3: PROPANE SUPPLY CHAINS

Propane in the United States is primarily produced as a byproduct of natural gas processing and petroleum refining, with the majority of production and storage concentrated in major hubs like Mont Belvieu, Texas, and Conway, Kansas[n] with Tennessee playing a comparatively minor role in this national infrastructure network. Tennessee does not host any major natural gas processing plants or large-scale propane storage caverns, due in part to the absence of suitable geologic formations such as salt domes or bedded salt deposits. This infrastructure gap is visible in the map of wholesale hydrocarbon gas liquids (HGL) storage facilities shown in **Figure 5**, which highlights the clustering of major storage sites (> 5 million barrels) in Texas and Kansas and the absence of any large-capacity facilities in Tennessee or its neighboring states.

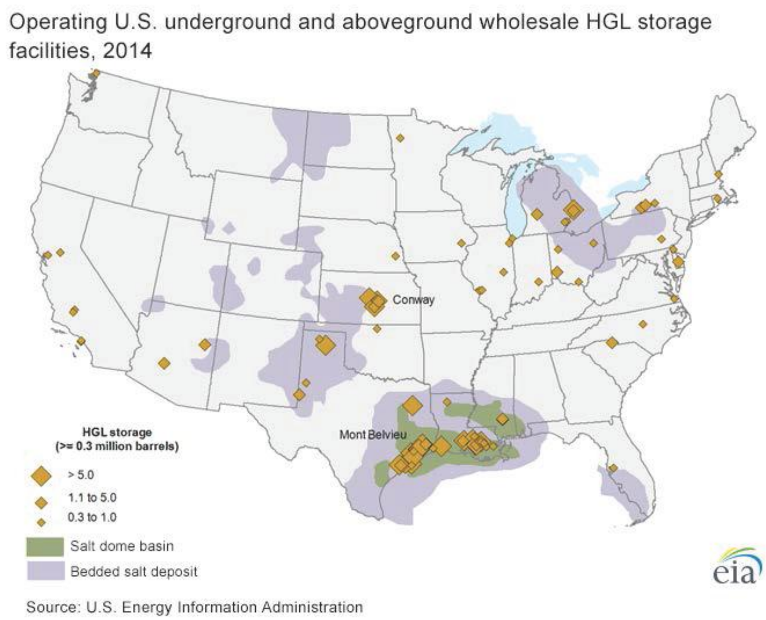
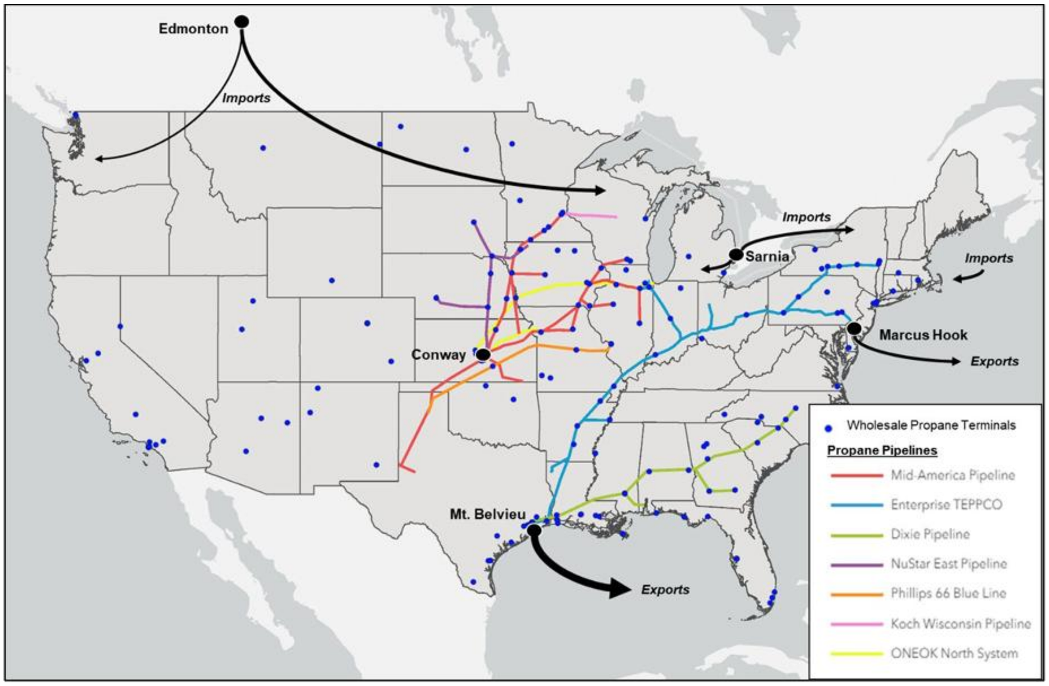


Figure 13: Geographic Distribution of Wholesale Hydrocarbon Gas Liquids

Source: EIA

Tennessee is connected to the national propane distribution network via the Enterprise TEPPCO pipeline, a major trunkline transporting propane from Gulf Coast production hubs through multiple Southeastern and Midwestern states.[o] This infrastructure supports several wholesale propane terminals across Tennessee, particularly in the eastern and central regions, as shown in **Figure 13**. Although the Dixie Pipeline serves Southeastern markets such as Georgia and the Carolinas, it does not supply Tennessee directly.

[n] eia.gov, 2023: https://www.eia.gov/energyexplained/hydrocarbon-gas-liquids/transporting-and-storing-hydrocarbon-gas-liquids.php
[o] Enterprise Products, 2025: https://enterpriseproducts.com/customers/natural-gas-liquids/#Texas/Southwest



Source: DOE analysis of EIA data

Figure 14: U.S. Propane Pipeline Infrastructure and Wholesale Propane Terminals

Sources: DOE and EIA[p]

As shown in **Figure 14**, Tennessee does not host pipeline infrastructure and is limited to one major terminal in Memphis. Tennessee's dependence on out-of-state propane supply becomes particularly critical during winter months, when cold weather and increased demand can strain interstate delivery systems. Propane plays a vital role in the state's energy mix, especially in rural and off-grid areas, serving as a primary fuel source for home heating, cooking, water heating, agricultural operations, commercial uses, and backup power.

Propane safety in Tennessee is governed by a combination of national and state-level regulations. At the federal level, National Fire Protection Association (NFPA) 58 and U.S. Department of Transportation regulations under 49 CFR establish safety standards for storage, transport, and handling. Within Tennessee, the Department of Agriculture regulates weights and measures for propane sales and delivery systems. Strategic energy planning and emergency fuel coordination, including propane, are led by TDEC OEP as the lead agency for Emergency Support Function 12 for Energy. During declared emergencies, OEP works in close coordination with TEMA and federal partners such as TVA and DOE CESER, which provide situational awareness and technical assistance. OEP's ongoing participation in the U.S. Energy Information Administration's (EIA) State Heating Oil and Propane Program (SHOPP) has also helped build strong relationships with propane distributors, which proved to be critical connections during the response to Hurricane Helene.

[p] U.S. Department of Energy, Office of Cybersecurity, Energy Security, and Emergency Response, "How It Works: Propane Supply Chain." https://www.energy.gov/sites/default/files/2023-08/Propane%20Supply%20Chain%20Backgrounder_v3-Formatted_041723_508.pdf

One such mechanism available during extreme fuel shortages is the state's Fuel Set-Aside Program, authorized under Tennessee Code § 4-3-513. This program allows the governor to reserve limited volumes of petroleum products, including propane, for prioritized use by emergency services, utilities, and agricultural operations.[q]

Geographic Distribution & System Characteristics

Tennessee's propane distribution system reflects the state's geographic diversity, with demand patterns, infrastructure presence, and supply chain vulnerabilities differing markedly between urban and rural regions. Propane use is most prominent in rural counties, particularly in East and Middle Tennessee, where electric or natural gas infrastructure is either absent or cost-prohibitive for low-density residential and agricultural users.

Propane currently serves as a primary or supplemental fuel for tens of thousands of Tennessee households and is critical to seasonal agricultural operations statewide. According to the U.S. Energy Information Administration's 2020 Residential Energy Consumption Survey, propane-consuming homes in Tennessee use an average of 2.66 million Btu annually[r]. The importance of propane in the agricultural sector is reflected in coordination efforts by state agencies and associations such as OEP, Tennessee Propane Gas Association, and Tennessee Poultry Association (which represents the largest non-residential propane usage in the state).

Infrastructure for storage and delivery remains highly localized. Tennessee hosts a modest number of secondary storage sites, primarily aboveground tanks at retail distributors, cooperative depots, and bulk plants (e.g., Admiral Propane in Northeast Tennessee, Holston Gases in Columbia, and National Gas in Knoxville), but Tennessee does not operate large-scale underground caverns or major pipeline-connected terminals[s]. For example, National Gas Distributors operates a propane rail terminal in Knoxville that is used to receive supply and feed secondary depots[t]. These smaller depots are typically supplied via rail or long-haul truck shipments from out-of-state pipeline terminals, thereby creating multiple logistical handoffs before propane reaches end users[u].

Impact of Hurricane Helene

Hurricane Helene underscored the critical role of propane in sustaining off-grid and rural households across East Tennessee, while revealing systemic vulnerabilities in how liquefied petroleum gas (LPG) is integrated into emergency response frameworks. Although propane serves a small share of households statewide (0.3%), its importance rises sharply in mountainous and remote counties. Among the eight counties designated under FEMA Disaster Declaration 4832-DR, average dependency reached 4.8%. In

---

[q] JUSTIA U.S. Law "U.S. Codes and Statutes: Tennessee Code": https://law.justia.com/codes/tennessee/title-4/chapter-3/part-5/section-4-3-513/

[r] EIA "CE4.6.LP,ST Annual Household site propane end use consumption in the United States by state avg., 2020

[s] TDOT: "Tennessee Statewide Multimodal Freight Plan, 2019": https://www.tn.gov/content/dam/tn/tdot/freight-and-logistics/TDOT_FreightPlan_AMENDED_04022019.pdf

[t] National Gas Distributors Inc.: https://nationalgasdistributors.com/services/

[u] Superior Energy Systems, Ltd: https://superiornrg.com/midstream/

Johnson County, 17.8% of households rely on propane for heating, representing 8.4% of the state's entire LPG-dependent population as seen in **Figure 14.** Given the timing of Hurricane Helene in autumn, heating was less of a concern and primary emergency usages were generally associated with food preparation during electricity outages.

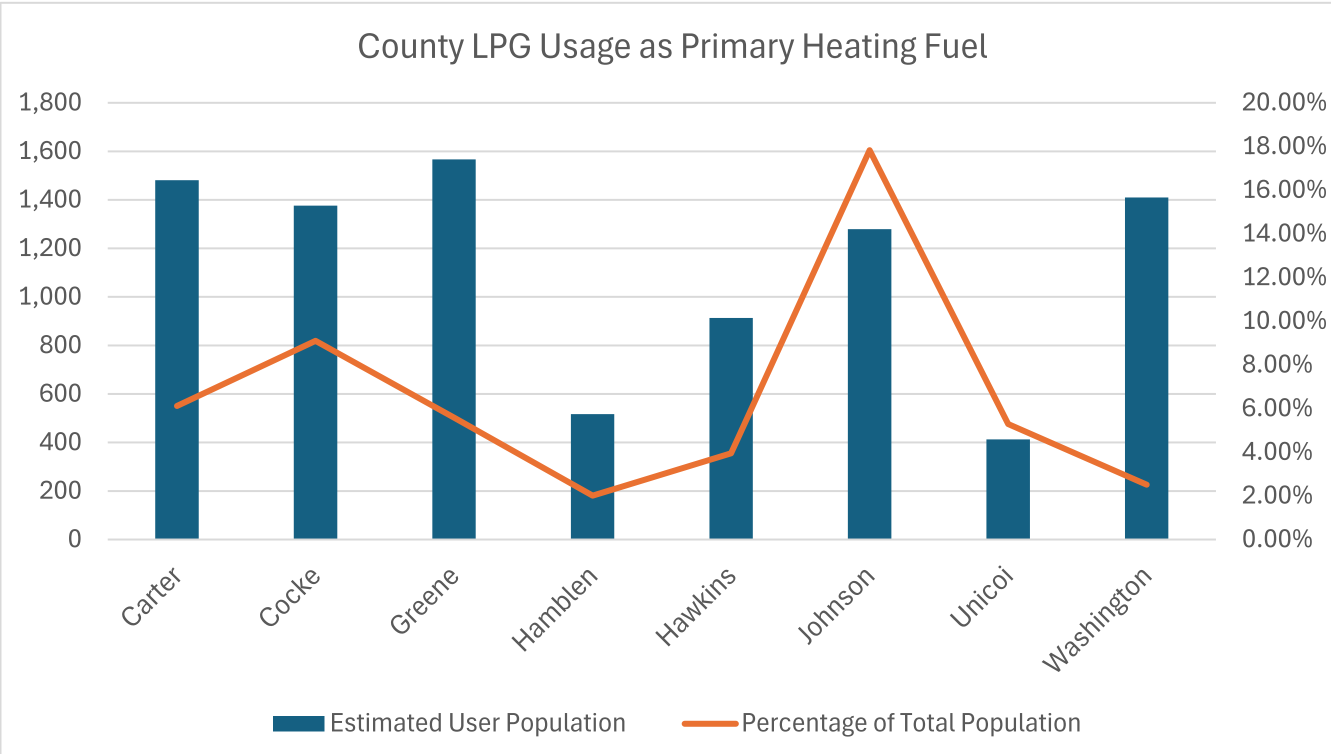


Figure 15: Estimated LPG Usage Across Helene-Affected East Tennessee Counties

Source: PNNL, Generated from Data Sourced from American Community Survey, U.S. Census Bureau

Propane delivery during Helene was challenged by both upstream and in-state disruptions. Landslides and flooding rendered critical segments of Interstates 40 and 26 impassable, delaying inbound fuel shipments across multiple energy sectors[v]. At the same time, upstream damage in western North Carolina disrupted supply lines, ten propane companies reported structural losses, including damaged tanks, vehicles, and depots. Several tanks were displaced by floodwaters and later recovered in Tennessee, compounding short-term supply gaps[w]. Given the scale and geographic spread of these disruptions, pulling propane usage data at the county level could help local emergency planners better understand their dependence on this fuel source and identify areas most vulnerable to supply interruptions.

[v] Institute for Supply Management. "Back-to-Back Hurricanes Wreak Havoc on Supply Chains." Accessed June 13, 2025. https://www.ismworld.org/supply-management-news-and-reports/news-publications/inside-supply-management-magazine/blog/2024/2024-10/back-to-back-hurricanes-wreak-havoc-on-supply-chains
[w] LP Gas. "Propane Industry Provides Aid to Areas Devastated by Hurricanes," November 5, 2024. https://www.lpgasmagazine.com/propane-industry-provides-aid-to-areas-devastated-by-hurricanes/

Propane supply in Tennessee relies heavily on long-haul truck deliveries, due to the absence of in-state bulk storage and limited pipeline-connected terminals, resulting in a relatively fragile logistics chain. Although federal transportation waivers were issued to expedite deliveries, delays in activation reduced their utility during the peak period of need. As propane reserves dwindled in rural households, heating access became uncertain. This strain was further exacerbated by local runs on small propane tanks across East Tennessee driven in part by increased use of propane-fueled outdoor grills as households sought alternative cooking options during extended power outages. This unexpected demand surge for sub-5-gallon tanks, commonly stocked at hardware and convenience stores, overwhelmed an already strained supply chain.

Despite these disruptions, sector coordination helped blunt long-term impacts. Blossman Gas mobilized 36 propane-fueled delivery trucks across Tennessee and neighboring states within 24 hours of landfall. In Carter and Johnson counties, technicians secured at-risk tanks to prevent hazardous conditions[x]. Temporary hygiene units powered by propane, operated by the Southeast Propane Alliance and Rinnai, provided shower and laundry access to both responders and displaced residents.

Recognizing the severity of fuel access challenges, the Tennessee General Assembly's January 2025 disaster aid package included targeted propane subsidies for households lacking grid-based alternatives[y]. This marked a shift in energy resilience policy, formally acknowledging LPG as a life-safety commodity deserving of dedicated recovery support.

While propane contributed meaningfully to household continuity during Helene, its availability remained contingent on road access, private-sector mobilization, and inter-state coordination. These dependencies highlight the importance of strengthening understanding of LPG supply chain vulnerabilities within existing local, state, and regional energy security planning efforts, particularly in high-use rural areas with limited infrastructure redundancy.

[x] Meyers, Michael. "Blossman's Strength Shines Amidst Hurricane Helene." Blossman Gas (blog), February 6, 2025. https://www.blossmangas.com/blossmans-strength-shines-amidst-hurricane-helene/

[y] Washwani, Anita. "Tennessee lawmakers approve Helene disaster aid package." Tennessee Lookout (news), January 30, 2025. https://tennesseelookout.com/2025/01/30/tennessee-lawmakers-approve-helene-disaster-aid-package

OBS-4: Energy System Interdependencies

Tennessee's energy landscape functions as an interconnected system of electricity generation and transmission, hydropower dams, liquid fuel supply chains, and backup infrastructure. During Hurricane Helene, these systems did not fail independently. Instead, transportation blockages, fuel shortages, and substation flooding revealed how disruption in one domain quickly cascaded into others, affecting healthcare, water, and communications services.

As shown in **Figure 8**, critical infrastructure assets, including power plants, high-voltage transmission lines, communication towers, and water treatment facilities, are densely clustered east of Knoxville in the foothills of the Appalachian Mountains. These nodes, many with limited fallback infrastructure, fell largely within the path of Hurricane Helene.

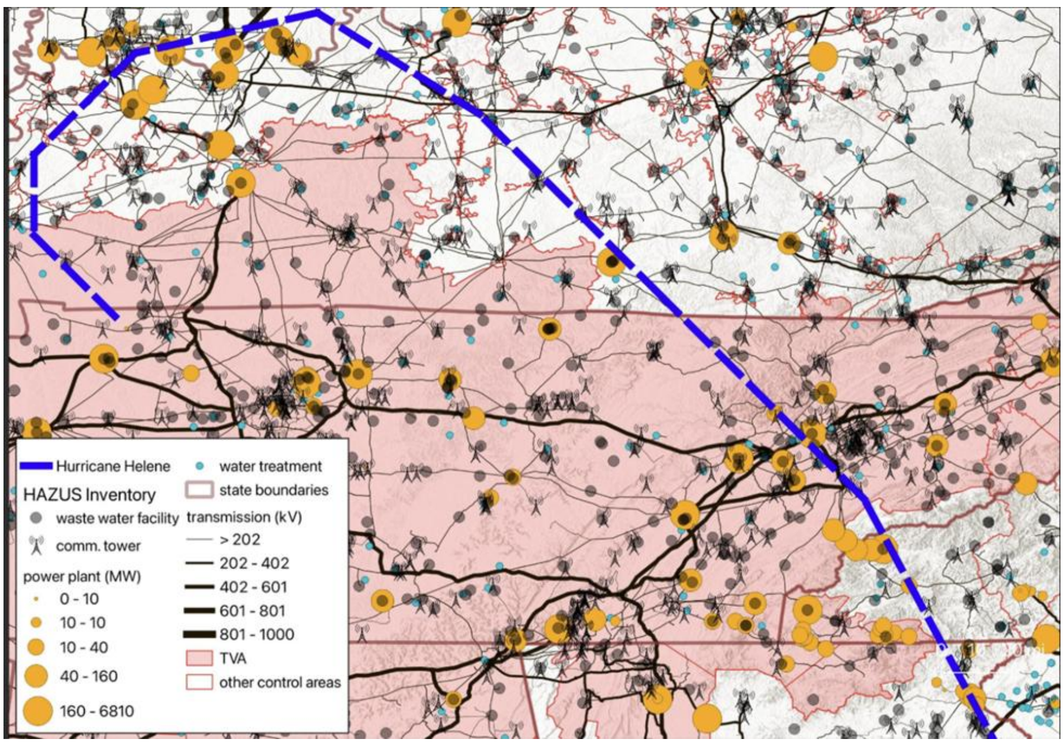


Figure 16: Infrastructure Interdependencies and Hurricane Helene's Path

Source: PNNL Figure Created with Data Sourced with HAZUS Inventory, FEMA 2024

The spatial overlap between high-value infrastructure and hazard exposure underscores the importance of modeling interdependence in emergency planning. According to PNNL hydrologic models that evaluate effects to critical infrastructure, during Hurricane Helene and in Tennessee alone, 23 critical communications facilities, 17 critical energy facilities, and 54 critical water facilities experienced 4 feet or greater levels of flood depth.[z]

[z] Original analysis for the Hurricane Helene Energy Systems Impact Report in East Tennessee.

Grid and Backup Fuel Dependencies (OBS-1, OBS-2, & OBS-3)

Hurricane Helene exposed a tightly coupled web of energy system interdependencies across Tennessee, where the failure of one component often triggered or amplified the failure of another. Grid outages, backup fuel shortages, and water access failures did not unfold in parallel, they unfolded in sequence, compounding each other in real time.

When utility-scale outages struck East Tennessee's rural electric cooperatives, the consequences extended far beyond lighting and heating. In communities where nearly 10% of households rely on electric-powered private wells for drinking water, the loss of grid power immediately severed access to clean water[aa]. Without electricity, well pumps failed. Without functioning pumps, neither water pressure nor disinfection systems could operate, albeit many residential wells do not require disinfection systems due to the purity of the water.[bb] In these areas, local distribution failure directly equaled water system failure, not over days, but within hours.

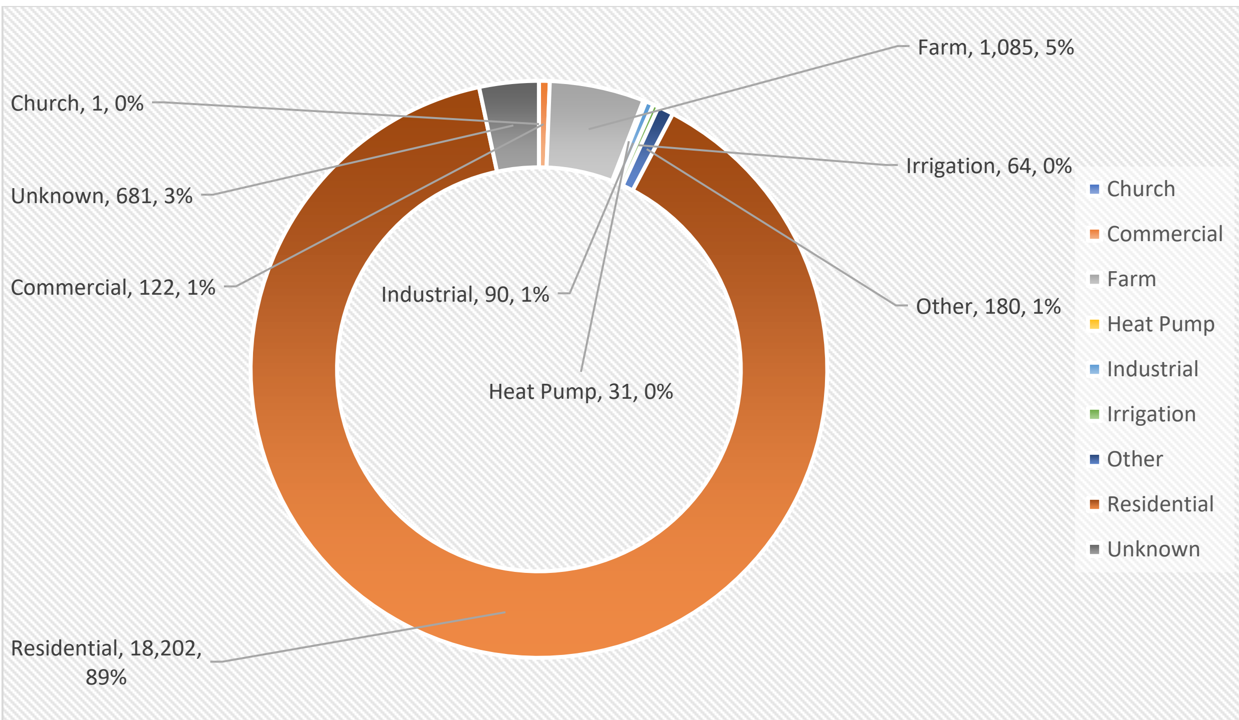


Figure 17: Distribution of Water Well Usage Types in Affected Counties

Source: PNNL graphic representing data from TDEC Division of Water Resources Water Well Data Viewer

This vulnerability was especially acute in residential areas as these uses account for 89% of all recorded well types in the affected counties, far outweighing commercial, industrial, or agricultural use. This

[aa] TN Department of Health: https://www.tn.gov/health/cedep/environmental/environmental-health-topics/eht/private-water-supply.html
[bb] "The Energy-Water Nexus | U.S. Geological Survey," June 9, 2024. https://www.usgs.gov/programs/energy-resources-program/science/energy-water-nexus.

overwhelming share underscores how energy failures directly escalated into public health risks, particularly for household's dependent on groundwater systems powered by electricity.

Backup systems are intended to bridge this gap, but they, too, had dependencies. Most backup generators relied on diesel fuel, and that fuel required functioning transportation routes. Washed-out bridges and landslides shut down access routes, including a key stretch of Interstate 40, delaying and complicating fuel deliveries. This transportation-energy interdependence became a recurring bottleneck. Damage to roads not only delayed electric outage repairs and generator resupply efforts but also impeded water pipeline repairs, thus impacting electricity, fuel, and water infrastructure simultaneously.

Propane distribution faced similar constraints. In counties like Johnson, where nearly 18% of households rely on LPG for heating, delivery trucks were unable to access remote areas due to damaged roadways. Although supply was available, the inability to transport it effectively left many off-grid homes without heat, demonstrating how even decentralized energy solutions were entangled in the broader fragility of the transportation network.

Water and wastewater systems experienced parallel cascading effects. More than 20 utilities issued boil water advisories in the aftermath of Helene. In Mountain City, the wastewater treatment plant failed entirely after losing both grid power and backup generation. In Greeneville, a bypass reservoir mitigated the need for a full shutdown, but the system still remained under a boil water advisory for 10 to 12 days.

These cases underscore how factors like power continuity, site elevation, and stormwater intrusion collectively determine whether lifeline services can remain operational. They also highlight how system-level vulnerabilities, especially in "hub-and-spoke" water distribution networks, can create far-reaching ripple effects, as seen in Greene County and other interconnected regions.

Dams, Power, and Lifeline Services (OBS-1 & OBS-2)

While many of the failures during Hurricane Helene stemmed from direct storm impacts, including flooding, outages, and access barriers, some of the most consequential disruptions were shaped by decisions made far upstream. TVA's dam network played a central, dual role: both as a generator of hydroelectric power and as a critical system for flood control.

This role is consistent with the responsibilities assigned to the agency under the TVA Act of 1933, which identified energy, environmental stewardship, and economic development as core areas of focus – sometimes referred to as the agency's "three E's." In the context of Helene, TVA's dams were not merely background infrastructure; they served as active support systems in Tennessee's crisis response, fulfilling the agency's original mandate in real time[cc].

[cc] Tennessee Valley Authority, "Managing the Tennessee River for Multiple Benefits. https://www.tva.com/environment/managing-the-river

Rainfall reached record levels across East Tennessee during Hurricane Helene. In response, TVA's River Forecast Center executed rapid water releases across its reservoir system to preserve structural integrity. Although the primary objective was flood control, these releases also drove a significant surge in hydroelectric output. Between September 29th and October 5th, TVA's hydro units generated an average of 2,869 MW/day – 1,600 MW more than during the same week the previous year or an increase of approximately 126% over the prior-year baseline[dd].

To manage extreme inflows, TVA ramped up discharges at Douglas Dam from approximately 420,000 gallons per second on September 28th to a peak hourly flow of nearly 475,000 gallons per second on September 29th, surpassing the previous record set in 1984[ee]. This emergency reservoir control was critical to preventing overtopping and maintaining dam integrity. The resulting surge in generation also helped maintain electricity continuity in urban centers such as Knoxville, where backup systems were already strained due to earlier fuel supply chain disruptions[ff].

However, this upstream relief came with consequences downstream. Communities along the lower French Broad River east of Knoxville faced rising water levels as TVA continued releasing floodwaters from Douglas Dam[gg]. While these controlled discharges were necessary prevention measures, they elevated flood risk in low-lying areas. In counties to the west of the hardest Helene impacts such as Knox and Sevier, emergency managers warned of localized inundation that temporarily closed roads, overtopped culverts, and strained wastewater infrastructure[hh]. The operational strategy that reduced upstream hazard thus introduced new downstream challenges, highlighting how even proactive flood control measures can create tradeoffs across interconnected infrastructure systems.

Nowhere was the precarious balance between flood mitigation and infrastructure risk more apparent than at Nolichucky Dam. Originally built in 1913 and integrated into TVA's system in 1945, the dam came under extreme hydrologic stress as floodwaters surged in the wake of Hurricane Helene. On September 27th, TVA's River Forecast Center issued a 'Condition Red' alert, signaling that dam failure was imminent without immediate intervention[ii]. By late morning on the 28th, water levels had peaked,

---

[dd] Wolfe, Sean. "TVA Says Its Flood Mitigation during Hurricane Helene Saved $406 Million in Damages." Factor This™, November 5, 2024. https://www.renewableenergyworld.com/hydro-power/dams-civil-structures/tva-says-its-flood-mitigation-during-hurricane-helene-saved-406-million-in-damages

[ee] Tennessee Valley Authority, "TVA-Releases-helene-data". https://www.tva.com/news-media/releases/tva-releases-helene-data

[ff] 91.9 FM WUOT, Your Public Radio Station. "TVA Releases Water from Douglas Dam, Sparking Concerns of Flooding Downstream in East Knox County," September 28, 2024. https://www.wuot.org/news/2024-09-28/tva-releases-water-from-douglas-dam-sparking-concerns-of-flooding-downstream-in-east-knox-county

[gg] Sean Wolfe, 2024 "Dam safety update: New house bill and TVA work to stabilize dams after Helene": https://www.renewableenergyworld.com/news/dam-safety-update-new-house-bill-and-tva-work-to-stabilize-dams-after-helene/

[hh] 10News "TVA closes Douglas Dam spillway after releasing billions of gallons of water from hurricane": https://www.wbir.com/article/news/local/douglas-dam-spillway-gates-close-days-after-helene/51-c7e41ec7-b5f3-470b-8673-84e6d85430d1

[ii] WVLT8 "Failure of Nolichucky Dam imminent, could cause life-threatening flooding" https://www.wvlt.tv/2024/09/28/failure-nolichucky-dam-imminent-could-cause-life-threatening-flooding-tva-says/

and TVA confirmed the structure had stabilized, allowing the emergency status to be lifted [jj]. Even without a structural failure, the crisis at Nolichucky Dam underscored the vulnerability of downstream infrastructure in Greene and Unicoi counties. Torrential floodwaters, driven by record rainfall rather than dam release, overwhelmed hospitals, water treatment systems, and emergency shelters concentrated in narrow river valleys. Unicoi County Hospital required rooftop rescues, and local utilities experienced widespread outages as mentioned in OBS-2. The incident demonstrated that the dam's structural integrity was more than an engineering concern, it was a critical link in managing floodwaters in time of high vulnerability and reduced capacity for response.

[jj] TN Department of Military-TEMA "Flash Report#5 Hurricane Helene": https://www.tn.gov/tema/news/2024/9/28/flash-report--5-hurricane-helene.html

OBS-5: INTERDEPENDENT COORDINATION SYSTEMS AND EMERGENCY RESPONSE

Preliminary accounts and publicly available documentation from Hurricane Helene suggest that effective emergency response relied not only on physical infrastructure performance, but also on the degree of coordination across interdependent agencies and systems. As cascading disruptions affected power, water, fuel, communications, and transportation, the ability to sustain situational awareness and deploy resources appeared to vary across jurisdictions and institutions.

Early stage operational coordination, particularly among federal, state, and regional entities such as TVA, TEMA, DOE-CESER, and FEMA, was generally described during interviews with TVA and TDEC as prompt and collaborative. As floodwaters rose and system degradation accelerated, communications infrastructure challenges began to affect situational awareness and information flow. One notable example was the degradation of cellular communications across parts of East Tennessee. According to FCC data, more than 25% of cell towers in the region were offline during peak response periods, with limited backup power coverage[kk]. In some counties, these disruptions constrained real-time communication between field crews, emergency managers, and critical facilities, although coordination efforts continued through field personnel and public safety communication networks.

The loss of real-time communication reportedly affected other interdependent services. Media and public statements from local officials indicated that fuel deliveries, generator resupply, and infrastructure inspections were in some cases delayed not by resource scarcity, but rather due to a lack of operational visibility or limited ability to coordinate access[ll]. These challenges were driven in part by degraded communications and difficulties in collecting real-time field data under disrupted conditions. In some cases, utilities relied on manual or paper-based workflows or lacked public-facing status dashboards, reflecting adaptations to these constraints during the initial response window.

Public accounts also describe uneven adoption of digital coordination tools. For example, Oak Ridge National Laboratory supported emergency efforts with drone imagery and data aggregation platforms (e.g., Mapster and EAGLE-I), which were reportedly shared with state officials and emergency managers[mm]. These tools provided enhanced visualization and analysis of available data; however,

---

[kk] Wireless Estimator. "Unprecedented Outage: No Hurricane Has Knocked out More Cell Sites than Category 4 Helene," September 29, 2024. https://wirelessestimator.com/articles/2024/unprecedented-outage-no-hurricane-has-knocked-out-more-cell-sites-than-category-4-helene/

[ll] Feinberg, Allie. "How Far Tennessee Lagged behind Neighboring States in Requesting Federal Aid for Helene." Knoxville News Sentinel. Accessed June 13, 2025. https://www.knoxnews.com/story/news/2024/10/09/tennessee-lagged-behind-states-requesting-federal-aid-hurricane-helene-flooding/75511820007/

[mm] US Department of Energy, UT-Battelle LLC. "A New Kind of First Responder: The Role of Technology in Hurricane Aftermath," December 20, 2024. https://www.ornl.gov/news/new-kind-first-responder-role-technology-hurricane-aftermath

their effectiveness remained dependent on underlying data availability and collection under disrupted conditions. Documentation on how widely or consistently these tools were utilized at the local level remains limited. The same is true for geospatial platforms used by nonprofits such as the Information Technology Disaster Resource Center (ITDRC), whose contribution helped identify communication gaps in isolated areas, according to organizational press releases and interviews.

Challenges related to federal engagement were evident in the timing and structure of disaster declarations. Tennessee received an Emergency Declaration shortly after Hurricane Helene's landfall, but the state's request for a Major Disaster Declaration was not approved until several days later, on October 2nd [nn]. During this interim period, response operations continued to be led by local jurisdictions with coordination and support from TDEC, consistent with standard emergency management structures. Federal support during this time included FEMA personnel – who were embedded at TEMA and provided support and coordination assistance, but not leading response operations – and voluntary organizations such as the American Red Cross and Tennessee VOAD. Although it is unclear whether the timing of the Major Disaster Declaration materially affected overall response outcomes, the sequence highlights the role of federal processes in scaling additional resources and support.

Further, localized coordination challenges were noted in after-action reports and statements from state and federal officials. The Tennessee National Guard, for instance, cited difficulties in coordinating missions with county emergency offices, sometimes due to unclear tasking or incompatible communication platforms[oo]. In rural areas, field teams often relied on in-person assessments due to ongoing power and connectivity outages, as remote data collection was not feasible under disaster conditions. While necessary, this reliance on field-based assessment constrained the speed of situational awareness and operational decision-making.

Despite these constraints, public and nonprofit partnerships appear to have played a supporting role in restoring response capabilities. Efforts by groups such as the East Tennessee Foundation, United Way, and Tennessee Fuel and Convenience Store Association helped fill early logistics gaps, particularly in hard-to-reach areas[pp]. For example, members of the Tennessee Fuel and Convenience Store Association donated three truckloads of bottled water through direct coordination with OEP and local county emergency managers. Additionally, the Bristol Motor Speedway was successfully repurposed as a regional donation center, serving as a high-capacity hub for the intake and distribution of critical goods.

[nn] FEMA "Tennessee Tropical Storm Helene DR-4832-TN": https://www.fema.gov/disaster/4832

[oo] awinters@sixriversmedia.com, ALLISON WINTERS. "After the Storm: Tennessee National Guard Reports Reveal Lessons Learned." Kingsport Times News, January 4, 2025. https://www.timesnews.net/helene/after-the-storm-tennessee-national-guard-reports-reveal-lessons-learned/article_f577b014-c9e5-11ef-a302-439c237bd5d0.html

[pp] "Emergency Relief - We're After Solutions That Create Real Change," October 14, 2020. https://unitedwayetnh.org/help/

However, integration between these community-led initiatives and formal state or federal response structures was not always seamless, and administrative requirements such as documentation for federal matching funds were cited as barriers for smaller organizations.

Taken together, these examples highlight how coordination, communication, and decision-making processes influenced response operations alongside physical infrastructure performance. While publicly available information cannot fully characterize the scope or effectiveness of internal agency coordination, the observable response timeline, along with documented delays, data access limitations, and reported inconsistencies, suggests potential opportunities to improve real-time information sharing and coordination across sectors and jurisdictions.

CONCLUSION AND RECOMMENDATIONS

Hurricane Helene revealed both the resilience and fragility of East Tennessee's energy systems. In the face of historic flooding, prolonged outages, and cascading infrastructure stressors, coordinated actions among local, state, federal, and community-based actors helped prevent greater damage. However, the event also exposed enduring vulnerabilities in energy coordination, rural infrastructure planning, and cross-sector data management.

This situational insight report provides a system-level overview of energy-related challenges and strengths observed during and after the storm, based on available public data, geospatial analysis, and limited agency and utility engagement. While findings are informed by these sources, the analysis does not represent a comprehensive assessment of all system components, particularly privately owned infrastructure and associated operational decision-making. This report does not serve as a performance evaluation, but instead offers targeted observations and insights to help inform future planning and resilience strategies.

System Strengths

Several promising practices emerged from the response to Hurricane Helene:

- **Coordinated state-level leadership**: Agencies such as TDEC and TEMA provided stable coordination platforms throughout the response, working in conjunction with federal partners and supporting locally led operations.
- **Utility sector effectiveness**: TVA and organizations such as TECA supported restoration efforts through coordination and mutual aid mechanisms. Restoration timelines varied across local utilities, with more resource-constrained and geographically challenging service areas experiencing longer outages. At the same time, coordination among local, state, federal, and industry partners contributed to effective response efforts in several areas.
- **Locally driven responses**: Community-based organizations, volunteer groups, and mutual aid networks mobilized rapidly to fill critical access and communication gaps.
- **Trusted regional intermediaries**: Foundations such as the East Tennessee Foundation provided fast-turnaround funding for essential services, supported by deep local knowledge.
- **Mapping and data support**: Entities like the Tennessee Geographic Information Council (TNGIC) played a key role in situational awareness through real-time mapping tools.

Key Challenges and Areas for Improvement

Despite progress, Hurricane Helene highlighted several cross-sector gaps:

- **Delays in disaster declarations and fragmented communication protocols** were reported as challenges during the response, with potential implications for coordination and the timing of certain assistance efforts.
- **Public trust erosion** occurred due to conflicting reports and the spread of misinformation during the response, highlighting the importance of clear, consistent, and locally accessible communication, including the availability of materials in multiple languages.

- **Siloed infrastructure data** across multiple public and private entities may have limited interagency visibility and made it more difficult to assess cascading failures across electric, water, and fuel systems.
- **Faith-based and other local organizations stepped in to provide essential assistance** in fulfilling disaster response requirements, particularly for smaller counties and nonprofits that struggled to handle the complexity and surge of documentation and matching requirements needed to unlock federal aid.

<u>Strategic Recommendations</u>

To address these challenges and build on existing strengths, the following actions are recommended:

- **Establish a cross-agency energy task force** for East Tennessee that convenes key actors from state, local, utility, and emergency sectors to coordinate disaster planning and interdependencies across this complex landscape. Where feasible, this could build on or be integrated with existing regional emergency planning groups already active in East Tennessee.
- **Improve situational awareness through enhanced data availability and platforms** for electric, water, and fuel (including propane for residential use and petroleum-based fuels like diesel and gasoline for generators and emergency fleets) systems to benchmark basic systems during routine conditions and improve operational awareness and response during crisis conditions.
- **Enhance alignment of emergency public communication practices across state and local agencies**, including the use of multilingual, validated, and locally trusted dissemination approaches.
- **Conduct annual cross-functional response exercises** that simulate system outages, test interagency response flows, and strengthen working relationships across sectors.
- **Improve accessibility of disaster funding pathways for small counties, nonprofits, and volunteer-led groups** by reducing administrative complexity and aligning with ongoing state and federal efforts to streamline application and reimbursement processes.
- **Develop a mitigation investment strategy tailored to the East Tennessee region to reduce disruptions to critical services.** These efforts may include building on existing mutual aid frameworks, enhancing shared emergency response capabilities, targeted infrastructure investments to harden vulnerable assets, and improved tools and data to support local service providers across interconnected systems. Consideration of these strategies could be supported through existing policy bodies, such as the State Mitigation Policy Committee or other appropriate coordination forums.
- **Improve integration of East Tennessee community perspectives into existing disaster planning efforts**, recognizing long-standing cultural dynamics, generalized mistrust of outside systems, and community-specific needs in response and recovery.

- **Initiate localized energy resilience planning efforts at the regional level** in collaboration with community-based stakeholders, utilities, and emergency management agencies. These efforts should identify site-specific vulnerabilities, prioritize locally-relevant mitigation actions, and build sustained coordination mechanisms to improve enduring energy security across East Tennessee.

Next Steps

This report provides a foundation for post-Helene engagement across agencies. A powerful next step would be for the Tennessee Department of Environment and Conservation, Office of Energy Programs, in its role as Tennessee's ESF-12 lead, to convene a regional energy security and resilience task force for East Tennessee. This effort could follow models used in other states, such as Hawaii's emerging Energy Security Task Force, or national coordination mechanisms like DOE CESER's Energy Sector Coordinating Council (ESCC). Whether structured through a formal charter, memorandum of understanding, or convened on an ad hoc basis, the overall goal is to institutionalize cross-sector collaboration and clarify response roles before the next disaster.

The following organizations and operational functions are recommended as initial conveners and participants in such a regional discussion:

- **TVA** – River Forecast Center
- **TEMA** – East Region Regional Administrator & District Coordinators
- **Mountain Electric Cooperative** – GM/CEO
- **TECA** – VP of Government Affairs
- **TDEC OEP** – Emergency Services Coordinator ESF-12 Lead

Although not all critical agencies were available for interviews during this assessment, their operational role in response and restoration was significant. Future reports would benefit from broader agency participation and real-time access to operational data. Additional organizations for coordination and planning are TVA's Transmission, Nuclear Plant, and Emergency Response Manager(s), Telecommunications (AM/FM and Wireless), Propane and LNG, Water, Tennessee Department of Transportation.

Final Note

Some information included in the Hurricane Helene Energy System Impact Report may evolve or become outdated following its publication. However, the systemic insights and recommendations herein remain relevant as the state prepares for future extreme weather events. Effective energy resilience planning requires not just physical infrastructure investments, but also relational infrastructure, trusted coordination, shared information, and inclusive planning. Helene serves as a reminder that preparation must be proactive, coordinated, and continuous.

APPENDIX A: INTERVIEW QUESTIONS

Table 2: Interview Questions

Interview Question	Audience
What were the most significant gaps or challenges in preparedness planning for Hurricane Helene? How can future resilience efforts be improved to mitigate similar risks?	Emergency Response Officials
How did your agency address misinformation and ensure that timely, accurate updates reached all affected communities, particularly in remote or underserved areas? What is some of the misinformation that has been generated throughout this event and how has it been handled?	Emergency Response Officials
How does the current operational coordination process work between federal, state, and local emergency response entities? What were the biggest logistical hurdles in coordinating emergency response efforts across federal, state, and local agencies? What lessons were learned to improve future multi-agency disaster responses?	Emergency Response Officials
How long did Ballad Health mobile medical unit remain operational after Hurricane Helene, what services were provided, and was it able to meet care needs beyond initial triage?	Emergency Response Officials
Can you confirm whether backup generators at hospitals remained operational during flooding and, if so, how long they provided power?	Emergency Response Officials
Which hospital received emergency fuel from TDEC during Hurricane Helene, and did other facilities experience unmet fuel needs or request similar assistance?	TDEC
What was the operational status of flood gauges in Unicoi County prior to Hurricane Helene? Were flood warnings issued in time to support hospital-level emergency decision-making?	Power Companies / Utility Regulators / Emergency Response Officials
Have any healthcare or water facilities conducted post-event assessments of generator performance following Hurricane Helene? If so, are those findings documented and available for review?	Utility Operators / Regulatory Agencies

Interview Question	Audience
Do coordinated emergency planning frameworks or joint training exercises exist among regional hospitals and emergency response agencies, specifically addressing multi-day outages and evacuations?	Power Companies / Utility Regulators / Emergency Response Officials
Do utility providers in East Tennessee follow specific criteria to prioritize power restoration for critical infrastructure? Were these criteria applied during Hurricane Helene recovery?	Power Companies / Utility Regulators / Emergency Response Officials
Did wastewater treatment facilities in affected counties engage their backup power systems during Hurricane Helene? Were there any generator failures or fuel shortages?	Power Companies / Utility Regulators /
Did TECA or county emergency managers formally track how transportation-related access constraints (e.g., road closures, bridge damage) delayed power restoration following Hurricane Helene?	TECA Representatives / County Emergency Managers / TDOT Officials
Did out-of-state mutual aid deployments reduce in-state restoration capacity for Tennessee co-ops like MEC during the first week of Hurricane Helene response?	TECA Coordination Team / Local Cooperative Managers / Field Operations Supervisors
Can you confirm whether Mountain Electric Cooperative (MEC) submitted outage updates to DOE beyond September 30, and does DOE reconcile ongoing local restoration data?	MEC Representatives / DOE Regional Liaisons / Emergency Energy Coordinators
Does MEC's emergency communications policy include a public-facing outage dashboard, and were those protocols followed during Hurricane Helene?	MEC Communications Officers / Emergency Response Planners / TDEC Energy Officials
Did TVA experience any outages, emergency operations, or generation curtailments at its nuclear, hydroelectric, or fossil generation facilities during Hurricane Helene?	TVA Operations Managers / Grid Reliability Analysts / Energy Infrastructure Planners
Can you confirm how and when interpreter services were deployed during Hurricane Helene in counties like Carter, Washington, Sullivan, Cocke, and Greene? Were there gaps in ensuring Spanish-speaking residents received timely emergency information, and what challenges affected outreach?	Emergency Response Officials / TEMA / Community Advocacy Organizations
Can you confirm the power restoration timelines across rural and urban areas in East Tennessee during Hurricane Helene recovery? Specifically, which counties experienced the most prolonged outages, and what infrastructure challenges contributed to the delays?	Power Companies / Local Utilities / Emergency Response Officials

Interview Question	Audience
Can you describe any specific challenges faced in providing emergency alerts and evacuation instructions in Spanish to Spanish-speaking communities across affected counties? Were certain areas underserved, and what lessons were identified for future responses?	Emergency Response Officials / Community Advocacy Groups / TIRRC
Were there instances where East Tennessee communities declined federal or state aid during Hurricane Helene recovery? If so, what reasons were cited, and did this result in service or resource gaps?	Local Government Officials / Emergency Managers / Community Leaders
Did coordination challenges arise between local development districts, state agencies, and nonprofits during Hurricane Helene recovery? If so, what were the impacts or consequences?	Local Development Districts / State Officials / Nonprofit Organizations
Can you describe the scale and specific contributions of mutual aid groups during Hurricane Helene? What services did they provide, and to whom?	Mutual Aid Leaders / Community-Based Organizations

APPENDIX B: OBSERVED ENERGY PLANNING AND RESPONSE FOR FUTURE COORDINATION

Table 3: Observations of Planning, Infrastructure, Engagement, and Data for Industry and State Agencies

Topics	TEMA	TDEC	TECA	Electric Coops	TVA River Management	TVA Transmission	TVA Nuclear Sites	Telecommunications	Propane and LNG	Water	Well Water	TN DOT	Hospitals
Energy Emergency Planning, Coordination, & Reporting													
Agency or Organization Emergency Plans	●	●	●	•	●	○	○	○	○	○	○	○	●
Inter-Agency Planning	●	●	●	●	●	○	○	○	○	○	○	○	○
System Prioritization	•	•	•	•	●	○	○	○	○	○	○	○	○
Outage and/or system reporting	●	●	○	•	●	○	○	○	○	○	○	○	○
Transportation Coordination	•	•	•	•	○	○	○	○	○	○	○	•	•
Infrastructure & Backup Generation (and fuel supply)													
Critical Infrastructure Identified	○	•	○	○	●	○	○	○	○	○	○	○	●
Resilieence Hubs Identified with backup power and fuel	○	○	○	○	○	○	○	○	○	○	○	○	○
Backup Generator and Fuel readily available for outage	○	○	○	○	○	○	○	○	○	○	○	○	●
Water and Wastewater treatment back-up power	○	○	○	○	○	○	○	○	○	○	○	○	•
Emergency Operations Centers	○	○	○	○	○	○	○	○	○	○	○	○	○
Communications & Community Engagement													
Emergency Communications Plan & Protocols for public	•	•	○	○	•	○	○	○	•	•	•	•	•
Community Engagement Plans	○	○	○	○	○	○	○	○	○	○	○	○	○
Language Translators and/or Translation	○	○	○	○	○	○	○	○	○	○	○	○	○
Data Management and Updates													
System data is captured and regularly updated for agencies and public	•	•	•	•	•	•	•	•	•	•	•	•	●
Customer data related to systems is in database and updated	•	•	○	•	●	○	○	•	•	•	•	○	●
Data and locational information is shared across agencies	•	•	•	•	●	○	○	○	○	○	○	○	○

	Legend
•	Limited information, inconsistent , or undocumented information
●	Information discovered assumes plans, coordination, data available
○	Information not found

Table 4: Observations of Planning, Infrastructure, Engagement, and Data for East TN counties

Topics	Carter	Cocke	Greene	Greeneville	Hamblen	Hawkins	Johnson C	Morristow	Newport	Washington	Unicoi
Energy Emergency Planning, Coordination, & Reporting											
Agency or Organization Emergency Plans	○	○	○	○	○	○	○	○	○	○	○
Inter-Agency Planning	○	○	○	○	○	○	○	○	○	○	○
System Prioritization	○	○	○	○	○	○	○	○	○	○	○
Outage and/or system reporting	○	○	○	○	○	○	○	○	○	○	○
Transportation Coordination	○	○	○	○	○	○	○	○	○	○	○
Infrastructure & Backup Generation (and fuel supply)											
Critical Infrastructure Identified	○	○	○	○	○	○	○	○	○	○	○
Resilieence Hubs Identified with backup power and fuel	●	•	•	○	○	○	○	○	○	○	•
Backup Generator and Fuel readily available for outage	○	○	○	○	○	○	○	○	○	○	•
Water and Wastewater treatment back-up power	●	○	○	○	○	○	○	○	○	○	○
Emergency Operations Centers	●	•	•	○	●	○	○	○	○	○	○
Communications & Community Engagement											
Emergency Communications Plan & Protocols for public	○	○	○	○	○	○	○	○	○	○	○
Community Engagement Plans	○	○	○	○	○	○	○	○	○	○	○
Language Translators and/or Translation	○	○	○	○	○	○	○	○	○	○	○
Data Management and Updates											
System data is captured and regularly updated for agencies and public	○	○	○	○	○	○	○	○	○	○	○
Customer data related to systems is in database and updated	○	○	○	○	○	○	○	○	○	○	○
Data and locational information is shared across agencies	○	○	○	○	○	○	○	○	○	○	○

	Legend
•	Limited information, inconsistent , or undocumented information
●	Information discovered assumes plans, coordination, data available
○	Information not found