

## **DISCLAIMER**

**This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof. Reference herein to any social initiative (including but not limited to Diversity, Equity, and Inclusion (DEI); Community Benefits Plans (CBP); Justice 40; etc.) is made by the Author independent of any current requirement by the United States Government and does not constitute or imply endorsement, recommendation, or support by the United States Government or any agency thereof.**



# TASTI-GRID

## Technical Assistance for States and Tribes Initiative Grid Resilience Investment Decision-making

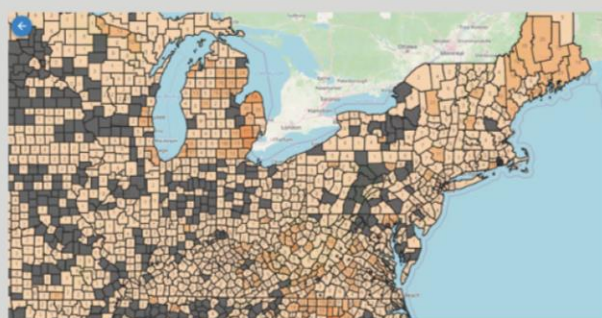
**TASTI-GRID is a nation-wide, comprehensive situational awareness tool for data-driven decision-making to improve critical infrastructure resilience and electric grid reliability.**

**TASTI-GRID** enables rigorous multi-systems analysis leveraging ORNL's core capabilities, such as:

- high-performance computing,
- national security sciences,
- energy technology, and
- environmental systems science, among others.

TASTI-GRID addresses states' most pressing needs for grid resilience and reliability improvements, identifying the greatest statewide challenges and the most optimal return on investment for regional resilience to help reduce major outages, address energy affordability, and protect customers with critical needs.

The TASTI-GRID team is providing hands-on technical assistance to state energy offices across the US.



### ABOUT THIS REPORT

This document provides a concise overview of the analytical capabilities of the TASTI-GRID team. Utilizing additional data and resources, it synthesizes platform insights to present a distinct perspective on investing in grid resilience throughout Mississippi. This document is not intended to influence or direct state-level decisions related to investments in grid resilience and reliability. TASTI-GRID should not be used for real-time monitoring, supporting the ESF #12 emergency response functions, or predicting the restoration times for outages.

Utilizing over 60 publicly available datasets, **TASTI-GRID** demonstrates aspects of the domestic power grid, including:

- Electricity generation and transmission,
- Critical assets and infrastructure (such as substations)
- Historic major outages
- Extreme weather events and their measured impacts
- Demographics to demonstrate system resilience models

The platform enables analysis of state energy profiles, variation among residential and industrial metering, utility customer demographics, and energy rate affordability.

**TASTI-GRID's** visual, geospatial capabilities, and the team's in-depth analysis attract users across government and industry, meeting ORNL's Scientific Impact mission, establishing the laboratory as the national leader in meeting the challenges of a rapidly evolving energy landscape.

Since its initial development in FY24, **TASTI-GRID** has evolved from a 40101(d)-formula grant investment tool to the premier platform for State Energy Offices' strategic short-and-long range development, providing visualizations of historic outages and exploring time-series restoration and resilience metrics by county.

**TASTI-GRID's** originality lies in its innovative conflation of diverse datasets and modeling techniques, unifying grid reliability, economics, and resilience analytics.

This creative integration sets a new benchmark for addressing complex, interdisciplinary challenges in critical infrastructure through data-driven innovation and case-study analysis.

The GIS-based platform provides summaries and map visualizations of historic US outages with narrative analysis and recommendations for sub-regional asset management and outage mitigation strategies.

**ORNL Point of Contact for West Virginia**  
Steve Peterson, [petersonsk@ornl.gov](mailto:petersonsk@ornl.gov)

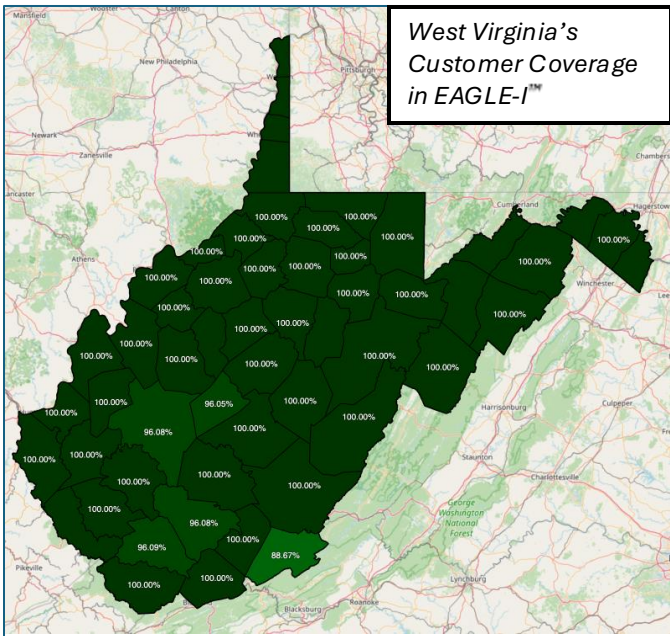
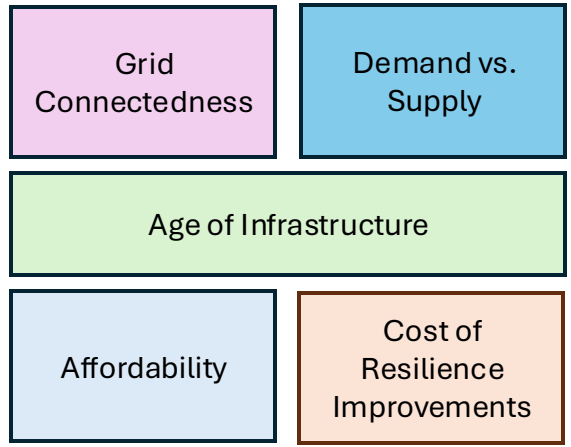
#### Report Author Contact

Hillary K. Fishler & Varisara Tansakul  
[tastigrd@ornl.gov](mailto:tastigrd@ornl.gov)

This report is based on estimates of the best available data. Some data utilized by TASTI-GRID is no longer publicly accessible, though is maintained by the platform. Metrics leverage several datasets in which data may be incomplete, missing, or misrepresented. EIA-861 data on meters and reliability is incomplete for some utilities.

# An Overview of West Virginia's Grid Resilience Challenges

**West Virginia's** legacy as a top power producer with a legacy of mining and natural gas is well-known across the country. A state with historic underinvestment, vulnerability to natural hazards, and a large rural population – much of West Virginia's critical energy infrastructure is beyond its recommended lifecycle at 75+ years old. West Virginian's are feeling the effects of neighboring Virginia's data center growth, as its grid interconnectedness with neighboring states have impacted energy affordability as power supply has not kept up with demand. The state aims to attract data centers to improve economic development, however, the age of infrastructure, utility reliability, weather-induced major outages, and cost of proposed improvements compound West Virginia's resilience challenges.



West Virginia's Customer Coverage in EAGLE-1™

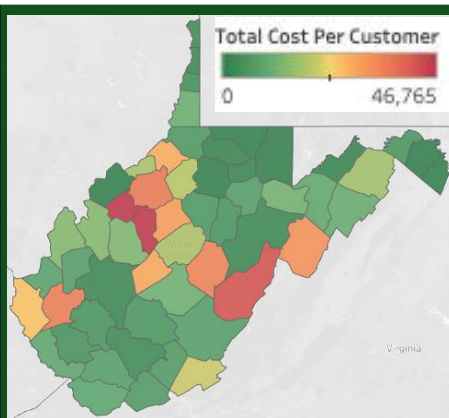
West Virginia's data capture for outages is considerably stronger than the rest of the US. Counties without 100% data coverage include Monroe, Clay, Kanawha, Raleigh, Wyoming, and Putnam.

## Top Major Outage Events related to Severe Weather (2018-23)

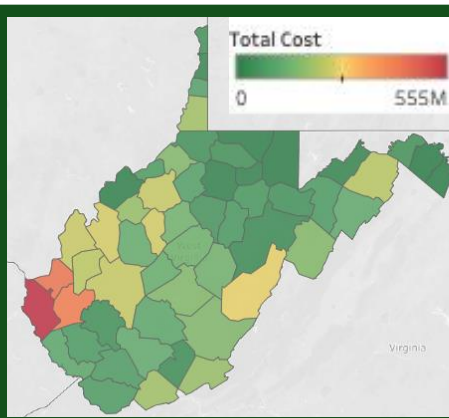
Major Outage Event Date & Severe Storm	Customers Impacted by Outage Event (OE)	Avg. Customer's Outage Duration (hrs)
<b>Feb 12-19, 2021*</b> Winter Storm	OE 1: 67,560 OE 2: 35,570 OE 3: 28,171 OE 4: 21,940 OE 5: 18,901	OE 1: 30.55 OE 2: 44.13 OE 3: 24.85 OE 4: 45.96 OE 5: 77.60
<b>Oct 19-22, 2018*</b> Extreme Cold & Wind	OE 1: 52,721 OE 2: 45,427	OE 1: 54.67 OE 2: 59.70
<b>June 24-25, 2019</b> Severe Storms, Tornado	30, 130	2.55
<b>Nov 15-16, 2018</b> Winter Storm	22,069	18.80
<b>Feb 25, 2019</b> High Winds	14,009	4.15

\*Impacts across the state – causing several instances of major outages from the same storm system.

## West Virginia's Cost of Outages



By-county outage costs **per** customer (residential & non-residential).



Total by-county cost for **all** customers.

**Cost of outages per year :** What customer would pay for backups to avoid service interruptions. Captures both tangible & intangible losses willingness-to-pay schema for both residential & non-residential customers.

Major long-duration outages can impact a state's economy. For industries with high shut-down, restart, and facility costs, this can have high economic consequences, workforce impacts, and capital for improvements. While mining and natural gas operations are not candidates for relocation, outages may have implications for attracting data centers & other industries.

### Top per-customer costs (by county):

1. Wirt
2. Calhoun
3. Pocahontas
4. Ritchie
5. Lincoln
6. Webster
7. Pendleton
8. Gilmer
9. Clay
10. Tyler

### Top 10 Counties & Industries with Highest total Customer Costs

1. Cabell – manufacturing & nickel
2. Calhoun – oil, gas, pipelines, timber
3. Jackson – food processing & manufacturing
4. Kanawha – chemicals, petrochemicals
5. Lincoln – coal mining, forestry
6. Mason – steel/metal manufacturing
7. Pocahontas
8. Putnam – automotive manufacturing, fabrication, chemicals
9. Ritchie – oil & gas
10. Wayne – coal mining, manufacturing,

# Restoration Metrics in TASTI-GRID

Of all US states, DC, and Puerto Rico, **West Virginia's** grid resilience is a mixed bag, ranking:

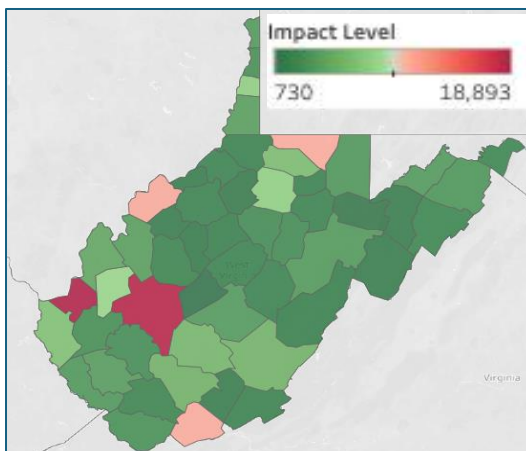
- **7th** in **impact level**, or the maximum number of customers impacted during extreme events ( $\approx$  **2377.9** customers),
- **28th** in **recovery duration**, or the amount of time it takes to restore power for the maximum number of customers ( $\approx$  **1,022.9** minutes – or **17** hours), and
- **49th** in the per minute **recovery rate** of customer outages ( $\approx$  **2.32** meters/min).

West Virginia performs near the top in prevention of major customer outages during extreme events. However, once the power is out, customers can experience long wait times for return to service. Further, once power restoration begins, West Virginia ranks near the bottom in the number of restored customers per minute.

**2023**  
**Statewide**  
**Averages**

**SAIDI**  
**751.5 min (MED)**  
**385.7 (w/o MED)**

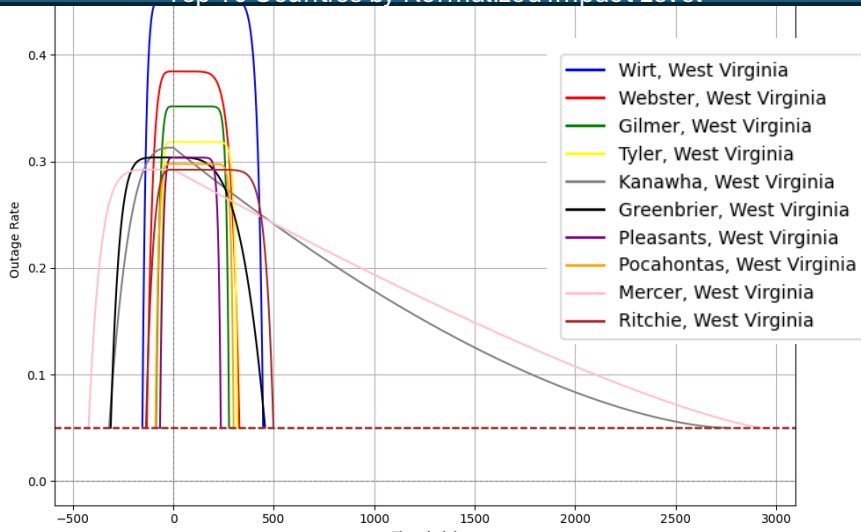
**SAIFI**  
**2.4 (MED)**  
**1.9 (w/o MED)**



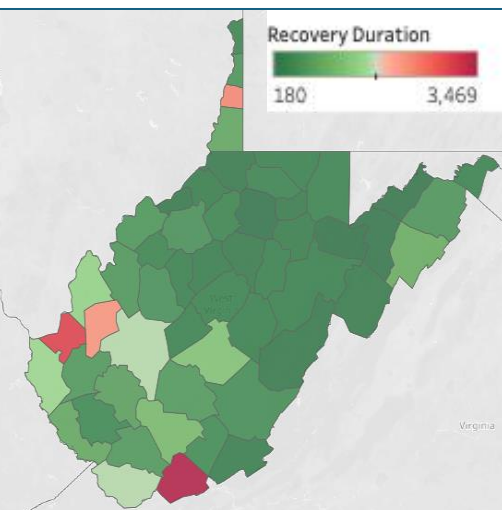
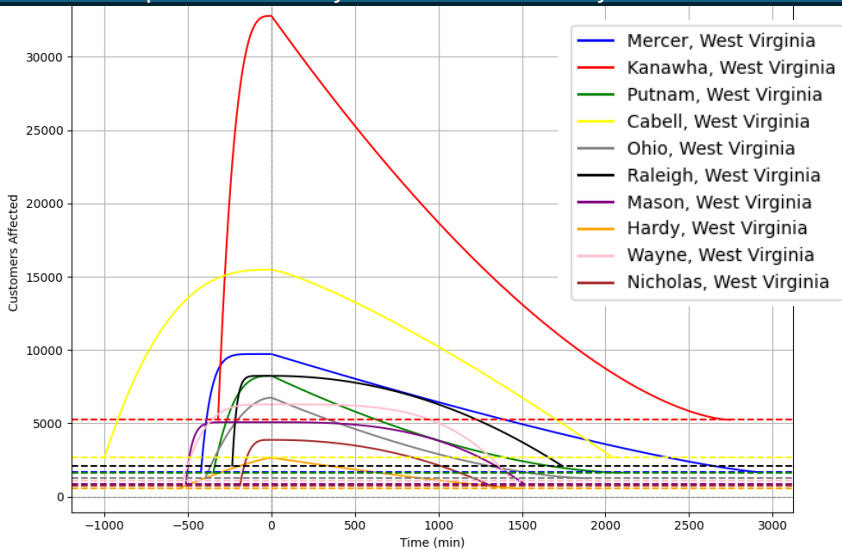
**IMPACT LEVEL:**  
*Max. # of customers impacted by outage event.*

**Most Customers Impacted:**  
Cabell, Kanawha, Wood, & Monongalia counties.

Top 10 Counties by Normalized Impact Level

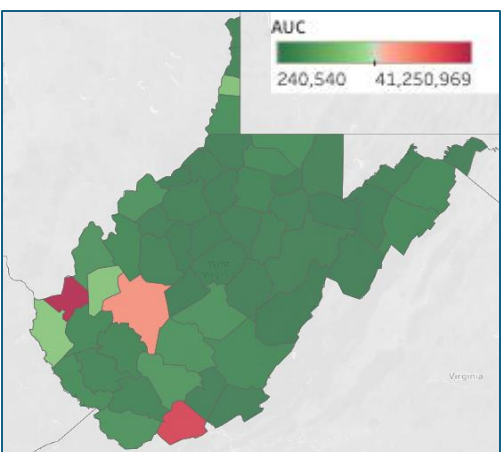


Top 10 Counties by Normalized Recovery Duration



**Recovery Duration:** *Time between when max. # of customers are impacted by an outage, & the end of the event.*

**Longest Recovery Durations:** Mercer, Cabell, Ohio, & Putnam Co.



**Normalized analysis demonstrates outage rates offering valuable insights into state outage response & resilience.**

Few outages but longest recovery durations:

Kanawha: 2,745 min.  
Mercer: 2,927.14 min.

Notable Outage Frequencies

Webster: 123  
Pleasants: 49  
Wirt: 40  
Pocahontas: 68  
Tyler: 46  
Ritchie: 32

**Area Under the Curve (AUC):** *Demonstrates units of “customer-minutes” – combining Impact Level & Event Duration into one.*

Cabell, Mercer, Kanawha, & Wayne counties have high impact levels long outage durations, showing challenges related to increased susceptibility to major weather-related outages.

# Appendix

## DATA USED IN TASTI-GRID

This report is based on estimates of the best available data. Some data utilized by TASTI-GRID is no longer publicly accessible (such as HIFLD), though is maintained by the platform. Metrics leverage several datasets in which data may be incomplete, missing, or misrepresented. EIA-861 data on meters and reliability is incomplete for some utilities. The indirect implications from missing data are explored in alignment with accepted norms in the fields of social science. Service territories/counties for which there are incomplete/missing data should not be excluded from consideration for resilience initiatives.

Platforms & Datasets	Date Range
Abandoned Mine Land Inventory System	2017
American Communities Survey	2015-2020
Bureau of Economic Analysis County Business Patterns	2022-2023
Bureau of Indian Affairs Tract Viewer	2018
Centers for Disease Control PLACES Datasets	2019
Comprehensive Housing Affordability Strategy (CHAS)	2014-2018
Department of the Interior Land Mgmt Agencies Monitoring Data	2024 - Current
EAGLE-I™ Outages	2018 – 2024
Energy Information Administration (EIA) Datasets	2013 - 2022
FEMA USA Structures Dataset	2021
FSim – Wildfire Risk Simulation Data (USDA Forest Service)	2023
Homeland Infrastructure Foundation-Level Data (HIFLD)	2024
ICE Calculator v2.0 – Cost of Outages Tool	2025
Invasive Species Habitat Tool – US Geological Survey	2024 - Current
Low Income Energy Affordability Data Tool (LEAD)	2018
Multi-Resolution Land Characteristics National Land Cover Database	2019
National Air Toxics Assessment	2017
National Community Reinvestment Coalition Data	2010
National Risk Index	2014 - 2021
National Weather Service (NWS)	2018 - 2024
Outage Data Initiative Nationwide (ODIN)	2022 - 2024
US Small-area Life Expectancy Estimates Project (USLEEP)	2015

## ABBREVIATIONS

APPA	American Public Power Association	NWS	National Weather Service
AUC	Area Under the Curve	ORNL	Oak Ridge National Laboratory
EAGLE-I	Env. for Analysis of Geo-located Energy Information	PSC	Public Service Commission
EIA	Energy Information Administration	ROI	Return/s on investment
GIS	Geographic information system	SAIDI	System Average Interruption Duration Index
HIFLD	Homeland Infrastructure Foundation-Level Data	SAIFI	System Average Interruption Frequency Index
IEEE	Institute of Electrical and Electronics Engineers	SEOs	State energy offices
kWh	Kilowatt hour(s)	TASTI-GRID	Technical Assistance for States and Tribes Initiative – Grid Resilience Investment Decision-making
MDA	Mississippi Development Authority		
MED	Major Event Days		
NOAA	National Oceanic & Atmospheric Association		

## References

- American Public Power Association. 2024. “What Causes Electrical Outages?” <https://www.publicpower.org/periodical/article/what-causes-electrical-outages>.
- Brelsford, C., et al. 2024. “A Dataset of Recorded Electricity Outages by United States County 2014-2022.” Scientific Data 11:271. <https://doi.org/10.1038/s41597-024-03095-5>.
- EAGLE-I. 2025. Managed by Oak Ridge National Laboratory. <https://eagle-i.doe.gov/>.
- IEEE. Standard 1366.
- National Centers for Environmental Information, National Oceanic & Atmospheric Administration. 2024. West Virginia Summary. <https://www.ncei.noaa.gov/access/billions/state-summary/WV>. <https://www.ncei.noaa.gov/access/billions/risk>.
- TASTI-GRID. 2025. Managed by Oak Ridge National Laboratory. <https://tasti-grid.ornl.gov>.
- U.S. Department of Energy (DOE) Office of Cybersecurity, Energy Security, and Emergency Response (CESER). 2021. State of West Virginia Energy Risk Profile. <https://www.energy.gov/sites/default/files/202109/Mississippi%20Energy%20Sector%20Risk%20Profile.pdf>.
- U.S. Census Bureau, American Community Survey. 2025. <https://www.census.gov/quickfacts/fact/table/MS/PST045224>.
- U.S. Energy Information Administration. 2025. West Virginia State Profile and Energy Estimates. <https://www.eia.gov/state>
- U.S. Energy Information Administration. 2025. West Virginia Utility and Reliability Data. <https://www.eia.gov/electricity/data/eia861/> [https://www.eia.gov/electricity/annua/htm/epa\\_11\\_01.html](https://www.eia.gov/electricity/annua/htm/epa_11_01.html) [https://www.eia.gov/electricity/annua/htm/epa\\_11\\_02.html](https://www.eia.gov/electricity/annua/htm/epa_11_02.html) [https://www.eia.gov/electricity/annua/htm/epa\\_11\\_03.html](https://www.eia.gov/electricity/annua/htm/epa_11_03.html).
- U.S. Energy Information Administration. 2022. “Today in Energy: Energy Outages from Extreme Weather.” <https://www.eia.gov/todayinenergy/detail.php?id=6130>