NASEO · MEASURING WHAT MATTERS

Resilience Burden

Measuring grid resilience in Mississippi from the customer's side

Mississippi Development Authority · Energy and Natural Resources Division

How resilience has been measured

Index	What it describes
SAIDI	System average interruption duration index; the total average time a customer spends without power over a year
SAIFI	System average interruption frequency index; how frequently outages occur over a year
CAIDI	Customer average interruption duration index; average restoration time once outage has begun
VoLL	Value of lost load; an estimated dollar cost of each unit of power lost

> The indices tell us about the reliability of a system, but the data is aggregated across a large area and difficult to understand from the consumer's perspective. VoLL is more intuitive, but still has key limitations.

Problem 1: reliability is not resilience

RELIABILITY

The day-to-day state of the grid



Small, frequent blips

vs

RESILIENCE

The ability to withstand and recover from severe events



One severe event, long recovery

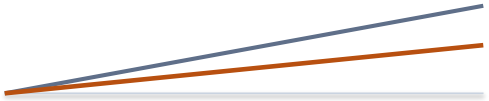
> Resilience shocks may be less frequent than reliability blips, but they are still part of a customer's lived experience. As extreme weather events become more commonplace, we require better metrics to capture its impacts.

Problem 2: what is the actual impact?

Value of lost load (VoLL) puts outages in dollar terms, but it is most compatible with reliability events rather than extreme cases of resilience. It's a useful tool for:

Short outages

A fixed rate cannot capture costs that compound as an outage drags on.



Close early on, then diverge

Contained outages

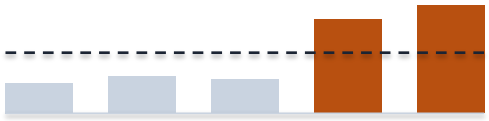
It assumes outages do not trigger widespread interdependence failures across systems.

Power	**Healthcare**
Water treatment	**Food access**

Severe outages can bring down critical infrastructure, leading to a dramatic spike in costs.

An aggregated view

The output is still at the system level, which can obscure the compounding costs experienced by vulnerable households.



The average hides the costliest households

The solution: resilience burden

ENERGY BURDEN: FIXED, TIME-BOUND

∑ Energy costs ÷ Household income

RESILIENCE BURDEN: DYNAMIC, NO UPPER BOUND

Cost of a major interruption ÷ Household income

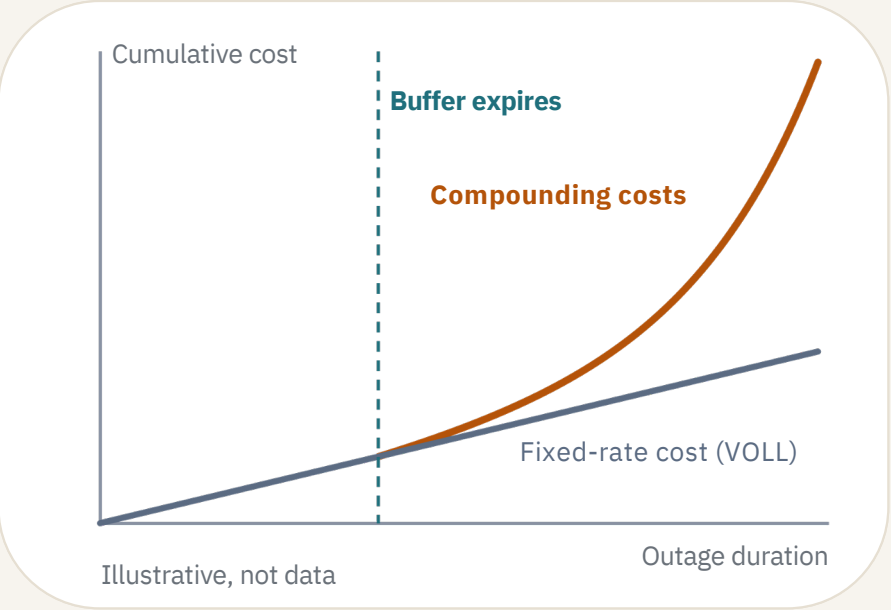
> Puts the customer's experience back at the center and better connects utilities to customers. But while energy burden occurs within a fixed period, **compounding resilience costs can continue indefinitely until properly addressed.**

Outage costs can spiral quickly

Build off of VOLL, but make costs exponential based on household buffer time. A household's buffer is how long it can delay financial and physiological damage. It depends on:

- Thermal retention of the dwelling
- Backup power generation
- Ability to relocate or access resilience hubs.

> Knowing what that cost looks like lets us target investments that reduce outage costs.



Costs hit hardest where capacity is lowest

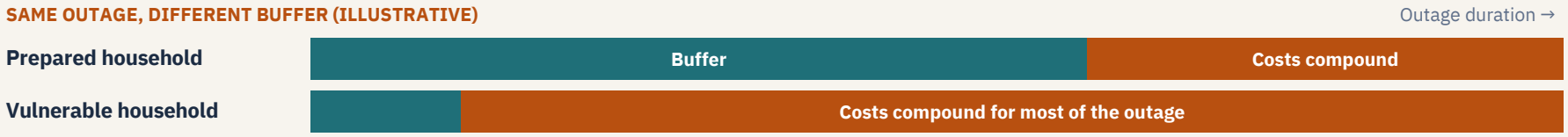
Households with lower incomes and fewer resources tend to be more vulnerable to outages, and the effect compounds on both sides of the ratio. Until critical infrastructure and household conditions are restored, costs will continue to accumulate.

Numerator rises ▲

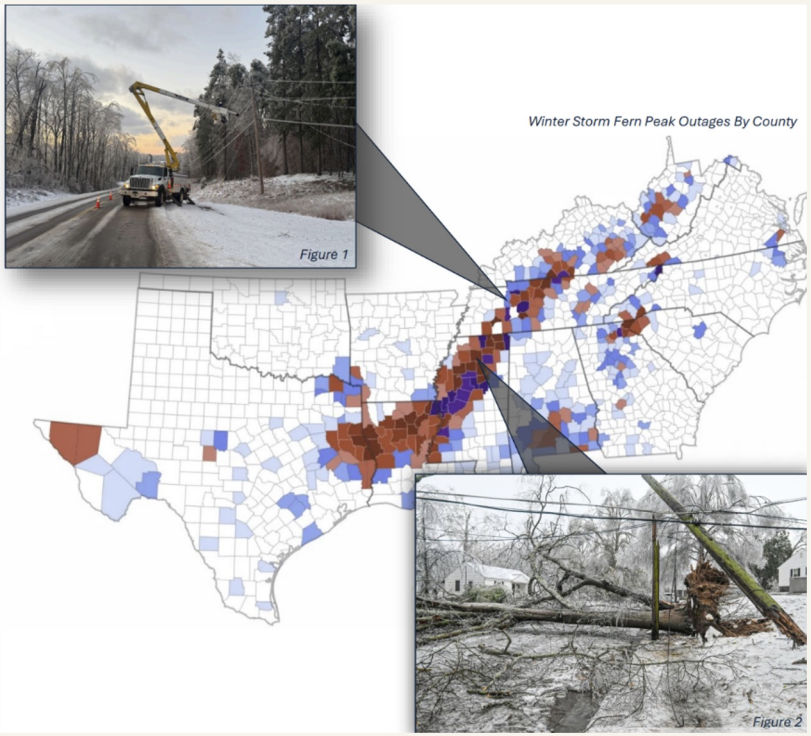
Less preparedness means higher outage costs.

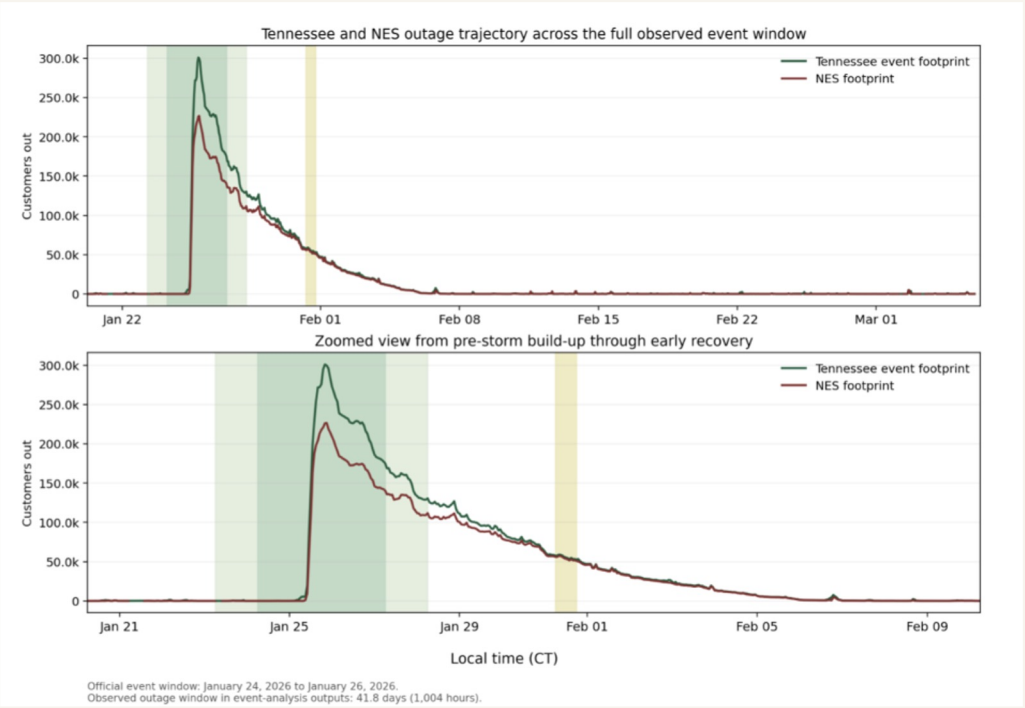
Denominator shrinks ▼

Lower income makes those costs harder to absorb and pay off.



How: a survey of Winter Storm Fern





Left figures: https://tnelectric.org/2026/01/27/winter-storm-fern-restoration-update-mutual-aid-crews-arrive-to-support-tennesseeelectric-co-ops/ ; https://oxfordeagle.com/2026/01/25/photo-gallery-winter-storm-fern-damage/ ; https://poweroutage.us/research/winter-storm-fern-analysis

Right figures: **Iyer et al. (2026), Winter Storm Fern: Cross-State Outage and Economic Cost of Outage to Electric Utility Customer Analysis Report.**

Our contribution

The Fern survey lets us refine how we measure resilience moving forward.

1. Closer look at reported costs

Survey questions designed to capture what households actually lost and paid after the storm.

2. Where should we be investing?

Differences in reported cost across socioeconomic groups, and across experienced outage durations.

Thank you!

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