Sandia National Laboratories

SPATIAL RISK ANALYSIS TO SUPPORT RESILIENCE-ORIENTED ENERGY STORAGE PLANNING FOR KCEC

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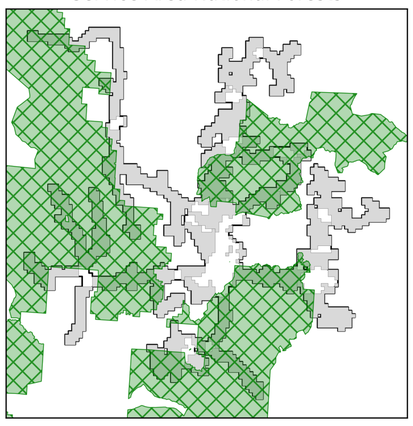
PROJECT PROFILE

Topic: Grid Resilience & Reliability
Vertical: Analytics, Grid Integration and Field Validation
Strategic Pathway: Stabilize
Project start and finish: FY25-FY26

PROBLEM

- KCEC serves a rural, hazard-exposed service territory in northern New Mexico
- Key **risks** include:
  - wildfire exposure
  - long feeder outages
  - difficult access
  - dispersed critical loads and vulnerable populations
- **Planning challenge:** where do hazard exposure and high-consequence community impacts overlap?
- **Need:** a transparent, data-driven way to prioritize resilience investments

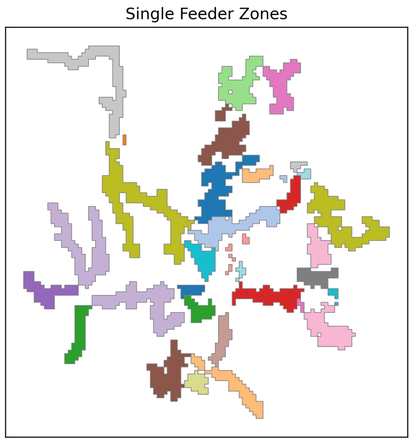
Service Area National Forests

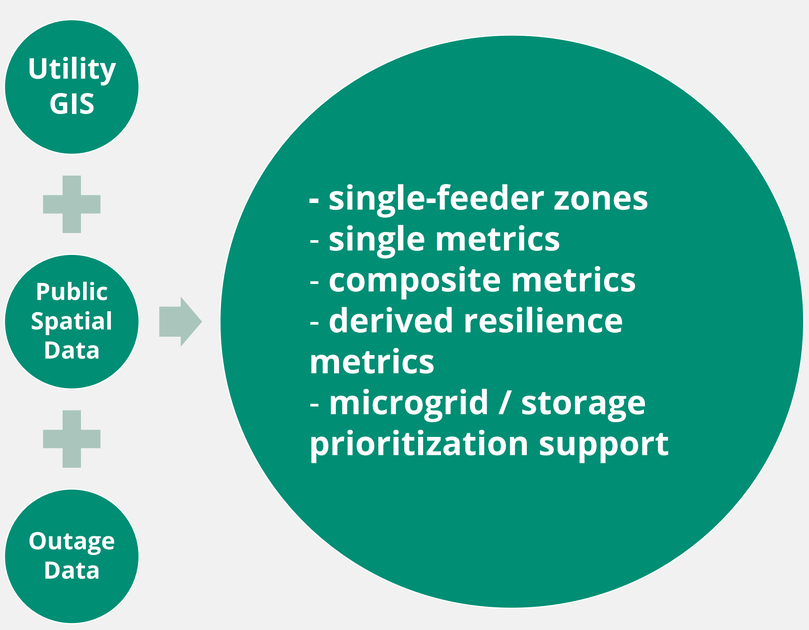


APPROACH

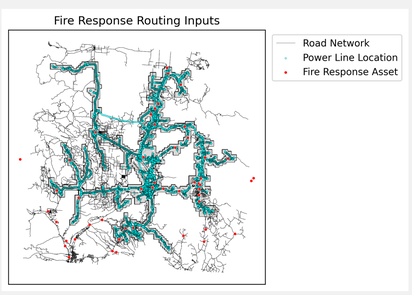
- Defined **34 single-feeder zones** as comparable units of analysis
- Collected and associated spatial data for each zone:
  - critical infrastructure
  - outage history
  - fire response access
  - national forest overlap
  - wildland fire potential
  - tribal and at-risk population indicators
- Developed:
  - single metrics
  - composite metrics
  - derived resilience metrics
- **Goal:** move from hazard awareness to consequence-aware prioritization

Single Feeder Zones

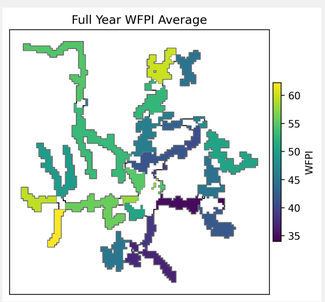




Fire Response Routing Inputs



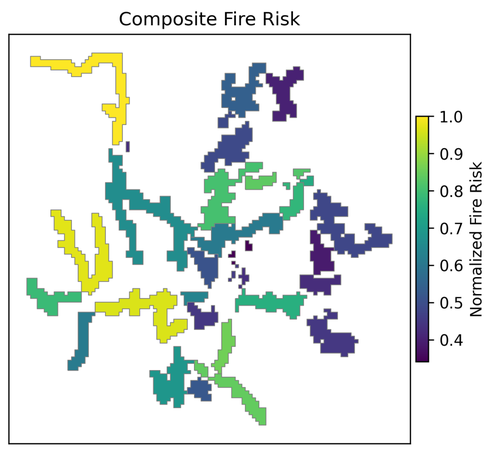
Full Year WFPI Average



RESULTS

- Developed normalized maps for:
  - outage impact
  - fire risk
  - system criticality
  - at-risk populations
- Derived metrics highlight zones where:
  - wildfire exposure overlaps with critical infrastructure
  - outage burden overlaps with vulnerable populations
- Main insight: **hazard and consequence do not always align**
- Value: identifies zones where resilience interventions may provide higher benefit

Composite Fire Risk



CONCLUSIONS & IMPACT

- Provides a **data-driven resilience screening framework**
- Supports prioritization of investments that strengthen:
  - **reliability**
  - **security**
  - **continuity of electric service**
- Enables more informed decisions about:
  - where storage-enabled microgrids may provide higher value
  - where hazard exposure overlaps with higher-consequence community needs
- Aligns with OE strategic pathways:
  - **Stabilize** service in high-risk areas
  - **Optimize** resilience planning decisions
  - **Grow** future-ready microgrid and storage deployment

FUTURE DIRECTIONS

- Refine weights and assumptions with utility stakeholder input
- Incorporate updated feeder, outage, and critical load data as available
- Connect spatial screening outputs to:
  - site-level storage analysis
  - microgrid design
  - resilience investment planning
- Adapt the framework to future KCEC microgrid candidates and similar rural utility systems

References

1. U.S. Census Bureau, American Community Survey 5-Year Estimates, 2024.
2. U.S. Geological Survey, Wildland Fire Potential Index, 2026.
3. U.S. Forest Service, Forest Administrative Boundaries, 2026.
4. Boeing, G., “Modeling and analyzing urban networks and amenities with OSMnx,” Geographical Analysis, 2025.

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