WHITE PAPER

Optimizing Resiliency for Critical Utility EV Service Fleets

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As utilities rapidly electrify the large vehicle fleets needed to maintain service resiliency, it becomes essential to plan for reliable charging during power outages.Without thoughtful resiliency strategies, utility vehicles risk being sidelined by the same grid disruptions they're sent to resolve.

Utilities are moving rapidly to electrify the light-, medium-, and heavy-duty fleet vehicles needed for storm responses, outage restoration, field inspections and routine maintenance of equipment deployed across service territories that may span hundreds of square miles.

As these mission-critical vehicles transition away from internal combustion engines, there is a growing need for EV resiliency. This key challenge is on the minds of utility fleet operators:

How can utilities reliably charge their fleets during grid disruptions without overbuilding costly backup solutions?

Data-Driven Approach

Though EVs driven by the general public may be able to sit idle during an outage, utility service vehicles are most needed during that time. They must be dispatched to repair downed power lines, restore blown transformers, reset breakers and make other emergency repairs to get consumers back online as rapidly as possible.

This requirement for continuous availability makes charging disruptions especially challenging for utility operations. However, as regulated utilities, overbuilding costly backup infrastructure can lead to unnecessary capital expenditures, higher rates for customers and regulatory scrutiny. A practical approach requires targeted, data-driven planning that balances resiliency, coverage and cost across a distributed fleet network.

Grid Outage Risks

All utilities are well-acquainted with the events that can cause service disruptions. A few of the most common causes include:

Extreme weather events like hurricanes, tornadoes and the heavy flooding that these storms often produce.

Public Safety Power Shutoffs (PSPS) that are implemented by local and regional emergency response authorities during high-risk periods in wildfire-prone areas.

Grid overloads during periods of excessively hot or cold temperatures, leading to brownouts or rolling blackouts.

Cyberattacks and related infrastructure failures that can take unprotected digital equipment out of service.

Aging power equipment or maintenance errors that can cause unexpected, localized power outages.

Physical damage from accidental vehicle strikes, construction mishaps or component failures, such as when vegetation comes in contact with power lines.

Each of these potential events raises the stakes for utility operations managers to develop proactive resiliency strategies that will keep their fleets ready to respond to any of these risk factors.

Moving Beyond Depot-Based Backup

Traditional backup strategies for critical fleet charging have focused on depot-centric solutions where diesel generators, battery storage and other elements of fixed power infrastructure are installed. While this strategy works for small fleets, installing similar localized charging at multiple depots needed to support large, dispersed fleets can result in overbuilt and underutilized infrastructure.

A network-wide optimization strategy is a smarter and more cost-effective approach because it shifts the focus to a data-driven assessment aimed at determining the minimum number of depots required to provide full resiliency across the entire service territory.

This approach minimizes infrastructure costs while maintaining operational continuity. Geographic information system (GIS)-based network modeling can be used to:

- Assess travel-time constraints that may prevent vehicles from reaching alternative charging sites within reasonable timeframes.
- Analyze fleet distribution and restoration priority areas, aligning backup power placement with field operation needs and outage response requirements.
- Optimize infrastructure deployment so that unnecessary investments are avoided, while still supporting fleet-wide storm-readiness and service reliability.

This reverse-engineered strategy helps utilities avoid excessive costs while keeping their EVs charged and mission-ready during grid disruptions.

Establishing Charging Resiliency

Though each utility will have unique considerations when developing plans for charging resiliency, it is generally the case that more backup sites do not always equate to better resiliency. Instead, the goal is to identify the optimal number of depots that must remain operational during an outage. Here are a few of the common questions that should be addressed during this evaluation:

- How many depots will be needed for strategic backup coverage and remain functional during a service disruption?
- What is the right mix of fixed versus mobile solutions?
- What is the maximum acceptable travel distance for vehicles to reach backup charging?
- At what point do additional backup sites provide diminishing returns?

The Right Mix

Given the diverse vehicle types and operational needs utilities manage, a hybrid approach using both stationary and mobile backup solutions can provide the flexibility needed to respond effectively to outages and emergency scenarios.

Stationary backup power is best suited for utility-owned locations where vehicles return regularly and where higher-capacity charging is required. These locations may include:

- **Mission-critical operations sites**, such as grid restoration yards, substations with fleet staging and regional service centers that must remain functional during major outages.
- **High-density charging locations** where multiple vehicles charge overnight requiring a consistent and predictable energy supply.
- **Sites in areas prone to long-duration outages**, where mobile solutions alone may not provide adequate support.
- **Grid-supporting infrastructure**, such as locations with on-site solar, storage or microgrids capable of sustaining power independently during disruptions.

Stationary charging solutions can include each of these power sources separately or in some combination.

- Battery energy storage systems (BESS).
- Microgrids configured with on-site solar and energy storage.
- Diesel or natural gas generators.

Mobile backup charging is well suited for fleets with variable routes, remote field operations, or temporary depot requirements. These fleets may be needed to support:

Factor	Fixed Backup (Stationary Power)	Mobile Backup (Battery Trailers, Generators)
Reliability	Always available at key depots	Deployable to affected areas
Cost	Higher capital and O&M cost, lower logistics	Lower capital and O&M cost, higher logistics
Flexibility	Fixed to a single location	Moves to where it's needed
Best Use Case	Continuous backup for critical fleet depots with regular vehicle returns	Temporary charging support for field crews, remote operations, or during localized outages

***Figure 1:** These key considerations for fixed vs. mobile power will guide planning for the optimal charging strategy.*

- **Field-based utility crews**, such as line workers operating service trucks that may need to charge while deployed for grid repair or storm response.
- **Remote or satellite depots** in locations that may need only temporary backup power.
- **Resolution of short-duration grid outages**, where power may be out for only a few hours, making full-scale backup unnecessary.
- **Emergency response calls** utilizing vehicles that must be rapidly recharged at different locations depending on disaster response needs.

Mobile backup power solutions commonly include:

- Battery trailers with integrated or paired DC fast chargers.
- Portable diesel or hybrid generators for temporary power supply.

Modeling to Optimize Backup Power Placement

GIS tools can support cost-effective and efficient backup power planning by using geospatial data to model factors like vehicle routes, depot locations, and outage risk. The outcomes may include:

- **A detailed utility fleet analysis** mapping vehicle movement patterns and energy needs.
- **Optimization modeling** that identifies the minimum number and ideal placement of backup-equipped depots needed to maintain coverage across all fleet locations within a defined travel-time threshold.
- **Weighting considerations** to determine the best locations to house mobile backup assets, including factors such as regional vehicle density, restoration priority, depot criticality, travel logistics, and historical outage exposure.

By leveraging real-world fleet data, operators can avoid unnecessary infrastructure spending while supporting grid service continuity during outages.

Resiliency Planning in Action

A regional utility with more than 200 locations and operating a fleet comprised of several thousand EVs needed to improve charging resiliency without excessive capital investment. We supported the utility by applying a data-driven, network-wide resiliency strategy that included:

- Mapping fleet operations to identify priority vehicles and locations.
- Assigning stationary or mobile backup power based on site criticality.
- Optimizing asset placement so all depots could access emergency charging within 20 minutes.

When implemented, this strategy is expected to maintain service readiness while reducing the total number of backup sites and lowering infrastructure costs by 15%, resulting in several million dollars in potential avoided capital investment.

Future Proofing

For utilities, emergency response, logistics, and transit operators, planning for charging resiliency requires more than just installing backup power. Achieving the right mix of resiliency and continued service readiness must be based on strategic, data-driven decision-making.

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