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WHITE PAPER

Get Ahead of the Crisis: Factor Evacuation-Driven Demand Into Utility Plans for EV Charging

By Cody Ruben

Electric vehicle (EV) adoption is growing rapidly, as are instances of extreme weather. Are these two growth trends on a collision course? As utilities develop emergency response plans for extreme weather events, they should plan for mass evacuations in which a significant number of those fleeing are driving EVs. Incorporating these scenarios can help utilities sidestep the risk of overloaded power grids along heavily traveled routes.

The widespread adoption of EVs is already in progress, with the global market expected to register 40% growth by 2027, according to Precedence Research. That means millions of EVs on the road in North America. Utilities are already prepping for expanded charging infrastructure and growing loads. But — as the staggering rise in extreme weather events continues — a new challenge emerges: helping keep all drivers safe during a mass evacuation, whether their vehicles are powered by gasoline or electricity.

Over the decades, utilities have become skilled at developing emergency response plans for extreme weather events. As more of these events force mass evacuations, new realities arise as more customers are relying on EVs to get out of danger zones. Utilities should anticipate this shift by factoring in the prospect of surges in load along evacuation routes as EVs recharge. Both preventive and proactive steps will prepare utilities for their role in future public safety.

Potential Impact of Mass EV Evacuations

Those who have evacuated in the face of an oncoming storm or threatening wildfire can speak to the stress of fuel shortages. Waits can last hours, only to find the station has run out of gasoline upon finally getting to the pump. Now imagine lines of EVs waiting for a charging station, only to find power is unavailable when you finally plug in. In those

scenarios, the utility has likely needed to implement rolling curtailments to prevent widespread system instability or blackouts due to the surge in demand.

In 2017, researchers at Princeton University examined evacuation patterns during Hurricane Irma and projected the impact of a larger number of EVs on Florida utilities. The study found potential problems emerging at the edge of driving ranges for EVs moving northward. Southern Florida utilities would have seen little impact, but central Florida utilities likely would have experienced some system problems if EVs comprised just 35% of traffic. With EV traffic at 45%, the study projected, most central Florida utilities would see serious system problems, including large cascading outages throughout the Southeastern U.S.

While the study assumed a worst-case scenario, it's instructive on the potential impact. The issue is quickly gaining attention from policymakers. In 2020, Florida Gov. Ron DeSantis signed a statewide mandate requiring construction of more public charging stations along state highways to enable EV-driving residents to evacuate northward more quickly during hurricanes or other emergencies.

EV Charging Technologies

There are three primary types of EV charging stations:

- **Level 1 charging** through a 120-volt outlet. These are relatively slow charging units due to voltages usually found in residential settings.
- **Level 2 charging** through a 240-volt service. This type of charger is becoming more prevalent in the United States, offering about 25 miles of range per hour of charging.
- **DC fast chargers (DCFC).** These are the preferred charging systems at highway locations, offering approximately 100 miles of range for every 15 minutes of charging.

According to the National Renewable Energy Laboratory (NREL), availability of Level 2 and DCFC charging is expected to continue to grow at a rapid pace. An NREL report estimates that the U.S. will have about 600,000 Level 2 chargers by 2030, up from nearly 72,000 at the end of 2020, and that the number of DCFC stations will double to more than 27,000 during the decade. Much of this growth is forecast to take place in California, Florida and elsewhere along the East Coast — places prone to fires or other extreme weather events that can require evacuations.

The NREL study is one of many that projects EV growth as a near certainty as battery cost continues to decline and fast-charging technologies continue to advance. Utilities serving areas where mass evacuations are likely to occur will face increasing difficulty forecasting peak demands and system impacts from emergency charging scenarios.

Looking Ahead in Planning Measures

Renewable sources will comprise much of the new generation coming onto the grid, with both utility-scale renewables and distributed energy resources (DERs) likely to account for the largest share of new power coming online. Utilities could begin planning to incorporate some of this new capacity at critical points along transportation corridors where fast-charging EV charging stations are likely to be added.

Other planning measures could involve:

- Emergency capacity purchase agreements with neighboring utilities
- Development of microgrids
- Vehicle-to-grid (V2G) charging
- Utility-owned charging stations
- Practices to reduce cybersecurity risks

Capacity Sharing Arrangements

Where adequate spinning reserves of capacity are available, utilities could develop agreements with neighboring utilities to boost standby generation in mass evacuation zones. If these agreements already exist, adding or adjusting an emergency response clause might be considered. Generation dispatch would ramp up in coordination with local and state authorities as evacuation orders are issued in advance of storms, floods or wildfires. Utilities already have effective models to work from, with the mutual assistance agreements that send line crews across the country to restore service in the wake of storms.

Regional transmission organizations and utilities should also jointly plan capacity limits on transmission and distribution networks for the emergency dispatch of power to recharging zones. Wires, transformers, protection devices and other grid components may need upgrades to safely handle these short-term surges. This proactive system planning will require close coordination among several public and private stakeholders, including obtaining accurate maps of EV charging stations being considered by government transportation agencies.

Microgrids

Microgrids could deliver multiple benefits, especially as advances in research and technology, as well as increasing capacity from DERs are making them a viable grid planning tool. Microgrids could deliver system stability when isolated pockets of the grid are experiencing stress. They could be

at the forefront of post-emergency service planning for fast recovery from outages once the natural disaster has passed.

Before DERs, areas cut off from generation were left in the dark until downed lines and poles were repaired and placed back in service. With strategically dispersed DER generation integrated with microgrids, power could quickly be restored to key sectors, including mission-critical facilities like hospitals, public safety agencies and temporary shelters.

Vehicle-to-Grid Charging Technology

Fully charged batteries within EVs could become another source of dispatchable DER, even when a homeowner has evacuated through other means. Large numbers of EVs outfitted with V2G charging technology and left plugged into the grid would be feasible sources of dispatchable power available within a temporary microgrid.

Though V2G technology is still being piloted, EVs could become an important part of emergency response planning. Incentive programs might encourage EV owners to leave their vehicles plugged in if they have other evacuation options. As more drivers opt for EVs in coming years, utilities can track the numbers of EVs within their service territory to develop reliable forecasts on how much dispatchable EV capacity could be available for post-storm recovery.

Utility-Owned Charging Stations

Some utilities have already invested in their own network of charging stations, which lets them install in locations most optimal for their system. This gives utilities the ability to manage charging demand at points on the distribution grid that can best handle fluctuations in voltage while also providing convenient charging options for customers. To make this economically viable, utilities can apply for government funding — at the federal and state level — for installation of stations.

Utility-owned charging stations can provide multiple benefits — as a source of revenue and for predictive analytics data on EV loads. This data will be helpful for utilities planning basic frequency control on the network. Strategic points where power quality issues have occurred could dictate locations of new charging stations. If stations are located along evacuation routes, this could simplify dispatch schedules and long-distance power transmission during emergencies in which charging-related load spikes can be anticipated.

Charging stations located near generation resources could also provide reliable charging options for EV drivers when they return home after an emergency. Even if service hasn't been restored throughout the grid, utility-owned charging stations near generation resources would be at far lower risk of outages. Depending on the utility's priorities, the number, type and location of charging stations could be strategically optimized based on algorithms to model specific service needs and operational profiles.

Besides providing more EV charging stations, some government agencies are planning to use portable charging options for emergency evacuation scenarios. Utilities should be proactive participants in these discussions, as these stations could both reduce the peak loads from evacuating EVs and give utilities another potential customer for renewable energy that would otherwise have to be curtailed.

Thinking About Cybersecurity

As utilities deploy more EV charging stations within their service territory, fundamental cybersecurity controls must be a part of the conversation. These stations are just like any other cyber asset that can be compromised or exploited — except that these external network systems are unlikely to have the same numerous layers of cybersecurity controls already implemented on a typical information technology/operational technology network.

Utilities should make it a priority to include and manage EV charging stations within their cybersecurity risk management framework. As EV adoption continues to increase, thinking ahead and identifying the criticality of providing secure and reliable charging station infrastructure is vital, especially during emergency scenarios like mass evacuations.

A Few Other Considerations

Adding more DERs or other forms of peaking generation to the grid to cope with emergency scenarios comes with its own set of challenges. Mass evacuations are relatively short-duration events, placing utilities in the position of building or buying far more capacity than is needed during normal operating periods.

This could be difficult to justify to shareholders or cooperative members — and likewise concerning to regulators. This is especially true given that curtailment of renewable generation is already occurring at many utilities. In some scenarios, the utility still might have to step in to curtail certain charging stations if load conditions indicated risks of system instability or cascading blackouts. This would create the danger of stranding those are waiting to recharge as well as those who have not yet evacuated.

Conclusion

Extreme weather and natural disasters have long been the focus of utility emergency response planning. With these events increasing in intensity, duration and frequency, the need for creative and proactive solutions has never been greater. Though the increased market share of EVs in consumer and commercial transportation will undoubtedly cause major shifts in load demand for utilities, these trends could help provide some interesting options that could soften the blow.

Microgrids, V2G technology and proactive placement of DERs on the grid can be part of the solution for helping empower safe mass evacuations and deliver shorter timelines for restored service post-emergency. What seems like the perfect storm could instead become the perfect opportunity for generational changes that propel the utility industry forward.

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