

HOME HEALTH CARE IN THE DARK

Why Climate, Wildfires and Other Emerging Risks Call for Resilient Energy Storage Solutions to Protect Medically Vulnerable Households from Power Outages



ABOUT THIS REPORT

Clean Energy Group and Meridian Institute's work at the intersection of health care and energy storage aims to develop and advance clean energy strategies that can prevent or minimize deaths and public health crises caused by power outages by creating models for clean, resilient power systems in vulnerable homes and critical health facilities. This report examines the risks associated with power outages for individuals reliant on electricity for in-home medical and mobility equipment. It provides an overview of existing data systems illustrating the demographics of this population and describes several mitigation strategies currently used to assist these individuals during emergencies. A set of recommendations is included to suggest concrete opportunities to improve access to resilient backup power technologies.

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Contents

- 4 Introduction**
- 6 Executive Summary**
- 9 Who Is Affected Most by Power Outages?**
- 11 Impacts of Power Outages on Home Health Care**
- 13 Emergency Preparedness for Home Health Care**
- 18 Backup Power and Opportunities for Resilience**
- 22 Recommendations**
- 26 Conclusion**
- 27 Endnotes**
- 32 Resources**

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Introduction

“We are a society so dependent on electricity. It will be difficult for folks dependent on medical equipment.”¹

—Junice Wilson, Mendocino Coast Home Health and Hospice, Wall Street Journal (4.27.2019)

Every day, power outages are a fact of life in America’s health care system. Outages compromise the delivery of health care to millions of residents reliant on electricity for in-home medical equipment. Even short-term power outages can adversely affect public health; more often than not, the elderly, the sick, and the poor are most negatively impacted. For residents dependent on electricity for in-home medical equipment, an outage can be potentially fatal.²

Solar and energy storage technologies can protect vulnerable populations in the event of an outage. With the right policies, incentives and market designs in place, these resilient power technologies can serve all in need of reliable and resilient power systems.

Battery storage systems, which can store electricity for use when grid power is unavailable, can prevent a home health care routine from being upended by an outage, but few people are aware that

residential battery storage is a resilient power option. For many that would benefit the most from this technology, high upfront costs remain a barrier. As outages become more commonplace and the need for home health care continues to grow, obstacles to accessing home battery storage will need to be addressed and solutions prioritized to ensure that medically vulnerable households can safely withstand a power outage.

This report examines the risks associated with power outages for individuals reliant on electricity for in-home medical and mobility equipment. An overview of existing data systems illustrating the demographics of this population is provided and the mitigation strategies currently used to assist these individuals during emergencies are described. A set of recommendations is included to suggest concrete opportunities to improve access to resilient power technologies.

What is Resilient Power?

First and foremost, resilient power is the ability to deliver continuous, reliable power even when the electric grid goes down for an extended period of time. Truly resilient power should be generated onsite, should not be dependent on supply chains that may be disrupted during catastrophic events, and should provide benefits throughout the year, not just during emergencies.

Solar PV paired with battery storage (solar+storage) represents a clean, reliable alternative to traditional generators, one that isn't prone to fuel supply disruptions and can deliver savings through the year. When the grid is running normally, a resilient solar+storage system produces energy to meet onsite electricity use, manages demand for grid electricity, and can even generate revenue by participating in utility and grid services programs. When there is a power outage, a resilient system disconnects from the grid and operates independently as a microgrid, a process known as islanding, powering critical loads until grid power is restored. This combination of savings and resilience benefits, along with falling technology costs, has led more and more building owners to consider and implement solar+storage as a cost-effective resilient power solution.

While solar combined with battery storage is an ideal resilient power technology combination, battery storage can also store power from the main grid for use during an outage.



In Eddie Lopez's Concord, California home, electricity does far more than keep the lights on: It powers life-sustaining machinery that his daughter depends on every day. Massiel Lopez's ventilator will only last an hour or two on the unit's backup battery power.³

Photo: Paul Chin/
San Francisco Chronicle/
Polaris

Executive Summary

Home health and home care are on the rise, as more people opt to receive care at home rather than in an institution such as a hospital or nursing home. For many, home health care means relying on electricity-dependent medical equipment, such as oxygen concentrators and nebulizers. There are currently at least 2.5 million individuals reliant on electricity for in-home medical equipment in the United States. There are potentially millions more who rely on electricity-dependent devices and other services to aid in their daily “home care” living tasks, such as climbing up the stairs, bathing, or making a meal. For these households, reliable power can be a matter of life or death. Even a short-term

power outage can quickly become a life-threatening situation. Despite this heightened risk, there are limited opportunities for low-income, medically vulnerable populations to access in-home backup power systems.

Natural disasters and severe weather are resulting in more frequent and longer duration power outages. Electric power outages almost doubled in duration in 2017, compared to 2016.⁴ Five months after Hurricane Maria decimated Puerto Rico’s energy infrastructure, 400,000 people remained without power.⁵ In 2018, Hurricane Michael and Hurricane Florence each left upward of a million people in the dark across the Southeast United States.^{6,7}

Search and rescue teams scramble to evacuate patients as the Feather River Hospital burns during the Camp Fire in Paradise, California, on November 8, 2018.

Photo Josh Edelson/
AFP/Getty Images



For individuals reliant on electricity for home care and home health services, an inability to access power can result in a medical crisis. Health care complications, including outage-related issues like medical device failure, accounted for almost one-third of the estimated 4,645 additional deaths in the three months following Hurricane Maria.⁸

New utility strategies for wildfire prevention also threaten to disrupt home health care routines for already vulnerable residents. Wildfires have become rampant in states like California, where drought and high winds can exacerbate forest fires. In order to avoid another Camp Fire catastrophe, some California utilities are looking to de-energize, or shut down, the grid for periods of time when transmission lines and utility equipment are most likely to spark a fire. Deemed “public safety power shutoffs” by some utilities, de-energizing the grid as a preventative measure would leave customers in the dark for hours, days, or even a week at a time, even if there is no fire.⁹

Pacific Gas and Electric (PG&E), California’s largest utility, has already indicated that the 2019 wildfire season could result in five to 15 grid shutoffs.¹⁰ For medically vulnerable households, these precautionary outages could result in an inability to operate critical medical devices.

According to Michael Wara, director of the Climate and Energy Policy Program at Stanford and member of California’s Wildfires Blue Ribbon Commission, “Everyone who lives in wildfire country in California, which is something like 20 percent of the state, needs to be thinking about this problem as something *they* need to solve. . . . It’s not going to be something that the utility can really solve for them in the near term.”¹¹

Hospitals and other medical institutions are required to install and regularly test alternate backup power sources to ensure the facility will be prepared in the event of an outage; however, for home health care patients, only those with financial means can invest in a backup power system.¹²

Diesel generators, the most readily available residential backup power option, require frequent refueling, often emit pollutants, are prone to failure, and can lead to sickness or death when used improperly.¹³ Generators can also be difficult to operate and refuel, especially if an individual is weak, mobility impaired and living independently.

Battery storage is a safe and reliable emergency power resource. When combined with solar PV, it can provide a longer duration of backup power than storage alone. Places like Puerto Rico have already begun to see the value of resilient energy. A combination of donated and purchased systems doubled rooftop solar installations in Puerto Rico in the year after Hurricane Maria and resulted in 10,000 new residential battery systems.¹⁴ Increased resiliency was the leading motivation for the installations.

Programs to assist electricity-dependent households in gaining access to battery storage remain limited to regional pilot projects. As extreme weather trends persist, and power outages become more frequent events, those responsible for the well-being of medically vulnerable communities will need to build on existing resilient power programs and recognize battery storage as essential to emergency preparedness. In doing so, electricity-dependent residents will be able to confidently shelter in place or safely wait for evacuation in the event of severe weather and power outages.

Key Recommendations for Advancing Battery Storage for Medically Vulnerable Individuals

Support research. So far, the impact that outages have on medically vulnerable households remains only narrowly explored, and even fewer resources are available regarding the role of battery storage in mitigating those impacts. Energy security and resilience in home health care should be funded as a priority research field within public health, including issues regarding low-income access to technology innovation and the public health benefits of installing resilient power systems in home health care settings.

Develop better data. The lack of a comprehensive, publicly available dataset makes it difficult to determine the exact size and demographic characteristics of the in-home, electricity-dependent population. In order to determine the size and scope of the electricity-dependent population, agencies such as Medicare and Medicaid should pool resources, coordinate data, and fund researchers to develop more reliable information into a single, unified source.

Technology innovation and market development. There is no market today for third-party providers to offer solar and storage technologies to home health care households. There is an urgent need for a comprehensive market development effort that will focus on technology innovation to develop suitable products and bring down costs.

Utility administered residential battery storage programs. In addition to maintaining a database of electricity-dependent residents, utilities should provide battery storage to homes to protect against outages as part of new residential battery storage services. States should consider requiring utilities to provide these critical technologies as a service for customers who depend on electricity to power medical equipment in their homes. Expanding utility energy efficiency programs to include battery storage also would establish a steady stream of funding for low-income battery storage programs.

Expand Medicare coverage to include in-home battery storage. If battery storage was included in the list of Medicare eligible durable medical equipment (DME), doctors would be able to prescribe battery storage. Medical device providers would then supply resilient power systems to home health care residents dependent on electricity for medical equipment.

For further information, and to review a complete list of recommendations, see the [“Recommendations”](#) section on page 22.



Who Is Affected Most by Power Outages?

Currently, there is no single, publicly available database listing the population of individuals dependent on electricity for in-home medical equipment. The resources that do exist suggest that the population is upwards of 2.5 million and consists primarily of adults over the age of 65.

Medicare and Medicaid Recipients

Medicare covers 44 percent of home health expenditures in the United States, the most of any one provider in the country.¹⁵ The Department of Health and Human Services' (HHS) emPOWER map, which provides county and zip code level data for Medicare beneficiaries that rely

on in-home, electricity-dependent medical equipment, has over 2.5 million beneficiaries mapped.¹⁶ Some estimates have Medicare beneficiaries accounting for up to 90 percent of the electricity-dependent population.¹⁷ Medicaid is the second largest provider of home health expenditures, covering 38 percent of the market. Unlike Medicare, Medicaid does not provide a map or publicly available dataset of electricity-dependent beneficiaries.

Private insurance and third-party payers account for 10 percent of all home health expenditures.¹⁸ Although significantly less than Medicare and Medicaid, the population of privately insured individuals reliant

During Hurricane Harvey in 2017, vulnerable residents in Houston, TX are encouraged to register at city hall.

Photo: Jill Carlson/
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ELDERLY DISABLE AND SPECIAL
NEEDS REGISTER AT CITY HALL
281 399 2660

on in-home, electricity-dependent medical equipment is still potentially large. A 2012 study estimated that 366,619 individuals reliant on electricity-dependent medical devices to treat chronic respiratory illnesses were privately insured.¹⁹

Children

Children also represent an important portion of the in-home, electricity-dependent population. A 2013 study estimated that 0.1 to 0.25 percent of children in the United States rely on an electricity-dependent medical device at any given time, which equates to 73,600 to 184,000 children (based on the most recent census data).²⁰ Many of these children receive health care at home, rather than in a hospital.

Seniors and the Chronically Ill

The vast majority of those reliant on in-home, electricity-dependent medical equipment are senior citizens (adults 65 and older). More than three quarters of American seniors have at least one chronic condition, over half suffer from at least two, and many rely on continued medical treatment.²¹ Over 80 percent of Medicare beneficiaries are age 65 or older.²²

Traditionally, many individuals suffering from multiple chronic illnesses have relied on nursing homes or assisted living facilities for daily care. However, a new trend spurred by recent changes in health care policy and legislation has emerged: seniors are opting to remain at home and age in place. Aging in place is increasingly popular and, as a result, the home health care industry has experienced rapid growth in order to meet the rising demand.^{23,24}

In recent years, healthcare policy and regulation has progressed to reflect the growing demand for home and community-based services. In fact, health care experts estimate that demand for long-term services and support (LTSS) will increase significantly in the coming years as the “baby boomer” generation ages.²⁵ Dementia related to Alzheimer’s disease is expected to play a major role in the demand for those services.

As the population of individuals using home-based community health services increases, Medicaid will also play an important role in financing home and community-based services for those with intellectual and developmental disabilities. In addition, the Medicaid Home-and-Community-Based Service (HCBS) waiver program allows states to waive certain Medicaid program requirements and provide care for people who would not otherwise be eligible for Medicaid.²⁶ Government initiatives like the Office of Disability, Aging, and Long-Term Care Policy (DALTCP) in the U.S. Department of Health and Human Service are also working to protect the well-being of vulnerable, electricity-dependent populations across the country.²⁷

For many, aging in place means relying on in-home, electricity-dependent medical equipment, like oxygen concentrators or ventilators, as part of a home health care routine. With the senior population expected to double by 2060, and home health care trends likely to continue, households reliant on electricity-dependent medical equipment will become even more prevalent.²⁸

Impacts of Power Outages on Home Health Care

For many, the combination of natural disasters and medical conditions can have deadly consequences. The Centers for Disease Control and Prevention (CDC) published mortality data after 2017's Hurricane Irma battered the Gulf Coast; the data showed that more than 15 percent of deaths were attributed to power outages worsening an existing medical condition. Furthermore, an additional two percent of deaths were related to a disruption in medical services caused by a power outage.²⁹ The average age of all victims was 63.

During the 2003 North American blackout, a single Manhattan emergency department reported 23 patients with issues related to medical device failure due to power loss.³⁰ The average age of the patients was 67, and more than half arrived within four hours of the start of the blackout.

Evacuating to Health Care Facilities

Many electricity-dependent residents also struggle with transportation issues when trying to reach shelters or medical facilities during power outages.³¹ Those who are in

A helicopter aircrew rescues people stranded by Hurricane Florence floodwaters near Wilmington, North Carolina.

Photo: Dustin Williams, US Coast Guard



a position to leave their homes mostly turn to their local hospital or medical clinic for electricity and support, and often rely on emergency medical transportation funded by local counties. A blackout study published in 2003 in the *Critical Care Medicine Journal* found that respiratory device failure accounted for 65 emergency department visits and 37 hospitalizations over a two-day period.³² Residents that are evacuated to shelters face similar issues. Of the 1,400 people that checked-in to Louisiana and Texas medical emergency shelters during 2008's Hurricane Gustav, 20 percent to 40 percent relied on electricity-dependent medical equipment.³³

In the event of an outage, individuals reliant on electricity to power medical devices will oftentimes turn to critical community facilities to charge medical equipment. The influx of medically-vulnerable individuals to hospitals and other critical facilities during an outage further stresses these facilities, which are already dealing with the capacity and operational challenges associated with an emergency. For example, disaster-related costs for Texas hospitals after Hurricane Irma alone were an estimated \$460 million.³⁴

In-home battery storage systems could provide electricity-dependent residents with critical on-site power throughout an outage or until evacuation can be safely provided. Giving electricity-dependent residents the ability to shelter in place with access to resilient power for their medical devices can mitigate some of the demands on critical community and medical facilities during an emergency: patient influxes

could be reduced, and the economic and operational burden felt by hospitals and other critical facilities could be relieved.

Sheltering in Place

Emergency assistance during an outage is especially imperative for residents reliant on in-home, electricity-dependent medical equipment. Unfortunately, alerts identifying impending outages are not always effective in ensuring residents actually leave their homes for shelters, and evacuation during or immediately following an emergency event can take time and be dangerous.

The reality is that, despite warnings and disaster preparedness programs, medically vulnerable households are only marginally more likely to evacuate prior to emergency weather conditions.³⁵ Of the 680 people that had to be evacuated to Houston after Hurricane Katrina, over 40 percent had chronic health conditions such as heart disease, hypertension, and diabetes.³⁶ The seemingly dangerous choice to shelter in place during an emergency can be attributed to a variety of factors, including immobility, economic limitations, dependency on heavy medical equipment, not having access to a car or an inability to drive, and/or a lack of a social network outside of the immediate community.

Providing electricity-dependent residents with the ability to shelter in place by ensuring that they have access to resilient backup power for their medical devices can mitigate some of the adverse impacts of power outages.

Emergency Preparedness for Home Health Care

For emergency preparedness to be effective for electricity-dependent households, there needs to be a focus on improving education and outreach, registries for household identification, and emergency alert systems.

Education and Outreach

Emergency preparedness for electricity-dependent residents is typically limited to informational materials. The Federal Emergency Management Agency (FEMA), for example, encourages residents to “plan for batteries and other alternatives,” but FEMA does not detail how individuals can access backup batteries for their medical equipment.³⁷ The U.S. Food and Drug Administration (FDA) offers similar recommendations and includes a section about how to handle medical devices that require refrigeration.³⁸

Materials developed by agencies that directly serve electricity-dependent populations are more useful. The Americans with Disabilities Act Network has prepared the “Emergency Power Planning Checklist,” which differentiates between the types of electricity-dependent medical equipment and includes recommendations, such as “know the working time of any batteries that support your systems” and “check with your vendor/supplier to find alternative ways to charge batteries.”³⁹ The checklist also includes preparedness tips for emergency generator users but does not provide additional information about how residents can access a generator.

There are few, if any, materials or programs available that instruct in-home, electricity-dependent residents on the benefits of battery storage for emergency backup power. Even the materials that cite the potential dangers associated with operating a natural gas or diesel generator do not reference alternative backup power options.⁴⁰



Coast Guard personnel assist 142 residents in need of food, water and portable oxygen at Panama City Health and Rehabilitation Center in Florida following Hurricane Michael.

Photo: US Coast Guard

Registries

Registries have emerged as a popular tool for emergency preparedness; these systems help to identify and catalog vulnerable populations prior to an emergency, though they continue to face challenges related to user interaction and data monitoring.

Many utilities, emergency responders, state governments, and others utilize registries to identify vulnerable individuals that rely on electrical medical equipment. In an effort to better prepare first responders in the event of an emergency, FEMA encouraged jurisdictions to maintain a voluntary registration database of high risk, vulnerable populations.⁴¹ Florida and Texas have incorporated that recommendation by designing statewide registries.^{42,43} Florida's approach also included the creation of a statewide registry for vulnerable households to register with the Florida Division of Emergency Management. In addition, one Florida county created a similar registry for its residents to opt into. Broward County released a "Vulnerable Population Registry" for high-risk populations and developed additional preparedness tools for electricity-dependent residents, including the "Broward County Special Needs Emergency Sheltering and Transportation Program."⁴⁴ The program provides pre-registered residents with specialized evacuation services and access to shelters that provide medical support and backup power for essential medical equipment.

Most states also require utilities to provide similar registry opportunities for electricity-dependent customers. In every state except Florida and Hawaii, state policy mandates that the electric utility either ban or delay termination of service for customers that depend on electricity for medical purposes.

To comply, utilities have set up registration programs aimed at identifying medically vulnerable customers. Utilities typically continue services to those customers regardless of delinquent or past due bills; but state policies vary widely.⁴⁵

In Massachusetts, utilities cannot shut off service if someone in the household is seriously ill, regardless of payment.⁴⁶ Massachusetts also requires utilities to communicate with electricity-dependent residents "before, during and after an Emergency Event, providing information to public safety officials regarding the status of electric service to Life Support Customers' homes, and procedures for prioritizing power restoration to Life Support Customers."⁴⁷

Other states, including Alaska and Wyoming, only require utilities to delay disconnection for 30 days or less. In either case, eligible residents will usually have to fill out a form to certify their medical condition as requiring electricity-dependent equipment and obtain a physician's signature.⁴⁸ While individual utilities can, and do, make stricter disconnection restrictions, state policy ultimately sets the threshold for the minimum time requirements utilities must abide by when moving forward with service termination for customers dependent on electricity for health reasons.

Registry operators continue to face challenges related to user interaction and data monitoring. For example, vulnerable individuals may face difficulties enrolling in registries due to health literacy issues, in which they are unable to describe the equipment they use or navigate an oftentimes lengthy medical review process. In some instances, individuals may not update their registry information when they move or adopt new medical devices.



Electric Utility Alerts

In addition to state mandated registries, some utilities send emergency alerts to customers. NV Energy in Nevada texts power outage alerts and updates to all the customers enrolled in text message updates for their account. NV Energy also created an online Outage Center to keep customers updated as to outages and restoration times. San Diego Gas and Electric (SDG&E) went so far as to meet with each electricity-dependent customer to discuss emergency preparedness.⁴⁹ During the California wildfires, Pacific Gas and Electric (PG&E) called 109,000 electricity-dependent customers and knocked on the doors of those it could not contact otherwise.⁵⁰ One resident still required emergency evacuation when their oxygen machine lost power.

Regardless of how advanced the program, many electricity-dependent customers won't register with their utility, or forget to update the utility or register with a new utility after they move. A survey of almost 900 vulnerable residents in New York City found that only 40 percent of electricity-dependent residents were registered with a utility company to receive alerts.⁵¹

Even for residents that register with their utility, there are no guarantees. There have been multiple reports of registered customers fatally falling through the cracks.⁵² In some instances, families have tried to hold the utility responsible. Georgia Power was sued after it disconnected service that resulted in the death of a woman whose oxygen concentrator could not be powered.⁵³ However, utility

Damage from Hurricane Katrina in 2005.

Photo: Creative Commons/Infrogmation of New Orleans

lawsuits are complicated and difficult to win due to strict limited liability language written into tariffs.⁵⁴ During a widespread outage, utilities will prioritize critical facilities like fire stations and hospitals before individual households. Instead of focusing on households registered as electricity-dependent, crews will be directed to population-dense areas to restore power to the highest number of people in the shortest amount of time.⁵⁵

Emerging Utility Prevention Strategies—Preemptive Grid Shutdowns

As grid reliability during extreme weather becomes more of a concern and resiliency becomes more of a priority, some utilities are changing disaster planning to include preemptive grid shutdowns. The 2018 Camp Fire in California, the deadliest and most destructive wildfire in the State of California’s history, resulted in 85 deaths and forced thousands to seek emergency shelters.

The 2018 Camp Fire that devastated California “was caused by electrical transmission lines owned and operated by PG&E.”

The California Department of Forestry and Fire Protection determined that the fire “was caused by electrical transmission lines owned and operated by Pacific Gas and Electricity (PG&E)...”⁵⁶ Malfunctioning equipment ignited the fire and dry weather and high winds allowed the fire to spread quickly.⁵⁷

In the aftermath, the utility servicing the affected territory, PG&E, is considering de-energizing power lines to its 5.3 million electric customers to reduce the risk of accidentally sparking a wildfire.⁵⁸ Southern California Edison (SCE) and San Diego Gas and Electric Company

(SDG&E) are also considering de-energizing their power lines as a fire prevention measure. The California Public Utilities Commission has approved utility plans to move forward with the preventative shutoffs.⁵⁹

For utilities like PG&E and SDG&E, power shutoffs are meant to avoid a fire that could lead to a larger catastrophe. Unfortunately, each outage would compromise the safety of numerous electricity-dependent residents.

For electricity-dependent home health patients with financial resources, buying or leasing a battery storage (or solar+ storage) system would enable them to be better prepared for these types of potential shutdowns. Unfortunately, investing in a resilient power system is too expensive for many. Programs need to be created to allow more equitable access to resilient power technologies.

Medical Device Providers and Insurance Coverage

Opportunities to access battery storage are not currently available through Medicare and Medicaid. The Center for Medicare and Medicaid Services (CMS) does not consider a generator as medical equipment, and therefore does not cover any associated costs.⁶⁰ However, state Medicaid self-direction programs may include an option for beneficiaries to use a portion of their individual budgets to purchase (or lease, if available) goods and services included in their approved individual plan, which would allow for a generator.

In Ohio, for example, eligible beneficiaries have received a home generator through the Ohio Home Care Waiver Program, which allowed for a portion of their individual self-direction budget to be allocated

towards installing a generator.⁶¹ Self-direction services programs provide Medicaid beneficiaries with autonomy over their services and supports by allowing them to control a portion of their budget, including purchasing goods and services and hiring their own support workers.⁶² States with flexible self-direction programs could be in a unique situation to begin accepting battery storage applications within pre-existing waiver programs.

Medical device providers and insurers can provide backup power resources to vulnerable populations before, and in some instances, during and after a disaster. Batteries exist for a variety of electricity-dependent medical devices, but insurance coverage can be limited and is usually based on the equipment.

Home health care patients reliant on respiratory equipment are among those at highest risk during an outage. There are a variety of critical respiratory devices used in home health care that require electricity, such as ventilators and oxygen equipment. Ventilators have some built-in backup power capabilities, ranging between 45 minutes to a couple hours; however, Medicare does not currently cover a second ventilator if its sole purpose is to serve as a back-up in the event of a power outage.

Oxygen equipment is the most common medical device used by home health care patients. Over one million Medicare beneficiaries currently depend on home oxygen equipment, and 94 percent of them utilize oxygen concentrators that plug into an outlet.⁶³ Some concentrators have batteries that can provide short-term power. In addition to a portable oxygen concentrator, Medicare may also cover a stationary oxygen supply, such as an

oxygen tank, which could be used as a backup supply.⁶⁴

Depending on the agency, certain home health and medical device providers also supply backup air tanks for emergency use. Tanks vary in capacity, and the medical requirements of the patient will regulate how long the backup lasts.⁶⁵ Larger tanks could provide two and half days' worth of oxygen for a patient requiring continued use, whereas a small tank could last under six hours. Home medical device providers have found that, due to size, appearance, and weight, patients will oftentimes refuse a backup tank altogether.⁶⁶

Even those with private homeowners insurance may not be insured against the impacts of power outages, such as damage to electronics, incurred hotel expenses, or spoiled food.

Medical device providers have partnered with local governments to expedite medical equipment delivery during a disaster. In 2005, after Hurricane Katrina levelled infrastructure and flooded New Orleans, the American Association for Home Care asked that the City certify oxygen providers as first responders to ensure oxygen could be delivered with as few barriers as possible. However, the resources available suggest that these partnerships are uncommon.

It should be noted that even those with private homeowners insurance may not be insured against the impacts of power outages, such as damage to electronics, incurred hotel expenses, or spoiled food. In fact, private homeowners insurance for power outages depends on a number of specific variables and differs significantly between individual carriers and policies.⁶⁷



Backup Power and Opportunities for Resilience

Having dominated the market for so long, diesel generators are accepted as a standard, but the emerging battery storage industry demonstrates that the risks and unreliability of diesel generators no longer need to be a necessary evil. There are cleaner and more reliable alternatives. Battery storage could disrupt the diesel generator industry and mitigate the risks faced by home health care patients in the event of an outage. Battery storage generates a better quality of power than a diesel generator and without the harmful residual effects and can be more easily sited in densely populated areas.

Diesel Generators

Diesel generators made up 80 percent of the global generators market in 2017.⁶⁸ Residential diesel generators remain popular, but residents must compromise by accepting unnecessary risks and limitations. Spikes in carbon monoxide poisonings coincide with natural disasters as people improperly operate diesel generators inside during an outage. In fact, one study found that 83 percent of fatal disaster-related carbon monoxide poisonings in the United States were attributed to improper generator use.⁶⁹ Carbon monoxide poisoning from improper generator use killed twelve people after 2012's Hurricane Sandy resulted in power outages throughout the Northeast.⁷⁰ Dozens were affected and at least six people died from generator-related carbon monoxide poisoning after Hurricane Irma.⁷¹

Additionally, gas shortages, a common occurrence after an emergency event, also impact diesel generator reliability. A gas rush in the wake of Hurricane Florence resulted in 56 percent of gas stations in Wilmington, North Carolina running out of fuel, leaving residents without gas for their cars or generators.⁷²

GENERATORS AND PUERTO RICO

After Hurricane Maria hit Puerto Rico in 2017, a team from the University of Washington travelled to the island to research the potential for solar+storage technologies to support the critical medical needs of electricity-dependent households.⁷³ In their investigation, they found that households that relied on a diesel generator reported that the generator was too noisy to be used at night, released toxic gases that worsened some medical conditions, and were prohibitively expensive to fuel at \$10 a day. Additionally, because diesel generators are not meant to provide continuous power, even staggering use overworked some generators and resulted in mechanical failure.

The researchers interviewed 15 households where solar+storage systems were installed and noted that all fifteen households preferred solar+storage, and that nine of the fifteen reported improved health when compared to living with a diesel generator. Though the upfront costs of solar+storage exceeded that of a diesel generator, solar+storage systems were found to be the more cost-effective backup power solution after repeated or extensive outages.

“During Hurricane Maria, hundreds of people died simply because they couldn’t keep their insulin refrigerated or their oxygen machines running. We need the solar and storage . . . so we can protect health and safety through the next hurricane with distributed, reliable energy infrastructure.”⁷⁴

—Ariana Gonzales, Sierra Club Environmental Justice Organizer

Residential Battery Storage

The current market for battery storage is largely focused on commercial customers or affluent residential customers. While there may be some home health care beneficiaries with the means to purchase a battery storage or solar+storage system outright, for the majority, high upfront costs make the investment challenging. In order for there to be widespread battery storage adoption by the home health care community, a new market will need to be built that serves the needs of these populations.

There are significant challenges to scaling up this market, and the issues to resolve are complex. First, many of the battery storage technology options available today may not be well-suited to all home health

care situations, because many battery system offerings would be oversized for most of these smaller medical loads, and therefore too expensive for many of these applications. Second, residential storage markets today are still immature, and most companies target more lucrative commercial or high-end residential customers. Third, as noted elsewhere, there are no dedicated policies or incentives to create inducements for battery storage companies to sell into this market. Fourth, many home health care beneficiaries live in low-income households or are renters, and they cannot afford the upfront cost of these technologies or qualify for financing.

The lack of battery storage market development for the home care population has resulted in non-traditional providers

After Hurricane Maria destroyed the main building, providers at COSSMA San Lorenzo medical facility were forced to treat medical and social patients using a shelter and two military-style trailers.

Photo: Preston Keres, USDA



Sonnen battery storage system at the McKnight Lane Redevelopment Project in Vermont. McKnight Lane was one of the first examples of resilient, zero-energy, modular housing in a rural community.

Photo: Clean Energy Group



stepping in and creating opportunities for residential resilient power systems. For example, disaster relief funding presents a unique opportunity to rebuild more resilient home power systems and select utilities have emerged as opportune resilient power providers, especially for electricity-dependent households. Below are several examples of innovative new programs that are being implemented to bring battery storage to at-risk and vulnerable populations.

GREEN MOUNTAIN POWER, VERMONT

Green Mountain Power (GMP), the largest utility in Vermont, partnered with Tesla for a pilot program that will provide Powerwall battery systems to 2,000 customers.⁷⁵ What sets GMP's program apart from other residential battery programs is its equity component. For 100 low-income customers who are dependent on electricity for medical purposes, the Powerwalls will be installed at no fee and eligibility is not dependent on home ownership (i.e., renters can participate). All other customers will be subject to a \$15 a month payment

(or \$1,500 upfront) to use the Powerwall for backup power during an outage.

The Tesla Powerwalls are connected to and charged by the grid and therefore don't require solar PV, although customers with preexisting solar systems could also connect their solar system to the Powerwall. GMP operates the network of batteries as a virtual power plant, drawing on the stored energy during times of peak electricity demand. The eight million dollars in upfront costs for the market rate program was provided by GMP, while the subsidized rate for electricity-dependent households was made available through a Vermont Low Income Trust for Electricity (VLITE) grant. GMP used their internal critical medical equipment registry to outreach to potential VLITE Powerwall recipients. GMP also offers a "Bring your Own Device Program," which credits customers for connecting their own energy storage devices to the grid.

The 1,200 batteries currently installed through GMP's programs are already proving valuable economic and resiliency benefits. For example, when severe winter weather impacted service to over 116,000 GMP customers in November 2018, Powerwalls installed in 438 homes supplied power to those homes for an average of 12 hours. One homeowner who connected a Powerwall to an existing solar PV system powered his home for over for 83 hours.⁷⁶ In August 2018, GMP saved \$600,000 when the Powerwalls and larger grid-scale battery installations offset peak demand with reserved energy.⁷⁷ The savings incurred by the utility will ultimately be passed to the ratepayers, helping to lower the overall energy burden for every Vermonter.

LIBERTY UTILITIES, NEW HAMPSHIRE

Liberty Utilities is set to launch a home battery storage pilot in New Hampshire.⁷⁸

Similar to GMP's program, the batteries will be installed in homes as resilient backup power and act as a virtual power plant to offset peak energy usage. The first stage of the pilot consists of Liberty installing 500 batteries, two in each home. The batteries will cost households \$2,433 per system or \$25 per battery per month. The second stage of the pilot will allow private companies to install up to 500 additional batteries, open up third party ownership options for an additional 2.5 megawatts of battery capacity, and include a "bring-your-own-device" program. Currently, there is no indication that a portion of batteries will be subsidized for low-income or electricity-dependent residents.

CLEANCHOICE ENERGY, MARYLAND

Unlike Liberty Utilities and GMP, CleanChoice Energy in Maryland is a third-party energy supplier that provides customers with the option to purchase their electricity from renewable sources.⁷⁹ CleanChoice partnered with Swell Energy, a solar and storage developer, for a home energy storage battery program in Maryland.⁸⁰ The batteries will provide grid services as well as resilient power benefits for the homeowner. A \$5,000 state tax credit will help to offset upfront costs.⁸¹

GLASGOW ELECTRIC PLANT, KENTUCKY

Glasgow Electric Plant, a small rural municipally-owned utility in Kentucky, installed battery storage systems in 165 homes to combat peak demand.⁸² The distributed energy system will be connected by the grid and energy management software will control the individual systems as a single virtual power plant. The systems will reduce emissions caused by peak generation power plants and lower demand costs for customers. Customers with the batteries receive the added benefit of resilient power during an outage.

DISASTER RELIEF FUNDS, PUERTO RICO

In the wake of Hurricane Maria, a resilient power movement has taken root in Puerto Rico. Solar+storage systems have been installed in residences and critical facilities, including health centers.⁸³ Continuing this commitment, the Puerto Rican government proposed in the "Puerto Rico Disaster Recovery Action Plan" that \$436 million of \$8.2 billion in Community Development Block Grant Disaster Relief (CDBG-DR) be earmarked for solar and storage incentives.⁸⁴ Incentives will prioritize vulnerable populations, including those with critical medical needs. An additional \$75 million will be set aside for Community Resilience Centers and \$100 million for a revolving loan fund to support contractors. It will be the largest energy incentive in the country and set a precedent for future federal disaster relief funding to support resilient rebuilds that prepare states for the next disaster, rather than only recover from the last one.⁸⁵

Sunverge resilient battery storage system at the Clinica Profamilia in San Juan, Puerto Rico. Pictured is a Clinica Profamilias staff member.

Photo: Clean Energy Group





Recommendations

As more people require electricity for critical health services, technology innovations for improving back-up power systems are inevitable. The growing residential battery storage market can transform how electricity-dependent households prepare for and prevail through a storm or power emergency. The federal, state, and local entities that play a key role in addressing energy access and meeting the health and security needs of medically vulnerable populations should coordinate with utilities. They should consider battery storage (or more ideally, solar+storage) as critical to life supporting medical devices that would protect public health during a disaster and provide opportunities for electricity-dependent individuals to access resilient systems.

Below are several recommendations to address the challenges to the adoption of battery storage technologies for home health care resiliency.

Research

More research is needed to better understand the impacts of power outages on medically vulnerable households and how battery storage could mitigate those impacts. In addition to data gaps, there remains technology gaps, such as how much battery storage capacity is required by medical device type. Pre-existing preparedness programs, like utility disconnect registries, require evaluation. Deaths relating to utility disconnects should be compiled and analyzed, in order to determine the impacts of the disconnects and how

they can be improved. Additionally, pre-existing battery storage pilot programs should be analyzed to understand system performance in the event of an outage. Finally, climate trends will inevitably continue to affect health trends. The connection between climate, outages, and health exists, but it's not clear to what extent. Research focused on these relationships can better inform future policies and programs aimed to serve medically vulnerable households.

Data

In order to accurately determine how extensive the electricity-dependent population is, agencies such as Medicare and Medicaid will need to pool resources and coordinate data into a single, unified source. Although tracking systems that identify the number and location of electricity-dependent medical equipment have evolved significantly over the past decade, there are ample opportunities to use big data and technology to better identify those dependent on electricity for medical devices. For example, durable medical equipment (DME) could incorporate devices that monitor equipment battery power and signal emergency responders using GPS once battery charge falls below a certain threshold.⁸⁶ In addition, local and state governments, utilities, and Medicaid can improve data tracking of electricity-dependent individuals by exploring potential data-sharing with the HHS emPOWER Program. The emPOWER map provides a monthly updated total of claims data, down to the zip code, for Medicare

beneficiaries that rely upon 14 different types of electricity-dependent medical equipment and devices.^{87,88}

There may also be opportunities to standardize patient risk categories so that emergency response personnel can clearly identify the individuals that must be prioritized during an emergency event. Finally, appropriate protective measures must be implemented to ensure that patients' privacy is protected in accordance with applicable laws and regulations.

Technology Innovation and Market Development

There is no market today for third-party providers to offer battery storage technologies to protect high risk populations, like home health care households, during an outage. There is therefore a need for a comprehensive market development effort that will focus on technology innovation to develop suitable products and bring down costs. It will be necessary to coordinate market development with building battery storage awareness in the home health and home care community in order to ensure that consumer demand is created for these new products and services.

Utility Programs

In the absence of robust third-party energy markets or in states where utility monopolies still prevail, utilities are in an ideal position to administer residential battery storage programs. In addition to having access to a database of electricity-dependent residents, a utility can also reap the benefits associated with a virtual power plant. Pilot residential programs like Green Mountain Power's are already affirming that resilient power can improve the quality of life for medically vulnerable households and prove cost effective savings through grid services. Market-rate batteries can be leased to homeowners for a low fixed

rate, whereas long-term resilient power solutions for low-income populations will require utility, governmental, and regulatory authority partnerships. Expanding energy efficiency programs to include battery storage would establish a steady stream of funding for low-income battery storage programs.



Affordable Housing Standards

Battery storage should be incorporated into affordable housing standards. Although the Low-Income Housing Tax Credit (LIHTC), the largest federal subsidy available for affordable housing development in the United States, does not require green building standards, affordable housing leaders are mandating that certain criteria are met in their own projects and in the projects they fund.⁸⁹ Enterprise Community Partners, a prominent nonprofit organization that advocates for, finances, and develops affordable housing, instituted the Green Communities program to create healthier living situations for low-income residents.⁹⁰ Green Communities Criteria includes resource conservation

A battery storage unit is combined with rooftop solar at the Marcus Garvey Apartments in Brooklyn, NY.

Photo: Demand Energy

and energy efficiency measures. Battery storage should be included in that criteria, especially for housing that serves the elderly and disabled, as important a measure as energy efficiency. Mandating resilient power systems in affordable housing complexes will prioritize resident well-being, especially for electricity-dependent households, by investing in energy security measures.⁹¹

Insurance Providers

Insurance providers have not kept up with the rapidly evolving needs of the growing home health care population. Fatalities resulting from outages can be avoided with resilient back-up power systems. While batteries for certain equipment are covered, they are oftentimes inconvenient and unable to last for long durations. The Federal Medicare Program, in an effort to protect the health of their beneficiaries, should expand coverage to include battery storage as durable medical equipment (DME) for lease or purchase.⁹² In doing so, doctors would be able to effectively prescribe battery storage. Medical device providers would then supply resilient power systems to home health care residents dependent on electricity for medical equipment. With Medicare's commitment, partner agencies would be motivated to bridge the 20 percent out-of-pocket costs requirement through incentives for low-income households.

In addition to approving battery storage as eligible DME, each state's Medicaid self-direction program(s) that include budget authority—which allows participants to “have decision-making authority over how the Medicaid funds in a budget are spent”—should provide an option for electricity-dependent beneficiaries to use a portion of their individual budgets to purchase (or lease, if available) home battery storage systems.⁹³ In doing so,

eligible individuals could submit a request for additional funding for battery storage systems or to reserve a portion of monthly funds to be used for a battery storage system purchase (or lease, if available).

Disaster Relief Funds

Puerto Rico has created the new template for how cities and states can rebuild more resilient power systems after a natural disaster. Moving forward, disaster relief funding should be a tool for recovery and mitigation initiatives. Requiring incentives and fiscal carve-outs for the installation of resilient solar and battery storage systems, both for critical facilities and electricity-dependent residents, will contribute to a more reliable energy system.

State Mandates

States should include battery storage in emergency preparedness mandates. Twelve seniors died in Florida in 2017 when their nursing home lost power and the lack of air conditioning resulted in extreme heat.⁹⁴ In the wake of that tragedy, Florida now requires nursing homes and assisted living facilities to have back-up power, however only gas generators are included in the Emergency Power Plan Rules.⁹⁵⁻⁹⁶ In Maryland and Texas, dialysis centers are required to have emergency generators.⁹⁷ States already imposing emergency power requirements should educate health service providers about the benefits of resilient power and provide incentives to encourage clean energy alternatives.

Collaboration and Partnerships

As the universe of players involved in home health care continue to grapple with the effects of power outages, multi-stakeholder dialogue will be more important than ever. Utilities, medical equipment manufacturers, consumer-rights groups, insurers, and home care/home health

associations are all deeply invested in protecting electricity-dependent individuals during an emergency. Yet, there has been little knowledge-sharing about resilient backup power options between these various sectors to date. These multi-sectoral discussions will be critical to identifying knowledge gaps, capacity needs, and strategies for scaling resilient backup power solutions to the individuals that need them most. Stronger relationships between the universe of players in the home health and home care space can inspire systems change and provide a platform for swift, coordinated, and effective emergency management.

Critical Facilities

Even with in-home resilient backup power, some households will ultimately require evacuation. Critical community facilities such as medical clinics, dialysis centers, community centers, and fire stations need to be prepared for an influx of medically vulnerable residents in the event of an outage.⁹⁸ Critical facilities can be better prepared to serve this population by installing solar+storage systems and designating spaces for electricity-dependent residents to power their medical equipment. Resilient power would also benefit the entire community by providing electricity at emergency shelters to help meet basic necessities, such as refrigeration for medicines and charging outlets, in the event of an outage.



Oxygen concentrator
Photo: Spaghettk/Bigstock.com

Conclusion

*“California’s three largest investor-owned utilities serve more than 150,000 customers who rely on life-support equipment, many of whom are considered low income,” state Senator Bill Dodd said. The Democrat from Napa wants utilities to provide backup electricity or financial assistance so high-risk customers can buy generators or batteries.*⁹⁹ — Associated Press (05.30.2019)

Soldiers with the South Carolina Army National Guard help escort fire rescue paramedics through flooded roads to reach someone in need of medical attention during Hurricane Matthew.

Photo: Jorge Intriago/
US Air National Guard

Bringing resilient power to home health care is a public health priority. Unfortunately, it has received far too little attention. Technologies like solar and battery storage have the potential to provide safe, reliable power to those reliant on electricity for medical devices in their home.

Current energy security technologies and policies will need to adjust to meet the needs of the home health care community. Policy barriers should be replaced with incentives and programs that make solar+storage adoption easier. These challenges are not unsurmountable, especially if the agencies responsible for the wellbeing of medically vulnerable residents, like insurance providers and the utilities, join in to develop and deploy resilient power solutions.

As more and more people are encouraged to receive health care at home, rather than seek care in hospitals and nursing homes, the health care community must ensure an equally high standard of emergency care and support in home settings as exists in medical facilities. People who are at home with medical or home care equipment should not have to worry about how to survive the next power outage. The technology to improve resiliency and energy independence exists, and it must be made more accessible to those who could benefit most from it.



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OTHER RESILIENT POWER PROJECT RESOURCES

Clean Energy Group and the Resilient Power Project have produced reports and analysis on a wide range of resilient power policy, finance, and technology application issues. Please see below for a sample of publications that overview opportunities for resilient power in the health care sector. For a complete list of the Resilient Power Project’s other informational resources, please visit www.resilient-power.org to access its extensive knowledge base, including webinars, blogs, and presentations. To learn more about the intersection of health care and energy storage visit: www.cleanenergygroup.org/ceg-projects/energy-storage-and-health.



Health Care at Home: The New Risks from a Growing Trend (03.25.2019), by Marriele Robinson, Clean Energy Group. Outages can have widespread public health implications, but for those dependent on electricity for in-home medical equipment, even a short-term outage can be potentially fatal. As more people opt to receive medical care at home, access to resilient emergency backup power will need to be prioritized and made more accessible, especially to low-income households.



Battery Storage Could Revolutionize Home Health Care: Lessons Learned from Puerto Rico (01.30.2019), by Lewis Milford, Clean Energy Group. Dr. Lilo Pozzo and her colleagues at the University of Washington recently published a new study on electricity-dependent households in Puerto Rico following Hurricane Maria, “PV-Battery Systems for Critical Loads During Emergencies: A Case Study from Puerto Rico After Hurricane Maria.” Over a period of several months, Dr. Pozzo led a team on three field trips to Jayuya, a remote town in the mountainous center of Puerto Rico, to collect information on critical home medical needs requiring electricity and to install small solar and battery storage systems to support in-home health care devices and essential services, such as refrigeration of medications.



It's Time to Recognize the Value of Resilience (01.30.2018), by Seth Mullendore, Clean Energy Group. A paper released by the National Renewable Energy Laboratory (NREL) and Clean Energy Group (CEG), *Valuing the Resilience Provided by Solar and Battery Energy Storage Systems*, confirms that placing a value on the benefits provided by solar+storage technologies during power outages can significantly boost the economics of these projects. The researchers found that valuing resilience tends to result in larger optimal solar+storage system designs, which can make solar+storage economically viable in cases where it might not be otherwise.

ORGANIZATION DESCRIPTIONS



CLEAN ENERGY GROUP

Clean Energy Group (CEG) is a leading national, nonprofit advocacy organization working on innovative policy, technology, and finance strategies in the areas of clean energy and climate change. CEG promotes effective clean energy policies, develops new finance tools, and fosters public-private partnerships to advance clean energy markets that will benefit all sectors of society for a just transition. CEG created and manages The Resilient Power Project (www.resilient-power.org) to support new public policies and funding tools, connect public officials with private industry, and work with state and local officials to support greater investment in power resiliency, with a focus of bringing the benefits of clean energy to low-income communities. www.cleanegroup.org



Meridian Institute

Connecting People to Solve Problems

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Meridian Institute works with diverse partners to build understanding, guide collaboration, and drive action to address our world's complex challenges. We do this with an innovative approach that brings together three elements: our deep understanding of the issues at hand, as well as the people, politics, and power dynamics that surround them; our dedicated, expert team; and our ability to foster constructive discussions, manage decisions, and support actions that shape the world for the better. Meridian Institute manages the Resilient Power Project in partnership with Clean Energy Group. Established in 1997, Meridian is a not-for-profit organization with offices in Colorado and Washington, DC. www.merid.org

ABOUT THE RESILIENT POWER PROJECT

The Resilient Power Project, a joint initiative of Clean Energy Group and Meridian Institute, is working to accelerate market development of solar PV plus battery storage (solar+storage) technologies for resilient power applications serving disadvantaged communities. The Resilient Power Project works to provide new technology solutions in medically vulnerable households, affordable housing, and critical community facilities to address key climate and resiliency changes facing the country:

- **Community Resiliency** — Solar+storage can provide revenue streams and reduce electricity bills, enhancing community resiliency through economic benefits and powering potentially life-saving support systems during disasters and power outages.
- **Public Health Preparedness** — Solar+storage can prevent or minimize deaths and public health crises caused by power outages by creating models for clean, resilient power systems for medically vulnerable households and in critical health facilities such as hospitals and nursing homes.
- **Climate Adaptation** — Solar+storage systems can provide highly reliable power resiliency as a form of climate adaptation in severe weather, allowing residents to shelter in place during power disruptions.
- **Climate Mitigation** — Battery storage is an enabling technology and emerging market driver to increase adoption of solar PV for distributed, clean energy generation and to advance climate mitigation efforts accelerating the retirement and replacement of fossil-fuel power plants with clean energy alternative.

For more information about the Resilient Power Project, contact Marriele Mango at Marriele@cleanegroup.org.



RESILIENTPOWER

A project of Clean Energy Group and Meridian Institute



Clean Energy

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Battery Storage

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