



RESILIENT POWER



What Cities Should Do: A Guide to Resilient Power Planning

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ABSTRACT

This paper is one in a series of reports and white papers Clean Energy Group will publish over a three- year period on the topic of Resilient Power. Resilient Power is the ability of a community to provide clean, reliable energy in the face of power outages, an increasingly regular event due to severe weather. New resilient power technologies can provide electricity during outages, and also at other times so communities benefit fully from clean reliable energy.

Clean Energy Group's Resilient Power Project is designed to help states and municipalities with program and policy information, analysis, finance tools, technical assistance, and best practices to speed the deployment of clean, resilient power systems in their communities. An important focus of the project is to help vulnerable and low-income communities deal with power outages due to severe weather events, as they have suffered disproportionately in damaging storms like Superstorm Sandy and Hurricane Katrina. Installing clean energy technologies such as solar and storage in multi-family housing, assisted living centers, fire stations, and schools that serve as shelters can protect people from harm, reduce pollution, and create community-driven decision making. This series of reports describes the continuing effort of Clean Energy Group to make resilient power a major part of disaster planning and energy policy, work that is now showing results in new state and local programs to fund resilient power across the country. But much more needs to be done.

Acknowledgements

This paper is a product of Clean Energy Group and part of a series of reports issued through the Resilient Power Project, a joint project of Clean Energy Group and Meridian Institute. This project works to expand the use of clean, distributed generation for critical facilities to avoid power outages; to build more community-based clean power systems; and to reduce the adverse energy-related impacts on poor and other vulnerable populations from severe weather events. This project has been generously funded by The JPB Foundation, The Kresge Foundation, and The Surdna Foundation. The views and opinions expressed in this report are those of the authors' alone.

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INTRODUCTION

Cities and Resilient Power

Every city should have a resilient power plan for critical public and private facilities to keep the lights on, the communication systems running, and emergency services operational when the grid goes down. Most cities don't, and that leaves millions of their most vulnerable people at risk from the damaging effects of long-duration power outages.

Right now, there is a missing link in most city planning efforts to protect populations from the serious impacts of severe weather. It's the lack of an integrated set of policies and plans to deploy resilient power technologies like solar plus battery storage to protect critical facilities from power outages and provide energy systems that reliably work in an emergency.

The 50 percent failure rate of diesel generators during Superstorm Sandy¹ shows that the status quo protection for critical facilities does not work. The result was devastating: two major New York hospitals had to be evacuated due to loss of power and thousands of low-income, disabled or elderly residents were stranded in buildings with no electricity to power heating systems, run the elevators, or refrigerate food and medicines.

Cities need to re-think their power and back-up systems and protect critical facilities with smarter, resilient power technologies. Whether power failures are caused by severe storms, hurricanes, tornadoes, earthquakes or wildfires and extreme heat—in every part of the country—cities need to be prepared to safeguard their communities during power emergencies.

What is needed is more than a plan of action. What's needed is a Resilient Power Implementation Plan and investment strategy to better prepare for the next event.

A city's Resilient Power Plan should have several essential elements:

- **Assign a person or group to be in charge of the designing and implementing the plan.**

- **Identify the list of top critical facilities in need of protection.**
- **Assess the critical power loads in each priority building/facility that needs power protection.**
- **Determine the costs and technology options, including solar plus battery storage, for each resilient power system needed.**
- **Find a good developer to design and build the project.**
- **Identify financing options to get the job done at least cost, including new revenue streams based on battery storage grid benefits.**

This guide will examine each of the elements of the plan.

This paper will also explain the problems cities face with their energy systems in times of severe weather. It then outlines steps cities can take to begin to assert control over their most important public function—to keep critical services operational during power outages.

Above all, this paper outlines a new technological and financial approach to solve this problem. The bottom line is this: cities must go beyond plans to actions that will finance and install projects to protect people from the next disaster.

Rather than relying on more diesel generators, this paper will explore new technology applications such as solar photovoltaic (PV) and energy storage (solar+storage) systems that could do a much better job providing needed electricity during power failures. In addition to offering reliable power continuously as well power protection when the grid goes down, such systems could also save money, generate revenue twenty-four hours a day, harden the grid, protect critical equipment, and reduce reliance on dirty fossil fuel systems.

It's time for cities to take lead in implementing more resilient and cleaner power systems. Communities across America need a resilient power game plan. This paper lays out the elements of that plan for them to consider.

RESILIENT POWER NEEDS

Resilient power, sometimes called “energy assurance,” expresses a simple concept: it is the ability to provide needed power, independent of the grid. Because our electric grids are vulnerable to storms and other disasters, the ability to generate electricity to power critical facilities and infrastructure should the grid go down is paramount in emergency planning.

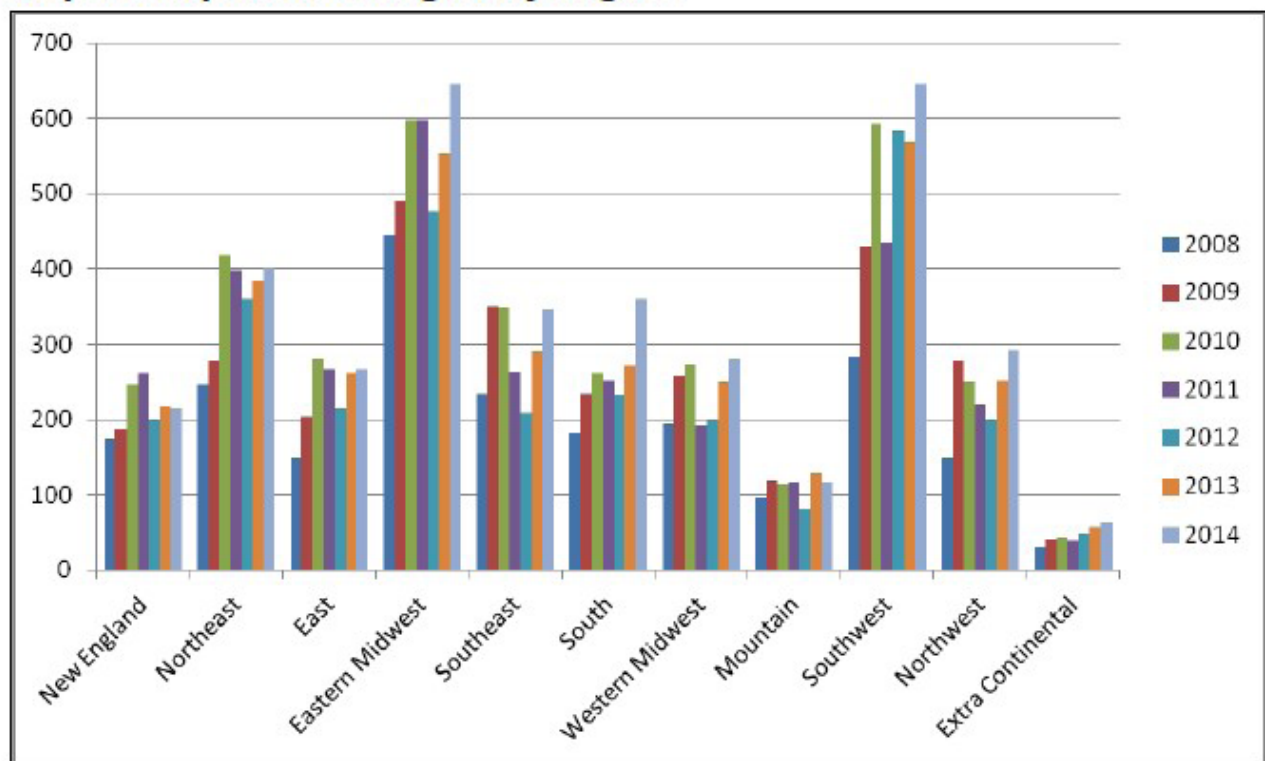
The vulnerability of centralized electric service to disruption is not a new problem, although it has become more

urgent due to the increasing frequency and severity of storms. Superstorm Sandy alone knocked out power to over 8 million utility customers across the Mid-Atlantic states and New England in 2012.

These outages are also not just an Eastern problem. The graph below shows power outage statistics for 2014, and it demonstrates a problem that occurs throughout the country.

Figure 1 - 2014 Reported Power Outages by Region - U.S.

Reported power outages by region



Regions:

New England: Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, Maine

Northeast: New York, Pennsylvania, New Jersey

East: Virginia, North Carolina, Maryland (includes Washington DC), Delaware

Eastern Midwest: Wisconsin, Illinois, West Virginia, Ohio, Michigan, Kentucky, Indiana

Southeast: Tennessee, Georgia, Alabama, Mississippi, South Carolina, Florida

South: Texas, Louisiana, Arkansas, Oklahoma

Western Midwest: South Dakota, North Dakota, Nebraska, Minnesota, Missouri, Kansas, Iowa

Mountain: Colorado, Wyoming, Utah, New Mexico

Southwest: Nevada, California, Arizona

Northwest: Washington, Oregon, Idaho, Montana

Extra Continental: Alaska, Hawaii

Source: Blackout Tracker, Eaton, 2014²

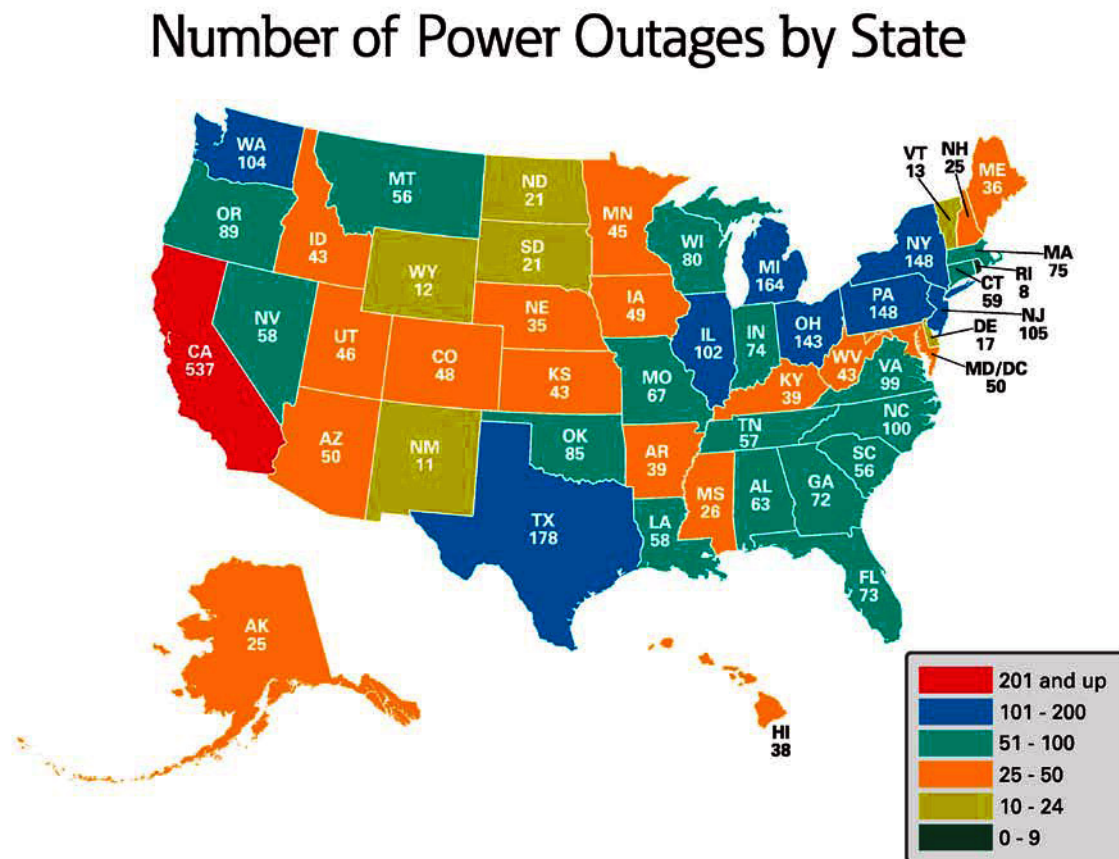
The traditional solution to deal with outages has been facility-based backup power in the form of diesel generators. But these are designed to run only during emergencies and are therefore prone to fail when called upon. Furthermore, once on-site fuel supplies are exhausted, diesel generators are dependent on fuel deliveries that may not be possible during a disaster. And, because they sit idle most of the time, they represent sunk costs with little ability to generate revenue.

Clean Energy Group, a national nonprofit organization working on clean energy policy, technology and finance issues, believes a better solution can be found in clean distributed generation systems, such as solar+storage, as well as other systems like combined heat-and-power (CHP)

systems and fuel cells. Such systems can provide on-going benefits such as continuous power, energy cost savings, and lower emissions, as well as provide emergency power to cover local critical loads when the grid goes down.

These clean energy technologies can be designed for a specific single facility, or designed in a microgrid configuration to support a campus or larger distribution area. They can also create multiple revenue streams when used to provide ancillary grid services, such as frequency regulation.

Figure 2 - 2014 Number of Power Outages by State (Reported)



RESILIENT POWER SOLUTIONS

Clean Energy Group has been working on state and city-wide approaches to resilient power over the past several years. In 2013, the Abell Foundation commissioned Clean Energy Group to explore how to expand the use of renewable power in Baltimore.

In the resulting report, *Clean Energy for Resilient Power Communities: Expanding Solar Generation in Baltimore's Low-Income Communities*, Clean Energy Group recommended how to take a good disaster management plan to the next level by creating a resilient power plan for the city. In the report, Clean Energy Group stated that the best way to expand clean energy and provide resiliency was to:

...expand the use of solar photovoltaic (PV) with battery storage—to enable low-income populations to benefit from the long-term savings that can be realized through the use of renewable energy, and to protect vulnerable populations from the damaging effects of power outages in severe weather events.⁴

The report detailed several findings:

- Extreme weather events and resulting power outages deprive a community of its most basic need—the electricity that powers multiple levels of urban infrastructure and economic activity, and makes social interdependence possible.
- Resilient communities need resilient power. Without dependable power, a community can be brought to its knees, and the most vulnerable will suffer the most.
- New technologies like solar with storage, with new financing tools, can be effective strategies to provide critical public facilities with more reliable power. New businesses are emerging that can provide leasing and other financing options to bring these reliable technologies to broader markets.

With regard to power outages and vulnerable populations in Baltimore, the report recommended:

- City officials should implement policies to advance distributed solar generation and support the deploy-

ment of solar with storage as a resilient power application for critical facilities that provide services to low-income communities.

- Critical facilities identified in Baltimore's Disaster Preparedness and Planning Project (DP3) report should be evaluated for their suitability for resilient solar power with battery storage.
- The city of Baltimore and its development finance agencies should utilize existing bond financing and credit enhancement mechanisms, as well as third-party ownership and financing structures, to develop solar on public buildings and nonprofit-owned facilities using battery storage.

Our work subsequent to the report convinced us that even more analysis is needed. We looked at what other cities had done, and we began to see a pattern of missing pieces, and then worked to identify key elements that a good city resilient power plan should contain.

We saw that many cities had identified the energy assurance problem in their disaster or climate preparedness plans. Many cities have made good strides in evaluating vulnerabilities of their multiple infrastructures as part of their disaster preparedness planning.

But few cities have focused on risks and mitigation strategies associated with extended grid power outages for critical facilities.

And none has yet developed a citywide resilient power implementation strategy to protect critical facilities and vulnerable populations with more advanced and cleaner systems like solar+storage when electric service is disrupted. And no city has begun to employ the beneficial FERC rules that can help finance resilient power systems with revenues generated by ancillary services provided by battery storage technologies to help the grid operate more smoothly.

In the end, resilient power protection is an entirely new approach to safeguard vulnerable populations through combinations of cleaner energy systems and new

financing strategies, which could be used to substantially reduce the costs of these systems to cities strapped for revenue. If done well, these systems actually could provide protection and reduce electric bills.

This new approach requires a different response than the conventional purchasing more back-up diesel generators, which have a poor performance track record and represent sunk costs rather than revenue generating opportunities.

These new solutions require that cities take a different approach to addressing power failures and electricity needs; it requires close coordination between city departments, as well as leadership and accountability

in implementing resilient power technologies across a prioritized portfolio of public buildings and community facilities. It also requires the support of a coordinated budget planning and public finance process to identify a range of project finance options (including third-party ownership and leasing structures).

What is required is a plan to identify resources and a workable implementation strategy that will ensure that a citywide effort to protect critical facilities with resilient power is set in place.

Top 10 Cities Likely to See Big Increases in Power Outage Risks⁵

- 
1. New York City
 2. Philadelphia, PA
 3. Jacksonville, FL
 4. Virginia Beach, VA
 5. Hartford, CT
 6. Orlando, FL
 7. Tampa, FL
 8. Providence, RI
 9. Miami, FL
 10. New Orleans, LA

RESILIENT POWER EXAMPLES

Some cities have begun to make resilient power planning a top priority. Their experience offers some key insights to other cities who are considering how to address resilient power needs.

Baltimore, MD

Baltimore is city that has done an excellent job of going beyond the basic requirements of a disaster preparedness plan to incorporating climate adaptation planning recommendations for critical facilities that could lose power during severe weather. While this was done before our Baltimore report, it is good work worth highlighting now.

In 2012, Maryland and the City of Baltimore suffered massive power disruptions from severe weather events. Over 3 million people lost power, many for long periods of time. Major economic disruptions and personal hardships resulted, with disproportionate impacts on vulnerable populations like the poor, elderly, and low-income populations.

Partially in response to these dramatic events, the City of Baltimore created its disaster preparedness and climate adaptation plan or DP3 Plan in 2013. In it, the City of Baltimore identified the protection of power outages at critical facilities as a top priority. The report noted that the City must “minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities located within the City.”⁶

As part of the plan, the city officials identified 190 critical facilities in the city. These included fire stations, nursing homes, police stations, community distribution centers, correction facilities, dialysis centers, emergency operation centers and hospitals. The report also concluded, “Beyond strengthening existing systems, increasing system redundancy is a vital measure for protecting critical infrastructure from power outages.”

New York City (NYC)

It is also important for any city to develop an investment plan to finance new clean energy solutions to power resilient problems.

Leadership in this area has been taken by New York City’s City Controller, Scott Stringer, who announced in September 2014 a truly significant advance in the area of financing for resilient infrastructure. Stringer released a multi-billion dollar “Green Bond Program for New York City” that is likely to become a model for the country.⁷

In the green bonds plan for NYC, Stringer proposed to use bonds issued by the city to finance post-Sandy reconstruction efforts and other infrastructure investment. This would likely include water and power infrastructure projects in places like public housing and wastewater facilities. A key aspect of the green bonds plan for NYC is incorporating Green Bonds in the capital budget process with key agencies.⁸

This NYC action is a critical step to advance clean energy and climate finance. It brings together two worlds, bond finance and power resiliency, and shows how one can finance the other, which is needed as we move forward with climate mitigation efforts and resilient power strategies.



Other Emerging Elements of Resilient Power Plans

New York City and Baltimore, as well as the states of Massachusetts, Florida and New Jersey, have each made significant progress in planning and addressing their local resilient power vulnerabilities. We are beginning to see an emerging set of solutions that cities should consider in a resilient power plan.

Addressing Local Barriers to Implementing Resilient Power Projects

City University of New York, through Sustainable CUNY, has been awarded an \$800,000 U.S. Department of Energy SunShot grant to develop a strategic pathway to accelerating resilient solar power systems. New York State has more than 18,000 solar PV systems, but there are few known PV systems with battery storage in NYC, and local utilities have no process to track resilient PV systems. This three-year initiative is focused on implementing pilot projects to address near-term legal and policy issues, hardware and software options and finance and deal structure issues.

Addressing Community Equity Issues

We are starting to see strong interest in NYC, Washington, DC, Chicago and Boston from developers and owners of affordable housing, elderly, and assisted-living facilities to develop solar and storage projects to protect the most vulnerable. We also see interest from city officials to bring solar and energy storage systems to police and fire facilities, schools, and community emergency centers.⁹

Leveraging State Resilient Power Funding for Local Initiatives

An increasing number of states are implementing resilient power programs to support city project initiatives. The following are examples of successful programs:

- **Florida's SunSmart Emergency Shelter Program** has installed more than 115 solar+storage systems in Florida schools, supplying over 1 MW of solar generation capacity and providing resilient power to emergency shelters across the state. Each solar +storage system is composed of a 10-kW PV and battery array; combined, the 115 resilient power systems have the capacity to shelter up to 50,000 people during a disaster.
- **Massachusetts Department of Energy Resources – Community Clean Energy Resiliency Initiative.** This \$40 million municipal grant program has awarded funds to cities throughout the state for 31 community resilient power projects at critical facilities using clean energy technology. Grants funded both technical assistance and project implementation for a range of city facilities, from school and community emergency shelters, and police and fire stations to a regional hospital and a municipal fueling station.
- **New Jersey Energy Resilience Bank.** In July of 2014, New Jersey created the nation's first Energy Resilience Bank (ERB). This innovative approach is capitalized with \$200 million of Community Development Block Grant-Disaster Recovery (CDBGDR) allocation. According to NJ Governor Christie's announcement, "The ERB will support the development of distributed energy resources at critical facilities throughout the state ...to minimize the potential for future major power outages and increase energy resiliency."¹⁰

For additional explanation of many resilient power issues, from financing to model programs, see a list of the Clean Energy Group's most recent publications at the conclusion of this report.

A PROJECT-BASED RESILIENT POWER STRATEGY FOR CITIES

To date, we have not seen a city implement a comprehensive planning and implementation approach to safeguard critical community facilities and services that uses new clean technologies like solar plus battery storage.

The planning process in cities needs to catch up with technology and financing trends that can be leveraged to provide better power protection than old technologies like diesel generators. We now have new hybrid systems that can provide much greater power protection than the status quo diesel generators that now dominate the power protection field.

It's time for cities to move into the 21st century and take a new look at how to protect their vulnerable populations from power outages.

Based on a review of city challenges in the last few years, we concluded a simple guide was needed to explain how a city can approach resilient power and advance this conversation—hence this report. It is designed as a “first-step” tool to address how a city might start a process to install of resilient power technologies at critical locations.

If a city wants to assess how renewable power sources like solar PV and energy storage (solar+storage) can be used to provide power protection to key critical facilities, we list below a few recommendations to consider:

- **Make sure it's someone's job to accomplish this work.**
- **Identify the critical facilities in the city in need of protection.**
- **Identify the critical power loads at select critical facilities in the city.**
- **Conduct an engineering assessment of how renewable resilient power, including solar + storage, could provide 24/7 power protection for those critical loads.**

- **Develop a viable financial plan with private developers to install these technologies under a lease or other acceptable option to meet the City's fiscal needs—a capital investment plan that could also include electric utilities and one that should take advantage of new federal financing options through FERC in markets where battery storage could become a revenue generating opportunity to bring down project costs.**
- **Develop and supervise an implementation and oversight plan for the installation of technologies, including evaluation of project performance.**

In particular, we recommend the following strategies to cities that want to implement resilient power solutions:

- 1. Assign Staff to Complete the Task.** In any city, it must be someone's job to complete this task from assessment to project implementation. Someone must have the ultimate responsibility to undertake this assignment to completion, as well as authority and a clear mandate from the Mayor to implement a resilient power strategy for the city.
- 2. Assess critical power loads at select critical facilities in the city.** The first step in this process is to identify the most critical of the facilities in the city that deserve better power protection. Then in those facilities, it is necessary to identify only those critical electric loads (lighting, refrigeration, water booster pumps for toilets, cool rooms) that would provide essential benefits and services to building occupants and vulnerable communities. (For a guidebook to resilient solar and battery storage technologies, see the accompanying report issued by Clean Energy Group, titled *Solar+Storage 101: An Introductory Guide to Resilient Power Systems*).
- 3. Conduct an engineering assessment of critical loads.** The city would then assess how well different clean resilient power options, including solar PV and CHP plus battery storage, could provide 24/7 power protection for those critical loads. This will require

a detailed engineering, financial, and mechanical assessment of what technologies are appropriate to serve the critical loads.

4. **Develop a viable financial plan with private developers.** The city's intention is to discuss with private developers how to install these technologies under a lease or other acceptable option to meet the city's fiscal needs. The city wants a viable financial plan that does not rely on excessive grants or subsidies, but rather third-party ownership or leasing of resilient power systems. This effort could include discussions

with electric utilities over various ownership structures for these systems. It should also include discussion of the new FERC revenue rules that could help finance a project (see Text Box on FERC Order 755).

5. **Develop and supervise an implementation and oversight plan.** Once a developer(s) is selected for the installation of technologies, oversight and supervision of the implementation plan is essential to ensure success. That plan must include performance evaluation over time.

Resilient Power for Low-Income, Affordable Housing

As with many other economic goods, access to resilient power can often depend on what economic assets are needing protection. Some of the most innovative energy technologies used to protect against power outages can be found in high-end private companies such as financial data centers and banks. In these instances, there is a high priority placed on protecting economic transactions from power outages and a strong motivation to invest in expensive technologies like fuel cells and fly wheels. These applications do not rely only on diesel generators to protect their critical electric loads in storms or severe weather events.

In affordable housing, senior centers, and assisted-living facilities, it is a different story. Ironically, where there is the greatest need to protect people from severe weather and power outages, the technologies used are usually second-best. Outmoded diesel generators, or nothing at all, are used to protect the most vulnerable from the damaging effects of power outages.

However, this story is beginning to change. Clean Energy Group is engaging with affordable housing and other developers in major cities across America to team up with solar storage developers to ensure that critical building loads are covered when the power grid fails. In many instances, only a limited amount of resilient power may be needed to power critical lighting, provide a common area "cool room," or cover essential medical/communications equipment. If designed properly, solar and storage technologies can allow residents to shelter in place in times of extended power outages, thus reducing the demand on overwhelmed first responder and emergency shelter services when the power goes out.

The good news is that for the first time more communities are beginning to plan and build resilient power projects to protect their low-income and vulnerable populations from power outages, broadening access for all members of their community to equal resilient power opportunity.

FERC Order 755: Creating New Revenue Streams to Monetize Resilient Power

In December 2011, the Federal Energy Regulatory Commission (FERC) finalized FERC Order 755 that enabled fast-responding energy storage technologies (batteries and flywheels) to enter frequency regulation markets.¹¹

Frequency regulation helps stabilize the grid by providing balance in the supply and demand of power (frequency regulation). FERC Order 755 (later expanded by FERC Order 784) establishes a financial value for performance benefits, requiring regional markets to reward resources that provide quick and accurate frequency regulation. The FERC order ensures that faster-responding resources, including energy storage, can now compete with and receive higher payment than conventional resources such as gas-fired peaker plants.

The effect of FERC 755 and the associated orders has been dramatic. In 2013, fast-responding resources for frequency regulation tripled in the PJM Interconnection, a regional transmission organization in the East, and the clearing price for the resources nearly tripled as well, according to a report from PJM. PJM was the first territory to fully comply with the FERC Order and is still the best frequency regulation market for energy storage. Other regions of the country are on track to implement similar financing rules in the near future.

FERC Order 755 has resulted in the growth of new companies focused on monetizing these new revenue streams. We are beginning to see increased revenue for storage devices, which are becoming a new driver for additional clean energy generation resources on the grid.

Many energy storage developers use third party ownership structures, which when combined with lease financing or power purchase agreements (PPAs) often require no upfront costs for the building owner or prime tenant. This is especially the case in those grid territories such as PJM that have complied with the new FERC rules, where grid-tied smart energy storage systems can capture grid services payments.

Even small grid-tied resilient power systems can now participate in these new revenue markets through aggregation of small systems into a virtual large system that responds together to grid signals.

DELIVERABLES AND TIMELINES

A simple timeline for implementing a resilient power plan could look something like the following. The following table assumes that a prioritized list of critical city facilities has already been prepared.

This could be a two-year plan that involves a complex set of energy and engineering analyses. Multiple

independent consultants should conduct the expert assessments. Private developers should be brought into the process for involved complex negotiations. Therefore, the timeline is suggestive of the process, but might well change as the in-depth analysis begins.

Task	Months	Deliverable
Assess critical power loads at select critical facilities in the city	1-2	Produce assessment of loads at select facilities amenable to engineering review
Conduct an engineering assessment of critical loads	3-6	Produce engineering review with key financial, technical, mechanical, and other details for developer-ready participation
Develop and implement a viable financial plan	6-24	Work to secure third-party developer to provide technology service under a viable financing model, likely a PPA and/or leasing, including assessment of utility role
Develop and supervise an implementation and oversight plan	12-24	Develop a management plan so that the city can effectively oversee project implementation

CONCLUSION

Cities that have plans for climate adaptation and emergency services should be applauded.

But planning is not protection.

A plan is only a job half done. The harder part is to carry out those plans to ensure projects are financed and completed, especially with modern and cleaner technologies like solar+storage.

That is the hard work of resilient power implementation as outlined in this paper.

All cities should start this process to protect their most vulnerable populations with the most up-to-date technologies, and with the smartest financial incentives now available.

About Clean Energy Group and the Resilient Power Project

Since 1998, Clean Energy Group, a national nonprofit organization, has worked to expand markets for clean energy technologies, including solar, land-based wind, offshore wind, fuel cells, energy storage, and biomass. In 2002, Clean Energy Group created and now manages a sister organization, Clean Energy States Alliance (CESA), another nonprofit organization that helps state and municipal clean energy funds to work together to deploy tens of thousands of clean energy projects around the country.

As part of our work, Clean Energy Group has advocated for the use of advanced clean energy technologies in critical public and private facilities that need reliable power during power outages. Instead of depending on unreliable diesel generators, Clean Energy Group has advocated for the use of clean, community-driven, distributed energy sources like solar+storage to provide energy security and backup power in the event of power emergencies.

In 2013, with support from major foundations and in a joint effort with Meridian Institute, Clean Energy Group launched a new national project—The Resilient Power Project—to advance the deployment of resilient power technologies in states and local communities. The project will help communities to better prepare for, and more quickly recover from, damages caused by power outages, with installations of cleaner distributed energy sources.

Through the Resilient Power Project, Clean Energy Group works to help communities install these systems in critical facilities such as police and fire stations, schools that serve as community shelters, multi-family housing, food banks, wastewater treatment facilities, and other locations that need power to keep communities safe when the grid goes down. The project is especially interested in ensuring that these new protective power technologies are deployed in low-income communities, which are particularly vulnerable to grid outages, and are often overlooked when new, innovative technologies are adopted.

The Resilient Power Project provides technical assistance on the technology options available and on financing solutions that can make resilient power installations more affordable. Clean Energy Group also has limited funding available for predevelopment costs associated with near-term clean energy storage projects.

More information about Clean Energy Group and the Resilient Power Project can be found online at www.cleanegroup.org and www.resilient-power.org.

Recent publications:

[Ramp Up Resilient Power Finance: Bundle Project Loans through a Warehouse Facility to Achieve Scale Financing for Clean, Resilient Power Solutions](#)

[Resilient Power: Evolution of a New Clean Energy Strategy to Meet Severe Weather Threats](#)

[Clean Energy for Resilient Communities: Expanding Solar Generation in Baltimore's Low-Income Neighborhoods](#)

These and additional publications are available online at <http://www.cleanegroup.org/ceg-projects/resilient-power-project/publications/>.

Recent webinars:

[New Initiatives in Community Resilient Power](#)

[Energy Storage in FERC Territories](#)

[MassDOER Resilient Power Solicitation](#)

[Financing Resilient Power](#)

[New Jersey's Energy Resilience Bank](#)

These and additional webinars are available online at <http://www.cleanegroup.org/ceg-projects/resilient-power-project/webinars/>.

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Lewis Milford is president and founder of Clean Energy Group (CEG) and founder of the Clean Energy States Alliance (CESA), two national nonprofit organizations that work with state, federal, and international organizations to promote clean energy technology, policy, finance, and innovation. For Clean Energy Group, Mr. Milford directs the Clean Energy Finance Project (www.cleanegroup.org/ceg-projects/clean-energy-finance/) and the Resilient Power Project (www.resilient-power.org) as well as other projects involving natural gas and renewable power. Mr. Milford is also a nonresident senior fellow at the Brookings Institution. He works with many public agencies and private investors in the United States and Europe that finance clean energy. Mr. Milford is frequently asked to appear as an expert panelist at energy conferences throughout the United States and Europe. His articles on clean energy have appeared in many publications including The New York Times, The Boston Globe, The National Journal, The Huffington Post, and Solar Today. He has a J.D. from Georgetown Law Center. LMilford@cleanegroup.org

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Endnotes

¹ Dan Ton, Acting Deputy Assistant Secretary, Power Systems Engineering Research and Development. Presentation to members of the Clean Energy States Alliance, November 18, 2014.

² See http://images.electricalsector.eaton.com/Web/EatonElectrical/%7Baa0d93cf-362a-4bd9-9005-bb723dd40d97%7D_USBlackoutTracker2014ReportFinal.pdf

³ See http://images.electricalsector.eaton.com/Web/EatonElectrical/%7Baa0d93cf-362a-4bd9-9005-bb723dd40d97%7D_USBlackoutTracker2014ReportFinal.pdf

⁴ See <http://www.cleangroup.org/assets/Uploads/2014-Files/Clean-Energy-for-Resilient-Communities-Report-Feb2014.pdf>

⁵ See <http://releases.jhu.edu/2014/12/15/how-climate-change-could-leave-cities-in-the-dark/power-outage-list-3/>

⁶ Baltimore D3 Plan, Exhibit G; see <http://www.baltimoresustainability.org/disaster-preparedness-and-planning-project>;

⁷ See Clean Energy Group's blog post on this topic at <http://www.cleangroup.org/blog/emerging-finance-models-for-resilient-infrastructure/#.VPSeOvkC58E>

⁸ This move is part of a trend to use infrastructure financing for new clean energy and power resiliency purposes. Clean Energy Group has been at the forefront of this effort through its Clean Energy and Bond Finance Initiative (www.cebf.org) and Resilient Power Project (www.resilient-power.org).

⁹ When it comes to reliable energy technologies to protect against power outages, there is a disparity between the haves and the have-nots. Some of the most innovative energy technologies used to protect against power outages can be found in high-end private companies such as financial data centers and banks, where economic transactions are protected from power outages with expensive technologies like fuel cells and fly wheels – no matter the cost. There is a disproportionate impact of power outages on low-income and vulnerable populations. These communities include elderly and disabled citizens who rely on electricity for survival, such as power that is needed for elevators, mobility equipment, refrigeration for medicines, heating and cooling systems and respirators.

¹⁰ The ERB makes direct loans and grants, but can also provide credit enhancement for bond issuances and other private financing participations. Although the initial priority is clean water and wastewater treatment facilities, other critical facilities that can also be funded include hospitals, emergency response facilities, municipal town centers, correctional facilities, transportation and transit, public housing and regional high schools that can be used as shelters in case of emergency.

¹¹ See http://www.cleaneecnyc.org/wp-content/uploads/2012/09/ESF_-Recent-U.S.-Policy-Implications-for-Energy-Storage.pdf



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Clean Energy Group

Clean Energy Group (CEG) is a national, nonprofit organization that promotes effective clean energy policies, develops low-carbon technology innovation strategies, and works on new financial tools to advance clean energy markets. CEG works at the state, national, and international levels with stakeholders from government, the private sector, and nonprofit organizations. CEG promotes clean energy technologies in several different market segments, including resilient power, energy storage, solar, and offshore wind. Above all, CEG also works to create comprehensive policy and finance strategies to scale up clean energy technologies through smart market mechanisms, commercialization pathways, and financial engineering. CEG created and now manages a sister organization, the Clean Energy States Alliance, a national nonprofit coalition of public agencies and organizations working together to advance clean energy through public funding initiatives.



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