New Orleans

RESILIENT SOUTHEAST

Exploring Opportunities for Solar+Storage in New Orleans, LA

CleanEnergyGroup
Innovation in Finance, Technology & Policy

ABOUT THIS REPORT

Resilient Southeast—New Orleans is one in a series of reports that explores the obstacles and opportunities for solar PV and battery storage to strengthen the resilience of communities throughout the Southeast. In this report, four types of facilities that could provide services during a disaster are evaluated for the potential economic opportunities resulting from the installations of solar alone or solar plus battery storage systems. This report also presents potential near-term opportunities for policies and regulatory changes that could advance resilient solar+storage development in New Orleans and concludes with a set of recommendations. Clean Energy Group partnered with the Alliance for Affordable Energy for this report. The economic analysis was performed by The Greenlink Group.

ABOUT THIS REPORT SERIES

Resilient Southeast is a collection of reports that evaluates the current policy landscape and economic potential for solar and battery storage to provide clean, reliable backup power to critical facilities in five cities: Atlanta, GA; Charleston, SC; Miami, FL; New Orleans, LA; and Wilmington, NC. These reports are produced under the Resilient Power Project (*www.resilient-power.org*), a joint project of Clean Energy Group and Meridian Institute. The Resilient Power Project works to provide clean energy technology solutions in affordable housing and critical community facilities, to address climate change and resiliency challenges in disadvantaged communities. The Resilient Power Project is supported by The JPB Foundation, Surdna Foundation, The Kresge Foundation, Nathan Cummings Foundation, The New York Community Trust, Barr Foundation, and The Robert Wood Johnson Foundation.

The full report series, including a *Series Overview* and a *Technical Appendix*, is available online at *www.cleanegroup.org/ceg-resources/resource/resilient-southeast*.

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DISCLAIMER

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Rooftop solar panels on Magazine Street in New Orleans.
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Executive Summary

In the event of an emergency, residents often turn to trusted local services like emergency response centers, police, and fire stations for support. Unfortunately, natural or man-made disasters and extreme weather can result in widespread power outages that leave critical community facilities in the dark. Without electricity, public service providers may be severely limited or completely unable to provide assistance to the communities they serve. Even facilities with diesel generators face issues due to equipment failure and limited fuel supplies. Resilient power systems that combine solar PV with battery storage (solar+storage) represent another option for reliable backup power to keep critical facilities up and running in cities like New Orleans, ensuring that residents have access to critical services in the event of an emergency.

When savings from avoiding the loss of power are considered, solar paired with battery storage was found to make economic sense for all building types evaluated.

By exploring the opportunity landscape for deploying solar+storage systems at critical facilities in New Orleans, this report aims to answer the question: does solar paired with battery storage make economic sense for strengthening the resilience of Louisiana communities? Based on the results of detailed economic analysis of critical building types in New Orleans, the answer is yes, but only when the value of resilience is fully taken into account.

The findings show that significant challenges and barriers remain that must be addressed for resilient solar+storage systems to become more economical and widely adopted. Given the current regulatory landscape and lack of incentive opportunities for solar+storage systems, *New Orleans ranked last for economic opportunities to deploy resilient solar+storage among the five Southeastern cities evaluated in this report series.*

Figure 1 summarizes the findings of detailed economic evaluations for solar and battery storage at four critical facilities in New Orleans: a school, a nursing home, a multifamily housing property, and a fire station. Solar was not found to be a cost-effective solution for any of the buildings evaluated. These discouraging results are primarily due to the design of electric rate tariffs for non-residential customers in New Orleans. The addition of battery storage also results in negative economic outcomes for the buildings when only electric bill savings are considered. However, when savings due to avoiding loss of power are factored into the economics, *solar paired with battery storage was found to make economic sense for all four building types.* This important finding makes a strong case for public investment in resilient solar+storage systems providing community services.

The analysis results and the overall landscape for solar+storage in New Orleans are dependent on a variety of factors, from net energy metering policies and utility electric rates to available incentives and financing options. These factors are summarized in **Figure 2**. New Orleans benefits from favorable city net metering policies, but New Orleans suffers from low potential for electric bill savings due to the structure of commercial utility rates and a lack of supportive incentives or policies. This creates a challenging environment for the development of resilient solar+storage.

FIGURE 1
What Works in New Orleans—Results of analysis by technology and building type

Four critical community building types were evaluated to explore the economic opportunity for solar PV and battery storage in New Orleans. Neither solar alone nor solar paired with battery storage, which can be configured to provide resilient backup power during grid outages, was found to be an economical option based on bill savings alone. Factoring in savings due to avoided outage costs significantly improves the overall economics of solar paired with battery storage, resulting in positive economics for all building types.

Solar Alone without Battery Storage	**Solar** paired with **Battery Storage**	**Solar** paired with **Battery Storage** plus value of **Avoided Outage Costs**
Not economical for these building types.	Not economical for these building types.	

KEY: School  Nursing Home  Fire Station  Multifamily Housing 

To address these challenges, this report presents potential near-term opportunities for policies and regulatory changes that could advance solar+storage development in New Orleans and concludes with a set of recommendations. Ongoing efforts to institute local renewable energy goals and current negotiations with the regional electric utility, including a rate case and renewable energy project proposals, are highlighted as potential opportunities. Recommendations include policy and programmatic changes, *such as incentive programs, demonstration projects, and carve-outs in disaster relief and mitigation funds, which have shown success in the Southeast and throughout the United States.*

FIGURE 2
Solar and Battery Storage Opportunity Landscape in New Orleans

The opportunity for customer-sited solar and battery storage development in New Orleans is highly dependent on a number of state, regional, and local factors, such as policies, incentives, and utility electric rates. New Orleans was found to have a largely unsupportive mix of key factors, resulting in a challenging landscape for deployment of resilient solar and battery storage.

Solar Incentives	Net Energy Metering	Potential for Electric Bill Savings	Financing Options	Supportive Policies and Programs	
				State/Local	Utility
					

 = Not Favorable  = Highly Favorable

Recommendations for Advancing Resilient Power in New Orleans

The following recommendations represent proven and emerging actions that have been implemented to advance resilient solar+storage development in other states and municipalities:

- **Allocate grant funding for solar+storage demonstration projects.** Solar+storage demonstration projects can educate residents about resilient energy, spur market development, and provide communities with a valuable service.
- **Establish public technical assistance funding.** Many solar+storage project opportunities, particularly those in the public and nonprofit sectors, are never explored simply due to the prohibitive upfront cost of performing a technical and economic feasibility assessment.
- **Provide targeted incentives for battery storage.** Strong incentives, with carve-outs and/or added incentives to encourage equitable deployment in low-income and disadvantaged communities, can help catalyze battery storage installations while upfront technology prices continue to decline.
- **Establish energy storage procurement targets and goals.** Much in the way that Renewable Portfolio Standards have accelerated solar and wind development in many states across the country, several states have begun to implement utility procurement targets and goals for energy storage.
- **Create market opportunities for energy storage to provide grid services.** Establishing market-based revenue generating opportunities, such as frequency and voltage regulation and demand response, can greatly improve the economics of battery storage systems.
- **Include energy storage in state energy efficiency programs.** For states without ready funds to support new incentives for emerging technologies, established energy efficiency programs represent an opportunity to allocate existing funds to advance cost-effective energy storage solutions.
- **Include resilient power in disaster relief funding.** By including incentives and carve-outs for the installation of resilient solar+storage systems when implementing disaster relief and mitigation funds, states can prepare for the next storm as they recover from the last.

The Need for Resilient Power

As natural disasters increase in frequency and intensity, the impacts are more severe, and recovery times are extending. Underserved communities are often hit first and worst by natural disasters and extreme weather events. Vulnerable populations are disproportionately impacted and face increased risk as prolonged power outages become the norm post disaster.

Low-income households oftentimes don't have the means or ability to temporarily evacuate during a disaster. Residents with physical disabilities or health issues must contend with mobility limitations and medical equipment requirements that make evacuation difficult or impossible. Even after the storm has passed, the aftermath can result in new complications for vulnerable populations and exacerbate existing ones. Already under-resourced communities face additional recovery challenges, including access to electricity, shelter, communications, medical attention, and basic necessities. Recovery is an uphill battle to regaining normalcy, and communities struggle with how to be better prepared in the future.

Community facilities such as nursing homes, schools, fire stations, and multifamily housing are increasingly turned to for emergency services, shelter, and/or access to electricity. Ensuring that these facilities can provide critical services in the event of an emergency will require investments in energy resilience.

For first responders and healthcare providers, the implications of power outages can be immediate and life threatening, such as when communications are down at a fire station, or when a nursing home can't regulate room temperatures for vulnerable elderly residents. Designated emergency shelters, such as schools and multifamily housing complexes, are hampered without access to reliable backup power. When shelters aren't operational due to lack of electricity and therefore lack basic necessities, such as water pumping for sanitation, outages can quickly develop into a public crisis. Without access to a safe space with lighting and electrical charging for cell phones or medical equipment, residents are forced to search for needed shelter despite dangerous conditions.

A temporary emergency shelter is set up at the Baton Rouge River Center in Baton Rouge, LA in August 2016 as flooding pushed residents from their homes.
Photo: Spc. Garrett L. Dipuma, US Army National Guard

Customer-sited solar PV combined with battery storage systems (solar+storage) can generate reliable and cost-effective backup power during an outage.[1] Solar+storage projects across the country are transforming community centers into emergency shelters and resilience hubs, and better preparing first responder facilities. For example, Florida's SunSmart Emergency

Shelters Program resulted in more than 100 solar+storage systems installed in school districts throughout the state.[2] During a grid outage, solar+storage powered SunSmart E-Shelters can provide a variety of emergency services, including sanitation, medical equipment, communications, charging, and food.

In New York City, the Marcus Garvey Apartments, a 625-unit affordable housing complex, installed a solar+storage microgrid to reduce electricity costs, improve grid reliability, and provide backup power. During an outage, the microgrid can power essential loads up to 12 hours, including a community room for residents sheltering in place.[3]

For first responders and healthcare providers, the implications of power outages can be immediate and life threatening, such as when communications are down at a fire station, or when a nursing home can't regulate room temperatures for vulnerable elderly residents.

In anticipation of grid shutoffs during wildfires, fire stations in Freemont California are investing in solar+storage, rather than diesel generators.[4] Three fire stations have already installed microgrids to ensure critical services remain operational in the event of a planned or unexpected outage.

In addition to increasing community resilience, solar+storage can reduce utility costs and provide system benefits to the grid. When the grid is operational, solar+storage can offset retail electricity rates and combat expensive demand charges to reduce electric bills.[5] However, the cost-effectiveness of solar+storage to support energy resilience remains out of reach for many property owners, particularly community facilities managed by public and nonprofit entities. Declining technology costs, combined with solar+storage enabling policies, programs and incentives, could change that.

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.

Fossil fuel generators, most often diesel generators, have historically been the default solution for backup power. They also have a history of failure when true emergencies arise, whether due to lack of maintenance, exhaustion of fuel supplies, or simple wear and tear during a prolonged outage. Because generators are designed for only one purpose, backup power, they sit idle most of the time, representing sunk costs with no associated savings or value streams.

Solar PV paired with battery 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.

A Growing Need for Resilience in Louisiana

In the past decade, new weather patterns and intensified storms have forced the state government and local leaders in Louisiana to re-evaluate disaster preparedness and response. Hurricane Katrina was one of the most devastating hurricanes in the history of the United States. Historic flooding in 2016, and frequent flooding events since, further devastated vulnerable communities, damaged infrastructure, and cost Louisiana millions in recovery and mitigation efforts. Vulnerable critical infrastructure and transportation issues have emerged as major hurdles to emergency response. Power outages are leaving vulnerable populations in the dark and without access to air conditioning in extreme temperatures. Resilient power systems in critical community facilities could provide residents with access to safe spaces to seek shelter and support in the event of an emergency.

HURRICANE KATRINA

In August 2005, Hurricane Katrina made landfall as a Category 3 storm in southeast Louisiana with sustained winds over 125 mph. New Orleans suffered catastrophic flooding after levees failed, with some areas submerged in as much as ten feet of water. Over 950 people died, nearly of half of whom were seniors over the age of 74. Hurricane Katrina was the most expensive disaster in US history, totaling over $125 billion in damages.[6]

Entergy Corporation, the parent company for the largest electric utilities in Louisiana, spent over a billion dollars to rebuild energy infrastructure. In the aftermath of Katrina, almost 900,000 customers, 42 percent of the state, lost power. In some parts of the city, power line repairs couldn't begin for two weeks following the storm, as crews had to wait for the water to drain from the city.[7] Two power station locations in the city flooded, and only one was later brought back online, eight months later. Two dozen hospitals lost power and hundreds of patients had to be evacuated.

Damage from Hurricane Katrina in 2005.

Photo: Creative Commons/ Infrogmation of New Orleans

Over 400,000 people evacuated due to Katrina and some never returned. The Louisiana Superdome sheltered 25,000 residents during and after the storm, but hundreds had to be turned away. While acting as a shelter, the arena's backup generator failed, and temperatures quickly rose. After the city's water supply shut down, sanitation quickly deteriorated and health concerns grew.[8]

2016 FLOOD

Southern Louisiana experienced torrential flooding again in August of 2016, when up to 30 inches of rain fell over a three-day period. The Federal Emergency Management Agency (FEMA) declared 20 parishes as disaster areas.[9] Hundreds of commuters were trapped on flooded roads.[10] Over 10,000 people stayed in sixteen emergency shelters and at least 20,000 people had to be rescued. Over 30,000 residents lost power and 12,000 remained without power the next day. Louisiana incurred over $8 billion in damages.[11]

Louisiana's Solar and Storage Landscape

A lack of supportive regulatory policies has hindered the growth of solar PV and battery storage development in Louisiana. Louisiana ranks 35th in the country for state solar installations, and solar generates only 0.12 percent of the state's total electricity.[12] Louisiana does not have a Renewable Portfolio Standard and has not set any voluntary renewable energy or energy storage mandates or targets. The state previously offered a solar tax credit amounting to 50 percent of the first $25,000 of a rooftop solar installation, however, the program ended in 2016 and has not been replaced.

A lack of supportive regulatory policies and financial incentives has hindered the growth of the solar and battery storage markets in Louisiana.

Financing has been a major impediment to the residential and commercial battery storage market in Louisiana. Solar leasing, a popular financing option with no or little upfront costs, is available in Louisiana. It is still illegal for a third party to sell electricity to customers, which is typically how third-party power purchase agreements (PPA) are structured. Third-party PPAs are a popular financing option in parts of the country where they are available.[13] Louisiana's solar leasing option is different in that customers pay a flat fee per month to a company to lease equipment, rather than purchase the energy generated.

Property Assessed Clean Energy (PACE) financing is also not offered in Louisiana. The Louisiana legislature has actually enabled PACE, and the City of New Orleans took steps to implementing it. However, the City was unable to secure a participating lending institution and therefore PACE remains unavailable. PACE provides low-interest financing and repayment periods that can extend up to 20-years for energy efficiency and renewable energy projects, including battery storage.[14] Loans are typically secured with a lien on the property and paid through an assessment on the customer's annual property tax bills. Commercial PACE programs have proven successful as financing mechanism for solar+storage projects in other states, including a microgrid in Connecticut that services mixed-income housing and retail space.[15]

New Orleans is a unique case in the Southeast in that the New Orleans City Council regulates the investor-owned utility serving the city, Entergy New Orleans (ENO). ENO is a retail utility subsidiary of the Entergy Corporation, which operates utilities in six states. The Louisiana Public Service Commission is the regulatory authority for the remainder of the state, including Entergy Louisiana.[16] Neither ENO nor the City of New Orleans offers a solar or battery storage incentive.

CITY OF NEW ORLEANS

New Orleans is plagued with frequent outages and unreliable service: 2,599 outages were reported between June 2016 and May 2017 alone. More than half of the outages occurred when there were no inclement weather conditions.[17] Despite distribution and reliability issues, solar and solar+storage development has been limited in New Orleans.

New Orleans benefits from favorable net metering policies for residential and commercial customers. ENO is required to provide retail rate crediting to customers for exported solar energy to the grid, which is credited to the customer's account for the following month, and ENO reimburses the customer for excess credits after the customer terminates service. There is no aggregated capacity limit for the amount of customer-owned distributed solar allowed to participate in net metering. Individual net-metered solar systems are limited to 300 kilowatts for commercial and agricultural customers and 25 kilowatts for residential customers.[18]

There are limitations on where solar can be sited within the city. The French Quarter neighborhood does not currently allow for rooftop solar panels due to historic designation statutes. The New Orleans Central Business District is unable to participate in net metering due to ENO's determination that this portion of distribution grid is unable to accommodate exported solar energy. A properly-sized solar+storage installation could be designed to ensure there is no export of energy to the grid and could potentially be installed in the district.

Residential rooftop solar has, until recently, driven renewable energy progress in New Orleans. However, solar growth slowed dramatically after the state tax incentive was eliminated. Battery storage development has lagged across all sectors. ENO's first utility-scale solar project, which was also the company's first battery storage project, was completed in 2016. The installation consists of a one-megawatt solar array and a 500-kilowat-hour battery.[19]

NEW ORLEANS CITY COUNCIL

The New Orleans City Council (NOCC) regulates ENO, which serves almost 200,000 electric customers in New Orleans. The NOCC is responsible for approving any rate changes and utility programs, including those pertaining to clean energy development.

In 2018, the NOCC ruled in favor of a community solar program, opening up solar for all residents, including renters and low-income residents, as well as large commercial customers. The program relies on a subscription program where customers receive bill credits for subscribing to a portion of a large community solar development, rather than incentivizing customer-sited solar installations. New solar capacity created through the program cannot exceed 55 megawatts.[20] Low-income customers will receive full retail credit for each kilowatt-hour generated by their portion of a project.[21] All other subscribers will receive credit based on a value of energy and capacity of the project. The details of the new community solar program have yet to be finalized.

The NOCC also approved a commercial-scale rooftop solar pilot program developed by ENO in 2018. The five-megawatt initiative consists of panels owned and operated by ENO on a variety of commercial properties. 2.5 megawatts of the pilot have already been installed on warehouse rooftops. The remaining 2.5 megawatts will be installed on schools, nonprofit organizations, and government entities.[22] The installations will export solar

This affordable housing development for veterans and seniors in New Orleans will be powered by solar+storage. At the groundbreaking ceremony, Entergy Louisiana CEO Davis Ellis addresses the crowd. Also pictured is Zack Rosenburg, SBP Co-founder and CEO.
Photo: SBP

energy directly to the distribution grid, on the utility side of the meter, and commercial "hosts" will receive a lease credit on bills for the 20-year life of the system. Entergy has stated they believe they could grow the program up to an additional 50 megawatts on large commercial rooftops. Battery storage is not currently contemplated as part of this program, and the utility-focused design of installations would make resiliency benefits more difficult for customers to achieve.

As the authority for new generation assets, the NOCC approved a 126-megawatt natural gas plant proposed by ENO. Since that approval in 2018, the process has been embroiled in controversy. Opponents of the plant argued that ENO could instead be investing in renewable energy resources to meet new generation obligations.

In 2018, the New Orleans City Council created a new subcommittee: the Smart and Sustainable Cities Committee, with a focus on developing new technologies to improve both quality of life and sustainability.

After it came to light that ENO hired actors to support the plant at NOCC meetings, public outcry resulted in the Council reconsidering the plant. Local groups submitted third-party analysis supporting battery storage as a viable, cost-effective alternative that would not have the same negative emissions and public health impacts as the gas plant.[23] ENO offered to pay a $5 million fine to continue with the plant as planned, but the Council opted to issue a revote. Following ENO's announcement that they have already spent $96 million on the power plant, which has yet to be constructed, the Council voted in February 2019 to approve the utility's proposal to move forward with the plant and sanction ENO $5 million. Three lawsuits are now pending in Louisiana civil courts related to this power plant.

This affordable housing development for veterans and seniors in New Orleans will be powered by solar+storage. The photo shows SBP and community partners breaking ground. Photo: SBP

In 2018, the New Orleans City Council created a new subcommittee: the Smart and Sustainable Cities Committee, with a focus on developing new technologies to improve both quality of life and sustainability for residents, businesses, and visitors. The Committee's creation coincides with the beginning of smart-meter deployment by ENO for electric and gas, and similar smart metering under consideration for the city's water utility. In addition, the committee is taking up policy to solve the city's stormwater flooding concerns. The Committee is seen by the Council as a platform for progressive policies and technologies to improve resilience and sustainability challenges.

BEHIND-THE-METER SOLAR+STORAGE

ENO partnered with SBP, a disaster recovery nonprofit, to build a resilient, affordable housing complex for veterans, low-income, elderly, and disabled residents in New Orleans. The 50-unit facility will include 450 solar panels and a battery storage system. ENO provided funding for the solar panels, and Toyota donated the batteries. The facility will be net-zero emission, meaning it will produce as much energy as it consumes. The construction of the complex has already begun, and it is anticipated to open in the fall of 2019.[24]

Economic Analysis Methodology

For this report series, Clean Energy Group partnered with The Greenlink Group, an Atlanta-based energy analysis firm, to model the economics of solar and battery storage to achieve savings and to strengthen the energy resilience of four types of critical community facilities in New Orleans: a secondary school serving as a community emergency shelter, a nursing home providing critical heath care services, a multifamily housing facility sheltering residents in place, and a fire station serving as critical first responders.[25]

While these building types do not represent a comprehensive list of critical facilities, they were selected as a proxy for four key areas of essential services: community safety and recovery, medical care, housing, and disaster response.

The analysis explored two modeling scenarios for the four building types:

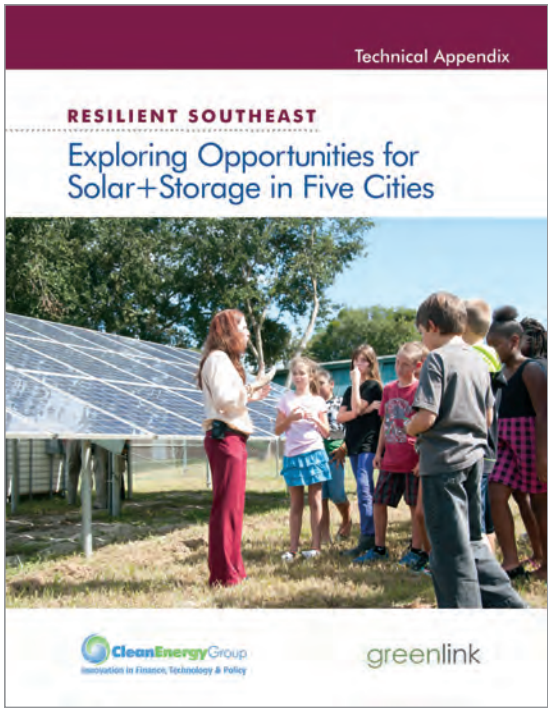
1. **Economic Scenario:** The economic scenario evaluates the most cost-effective system configuration based on electric bill savings opportunities and available incentives. The objective of the economic scenario is to maximize net savings (net present value) over a 25-year period, the expected useful life of a solar PV system.[26,27]
2. **Resilient Scenario:** The resilient scenario evaluates a system configuration capable of providing onsite backup power to critical loads.[28] The objective of the resilient scenario is to model a solar+storage system that can keep critical services powered and operational for at least several hours during a grid outage.

In some cases, the **Economic Scenario** may find that neither solar or battery storage would result in net savings over time, in which case no system would be recommended. The **Resilient Scenario** requires that both solar and battery storage are modeled to support critical loads and may result in a system that does not achieve net savings over time. The **Resilient Scenario** only considers the cost of the solar and battery storage components of the system. It does not include any additional costs that may be associated with allowing the system to operate independent of the grid during an outage.[29]

To understand the economic feasibility of solar and battery storage for different building types, the costs of the systems were evaluated against electricity bill savings over time.

To understand the economic feasibility of solar and battery storage for different building types, the costs of the systems were evaluated against electric bill savings over time. To accomplish this, hourly load profiles were developed to approximate how each building uses electricity throughout the year. These load profiles were then modeled against utility electric rate tariffs to determine electric bill savings the system could realize over 25 years of operation.

Incentives are also factored into the analysis. The model assumes all building types are able to take advantage of the federal investment tax credit (ITC) for solar, and for battery storage when paired with solar.[30] While nonprofit entities like municipalities cannot directly benefit from tax incentives, there are third-party leasing arrangements and tax equity partnerships that can pass along incentive savings to nonprofit organizations.[31] In addition to federal tax incentives, the analysis assumes all solar systems participate in net energy metering, with exported generation credited back to the customer at the full retail rate.



The *Resilient Southeast* report series includes a *Technical Appendix* report, which provides information about the methodologies used for the analyses and details the results for each of the five cities examined.

Along with bill savings, the **Resilient Scenario** explores the value of savings due to avoiding the costs of power outages. These avoided outage costs represent the value of losses that would be incurred if a facility were to experience a power outage without a backup source of energy generation. For a business, this could include lost workforce productivity or losses due to interruption of services. For critical community facilities, outage-related costs could range from lost communications due to lack of cell phone charging or wireless connections to loss of life due to lack of medical care or disaster response services.

When solar PV is paired with battery storage, the systems can be configured to deliver power to critical loads during a grid outage, thus avoiding some or all of these outage-related costs. This analysis uses a methodology developed by the Lawrence Berkeley National Laboratory to estimate avoided outage costs.[32] This methodology assumes outage costs for small and large commercial customers, which likely underestimate the value of keeping potentially life-saving services up and running.

For more information about the methodology and assumptions used in this analysis, refer to the *Resilient Southeast—Technical Appendix*.[33]

Along with bill savings, the Resilient Scenario explores the value of savings due to avoiding the costs of power outages.

Avoided Outage Costs: Calculating the Benefit of Energy Resilience

When a building loses power, organizations incur a variety of losses due to the interruption of basic services. When an organization provides services to the surrounding community, such as a shelter or health care provider, those losses can have widespread impacts, particularly during a crisis. Unfortunately, it can be challenging to assign a value to outage-related losses and the resulting benefits of avoiding an outage when a resilient power system delivers backup power.

The analyses in this report series use the Department of Energy's Interruption Cost Estimate (ICE) Calculator to calculate avoided outage costs (see *https://icecalculator.com*). The ICE Calculator, developed by Lawrence Berkeley National Laboratory, has been widely adopted by academics, analysts, and other national laboratories as a trusted methodology to estimate these types of costs. The ICE Calculator bases its outage valuation on two reliability indicators annually reported by utilities to the U.S. Energy Information Administration: System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI). These indicators measure the average length of a utility's annual outages (SAIDI) and how often those outages occur (SAIFI).

Analysis Results for New Orleans

Overall, the analysis resulted in poor economic outcomes for solar+storage to support critical community facilities in New Orleans. New Orleans ranked last among the five cities evaluated based on the economic opportunity for solar+storage development.[34] See **Figure 3**.

The Economic Scenario analysis for New Orleans found that solar PV, without battery storage, would not be an economic investment option for any of the buildings evaluated. These discouraging results are primarily due to the design of electric rate tariffs offered by Entergy New Orleans.

Larger building types analyzed, the school and nursing home, are subject to ENO's Large Electric Service tariff, which has an energy charge rate of 5 cents per kilowatt-hour for the first 5,000 kilowatt-hours of energy consumption in each billing period. The energy charge rate then drops to less than 3 cents per kilowatt-hour for remaining consumption. This very low, second-tier, energy charge rate makes it difficult for solar to compete with the price of grid electricity. The large electric service tariff also includes a fixed demand charge of more than $500 for the first 50 kilowatts of energy demand. Because ENO has structured the charge as a fixed fee, larger commercial customers are charged $500 each billing period regardless of whether their demand is below 50 kilowatts for that period. This again undercuts the bill savings that solar and battery storage can achieve.

Factoring in the additional value of avoided outage costs by powering critical loads during grid disruptions significantly improved the lifetime savings for all building types, resulting in positive economics for the solar+storage systems in all cases.

Smaller building types analyzed, the multifamily housing and the fire station, are subject to ENO's Small Electric Service tariff. The tariff has an energy charge rate of 6 cents per kilowatt-hour for the first 1,000 kilowatt-hours, dropping to about 4 cents per kilowatt-hour for remaining electricity consumption. While these rates are higher than for larger customers, the economics of solar for these customers is still challenging. The Small Electric Service tariff also includes a fixed demand charge but,

FIGURE 3

Summary of Results: Ranking the Opportunities for Resilient Solar+Storage in New Orleans

	Opportunities	Barriers
New Orleans, LA 	**New Orleans ranked fifth among the five cities evaluated, with the weakest solar economics; solar+storage was only found to be a cost-effective solution when accounting for additional savings due to avoided power outages.**	
	• favorable net metering policies	• low potential for electric bill savings • lack of supportive incentives or policies

Photo: iStockphoto/powerofforever

at $12.64 for the first 5 kilowatts of demand, its impact is minimal.

When the buildings were analyzed under the Resilient Scenario, solar+storage was not found to be an economical option for any of the buildings based on electric bill savings alone. Factoring in the additional value of avoided outage costs by powering critical loads during grid disruptions significantly improved the lifetime savings for all building types, resulting in positive economics for the solar+storage systems in all cases.

All of the solar+storage systems were able to provide up to 12 hours or more of backup power to critical loads. These backup power durations could be extended by careful management of critical loads and, during multiday extended outages, some level of backup power would be available any days there were sufficient solar energy from the PV panels to recharge the battery system.[35]

New Orleans School

The analysis results for a secondary school in New Orleans are summarized in **Figure 4**. As with all building types evaluated in New Orleans, rate design and lack of opportunity for significant electric bill savings result in solar PV being an uneconomical investment option for the school.

In an emergency situation, the school was modeled to serve as a temporary emergency shelter, providing basic services to the surrounding community by keeping a portion of the building, such as its gymnasium, auditorium, or cafeteria, powered during grid outages. This was modeled by assuming the school would operate at 25 percent of normal load during a power outage.

Installing a 115.7-kilowatt solar system—the maximum system size for the building given available roof space—paired with a 91.3-kilowatt-hour battery system would provide up to 14 hours of backup power to keep emergency services fully operational at the school.[36] Solar+storage was not found to be an economical investment for the school based on electric bill savings alone.

Factoring in savings achieved through avoided outage costs nearly quadruples the annual savings the solar+storage system can deliver to the school. These added savings result in marginally positive economics for the solar+storage system, with a simple payback period of under 11 years.

FIGURE 4
Results of Analysis for a Secondary School in New Orleans

Based on modeling of utility bill savings and available incentives, solar PV and battery storage were not found to be economical options for a secondary school in New Orleans. When modeled for resilience, the resulting combined solar and battery storage system provides up to 14 hours of backup power to a portion of the school that could serve as a temporary emergency shelter. Factoring in the value of avoided outage costs significantly improves the overall economics of the resilient power system,

Economic Scenario

Most economical system based on available savings and incentives

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
0 kW	0 kWh	0 hours	$0	$0	0

Resilient Scenario

Solar paired with battery storage to deliver reliable onsite emergency power

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
115.7 kW	91.3 kWh	14 hours	$7,800	(-$143,600)	33
		With Avoided Outage Costs	$31,000	$6,900	10.8

New Orleans Nursing Home

The analysis results for a nursing home in New Orleans are summarized in **Figure 5**. Solar PV, without battery storage, was not found to be an economical option for the nursing home.

In an emergency situation, the nursing home was modeled to provide essential services to its residents, such as the continued operation of medical devices, refrigeration of medicines, and heating and cooling, to keep residents comfortable during shorter outages and allow for more time to safely evacuate residents during a prolonged outage. This was modeled by assuming the nursing home would operate at 20 percent of normal load during a power outage.

Installing the maximum solar system size of 30.9 kilowatts and a 45.7-kilowatt-hour battery storage system would provide up to 12 hours of backup power to keep essential services operational at the nursing home. Again, solar+storage was not found to be an economical investment for the nursing home, based on electric bill savings alone.

Avoiding power outages delivers more than 17 times the savings that the solar+storage system could achieve through electric bill savings. Incorporating these avoided outage costs makes the solar+storage system a marginally cost-effective investment for the nursing home.

FIGURE 5

Results of Analysis for a Nursing Home in New Orleans

Based on modeling of utility bill savings and available incentives, solar PV and battery storage were not found to be economical options for a nursing home in New Orleans. When modeled for resilience, the resulting combined solar and battery storage system provides up to 12 hours of backup power to a portion of the nursing home providing medical care and emergency services to residents. Factoring in the value of avoided outage costs significantly improves the overall economics of the resilient power system, resulting in net savings over time.

Economic Scenario

Most economical system based on available savings and incentives

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
0 kW	0 kWh	0 hours	$0	$0	0

Resilient Scenario

Solar paired with battery storage to deliver reliable onsite emergency power

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
30.9 kW	45.7 kWh	12 hours	$1,600	(–$65,500)	53.9
			With Avoided Outage Costs		
			$30,200	$800	10.4

New Orleans Multifamily Housing

The analysis results for a multifamily housing property in New Orleans are summarized in **Figure 6**. For simplicity, only the common area loads of the property were considered in the analysis. These areas include hallways, offices, outdoor and emergency lighting, laundry rooms, and community spaces.

While the economics for solar in New Orleans are slightly better for smaller commercial customers like the multifamily housing property, solar PV was still not found to be an economical option for the property based on electric bill savings.

During an outage, the model assumes the property's common areas continue to operate at 100 percent of normal load, keeping these shared areas fully powered to give residents that may be sheltering in place access to electricity and critical services such as clean water, heating and cooling, device charging, and communications. These services are particularly important for vulnerable populations like elderly residents, those with disabilities, and low-income residents with fewer resources to relocate and less access to transportation in times of emergency.

Installing the maximum solar system of 20.4 kilowatts along with a 9.8-kilowatt-hour battery storage system would provide up to 12 hours of backup power to the multifamily housing common areas. Solar+storage was not found to be an economic option for the multifamily housing property without accounting for avoided outage costs, which more than double the annual savings delivered by the system. With avoided outage costs incorporated, solar+storage would result in positive economics for the property.

FIGURE 6
Results of Analysis for a Multifamily Housing Property in New Orleans

Based on modeling of utility bill savings and available incentives, solar PV and battery storage were not found to be economical options for a multifamily housing property in New Orleans. When modeled for resilience, the resulting combined solar and battery storage system provides up to 12 hours of backup power to the common area spaces of the property, giving residents access to basic services and electricity when sheltering in place during an emergency. Factoring in the value of avoided outage costs significantly improves the overall economics of the resilient power system, resulting in net savings over time.

Economic Scenario

Most economical system based on available savings and incentives

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
0 kW	0 kWh	0 hours	$0	$0	0

Resilient Scenario

Solar paired with battery storage to deliver reliable onsite emergency power

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
20.4 kW	9.8 kWh	12 hours	$1,600	(–$19,600)	26.4
		With Avoided Outage Costs	$4,000	$3,600	10.5

New Orleans Fire Station

The analysis results for a fire station in New Orleans are summarized in **Figure 7**. Solar PV, without battery storage, was not found to be an economical option for the fire station.

As a critical first responder, the model assumes the fire station must remain fully powered during an emergency, so 100 percent of normal load is modeled as the building's critical load during grid disruptions.

Installing the maximum solar system size of 13.6 kilowatts paired with 9.8 kilowatt-hours of battery storage would provide up to 12 hours of backup power to the fire station. Solar+storage was again not found to be a positive investment for the fire station without accounting for avoided outage costs. Savings from avoided outages triples the annual savings delivered by solar+storage, resulting in the most favorable economics of all the New Orleans building types evaluated, with a simple payback period of less than seven years.

FIGURE 7

Results of Analysis for a Fire Station in New Orleans

Based on modeling of utility bill savings and available incentives, solar PV and battery storage were not found to be economical options for a fire station in New Orleans. When modeled for resilience, the resulting combined solar and battery storage system provides up to 12 hours of backup power to keep the station fully operational during an emergency. Factoring in the value of avoided outage costs significantly improves the overall economics of the resilient power system, resulting in net savings over time.

Economic Scenario

Most economical system based on available savings and incentives

Solar	Battery Storage	Backup Power	1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
0 kW	0 kWh	0 hours	$0	$0	0

Resilient Scenario

Solar paired with battery storage to deliver reliable onsite emergency power

Solar	Battery Storage	Backup Power		1st Year Savings	Net Lifetime Savings (25-year NPV)	Simple Payback (years)
13.6 kW	9.8 kWh	12 hours		$1,000	(–$16,900)	30.6
			With Avoided Outage Costs	$3,000	$17,200	6.9

Opportunities for Solar and Storage in New Orleans

Progressive renewable energy goals and a motivated local government could help prioritize solar+storage development in New Orleans. Upcoming New Orleans City Council hearings could also have widespread implications on the renewable energy industry.

THE CITY OF NEW ORLEANS

The City of New Orleans has emerged as a clean energy leader in Louisiana. In 2017, the City pledged to cut greenhouse gas emissions in half by 2030. The pathway to a clean energy transition was outlined in the report, *Climate Action for a Resilient New Orleans*.[37] In the plan, city-owned buildings are identified as opportunities to incorporate rooftop solar. The plan also established a target to install over 255 megawatts of solar, which would equate to 20 percent of the City's potential rooftop solar capacity, by 2030.

The City is working with stakeholders, including the NOCC, to improve access to solar. However, the City has not specified which market mechanisms or case studies will be used as models to inform program design. The report does include references to battery storage and microgrids as necessary technologies for improving resiliency and reducing emissions, however, the City has not established any battery storage targets.

NEW ORLEANS CITY COUNCIL

In 2016, ENO opened a request for proposals for 20 megawatts of renewable energy. Then, in 2017, ENO proposed a commitment to acquiring 100 megawatts of renewables. The City Council has taken no action on this proposal. In 2018, with only one megawatt of solar installed by ENO in the city, the NOCC required the utility to file an application to acquire the 90 megawatts of solar that ENO said was available as a result of responses to their request for proposal process to solicit bids for potential projects. The submitted plan included only one project in New Orleans, a 20-megawatt solar array. The project would be owned and operated by ENO.[38] The other two projects include a power purchase agreement where ENO will purchase power from an independent power producer and a Build-Own-Transfer.[39] The 90-megawatt plan has yet to be approved by the Council but is in a settlement phase with the intervenors.

The Council is also in the middle of a rate case proceeding with ENO. In the current rate proposal, large commercial customers would see a rate decrease, while smaller commercial and residential customers would see rate increases.[40]

Community and advocacy organizations are currently encouraging the Council to adopt a Renewable Portfolio Standard (RPS) for New Orleans. Thirty-six organizations signed on to a petition for New Orleans to adopt a RPS, which was submitted it to the Council in mid-2018. In response, the Council has opened a RPS rulemaking that positions the city to have an RPS in place by the end of 2019.

A battery storage system located in a low-income housing rental property for resilient power and cost savings. This installation was supported by Clean Energy Group's Resilient Power Project. Photo: Clean Energy Group

Recommendations

The results of this analysis illustrate a poor economic environment for resilient solar+storage development in New Orleans. While the analysis found positive solar+storage economics for all facilities when considering avoided outage costs, none of the critical facilities had positive economic outcomes for solar or solar+storage based on electric bill savings alone.

Enabling policies and programs, such as grant programs for solar+storage demonstration projects and targeted incentive programs, could contribute to a more robust solar+ storage industry and accelerate the deployment these technologies for critical facilities.

This outcome is in large part due to the electric rate tariffs offered by Entergy New Orleans. Enabling policies and programs, such as grant programs for solar+storage demonstration projects and targeted incentive programs, could contribute to a more robust solar+storage industry and accelerate the deployment these technologies for critical facilities.

The following recommendations represent proven and emerging actions that have been implemented to advance solar+storage development in other states and municipalities:

- **Allocate grant funding for solar+storage demonstration projects.** Solar+storage demonstration projects can educate residents about resilient energy, spur market development, and provide communities with a valuable service. Florida has already built resilient community facilities that can withstand prolonged outages through the SunSmart Emergency Shelter Program. This has installed solar+storage systems in over 100 schools that can now serve as shelters in the event of a disaster. Maryland and Massachusetts have all also implemented resilient power initiatives worth considering. The Maryland Energy Administration's new Resilience Hub Program provides $5 million in incentives to support solar+storage installations in community resilience hubs serving low-income communities. The Massachusetts Community Clean Energy Resiliency Initiative has helped municipalities avoid future outages by providing grants to install solar+storage in community facilities such as hospitals, first responders, community centers, and high schools.[41] The City of New Orleans was awarded $141 million from the Department of Housing and Urban Development's (HUD) National Disaster Resilience Competition. The HUD award will fund the creation of the City's first resilience district in Gentilly, a neighborhood in New Orleans that was greatly impacted by Hurricane Katrina. Approved Gentilly Resilience District initiatives include investments in microgrids and alternative energy resources for critical water infrastructure. The City is currently working with partners to develop the final framework for Gentilly and has an opportunity to incorporate solar+storage early-on.[42]

- **Establish public technical assistance funding.** Many solar+storage projects are never explored simply due to the prohibitive upfront cost of performing a technical and economic feasibility assessment. This is a barrier particularly for public and nonprofit organizations, which may not have the same access to resources as large private companies. To help communities and organizations understand the benefits and limitations of resilient solar+storage projects, states and municipalities should consider establishing public funding programs to help organizations obtain objective information about whether solar+storage projects will work for their communities. These programs should be targeted to assist projects providing critical services to vulnerable populations. Clean Energy Group's Technical Assistance Fund, leveraged by multiple foundations, has supported dozens of solar+storage project evaluations for affordable housing and critical community facilities across the country.[43]

- **Provide targeted incentives for battery storage.** States with strong incentives in place are unsurprisingly leading in battery storage installations. To help ensure equitable deployment of resources, leading states have also begun to include carve-outs and/or added incentives for storage development in low-income and disadvantaged communities. In 2018, California acted to extend its successful behind-the-meter battery storage incentive program, the Self-Generation Incentive Program (SGIP), through 2025. The extension will result in an additional $830 million to support customer-sited battery storage projects. SGIP has helped establish California as the nation's leader in commercial battery storage installations. Twenty-five percent of SGIP's funding is dedicated to projects in low-income and disadvantaged communities.[44] The Solar Massachusetts Renewable Target (SMART) program includes incentives for solar installations that incorporate a battery storage component.[45] The SMART program also aims to develop markets in underserved communities by including additional incentives for solar projects serving low-income communities and community shared solar projects. The New Orleans City Council has the opportunity to request an alternative plan to meeting the 20 megawatts of new solar capacity proposed for New Orleans by ENO, such as a distributed energy incentive program. ENO could reallocate funds away from the utility-scale project and into rebates or financing that would incentivize customers to invest in rooftop solar systems. In this scenario, battery storage could also be incentivized to account for its resilience benefits.

Louisiana flooding damage in August 2016.
Photo: US Department of Housing and Urban Development

- **Establish energy storage procurement targets and goals.** Much in the way that Renewable Portfolio Standards have accelerated solar and wind development in many states across the country, several states have begun to implement utility procurement targets and goals for energy storage. California adopted the first state energy storage mandate in 2010, requiring the state's three investor-owned utilities to procure 1.3 gigawatts of energy storage by 2020. Importantly, California established deployment targets for both grid energy storage and distributed customer-sited energy storage and placed limitations on utility ownership, ensuring a diverse and competitive market. State storage targets and mandates have been more recently implemented across the Northeast, with Massachusetts, New York, and New Jersey all setting ambitious energy storage deployment goals. In 2016, New York City established the first citywide storage goal of 100 megawatt-hours by 2020, along with an expanded solar target of 1,000 megawatts by 2030.[46] Any determined goals or targets should be legally enforceable to ensure that battery storage development is a priority, rather than a symbolic gesture.

For states without ready funds to support new incentives for emerging technologies, established energy efficiency programs represent an opportunity to allocate existing funds to advance cost-effective energy storage solutions.

- **Create market opportunities for energy storage to provide grid services.** The primary obstacle to solar+storage development remains system economics. While battery storage has the ability to provide many beneficial services to utilities and grid operators, such as frequency regulation and demand response, there are little to no opportunities for storage to generate revenue for providing these services in Louisiana. Some utility demand response or demand side management programs do exist, but these tend to be tailored to big energy users like large corporations or industrial customers. PJM, the regional transmission organization (RTO) serving the mid-Atlantic region from Washington, DC to Chicago, created one of the biggest markets for energy storage in the country by recognizing the unique abilities of storage to serve as a fast-response resource for frequency regulation. PJM took these steps to comply with Federal Energy Regulatory Commission (FERC) Order 755. FERC Order 841, which is currently being implemented, requires all RTOs and independent system operators (ISOs) to take similar actions to allow for energy storage participation in grid services markets.

  Louisiana falls within the Midcontinent Independent System Operator (MISO) transmission territory. MISO has begun to lay out changes to its market rules and regulations that could open up new revenue opportunities for cost-effective energy storage solutions, but the details and impact these changes will have on battery storage throughout the MISO territory remain to be seen. Utilities like Entergy New Orleans can also take similar actions by creating market opportunities for battery storage to provide valuable distribution-level services.[47]

- **Include energy storage in state energy efficiency programs.** Massachusetts recently became the first state in the country to approve energy storage as an eligible technology under its Three-Year Electric & Gas Energy Efficiency Plan.[48] For states without ready funds to support new incentives for emerging technologies, established energy efficiency programs represent an opportunity to allocate existing funds to advance cost-effective energy storage solutions. Louisiana allocated $7.3 million in electric efficiency program spending in 2017.[49]

- **Include resilient power in disaster relief funding.** After Hurricane Maria, the government of Puerto Rico proposed that federal Community Development Block Grant Disaster Relief funds include over half a billion dollars for resilient infrastructure investments. $436 million will translate to solar+storage incentives for resilient energy and water installations, $75 million for Community Resilience Centers, and $100 million for a revolving loan fund to spur private industry development by reducing credit risk faced by contractors. By requiring incentives and carve-outs for the installation of resilient solar+storage systems, Puerto Rico is preparing for the next storm as they recover from the last.

Conclusion

There is little debate over the need for stronger energy resilience in locations prone to severe weather and power outages such as New Orleans. While diesel generators have served as the go-to resource for onsite backup power for decades, it is time to explore and embrace cleaner, more efficient technologies that can do more than sit around waiting for the next emergency. As the findings detailed in this report suggest, solar+storage can provide a clean, cost-effective alternative to traditional backup generators—one that delivers benefits throughout the year.

Solar+storage can provide a clean, cost-effective alternative to traditional backup generators—one that delivers benefits throughout the year.

Currently, the opportunity for resilient solar+storage development in New Orleans can be challenging due to a lack of supportive policies, the design of commercial utility electric rate tariffs, and the sometimes-prohibitive, upfront cost of battery systems. Policies and programs that recognize and reward the true value of resilient solar+storage could drastically change that dynamic.

The results detailed in this report support the need for evaluation and implementation of new supportive policies, programs, and regulations to advance resilient, customer-sited solar+storage in New Orleans. The findings and recommen-dations presented here are meant to start a conversation about the steps that New Orleans and the state of Louisiana could take to ensure a more resilient future for its residents before the next storm strikes.

Rooftop solar panels at Oakwood Center in Gretna, LA.
Photo: Solar Alternatives

ENDNOTES

1 Customer-sited solar PV and battery storage refers to what are often called behind-the-meter systems. This means that the systems are installed on the customer side of the utility meter, so that solar generation and energy discharged from a battery meet onsite needs for electricity before any excess electricity is exported to the utility grid. In contrast, a front-of-the-meter system exports electricity directly onto the utility grid.

2 Clean Energy Group. SunSmart Emergency Shelters Program (Webinar recording). *Featured Resilient Power Installations.* March 31, 2015. *https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/sunsmart-emergency-shelters-program.*

3 A microgrid is essentially a small self-contained electricity grid with onsite generation that can operate independently of the utility grid. While microgrids may be grid-connected or completely off-grid, they all have the ability to continue providing power to select onsite loads in the event of an outage, even if utility service is interrupted. To learn more about the Marcus Garvey Apartments microgrid, visit Clean Energy Group's Featured Installation page: Clean Energy Group. SunSmart Emergency Shelters Program (Webinar recording). *Featured Resilient Power Installations.* 2017. *https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/marcus-garvey-apartments.*

4 To read more about the Fremont Fire Stations: Stark, Kevin. "This East Bay Energy Startup Is Building Microgrids for California's Fire Stations." *GTM^2. January 15, 2019. https://www.greentechmedia.com/articles/read/startup-microgrids-fire-stations?utm_medium=email&utm_source=Daily&utm_campaign=GTMDaily#gs.1hXMUmb5.*

5 Demand charges, which are typically only applied to commercial customers, are typically billed based on the highest rate of electricity consumption a customer experiences during a billing period, measured in kilowatts. This highest level of demand is known as peak demand. For more information about demand charges and how energy storage can lower peak demand, see Clean Energy Group and National Renewable Energy Laboratory. "An Introduction to Demand Charges." August 2017. *https://www.cleanegroup.org/wp-content/uploads/Demand-Charge-Fact-Sheet.pdf.*

6 CNN. "Hurricane Katrina Statistics Fast Facts." August 31, 2018. Accessed March 14, 2019. *https://www.cnn.com/2013/08/23/us/hurricane-katrina-statistics-fast-facts/index.html.*

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9 Yan, Holly and Rosa Flores. "Louisiana flood: Worst US disaster since Hurricane Sandy, Red Cross says." *CNN.* August 19, 2016. *https://www.cnn.com/2016/08/18/us/louisiana-flooding/index.html.*

10 Gutierrez, Gabe, Cassandra Vinograd and Elisha Fieldstadt "Louisiana Flooding: At Least Four Dead, 20,000 Rescued." *NBC News.* August 14, 2016. *https://www.nbcnews.com/news/us-news/louisiana-flooding-least-three-dead-officials-warn-more-rain-come-n630331.*

11 Press release. "Restoration Efforts Continue After Great Flood of 2016." *Entergy Corporation.* August 17, 2016. *https://www.entergynewsroom.com/news/restoration-efforts-continue-after-great-flood-2016.*

12 Solar Energy Industries Association. "Louisiana Solar." Accessed March 14, 2019. *https://www.seia.org/state-solar-policy/louisiana-solar.*

13 Third-party ownership of systems, often structured through Power Purchase Agreements (PPA), are still illegal in Florida. A PPA is a financial agreement where a developer finances, installs, owns, and operates an energy system on a customer's property. The customer pays the developer for the power generated at a fixed rate that is typically lower than the regular electricity rate charged by the electric utility.

14 To learn more about PACE and the projects that have been funded, visit: PACENation. "What is PACE Financing?" Accessed March 14, 2019. *https://pacenation.us/what-is-pace.*

15 The first Commercial PACE funded microgrid in the country serves a 285-unit mixed-income housing and retail development in Hartford, Connecticut. Solar and storage adds resilience to the development in the event of a natural disaster and helps to reduce electric bills by lowering demand-related charges. In its first year of operation, the microgrid generated over $300,000 in electric bill savings. To read more, visit: Better Buildings. "Commercial PACE Financing for Microgrid in Mixed-Use Building." *U.S. Department of Energy.* Accessed March 15, 2019. *https://betterbuildingsinitiative.energy.gov/implementation-models/commercial-pace-financing-microgrid-mixed-use-building.*

16 Entergy Louisiana provides power to over 50 parishes in Louisiana and is also an Entergy Corporation subsidiary.

17 Alliance for Affordable Energy. "New Orleans has been Kept in the Dark: Making Sense of Outages, Reliability, & Resilience." September 2017. *https://www.all4energy.org/uploads/1/0/5/6/105637723/outages_reliablity_resilience.pdf.*

18 The grid does not permit customers in the Central Business District to connect solar PV due to an inability to accept bi-directional energy transmission. Bi-directional means that electricity can be transmitted in two directions, both from the customer to the grid, and from the grid to the customer. Net metering requires bi-directional metering capabilities so a utility can meter the amount of energy being generated and sent back to the grid.

19 Bucci, Margaret. "Entergy New Orleans' Solar Plant Tours Provide Inside Look at Emerging Technology." *Entergy.* December 7, 2017. *https://www.entergynewsroom.com/article/entergy-new-orleans-solar-plant-tours-provide-inside-look-at-emerging-technology.*

20 Williams, Jessica. "City Council approves first steps toward 'community solar' power program." *The New Orleans Advocate.* June 21, 2018. *https://www.theadvocate.com/new_orleans/news/article_2a9507c6-749b-11e8-82a0-7ff66bf8f063.html.*

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24 Larino, Jennifer. "See plans for a new $7.4 million affordable housing complex for veterans off Broad Street." *NOLA.com, The Times-Picayune.* January 18, 2019. *https://www.nola.com/business/2019/01/see-plans-for-a-new-74-million-affordable-housing-complex-for-veterans-off-broad-street.html.*

25 The Greenlink Group has performed more than a dozen analyses on the economics of solar, battery storage, and the combination of the two in the Southeast.

26 Net present value (NPV) is defined as the difference between the present value of economic benefits and the present value of expenses over the life of the system. Future benefits and expenses are discounted over time. A positive NPV indicates that it would be economically beneficial to install the system, whereas, a negative NPV would indicate that the system would not result in net savings over time. In cases where no solar or battery storage system would result in a positive NPV, the most economic scenario is assumed to be the business-as-usual case where no solar or storage system is installed.

27 The battery storage portion of any modeled system is assumed to have a useful life of 15 years based on expected operation. The analysis assumes replacement of the battery storage system and inverter after year 15 for any system that incorporates battery storage. Replacement costs are included in all NPV calculations.

28 Critical loads may represent anything from emergency lighting and cell phone charging to medical devices and air conditioning depending on the services provided by a facility. For simplicity, this analysis assumes critical loads are represented by the normal building load or a specified percentage of normal building load depending on the building type.

29 Additional costs associated with making a system able to disconnect from the grid and operate independently can vary widely depending on the project. Added expenses may include additional hardware components, such as a transfer switch or critical load panel; software components; electrical design complexity, such as isolating critical loads; and permitting costs. These factors must all be considered when determining the full cost of a solar and battery storage system designed to deliver backup power.

30 According to guidance issued by the Internal Revenue Service, battery storage is eligible for the ITC when paired with and at least 75 percent charged by onsite solar. The analysis assumes the solar and battery storage systems are DC connected, with no ability for the storage system to be charged by the grid. This means that the battery storage system is 100 percent charged by onsite solar and, therefore, eligible to take advantage of the full 30 percent ITC incentive.

31 For more information about solar and battery storage third-party ownership financing structures, see: Milford, Lewis and Robert Sanders. "Owning the Benefits of Solar+Storage: New Ownership and Investment Models for Affordable Housing and Community Facilities." *Clean Energy Group*. February 15, 2018. *https://www.cleanegroup.org/ceg-resources/resource/owning-the-benefits-of-solar-storage*.

32 Lawrence Berkeley National Laboratory and Nexant, Inc. "Interruption Cost Estimate (ICE) Calculator." *Transmission Permitting and Technical Assistance Division of the U.S. Department of Energy's Office of Electricity (OE) Delivery and Energy Reliability (Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231)*. Accessed March 15, 2019. *https://icecalculator.com/home.*

33 More detailed analysis results are available in the *Resilient Southeast—Technical Appendix*. *https://www.cleanegroup.org/ceg-resources/resource/resilient-southeast-technical-appendix.*

34 More detailed analysis results are available in the *Resilient Southeast—Technical Appendix*.

35 It is important to note that the backup power values do not represent the maximum total hours the system could power critical loads during an extended outage, just the number of hours the solar and battery storage system could support those loads before the batteries were depleted. When sufficient solar is available to recharge the batteries, the system could again provide backup power.

36 The analysis assumes that approximately 40 percent of a building's rooftop space is available for the economically viable installation of solar panels. The remaining 60 percent of roof space is considered unavailable due to a variety of factors including: roof penetrations, such as venting; rooftop equipment, like water tanks and air conditioning; and building code offset requirement. 40 percent of rooftop space is considered the upper boundary for solar system sizing. In practice, there are other options for expanding solar system sizing, such as parking lot canopies, ground-mount systems, and elevated rooftop systems, however, these options are not considered in this analysis.

37 To read *Climate Action for a Resilient New Orleans,* visit: City of New Orleans. "Climate Action for a Resilient New Orleans." *Office of Resilience & Sustainability.* July 2017. *https://www.nola.gov/nola/media/Climate-Action/Climate-Action-for-a-Resilient-New-Orleans.pdf*.

38 Roselund, Christian. "New Orleans may actually get 90 MW of big solar." *PV Magazine.* August 21, 2018. *https://pv-magazine-usa.com/2018/08/21/entergy-new-orleans-may-actually-get-90-mw-of-solar.*

39 In a Build-Own-Transfer model, a third party develops the solar farm and then, once the installation is completed, ownership is transferred to the utility.

40 *https://www.nola.com/expo/news/erry-2018/10/46c90f59868357/how-much-should-electricity-co.html*

41 To learn more about the Massachusetts Community Clean Energy Resiliency Initiative visit *https://www.mass.gov/files/2017-07/resilency-poster-3-24-15.pdf*.

42 *https://www.theadvocate.com/new_orleans/news/politics/article_deac41f7-091f-5ab3-b38c-0b04295631e0.html*

43 *https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations*

44 *http://www.cpuc.ca.gov/sgip*

45 To read more about Massachusetts SMART program visit *https://www.mass.gov/solar-massachusetts-renewable-target-smart.*

46 *https://www.greentechmedia.com/articles/read/new-york-city-becomes-first-to-set-citywide-energy-storage-target.*

47 For more information on market opportunities for energy storage, see "Energy Storage and Electricity Markets: The value of storage to the power system and the importance of electricity markets in energy storage economics" at *https://www.cleanegroup.org/ceg-resources/resource/energy-storage-and-electricity-markets-the-value-of-storage-to-the-power-system-and-the-importance-of-electricity-markets-in-energy-storage-economics.*

48 "Storage: The New Efficiency, How States can use Energy Efficiency Dollars to Support Battery Storage and Flatten Costly Demand Peaks", Clean Energy Group and Applied Economics Clinic, April 2019

49 ACEEE, The 2018 State Energy Efficiency Scorecard, *https://aceee.org/research-report/u1808.*

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*

THE GREENLINK GROUP

Greenlink is an Atlanta-based energy research and consulting firm equipped with sophisticated analytical technologies and deep industry knowledge in the clean energy space, receiving accolades from MIT and Georgia Tech, among others. Greenlink provides the evidence and expert analysis needed to evaluate the most pressing issues faced by today's energy market, namely the integration of a wide range of clean energy options, such as energy efficiency in buildings, demand side management, and centralized and distributed renewable resources. *www.thegreenlinkgroup.com*

ALLIANCE FOR AFFORDABLE ENERGY

The Alliance for Affordable Energy safeguards Louisiana's future by protecting consumers' right to an affordable, equitable, and environmentally responsible energy system. We are committed to promoting a new vision for energy policy in Louisiana, from an "energy state" to a "clean energy" leader in the South. Serving as both a consumer advocate and public health advocacy organization, our policy work meets at the crossroads of social justice, sustainable economic development, and environmental protection. *www.all4energy.org*

RESILIENT POWER

A project of Clean Energy Group

Clean Energy + Battery Storage = Climate Mitigation, Lighting & Electricity, Running Water, Telecom, Elevators & Accessibility, Savings & Revenue, Life-Supporting Technology

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