Wilmington

RESILIENT SOUTHEAST

Exploring Opportunities for Solar+Storage in Wilmington, NC

CleanEnergyGroup
Innovation in Finance, Technology & Policy

ABOUT THIS REPORT

Resilient Southeast— Wilmington is one in a series of reports that explores the obstacles and opportunities for solar PV and battery storage (solar+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+storage systems. This report also presents potential near-term opportunities for policies and regulatory changes that could advance resilient solar+storage development in Wilmington,NC and concludes with a set of recommendations. Clean Energy Group partnered with Southern Environmental Law Center 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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Rooftop solar array at the Faith Community Church in Greensboro, NC.
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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 Wilmington, ensuring that residents have access to critical services in the event of an emergency.

Wilmington ranked first for opportunities to deploy resilient solar and battery storage among the five southeastern cities evaluated in this report series

By exploring the opportunity for deployment of solar and battery storage systems for critical facilities in Wilmington, this report aims to answer the question: does solar paired with battery storage make economic sense for strengthening the resilience of North Carolina communities? Based on the results of detailed economic analysis of critical building types in Wilmington, the answer is yes, though some challenges and barriers still remain that must be addressed to allow these types of resilient power systems to be widely adopted. *Wilmington ranked first for opportunities to deploy resilient solar and battery storage among the five Southeastern cities evaluated in this report series.*

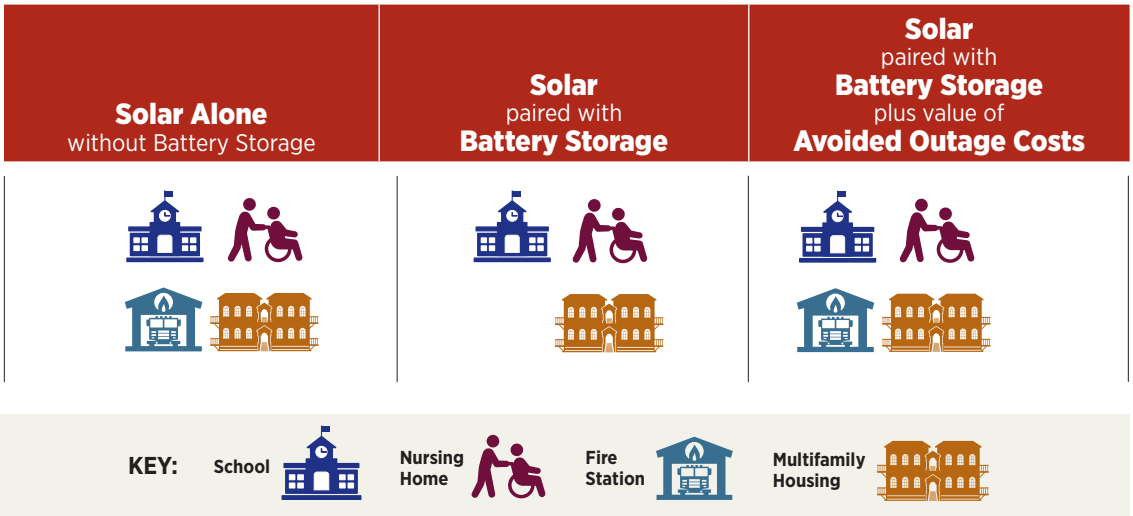
Figure 1 summarizes the findings of detailed economic evaluations for solar and battery storage at four critical facilities in Wilmington: a school, a nursing home, a multifamily housing property, and a fire station. Solar was found to be a positive economic investment for each of the four building types. With the addition of battery storage, resilient solar+storage remains an economical option for the school, nursing home, and multifamily housing based solely on electric bill savings. The added expense of battery storage makes the combined systems uneconomical for the fire station when the value of resilience is not accounted for. However, when savings due to avoiding power outages are factored into the economics, *solar paired with battery storage was found to make economic sense for all building types evaluated.* 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 Wilmington 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**. Wilmington benefits from favorable state net-metering policies and a utility solar incentive, but Wilmington is limited by a lack of certain financing options and little support for customer-sited battery storage. This mix of factors creates an encouraging though still challenging environment for the development of resilient solar+storage.

FIGURE 1

What Works in Wilmington—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 Wilmington. Solar alone, without storage, was found to be a positive investment for all building types. Solar paired with battery storage, which can be configured to provide resilient backup power during grid outages, was also found to an economical option for a secondary school, nursing home, and multifamily housing based on bill savings alone, and for a fire station when factoring in savings due to avoided outage costs.



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To address these challenges, this report presents potential near-term opportunities for policies and regulatory changes that could advance solar+storage development in Wilmington and concludes with a set of recommendations. Innovations in project financing and the encouraging results of the state's battery storage study 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 to advance resilient power solutions.*

FIGURE 2

Solar and Battery Storage Opportunity Landscape in Wilmington

The opportunity for customer-sited solar and battery storage development in Wilmington is highly dependent on a number of state, regional, and local factors, such as policies, incentives, and utility electric rates. Wilmington was found to have a predominately supportive mix of key factors, resulting in an encouraging 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 Wilmington

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. 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 areas 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,

North Carolina following Hurricane Florence.
Photo: Creative Commons/NC National Guard

are handicapped without access to reliable backup power. When shelters aren't operational due to lack of electricity and lack 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.

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 provide a variety of emergency services, including sanitation, medical equipment, communications, charging, and food.

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.

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.

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 North Carolina

In the past decade, new weather patterns and intensified storms have forced the state government and local leaders in North Carolina to re-evaluate disaster preparedness and response. North Carolina experienced one the most damaging hurricanes on record, and severe winter weather conditions have become more frequent. Transportation concerns and heavy flooding have emerged as major hurdles to emergency response. Power outages are leaving vulnerable populations in the dark and, in some cases, without heating and cooling 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.

WINTER WEATHER

For a state that rarely has to deal with severe winter weather, major snow and ice storms have resulted in North Carolina declaring a state of emergency in December 2018 and then again in January 2019. In December, up to two feet of snow fell in parts of North Carolina. Over 200,000 customers lost power and over 140,000 households remained without power the following day. One critical care home patient died after her oxygen supply lost power.[6] People turned to hotels and shelters as temperatures dropped and crews required time to repair damaged powerlines.[7] Some households were unable to evacuate and had to remain trapped in their homes without power for three days.[8] The following month, upwards of a foot of snow and half an inch of ice resulted in another 200,000 power outages across North Carolina.[9] Unsafe roadways resulted in crashes and warnings for people to not leave their homes.

HURRICANE FLORENCE

Hurricane Florence made landfall near Wilmington in September of 2018. The Category 1 hurricane had wind speeds near 90 mph and resulted in nearly three feet of rain in some areas. Over 900,000 customers lost power in North Carolina.[10] In Wilmington, 60 percent of homes and businesses were without power and over 80,000 customers remained without power in the days after the storm.[11] Special medical needs shelters were opened for vulnerable populations throughout North Carolina and over 10,000 residents remained in shelters following the storm.[12]

The 40 solar sites in North Carolina owned and operated by Duke Energy incurred little to no damage and were back up and operational within days after the hurricane.

Critical facilities were hit hard. After Wilmington's wastewater treatment facilities lost power and the facility's backup generators failed, more than five million gallons of partially treated sewage made its way into Cape Fear River.[13] A mobile hospital had to be dispatched after heavy flooding resulted in the evacuation of a hospital. Recovery has also been a slow and costly process. Duke Energy Corporation, which owns the two largest utilities in North Carolina, Duke Energy Progress and Duke Energy Carolinas, spent over $760 million to remediate damages caused by 2018 storms. Duke Energy Progress, the utility serving Wilmington and most of eastern North Carolina, has spent over $500 million on Hurricane Florence recovery and repair alone.[14] However, the 40 solar sites in North Carolina owned and operated by Duke Energy incurred little to no damage and were back up and operational within days after the hurricane.[15]

North Carolina's Solar and Storage Landscape

A supportive regulatory environment has resulted in a robust solar industry in North Carolina, but battery storage has yet to have access to the same support and benefits. North Carolina is second only to California for state solar capacity, with over 4,000 megawatts of installed solar. Almost 5.5 percent of the state's total electricity is generated by solar.[16]

Favorable net metering policies have improved solar economics for residential and commercial customers in North Carolina.

Of the five Southeastern states analyzed in this series, North Carolina is the only state to have a Renewable Portfolio Standard (RPS).[17] A RPS mandate that requires investor-owned utilities to supply 12.5 percent of retail electricity sales by 2021 from renewable energy and energy efficiency measures, in addition to a 0.2 percent solar target, made solar a requirement for utility power generation plans in the state. North Carolina does not currently have any local or statewide battery storage targets or mandates.[18]

Utility-scale solar installations have driven statewide solar growth. By 2017, Duke Energy had over 2,000 megawatts of utility-scale solar installed in its North Carolina service territories. In contrast, Duke Energy had less than 200 megawatts of distributed solar capacity in North Carolina.[19] In fact, distributed solar has achieved a combined capacity of less than 200 megawatts across all investor-owned utilities in North Carolina. Utility-scale battery storage has just started to gain traction in North Carolina, and behind-the-meter projects remain minimal, resulting in only one megawatt of battery storage installed capacity.[20]

Favorable net metering policies have improved solar system economics for residential and commercial customers in North Carolina. Investor-owned utilities are required to provide retail rate crediting to customers for exported solar energy, there is no aggregated capacity limit for the amount of customer-owned distributed solar allowed to participate in net metering, and customer-owned systems participating in the program can be up to one megawatt in capacity.[21,22] A number of North Carolina's electric cooperatives and municipal utilities have already begun incorporating storage into their operations. The Brunswick Electric Membership Corporation in southeast North Carolina is in the process of installing a 12-megawatt-hour battery project that will serve its 100,000 customers.[23]

Duke Energy customers in North Carolina also benefit from a solar rebate. Residential customers can receive $0.60 per watt, up to $6,000; commercial customers can receive $0.50 per watt, up to $50,000; and nonprofit customers can receive $0.75 per watt, up to $75,000. Neither Duke nor the state provides a battery storage incentive.

Current regulations have had the opposite impact on the battery storage industry. Battery storage systems are eligible to participate in net metering but using batteries to lower electricity costs under time-varying electric rate tariffs is prohibited. Time-of-use (TOU) rates charge customers different prices for electricity depending on the time of day, with higher-priced peak periods and lower-priced off-peak periods. Due to this restriction, battery storage cannot store energy from off-peak times to release during peak times, thus offsetting the higher energy costs associated with peak electricity pricing. This restriction limits the value of battery storage to customers subject to TOU rates,

negatively impacts system economics, and misses opportunities to add value to the grid.

Recent policy developments aim to further define and expand the renewable energy industry in North Carolina. House Bill 589 (HB589), *Competitive Energy Solutions for North Carolina*, requires Duke Energy Progress and Duke Energy Carolinas (together, Duke Energy) to competitively procure 2,660 megawatts of renewable energy resources. Duke Energy Progress issued a Request for Proposals in 2018 for 80 megawatts of renewables in North and South Carolina and received 15 times that amount in bids.[24]

Financing has been major impediment to the residential and commercial battery storage market in North Carolina. HB589 also disallows third-party sales of solar energy in North Carolina, which is typically how third-party power purchase agreements (PPA) are structured. This rule was reinforced recently when an environmental organization was challenged by Duke after installing a solar system on a church roof. The payback was structured as a third-party financing arrangement, where the environmental organization charged the church a reduced per-kilowatt-hour rate for the electricity generated by the solar system. The North Carolina Utilities Commission ruled in favor of Duke. The case was brought to the North Carolina Supreme Court, which ruled in favor of the North Carolina Utilities Commission, reaffirming that only a utility company can sell electricity.[25]

Solar leasing, a popular financing option with no or little upfront costs, was not clearly made available until HB589 was passed in 2017 and is just now being offered into the market. Solar leasing is different than third-party sales 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 has not been utilized in the state, despite the passing of PACE-enabling legislation. 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.[26] Loans are typically secured with a lien on the property and paid through an assessment on the customer's annual property tax bills.

Financing has been major impediment to the residential and commercial battery storage market in North Carolina.

HB589 also restructured the Public Utility Regulatory Policies Act of 1978 (PURPA). As a result, Duke will now have more authority over the location and operation of solar projects for projects over one megawatt, which could pose a barrier to the development of larger non-utility-owned solar projects. Prior to HB589, over 90 percent of North Carolina's utility-scale PV was certified under PURPA.[27] A battery storage mandate or target was not included in the bill, but it did call for an energy storage feasibility study to explore the value that battery storage would have on the grid and for customers. The study is discussed in more detail in the *Opportunities* section of this report.

NORTH CAROLINA UTILITIES COMMISSION

The North Carolina Utilities Commission (NCUC) regulates the investor-owned electric utilities in the state, including the two largest

The McAlpine Creek solar+ storage demonstration project provides resilient power to Fire Station 24 in Charlotte, NC.
Photo: Creative Commons/ Duke Energy

utilities: Duke Energy Progress and Duke Energy Carolinas. Duke Energy Progress, the primarily electric utility for Wilmington, serves approximately 1.5 million customers in North Carolina. As the regulatory authority, the NCUC sets utility rates and incentives, and must approve any proposed rate changes. NCUC is overseeing the regulatory changes required by HB589 and has already accepted PURPA modifications, including decreased avoided cost rates paid to renewable energy developers, reduced eligible project size from five megawatts to one megawatt, and shortened contract lengths from 15 years to 10 years.[28]

Both solar+storage systems remained operational through Hurricane Irma in 2017, despite widespread outages reported in neighboring communities.

The NCUC also reviews plans to build new generation assets and can mandate that investor-owned utilities include clean energy development in their planning processes. Duke Energy's most recent 2018 Integrated Resource Plan (IRP) suggests additional solar and storage development in the future for both North and South Carolina.[29] The utility's installed solar capacity is planned to grow from 1,200 megawatts to 3,400 megawatts by 2033. Battery storage is projected to make up 4 percent of new capacity with the addition of 300 megawatts.[30] Over the next 15 years, that could result in upwards of $500 million in battery storage investment.[31] The IRP process is currently underway, but the NCUC has yet to approve a final plan.

Utility workers restore power after Hurricane Matthew in NC.
Photo: Creative Commons/Lance Cheung, USDA

BEHIND-THE-METER SOLAR+STORAGE

In 2017, Duke Energy Progress installed a 10-kilowatt solar PV and 95-kilowatt-hour battery storage system in the Great Smoky Mountains National Park to support a communications tower. The tower's remote location made it difficult and expensive to maintain a power line serving the facility and service was often unreliable. Since solar+storage was installed, the power line was taken down and the Mount Sterling communications tower runs solely on resilient power.[32]

A second microgrid was completed by Duke Energy Progress' sister company in North Carolina, Duke Energy Carolinas. The microgrid consisted of a 50-kilowatt solar PV and 200-kilowatt/500-kilowatt-hour battery storage system serving a fire station in Charlotte, NC. The microgrid allows the fire station to island from the grid and continue operations in the event of an outage. Both solar+storage systems remained operational through Hurricane Irma in 2017, despite widespread outages reported in neighboring communities.[33]

In 2018, Duke Energy Progress submitted plans for a remote microgrid project in Western North Carolina to the NCUC. The proposed microgrid consists of a two-megawatt solar system and four megawatts of battery storage. The proposed project would allow for the remote community of Hot Springs to island from the grid in the event of an outage. The microgrid will provide economic benefits by meeting 90 percent of the community's peak electricity load, allowing Duke to defer the construction of a natural gas-fired power plant and avoid expensive maintenance and upgrades to existing power lines.[34]

Economic Analysis Methodology

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 Wilmington—secondary schools serving as community emergency shelters, nursing homes providing critical heath care services, multifamily housing with residents sheltering in place, and fire stations serving as critical first responders.[35]

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 explores 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.[36,37]
2. **Resilient Scenario:** The resilient scenario evaluates a system configuration capable of providing onsite backup power to critical loads.[38] 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.[39]

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.

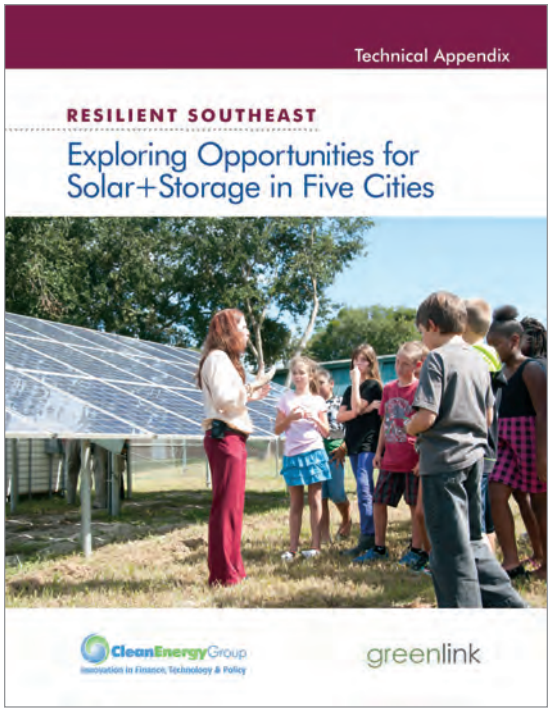
To understand the economic feasibility of solar and battery storage for different building types, the costs of the systems were evaluated against electricity bill savings over time.

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.[40] 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.[41]

Duke Energy Progress is the only utility explored in this report series that offers additional

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.



distributed solar incentives. The program's $0.50 per watt solar rebate for commercial customers is applied to all solar systems modeled for the nursing home and multifamily housing property in Wilmington. The $0.75 per-watt rebate for nonprofit customers is applied to solar systems modeled for the school and fire station.[42] In addition to the utility rebate and 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.[43]

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 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.[44] This analysis uses a methodology developed by the Lawrence Berkeley National Laboratory to estimate avoided outage costs. 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*.[45]

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 Wilmington

Overall, the analysis results for solar+storage to support critical community facilities in Wilmington are promising. Wilmington ranked first among the five cities evaluated based on the economic opportunity for solar+storage development.[46] See **Figure 3**.

Economic outcomes were found to be positive for all building types across both scenarios, except for the fire station under the Resilient Scenario when avoided outage costs are not considered. These encouraging results are due in large part to the solar rebate program offered by Duke Energy Progress, positioning Wilmington as one of the top two economic opportunities for solar+storage development among the five cities evaluated in this series.[47]

The Economic Scenario analysis found that solar, without battery storage, would be the most economical option for all four building types in Wilmington, based purely on electric bill savings with no consideration of improved energy resilience. For three of the four building types, savings would be maximized by installing the largest solar systems possible for the buildings given constraints on available rooftop space.[48] A smaller solar system was found to be the optimal solution for the multifamily housing property.

When the buildings were analyzed under the Resilient Scenario, solar+storage was still found to result in net savings for the secondary school, nursing home, and multifamily housing property, despite the added cost of the battery system. 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.

The additional value of avoided outage costs by powering critical loads during grid disruptions significantly improved the lifetime savings for all building types.

Three of the four solar+storage systems analyzed were able to provide up to 12 hours of backup power to critical loads. High energy demands and constraints on system sizing limited backup power to a maximum of six hours at a time for the nursing home. 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 on days when there was sufficient solar energy from the PV panels to recharge the battery system.[49]

FIGURE 3

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

	Opportunities	Barriers
Wilmington, NC 	**Wilmington ranked first among the five cities evaluated, with the strongest economics; solar+storage was found to be a cost-effective solution for most facilities based on electric bill savings alone.**	
	• utility solar incentive • favorable net metering policies	• lack of certain financing options • little support for customer-sited battery storage

Wilmington School

The analysis results for a secondary school in Wilmington are summarized in **Figure 4**. The most economical option for the school was found to be a 192-kilowatt solar system, which is the largest rooftop system the building could host given space constraints. The school was found to have the best solar economics of all four building types, with a little over a four-year simple payback period.

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.

Adding a 137-kilowatt-hour battery system to the solar system would provide up to 12 hours of backup power to keep emergency services fully operational at the school. While the battery system increases costs by more than it would offset through additional electric bill savings, the combined solar+storage system remains a cost-effective solution for the school, adding about two and a half years to the payback period. Incorporating avoided outage costs makes solar+storage an even more promising investment opportunity for the school.

FIGURE 4

Results of Analysis for a Secondary School in Wilmington

Based on modeling of utility bill savings and available incentives, solar PV was found to be the most economical option for a secondary school in Wilmington. Incorporating battery storage adds upfront costs, but the combined system provides up to 12 hours of backup power to a portion of the school that could serve as a temporary emergency shelter; and it still results in net savings over time. 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)
192 kW	0 kWh	0 hours	$48,000	$472,400	4.4

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)
192 kW	137 kWh	12 hours	$49,800	$361,900	7.0
			With Avoided Outage Costs		
			$54,900	$411,000	6.4

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Wilmington Nursing Home

The analysis results for a nursing home in Wilmington are summarized in **Figure 5**. The most economical option for the nursing home was found to be a 52-kilowatt solar system. Like the school, this is the largest rooftop system the building could host given space constraints. The nursing home is subject to the Duke Energy Progress Medium General Service rate tariff, which at less than 7 cents per kilowatt-hour, has much lower energy charges than the school. As a result, the economic case for solar is not as strong 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.

Adding a 45.7-kilowatt-hour battery system to the solar system would provide up to six hours of backup power to keep essential services operational at the nursing home. Despite the added expense, the combined solar+storage system was again found to be a cost-effective solution, though only marginally so. Accounting for avoided outage costs results in a much stronger economic case for solar+storage at the facility.

FIGURE 5

Results of Analysis for a Nursing Home in Wilmington

Based on modeling of utility bill savings and available incentives, solar PV was found to be the most economical option for a nursing home in Wilmington. Incorporating battery storage adds upfront costs, but the combined system provides up to 6 hours of backup power to a portion of the nursing home providing medical care and emergency services to residents; and it still results in net savings over time. 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)
52 kW	0 kWh	0 hours	$5,400	$23,100	9.8

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)
52 kW	45.7 kWh	6 hours	$6,000	$200	18.5
			With Avoided Outage Costs		
			$11,400	$78,200	9.7

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Wilmington Multifamily Housing

The analysis results for a multifamily housing property in Wilmington 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.

A 12-kilowatt solar system was found to be the most economical option for the multifamily housing property. Unlike the other building types evaluated, this is not the largest solar system the building's roof would allow, which is 15.3 kilowatts. While the property is subject to higher energy charges than the nursing home and fire station, it has the lowest electricity use needs of all the building types evaluated in Wilmington, reducing the economic case for a larger system when energy resilience is not a consideration.

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.

Boosting the solar system to 15.3 kilowatts and adding a 9.8-kilowatt-hour battery system would provide up to 16 hours of backup power to the multifamily housing common areas. Like the nursing home, the combined solar+storage system was again found to be only marginally cost-effective based on electric bill savings alone. The property is subject to a rate tariff that does not include demand charges, which limits any additional electric bill savings the battery system can deliver. Accounting for avoided outage costs significantly improves the economics of solar+storage for the property, resulting in a simple payback period of less than seven years.

FIGURE 6

Results of Analysis for a Multifamily Housing Property in Wilmington

Based on modeling of utility bill savings and available incentives, solar PV was found to be the most economical option for a multifamily housing property in Wilmington. Incorporating battery storage adds upfront costs, but the combined system provides up to 16 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; and it still results in net savings over time. 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)
12 kW	0 kWh	0 hours	$1,700	$9,900	8.4

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)
15.3 kW	9.8 kWh	16 hours	$2,100	$1,000	13.6
			With Avoided Outage Costs		
			$4,300	$32,100	6.8

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Wilmington Fire Station

The analysis results for a fire station in Wilmington are summarized in **Figure 7**. As was the case for the school and nursing home, the largest solar system the building could host was found to be the most economical option for the fire station, a 13.6-kilowatt system.

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.

Adding a 9.8-kilowatt-hour battery system to the solar system would provide up to 12 hours of backup power to the fire station but was not found to be an economical investment opportunity without accounting for avoided outage costs. The fire station is subject to the same electric rate tariff as the nursing home, with a fairly low energy charge. The fire station is also a smaller building. Because of limited roof space, the facility can only host a relatively small solar system that costs more to install on a per watt basis than the system modeled for the nursing home. Factoring in avoided outage costs dramatically improves the economic case for solar+storage, resulting in the best return for any of the Wilmington building scenarios analyzed, with a simple payback period of less than three years.

FIGURE 7
Results of Analysis for a Fire Station in Wilmington

Based on modeling of utility bill savings and available incentives, solar PV was found to be the most economical option for a fire station in Wilmington. Incorporating battery storage adds upfront costs, but the combined 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)
13.6 kW	0 kWh	0 hours	$1,400	$6,000	9.9

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	$1,500	(–$2,400)	15.7
			With Avoided Outage Costs		
			$9,600	$75,300	2.5

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Opportunities for Solar and Storage in Wilmington

North Carolina solar and battery storage markets could be completely reshaped by innovations in project financing and new market opportunities created through HB589. The state's energy storage feasibility report, *Energy Storage Options for North Carolina,* could be a positive first step towards a more supportive regulatory environment for battery storage in North Carolina.

HB589 REPORT: *ENERGY STORAGE OPTIONS FOR NORTH CAROLINA*

The North Carolina Policy Collaboratory released *Energy Storage Options for North Carolina* at the end of 2018. The report was mandated as part of HB589 to explore the potential value that energy storage could bring to both the grid and customers. Although a variety of energy storage technologies were evaluated, battery storage was determined to have the most potential in the immediate future. According to the report, utilities like Duke could benefit from a variety of grid services now, but customer solar+storage systems will require the establishment of market opportunities and changes to rate structures to be more widely cost effective. State policy is also highlighted as necessary to improving the cost-effectiveness of storage.[50]

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

FINANCE

Project finance remains problematic for residential and commercial customers interested in investing in solar+storage. HB589 approved solar leasing and, in doing so, opened the doors for low or no upfront cost financing mechanisms. However, HB589 does not currently authorize or prohibit solar+storage or stand-alone storage as the bill only addresses solar PV.[51]

The North Carolina Building Performance Association introduced a commercial PACE (CPACE) bill in 2017, but it has yet to pass. The proposed bill would allow municipalities to setup local CPACE programs and has proven a successful financing mechanism for solar+storage projects in other states, including a microgrid in Connecticut that services mixed-income housing and retail space.[52] If passed, CPACE funds could help to spur more nonprofit and critical facility solar+storage installations in North Carolina.

NORTH CAROLINA UTILITIES COMMISSION (NCUC)

HB589 has recalibrated the trajectory of the renewable energy industry in North Carolina

and the NCUC is responsible for translating those changes into a concise regulatory framework. NCUC has authority over the new programs and mandates issued, including procurement targets, rate changes, and leasing oversight.

NCUC is responsible for the new Competitive Procurement of Renewable Energy (CPRE) program, which was established to drive renewable energy project development. Through the CPRE program, Duke Energy is required to competitively procure an addition 2,600 megawatts of renewable resources over a 45-month period after the program is approved by the NCUC. The NCUC will review and approve project proposals.[53] Duke Energy is also required to file revised net metering rates. Higher net metering rates make solar PV more economical and improve overall solar+storage economics. Reducing net metering rates will have an opposite effect.

NCUC will also have authority over the recently legalized leasing industry in North Carolina. In addition to private solar contractors, an affiliate of Duke Energy, Duke Energy Clean Energy Resources (DECER), has requested NCUC approval as a certified solar lessor for commercial customers. DECER's lessor application focuses solely on commercial solar; opportunities to lease battery storage (or solar+storage systems) are not presented.[54] If NCUC approves application, DECER can own, operate, and finance solar systems up to one megawatt, and provide leasing agreements to business customers.[55]

DECER will benefit from an affiliation with Duke Energy, including easier access to investment and a built-in potential client database, which could result in quick market penetration. However, the affiliation between DECER and Duke Energy could result in a market advantage that could dominate the solar leasing space and potentially shutout alternative leasing finance providers. If this were to result in limited alternative leasing options, solar system lease prices could be higher than those in regions with more competitive markets.

Duke Energy has filed a petition with NCUC that asks the Commission to consider a rate hike that would help cover expenses related to natural disasters. Duke Energy Progress spent $557 million on hurricane recovery and wants to recover most of the costs through rate increases over the next eight years.[56] Depending on how it is designed, a rate increase could reduce the overall solar+storage system economics and hinder battery storage development for commercial customers, including critical facilities and nonprofits. An increase to fixed charges could hurt the economics of solar+storage. Alternatively, an increase to energy or demand charges could improve system economics.

Adjustments to rate design and setting solar and/or storage mandates could significantly impact the economics for behind-the-meter solar+storage in North Carolina. Leasing could also spur more commercial development by reducing the need for upfront costs and providing secure financing for solar. However, leasing would need to include battery storage options to have a meaningful impact on the solar+storage market.

Additionally, the NCUC is currently in the process of reviewing Duke Energy's renewable energy avoided cost rates and contract terms and conditions under PURPA. As part of the avoided cost proceeding, Duke Energy has proposed contract terms and conditions for solar facilities that add behind-the-meter storage to existing facilities or that build a new solar facility with battery storage. If approved, Duke will have significant operational control over the battery storage portion of a facility. Duke has also proposed to require solar facilities that add storage to forfeit existing long-term contracts. Under these proposals, Duke would attain unilateral authority to reject proposals by solar developers to add storage to existing facilities. If the NCUC rejects this aspect of the proposal, future solar+storage projects in North Carolina will have greater opportunities to develop installations and, ultimately, add more value to the grid. Alternatively, if Duke Energy is allowed to move forward with its proposal, private solar and storage development could be negatively impacted.

Recommendations

The results of the analysis illustrate an encouraging environment for resilient solar+storage development in Wilmington. The results were noteworthy, with positive solar+storage economic outcomes for three of four critical facilities based on electric bill savings and positive economics for all facilities when considering avoided outage costs.

Enabling policies and programs, such as energy resilience carve-outs in federal disaster funding and state targeted incentive programs, could contribute to a more robust solar+storage industry and accelerate the deployment of these technologies for critical facilities.

This outcome was in large part due to the Duke Energy Progress rebate for solar PV. Enabling policies and programs, such as energy resilience carve-outs in federal disaster funding and state targeted incentive programs, could contribute to a more robust solar+storage industry and accelerate the deployment of 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 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.[57]

- **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 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.[58]

- **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.[59] The Solar Massachusetts Renewable Target (SMART) program includes incentives for solar installations that incorporate a battery storage component.[60] 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.

- **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.

Filling a generator in Wilmington, NC after Hurricane Florence, 2018.
Photo: Creative Commons/ US Customs and Border Patro

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.

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.[61] Any determined goals or targets should be legally enforceable to ensure that battery storage development is a priority, rather than a symbolic gesture.

- **Create market opportunities for energy storage to provide grid services.** 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. PJM covers a small portion of northeastern North Carolina, but the majority of North Carolina does not fall within the jurisdiction of any RTO or ISO and is not subject to these orders. However, utilities like Duke Energy Progress can take similar actions by creating market opportunities for battery storage to provide valuable services such

McAlpine Creek solar+storage demonstration project powers Fire Station 24 in Charlotte, NC.
Photo: Creative Commons/Duke Energy

Members of the North Carolina National Guard meet with emergency management personnel to discuss current flooded areas during Hurricane Florence in Fayetteville, NC, September 15, 2018.

Photo: Creative Commons/ North Carolina National Guard

as frequency and voltage regulation and demand response. Establishing new revenue generating opportunities can greatly improve the economics of battery storage systems.[62]

- **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.[63] 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. North Carolina allocated $180.9 million in electric effi-ciency program spending in 2017.[64]

- **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. In addition to FEMA disaster funding, states impacted by Hurricane Florence are anticipated to receive an additional $1.68 billion in federal assistance. The funds will be allocated to the Department of Housing and Urban Development and used for the Community Development Fund for long-term disaster recovery.[65] Disaster mitigation and recovery initiatives are supported through this funding source. North Carolina has the opportunity to commit a portion of their funds to solar+storage installations in critical facilities.

North Carolina has the opportunity to commit a portion of their funds to solar+storage installations in critical facilities

Conclusion

There is little debate over the need for stronger energy resilience in locations prone to severe weather and power outages such as Wilmington. 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 Wilmington is positive but can be a challenge due to a lack of supportive policies for battery storage 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 Wilmington. The findings and recommendations presented here are meant to start a conversation about the steps that Wilmington and the state of North Carolina could take to ensure a more resilient future for its residents before the next storm strikes.

Photo: Bigstock.com/Digidream Grafix

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.

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37 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.

38 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.

39 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.

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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*

SOUTHERN ENVIRONMENTAL LAW CENTER

Southern Environmental Law Center is a non-profit environmental organization dedicated to the protection of natural resources, communities, and special places in a six-state region of the Southeast. SELC partners with over 150 national and local groups to achieve its goals and works in all three branches of government. *www.southernenvironment.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*

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