RESILIENT SOUTHEAST

Exploring Opportunities for Solar+Storage in Atlanta, GA

CleanEnergyGroup
Innovation in Finance, Technology & Policy

ABOUT THIS REPORT

Resilient Southeast—Atlanta 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 Atlanta and concludes with a set of recommendations. Clean Energy Group partnered with Southface Institute, Southern Environmental Law Center, Southern Alliance for Clean Energy, and Energy and Policy Institute 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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Solar panels in downtown Atlanta.
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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 Atlanta, 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 for deployment of solar PV and battery storage systems for critical facilities in Atlanta, this report aims to answer the question: does solar paired with battery storage make economic sense for strengthening the resilience of Atlanta communities? Based on the results of detailed economic analysis of critical building types, the answer is yes, but challenges and barriers remain that must be addressed before these types of resilient power systems will be widely adopted. *Atlanta ranked third for opportunities to deploy resilient solar and battery storage among the five Southeastern cities evaluated in this report series.*

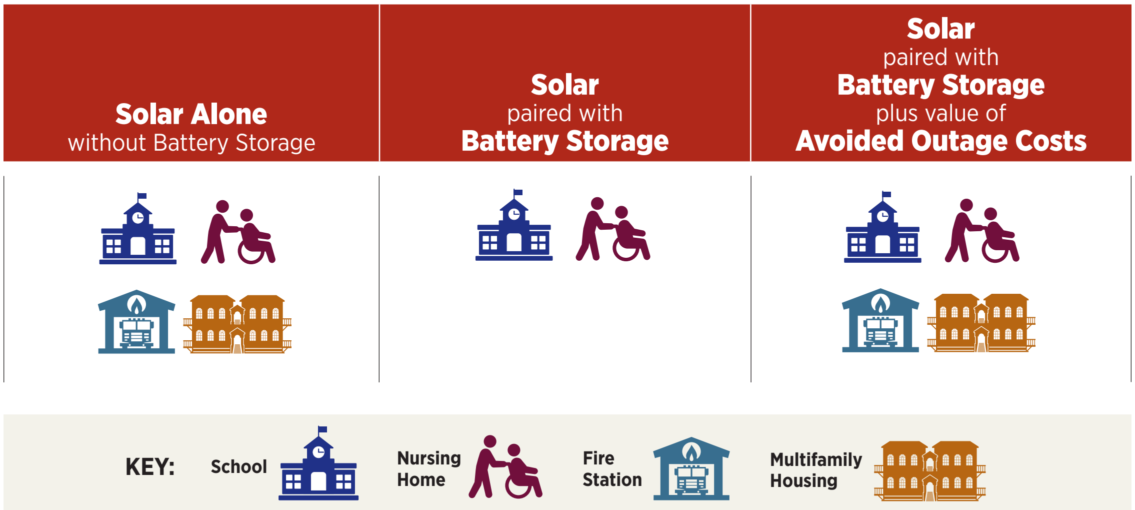
Figure 1 summarizes the findings of detailed economic evaluations for solar and battery storage at four critical facilities in Atlanta: a school, a nursing home, a multifamily housing property, and a fire station. As can be seen from the results, solar was found to be a positive investment for each of the four building types. With the addition of battery storage, resilient solar+storage remains an economic option for the school and nursing home. However, the expense of adding battery storage makes the combined systems uneconomical for the multifamily housing property and fire station, based on electric bill savings alone. However, when savings from avoiding the loss of power are considered—the added benefit of a resilient power system—*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 Atlanta is 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**. Atlanta benefits from a strong potential for electric bill savings due to the design of electric rate tariffs and a variety of financing options for both solar and battery storage, but Atlanta suffers from a lack of net energy metering and supportive incentives or policies. This creates a challenging environment for the development of resilient solar+storage.

FIGURE 1

What Works in Atlanta—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 Atlanta. 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 and nursing home based on bill savings alone, and for a fire station and multifamily housing when factoring in savings due to avoided outage costs.

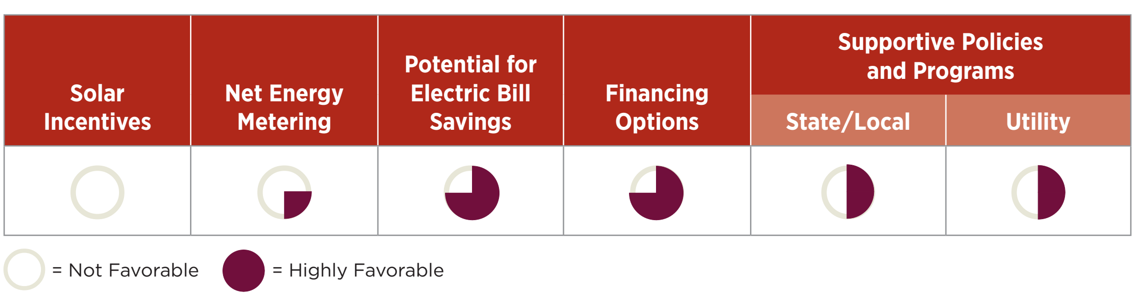


To address these challenges, this report presents potential near-term opportunities for policies and regulatory changes that could advance solar+storage development in Atlanta and concludes with a set of recommendations. Ongoing efforts led by the City of Atlanta to develop renewable energy targets and invest in battery storage 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 Atlanta

The opportunity for customer-sited solar and battery storage development in Atlanta is highly dependent on a number of state, regional, and local factors, such as policies, incentives, and utility electric rates. Atlanta was found to have a fairly even mix of supportive and unsupportive factors, resulting in a challenging but also encouraging landscape for deployment of resilient solar and battery storage.



Recommendations for Advancing Resilient Power in Atlanta

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.

An employee of Georgia Power restores electricity in Atlanta, GA following Hurricane Irma in September 2017.
Photo: Creative Commons/Thomas Cizauskas

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 back-up 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.

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 providing electricity to a community room so residents can shelter in place.[3]

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 back-up 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 Georgia

In the past decade, new weather patterns and intensified storms have forced the state government and local leaders in Georgia to re-evaluate disaster preparedness and response. Recently, Georgia experienced one of the most damaging hurricanes on record, and winter weather conditions have become more frequent. Power outages and transportation crises have emerged as major hurdles to emergency response and recovery. In recent disasters, people have been forced to abandon stranded cars in search of basic services, others have turned to schools and businesses for shelter. 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 winter weather, snowfall has resulted in at least two state of emergency declarations in Georgia since 2010. Three inches of snow and ice were enough to shut down metro Atlanta in 2014. More than 210,000 people lost power, many of whom sought warmth in shelters or the City of Atlanta's only designated warming center, the Old Adamsville Recreation Center.[6] Abandoned cars littered the highway as people searched for shelter elsewhere. Over 2,000 children, unable to return home, slept at schools.[7] Medically vulnerable residents couldn't access medications and family members couldn't navigate the roads or use public transportation to help their loved ones.

Three years later, a snow and ice storm covered metro Atlanta with seven inches of snow and resulted in similar issues. Schools let children out early, warming shelters were opened, and unsafe roadways made transportation difficult. Over 230,000 people lost power and remained without power the following day.[8]

City crew removes a tree from power lines in Atlanta, GA following Hurricane Irma in September 2017.
Photo: Creative Commons/ Thomas Cizauskas

HURRICANE MICHAEL

In 2018, Hurricane Michael was the first Category 3 (or larger) hurricane to impact Georgia in over a hundred years. Over 300,000 power outages were reported, and an estimated 200,000 homes and businesses remained without power in the following days. In anticipation of 50 mph wind speeds and heavy rainfall, community institutions, such as schools and churches, opened as shelters across the state.[9]

Critical facilities were also hit hard. Twenty hospitals and fifteen nursing homes required generators to operate.[10] One hospital only had enough generator capacity to operate some offices and operating rooms.[11] Power outages resulted in additional critical services losses, especially in smaller cities and rural areas. Sewer lift stations, which prevent waste overflow from the sewers, were inoperable for one city and another had to completely shut down the city water system. In one instance, a 911 call center was left without power when a generator failed to start.[12]

Georgia's Solar and Storage Landscape

A lack of supportive regulatory policies and financial incentives has hindered the growth of the solar and battery storage markets in Georgia. Georgia does not have a Renewable Portfolio Standard and has not set any renewable energy or energy storage mandates or targets. Georgia previously offered a state solar tax credit, the Georgia Clean Energy Investment Tax Credit, which covered 35 percent of the first $10,500 of residential installations and $500,000 for commercial installations. However, the credit expired 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 Georgia.

Of the five Southeast cities analyzed in this series, Atlanta is the only city where utilities are not required to provide solar net energy metering.[13] In Georgia, a utility can voluntarily create a program to compensate residential and commercial distributed generation systems for exported energy but is not required to compensate customers at the full retail electricity rate, or anything above full retail rate. Georgia Power does offer a Solar Buy Back program, which compensates customers for energy generated by distributed solar systems.[14] For example, Georgia Power offers a buy back purchase price of $0.032 per kilowatt-hour for solar energy exported from a commercial solar system, about one-third of the typical cost of electricity for commercial customers in Atlanta.

Solar programs can also be restrictive. Individual solar PV system sizes are constrained to 10 kilowatts for residential customers and 125 percent of peak demand for commercial customers.[15]

Despite a less than ideal regulatory environment for distributed solar, Georgia ranks 11th in the country for state solar development and, as of 2017, solar generated just over 1.5 percent of the state's total electricity.[16] Utility-scale solar installations have driven solar development and dominated the renewable energy landscape in Georgia. To date, utilities have completed 243 utility-scale solar projects, which combined exceed 1,300 megawatts of capacity. The residential and commercial sectors have not experienced the same growth, with a combined capacity of just over 62 megawatts.[17]

In an effort to address financial barriers to customer-sited, behind-the-meter solar development, Georgia passed the *Solar Power Free-Market Financing Act of 2015* and opened the doors to third-party financing.[18] Solar Energy Procurement Agreements (SEPA) in Georgia act the same as a power purchase agreement (PPA) or solar lease in other states, allowing property owners to finance solar at little to no up-front cost through a solar contractor.[19] Residential and commercial property owners are eligible for the program.

To date, only a few municipalities have completed SEPA financed projects.[20] Municipalities may be early adopters due to local government motivations to meet emission reduction or other resilience-based goals. Additionally, municipalities benefit from the ability to aggregate multiple facilities into one project, effectively achieving economies of scale that reduce costs and improve the overall return on investment. The City of Atlanta already has plans to use SEPA-enabled financing for the recently launched Solar Atlanta program, which will install solar panels on municipal facilities.

GEORGIA PUBLIC SERVICE COMMISSION

The Georgia Public Service Commission (GPSC) regulates the only investor-owned electric utility in the state, the Georgia Power Company. Georgia Power serves over 2.4 million customers statewide and is the sole electricity provider for Atlanta. As the regulatory authority, the GPSC sets utility rates and incentives, and it must approve any proposed rate changes. Georgia Power is set to file a rate case with the Georgia GPSC in mid-2019.

The GPSC also reviews plans to build new generation assets and can require Georgia Power to include clean energy development. In July 2016, the GPSC required Georgia Power to increase electricity generated from renewable energy resources. The approved Integrated Resource Plan (IRP) required procurement of 1,600 megawatts of additional renewable resources by 2021. Of the 1,600 megawatts, 1,200 will be through the Renewable Energy Development Initiative (REDI), 1,050 megawatts for utility scale development, and 150 megawatts for distributed generation.[21] The first 976 megawatts installed have been solar PV. In 2018, Georgia Power issued its final Request for Proposals (RFP) for an additional 540 megawatts of utility scale renewable energy. Proposals can, but are not mandated to, include battery storage.[22] The GPSC will also oversee the approval process for Georgia Power's most recent IRP, filed in February 2019.

BEHIND-THE-METER SOLAR+STORAGE

After the success of its Alabama Power Smart Neighborhood program, Georgia Power's parent company, Southern Company, released plans for Atlanta Smart Neighborhood.[23] The community will allow Georgia Power to research the grid benefits of operating a virtual power plant.[24] The 46 market-rate townhome development will include solar+storage systems in every unit. Energy management software will connect the independent units into one unified virtual power plant and allow Georgia Power to regulate consumption and shift energy loads depending on peak demand times when energy costs are higher on the grid.

A second microgrid project was announced in 2018 and is currently in development at the Georgia Institute of Technology.[25] Equal parts research, business, and resilience, the one megawatt-hour microgrid will provide backup power for the university in the event of an outage and generate revenue through power purchase agreements with commercial businesses.

Solar panels on the roof of the Atlanta Community Food Bank.
Photo: Atlanta Community Food Bank

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 Atlanta: 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.[26]

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.

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.[27,28]
2. **Resilient Scenario:** The resilient scenario evaluates a system configuration capable of providing onsite backup power to critical loads.[29] 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 nor 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.[30]

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 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 that the system could realize over 25 years of operation.

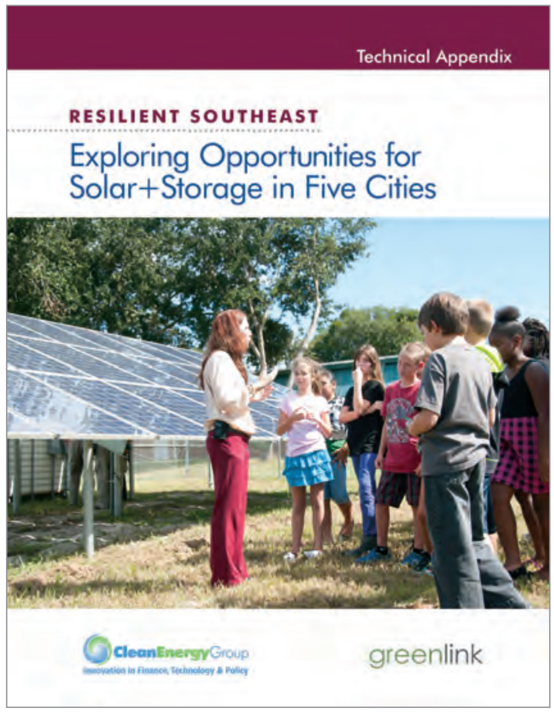
Incentives are also factored into the analysis. The model assumes all building types are able to take advantage of the federal investment tax credit (ITC) for solar and for battery storage when paired with solar.[31] While nontaxable entities such as nonprofits and government cannot directly benefit from tax incentives, there are third-party leasing and ownership arrangements as well as tax equity partnerships that can pass along the incentive savings to these types of organizations.[32] In addition to federal tax incentives, the analysis assumes all solar systems participate in Georgia Power's Solar Buyback Program for any solar generation exported to the grid.

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. This analysis uses a methodology developed by the Lawrence Berkeley National Laboratory to estimate avoided outage costs.[33] The methodology assumes outage costs for small and large commercial customers, which likely underestimate the value of keeping potentially life-saving services up and running.

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

For more information about the methodology and assumptions used in this analysis, refer to the *Resilient Southeast—Technical Appendix*.[34]



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.

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 wide-spread 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 Atlanta

Overall, the analysis results for solar+storage to support critical community facilities in Atlanta are promising. Atlanta ranked third among the five cities evaluated based on the economic opportunity for solar+storage development. See **Figure 3**.[35]

Economic outcomes were found to be stronger for the larger facilities, the school and nursing home, largely due to negative impacts from Georgia Power's low Solar Buyback rate and the lack of demand charges for smaller building types.

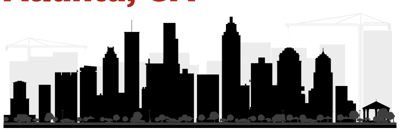
The Economic Scenario analysis found that solar, without battery storage, would be the most economical option for all four building types in Atlanta, based purely on electric bill savings with no consideration of improved energy resilience. For three of the four building types, savings would be maximized by installing the largest solar systems possible for the buildings given constraints on available rooftop space.[36] 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 paired with battery storage was still found to result in net savings for the secondary school and nursing home, 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.

Three of the four 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 9 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.[37]

FIGURE 3

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

	Opportunities	Barriers
Atlanta, GA 	**Atlanta ranked third out of the five cities evaluated; solar+storage was found to be a cost-effective solution for some facilities based on electric bill savings alone.**	
	• strong potential for electric bill savings • variety of financing options for both solar and battery storage	• no net energy metering • lack of supportive incentives or policies

Atlanta School

The analysis results for a secondary school in Atlanta are summarized in **Figure 4**. The most economical option for the school was found to be a 90.9-kilowatt solar PV system, which is the largest rooftop system the building could host given space constraints. Based on solar system sizing and the building's modeled load profile, the school would consume nearly all of the solar energy onsite, with very little exported to the grid. This high rate of on-site solar energy consumption improves the economics of the system, since Georgia Power compensates solar energy exported to the grid at about one-third of the electricity retail rate paid by the school and other buildings evaluated.

For 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 45.7-kilowatt-hour battery system to the solar PV 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. Avoided outage costs would more than double the annual savings delivered by the solar+storage system, resulting is a short payback period of just over four years.

FIGURE 4

Results of Analysis for a Secondary School in Atlanta

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 Atlanta. 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)
90.9 kW	0 kWh	0 hours	$18,100	$131,800	6.8

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)
90.9 kW	45.7 kWh	12 hours	$18,500	$71,900	10.2
		With Avoided Outage Costs	$44,200	$300,100	4.1

Atlanta Nursing Home

The analysis results for a nursing home in Atlanta are summarized in **Figure 5**. The most economical option for the nursing home was found to be an 84.3-kilowatt solar PV system. Like the school, this is the largest rooftop system the building could host given space constraints. Due to the facility's high energy needs in caring for elderly residents, the nursing home would consume all of the electricity generated by its solar system onsite, with no exports to Georgia Power.

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 PV system would provide up to 9 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. Factoring in avoided outage costs further improved the economic case for a solar+storage system, resulting is a short payback period of just over four years for the nursing home.

FIGURE 5
Results of Analysis for a Nursing Home in Atlanta

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 Atlanta. Incorporating battery storage adds upfront costs, but the combined system provides up to 9 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)
84.3 kW	0 kWh	0 hours	$14,800	$94,400	7.8

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)
84.3 kW	45.7 kWh	9 hours	$15,700	$42,200	11.4
		With Avoided Outage Costs	$42,500	$263,600	4.2

Atlanta Multifamily Housing

The analysis results for a multifamily housing property in Atlanta 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 10-kilowatt solar PV 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. The reason for this is that the property does not have enough daytime demand for electricity to use the majority of energy generated from a larger solar system onsite. Even the 10-kilowatt PV system was expected to export 30 percent of the electricity generated to the grid, making its economics less favorable than buildings able to directly consume more solar production onsite.

During an outage, the analysis 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 PV system to 15.3 kilowatts and adding a 9.8-kilowatt-hour battery system would provide up to 14 hours of backup power to the multifamily housing common areas. Because the economics of solar are not as strong for the multifamily housing property and the building does not have high enough electricity demand to incur demand charges, these added costs make the combined solar+storage system uneconomical based on electric bill savings alone. However, solar+storage becomes a cost-effective solution when accounting for avoided outage costs.

FIGURE 6

Results of Analysis for a Multifamily Housing Property in Atlanta

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 Atlanta. Incorporating battery storage adds upfront costs, but the combined system provides up to 14 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)
10 kW	0 kWh	0 hours	$1,300	$2,700	12

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	14 hours	$1,900	(–$7,200)	17.9
		With Avoided Outage Costs	$4,500	$4,000	11.1

Atlanta Fire Station

The analysis results for a fire station in Atlanta 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 PV system. Like the multifamily housing property, the fire station has lower daytime electricity needs than larger facilities and exports more solar electricity generated to the grid—about 12 percent—resulting in less favorable economics.

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. Due to the weaker economic case for solar and lack of demand charges, the combined solar+storage system was found to be uneconomical for the fire station based on electric bill savings alone. As with multifamily housing, factoring in avoided outage costs makes the combined system a cost-effective solution.

FIGURE 7

Results of Analysis for a Fire Station in Atlanta

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 Atlanta. 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	$2,100	$7,600	10.4

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)
13.6 kW	9.8 kWh	12 hours	$2,100	(–$1,600)	14.9
		With Avoided Outage Costs	$4,800	$24,000	6.6

Opportunities for Solar and Storage in Atlanta

Atlanta solar and battery storage markets could be completely reshaped by two upcoming Georgia Public Service Commission proceedings set for 2019: the Georgia Power Integrated Resource Plan and a rate case. Additionally, renewable energy policies and finance mechanisms set forth by the City of Atlanta could spur municipal, residential, and commercial development, and improve citywide resilience.

THE CITY OF ATLANTA

The City of Atlanta has emerged as a clean energy leader in both Georgia and the broader region. The City Council and Mayor's Office have set citywide renewable energy goals and committed to a 100 percent clean energy transition by 2035 for citywide operations and 2050 community wide. Atlanta has also approved bond programs for commercial and multifamily clean energy projects, and it was one of 25 cities awarded Bloomberg's American Cities Climate Challenge to combat building and transit emissions.[38] The City also launched its first solar energy program, Solar Atlanta. Through Solar Atlanta, solar systems will be installed on 24 municipal buildings, including fire stations.[39]

CLEAN ENERGY ATLANTA

In March of this year, the Mayor's clean energy plan, *Clean Energy Atlanta: A Vision for a 100% Clean Energy Future*, was unanimously approved by the Atlanta City Council.[40] Clean Energy Atlanta could provide a foundation on which to build future solar+storage development in Atlanta.

Clean Energy Atlanta: A Vision for a 100% Clean Energy Future details the potential applications of energy efficiency and renewable energy in Atlanta.[41] Although the City does not set any specific targets for solar and storage adoption, the proposal does highlight solar and storage in both long- and short-term policy goals as a necessary component to reaching 100 percent clean energy reliance. Solar and storage markets could be reinvigorated through educational programs, developing new projects, and upgrading existing properties. City-owned buildings are identified as opportunities to improve resilience by replacing diesel generators with solar+storage, and Resilience Hubs are included as vehicles to demonstrate solar+storage feasibility. The latter of these initiatives could bring clean energy investments and access to resilient power to Atlanta's most underserved neighborhoods.

Solar and storage markets could be reinvigorated through educational programs, developing new projects, and upgrading existing properties.

Baltimore, Maryland could serve as an example for Atlanta. In Baltimore, the Office of Sustainability partnered with local nonprofits to transform community centers in moderate- and low-income communities into resilience hubs through solar+storage installations.[42] The City of Atlanta has an opportunity to learn from Baltimore's experience by partnering with local community leaders to develop, design, and construct resilience hubs in the communities most vulnerable to the impacts of natural disasters.

FINANCE TOOLS

Atlanta will be the first city in Georgia to take advantage of Property Assessed Clean Energy (PACE). PACE provides 100 percent low-interest financing and repayment periods that can extend up to 20 years.[43] Loans are typically secured with a lien on the property and paid through an assessment on the customer's annual property tax bills. PACE has also expanded to include financing resiliency upgrades, including Commercial PACE (CPACE) financed solar+storage microgrids.[44] Atlanta's CPACE program, which is currently still in development, will offer $500 million in bonds to finance energy efficiency and renewable energy projects, including solar and storage, for commercial and multifamily property projects.[45] Once launched, it will be the first PACE program in Georgia and only the second of its kind in the Southeast.

Solarize Atlanta is another opportunity for solar+storage growth.[46] Although Solarize campaigns act more as incentive programs than financing mechanisms, the success of Solarize Atlanta has effectively doubled Atlanta's rooftop solar installations and created a residential battery storage market in under a year. It's the most successful Solarize campaign in the state, with over 855 kilowatts of solar PV and 534 kilowatt-hours of battery storage already installed.[47] So far, commercial installations have only made up a small fraction of Solarize deployments, 35 kilowatts.[48] There are a variety of factors that could contribute to the disproportionate participation, but the considerable success of the residential program remains a positive indicator for future commercial and nonprofit projects.

Adjustments to rate design could potentially tip the scales for customer-sited solar+storage in Atlanta.

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

GEORGIA PUBLIC SERVICE COMMISSION AND GEORGIA POWER

Georgia Power filed its 2019 Integrated Resource Plan (IRP) and is set to file a rate case with the GPSC in mid-2019. This will be Georgia Power's first rate case since 2013 and could potentially change electric rates that have been frozen since 2016.[49] In the past, rate cases have resulted in investment in environmental standards and clean energy technologies. Georgia Power's 2016 IRP included 1,600 megawatts of renewable energy by 2021. The 2019 plan proposes an additional 1,000 megawatts of renewable energy, which is less than the 2016 plan, and most initiatives proposed remain utility owned and operated. Of the renewable energy resources proposed, only 50 megawatts of the new renewable development is distributed generation; the majority is utility scale. The 2019 plan does include a 50-megawatt battery storage pilot program; however, all the battery storage will be built and owned by Georgia Power. The proposed systems would be both independently sited and installed at pre-existing solar facilities.[50]

Both the rate case and IRP have the potential to redefine the value of solar+storage for more than two million ratepayers. Adjustments to rate design could potentially tip the scales for customer-sited solar+storage in Atlanta. Alternatively, actions such as imposing higher fixed costs or introducing new charges for solar customers could negatively impact system economics.

Recommendations

While the results of the analysis were largely positive, the mixed economic results for resilient solar+storage development and the challenge of monetizing avoided outage costs for critical public services indicate that the current market and regulatory environment in Atlanta are not sufficient to support widespread deployment of these technologies.

Enabling policies and programs, such as energy resilience carve-outs in federal disaster funding 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.[51] Through the Solar Atlanta initiative, the City of Atlanta has already committed to install solar panels on 24 municipal buildings, including critical facilities like fire stations. The City could expand the project to include battery storage to promote resilience in city buildings and ensure continued operations in the event of an outage.

The City could expand the Solar Atlanta Initiative to include battery storage to promote resilience in city buildings and ensure continued operations in the event of an outage.

- **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.[52] Atlanta-based nonprofit, Southface, also provides technical assistance and solar access support to Georgia's nonprofits, communities of faith, and multifamily affordable housing, through the Solar for Underserved Markets program.[53]

- **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.[54] The Solar Massachusetts Renewable Target (SMART) program includes incentives for solar installations that incorporate a battery storage component.[55] 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

The Atlanta skyline.
Photo: Creative Commons/ Clinton Steeds

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.[56] 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. Georgia does not fall within the jurisdiction of any RTO or ISO and so is not subject to these orders. However, utilities like Georgia Power can take similar actions by creating market opportunities for battery storage to provide valuable services such as frequency and voltage regulation and demand response. Establishing new revenue generating opportunities can greatly improve the economics of battery storage systems.[57]

- **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.[58] 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. Georgia allocated $55.5 million in electric efficiency program spending in 2017.[59]

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.** 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 Atlanta. 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 Atlanta can be a challenge due to a lack of supportive policies 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 Atlanta. The findings and recommendations presented here are meant to start a conversation about the steps that Atlanta and the state of Georgia could take to ensure a more resilient future for its residents before the next storm strikes.

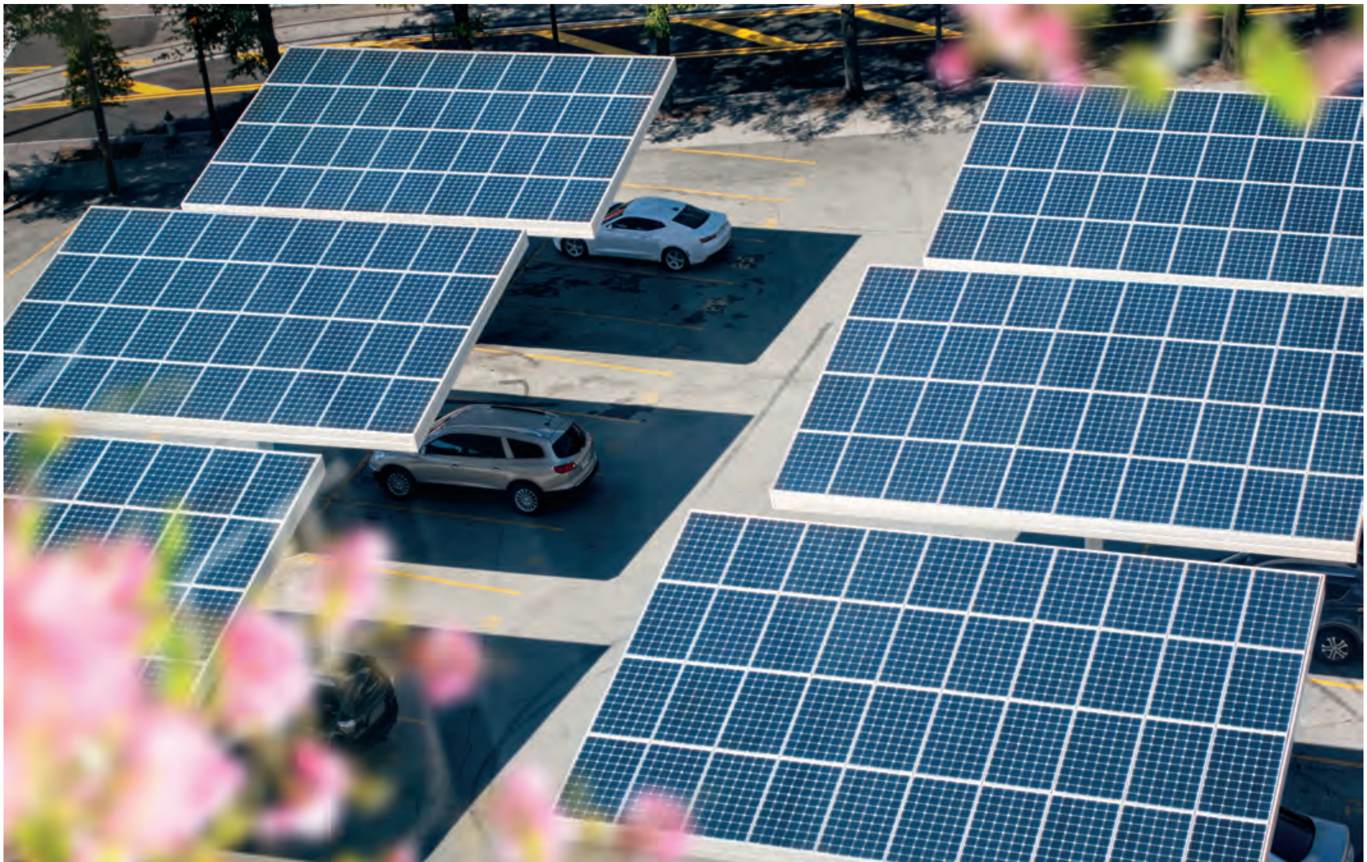


Photo: iStockphoto/Imagedepotpro

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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28 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.

29 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.

30 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*

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*

ENERGY AND POLICY INSTITUTE

The Energy and Policy Institute is a watchdog organization that exposes attacks on renewable energy and counters misinformation by fossil fuel and utility interests. *www.energyandpolicy.org*

SOUTHERN ALLIANCE FOR CLEAN ENERGY

The Southern Alliance for Clean Energy is a nonprofit organization that promotes responsible energy choices that work to address the impacts of global climate change and ensure clean, safe and healthy communities throughout the Southeast. *https://cleanenergy.org*

SOUTHERN ENVIRONMENTAL LAW CENTER

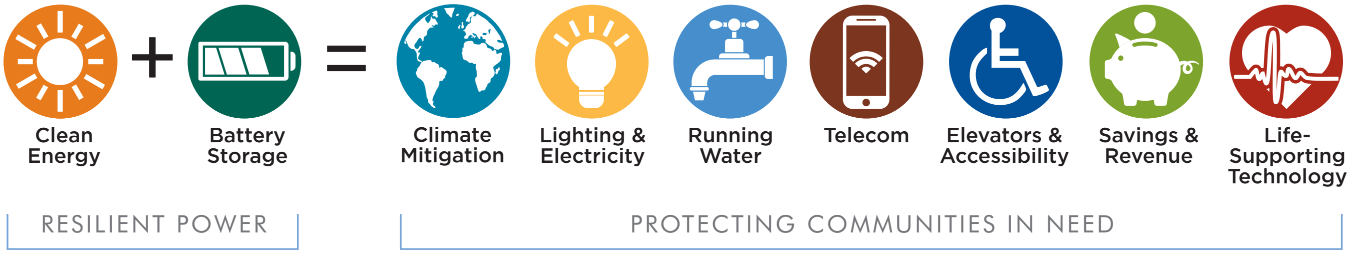
Southern Environmental Law Center is a non-profit environmental organization dedicated to the protection of natural resources, communities, and special places in a six-state region of the Southeast. SELC partners with over 150 national and local groups to achieve its goals and works in all three branches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

SOUTHFACE INSTITUTE

Southface Institute, a nonprofit 501(c)(3) organization, is a leader in sustainable advocacy, building, planning and operations across the U.S. With a mission to create a healthy and equitably built environment for all, Southface's consulting services, workforce development, research and policy practices are supporting better homes, workplaces and communities. Experts in the fields of resource efficiency, building tech and organizational sustainability since 1978, Southface is committed to building a regenerative economy to meet tomorrow's needs today. *www.southface.org*

RESILIENT POWER

A project of Clean Energy Group



www.resilient-power.org

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