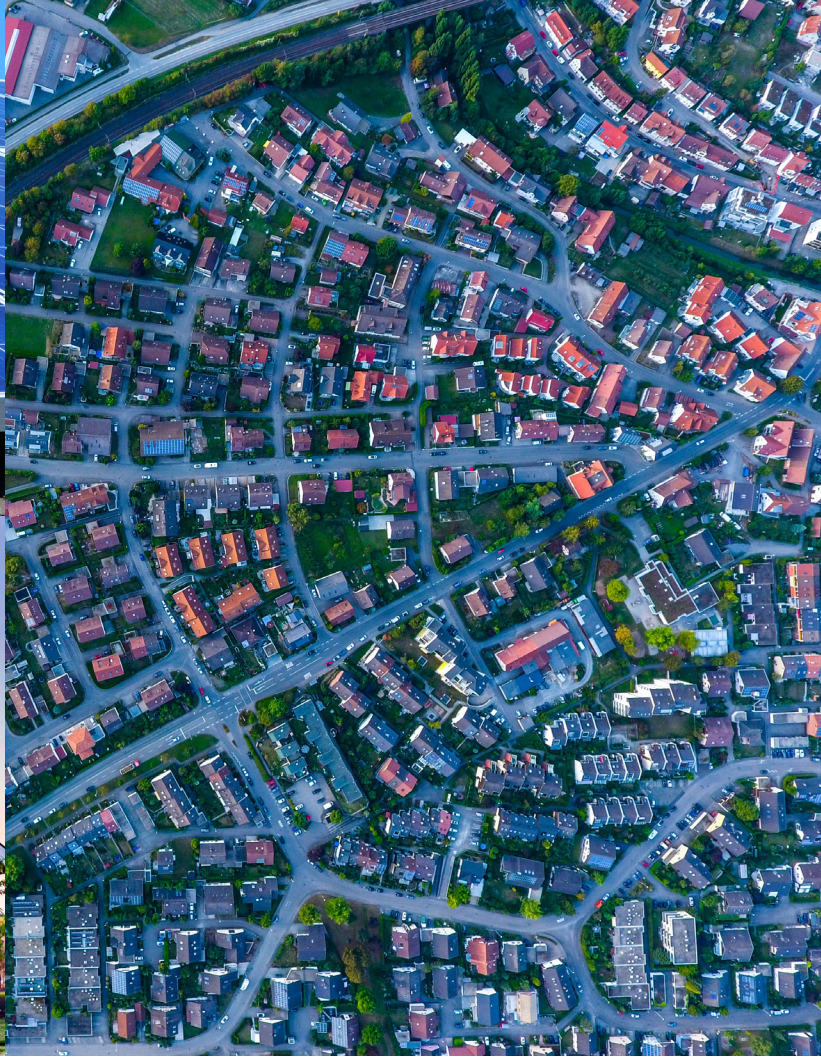
We Can Decarbonize Rapidly.

How Consumers Are Making It Happen

sunrun



About Sunrun

Sunrun (Nasdaq:RUN) is the nation's leading home solar, battery storage, and energy services company. With a mission to create a planet run by the sun, Sunrun has led the industry since 2007 with its solar-as-a-service model, providing clean energy to households with little to no upfront cost and often at a savings compared to traditional electricity. Sunrun's Brightbox home battery service manages household solar energy, battery storage, and utility power. The company designs, installs, finances, insures, monitors, and maintains the systems, while families receive predictable pricing for 20 years or more. Sunrun has more than 233,000 customers, 5,000 of whom have Brightbox home batteries, and operates in 22 states across the nation plus D.C. and Puerto Rico. These customers have saved over $300 Million on their electricity bills.

We are building a healthier, more resilient energy future. Going solar gives households the freedom to create their own energy and clean, solar energy protects the planet for future generations and creates meaningful local jobs. Sunrun has prevented 3.7 Million metric tons of greenhouse gas emissions (CO_2e), which is equivalent to eliminating 9 billion passenger vehicle miles or recycling 1.3 Million tons of waste. The company alone has created more than 4,000 quality jobs and thousands more through our partners.

For more information, please visit our website at www.sunrun.com.

> "We should boldly scale local energy resources, and experiment with how they can complement and streamline our centralized power plants and transmission system."

OUR CLIMATE IS CHANGING. Not only is it happening faster than expected, but extreme weather events are destroying the very electric grid we rely on. We only have about 12 years to act before the damage is irrevocable. The good news is that we have the technology and solutions to decarbonize our electricity system, and the public is overwhelmingly supportive. Sunrun is harnessing this good will and developing models to help us decarbonize affordably and quickly.

Last year, I wrote of the urgent need to rethink our existing energy system. The current system is a century old and not built for today's energy consumers, technology or weather. We are at risk of spending colossal amounts of money on infrastructure that will not be used by the time it's built, and we are underinvesting in people's desire to produce and share their own energy. Since writing, we have witnessed the largest investor-owned utility in California file for bankruptcy as a result of its aging infrastructure and challenges in coping with extreme weather. Lives have been lost, towns burned to the ground and communities devastated. According to PG&E, the estimated cost to mitigate for future fire risk on its system in 2019 alone is between $1.7 and $2.3 billion. However, this figure could exceed $30 billion if PG&E were to be found liable.

There is a better way. With no time to waste, we can empower local resources to speed along our efforts. So much of our ability to decarbonize will come down to local efforts—zoning and building codes, transportation policies, housing density, and, perhaps most important of all, persuading consumers to invest in solar and batteries and to share these devices in order to balance clean energy supply. The public is ready and willing to take action.

We should boldly scale local energy resources, and experiment with how they can complement and streamline our centralized power plants and transmission system. This will help us develop a reliable, affordable and decarbonized energy system on a timeline that supports a prosperous and sustainable future.

Power forward,

LYNN JURICH

CO-FOUNDER & CHIEF EXECUTIVE OFFICER | SUNRUN

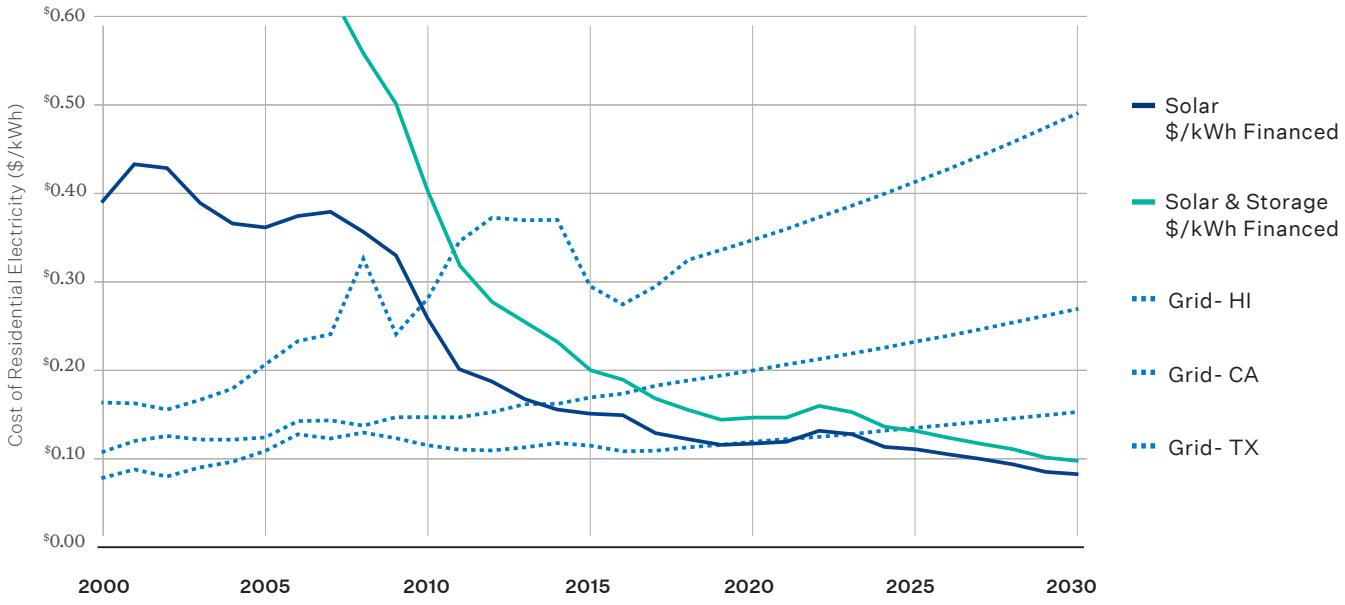
Executive Summary

To achieve a decarbonized energy system in today's extreme weather environment, we must manage growing amounts of wind and solar energy and make sure the underlying infrastructure can withstand disruptive events. Building new technology and developing the "muscle" in our energy system to better match supply and demand will help. Energy created, stored, shared and shaped on-site or in a local community is a necessity. There will still be a transmission grid, and large-scale centralized renewable power, however, this will be dwarfed by local resources. Exhibit 1 illustrates the inevitability of this. The structural advantages of distributed solar and batteries on residential electricity rates will only increase over time as costs improve while the cost to deliver centralized power increases.

Even though large scale renewables are cheaper than ever, the cost to transport this electricity to customers is steadily increasing. The portion of retail rates attributable to energy delivery costs increased by over 60% from 2006 to 2016, and now makes up over a third of retail costs.[1] This trend will continue as the grid undergoes an unprecedented investment cycle due to its aging infrastructure. The utility trade association, Edison Electric Institute, estimates that by 2030, the electric utility industry will need to make a total infrastructure investment of $1.5 Trillion to $2.0 Trillion, and required transmission and distribution ("T&D") investment of $880 Billion.[2]

Exhibit 1:

Actual and Predicted Cost of Solar and Batteries Compared to Utility Rates



This graph compares the historical and future cost to deliver a kilowatt-hour of electricity to a residential customer from rooftop solar, rooftop solar paired with energy storage, or from the grid in Hawaii, California and Texas. When all-in delivery costs are considered, the trend towards cost advantage of distributed resources becomes clear.[3]

Exhibit 2:

Investment in Transmission Infrastructure by Major Utilities (1996-2016)

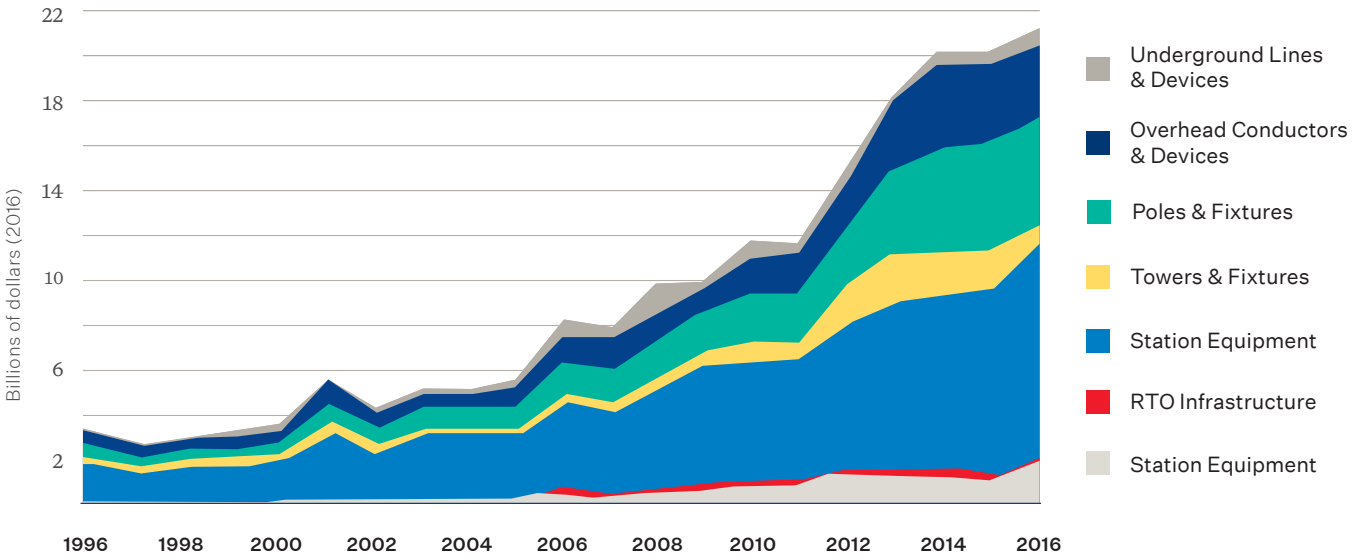
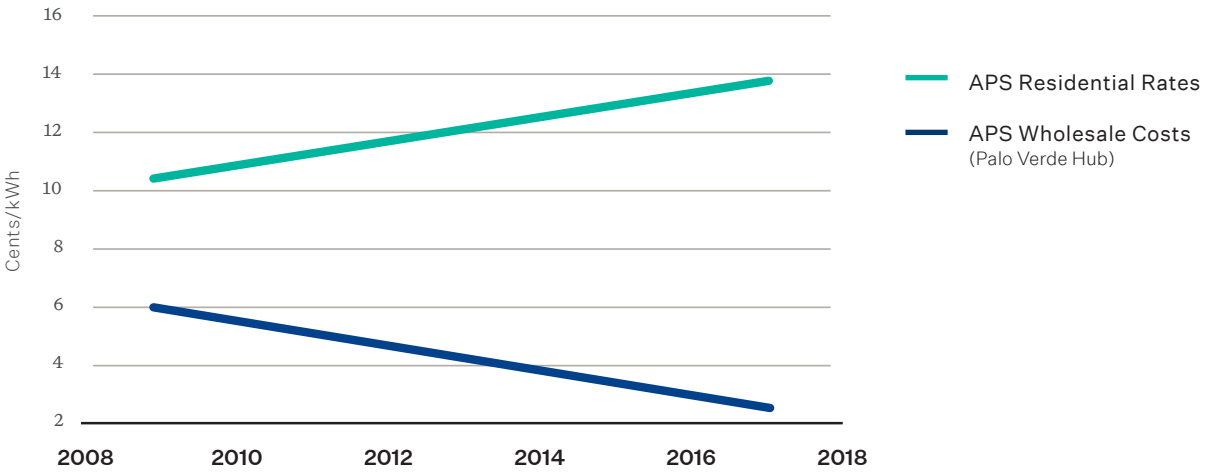


Exhibit 3:

Declining Wholesale Rates Disguise Cost of Capex

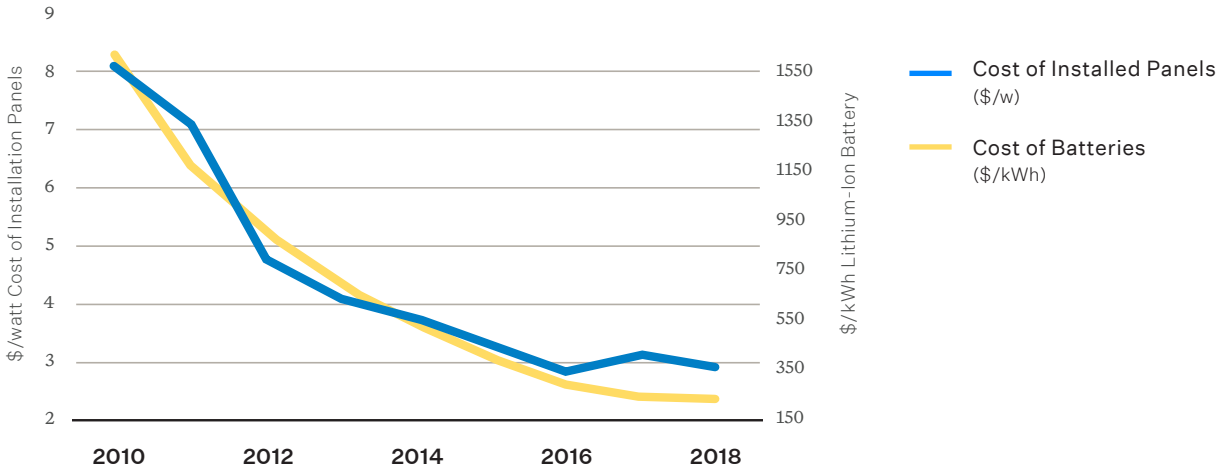


Sunrun[4] and others[5] have described our current crossroads of building two competing infrastructures: one centralized and dominated by incumbents with outdated business models, and one onsite with companies competing to deliver a superior energy service to the customer and local communities. If we continue to make these paths compete, it will be unnecessarily expensive, inefficient, and too slow to meet our climate goals. We need to encourage decentralization at scale, have the courage to allow for experimentation to redesign the grid, and, most importantly, let people help us drive this change and encourage them to participate in the grid by sharing their resources.

Rooftop solar and batteries are a beachhead for a more local, reliable and clean system. They are helping Americans become invested in their energy, demand clean, renewable power and seek solutions for the increasing incidence of blackouts. These people are not just consumers of energy, but are producing, storing and sharing it, taking control of their energy and their community's energy usage. Excellent customer experience and optimizing household needs encourages them to allow their devices to be used to help balance the overall electric system.

Exhibit 4:

Declining Cost of Solar Panels & Batteries By Year



Costs of installed solar panels and batteries have been declining year over year, with experts predicting this trend to continue.

This paper offers insights into customer behavior from a company with twelve years of experience listening to households' needs and innovating a superior energy service. We highlight some real-life examples of how we can leverage our scale of homeowner batteries and rooftop solar for the benefit of the entire system. We offer recommendations on the future role of the utility, ways to simplify permitting and other regulatory roadblocks to decentralize affordably at scale, and recommend investing to support our most vulnerable populations.

We must have the courage to redesign our energy system in a human-centered manner to take advantage of today's technology and consumer demand, and meet our climate goals quickly and cost effectively.

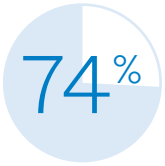
sunrun

Put People at the Center of the System

We can't change the unpredictability of weather patterns, but we can manage when and where we use electricity. This puts people, rather than power plants, at the center of the equation. Putting the people at the center is not a "nice to have"—it is fundamental to creating a new energy system. Behavior change is driven by more than economic logic; it only happens when we shift human motivation and create trust. It also provides the political capital to drive the massive transition that science requires of us.

It is easy to lose sight of the real people behind the "demand" and miss a deep understanding of their needs. People *want* clean, renewable energy. An Edison Electric Institute study found that 74% of the public thinks we should be using renewables "as much as possible," and 70% believe that in the near future, 100% of our electricity should come from renewables like wind or solar.[6] Americans put a higher value on clean power than fossil fuels. In the same study, 51% of respondents believed that 100 percent renewables is a good idea *even if it raises their energy bills by 30 percent.*[7]

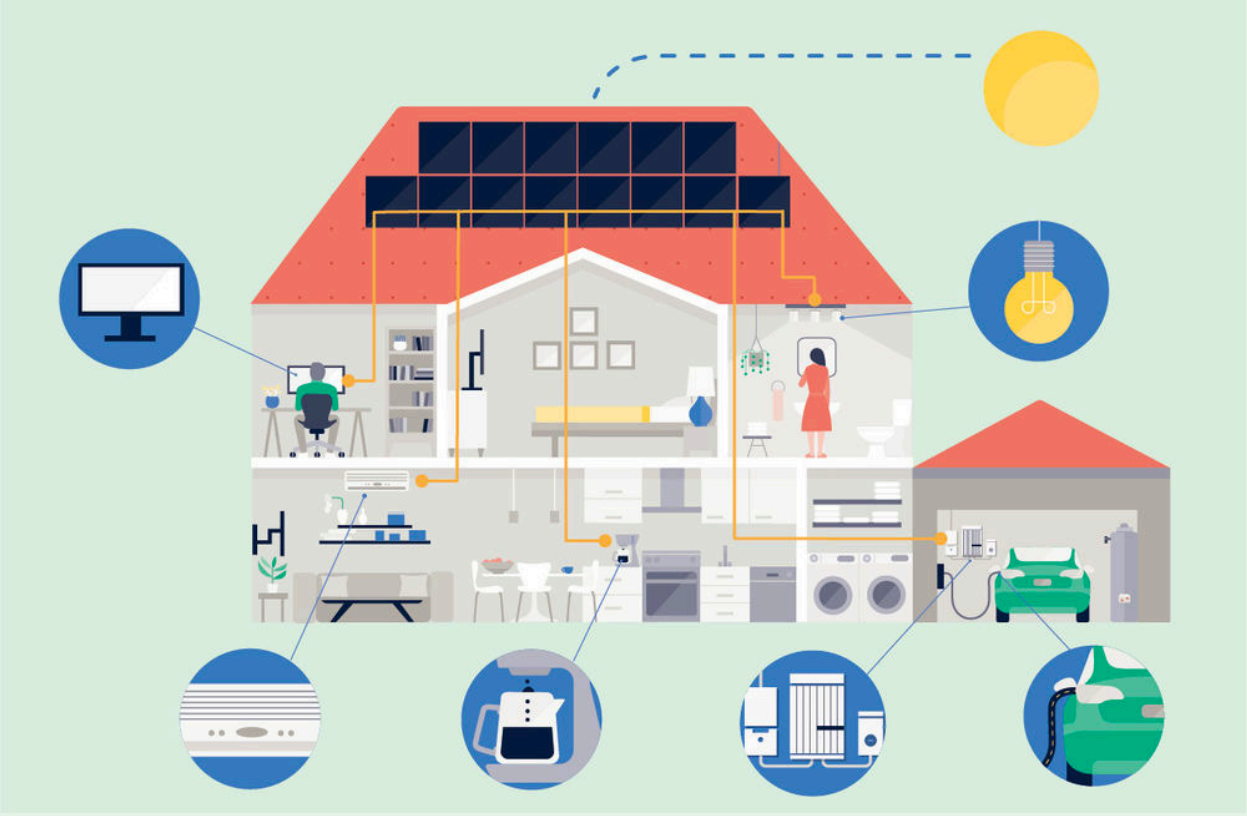
Home solar is the first time households were given a real choice for how to power their lives. With the solar-as-a-service model pioneered by Sunrun in 2007, it can be delivered with no upfront cost and with lower monthly expense than grid electricity for a significant number of American households today.



74% of the public thinks we should be using renewables "as much as possible"

70% believe that in the near future, 100% of our electricity should come from renewables like wind or solar. Americans put a higher value on clean power than fossil fuels.

During a span of less than 10 years, putting solar panels on the roof transformed from an expensive and complicated investment to a simple purchasing decision that makes it possible for the residential solar industry to install a new solar project every 100 seconds.



Home solar is the beachhead for a distributed, sharing energy economy. A home battery is an accelerator.

Residential electricity comprises 40% of power usage in the United States[8] and electrification of our homes is critical to achieving 100% clean, renewable energy in our energy system. Homes can generate solar power on rooftops, store and manage energy in batteries, heat with electricity rather than fossil fuels, and charge electric vehicles from renewables.

In addition to seeking savings and clean energy, our experience indicates people place significant value on the control and freedom that home solar and batteries offer them. The increasing affordability of batteries enhances this customer experience and will drive even more adoption of solar.

Residential electricity comprises 40% of power usage in the United States[8] and electrification of our homes is critical to achieving 100% clean, renewable energy in our energy system.

Electric power for consumers in the United States was interrupted for an average of about eight hours in 2017, nearly double the average duration of interruptions the year before.[9] People want their homes and families to be safe from unpredictable risk. Approximately 3 million homeowners have adopted standby (fossil-fueled) generators in recent years and millions more have purchased portable generators.[10]

Consumers are readily pairing batteries with rooftop solar as it becomes a viable solution to relying solely on the grid. Home battery installations in the United States have increased more than 200% annually during the past four years, and rapid growth is expected going forward.[11] Residential battery installations even exceeded utility scale deployments for the first three quarters of 2018.[12] With the right customer relationships, these assets can be an important advantage to our collective system. In a modest estimate, McKinsey & Company states that, already, residential energy-storage systems are attractive to more than 20% of U.S. households.[13]

Exhibit 5:

Annual Residential Energy Storage Installations in the US

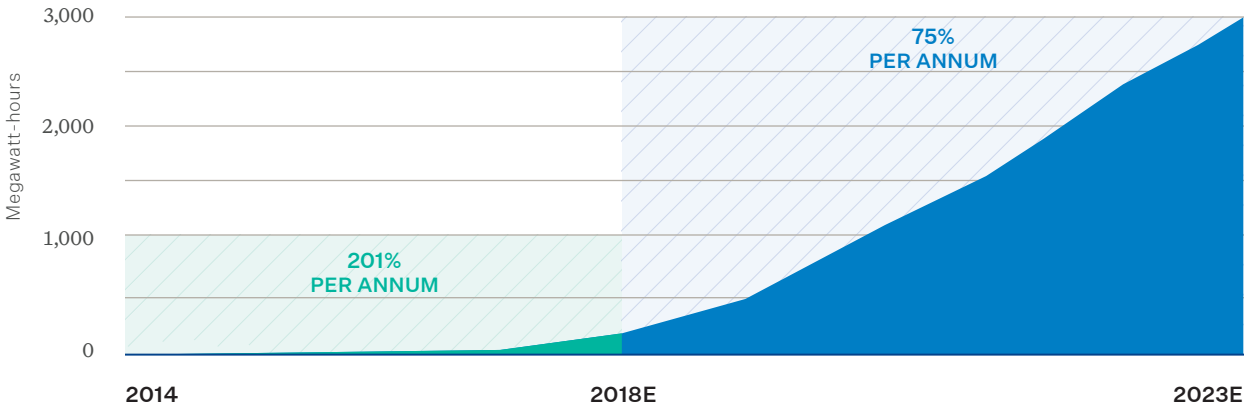
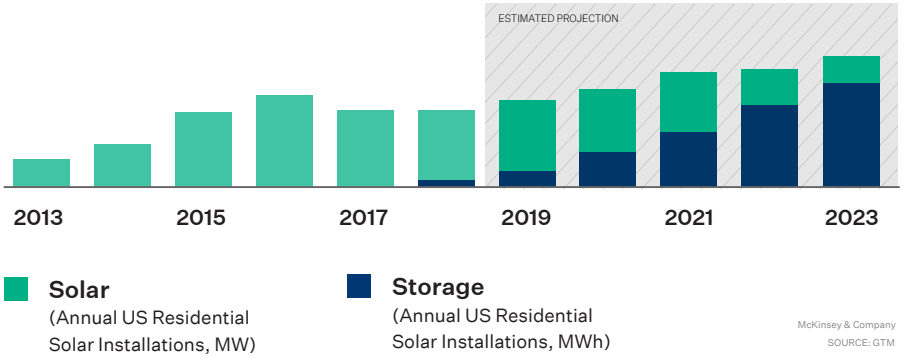


Exhibit 6:

Installation of Solar Only vs. Solar and Batteries Growth By Year[14]



Solar
(Annual US Residential Solar Installations, MW)

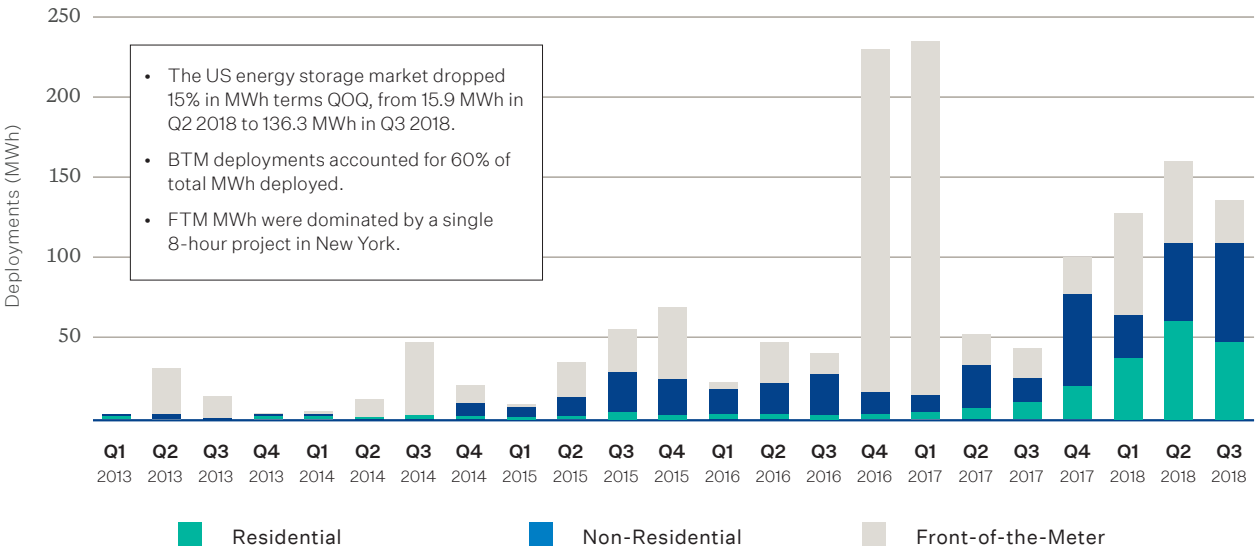
Storage
(Annual US Residential Solar Installations, MWh)

McKinsey & Company
SOURCE: GTM

Storage is expected to quickly become a standard component of residential installations.

Exhibit 7:

Residential Solar Installations Outpaced Front-of-Meter by Q2 2018[14]



Sunrun understands this home energy consumer. We are in the unique and privileged position of listening to and educating households through live face-to-face and phone conversations with each and every one of our customers. We have had substantive conversations with well over a million households across 23 different states and understand their needs; we maintain a 20+ year relationship with those who choose to go solar; we revisit them during this term to upgrade technology and adjust their requirements.

All of the steps that Sunrun has become expert in carrying out for home solar: such as in-depth customer education, reviewing energy usage, discussing preferences and financial goals, managing a multi-part design and installation process and then keeping customers happy throughout a 20+ year relationship—must be carried out for home batteries, EV charging, electrification of space or water heating, energy efficiency improvements, and more. Utilities and grid operators can work with home energy providers like Sunrun to coordinate these devices on behalf of customers. This will allow home energy to operate in sync with the variability of renewable energy and reduce strain on the grid.

Solar and home batteries are a cost-effective way to start the electrification of the home.

Because of the significant lifetime value of the solar and battery, the incremental cost of additional electrification can be supported. In contrast, the customer education needs and subsequent acquisition cost of many energy efficiency or automation products cannot be supported on a stand-alone basis:

When Sunrun installs a solar and battery system on a home, we estimate this accounts for 60-80% of the total incremental capex needed to realize this entire vision with a connected electric water heater, heat pumps for space heating, an electric vehicle (EV) and an EV charger.[15] Financing makes this available for as little as zero down, and additional technology can be rolled into this financing relationship.

The 20+ year customer relationship throughout the lifetime of a solar system provides the foundation for upgrading to electrification as vehicles, furnaces and water heaters reach replacement, including upgrading batteries as technology improves.

The investment that Sunrun and our peers make in customer education on home energy, including live face-to-face and personal phone conversations with each and every one of our customers when they adopt solar, lays the foundation for the human engagement required to introduce new home energy technologies.

The investment that Sunrun and our peers make in the software platforms to monitor and manage solar and battery systems for customers creates a natural touchpoint for utilities and grid operators to interface with distributed clean energy, without needing to connect to each system or customer.

The investment in a battery that a customer makes becomes a resource for low-cost, responsive energy management and grid services, with the potential to add other devices.

To achieve a consumer-centered vision for decarbonization we need to keep driving up the adoption of local clean energy, including solar and batteries on homes and businesses as the foundation for the future, while aligning utilities to participate in realizing this vision.

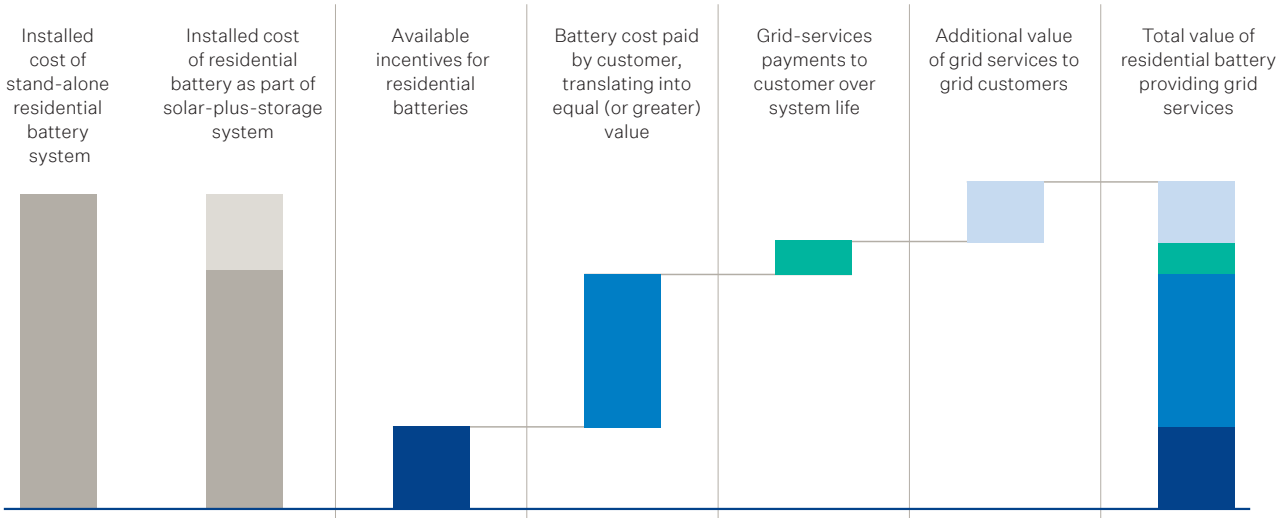
A Solar Powered Home is a Valuable Resource for Everyone

Electrification of transportation, water heating and space heating is likely to double or even triple the amount of energy a home uses annually, further enhancing the home's crucial role in overall power usage. Yet, because of the ability to reduce the need for "peaking" infrastructure across the grid, on-site generation and batteries can actually create a long term *reduction* in the cost of the grid needed to serve this home. With all of this intelligence, flexibility and local clean energy generation, such a system could be expected to push clean energy out to neighboring homes at key times of day instead of requiring transmission lines to deliver it, lowering costs for everyone.

These additional capabilities and services, known in the industry as "grid services," are of value to the entire energy system. Sunrun is actively prototyping a number of these services in several markets. McKinsey & Company evaluated the potential value streams from home batteries and identified significant value to both the customer and to society through grid services. Utilities, regional grid and market operators, and regulators will play key roles in unlocking grid service values by offering contracts or tariffs that fairly compensate customers and third party providers for the value they share with the grid. McKinsey notes in the graph below that "the battery's value is greater when it serves the customer as well as the grid."

Exhibit 8:

Home Battery System Value with Grid Services Compensation



McKinsey & Company

Importance of a Learning Curve

Progress Happens Through Deployment

Veteran energy analyst Hal Harvey recently published a compelling study of climate change policies that work.[16] Mr. Harvey says, "There's this naïve idea that the way technology works is, people sit in labs and think and worry and work on an idea, and then it pops into the world and becomes ubiquitous. The reality is, a very large fraction of progress on technologies happens through deployment. For that, you need very large volumes of sales, continued over time." He notes that the dramatic price reductions in wind and solar reflect this last part of the learning curve.

We are on this learning curve with distributed solar, batteries and other consumer-centered energy resources. We need to continue to encourage more adoption so we can experiment with how to share these resources and deliver services to the grid.

In our previous report, *A Better System For the People, By the People*,[17] we included a number of recommendations around stopping the constant and premature changes to the consumer's solar value proposition and challenges to Net Energy Metering that waste valuable time and resources, and halt innovation and investment. We continue to recommend maintaining simple regimes like NEM to give competitive solar providers the stability to encourage innovation and continue to drive down costs.[18] Consumers need simplicity to go solar. With more solar penetration, moving to time-of-day rate structures can encourage the use of a battery. As described above, people want to invest in batteries for control and outage protection, so we should continue to encourage this.

California and Hawaii

Hawaii and California are examples of letting deployments scale and the innovation that inevitably follows for all of society's benefit.

Sunrun developed its first home battery service, Brightbox, in Hawaii in 2016. After 20% of Hawaiian homeowners made the choice to go solar, Hawaii decided to transition from a NEM program to new tariffs where homeowners were incentivized to self-consume the solar energy they produced on their roof. Sunrun worked closely with the Hawaiian utilities, regulators, and hardware vendors to develop a home solar and battery solution and was the first installer to interconnect a system under the new Self Supply tariff. Since then, we have continued to refine our Brightbox service to also provide home backup, time of use management, and grid services. Our current install base of solar and battery customers in Hawaii is opening up opportunities for us to coordinate with the utility to provide services and peak management.

In just two years, our Brightbox solar and battery solution has become available in seven states and Puerto Rico. As of the end of 2018 in California, more than 25% of new customers opted to add a home battery to their solar service. California has supported this progress through a battery incentive and time of day rate structures to encourage batteries to discharge power during evening hours when electricity is most expensive and carbon-intensive to deliver. This is a prime example of using home energy to match supply and demand.

In 2018, the California Energy Commission voted to adopt a policy requiring nearly all new homes to incorporate rooftop solar—the first state-level requirement of this kind in the country. Once the new policy takes effect, the number of new homes that are built each year with solar panels is expected to jump from 15,000 to around 100,000. The expansion of home solar and battery solutions in California can reduce household monthly electric bills while contributing to statewide efforts to increase the reliability and efficiency of the electric grid.

People are willing to share some of the cost of a battery to help provide the reliability and control against increasing outages. We need to experiment with the best way to share and compensate for the use of these batteries in order to revolutionize our grid. This is best done through getting more solar and battery systems in the ground. We need to scale to lower the cost and experiment to learn and persuade customers to help us balance the electric grid. Implementation through experimentation allows us to invite the community into new approaches, giving them control, time and space to make changes in their own behavior.

Experimentation is a new way to think about energy deployment and is enabled by the speed of change in technology. As energy commentator David Roberts puts it, fossil fuel and nuclear power plants only come in one increment: big. It takes a long time to build, iterate and improve them, and the capital barriers to entry in that market are high.

Distributed energy resources tend to be smaller and more connected to information and communication technology—things like electric cars, smart car chargers, new kinds of batteries and the software to manage it. The capital barriers are lower, the time it takes to iterate is much shorter, and learning and improvements spread much faster. Furthermore, the risk to society of stranded investments is lower.

Let's encourage and welcome innovation and prototyping, which comes from deployments at customers' homes.

Home Solar and Battery Systems Providing Grid Services Today: From Prototyping to Scale

Sunrun is innovating to push the boundaries of what our market structures enable for distributed energy based on what we know the technology can do. This is supported by our scale, our reach and customer demand for controlling their own energy. This innovation can deliver new business and service models, and gives the industry the knowledge and confidence we need to re-architect our grid, change the utility business model and decarbonize the electricity system quickly.

There are questions about where these distributed, customer-cited resources plug in—at the wholesale level, directly with utilities on the distribution system, or at microgrids in local communities.

There are questions about how many different sources of value distributed resources can provide—essential services addressing local power quality needs or system-wide needs like frequency response, and complete replacement of peaking gas power plants or the need for new distribution and transmission infrastructure. There are also questions about making our communities resilient and reliable in the face of extreme weather and other disruptive events. The best path forward is to prototype, such as Sunrun is by pushing forward in several models and markets. Energy sources are heterogeneous and multiple models will prevail, but importantly, we believe these real-life examples can give us confidence to move more boldly and avoid the current clash between centralized utility resources and those at the customer site.

New England

Model for Participation in the Wholesale Market

In New England, Sunrun is engaging in the wholesale capacity market run by the grid operator, ISO New England, to create a model that can be adopted nationwide. In February 2019, ISO New England awarded Sunrun a first-of-its-kind contract to deliver wholesale energy generation capacity from a network of home solar and battery systems. Sunrun will provide 20 megawatts of energy generating capacity from Sunrun's Brightbox home solar and battery systems beginning in 2022. Approximately 5,000 New England customers will participate.

ISO New England has one of the most rigorous auction qualification processes in the nation, which Sunrun met to participate in the market. By bundling and coordinating the energy stored in these systems, Sunrun can reduce the need for expensive and dirty power and will lower electricity costs for all New England ratepayers. This is a model that can be adopted by grid operators nationwide.

Bring Your Own Device Programs

Model for Partnering With the Utility

Utilities can play a catalytic role.

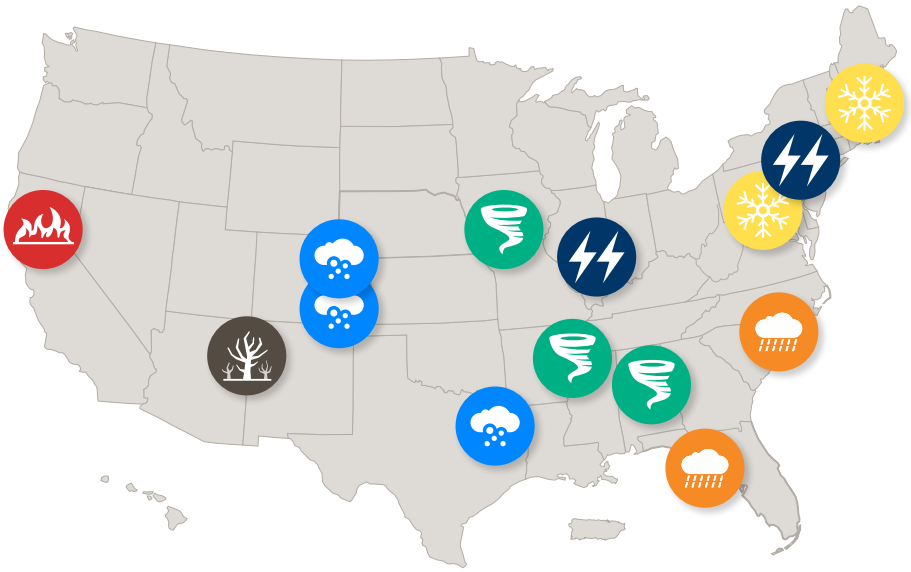
In just the past two years, utilities in New York, Massachusetts, Vermont, New Hampshire, Rhode Island and Colorado have launched or proposed programs with customers and residential solar and energy storage developers, like Sunrun, to drive adoption of residential batteries and then draw on them as "demand response" and beyond, to reduce energy usage during high-cost periods on the grid. Batteries can be utilized year-round, enabling these programs to "peak shave" throughout the year and reduce the cost of generation and transmission capacity for all customers. Consumer battery providers like Sunrun can make this seamless for both utilities and customers alike by managing battery charging and response. The impact can be huge; energy efficiency and demand response programs could significantly reduce the need for new generation capacity by about 38%.[19]

The "Bring Your Own Device" approach to these programs embodies an "open source" approach to enabling and connecting innovative technology on the grid. Consumer-centered utilities, such as Green Mountain Power in Vermont, know that engaging third-party innovators extends their capabilities in bringing new technologies to customers. Ultimately, this strengthens a customer's connection to the grid at a moment when technology could enable customers to simply begin unplugging from it. Sunrun has utilized Brightbox in programs, such as the National Grid Connected Solutions program in Massachusetts, and will continue to be an active participant as these programs grow.

Building Resilient Communities

Exhibit 9:

Billion-Dollar Extreme Weather Disasters In The US, 2018



Western Wildfires
California Firestorm, Summer-Fall

Plains Droughts
Southwest/Southern, 2018

Hail Storms
Rockies & Plains, August 6-7

Tornadoes & Severe Weather
Central & Eastern, July 19-22
Southern & Eastern, April 13-16
Southeastern, March 18-21

Severe Weather
Central & Eastern, May 13-15
Central Northeastern, May 1-4

Hurricane
Hurricane Florence, September 13-16
Hurricane Michael, October 10-11

Winter Storm
Northeast, March 1-3
Northeastern & Eastern, January 3-5

This map denotes the approximate location for each of the **14 separate billion dollar weather and climate disasters** that impacted the United States during 2018.

Extreme weather caused by climate change is tragically the new norm and we must plan for it. Our country is experiencing unprecedented weather that our century-old electricity infrastructure was not built to cope with. In particular, power lines are vulnerable in such weather. From wildfires in California, to Hurricanes Florence and Michael, the top 10 most significant outages in 2018 were all related to weather events. As the impact of climate change worsens, storms are expected to grow in frequency and intensity.

PG&E Estimated Wildfire-Related Costs

$1.7 - $2.3 BILLION

Estimated cost to reduce wildfire risk in PG&E's Wildfire Mitigation Plans.

- $344 - 347 Million vegetation management
- $797 Million - $1.4 Billion safety inspections
- $325 Million system hardening (including pole replacement, materials and other equipment)

$30 BILLION

Estimated cost if PG&E were to be found liable for certain or all of the costs, expenses and other losses with respect to the 2017 and 2018 Northern California wildfires.

$75 - $150 BILLION

Estimated cost of full compliance with the initial US District Court Order, including inspecting its entire electric grid in the coming months and turn off power during fire-prone weather if its equipment has not been deemed safe for those conditions.

Proposed Solution for California Wildfires

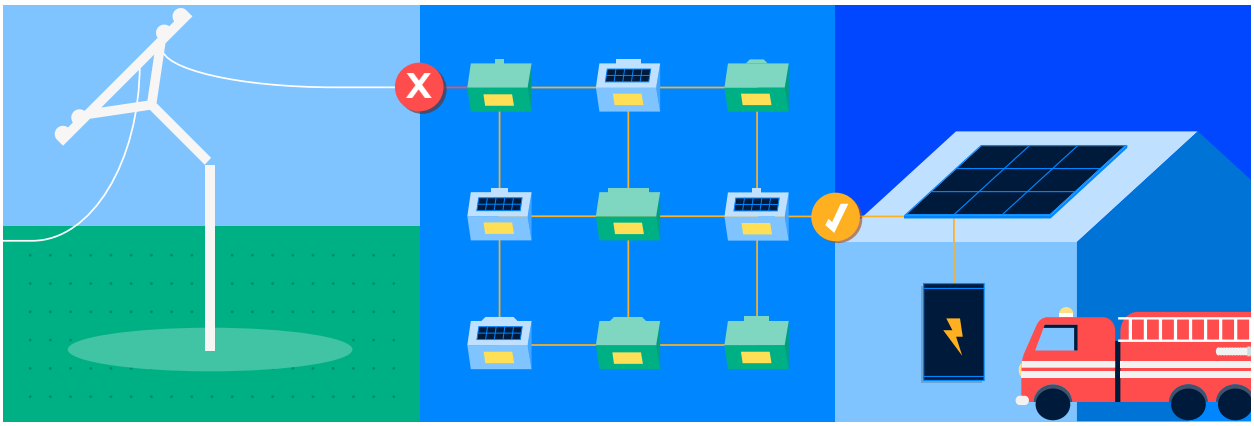
California's devastating wildfires are becoming more common and destructive, and will continue to threaten our country's people and energy systems. At a minimum, increased penetration of home solar and batteries may help prevent sagging lines that may spark in vegetation and cause wildfires. When high power flows through the lines, they can heat up and sag. Moreover, home solar and batteries can enable customers to continue to have power when the utility is forced to de-energize the lines frequently during high winds.

An even more impactful solution that Sunrun plans to explore is community-scale grid resilience, created through a collaboration between utilities and clean energy providers, and enabling regulations to cover the key needs in a geographic area.

Distribution substations, with the addition of a battery and modern switchgear, could become black start nodes for allowing existing communities to island from the transmission grid without loss of power. In cooperation with aggregators and customer-sited systems, utilities could enable a section of the grid to "island" in the event that a transmission line is proactively de-energized or actually impaired. These distribution islands would leverage existing utility lines and would be fueled by high penetrations of customer-sited solar and battery systems.

Exhibit 10:

Proposed Solution for Islanding Communities During Grid Outages



By leveraging the capacity of customer-sited resources across the microgrid, a wider range of conditions could be managed, for a longer period of time, without losing power.

Rebuilding the Energy System in Puerto Rico

Puerto Rico is an example of extreme weather catalyzing new thinking and action toward 100% clean, renewable and resilient energy. Following Hurricane Irma and Hurricane María, Puerto Ricans adopted batteries for homes, schools and critical facilities. Sunrun installed solar and battery systems on fire stations on the island, which have powered critical emergency equipment 24/7 through the longest blackout in American history. Today, Sunrun is delivering its Brightbox home solar and battery service to a growing number of households eager for reliable and affordable power.

Puerto Rico is advancing policies that enable the transition to a decentralized and democratized electricity system. For instance, Puerto Rico's Senate passed legislation in March 2019 that created a goal of 100% renewable energy by 2050. In contrast to other renewable energy standards, this legislation provides a clear role for distributed generation to play in achieving this goal.

The local utility, Puerto Rico Electric Power Authority (PREPA), has in its Integrated Resource Plan a goal of approximately one gigawatt of solar and a similar amount of energy storage by 2022 as part of a redesign of the island's energy generation.

Given the deep customer demand for both renewable energy and backup power, the question is now how these two parallel elements can be interwoven. The solar and battery systems that customers adopt can make up part of PREPA's target if customers can be enticed to stay more integrated with the grid. One way to do this is by encouraging customers to adopt batteries and be prepared for a future hurricane, while giving them the opportunity to earn value delivering clean energy from their batteries back to PREPA when the utility needs it. This is similar to the BYOD approaches being adopted in New England and will create a more stable system, as well as a more financially healthy utility, than one where customers decide to disconnect from the grid and rely on their own resources.

Replacing Gas Plants

We are at the point where we can cost-effectively start replacing "peaker" gas plants, which only run for short durations when electricity usage is at its highest, with clean energy stored in home batteries. The urban areas where gas plants tend to be much more expensive to construct and operate—and cause the greatest air pollution impacts—can be a proving ground for this new approach. With the ability to install a solar system in a day and reach a steady run-rate of thousands of homes going solar per year in a market, this capacity can be realized as fast or faster than a plant that must go through extended planning and permitting.

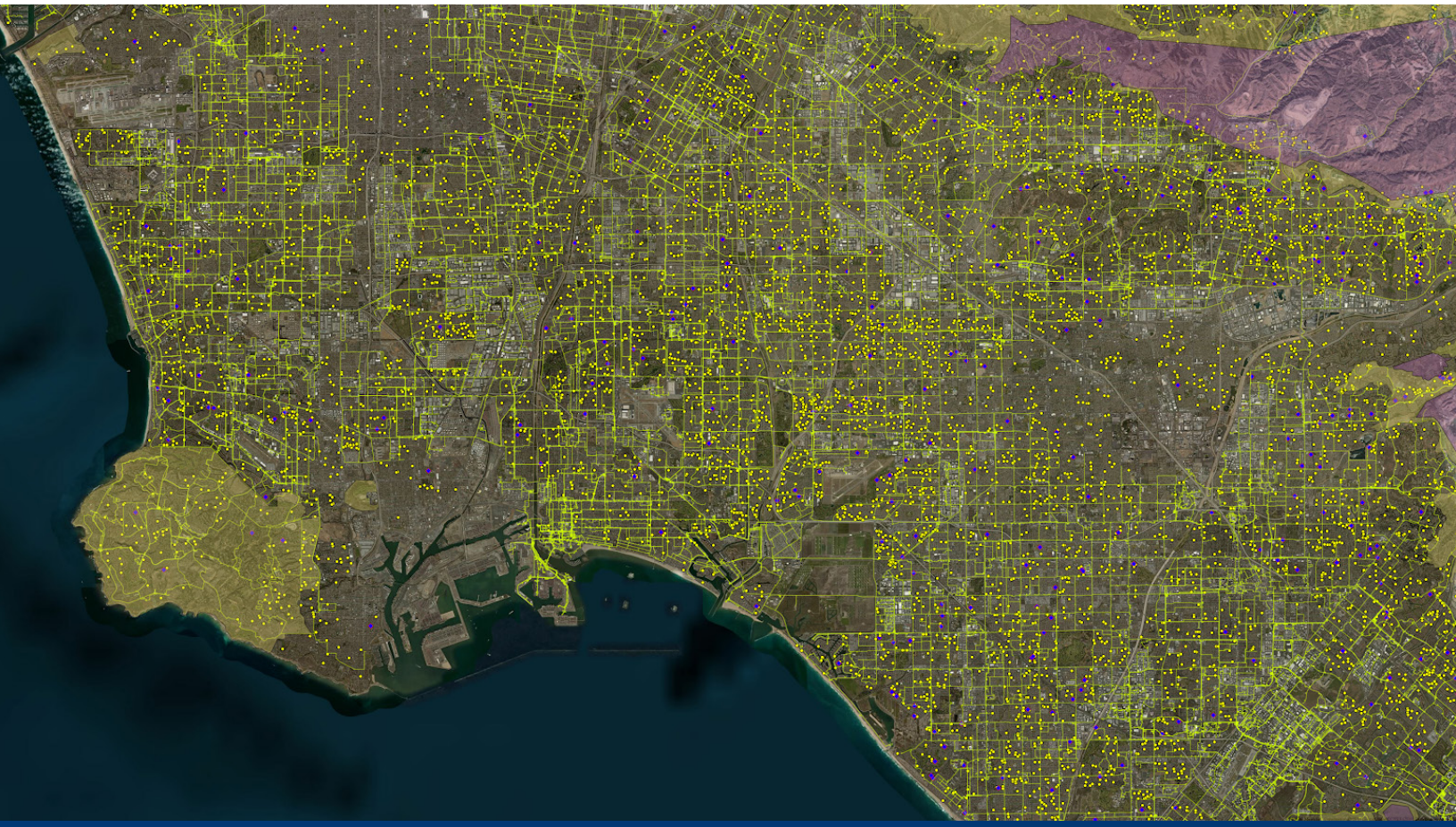
The Los Angeles municipal utility, the LA Department of Water and Power, has set itself on the commendable path to 100% renewable energy, including retiring three major gas plants in the Los Angeles basin during the course of the 2020s.

To identify how the need for peak generating capacity within the city can be addressed by solar and battery storage, Sunrun has identified over three gigawatts of prime solar potential from single family homes and multifamily buildings alone. Simply by continuing to grow its solar installations at current rates and adding batteries, LADWP can have 850 MW of solar and 1,100 MWh of storage from homes by 2029. This would deliver peak generating capacity equivalent to one of the three major gas plants LADWP will be retiring. Based on cost projections, we believe residential solar and batteries will be cost-competitive as early as 2020 and create substantial savings versus the cost that would be incurred starting in the mid-2020s if the gas plants were to be kept online.

Looking across California, Sunrun has examined local areas that the grid operator, CAISO, has identified as requiring local power generation for grid reliability. In both cities and rural regions across the state, Sunrun and its partners, Station A and Stem, comprehensively analyzed building stock datasets and found nine GWs of potential peak capacity from 48 GW of customer-sited residential, commercial and industrial solar and 42 GWh of battery storage, with commercially available technology today and positive customer economics.[23]

In regions across the country, home solar and batteries offer a pathway to retiring fossil fuels, especially in communities burdened by pollution. Replacing the nearly 500 gigawatts of thermal power generation that is due to retire during the next 12 years with clean energy promises to not only reduce carbon emissions, but save money. By not building and maintaining gas generators, the U.S. could finance a $350 billion market for renewables and DERs at a roughly 2-5% cost savings, according to Rocky Mountain Institute.[24]

These are just a few of the experiments happening today that will quickly drive decarbonization goals. As shown in the image below, Sunrun's deployment for solar and batteries in the SCE territory in southern California is growing rapidly and can be harnessed to support the grid and replace centralized generation.



Sunrun solar installations (yellow dots) and Sunrun Brightbox home battery systems (purple dots) are valuable assets which can support SCE's distribution grid (yellow lines).

Recommendations

Enable Customer-Driven Energy Transformation by Reforming Utility Incentives

Customer-driven innovation can be unleashed by changing the incentives that motivate utility investments and priorities. To get there, we must support as a foundational principle that the mandate of electric utilities is to ensure a safe, reliable and affordable electricity system for everyone. To do this, we need to evolve utility regulations so that utilities are incentivized to plan for and enable cleaner, more affordable services instead of building more infrastructure to reward investors with a rate of return.

This may differ from what is easiest for the utility to build based on its past experience and core competencies, and this is where clean energy innovators like Sunrun and our peers play an essential partnership role. Public utility commissions from Hawaii to Puerto Rico are beginning to explore performance-based ratemaking to re-align utility incentives, while other states like New York have adopted shared savings requirements. This type of regulatory experimentation is as important today as technology innovation.

To effectively support an interconnected energy system, utilities must evolve how they plan for the needs of the distribution system. Specifically, they should enable consumer participation and device interconnection to expand the capacity of the distribution and power system. In doing so, utilities can accommodate future clean energy needs at lower cost.

As managers of a distributed network, utilities need to interface directly with third parties, offer consumers options for a smooth interconnection process and coordinate capacity across the power system. This builds on the core competencies of the utilities by allowing them to manage the system, while still offering the benefits of local resources operated by third parties, who can enable customer transactions while responding to the needs of the larger grid. Lorenzo Kristov calls this “integrated decentralized” and explains that “thousands of local distribution areas [could be] operated by distribution system operators (DSOs), all connected to the bulk power system to trade and move wholesale energy and provide reliability services.”[25]

The consumer demand for energy services and products cannot be halted. Indeed, it is the engine for change that we need in order to address climate change. We invite all utilities to join in fully recognizing the opportunities that rooftop solar, batteries, EVs, and other new energy technologies and providers present, so that we can work together to maximize their transformative potential.

Cut the Red Tape

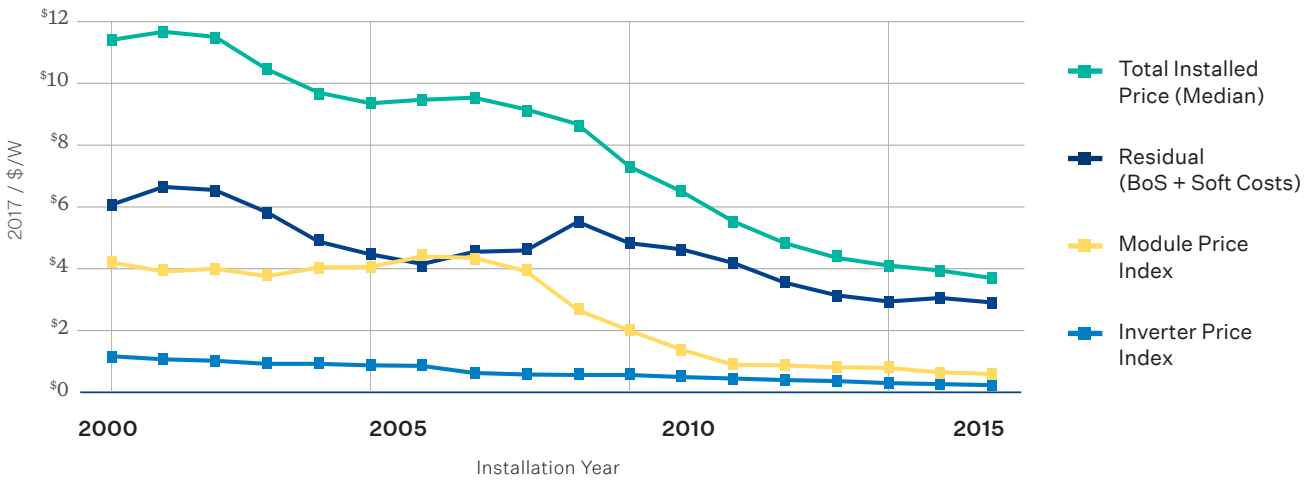
Don't Unnecessarily Increase the Cost of Distributed Solar & Batteries

Permitting and interconnection processes impose direct and indirect costs on home and business solar installations that can be two times higher in the US, depending on the specific jurisdiction, than in other developed countries with robust solar markets.[26] These costs include the direct cost of permit application, inspection and interconnection fees, as well as indirect costs such as physical trips for permitting and inspections, completing and submitting permit applications, and the high cost of losing customers who are frustrated with government or utility approval times. Direct and indirect costs add as much as $7,000 per customer.[27] Removing this unnecessary expense is equivalent to adding a home battery to every solar system for free.

Sunrun, the Solar Energy Industries Association, The Solar Foundation and other industry allies are working to encourage the Department of Energy to assist in creating a national online permitting portal and establish a program to work with cities and counties with jurisdiction over building permits to remove this unnecessary cost through standardization and cutting red tape.

Exhibit 11:

Costs Over Time for Residential Solar Systems



Note: *The Module Price Index is the U.S. module price index published by SPV Market Research (2018). The Inverter Price Index is a weighted average of residential string inverter and microinverter prices published by GTM Research and SEIA (2018), extended backwards in time using inverter costs reported for systems in LBNL data sample. The Residual term is calculated as the Total Installed Price minus the Module Price Index and Inverter Price Index.*

Promote Policies that Maximize the Value of Batteries

As we deploy batteries, we should maximize the value they deliver to both individual customers and the entire electric grid, and not push toward defection. To do this, we need to promote policies that maximize the value of batteries. These should include targeted battery incentives, such as California's Self Generation Incentive Program (SGIP) and Massachusetts' SMART program, along with grid services tariffs that remove bureaucracy, foster innovation and develop a market for networked distributed energy resources.

Currently in California, home solar and battery systems provide customers with backup power and manage time-of-use rates. As McKinsey demonstrated, these systems have additional capabilities to provide services that can benefit all customers on the grid by supporting grid planning and operations, in addition to avoiding costs that would have otherwise been incurred through traditional utility investments or operations.

Compensation mechanisms such as DER grid service tariffs, provide customers, developers, service aggregators and utilities the market rules and price signals necessary to deploy cost-effective DER solutions to meet grid needs, from system-wide peak capacity to distribution system needs. This type of mechanism, known as BYOD tariffs in some northeastern states, can offer consumers a cost effective and simple framework to share their battery resources and be compensated fairly for it. Battery providers like Sunrun manage battery operation for this purpose on behalf of customers, ensuring they'll see a reduction to their energy bills and have backup power if needed. A successful BYOD program can address the structural challenges of one-off solicitations for battery development on individual circuits—"non-wires alternative" projects aimed at deferring or avoiding near-term traditional infrastructure investments—and address other grid needs as they arise over a long-term planning horizon.

By providing customers the option to "bring their own" storage device, policymakers can ensure a simple and transparent market participation pathway for hundreds of thousands of customer-sited DERs to provide everything from distribution infrastructure capacity deferral to system-wide generation capacity.

Unlock Solutions, Resilience & Savings for Those Who Are Most Vulnerable

While prototyping creative solutions to expand access and bring down costs, it is essential that lower income residents and residents in disadvantaged communities benefit from the clean energy transition. Energy resiliency is especially important for lower income communities because, historically, these communities have been hit harder by disasters and associated grid outages than the general population. Moreover, these communities typically have fewer resources available to help them recover after a disaster.[28]

Local solar systems also improve local air quality, decrease reliance on fossil fuels and offer freedom from rising electric utility bills for residents. Smart policy in California, New York, Connecticut and Nevada has empowered innovative companies like Sunrun to expand access to solar. Through policies such as direct cash incentives and green bank financing, leading states are providing necessary financial support to enable lower income residents to purchase or lease solar systems.

Sunrun is working to expand access through two strategies:

1. **PARTNERING WITH A NON-PROFIT ORGANIZATION, GRID ALTERNATIVES,** that is committed to increasing solar access to those who need it most, working closely with low income communities across the country. Grid Alternatives has also been successful in leveraging additional funds to reduce project costs and providing workforce development opportunities for disadvantaged communities, especially among people of color.
2. **PARTICIPATING IN TARGETED STATE PROGRAMS,** such as California's Multifamily Affordable Solar Housing (MASH) Program, and it's successor program, Solar on Multifamily Affordable Housing (SOMAH).

This plan will directly benefit at least 50,000 moderate and low-income households. Installations will be done through building owners at no cost to the tenants, creating significant economic benefits and reducing cost for renters. Sunrun's commitment aims to satisfy one-third of the Solar on Multifamily Affordable Housing (SOMAH) program's goal of 300 megawatts of solar on affordable housing by 2030.

Policymakers should consider additional approaches—grants or rebates, financing support, and soft cost reductions—as tools to improve access to solar and batteries in low- and moderate-income communities.[29]

For example, policymakers could consider incorporating or expanding home batteries into existing incentive programs that support solar deployment, such as SREC and energy efficiency programs. Energy efficiency programs, in particular, can represent a significant untapped resource that could support home solar and battery deployments in low-income communities.[30]

They should also explore opportunities to redirect low-income energy bill subsidies into grants that eligible customers can apply to home solar and battery systems. By creating programs where home solar and batteries are quickly deployed, costs come down and the system becomes more beneficial to everyone.

This is a self-propelling cycle that makes home solar and batteries ever-more affordable and accessible, becoming mainstream for the people who need it most. By offering affordable home solar to residents in low- and moderate-income housing, Sunrun is supporting residents in communities that often experience the most harmful effects of pollution and climate change.

Sunrun has committed to developing a minimum of 100 megawatts of solar in California over the next 10 years on affordable multi-family housing, where 80% of tenants fall below 60% of the area median income.

We Can Decarbonize Rapidly. Let's Act Now

I am optimistic about our energy and climate future, if we act now. We're at the nexus of large scale decarbonization and decentralization using cutting-edge, affordable technology.

With home solar, people have a real choice for how to power their lives—and they love it. Now, households are both producers and consumers. They are partners in our energy marketplace, not just customers.

Let's move away from cautious discussion and towards bold experimentation. If we want costs to continue to come down, let distributed resources scale. This type of innovation requires courage, creative thinking and the right incentives.

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Exhibits

EXHIBIT 1

Actual and Predicted Cost of Solar & Batteries Compared to Utility Rates

Sources: Julia Attwood, "The Cost of Doing Business: Lithium Ion Batteryn Cost Breakdown and Forecast," BNEF, March 2016

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EXHIBIT 2

Investment in Transmission Infrastructure by Major Utilities (1996-2016)

Source: eia.gov

EXHIBIT 3

Declining Wholesale Rates Disguise Cost of Capex

Source: APS Residential & APS Wholesale Data: eia.gov

EXHIBIT 4

Declining Cost of Solar Panels and Batteries By Year

Source: Past Cost of Panels & Cost of Lithium Ion Battery Data: GTM Research

EXHIBIT 5

Annual Residential Energy Storage Installations in the US

Source: Jason Finkelstein, Sean Kane and Matt Rogers, "How Residential Energy Storage Could Help Support the Power Grid," McKinsey & Company, March 2019

EXHIBIT 6

Installation of Solar Only vs. Solar & Batteries Growth By Year

Source: Wood Mackenzie Q4 Energy Storage Monitor. 2018

Wood MacKenzie U.S. Solar Market Insight, 2018

EXHIBIT 7

Residential Solar Installations Outpaced Front-of-Meter by Q2 2018

Source: Wood Mackenzie Q4 Energy Storage Monitor, 2018

EXHIBIT 8

Home Battery System Value with Grid Services Compensation

Source: Jason Finkelstein, Sean Kane and Matt Rogers, "How Residential Energy Storage Could Help Support the Power Grid," McKinsey & Company, March 2019

EXHIBIT 9

Billion-Dollar Extreme Weather Disasters in the US, 2018

Source: "Billion-Dollar Weather and Climate Disasters," NOAA National Centers for Environmental Information (NCEI), 2019 https://www.ncdc.noaa.gov/billions

EXHIBIT 10

Proposed Solution for Islanding Communities During Grid Outages

Source: Sunrun Wildfire Mitigation Report, 2019

EXHIBIT 11

Costs Over Time for Residential Solar Systems

Source: "Tracking the Sun," Lawrence Berkeley National Lab, 2018