sunrun

AFFORDABLE, CLEAN, RELIABLE ENERGY

A better system created by
the people, for the people.

The United States suffers from the highest amount of power outages in the developed world[1]. And it's getting worse. For a century, delivering electricity to homes and businesses has remained essentially unchanged. This is a disservice to Americans. Too many energy consumers today lack choice, experience unreliable service, and are increasingly concerned about the environmental and public health consequences of fossil fuels.

But there is hope.

In recent years, technology and innovation have opened up a new generation of energy resources that are affordable, reduce the need for utility spending binges on unnecessary, outdated infrastructure, and meet Americans' desire for clean and reliable power. In the future, more local power from solar and batteries will improve reliability for consumers during increasingly common extreme weather events, and make our energy system more resilient for everyone.

We are at a crossroads: We can choose a path of building a more affordable, clean, reliable energy system that meets the needs of all Americans. Or, continue down a path of centralized, fossil fuel-based electricity production, building power plants and power lines that will be redundant in 10 years, while pushing consumers to go it alone.

Let's choose the first path.

We have technologies available today that we did not have 100, or even 10 years ago. These technologies offer consumers a system that responds to their choices and requirements. The system must maximize public benefits, not utility shareholder benefits.

Because it's inefficient to have multiple companies with multiple powerlines, utilities are allowed to operate as regulated monopolies in their regions. As they build and upgrade energy infrastructure to serve their communities, utilities pass those costs to consumers with a profit margin.

This system served us well in the past because growing American businesses and households historically demanded more and more power. Utilities delivered a reliable service at a reasonable price. Today, both are in question. The utility sector is still the most polluting, generating around one-third of America's total greenhouse gas emissions.[2] Particle pollution and other power plant pollution can increase the risk of heart disease, lung cancer, and asthma attacks.[3]

Over the past decade, demand for electricity stopped increasing.[4] Yet our energy infrastructure has a voracious appetite for upgrades and maintenance as a result of aging and extreme weather. More than 70% of America's transmission lines and large power transformers are at least 25 years old.[5] This aging infrastructure is subject to increased risk of failure and will need to be replaced.[6]

Under current regulations, utilities have much to gain from rebuilding our outdated networks, because the more they build, the more money they make. Utilities are forecasted to continue an unprecedented spending binge. The Edison Electric Institute estimates that utilities need to spend as much as $2 trillion on energy infrastructure between 2010 and 2030.[7] Yet with demand for electricity remaining flat since 2010, this means more cost spread over the same amount of power, and painful monthly cost increases to everybody who pays a power bill - especially low-income households.[8] An "energy burden" review of 48 major U.S. cities finds that low-income households devote up to three times as much income to energy costs as higher-income households.[9]

The good news is that there is another way. States like California and New York are requiring utilities to work with competitive companies on cleaner, distributed energy options, and providing incentives for them to do so. Forward-looking policymakers across the country are recognizing that consumers who adopt solar make the system more affordable, clean, and reliable for everyone – even for those who don't go solar.

Let's keep giving people the freedom to create a brighter future.

Lynn Jurich
Chief Executive Officer, Sunrun

Executive Summary

This paper details the trends that are converging to develop a better energy system. A system that will radically remake our dated, economically inefficient existing energy infrastructure into a more affordable, clean, and reliable system that puts people at the center of energy production and consumption.

We shed light on the political and regulatory decisions we are making today that will determine our future, and how quickly and cost-effectively we can move to a superior, cleaner energy system. A pressing question is whether incumbent powers will allow this transition to happen swiftly and without wasting significant capital on rebuilding yesterday's centralized utility infrastructure.

After 10 years of living and breathing the home solar and battery market, witnessing rapid technology developments, engaging policymakers, watching special interest groups get nervous, understanding the energy customer, and analyzing future trends, this paper summarizes what we've learned.

Most Americans are surprised to learn that the cost of moving electricity through transmission lines, transformers, and local power lines is greater than the cost of generating the electricity itself. Many power lines are old and frail and in need of massive upgrades. That means more power outages from extreme weather events and even higher bills to upgrade infrastructure.

How can we reduce these costs and improve reliability while lowering our dependence on harmful fossil fuels? We can put the clean power where it's used: solar power on roofs and batteries in garages. Households and businesses that adopt solar and batteries save money for themselves and their communities, reduce pollution, and increase system reliability and resilience for everyone. They also benefit from the power stored in their batteries, keeping their families and employees comfortable and safe during power outages.

LET'S STOP THE WAR ON SOLAR

Utility investors lose money when they cannot build new power plants because people adopt solar. This means powerful interests are motivated to make it unnecessarily difficult and punitive for households to produce their own clean power. "In 2017 alone, in 249 places across the country, proposals were put forth to change solar policies and rates."[10] A recent report found that "a national network of utility interest groups and fossil fuel-backed think tanks has provided the funding, model legislation and political cover to discourage the growth of rooftop solar power."[11] Policies that support consumer choice and home solar are under attack across the United States.[12]

These proposals attack a clean energy resource that is overwhelmingly popular with the American public.[13] They are introduced from a place of

In 2016, utilities spent $20 million on an anti-home solar ballot initiative in Florida - one of the nation's sunniest states that has 22 of the top 25 cities most threatened by sea level rise.

fear and often with the following static logic: even though the penetration of home solar is low today, as people generate more of their own electricity from the solar panels on their roofs, utility revenues will decline, and, unless the utility can find a more efficient way to operate, the remaining utility customers will have to pay more for the powerlines to keep the system running. That would increase the incentive for the remaining customers to leave. This is known as the utility "death spiral".

This reasoning fails to consider the overwhelming benefits of local energy. Without considering benefits, the punitive measures against solar are more about the threat of competition and reduced revenues than they are about protecting consumers from high prices. Most of the research suggests that solar customers already save utilities and energy consumers more money than they cost them.[14]

We will likely invest enough dollars to rebuild our entire energy system in the coming decades. investing in a system that puts energy consumers at the center, with the clean, local resources available today, can save us from investing in yesterday's redundant technology. It will also build the foundation for a more efficient, resilient system.

Most dangerously, the constant and premature changes to the consumer's solar value proposition removes the market stability required for innovation and the novel solutions technology will inevitably bring.

Utilities cannot be relied upon to drive this consumer-centered clean energy future. Even if they wanted to, utility investors are risk-averse and unlikely to support a program that could cause a short-term loss in revenue and dividends. Case in point: In 2016, utilities spent $20 million on an anti-home solar ballot initiative in Florida - one of the nation's sunniest states that has 22 of the top 25 cities most threatened by sea level rise.[15]

LET THE MARKET WORK

Let's stop this war on affordable, clean, reliable energy and create a market for innovation. These resources should be viewed as an opportunity. We should welcome and encourage power created by the people, for the people and give the market time to develop. Americans want clean power and backup power during outages, and they want the freedom to control their monthly energy costs. Let's incentivize it to happen quickly, allow competition to lower costs for the whole system, and accelerate the adoption of a better system.

Fortunately, the building blocks are in place. There are many positive case studies to share and some states are already drawing the roadmap for the future. The faster we do it, the more local jobs we create, and the faster we can get to a clean energy system. We'll avoid tearing up our land with polluting fossil fueled power plants and power lines that will become obsolete in the near future.

SOLAR IS AN ECONOMIC ENGINE

As of 2017, more than 250,000 Americans are working in solar, a 168% increase since 2010.[16] More than half of all solar workers are installers. According to data from the U.S. Department of Labor's Bureau of Labor Statistics (BLS), the solar installer will be the fastest-growing job in America over the next decade.[17] In just the last five years, solar employment grew nine times faster than the overall U.S. economy, and one in every 100 new jobs was a solar job.[18] There are now more than 9,000 solar companies employing Americans in every state.[19]

Domestic solar companies are providing what our country needs most: well-paying jobs that can't be exported or automated. Solar industry wages remain competitive with similar industries and above the national average. The majority of solar jobs don't require a bachelor's degree.[20] There's a huge opportunity for people from under-resourced or low-income communities to obtain a job that empowers them to have a career.[21] For many, solar provides a second chance at a prosperous future. For example, GRID Alternatives is a not-for-profit national leader in making clean, affordable solar power and solar jobs accessible to low-income communities and communities of color.

Veterans make up 9% of solar workers, which is 2% more than the overall U.S. workforce.[22] According to Jeff Sinclair, former U.S. Army combat veteran, and current Senior Training Manager for Sunrun, "So many of our nation's veterans are succeeding in solar because the industry values the traits servicemen and servicewomen learn in the military – teamwork, leadership, and dedication."

Home solar keeps more money in local economies. About one-quarter of home solar project costs - for customer acquisition, installation labor, permitting and interconnection, and permit fees - are spent locally.[23] By comparison, large commercial projects spend about 6% of their costs locally.[24]

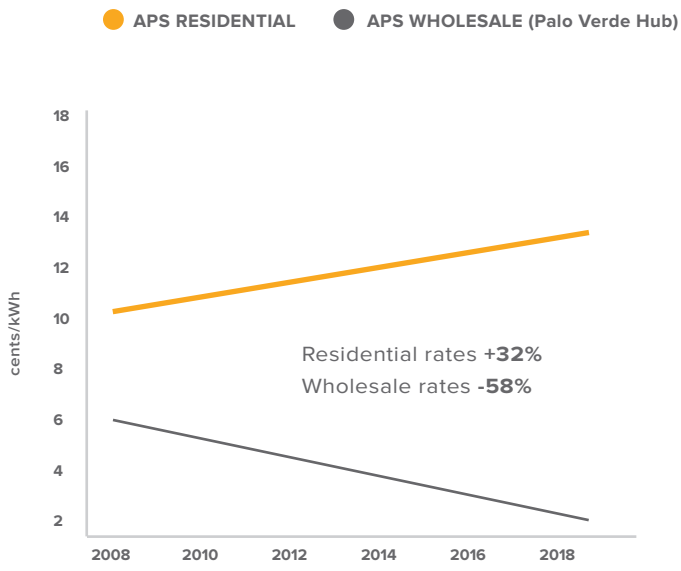
We have incredible potential before us. Solar energy generated just 2% of U.S. electricity last year;[25] home solar alone could meet 40% of total U.S. electricity demand.[26] As we are witnessing in California and New York today, regulators are creating mechanisms to utilize homes and businesses with solar and batteries as alternatives to building new fossil fuel power plants, transmission, and distribution infrastructure.[27] For example, California's grid operator has a new plan that saves 2.6 billion dollars in future costs by directing utilities to tap into home solar and efficiency resources, rather than building transmission projects.[28] When the sun is shining, homes and businesses can store extra power in their batteries and send it to the community when and where it is most needed. Households that adopt solar make the system more affordable for everyone – even for those that don't go solar.

The cost of this future is significantly lower than the alternative. This future will meet the values and expectations of Americans, and accelerate the retirement of harmful and polluting power plants to the great benefit of future generations.

Home solar alone could meet 40% of total U.S. electricity demand. As we are witnessing in California and New York today, regulators are creating mechanisms to utilize homes and businesses with solar and batteries as alternatives to building new fossil fuel power plants, transmission, and distribution infrastructure. For example, California's grid operator has a new plan that saves 2.6 billion dollars in future costs by directing utilities to tap into home solar and efficiency resources, rather than building transmission projects.

COST ADVANTAGES FOR RESOURCES THAT PUT THE CONSUMER AT THE CENTER

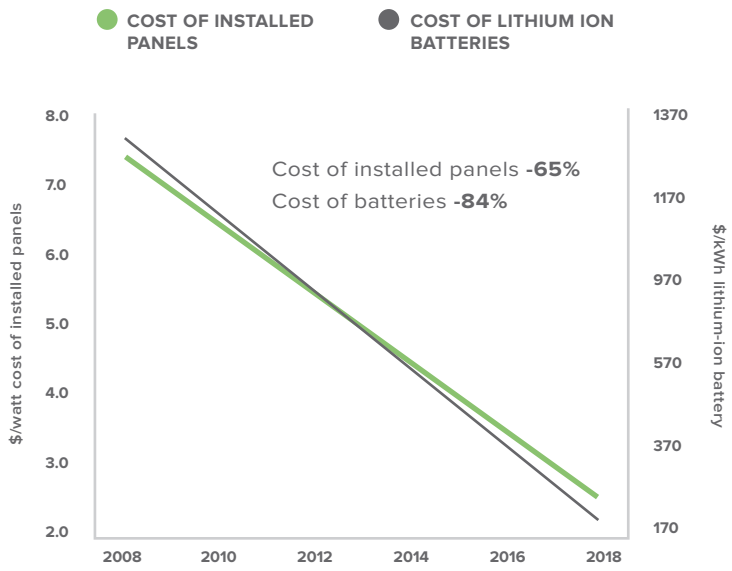
DECLINING WHOLESALE RATES DISGUISE COST OF CAPEX



With the expected capex trends and stagnant demand, even if wholesale prices fall to zero, retail rates will accelerate over the next ten years.

Aging infrastructure and extreme weather are likely to increase the frequency of outages.

COST OF SOLAR MODULES AND BATTERIES HAVE DECLINED SIGNIFICANTLY



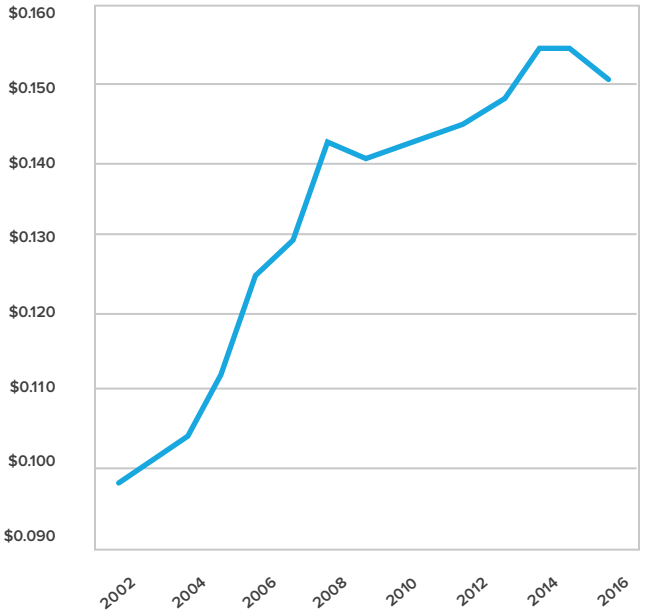
Market researchers forecast the cost of installed solar panels will decline 61% while the cost of batteries will decline 49% over the next 10 years.

Exhibit 1

UTILITIES ARE NOT ADDRESSING CUSTOMER NEEDS

EXPENSIVE

The cost of electricity has increased 3.1% on average per year for the last 14 years.

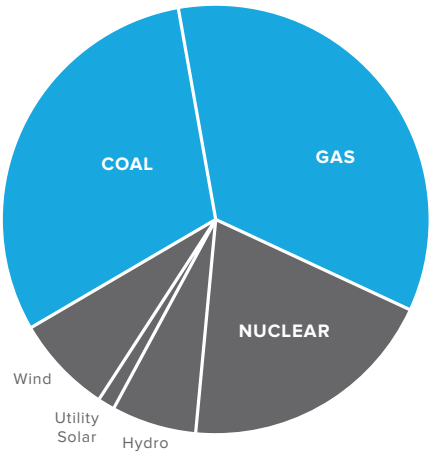


POLLUTING

U.S. ANNUAL EMISSIONS

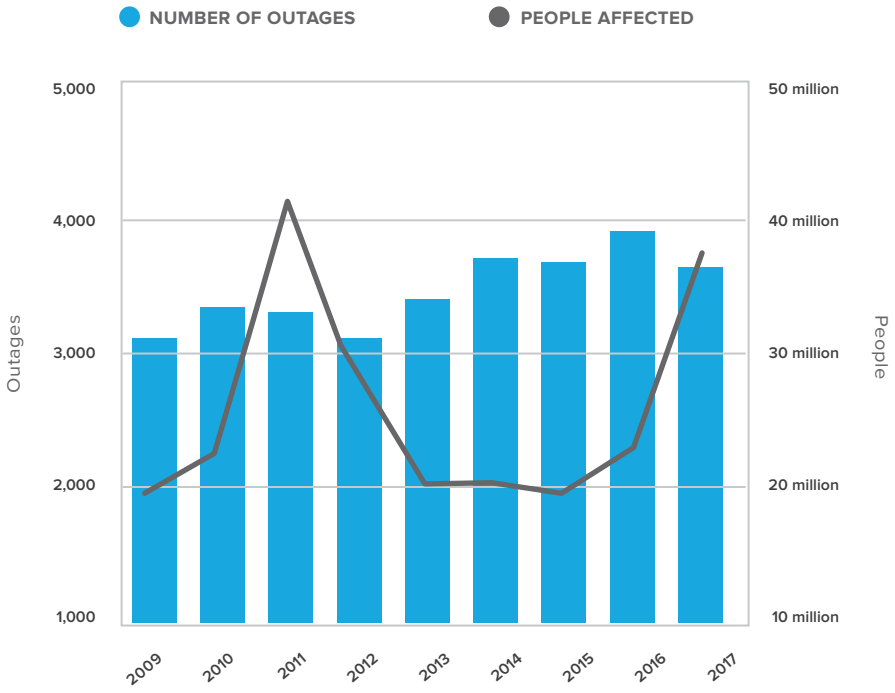
Carbon Dioxide	Sulfur Dioxide	Nitrogen Oxide
1.9 Billon Tons	1.8 Billion Tons	1.6 Million Tons

GENERATION SOURCES



UNRELIABLE

In 2017 there were 3,526 outages affecting 36 million people across all 50 states. Of the outages, 86 major disturbances resulted in customers collectively experiencing over 1 billion hours without power.



CONSUMER-CENTERED RESOURCES DELIVER SUPERIOR VALUE TODAY

Exhibit 2

The History of Home Solar

The solar-as-a-service model democratizes solar.

When we started Sunrun in 2007, we had a vision that solar was a breakthrough technology precisely because it could be installed on rooftops. It works on a small scale and has large impact. Just like centralized mainframe computers gave way to personal computers, we thought power plants would give way to home solar. We believed solar would completely change an antiquated system from one with big polluting power plants and bulky power lines to one that is local, responsive and powered directly for and by consumers. So while most of the emerging renewable energy industry was focusing on using solar within the existing system - big solar power plants out in the desert - we decided that if we could enable households to use their own real estate to install solar and produce it where it is used, we would save them money and build a more efficient system overall.

In 2007, the cost of solar cells - the most expensive component of panels - had already declined more than 90% since the 1970s.[29] We ran the math and saw that there was a decent payback for people to invest in solar, but most people don't want to spend the upfront cost or manage the complexity of owning and maintaining a system. So, let's provide solar as a service!

We launched our solar-as-a-service business model that year: Sunrun pays to install the system, owns and takes care of it, and simply sells the electricity the system produces to the household at a discount. The solar-as-a-service model democratizes solar. We started in California because there was a solar rebate, a lot of sun, and high power prices. We focused relentlessly on reducing our costs, improving our customers' experience, and making our offer attractive to consumers. With success, we believed we could be competitive in markets where there was less sun and lower power prices, gradually creating self-sustaining markets without subsidies.

Customer demand and cost reductions outpaced our most optimistic predictions. Today, Sunrun has more than 180,000 customers in 23 states, contributing to the 1.5 million American families that have adopted home solar. Sunrun is committed to providing solar access to low-income customers through our partnership with GRID Alternatives. Sunrun's solar families have already saved $150 million on electricity bills and the majority of them didn't have to make any upfront investment. At the same time, they are investing in their communities by creating local jobs, clean air and a healthier environment. We are currently installing a solar system somewhere in the country once every three minutes,[30] and this pace is accelerating. Sunrun is building a consumer-powered energy system. A system where consumers choose the energy they consume and benefit from what they produce.

While cost declines and consumer interest in solar have far surpassed our expectations, improvements in battery storage are beyond our wildest dreams. In early markets, it is now affordable for consumers to install a battery at home, both to protect their family during power outages and also to sell that extra power to their communities when it is most expensive - and needed. This saves everyone money by reducing demand for expensive peak power during the time of day when people consume the most electricity. Outside the scope of this paper, there are countless exciting consumer-centered resources, including smart thermostats, programmable appliances that use electricity at the most cost-effective times, and electric vehicles that can be used to store and provide energy.

Many of these innovations threaten the incumbent utilities' profit potential, yet empower people to maximize the value of their home solar systems for everyone's benefit.

New Orleans is planning to build a new $210 million 128 MW natural gas peaker plant to make the local energy system more reliable and resilient. Many opposed the plant because the utility is failing to look to clean energy as an option to meet the city's needs.

Many peaking natural gas plants run less than 10% of the year. If we assume that this plant will run 5% of the time, or for a little more than 430 hours annually, it will cost customers 31 cents per kilowatt hour. An average home battery today with a 10 year lifespan can meet peak energy demand for half the cost.

As we are witnessing in other parts of the globe, the resources from thousands of homes and businesses with solar panels and a battery can be pooled to replace a fossil fuel power plant -- and do so more affordably.

Understanding The Cost & Delivery of Electricity

The price of electricity is made up of both the cost to generate power and deliver it to consumers. Because users' needs ebb and flow throughout each day, the system is built to meet peak electricity needs. It's like designing a freeway for congestion: building 100 lanes, but only using a fraction of them most of the time. The system operates with highly variable costs and utilization at different times of day and at different locations, depending on congestion. The 100 lanes are almost never fully utilized, leading to major inefficiencies. The electric grid is the largest physical machine in the world, but it's intensely local.

Much of the system's cost comes from the need to deliver power at peak times and in congested places. Natural gas plants typically play this "peaker" role today. In fact, nearly one third of natural gas plants run less than 10% of the year and generate only 3% of total U.S. electricity.[31] In addition, the annual cost of congestion in our energy system can exceed $1 billion in a single region.[32] The existing business model encourages utilities to keep building infrastructure to meet these peak needs and to pass that cost to their customers. Richard Kauffman, the New York Chairman of Energy and Finance, notes that one of the core problems in the electricity industry is this low utilization. Mr. Kauffman explains that "utilities in New York operate with a 57 percent capacity utilization rate, compared with 71 percent for all U.S. manufacturing and 79 percent for auto manufacturing."[33] These numbers are expected to worsen as utilities continue to spend on overdue maintenance and unnecessary new infrastructure.

In South Carolina, regulators allowed a utility to start building two nuclear reactors that were never finished. Nonetheless, customers were stuck with the cost and are now paying on average an additional $27 per month for power plants that are not even running.[34] The utility holding company paid investors more than half a billion dollars with the money collected from customers.[35] In most states, consumers have no control over what type of power they receive, what they have to pay, or their utility's investment decisions. It's no wonder that some people have no loyalty to their utility and are looking for better options.

The Utility Spending Binge

Utility expenditures on transmission lines also went up five-fold over the last two decades

Much is made of reductions in the cost to generate power. From 2005 to 2015, the price of a key electricity fuel source - natural gas - fell by 60%.[37] But the price of retail electricity during the same decade actually rose by 34%.[38] Consumers paid higher and higher bills as the price of a key fuel plummeted. Why is this? It's because we have had years of neglecting maintenance and are just starting to catch up. Since 2010, utilities increased their annual capital expenditure by more than 50%,[39] while electricity sales per household declined 9% over the same period.[40] Utility expenditures on transmission lines also went up five-fold over the last two decades.[41]

SOUTH CAROLINA RESIDENTIAL VS WHOLESALE ENERGY PRICES

VC SUMMER NUCLEAR UNITS 2 & 3
$11 billion: Original projected cost of the two reactors

$20 billion: Minimum projected cost, due to delays and cost overruns, when SCE&G and Santee Cooper decided to abandon the project

$9 billion: What SCE&G and Santee Cooper have spent already on the halfway completed project
Units 2 & 3 = 2,200 MW (1,100MW each), which will never produce energy

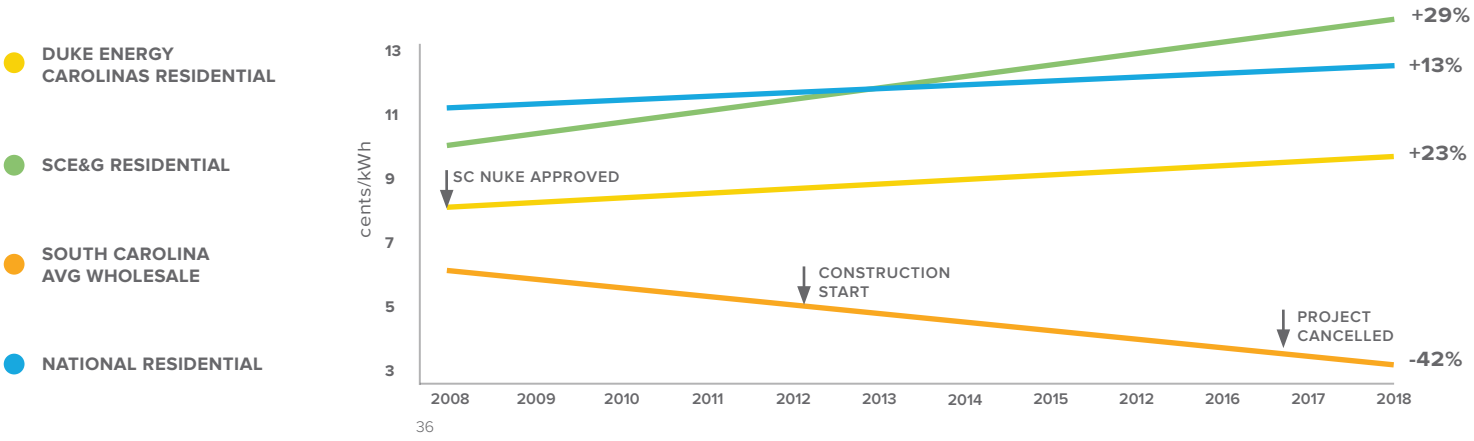


Exhibit 3

THE EXPLOSION IN TRANSMISSION INVESTMENT OVER THE PAST DECADE

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

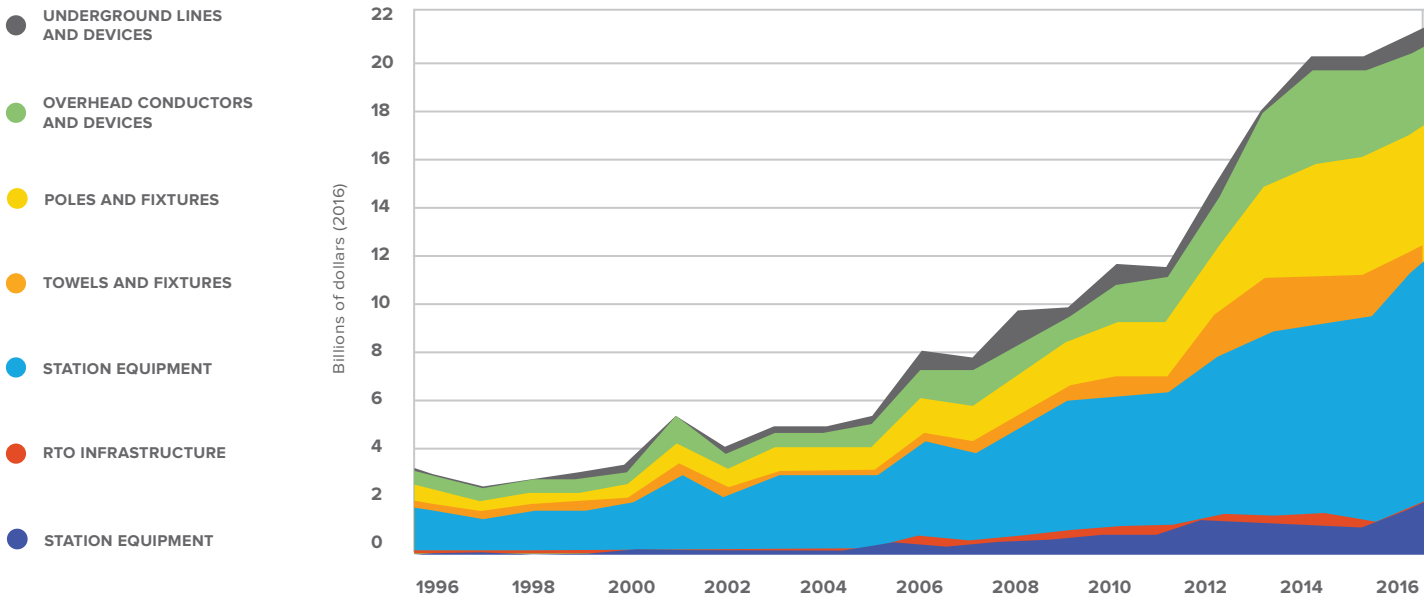


Exhibit 4

For example, in the past 10 years in Arizona, the cost to make power - wholesale - has declined 62%, while the cost to households has increased 41%. That means that the real inflation in energy prices is disguised.

Yet this recent spending binge is only scratching the surface of our maintenance and repair needs. Given extreme weather and the need to make the power lines stronger, a $2 trillion spend is expected by 2030.[43] This cost cannot be offset by ever cheaper natural gas prices, and the price of inflation to consumers will get even higher since there is no increasing demand. Even high penetration of electric vehicles is only projected to add 5% of total global power demand by 2040, according to BNEF estimates.[44] In 2001, the United States experienced 13 electric emergencies and disturbances, many resulting in outages. This number has risen to 149 electric emergencies in 2017.[45] The price of electricity continues to rise, yet the service worsens.

ARIZONA RESIDENTIAL VS WHOLESALE ENERGY PRICES

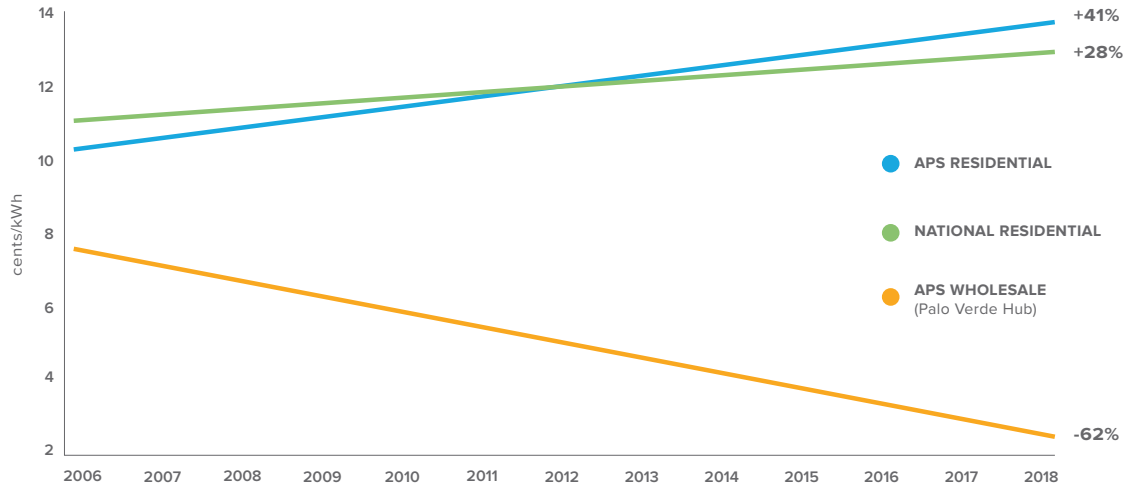


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Exhibit 5

These powerful forces at work – rising utility costs and more affordable solar and batteries – will eventually lead people to produce and consume the majority of their power from solar and battery storage.

IMPROVING COSTS IN HOME SOLAR AND BATTERIES

While the price of retail electricity continues to rise, the cost of both home solar and battery storage has come down considerably. From 2010 to 2015, the price to install a residential solar system fell by more than 50%.[46]

These powerful forces at work – rising utility costs and more affordable solar and batteries – will eventually lead people to produce and consume the majority of their power from solar and battery storage. This outcome is good news for consumers who can use solar and batteries to insulate themselves from rising utility rates and get clean power, but bad news for utility investors who refuse to acknowledge these forces and continue the spending binge on yesterday's technologies.

The primary way people switch to solar today is to remain connected to their utility. If families produce more power than they need during the day, the extra power flows to their neighbors. The family earns a credit for this extra power, which they can use at night when the sun isn't shining. Thirty-eight states and Washington, D.C. have enacted this policy, which is similar to roll-over minutes on cell phones.[47] It's called "net metering" and ensures solar households receive the same value that their neighbors would pay for electricity from the utility, the "retail rate".

Net metering has proven to be a simple, effective system to make it possible for Americans to go solar, particularly families from middle and low-income communities. It has also come under attack over the last few years, and many places are considering its abrupt end, and new charges for solar customers. But net metering is simple and it works. Keeping it intact can provide consistent access to affordable home solar and batteries across the country -- and to keep the wheels of innovation turning.

Historically, going "off-grid" by completely cutting ties with the utility was prohibitively expensive. The solar system needed to be much bigger and families needed large and expensive batteries to store the power for nighttime use. By integrating residential solar and batteries into the system, utilities and neighbors benefit from the extra power and additional revenue as the consumer stays connected to the grid.

However, in the not-so-distant future, the cost of batteries will be so low that Rocky Mountain Institute (RMI) indicates that large numbers of consumers will find it economic to defect from their utility and install these solar and battery systems.[48] Furthermore, with the solar-as-a-service business model Sunrun created, households benefit from a third party maintaining their solar and battery systems, and production guarantee. No maintenance headaches or upfront investment -- just affordable, clean, reliable power.

All members of society will be better served if solar households remain connected to our broader energy system. It's more efficient for the household and the system. However, if it becomes too punitive and expensive to stay connected, people will have more reason to defect from the energy grid altogether. An ensuing home solar drama is playing out across the country. Decisions made will encourage two very different outcomes.

Two Paths

Two Potential Futures

Path One

An affordable, clean, reliable system

On the first path, we design the system to incorporate the full value of consumer-centered resources and technologies, and incentivize entrepreneurs to create solutions we haven't yet imagined. These assets stay connected to the utility system and the two work together to produce a more reliable, resilient, low carbon energy system. Policymakers intentionally maximize public economic benefit, as opposed to utility shareholder benefit.

One of the key ways they do this is to match supply and demand more precisely. In most cases, home solar produces power during peak times - the time when we used to need the 100-lane freeway.

The home battery gives the system even more precision. Power can remain in the battery and discharge within minutes to smooth power demand spikes on the whole system. A study by RMI shows that under dynamic rates available today, customers can use enabling technologies like batteries to reduce their bills 10-40%.[49] If policymakers worked to expand access to these rates, thereby better matching energy supply with energy demand, they could actually cut energy system costs by 10-15%.[50]

The result is a cleaner, more responsive system that operates with much higher efficiency and fewer polluting resources.

The California Public Utilities Commission has authorized a number of pilots to examine how decentralized resources like home solar and batteries can replace traditional power lines. Two of the three California utilities issued solicitations to procure non-wire alternatives to replace traditional equipment. Utilities can get a return on these contracts as an added incentive. We are still waiting for the results of these efforts to see if the utilities follow through on these pilots.

Green Mountain Power provides another snapshot of what utilities could look like in the future. Because competitive, non-monopoly providers are often better positioned to provide the solutions that people want, Green Mountain Power is running an innovative "Bring Your Own Device" pilot program. This allows anyone with an eligible technology, like a home battery, to provide energy services that benefit all Vermonters - and receive bill credits in return. It also enables competitive solar companies to batch together a number of homes to provide the service - all without disrupting people's comfort. Not by accident, Green Mountain Power has earned a 94% satisfaction rating from its customers.[51] As CEO Mary Powell[52] put it, "We needed to become the Ben and Jerry's of the utility world."[53]

Path Two

Building infrastructure we don't need

The second path discourages the integration of home solar and batteries onto the system. We continue with the existing business model of more centralized power plants and transmission lines. More places find themselves in situations like South Carolina, with abandoned nuclear plants paid for by everyone's bills.

Abruptly moving away from net metering and ignoring the potential of consumer-centered and consumer-powered technologies leads us down this path.

We tear up more of the earth, build expensive, unhealthy, unsightly infrastructure, and prices continue to rise. In the short term, batteries and home solar in most places are still too costly to operate in isolation, or "off-grid." Consumers will stay with their utility and have little choice. Until one day, when it all changes.

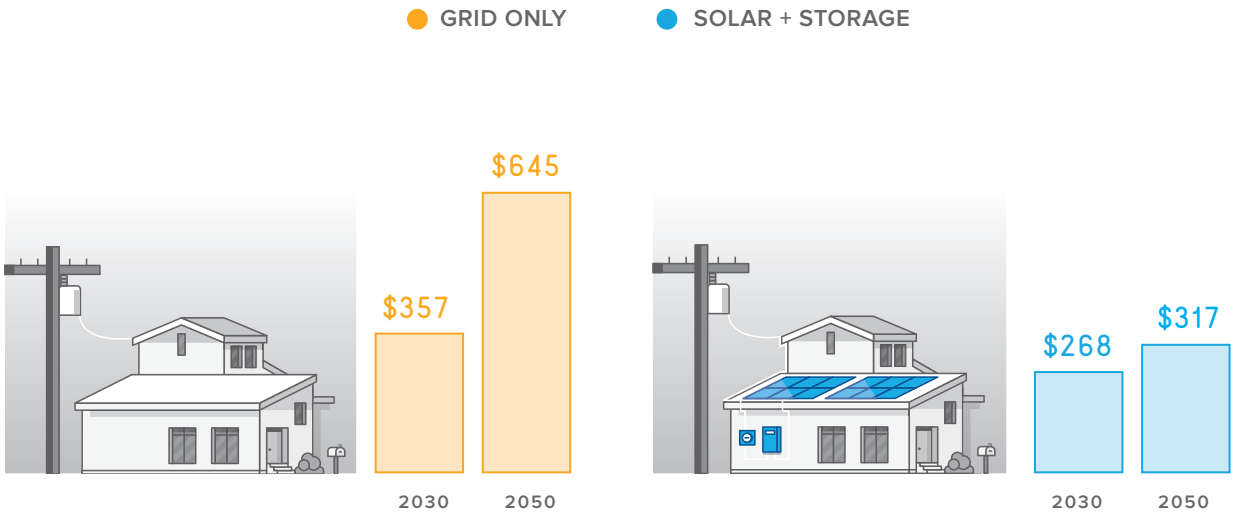
The tipping point will happen when it's cheap enough for businesses and consumers to leave the system and truly defect. Meanwhile, the unabated utility spending binge means we build 30 to 50-year assets we soon won't need. Further complicating matters, people will build the larger "off grid" systems that their neighbors can't benefit from. We'll have two overbuilt and underutilized resources. Everyone loses.

The tipping point can happen dramatically, and in numbers that may be surprising. For example, if innovators realize the radical price declines in home solar and batteries, in just six years, nearly half of all residential customers in mid-Atlantic states could find it less costly to go off-grid than retain their traditional utility service.[54] Even if we don't fully realize all of these price declines but merely continue the steady price declines that have fueled the growth of the home solar industry over the last decade, the majority of residential customers will find it economical to "partially" defect from the grid with home solar-plus-battery systems by 2030.[55] In geographies like the Northeast, this could represent as many as 10 million homes and as much as 50% of the utilities' total residential sales.[56] As McKinsey notes, "Utilities must start now to understand how low-cost storage is changing the future. In effect, utilities need to disrupt themselves—or others will do it for them."[57]

Both paths are playing out across the country. The first is predominantly favored by consumers, voters and policymakers. Unfortunately, there are hundreds of fear-based and, sometimes, well-intentioned proposed reductions to home solar compensation that could push us down the second path.

COST OF UTILITY POWER VS SOLAR + BATTERY IN WESTCHESTER COUNTY

AVERAGE MONTHLY ELECTRICITY BILL FOR A SAMPLE RESIDENTIAL CUSTOMER FROM WESTCHESTER COUNTY, NY



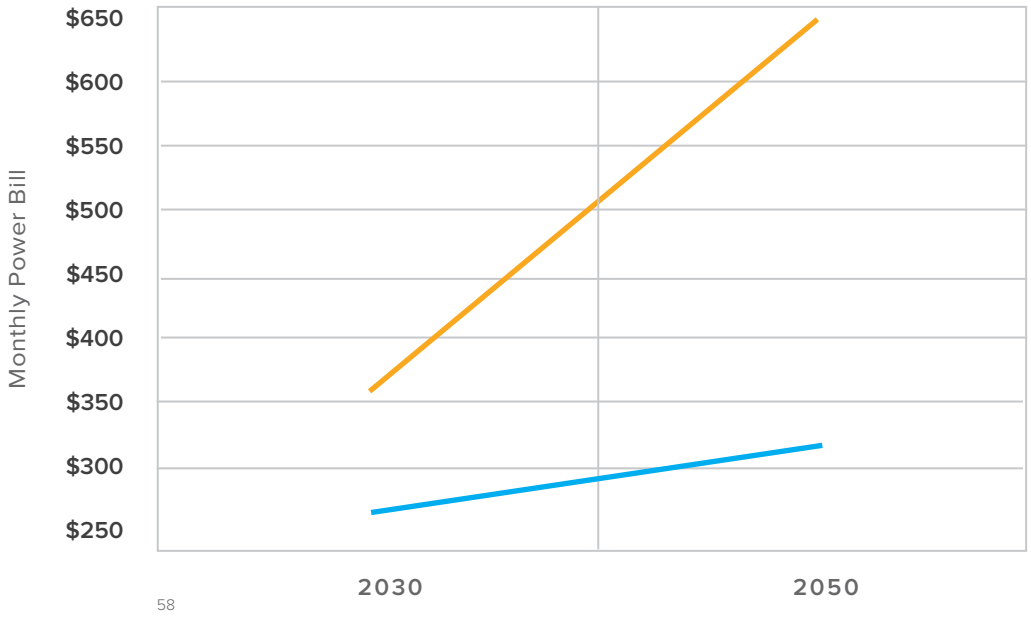


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Exhibit 6

War on the People's Energy

Electric utilities spend more than $100 million on lobbying activities each year.

Some utilities and their investors fear competition from home solar because it threatens their century-old business model: build more to profit more.

In 2012, the utility trade association Edison Electric Institute (EEI) issued a report titled "Disruptive Challenges" that laid out a grave new threat to the traditional utility business model: rooftop solar panels. The report explains that consumer-centered home solar is a "disruption" to utilities' long-standing business model. The report compared the utility to the U.S. Postal Service and home solar companies to FedEx. Aren't we better off having FedEx as an option?

Since EEI's report was issued, many utilities have sought to slow the growth of home solar by seeking to end net metering policies, or introducing new charges to make it punitive, or even just confusing for customers to switch to solar. This primarily occurs by changing rate structures for families who go solar. Across the county, regulatory commissions meet to determine rates. Most often this is done without much public participation, or even visibility.

For example, in December 2014, Arizona's second-largest utility, Salt River Project, decided to add charges of about $50 per month for new solar consumers. This ended a thriving, competitive market overnight. Applications for home solar plummeted 96%, and it was no longer cost-effective to install solar in one of the sunniest places in the country. A Salt River Project director shared her opinion that rooftop solar advocates were "the enemy." Meanwhile, the power provider spent roughly $1.7 million on its advertising campaign promoting exorbitantly high fees on solar customers. An email from the director to a public relations consultant directed the firm to: "Hold the fort down … feeling restless while the enemy is preparing for attack!"[59]

Beyond Arizona, in 2017, there were 249 proposed solar policy and rate changes.[60]

EEI supported NV Energy's initial request to eliminate net metering in Nevada. Many utility customers unknowingly subsidize EEI's anti-consumer political activities by simply paying their utility bills. This is because a number of utilities are able to pass through EEI membership expenses to their customers, even if EEI is lobbying against the customers' interests in choosing solar. Electric utilities spend more than $100 million on lobbying activities each year.[63]

Not all changes are as dramatic as those enacted in Arizona or Nevada, but even the rate changes that are well-intentioned are often premature, cause consumer confusion, and create market instability that discourages innovation. This steers us closer to "Path Two."

A Rocky Mountain Institute study demonstrates customer-sited storage provides unique benefits to the grid that are not provided by centralized, grid-connected storage.[61] Customer-sited storage can provide direct consumer services like backup power, utility services like distribution and transmission deferral, and services to our energy system like voltage support and frequency regulation. These backup power benefits came in handy during Hurricane Irma in September 2017. Solar-paired battery systems kept the lights on in 115 schools, which sheltered thousands of Florida residents while 6.7 million utility customers had no electricity. Centralized battery storage provides neither direct consumer benefits, nor local voltage support or other services to the distribution system.

There are locational benefits of locally-paired solar and battery resources as well. For example, there are specific geographical situations where building transmission lines or substations is near-impossible. For California's beaches and rugged coastal terrain, installing resources on site utilizing our built environment is both practical and preferrable.

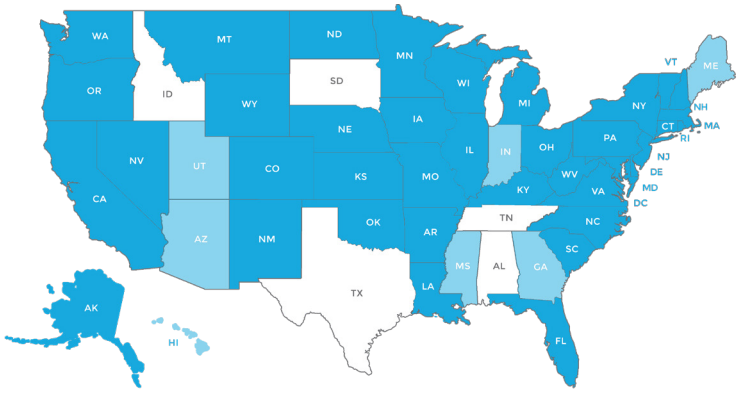
THE REAL COST SHIFT: FROM UTILITY SHAREHOLDERS TO CONSUMERS.

The most common argument against home solar and net metering asserts that solar customers are "not paying their fair share." They raise concerns that people who don't adopt solar are now left with higher electric bills to cover the burden, since those with solar are buying less power but are still attached to the system, using it to export power and buy power at night. This is referred to as a "cost shift." It is a red herring. It is undeniably intuitive and therefore a convenient and seductive redirection. Yet it is also undeniably fair that solar customers should be able to consume the energy they produce without a penalty, and should receive fair compensation for the energy they send to their neighbors and the larger energy system.

The majority of research suggests that solar customers save utilities at least as much money as they cost them.[64] This is because home solar reduces expensive peak demand for energy and moves power generation to existing rooftops. It, in turn, makes power lines last longer and avoids the minimum 5% of power that is completely lost in transport from power plants.[65] Moreover, a study by the U.S. Department of Energy estimates that, by 2030, the cost increase to customers due to the ongoing utility spending binge is likely to increase everyone's energy prices roughly twenty times more than solar net metering.[66] This suggests utilities' priorities are about reducing competition and protecting revenue, rather than protecting consumers from high rates.

The red herring is about fear of competition.

Net metering is a well-established, durable policy which allows excess power generation to be credited at retail energy rates as it is supplied to the grid and consumed by neighbors.

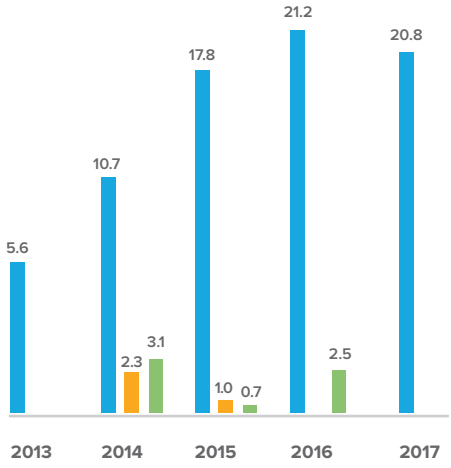


State-developed mandatory rules for certain utilities

Statewide distributed generation compensation rules other than net metering

No statewide mandatory rules, but some utilities voluntarily offer net metering

HOUSEHOLDS IN STATES WITH NEM POLICY ACTIONS
(in millions)



NEM SUSTAINED OR EXPANDED

NEM SETBACKS (ultimately reversed)

NEM SETBACKS (not ultimately reversed)

67

Exhibit 7

THE PERILS OF DUELING "COST-BENEFIT" STUDIES.

When regulatory commissions meet to discuss whether to move away from net metering, they often embark on studies to investigate and quantify the costs and benefits of net metered home solar. It's the classic economist solution and, again, has some intuitive appeal. But this is difficult to execute in practice and can come with a high cost of deterring innovation. And more importantly, many of these studies ignore the potential benefits of consumer-centric resources.

The vast majority of independent studies show that net metered home solar is an economic benefit to our entire energy system.[68] When analyses also consider job creation, meeting the values of consumers, and public health concerns, the benefits of home solar are overwhelming. But if you narrow the scope, some studies draw the opposite conclusion. After years of back and forth, it's clear that these studies are time-consuming, resource-intensive, and can be misused. They often favor utilities, which have more resources and political clout. Unlike competitive solar companies, utilities can pass regulatory and legal costs onto their customers when advocating against net metering.

Nevada is a great example of the dangers of using "cost-benefit" studies as a solution. The study that was used to justify eliminating net metering in 2015 failed to take into account the majority of benefits home solar provides because these benefits were claimed to be too difficult to quantify. The study contained sufficient data on only two of eleven variables to determine the value solar net metered customers pass onto other customers. The Commission specifically rejected many future benefits of home solar as being unquantifiable, despite forecasts showing that home solar avoids the need for more power lines and power to meet peak energy demand.[69]

The Nevada Commission ultimately used the study and their own methodology to abruptly end net metering. Nearly a year later, when Chairman Joe Reynolds was appointed to lead the Public Utilities Commission of Nevada (PUCN), he said, "how is monetary value to be placed on the prevention of climate change? Clean air? Encouraging job growth? Grid diversity? Energy choice and independence? Building a 'New Nevada' for our children? Commissioners of the PUCN could assert their personal judgments into these questions and very-likely arrive at a monetary valuation for [net metering] - but to do so may require subjectivity beyond the PUCN's jurisdiction - and these may be decisions best left to the policy makers of Nevada to at least provide more guidance on where that value lies."[70]

The following legislative session, policymakers recognized the enormous demand for and values of home solar and batteries, and restored net metering. Jobs came back to the state, but Nevadans first had to suffer layoffs and a year and a half of lost economic development.

Nevada illustrates the destructiveness of drastic changes to net metering. Intense consumer desire for clean energy options and the loss of thousands of solar jobs forced lawmakers to restore net metering within 18 months after state regulators eliminated it. A complete U-turn.

Throughout 2015, Las Vegas was Sunrun's largest branch office, installing more home solar than anywhere else in the country. But then the rules changed. A narrow study, used as justification for eliminating net metering, failed to take into account the vast majority of benefits home solar provides because these benefits were difficult to quantify.

Besides the utility NV Energy, which provided the data for the study, every other group in the case urged the Nevada Commission to reject the study based on flawed methodology.[62] The Nevada Commission ultimately used the flawed study and their own methodology to end net metering abruptly, finding a "cost shift" from solar households to others.

When half a dozen solar companies were forced to leave the state after the ruling, the utility faced less competition for customers. As Larry Cohen, Las Vegas Branch Operations Manager, says, "My colleagues excelled so well at what they did, they made the utility scared of us." Larry says January 6, 2016 was the worst day of his life. "To lay off coworkers who became friends and family is a day I'll never forget. It was heartbreaking. [We] took a whole generation of kids and gave them a career."

Fast forward to June 2017, when lawmakers nearly unanimously voted to restore net metering. Cohen remained at Sunrun the previous year, traveling from South Carolina to Denver to Baltimore to Phoenix, teaching other managers what he learned from running the Las Vegas branch office. When Larry got the opportunity to re-hire people for the Las Vegas branch, he says, "People far and away jumped at the opportunity to come back to work in solar."

Reacting to voters' demands, legislators also enshrined in the 2017 law a "Renewable Energy Bill of Rights" - protecting customers' choice to generate home solar and use batteries. The lesson from Nevada is that choice and access to clean energy are what consumers want, and they agree that the independence offered by home solar makes it a smart way to power our neighborhoods. Policymakers shouldn't take this away by abruptly throwing out net metering.

Enable Innovation & Affordability

Putting Consumers at the Center of Energy Production and Consumption

FOUR RECOMMENDATIONS TO ACCELERATE "PATH ONE"

We can accelerate more affordable, clean, reliable energy.

1 2 3 4

1 Let the market work to deliver innovation and affordability.

Open markets drive competition. Competition drives innovation and affordability.

Change and consumer choice is unlikely to come from regulated monopoly utilities alone. Utility investors are inherently risk-averse and make money through a rate of return on building expensive infrastructure. We have seen how that spending can run amuck to the detriment of consumers, such as with South Carolinians facing an extra $27 on their monthly bills for nuclear plants that will never run. This is particularly detrimental for low-income families, for whom every dollar counts.

Under traditional rate regulation constructs, utilities cannot be relied upon to give consumers options to control and create their own energy. Case in point: in 2015, Georgia Power launched a solar installation business. A year in, after receiving roughly 10,000 inquiries through its online platform, the utility's unregulated business had installed only five rooftop solar systems.[71] Over the past decade, Sunrun has served more than 180,000 customers.

The utilities have an important role to play in managing and maintaining the electricity network. But the answer does not require utilities to own home solar and batteries; rather it's to provide a platform for competitive solutions that empower customers to choose clean home energy options. Where utilities seek to directly engage with home solar and batteries, innovators like Sunrun can partner with them to ensure success in scaling up their deployment, while seamlessly connecting these clean energy resources to utility programs once installed.

For example, the New York Public Service Commission (PSC) is opening the gates to "Path One" for New York's utilities through its Reforming Energy Vision proceedings and orders. In a recent utility settlement, the PSC instructed a utility to partner with competitive companies. The goal is to develop mechanisms for shared savings and benefits, such as clean alternatives to traditional power lines.[72]

In approving Niagara Mohawk's settlement order, New York sought to "lower the costs of and accelerate the deployment at scale of solutions that create the most economic value for both consumers and for the State's energy system, drawing on innovation and investment from all sectors." The PSC recognized that utilities have "untapped potential to work with innovative third parties to develop alternative solutions" … "at lower ratepayer expense, at a faster rate, or both." Most importantly, the PSC paved a path forward for business model alternatives that yield "economics which can be shared among customers, the innovative provider, and the Company."

Competitive companies are ready to establish partnerships to make our energy system more efficient. To create a truly affordable, clean, reliable system, policymakers must allow the free market to work by ensuring utilities do not block competitive solutions - and better yet, create incentives to embrace them.

2 Maintain fair compensation with simple, stable rates to deliver affordable energy.

Competitive solar providers need stability to encourage innovation and continue to drive down costs. Consumers need simplicity to go solar. Policymakers should maintain consumer-friendly, pro-solar policies like net metering. This approach will allow consumer-powered home solar to provide more benefits to our entire energy system over time. Research confirms that for a city or community looking to maximize the economic value of solar, smaller is best.[73] Thus, there's a strong case for maintaining policies that allow households to be part of the solution.

Policymakers need to keep consumer protection front-of-mind. If consumers can't understand complicated new rates and respond to them appropriately, their financial well-being is jeopardized. This is particularly true with confusing rate structures like demand charges, which are based on the single period during a month when customers use the most energy. As an AARP Arizona Director wrote, "If approved by the Corporation Commission, demand charges would be difficult for most consumers to understand. Consumers often don't know when their household is experiencing its maximum electricity usage. This makes it nearly impossible for ratepayers to keep their electric bill as low as possible."[74]

Though less dramatic in other states, dozens of regulators and lawmakers have gone through the time- and resource-intensive debates about whether to maintain net metering, only to find that the policy works.

LONGER-TERM, TRANSITION TO TIME-VARYING RATES.

Net metering, particularly at low penetration levels, provides significant benefits to our energy system, including lowering peak demand in most states. As solar penetration dramatically increases, there can be some system cost adjustments to ameliorate. We should incentivize home solar production when the system most needs it.

NET METERING RATE STRUCTURES ARE STRAIGHTFORWARD AND STILL MAKE THE MOST SENSE FOR THE VAST MAJORITY OF STATES.

Yet utilities are spending tens-of-millions of dollars to do away with a successful policy that best provides home solar and battery storage access for their customers. For example, in Florida, utilities spent $20 million to block the solar service business model pioneered by Sunrun.[75] And fighting net metering isn't the only way utilities are challenging energy choice and clean energy policies. In Nevada, an NV Energy-led group pledged $30 million to defeat the Energy Choice Initiative, which is on the ballot in November 2018 after passing with a 72 percent margin in 2016.[76] And PG&E spent $46 million in California on a campaign to discourage counties like San Diego from purchasing its own power.[77]

At around 10% penetration, we encourage policymakers to support shifting to simple time-of-use rates to ensure solar and energy efficiency efforts properly align with the peak demand on the electrical grid. Under this structure, rates are set by local utilities and vary by time of day: more expensive during periods of peak demand, and less expensive during low demand periods. This best aligns system-wide costs with value and is happening in California today. Other states like Nevada are testing pilot time-of-use rates to incentivize home solar plus battery storage adoption before considering applying them more broadly. Policymakers can also incentivize pairing solar and home batteries to respond to energy system outages or high demand.

3 Support low-income programs so more Americans can benefit.

There is a serious economic and health crisis created by our old way of getting energy.

Communities that embrace home solar don't just benefit from lower bills, they also gain more local job opportunities and better health. Having a cleaner environment is especially significant for low-income families and communities of color. According to the NAACP, approximately 68% of African Americans live within 30 miles of a coal-fired power plant,[78] and a report by Clean Air Task Force found that close to 2 million Latinos live within a half mile of existing energy infrastructure.[79] As a result of proximity to pollution, these communities face elevated health risks: an African American[80] or Latino child[81] is twice as likely to die from an asthma attack as a white American child.

As a result of proximity to pollution, these communities face elevated health risks: an African American or Latino child is twice as likely to die from an asthma attack as a white American child.

This unjust energy imbalance cannot be part of our clean energy future. When traditionally underrepresented communities have the opportunity to literally seize the power, together we create the right consumer-centered policies to equip communities with better energy solutions.

Historically, a critique of home solar and batteries is that they do not directly serve low-and moderate-income consumers. Barriers include living in older homes with old roofs, lack of home ownership, lower credit scores, and limited tax liabilities. Yet with the right policies in place, these barriers are surmountable. Maintaining stable net metering policies, supporting direct cash incentives for low-and moderate-income home solar and community solar, and encouraging more green banks are a good place to start.

4 Accelerate an affordable, clean, reliable energy system by creating incentives for home batteries.

Home batteries today are where solar was 10 years ago. Just like solar, batteries offer enormous potential, allowing households to use their solar energy in the evening and store excess solar power that is generated and not needed by the household. The excess power stored in the battery can be shared when it is needed, and contribute to a more reliable, affordable energy system for everyone. Home solar paired with batteries provides an affordable antidote to the utility spending binge. We can aggregate hundreds of home batteries across neighborhoods to replace the need for utility upgrades. Incentivizing home batteries to accelerate adoption can help everyone.

For an example of how home batteries can immediately ease the utility spending binge, look to natural gas peaking plants. From 2005-2015, the U.S. built close to 400 natural gas plants to meet peak energy demand.[82] Peaker plants are among the costliest types of generation.[83] Batteries paired with home solar are part of the solution to replace these peaker plants, providing power during peak demand times. Home batteries can also defer the need for more expensive transmission lines to transport power long distances.

For consumers, their own home batteries can also provide immediate relief. Sunrun saw this first-hand in Puerto Rico. Sixty days after Hurricane Maria, about half of the islands' fire stations were still without power. The stations were powered by unpredictable diesel generators, operating with only a few hours of energy a day. Within days, Sunrun was able to install solar and battery-powered microgrids to help bring fire station communications online. As a result, employees could reliably take emergency phone calls and do their jobs. These efforts are just the first step in providing relief to a part of the country that will need support rebuilding its infrastructure.

There are currently incentives for home battery adoption in California, Massachusetts, Nevada, and Maryland.

What Is Possible?

As Dr. Gretchen Bakke notes in her prescient book “The Grid”, once a technological revolution gets rolling, it has the potential to outstrip even the most radical predictions regarding its progress. At the end of 1970, most people still rented their phones from their local monopoly phone company. A long-distance phone call was a luxury for the wealthy. No one could have imagined that, in 30 years, a phone would be a wireless tiny computer disconnected from a wall. Or that everyone would have one: from rural communities in undeveloped countries, to modern cities in the developed world.

Rather than creating unnecessary and expensive infrastructure that we won’t need in the future, today’s technology enables us to use existing resources, in homes and garages, and harness the abundance of the sun’s energy. Just as Lyft and AirBnB made existing transport and travel infrastructure more efficient, affordable, responsive and reliable, home solar and batteries will make energy infrastructure more efficient, affordable, responsive and reliable. It will also be cleaner, healthier and more resilient. We can increase the efficiency of our system, move to cleaner generation and meet people’s energy preferences. Local home solar and batteries are flexible, targeted, and offer energy consumers control and savings. States like California, New York and Massachusetts are already pursuing efforts to move towards a more consumer-centric system, forging the path for the rest of the country.

Existing utilities can evolve to become the managers of this optimized system, incorporating efficient assets from the people, for the people. This is a big change from the current model of “build more to profit more.”

The transition to this new system will involve taking some calculated risks to encourage innovation. The alternative - sticking with the status quo - may feel safer in the moment, but carries much greater long-term risk. History shows that technological improvements far exceed our expectations if we set up a stable, competitive market.

As the leading home solar company in the U.S., Sunrun is well-positioned to provide customer value through our Brightbox home solar and battery solution. We are actively working with utilities to aggregate our fleet of batteries to build a more reliable grid.

The possibilities are limitless. Along the coast of California, policymakers are retiring or denying power plants because of their environmental impact on ocean habitat. For example, California Commissioners denied a proposed gas plant because of environmental concerns and clean energy’s ability to fulfill the region’s energy needs.[84] Now, utilities like Southern California Edison are procuring resources like solar and battery storage to replace and avoid polluting power plants.

Outside of the United States, clean energy solutions are similarly proliferating. In Australia, Tesla is creating a “virtual” power plant with 250 megawatts of solar energy and 650 megawatt hours of battery storage. The cleaner, local power utilizes Tesla batteries to store energy collected from thousands of solar-powered homes. It’s capable of providing the same capacity as a large gas turbine or coal plant, powering 50,000 homes.

Why Are We Waiting?

2017 was the second-hottest year on record according to NASA[85] and the hottest year without the short-term warming influence of an El Niño event. It was also the most expensive year on record for natural disasters. Record-breaking hurricanes, fires and severe temperatures caused a total of $306 billion in damage.[86]

Home solar and batteries provide clean power - and can help mitigate the worst effects of extreme weather and pollution-related health issues. Overall, reductions in pollution from clean energy prevented 7,000 lost lives and saved $56 billion dollars in healthcare costs from 2007- 2015.[87]

The good news is that we have the technology and the will. Consumers want home solar and batteries. We just have to make them accessible.

Technology fuels the improvement of many industries. The power industry is next. So the question is not whether local, consumer-powered energy is the future. The question is whether this future will happen fast enough to avoid the most harmful effects of polluting fossil fuels on our planet, our health, and our future generations.

SUNRUN AT A GLANCE

Founded in 2007

HQ in San Francisco

Pioneered Residential Solar Service

A Mission to Create A Planet Run By The Sun

Solar Service Sold in 23 States + DC

3,200+ Sunrun Employees

Providing Premium Power with Rooftop Solar + Battery Storage

Back-Up During Power Outages

Typical Bill Savings of 10-40%

Over 180,000 Customers and Installing a New System Every 3 Minutes

2017 FINANCIAL PERFORMANCE

34% Cumulative Customer Growith

Turned Structurally Cash Flow Positive, Generating $43 Million

$314 Million of Net Present Value Created

About Sunrun

Sunrun is the nation's largest residential solar, storage and energy services company. In 2007, we pioneered the residential solar service model, creating a hassle-free, low-cost solution for homeowners seeking to lower their energy bills. By removing the high initial cost and complexity that used to define the residential solar industry, we have fostered the industry's rapid growth and exposed an enormous market opportunity. Our relentless drive to increase the accessibility of solar energy is fueled by our enduring vision: to create a planet run by the sun.

We provide clean, solar energy to homeowners at a significant savings to traditional utility energy. Through our Brightbox home battery service, we also offer battery storage along with solar systems to our customers in California, Nevada, New York, Massachusetts, Hawaii and Arizona. With our solar service offerings, we install solar energy systems on our customers' homes and provide them the solar power produced by those systems for a 20-year initial term. In addition, we monitor, maintain and insure the system at no additional cost to our customers during the term of the contract. In exchange, we receive 20 years of predictable cash flows from customers and qualify for tax and other benefits.

Residential solar is a cost-effective way to modernize the country's infrastructure to make it more resilient, affordable and environmentally sustainable. Sunrun's deployed solar systems are estimated to offset 43 billion tons of CO2 over their lifetime, equivalent to removing 6.9 million gas passenger cars on the road.

Today, Sunrun operates in 23 states, as well as the District of Columbia, employing more than 3,000 people throughout the U.S. We work with organizations such as the Center for Employment Training (CET), GRID Alternatives, the NAACP, Solar Ready Vets, and Women in Solar Energy (WISE) to achieve important diversity milestones, such as hiring women, veterans, and minorities.

Sunrun proudly serves more than 180,000 customers across the country and is growing quickly. With fast installation and great customer experience, we have a satisfied customer base. Sunrun has an A+ rating with the Better Business Bureau and our customer satisfaction scores are on par with Amazon.com, Southwest Airlines and Zappos.com. We have deployed an aggregate of 1,202 megawatts ("MW") as of December 31, 2017, and our Gross Earning Assets as of December 31, 2017 were approximately $2.2 billion.[88]

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Exhibits:

Exhibit 1
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Past Cost of Panels & Cost of Lithium Ion Battery Data: GTM Research

Exhibit 2
Energy Information Agency. Average price per KWhr of electricity for the residential sector in Sunrun’s current markets.
Eaton’s 2017 Blackout Tracker Annual Report
Sunrun analysis of “Electric Emergency Incident and Disturbance Reports” published by the Energy Information Agency as of November 2017.
Energy Information Agency. US Net Electricity Generation by Source and Emissions for 2016.

Exhibit 3
Sources: Duke Energy Carolinas,SCE&G & National Residential eia.gov SC Avg Wholesale: In absence of wholesale rates we used avoided energy costs as a proxy for wholesale rates.

Exhibit 4
Source: eia.gov

Exhibit 5
Sources: APS Residential: eia.gov APS Wholesale: eia.gov National Residential: eia.gov

Exhibit 6
Source: “The Economics of Load Defection.” Rocky Mountain Institute, April 2015

Exhibit 7
Source: DSIRE, www.dsireusa.org (Nov 2017)
Source: EQ Research, analysis of Net Metering policy decisions or regulatory actions from 2013-1H2017