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# RESILIENT CLEAN ENERGY FOR CALIFORNIA:

Protecting Vulnerable Communities, Critical Facilities,  
and the California Economy with Solar + Storage



**VOTE SOLAR**

Prepared for Vote Solar

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## EXECUTIVE SUMMARY

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The devastating wildfires of recent years, many triggered by electric power lines, have led to the biggest energy crisis in California since the Enron-driven fiasco two decades ago. The state's largest utility, PG&E, is bankrupt due to wildfire liability claims, and all three major utilities have resorted to shutting off power to millions of people to prevent more fires.

While the grid needs to be safer, making it fully fireproof would take many years and cost billions of dollars. We would also be chasing a moving target, as climate change makes California increasingly prone to fire.

Yet the impacts of the 2019 power shutoffs are also unacceptable. Electricity is a life and death matter for the many people who rely on powered medical equipment. First responders can be crippled by outages, endangering public safety, and low-income communities can suffer financial hits they can't afford.

Still, PG&E expects to rely on power shutoffs for the next decade, as they undertake the massive task of improving their sprawling grid.

Many Californians are taking matters into their own hands, resorting to diesel and gasoline backup generators, known as BUGs, to protect against outages. But relying on BUGs poses unacceptable safety, fire, and health risks, exacerbates inequities, and moves us backward on progress toward clean energy.

Fortunately, there is a better way. The combination of distributed solar power plus battery storage can protect customers from the impacts of outages while contributing to a safer and cleaner grid. California is a global leader in solar power, with over a million customer-sited systems, and is also in the vanguard of the emerging field of energy storage. Distributed solar + storage creates cost-effective synergies for a very wide range of applications, from streetlights to homes to microgrids.

In this report, we document the widespread impacts of power shutoffs in California and the drawbacks of conventional solutions. We document the risks of relying on dirty BUGs, including deaths from carbon monoxide poisoning, hazardous air pollution, and, ironically, fire hazards. We then show how solar + storage -- resilient clean energy -- can be used to cost-effectively provide small-, medium-, and large-scale solutions to reduce the harm from power shutoffs.

Most importantly for state and local policymakers, we propose a suite of policy solutions needed to secure a resilient clean energy future.

## REPORT HIGHLIGHTS

In response to the devastating wildfire season of 2018, California utilities have stepped up the use of public safety power shutoffs (PSPS) during high-risk weather events in peak fire season, sometimes for many days at a time. While these shutoffs probably prevented fires and saved lives in 2019, they also imposed risks, costs, and inconveniences on millions of people.

Their most serious threats posed by the outages were to medically vulnerable customers who rely on powered medical equipment and cooling, critical facilities like police and fire stations, and low-income households and communities. They also imposed huge costs on small businesses, and sowed chaos in regions that were evacuating, as cell phones and traffic lights went out.

In response to these risks, utilities have proposed greatly expanding funding for conventional solutions, like burying power lines underground, grid hardening, and vegetation management. These measures are prudent to consider, but likely to be slow and expensive to implement, keeping California exposed for many years and further raising utility bills. Even as spending ramps up on grid maintenance, the CEO of PG&E has said that the company will likely need to

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## 4 Resilient Clean Energy For California

resort to power shutoffs for a decade as they slowly make improvements to their vast system.

Another conventional response is coming from customers themselves, who are deploying backup generators (BUGs) fueled by diesel, gasoline, and natural gas. These “dirty BUGs” have proven to be a menace. Nationwide, they cause an average of 80 deaths per year from carbon monoxide poisoning. In California, they have been implicated in almost 400 fires over the past decade. And because they often lack pollution controls, a single generator can put out hazardous air pollution equivalent to hundreds of cars. The Air Resources Board estimated that 125,000 BUGs were operated during the October 2019 PSPS events, with emissions equal to tens of thousands of heavy duty diesel trucks. BUG sales are up statewide, including at data centers in Silicon Valley, which are installing hundreds of megawatts of BUGs.

A better solution is distributed solar power plus batteries. California is the king of distributed solar, with over a million rooftop systems already saving customers money and reducing pollution. Rapid price declines for batteries, thanks to incentive programs and the growth of the electric vehicle industry, are making energy storage a viable option for many homes and businesses.

Combining distributed solar and battery storage -- like chocolate and peanut butter -- makes resilient solar, which can serve customers’ most important power needs through outages, indefinitely if the system is sized correctly and the sun shines each day. And when the grid is operating normally, solar + storage produces clean energy, cuts utility bills, and helps move California toward a low-carbon future. Resilient solar acts as an insurance policy against power outages, while also helping us fight climate change and build our green economy.

Because solar and storage are modular technologies, they can be deployed in many configurations, from small to large, to solve the problems caused by outages.

- **Small-scale solutions** can be a single solar panel with a battery, like solar-powered street lights and stop lights. As people fled the Paradise fire in 2018, for example, cars on the highway sat surrounded by flames, stuck in a chaotic traffic jam exacerbated by dark traffic lights. The chaos can be compounded as shutoffs take down cell phone networks, since transmitters often have only short-term backups. Portable batteries and solar panels can provide reliable long-term power for people with medical equipment, or who live in apartments.
- **Medium-scale solutions** can keep the power on for individual buildings, including homes, businesses, and critical facilities that protect public safety. Fire stations in Fremont use solar and storage to make sure the fire department can still operate communications, lights, and computers. For homes, it can help people stay informed with news about emergency conditions, stay in touch with first responders and family, power life-saving medical equipment, and keep food and medicine from spoiling. For business, it can prevent financial losses from lost business and spoiled merchandise.
- **Large-scale solutions**, such as clean microgrids, can power campuses or clusters of buildings. The microgrid at Blue Lake Rancheria, in Humboldt County, was a shining star during the October 2019 outages, providing services to 13,000 visitors and saving the lives of seven medically vulnerable people.
- **An emerging opportunity** is electric cars, which can serve as batteries on wheels, providing power to a building during an outage and being recharged by the building’s solar panels. The state has a goal of putting 5 million EVs on the road by the end of the decade.

Solar has also been scaled up to grid proportions, and now provides about 20 percent of California’s electricity.<sup>1</sup> Batteries too are being deployed at the megawatt-scale.

<sup>1</sup> Energy Information Administration, 2019 data through October, includes 13% from utility-scale and 7% from small-scale systems under 1 MW, <https://www.eia.gov/electricity/data/browser>

## POLICY SOLUTIONS

While the technology, economic, and market trends for solar + storage are strong, a suite of state-level policies is needed to allow resilient clean energy to quickly and meaningfully protect the medically vulnerable, low-income people and communities, and critical public safety facilities during this era of wildfires and planned power outages.

We recommend the following policy approaches, with greater detail presented in Section 5.

- ❑ **Maintain and expand distributed energy policies:** Good policies have made California a leader in deploying distributed energy, but those policies must be maintained and strengthened. Distributed solar and storage should be fully valued through fair net metering and rate design, interconnection should be quick and easy, and incentive programs should be continued as needed. Microgrids face a number of obsolete barriers that should be removed, such as the “over the fence” rule. Solar + storage should be counted toward “resource adequacy” requirements for utilities and community choice energy programs, allowed to fully participate in markets for ancillary services, and taken seriously as “non-wires alternatives” in grid planning.
  - ❑ **Focus on medically vulnerable customers:** Lives must never be at risk from power outages, so people dependent on powered medical equipment must be the top priority in planning for PSPS events. But more information and better warnings are not enough; we need to help medically vulnerable people in a variety of living situations deploy resilient clean energy solutions, such as by making solar + storage systems eligible for medical insurance programs.
  - ❑ **Focus on low-income communities and communities of color:** Low income households and communities of color are often hit “first and worst” by pollution and by disasters. Power shutoffs can be an economic catastrophe for people living on the edge, resulting in lost wages, food, and security. Grid resilience efforts should
  - prioritize safety for these communities. For example, the “equity resiliency” reform of the Self Generation Incentive Program (SGIP) is a good step, but will require proactive outreach via trusted organizations to overcome the barriers that low-income customers face and may need more funding depending on demand. Policies should support “community resilience hubs” that are accessible to low-income people and deployment of resilient clean energy on tribal lands. Lastly, emissions from fossil backup generators should be more tightly regulated to protect public health.
  - ❑ **Focus on critical facilities and schools:** Critical facilities, such as police and fire stations, shelters, hospitals, elder care facilities, and many others, are the bedrock of public safety. Since PSPS events happen in fire season, keeping first responders fully operational is doubly important. Deployment of resilient clean energy on thousands of critical facilities should be accelerated through a statewide financing program along with technical assistance, and in some cases through mandates. A special opportunity for rapid deployment is to add batteries to the approximately 2,000 California schools that already have solar. In addition to educating children, schools serve as emergency shelters and feed thousands of low-income children every day.
  - ❑ **Provide state financing for local infrastructure:** Now that solar + storage and microgrid technologies are ready to deploy, we need easy, scalable, and low-cost financing. Prop 13, a measure on the March 2020 ballot that could raise \$15 billion for schools, could be used to fund resilient energy systems if passed. But other critical facilities, like police and fire stations, need a funding source to deploy resilient clean energy at scale. The state Infrastructure and Economic Development Bank (IBank) could provide a good vehicle for a multi-billion dollar financing plan.
  - ❑ **Take microgrid R&D to the next level:** Now that the California Energy Commission has helped prove microgrid feasibility, further research and development should focus on driving down costs, easing deployment, and exploring how clean
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microgrids can replace conventional grid solutions and high-risk power lines. Standardizing microgrid designs could be a big cost saver for gas stations, schools, and other replicable applications.

- ❑ **Integrate energy resilience into emergency planning and response:** Local governments should be aided in developing energy assurance plans, and executing on those plans to deploy resilient clean energy. Communities should add batteries to the million distributed solar systems already in place to provide distributed community resilience.

Even as utilities spend billions of ratepayer dollars on conventional fixes to the grid, planned power outages are bound to be a reality in California for years and maybe decades to come. Our huge power grid will keep aging, climate change will keep making weather more extreme, and utilities will continue to be financially liable for damages from fires caused by their equipment.

In this sobering vision of the future, resilient clean energy is a ray of hope. It is an insurance policy, making outages less harmful to Californians while keeping us moving toward our clean energy goals. It is both a response to a changing climate, and a solution to climate change. That's why boosting resilient clean energy should be a central element of the state's plan to address wildfires and power outages.



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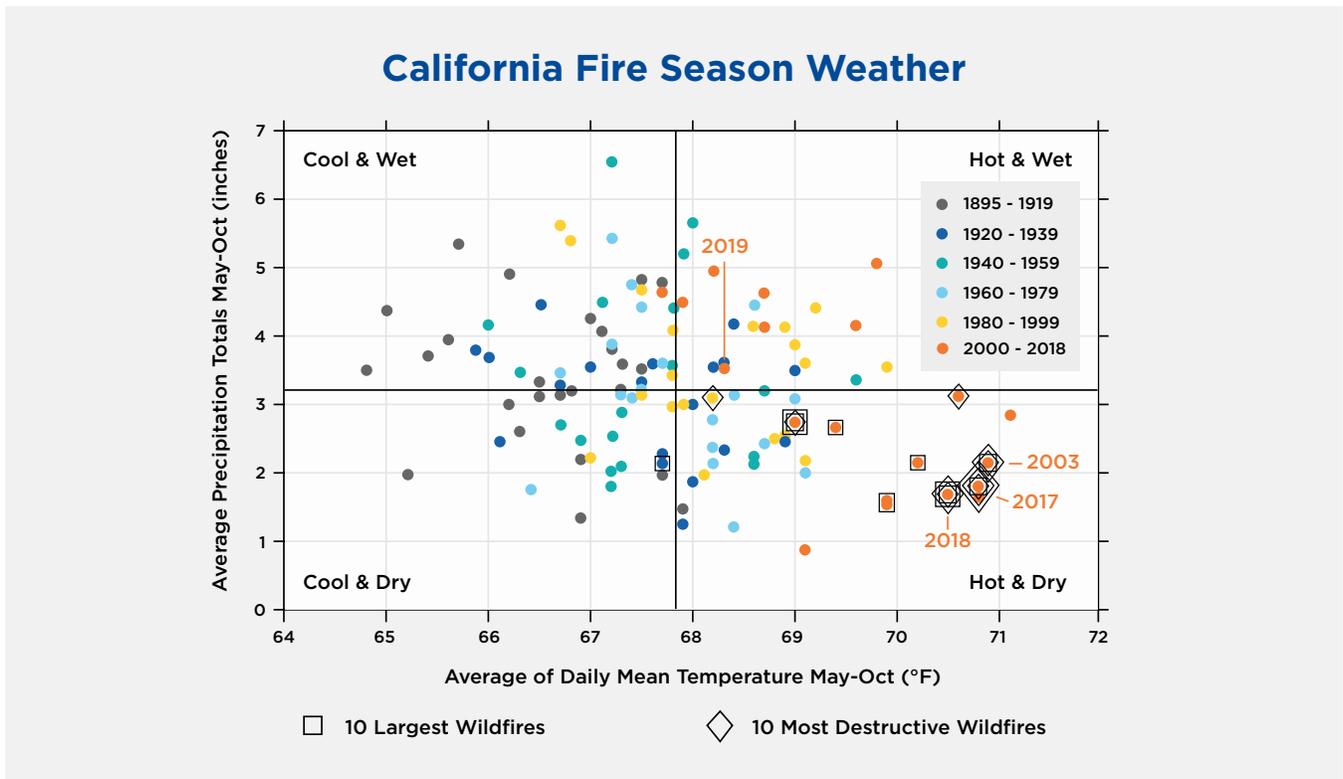
## INTRODUCTION

While California’s traditional “endless summer” has made fire a natural part of the landscape, the steady rise in temperatures due to climate change has increased the risk and severity of fires. The California climate is becoming hotter and drier, according to research from Berkeley Earth (see the figure below). Millions of acres of trees, killed by drought and beetle infestations, are ready kindling. Decades of fire suppression has helped make forests more prone to hotter and more devastating fires.

Californians have favored suburban homes for decades, and now as skyrocketing urban home prices further push people into the wildland-urban interface in search of affordable housing, the consequences of wildfire are becoming more expensive and more deadly. About half of the new housing built between 1990 and 2010 is in the interface. Now two million homes, or about 15 percent of all homes in the state,

are in zones that are at “high or extreme risk” for wildfire, according to the Center for Insurance Policy and Research.<sup>2</sup>

Stringing together California’s communities -- like a fuse -- is our century-old electricity system. The state has many thousands of miles of high voltage transmission lines, linking power plants and cities in a vast grid, and connecting us to the wider West. We have over 240,000 miles of lower-voltage wires, running throughout our cities and rural areas, bringing power down to the customer level. Such a vast system, often sited on difficult terrain and through remote forests, has been a challenge to maintain, and utilities have been accused of failing to adequately prioritize grid maintenance as climate change increases the threat. In addition, our grid is highly connected -- if some lines fail, they can black out major areas.



Source: Berkeley Earth

<sup>2</sup> Annie Lowrey, The Atlantic, “California Is Becoming Unlivable,” October 30, 2019, <https://www.theatlantic.com/ideas/archive/2019/10/can-california-save-itself/601135/>

All of these factors -- hotter and drier summers, forests made denser by drought and firefighting, more semi-rural homes, and a farflung, highly integrated and aging grid -- have come together in a series of catastrophes.

Ten of the twenty worst wildfires in state history happened in 2017 and 2018. In 2017, the Tubbs fire reached into the city of Santa Rosa, leveling the suburban neighborhood of Coffey Park, destroying 5,636 structures, killing 22 people, and causing a mass evacuation.<sup>3</sup> The Bay Area was smothered in the smoke from the fire for nearly two weeks, registering the most polluted air in the world.<sup>4</sup>

The 2018 fire season was even worse, with 310 fires burning an area of 1,618,033 acres, according to CalFire.<sup>5</sup> The worst was the Camp Fire, which in October destroyed the town of Paradise in a matter of hours, killing 85 people and burning 18,804 buildings. It was the deadliest and most destructive wildfire in California history. The Ranch and Carr fires, which both started in July and burned through the end of the year, burned four times as much area, though with less property damage and loss of life.

Additional fires were seen up and down the state in 2019, including the Woolsey fire in Los Angeles and Ventura counties, which burned 1,643 structures and killed three people.

***Hotter and drier summers, forests made denser by drought and firefighting, more semi-rural homes, and a farflung, highly integrated and aging grid have led to a series of catastrophes.***



*An ember wash spreads over the landscape pushed by high winds during the Kincadee Fire on Thursday, Oct. 24, 2019, near the town of Geyserville, California, in Sonoma County. (Kent Porter/The Press Democrat via AP)*

3 California Department of Forestry and Fire Protection, 2017 Incident Archive, <https://www.fire.ca.gov/incidents/2017/>.

4 Ted Goldberg, KQED, "Camp Fire Caused Nearly 2 Straight Weeks of Bay Area's Worst Air Quality on Record, December 19, 2018, <https://www.kqed.org/news/11712211/the-camp-fire-caused-nearly-two-straight-weeks-of-the-bay-areas-worst-air-quality-on-record>

5 California Department of Forestry and Fire Protection, 2018 Incident Archive, <https://www.fire.ca.gov/incidents/2018/>.

## CALIFORNIA WILDFIRES SINCE 2013

YEAR	AREA IN ACRES	NUMBER OF INCIDENTS > 10 ACRES	FATALITIES	STRUCTURES DAMAGED OR DESTROYED
2013	523,966	159	0	462
2014	620,000	7800	0	568
2015	890,000	8700	7	3217
2016	660,000	184	0	821
2017	1,566,344	436	44	11,643
2018	1,618,033	310	93	23,145
2019	253,321	6,872	3	732
<b>TOTAL</b>	<b>6,131,664</b>	<b>24,461</b>	<b>147</b>	<b>40,588</b>

A disturbing number of these fires were caused by power lines, including the massive Camp Fire that destroyed Paradise. Regulators have estimated that utility equipment has been the cause of 2000 fires over the past three years.<sup>6</sup> High winds can blow branches into wires, can cause wires to sway and contact, and can break key parts of transmission towers.

The massive financial liabilities for the damage from the 2017 and 2018 fires, over \$20 billion, drove PG&E into bankruptcy, and have spurred ongoing discussions among policymakers about how the utility should be reformed or reorganized to better prioritize public safety.

But as the legal and regulatory questions play out, the seasons roll on, and the 2019 fire season was set to be another bad one. In response, state regulators approved the use of Public Safety Power Shutoffs (PSPS), letting utilities cut power in high risk areas when dry winds and other weather factors boost the risk of wire-induced fires.

All three major California utilities, and PG&E especially, resorted to PSPS events in the fall fire season of 2019. Over the course of seven events, PG&E cut power to as many as 941,000 customers across 38 counties. The average duration of each outage was as high as 55 hours, but some customers reported being out for many days.<sup>7</sup>

6 Taryn Luna, Los Angeles Times, "California Utility Equipment has Sparked Over 2000 Fires in Three Years," January 28, 2019, <https://www.latimes.com/politics/la-pol-ca-california-utilities-wildfires-regulators-20190128-story.html>

7 Anthony Noll, California Public Utilities Commission, "Public Safety Power Shutoff Overview," [https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/Resiliency\\_Microgrids/3\\_BACKGROUND\\_CPUC%20Safety%20and%20Enforcement%20Division.pdf](https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/Resiliency_Microgrids/3_BACKGROUND_CPUC%20Safety%20and%20Enforcement%20Division.pdf)

### PG&E PUBLIC SAFETY POWER SHUTOFF (PSPS) EVENTS IN 2019

	JUNE 8-9	SEPT. 23-26	OCT. 5-6	OCT. 9-12	OCT. 23-25	OCT. 26 - NOV. 1	NOV. 20-21
<b>Customers affected (approx.)</b>	22,000	50,000	11,000	732,000	177,000	941,000	50,000
<b>Counties affected</b>	5	7	3	35	17	38	11
<b>Avg. duration of outage (hours)</b>	16	16	14	37	25	55	25

Source: CPUC

The PSPS policy seems to have successfully avoided significant fires in 2019. While there is suspicion that the Kincaid fire in Napa and Sonoma counties was caused by high voltage lines that had not been shut down, overall PG&E claims the PSPS prevented many fires during the high wind events of October 9-11.<sup>8</sup> Indeed, San Diego Gas & Electric has been using the PSPS strategy to reduce fire risk since 2008.

While some planned power outages appear necessary in the short term to protect public safety, they are not a sustainable primary solution over the long-term. Power shutoffs bring their own risks and impacts.

- People with disabilities, especially those that rely on powered medical equipment, are especially at risk. As one advocate for people with disabilities said at a CPUC workshop on the shutoffs, “When you shut off power you are creating an emergency for large parts of the community.”<sup>9</sup>
- Emergency response services and key infrastructure that lose power can become unable

to serve the community, putting lives at risk. These “critical facilities,” such as police and fire stations, hospitals, 911 call centers, shelters, and cell phone networks, are the first line of defense needed in any kind of disaster.

- Low-income families and communities are less able to absorb lost income as businesses shut down, less able to make backup plans for kids as schools close, and less able to replace spoiled food. Investing in contingency plans and backup power is often out of the question.<sup>10</sup>
- Businesses can see substantial financial losses. Lawrence Berkeley National Lab has estimated that short power interruptions can cost hundreds of dollars for residential customers, but thousands for commercial and hundreds of thousands for large industrial customers.<sup>11</sup> Long outages can be even more expensive. While total losses from the PSPS shutoffs have not been calculated, one quick estimate found the cost could be in the billions of dollars.<sup>12</sup>

8 J.D. Morris, San Francisco Chronicle, “PG&E CEO: Blackouts could last 10 years, but impact should ease,” October 18, 2019, <https://www.sfchronicle.com/business/article/PG-E-CEO-California-should-consider-taking-over-14545613.php>

9 CPUC Workshop on Impacts from De-Energization: Focus on Vulnerable Populations, Santa Rosa, December 14, 2018.

10 Anita Chabria and Taryn Luna, Los Angeles Times, “PG&E power outages bring darkness, stress and debt to California’s poor and elderly,” October 11, 2019, <https://www.latimes.com/california/story/2019-10-11/pge-power-outage-darkness-stress-debt-vulnerable>

Kristina Hamachi LaCommare, Joseph H Eto, Laurel N Dunn, and Michael D Sohn, Lawrence Berkeley National Lab, “Improving the Estimated Cost of Sustained Power Interruptions to Electricity Customers.” Energy, June 2018, <https://emp.lbl.gov/publications/improving-estimated-cost-sustained>

12 David R Baker and Mark Chediak, Bloomberg, “Massive California Blackout Could Prevent Fires -- At Big Cost,” October 9, 2019, <https://www.bloomberg.com/news/articles/2019-10-09/massive-california-blackout-could-prevent-fires-at-big-cost>

While billions of dollars in outage-related losses is a massive cost to be borne by the people of California, it is likely to be less than the cost of and harm from damages from rampant wildfires.

Indeed, the PSPS is not going away any time soon. PG&E CEO Bill Johnson has told regulators that it may take 10 years to make the system safe, and that the utility will likely use power shutoffs to prevent wildfires every fire season until then.<sup>13</sup>

This “new abnormal” for California’s power system has provoked an uproar from policymakers and the public. “We’re seeing a scale and scope of something that no state in the 21st century should experience,” Governor Gavin Newsom said at an October 10 press conference. “What’s happened is unacceptable and it’s happened because of neglect.”<sup>14</sup>

While California is a wealthy economy, that wealth is by no means evenly distributed, and many customers cannot afford a large increase in utility bills to pay for improvements. The solutions we pursue will have to be effective, but they will also have to be as affordable as possible. We must place a priority on protecting those most at risk from fires and power outages -- medically vulnerable customers, low-income households and communities of color, and the public safety infrastructure.

***We must place a priority on protecting those most at risk from fires and power outages -- medically vulnerable customers, low-income households and communities of color, and the public safety infrastructure.***

For those who are able to pay for resiliency solutions, we must continue existing supportive policies, point people away from dirty energy resources, and maximize the societal benefit of their clean investments. Policies can help ensure that clean energy is deployed in ways that help everyone. While state policies have long sought to create affordable, clean, and reliable energy, we now must increase the emphasis on equity, resilience, and public safety.

Indeed, we need to stay on the clean energy path we have established, heading for a 100 percent zero-emission power system no later than 2045. Considering that climate change is a prime driver of the fire-prone conditions we face, and that California plays an important policy leadership role worldwide, it would be unacceptable to abandon that pursuit.

Fortunately, clean energy technologies are now some of the cheapest ways to provide power. The remarkable synergies of solar power and batteries, scalable to practically any size, are a uniquely effective tool for reducing wildfire risks, limiting the impact of power shutoffs, and fighting climate change, all at once.

In this report we are going to explore the ways that clean energy can be resilient energy, how resilient clean energy can capture multiple benefits when properly deployed, and the policies needed to deploy the right solutions and avoid the wrong solutions.

<sup>13</sup> J.D. Morris, San Francisco Chronicle, “PG&E CEO: Blackouts could last 10 years, but impact should ease,” October 18, 2019, <https://www.sfchronicle.com/business/article/PG-E-CEO-California-should-consider-taking-over-14545613.php>

<sup>14</sup> Alex Dobuzinskis and Andrew Hay, Reuters, “California governor says broad power shutdown to prevent fires ‘unacceptable,’” October 10, 2019, <https://www.reuters.com/article/us-california-wildfire-pg-e/california-governor-says-broad-power-shutdown-to-prevent-fires-unacceptable-idUSKBN1WP2Z9>

## PRIORITY THREATS FROM POWER OUTAGES

While power outages can impose major costs and inconvenience on everyone, electricity service for customers with health conditions who rely on powered medical equipment or cooled medication can be a matter of life and death. First responders and other emergency and “critical” facilities need electricity to serve the community during outages and disasters, especially for communications, lighting, and temperature control. Disadvantaged communities often have fewer resources of their own to respond to outages, and are less able to afford the financial losses.

### MEDICALLY VULNERABLE CUSTOMERS

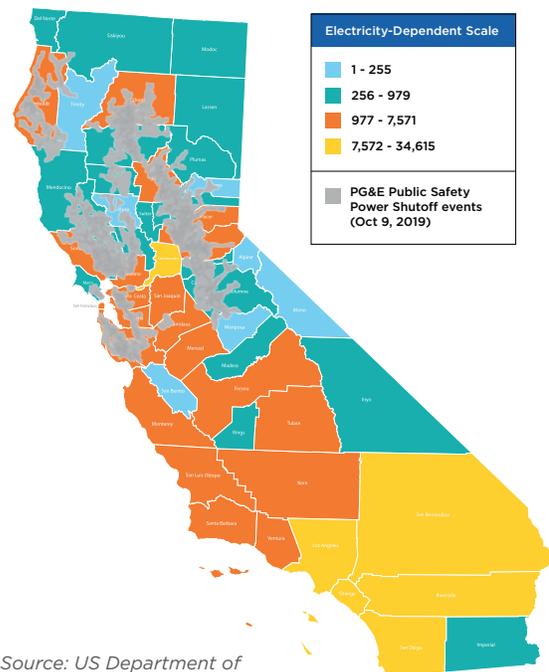
Electricity can be a matter of life or death for people who rely on electricity to power medical equipment. The US Department of Health and Human Services (HHS) currently identifies 175,907 “electricity dependent” people in California who rely on electricity to power life-giving medical equipment in their homes, though this includes only the 5.6 million in-state Medicaid and Medicare beneficiaries and is therefore not comprehensive.<sup>15</sup> The largest number of people in the HHS count is in Los Angeles County, with 35,000. Riverside, San Diego, San Bernardino, and Orange County all have over 10,000 electricity dependent customers in the HHS count.

As shown in the map, many people on Medicare or Medicaid with medical equipment live in rural areas and small towns that were subject to PG&E PSPS events, especially around Redding and Red Bluff, Oroville, Vacaville, and Sonoma County.<sup>16</sup>

While breathing equipment (oxygen concentrators) is the most common form of medical equipment used in homes, HHS tracks many other devices ranging from dialysis machines to wheelchairs. In addition to medical equipment, continuous refrigeration for medicines and cooling is imperative for many.

Loss of power can also affect the health of many more, such as people who use nebulizers, home dialysis, or CPAP machines. Loss of refrigeration can spoil insulin, threatening health and costing as much as \$500 per month to replace. About 2.3 million adults in California suffer from diabetes, especially the elderly and people of color, with about a quarter reliant on insulin.<sup>17</sup>

### Electricity Dependent Medicare/ Medicaid Recipients Subject to PG&E Oct 9 Power Shutoffs



Source: US Department of Health and Human Services

<sup>15</sup> US Department of Health and Human Services, emPOWER map 3.0, <https://empowermap.hhs.gov/>.

<sup>16</sup> For an online interactive version of this map showing the overlap of electricity dependent people PSPS regions, see <http://arcg.is/0HnCF9>.

<sup>17</sup> California Department of Public Health, Chronic Disease Control Branch, Burden of Diabetes in California, September 2014, [https://www.cdph.ca.gov/Programs/CCDC/DCDC/DCDC/CDPH%20Document%20Library/FINAL%20Rpt%20\(1877\)%20DM%20burden%202014\\_9-04-14MNR3.pdf](https://www.cdph.ca.gov/Programs/CCDC/DCDC/DCDC/CDPH%20Document%20Library/FINAL%20Rpt%20(1877)%20DM%20burden%202014_9-04-14MNR3.pdf)



Still others are vulnerable in other ways. Seniors can be trapped in apartments due to elevator outages, or have cars trapped by a powered garage door. “Some devices aren’t really medical devices, but are still needed for living,” says Melissa Kasnitz, attorney for the Center for Accessible Technology. “The definition of vulnerable people is broader than just those who are ‘electricity dependent.’”

California customers with medical needs can enroll in a “medical baseline” rate for electricity. Under tiered rates, all residential customers get an allotment of energy every month at the lowest price available on their rate. Medical baseline customers get an additional allotment of electricity and/or gas each month to cover their additional needs. PG&E, for example, has about 193,000 customers on medical baseline rates, or about 3 percent of their residential customers.<sup>18</sup>

Medical baseline applicants can further have their medical providers certify if they “require the use of life support devices” or if heating or cooling is “medically necessary.”<sup>19</sup> About 117,000 PG&E customers have received this certification, however PG&E doesn’t track the type or severity of risk if the power is shut off. In addition, an unknown number of electricity

dependent customers are not enrolled in the utilities’ medical baseline programs, with some unaware that the programs exist. Customers who live in a master metered facility, such as in a mobile home park or group living homes, can’t be on medical baseline.

The PSPS has raised the importance of determining which customers are electricity dependent, and utilities and public service agencies are working to identify and get better insight to the electrical needs of these customers.

They are also scrambling to come up with effective strategies for helping electricity dependent people during shutoffs.

The first step is notification: Utilities and agencies have been actively urging medical baseline customers to sign up for PSPS notifications, but due to language or technology barriers, not all are getting the message. Local agencies are resorting to phone trees and door knocking to reach customers. The City of Berkeley works through a program called BEACON, a network of local organizations and individuals that provide services to people with disabilities.<sup>20</sup>

<sup>18</sup> Susan Norris, Medical Baseline Product Manager, PG&E, personal communication, January 21, 2020.

<sup>19</sup> PG&E, Medical Baseline program application, [https://www.pge.com/includes/docs/pdfs/myhome/saveenergymoney/financialassistance/medicalbaseline/medbaseline\\_application\\_eng\\_v2.pdf](https://www.pge.com/includes/docs/pdfs/myhome/saveenergymoney/financialassistance/medicalbaseline/medbaseline_application_eng_v2.pdf)

<sup>20</sup> Natalie Orenstein, Berkeleyside, “Berkeley residents with disabilities say their needs ‘not built into’ PG&E shutoff policy,” November 5, 2019, <https://www.berkeleyside.com/2019/11/05/berkeley-residents-with-disabilities-say-their-needs-not-built-into-pge-shutoff-policy>.

The next step is mitigation: Even if they are notified in advance, not all electricity dependent people are able to respond to an outage, or are ready for a multi-day outage. Those who live in apartment buildings or independent living facilities may be unable to deploy their own rooftop solar + battery systems, or backup generators. They may have extra batteries for their equipment but those may not last long enough to ride out a multi-day outage. Evacuating these customers to an appropriate location with power can be difficult, especially in the chaos of a major emergency.

## CRITICAL FACILITIES

Another major risk to public health and safety is when power is shut off to critical facilities -- facilities that “are considered so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety,” according to the Department of Homeland Security (DHS).<sup>21</sup>

What exactly qualifies as a critical facility varies by the agency and program, and often by context. In terms of power outages, some facilities are more “electricity dependent” than others; a bridge, for example, is critical infrastructure but might not be impaired by a power outage.

DHS lists 16 broad critical infrastructure sectors, such as the transportation and chemical sectors. In their de-energization order, the CPUC used the DHS guidelines and input from parties to define the following list of critical facilities to be prioritized for restoration and communication during PSPS events.<sup>22</sup>

### The list includes:

#### Emergency Services Sector

- Police Stations
- Fire Station
- Emergency Operations Centers

#### Government Facilities Sector

- Schools
- Jails and prisons

#### Healthcare and Public Health Sector

- Public Health Departments
- Medical facilities, including hospitals, skilled nursing facilities, nursing homes, blood banks, health care facilities, dialysis centers and hospice facilities

#### Energy Sector

- Public and private utility facilities vital to maintaining or restoring normal service, including, but not limited to, interconnected publicly-owned utilities and electric cooperatives

#### Water and Wastewater Systems Sector

- Facilities associated with the provision of drinking water or processing of wastewater including facilities used to pump, divert, transport, store, treat and deliver water or wastewater

#### Communications Sector

- Communication carrier infrastructure including selective routers, central offices, head ends, cellular switches, remote terminals and cellular sites

#### Chemical Sector

- Facilities associated with the provision of manufacturing, maintaining, or distributing hazardous materials and chemicals.

A number of other facilities were proposed or prioritized by parties in the proceeding, and utility

<sup>21</sup> US Department of Homeland Security, “Critical Infrastructure Sectors,” accessed November 2019, <https://www.dhs.gov/cisa/critical-infrastructure-sectors>

<sup>22</sup> CPUC, “Decision Adopting De-Energization (Public Safety Power Shut-Off) Guidelines (Phase 1 Guidelines),” Decision 19-05-042, May 30, 2019, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M296/K234/296234220.PDF>

wildfire plans have their own lists. The CPUC said they would revisit the definitions based on experience.

### Some facilities missing from the original CPUC list include:

- Government agencies essential to national defense
- Major evacuation centers and shelters, including “community resilience hubs” that provide warm or cool space and other resources
- Major public transportation facilities such as airports, bus stations, transit rail and ferries
- Public housing or other affordable housing
- Paratransit fleet vehicle operators

The CPUC has since designated additional types of customers as eligible for the SGIP Equity Resiliency budget, including emergency operation centers, smaller-sized grocery stores and markets, independent living centers and food banks.<sup>23</sup>

### There are tens of thousands of critical facilities in California. According to the Governor’s Office of Emergency Services, California has:<sup>24</sup>

- 874 fire departments with 3,209 stations
- over 500 law enforcement agencies with 1,013 police stations
- 7,542 shelters in FEMA’s National Shelter System
- 592 emergency (911) call centers (a.k.a. Public Safety Answering Points)
- 11,134 schools
- 38 prisons and 123 county jails
- 545 acute care hospitals, 1,828 primary care clinics, 1,235 skilled nursing facilities, 907 hospice centers, among other health care facilities

<sup>23</sup> CPUC, “Self-generation Incentive Program Revisions Pursuant To Senate Bill 700 And Other Program Changes” , January 16, 2020, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M325/K979/325979689.PDF>

<sup>24</sup> To see an online map of these critical facilities in California, overlaid with high-risk fire zones and one PSPS event, go to <https://arcg.is/1zjvCO>.

*Throckmorton Ridge Fire Station Source: [www.marincounty.org](http://www.marincounty.org)*



***There are tens of thousands of critical facilities in California-- facilities that need reliable power to protect public health and safety.***

The disruptions caused by power outages can seriously impair critical facilities and public safety. Here are just a few examples from recent power outages.

## CELL PHONE SERVICE

California has an estimated 150,000 cell phone antennas. Loss of cell phone service prevented people in the 2018 Paradise fire from calling for help<sup>25</sup> and was again a problem in 2019, including outages for over half of antennas in Marin County in the October PSPS.<sup>26</sup>

In 2008, in response to widespread outages after Hurricane Katrina, the Federal Communications Commission ordered cell phone carriers to install backup power at towers. But the wireless industry challenged the order in court and won on procedural grounds, and the FCC dropped the effort.<sup>27</sup> The CPUC's Public Advocates Office has filed a motion to require hours or days of backup power, as would the proposed SB 431 from Sen. Mike McGuire (D-Healdsburg). Cell phone towers will need multiday backup power to be truly resilient to multiday PSPS events.

"The failure of our communications systems in emergencies is a life or death matter, and one that must be addressed immediately," said Ana Maria Johnson, program manager with the Public Advocates

Office. In November of 2019, the CPUC opened a proceeding that may lead to further action.

## ASSISTED LIVING FACILITIES

Retirement homes, assisted living facilities, and other housing can be deeply affected by power outages. In the October 2019 power shutoffs, a retirement home in Novato, The Villas at Hamilton, lost power for two days.<sup>28</sup> About a third of the Villas' 140 residents are reportedly too old, sick or cognitively impaired to care for themselves during an extended outage. At least 20 seniors with wheelchairs and walkers were essentially trapped for two days, as elevators shut down. Battery backups for hallway lighting ran out after 12 hours.

At a retirement home in Novato in an October 2019 planned power outage, at least 20 seniors with wheelchairs and walkers were essentially trapped for two days, as elevators shut down.

## HOSPITALS

The state Office of Emergency Services estimated that there were 248 hospitals in the regions that lost power in early October 2019.<sup>29</sup> State regulations require hospitals to have large diesel backup generators with onsite fuel storage, and hospitals reported that they were largely not disrupted by the outages.

But a number of health clinics -- which are not required to have backup power -- were closed, including those run by St. Joseph Health and the Santa Rosa Community Health clinics, while many hospitals canceled elective surgeries. John Muir Health in Walnut Creek moved medications that

25 PBS Frontline, "Fire in Paradise," October 29, 2019, <https://www.pbs.org/wgbh/frontline/film/fire-in-paradise/>

26 Leila Miller and Rong-gong Lin II, Los Angeles Times, "Cellphone Outages During Fires Preview Life After a Big Quake," November 5, 2019, <https://www.govtech.com/em/disaster/Cellphone-Outages-During-Fires-are-a-Preview-of-Life-After-a-Big-Quake.html>

27 Lisa Kroeger, San Jose Mercury News, "CPUC panel: Wireless carriers need to provide backup power," June 2, 2019, <https://www.mercurynews.com/2019/06/02/6091556/>

28 Janie Har, AP News, "Seniors at California complex 'abandoned' during blackout," October 31, 2019, <https://apnews.com/Od32cb3d9d1c4d83976d7b167f38dd72>

29 Tara Bannow, Modern Healthcare, "California hospitals rely on generators during PG&E power outages," October 11, 2019, <https://www.modernhealthcare.com/providers/california-hospitals-rely-generators-during-pge-power-outages>

need refrigeration from clinics affected by the power outage to clinics where power was maintained.<sup>30</sup> The humanitarian organization Direct Relief found in late 2019 that only 44 percent of the community health centers they surveyed across the state had any backup power at all.<sup>31</sup>

In the 2011 San Diego county blackout, a backup generator at Scripps Mercy Hospital in Chula Vista failed for two hours, forcing officials to transfer seven patients, including five on emergency battery-powered ventilators, to other hospitals. Scripps Health Chief Executive Chris Van Gorder announced plans to spend \$1 million on a second generator. “I like redundancy, so we’ll do whatever it takes,” he said. “Cost will not be an issue.”<sup>32</sup>

## TRANSPORTATION INFRASTRUCTURE

The Caldecott Tunnel delivers 181,000 commuters a day through the Oakland hills. When PG&E warned of a possible power shutoff, Caltrans rapidly deployed a set of temporary generators to power the lights, ventilation, and safety systems for the tunnel. As a longer term solution, they placed an order for a \$6 million generator that will be installed in early 2020.<sup>33</sup>

In a report on the 2011 San Diego outage, the North American Electricity Reliability Corporation (NERC) reported that the power failure “occurred near rush hour, on a business day, snarling traffic for hours. Schools and businesses closed, some flights and public transportation were disrupted, water and



sewage pumping stations lost power, and beaches were closed due to sewage spills.”<sup>34</sup>

## SCHOOLS

Schools typically serve as emergency shelters in communities hit by disasters, and feed thousands of kids through free and reduced price meal programs. Yet due to wildfires and PSPS events, 1,510 schools, serving more than 587,000 students, were closed between October 23 and November 1, 2019.<sup>35</sup>

School and community leaders are keenly aware of the problem.

<sup>30</sup> Ayla Ellison, Becker’s Hospital Review, “Power outages hit Kaiser, Dignity hospitals in California,” October 10, 2019, <https://www.beckershospitalreview.com/patient-flow/power-outages-hit-kaiser-dignity-hospitals-in-california.html>

<sup>31</sup> Direct Relief, “California Power Blackouts Reveal Widespread Vulnerability in Health Care System,” October 17, 2019, <https://www.directrelief.org/2019/10/california-power-blackouts-reveal-vulnerability-in-healthcare/>

<sup>32</sup> San Diego Union Tribune, “Scripps Mercy probed after generator fails,” September 16, 2011, <https://www.sandiegouniontribune.com/news/health/sdut-scripps-mercy-probed-after-generator-fails-2011sep16-story.html>

<sup>33</sup> KPIX-CBS, “Generators Will Keep Caldecott Tunnel Open During Power Outage,” October 9, 2019, <https://sanfrancisco.cbslocal.com/2019/10/09/power-outage-caldecott-tunnel-oakland-berkeley/>

<sup>34</sup> NERC, September 2011 Southwest Blackout Event, <https://www.nerc.com/pa/rrm/ea/Pages/September-2011-Southwest-Blackout-Event.aspx>

<sup>35</sup> Diana Lambert, EdSource, “California schools closed for unprecedented number of days due to fire, power outages,” November 5, 2019, <https://edsources.org/2019/california-schools-closed-for-unprecedented-number-of-days-due-to-fire-power-outages/619488>

“I think in those areas specifically served by PG&E we all feel a need to develop a plan,” Superintendent Ron Carruth, of the El Dorado Union High School District, told EdSource. “They have said publicly that this is a condition that will exist for the next 10 years. We have to find a way to not be dependent on PG&E, so we don’t have a school year disrupted like we had for the last two weeks.”

The District, just east of Sacramento, “flipped the switch” on 3.2 MW of solar on four school campuses in September. While the projects will save \$12.8 million over 25 years, and were financed by the installer, they are not paired with batteries so will not provide power during outages.<sup>36</sup> The District is planning to put a \$120 million facilities bond on the ballot on March 3 that could be used to buy backup batteries to keep the electricity on during power outages.

Given the long list of critical facilities in California, these events provide only a small sample of the widespread disruptions that can be caused by power outages, and the large expenses incurred by customers providing their own backup solutions.

## THREATS TO LOW-INCOME HOUSEHOLDS AND COMMUNITIES OF COLOR

While all communities may suffer from power outages, low-income households and communities of color are likely to suffer more. Low-income households and communities of color have fewer resources to rely on in the event of an emergency, and less ability to absorb financial losses from outages.<sup>37</sup> Closed businesses can mean no work and no pay for hourly employees, who often live paycheck-to-paycheck. School closures can have families scrambling to find childcare and losing work and wages as parents stay home with kids. Medical care including access to prescription drugs can be compromised, as well as transportation when public transportation, street lights or gas stations don’t function. Finally, communities with high rates of respiratory problems are especially vulnerable to harmful pollution when fossil backup generators are widely used during a power outage. Taken together, these impacts of power outages can be terrifying and damaging to underserved communities.

***Low-income households and communities of color have fewer resources to rely on in the event of an emergency, and less ability to absorb financial losses from outages.***

Food security is an especially acute problem for low-income households. Many low-income families rely on school meal programs to feed their kids. A sufficiently long outage can cause refrigerated food to spoil, wasting potentially hundreds of dollars worth of groceries. Households that rely on the Supplemental Nutrition Assistance Program (SNAP), school lunch programs, or other food assistance programs are especially at risk.

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<sup>36</sup> El Dorado Union High School District, Press release: “El Dorado Union High School District Energizes Campuses with Clean Energy Program - Will Save \$12.8 Million in Energy Costs,” September 16, 2019, <http://edcoe.org/el-dorado-union-high-school-district-energizes-campuses-with-clean-energy-program-will-save-12-dollars-8-cents-million-in-energy-costs>

<sup>37</sup> NAACP Environmental and Climate Justice Program, Lights Out in the Cold: Reforming Utility Shut-Off Policies as if Human Rights Matter, March 2017, [https://www.naacp.org/wp-content/uploads/2017/12/Lights-Out-in-the-Cold\\_NAACP.pdf](https://www.naacp.org/wp-content/uploads/2017/12/Lights-Out-in-the-Cold_NAACP.pdf).

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“School closures affect families differently,” said Tony Thurmond, state superintendent of public instruction. “Some families may not be able to make arrangements to stay home with their children or have healthy meals available at home. These students may be the same students that need school the most.”<sup>38</sup>

The US Department of Agriculture, which runs the SNAP program, offers D-SNAP -- Disaster SNAP -- to help income-qualified households with food loss or damage caused by a natural disaster by providing replacement funds for food. To authorize the program, a state must declare a disaster, and the President and USDA must approve it.<sup>39</sup> USDA approved two “mass replacement requests” after the PG&E power outages in October 2019, covering recipients in 28 California counties, allowing households to replace some of their SNAP benefit for the month.<sup>40</sup>

Lastly, many low-income people and people with disabilities are renters in apartments. As such, they are unable to control their own energy choices in the same way homeowners can, with solar panels and batteries or even fossil backup generators (which cannot safely be located indoors, due to carbon monoxide emissions). While California’s Solar on Multifamily Affordable Housing (SOMAH) and Single Family Affordable Solar Housing (SASH) programs are helping bring solar to low-income and disadvantaged communities, these programs are limited by geography and housing type, as well as funding, so those programs cannot reach every low-income or disadvantaged community household in need.<sup>41</sup>

38 Diana Lambert, EdSource, “California schools closed for unprecedented number of days due to fire, power outages,” November 5, 2019, <https://edsources.org/2019/california-schools-closed-for-unprecedented-number-of-days-due-to-fire-power-outages/619488>

39 US Department of Agriculture, Disaster Supplemental Nutrition Assistance Program (D-SNAP), accessed November 2019, <https://www.disasterassistance.gov/get-assistance/forms-of-assistance/5769>

40 US Department of Agriculture, California Disaster Nutrition Assistance, accessed November 2019, <https://www.fns.usda.gov/disaster/california-disaster-nutrition-assistance>

41 See <https://www.calsomah.org> and <https://gridalternatives.org/what-we-do/program-administration/sash> for more information.



## SIDEBAR: INTERVIEW WITH MICHAEL WARA

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### QUESTION:

**How did we get into our current predicament, both the wildfires and the PSPS?**

It has multiple causes. We built lots of suburban or exurban communities in the '50s through '80s, and the brush and trees have grown up around them, creating a lot of fuel. More homes means more overhead wires. Ignitions due to utility infrastructure come mostly from wind events, so if a fire starts it is rapidly spread.

Combine that with utility maintenance practices that tolerate a certain amount of failure in the grid, like when the first winter storm causes power lines to go out for a few hours, and PG&E comes out to fix the line—no big deal.

But climate change has now delayed the onset of rainy season, extending fire season into the fall. So now when those wind storms come and damage the lines they are happening with dry fuels instead of wet fuels.

All these things have led to risks accelerating over the past 12 to 15 years to an unacceptable level.

### QUESTION:

**How do we solve these problems?**

The most important step is to think systematically about reducing risk for residents in high-threat areas. We shouldn't think about risk in silos -- like grid resilience, or individual house hardening, or escape routes -- but about the whole constellation of actions. In energy, that means not just grid hardening but a comprehensive strategy that includes grid hardening when cost effective, combined with PSPS and microgrids.

Solar + storage is not a silver bullet, but it can keep people safe in certain contexts. We also have a need for speed. I filled out an application to get a Tesla PowerWall battery this week, and they called



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today and we are moving forward in a matter of weeks. Compare that to utility or forest management timelines, which are measured in years.

Of course, I can afford to write a check for two PowerWalls, but most people can't. So we need a way for everybody to get the help they need.

We also need to help alleviate the problems small businesses are facing. A resilient community needs thriving small businesses, especially in small towns. PG&E is doing their "resilience zones," kind of like a pop-up temporary microgrid, but we can do better than that. We can create resources for towns to help themselves, so they can keep the lights on downtown. And the same for critical infrastructure.

A key part of that is that policymakers need to solve the legal barriers to microgrids serving multiple owners and customers, like the over-the-fence

problem. [See the example of the BEAT project on page 48.] Everyone has an interest in solving this problem.

I think the CPUC needs to break some china here. They would have the strong support of the state. In the high threat areas, PG&E has an enormous interest in making this happen. It may cause them to lose a little money in the long run from losing some of their monopoly. But until they can stop needing to use the PSPS, then they need to be willing to make some trades.

**QUESTION:**

**Do you think the PSPS strategy is ever going away?**

We do need to make PSPS less disruptive, but we have to acknowledge it is a tool in the toolbox. What would it take to put it away? The most striking fact to me is that SDG&E is using it more than it ever has, even after a decade of hardening the grid, sectionalizing, adding weather stations, etc. They invented this whole approach, but they are using PSPS more than ever.

I have not seen a solution where we don't use PSPS a lot in the next 10 years. If PSPS is intolerable, then we need an alternative; otherwise, we have to live with it.

**QUESTION:**

**Why not just take everybody off the grid with solar and batteries?**

There are about 12 million single family homes in California. PSPS is a major problem for a million, and a lesser problem for another million, though that could grow with climate change. The other 5/6 of

the houses in the state still need a good transmission and distribution grid, plus a wider Western market to move power around the region.

I don't think we need solar + storage in every home in the state, but it has a different and unique value in fire country.

There is a wild card we need to keep in mind though. All the things PG&E wants to do to the grid are quite expensive. That means grid connection charges will go up on utility bills. If battery prices fall another 90 percent, like they have, that could lead to grid defection, where people use their solar and storage to disconnect from the grid. Solar has gotten cheap, and now batteries will enjoy the economies of scale from the growth of electric cars, so their prices could fall faster than solar.

Plus there's the idea of using the Tesla Model 3 I already have in my driveway during outages. That battery is the size of three PowerWalls. I don't know why I can't have that power my house.

**QUESTION:**

**Would public or cooperative ownership of the grid change things?**

I think there are good and bad investor-owned utilities and public utilities when it comes to safety and management. No one has been able to tell me how public ownership necessarily improves safety. It can definitely cut costs, by getting access to lower cost capital. But if it takes years of fighting to set it up, it will create delays at a time when we can't have delays.



## CONVENTIONAL SOLUTIONS TO WILDFIRES AND OUTAGES

The catastrophic wildfires of recent years, the resulting bankruptcy of PG&E, and the use of Public Safety Power Shutoffs as a preventative measure, have triggered widespread anger and frustration at utilities. But the crisis has also spurred a rapidly growing list of ideas for solutions, ranging from simple tree trimming to full public ownership of the grid.

Most of the proposed solutions are conventional -- simply do more of what has been done in the past. While each of these conventional strategies to wildfires and outages can protect public safety in some ways, they are also expensive, slow to implement, or dangerous. Many would further lock in what is clearly an unsustainable, inequitable and unsafe power system.

### GRID HARDENING, TREE AND BRUSH REMOVAL

A number of the major fires that have burned California in recent years were caused by the failure of power equipment. The Camp Fire, for example, which burned Paradise, California and killed 85 people, started when high winds blowing on PG&E transmission lines caused a line holder to break, dropping the live wire onto dry brush below.<sup>42</sup>

The tower suspected of causing the fire was 99 years old.<sup>43</sup>

California has 34,015 miles of high voltage transmission lines, and 147,007 miles of distribution lines above ground, and an additional 74,202 miles of underground lines which are almost entirely distribution lines in dense urban areas.<sup>44</sup> There are almost 4 million power poles, plus 200,000 transmission line towers.

PG&E has the largest service territory of California utilities, serving 5.3 million customers in 48 counties. It has by far the most wires and towers, with two-thirds of the state's above-ground wires and three-fourths of the transmission towers.

In their 2019 wildfire mitigation plan, PG&E reported that they removed 160,000 trees and cleared 760 miles of power line corridors of brush in 2018. In 2019, they planned to increase tree removals to 375,000 and clear 2,450 miles of corridors.<sup>45</sup>



<sup>42</sup> KCRA, "Cal Fire: PG&E transmission lines caused deadly 2018 Camp Fire," May 16, 2019, <https://www.kcra.com/article/camp-fire-wildfire-cause/27484272>

<sup>43</sup> Jill Cowan, New York Times, "What One Old Tower Says About PG&E's Lax Safety Culture," March 20, 2019, <https://www.nytimes.com/2019/03/20/us/tower-pge-safety-culture-camp-fire.html>

<sup>44</sup> California Public Utilities Commission, Utility Infrastructure data, accessed November 2019, [https://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/Utilities\\_and\\_Industries/Energy/Energy\\_Programs/Infrastructure/Utility%20infrastructure%20data%20-%20formatted.pdf](https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Infrastructure/Utility%20infrastructure%20data%20-%20formatted.pdf)

<sup>45</sup> PG&E, Wildfire Mitigation Plan, CPUC docket R18-10-007, February 6, 2019, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M263/K673/263673423.PDF>

Utilities are also deploying other measures to reduce fire risk, such as using non-wood poles that don't burn, wrapping wires to protect against short circuits, burying more lines, and installing rapid fault switches that shut off power before a broken wire hits the ground. Utilities can also use more precise digital controls to "sectionalize" the grid, allowing them to more finely control outages to specific areas. Greater situational awareness can come from distribution fault anticipation (DFA) technology, installing more weather stations that collect highly detailed information on wind, temperature, and dryness, and more video cameras, drones, and helicopters.

PG&E proposed all of these measures in their wildfire mitigation plan, with a total 2019 price tag of as much as \$1.9 billion for capital investments and \$885 million on operating expenses. Considering their approved revenue in 2019 was about \$13 billion, this could result in a sizable rate increase.<sup>46</sup>

## UNDERGROUNDING

While many people think burying lines underground -- "undergrounding" -- is the ultimate solution to reliability, this isn't necessarily so. Undergrounding lines is slow and costly, and does not guarantee that the lines are safe from damage. Indeed, when there is damage, locating it and repairing it underground can take longer and be more expensive than with overhead wires.

As mentioned, the state has almost 75,000 miles of wires underground, but much of this was installed when urban neighborhoods were built. Converting

above-ground distribution lines to underground in an already-built urban environment is extremely expensive, as much as \$5 million per mile.<sup>47</sup> A study for the City of Berkeley found that undergrounding 40 miles of distribution lines along major streets and wooded areas would cost over \$200 million, more than \$1600 per resident of the city. The study also calculated the benefits, and found that the largest benefit was "increased property values" for people who live near the undergrounded lines, often in the affluent Berkeley hills.<sup>48</sup>

**According to one economist's estimate, undergrounding transmission and distribution lines in PG&E's fire risk zones would cost about \$183 billion, while deploying microgrids could cost one-tenth as much.**

Undergrounding distribution lines costs less in rural areas, ranging from \$300,000 to \$2 million per mile, but there are many more miles. Undergrounding high voltage transmission lines cost much more, with estimates exceeding \$30 million per mile.<sup>49</sup> The regulatory economist Richard McCann did a rough calculation of undergrounding costs, assuming that PG&E has 25,000 miles of distribution lines and 4,300 miles of transmission in wildfire risk zones. He calculates that undergrounding the lines in these zones would cost about \$183 billion, while installing microgrids to serve a proportionate amount of load would cost about \$13 billion.<sup>50</sup>

While microgrids may not be a solution for all customers in high fire risk zones, and a more detailed

46 CPUC, Actions to Limit Utility Costs and Rates - Annual Report to the Governor and Legislature (SB 695), May 2019, [https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About\\_Us/Organization/Divisions/Office\\_of\\_Governmental\\_Affairs/Legislation/2019/SB%20695%20Report\\_May%202019\\_FINAL.pdf](https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About_Us/Organization/Divisions/Office_of_Governmental_Affairs/Legislation/2019/SB%20695%20Report_May%202019_FINAL.pdf)

47 Kenneth L. Hall, Hall Energy Consulting, Inc., Out of Sight, Out of Mind 2012: An Updated Study on the Undergrounding of Overhead Power Lines, Prepared for Edison Electric Institute, January 2013, <https://www.eei.org/issuesandpolicy/electricreliability/undergrounding/Documents/UndergroundReport.pdf>

48 Berkeley City Council Undergrounding Subcommittee, Conceptual Study To Underground Utility Wires in Berkeley, February 20, 2018, [https://www.cityofberkeley.info/Clerk/City\\_Council/2018/02\\_Feb/Documents/2018-02-20\\_WS\\_Item\\_03\\_Conceptual\\_Study\\_for\\_Undergrounding.aspx](https://www.cityofberkeley.info/Clerk/City_Council/2018/02_Feb/Documents/2018-02-20_WS_Item_03_Conceptual_Study_for_Undergrounding.aspx)

49 Kenneth L. Hall, Hall Energy Consulting, Inc., Out of Sight, Out of Mind 2012: An Updated Study on the Undergrounding of Overhead Power Lines, Prepared for Edison Electric Institute, January 2013, <https://www.eei.org/issuesandpolicy/electricreliability/undergrounding/Documents/UndergroundReport.pdf>

50 Richard McCann, M.Cubed, "Microgrids could cost 10% of undergrounding PG&E's wires," December 17, 2019, <https://mcubedecon.com/2019/12/17/microgrids-could-cost-10-of-undergrounding-pges-wires/>

engineering analysis is needed to confirm costs, the point is that resilient clean energy should be evaluated as a cost-effective alternative to undergrounding and other grid-hardening efforts. Like Borrego Springs, the best solution in some cases may be to live with periodic power shutoffs, but protect customers from harm -- and deliver other benefits -- with clean microgrids.

PG&E notes that “underground lines are not immune to weather damage and are vulnerable to equipment issues, lightning strikes, flooding, earthquakes, and excavation damage by a third party. When underground systems are damaged, locating fault areas and undertaking excavation processes can be time-consuming. Underground lines can take almost twice as long to repair when damage occurs.”<sup>51</sup>

Still, in some cases undergrounding makes sense, and utilities do continue to put wires underground, under the Rule 20 program. Launched in 1967, the program has funded work on about 2500 miles of utility lines. The program allocates \$95 million of credits across about 500 communities each year, which the communities save up to spend on underground conversion projects. Communities have built up credit balances of over \$1 billion as of 2016. Southern California Edison and San Diego Gas & Electric reported spending over half a billion dollars on undergrounding projects between 2006 and 2015.<sup>52</sup>

An audit of PG&E’s undergrounding program found that the company diverted \$123 million into other programs between 2007 and 2016 (about 22 percent of the program budget), was completing fewer projects than planned, and was spending more per mile than typical projects should cost.<sup>53</sup>

## FURTHER PLANNED POWER OUTAGES

Given the high cost and slow timeline of grid improvements plus the state policy of “inverse condemnation” that assigns utilities financial liability for fires started by their infrastructure -- regardless of whether they are found to be negligent -- utilities are expected to continue resorting to Public Safety Power Shutoffs for years to come. PG&E CEO Bill Johnson said as much at a CPUC hearing on October 18, 2019.

“We recognize the hardship that the recent PSPS event caused for millions of people and want to continue working with all key shareholders to lessen this burden going forward,” Johnson wrote in a letter to the PUC. But it will probably be 10 years before the need for shut-offs is “really ratcheted down significantly,” Johnson said.

Johnson defended the PSPS as a life-saving measure. “At the same time, we ask our customers, their families, and our local and state leaders to keep in mind that statistic that matters most: there were no catastrophic wildfires.”<sup>54</sup> Indeed, after the PSPS event of October 9-11, PG&E said they found more than 100 instances of damage or hazards to their de-energized equipment that could have started a fire, such as branches and trees that fell onto power lines.<sup>55</sup>

San Diego Gas & Electric has been using power shutoffs to prevent wildfires since 2008, after their lines were implicated in starting the Witch Fire, which destroyed 1650 structures and killed two people. Southern California Edison didn’t use a power shutoff until 2017, while PG&E did not develop a policy

51 PG&E, “Facts About Undergrounding Electric Lines,” October 31, 2017, <https://www.pgecurrents.com/2017/10/31/facts-about-undergrounding-electric-lines/>

52 California PUC, Program Review: California Overhead Conversion Program, Rule 20A, For Years 2011-2015: The Billion Dollar Risk!, November 23, 2016, [https://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/About\\_Us/Organization/Divisions/Policy\\_and\\_Planning/PPD\\_Work\\_Products\\_\(2014\\_forward\)\(1\)/PPD\\_Rule\\_20-A.pdf](https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work_Products_(2014_forward)(1)/PPD_Rule_20-A.pdf)

53 AzP Consulting, LLC, Audit of PG&E Rule 20A Undergrounding Program, CASE NO. A.15-09-001, October 15, 2019, <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442462983>

54 Richard Gonzales, NPR News, “California Can Expect Blackouts For A Decade, Says PG&E CEO,” October 18, 2019, <https://www.npr.org/2019/10/18/771486828/california-can-expect-blackouts-for-a-decade-says-pg-e-ceo>

55 J.D. Morris, San Francisco Chronicle, “PG&E CEO: Blackouts could last 10 years, but impact should ease,” October 18, 2019, <https://www.sfchronicle.com/business/article/PG-E-CEO-California-should-consider-taking-over-14545613.php>

until 2018. In July 2018 the California Public Utilities Commission set standards on the reasonableness,

notification, mitigation and reporting of power shutoffs, and in May 2019 they updated those standards.<sup>56</sup> In August 2019, the CPUC also opened a second phase to look at impacts on “functional needs populations,” communication with customers, mitigation measures, coordination with emergency responders, and shutting off transmission lines.<sup>57</sup>

Still, as Governor Newsom says, frequent and widespread power outages can’t be the new normal. They impose too many risks to public health and safety, and impose potentially huge costs on society. We need better strategies to deal with wildfire risk.

## FOSSIL BACKUP GENERATORS (BUGS)

The power outages have led many customers to seek their own solutions, often in the form of a gasoline- or diesel-fueled generator. These fossil backup generators -- sometimes called BUGs -- have a low initial purchase cost, but they come with a host of risks and problems.<sup>58</sup>

## CARBON MONOXIDE POISONING

Safety is the biggest risk with BUGs, both for the

health of the user and for the risk of starting a fire. BUGs are implicated in an average of 80 deaths per year from carbon monoxide (CO) poisoning, according to the Consumer Products Safety Commission.<sup>59</sup> Another 20,000 people

visit the emergency room and more than 4,000 are hospitalized each year from carbon monoxide poisoning from BUGs.<sup>60</sup>

Commonly, an inexperienced user will set up a portable generator either in a home, a basement, or an attached garage, and fill the house with the odorless and invisible carbon monoxide exhaust. In one devastating example, a single dad and his seven children were found dead in their Maryland home in 2015 after setting up a generator in their kitchen. Their power had been shut off for non-payment of their utility bill.<sup>61</sup>

A 5 kilowatt portable gasoline generator, big enough to power a home, produces carbon monoxide at a rate equivalent to 450 cars.<sup>62</sup> Emission rates as low as 27 grams of CO per hour continuously for 18 hours can result in dangerous levels of concentration, while generators tested by the National Institute for Standards and Technology (NIST) emitted CO at a rate of 500 to 4,000 grams per hour. The BUG industry has strongly resisted mandates from the Consumer Products Safety Commission (CPSC) to cut carbon monoxide emissions, even though it is technically feasible.<sup>63</sup>

56 CPUC Electric Safety and Reliability Branch, “Resolution ESRB-8: Resolution Extending De-energization Reasonableness, Notification, Mitigation and Reporting Requirements In Decision 12-04-024 To All Electric Investor Owned Utilities,” July 12, 2018,

57 CPUC, “De-Energization (PSPS)” web page, accessed November 2019, <https://www.cpuc.ca.gov/deenergization/>

58 They are also sometimes called small off-road engines, or SOREs.

59 Matthew V. Hnatov, U.S. Consumer Product Safety Commission, Incidents, Deaths, and In-Depth Investigations Associated with Non-Fire Carbon Monoxide from Engine-Driven Generators and Other Engine-Driven Tools, 2005-2017, September 2018, [https://www.cpsc.gov/s3fs-public/Generators%20and%20OEDT%20Fatalities%202018%20FINAL.pdf?EHbNEzxP3czGisZg9\\_BY2b7wPgMjltZu](https://www.cpsc.gov/s3fs-public/Generators%20and%20OEDT%20Fatalities%202018%20FINAL.pdf?EHbNEzxP3czGisZg9_BY2b7wPgMjltZu)

60 National Institute of Standards and Technology (NIST), “Study Provides Details on Portable Generator Emissions and Carbon Monoxide Exposure,” July 10, 2013, <https://www.nist.gov/news-events/news/2013/07/study-provides-details-portable-generator-emissions-and-carbon-monoxide>

61 Juliet Linderman, Associated Press, “Eight family members die in generator tragedy in Maryland,” April 7, 2015, <https://www.csmonitor.com/USA/Politics/2015/0407/Eight-family-members-die-in-generator-tragedy-in-Maryland>

62 Janet Buyer, U.S. Consumer Product Safety Commission, “Portable Generators And Carbon Monoxide Poisoning,” presentation at the SAE Small Engine Technology Conference, Charleston, SC, November 16, 2016, [https://www.cpsc.gov/s3fs-public/PresentationSAE\\_SETC.pdf](https://www.cpsc.gov/s3fs-public/PresentationSAE_SETC.pdf)

63 Jesse Eisinger and ProPublica, “The Deaths That Come When an Industry’s Left to Regulate Itself,” The Atlantic, December 8, 2017, <https://www.theatlantic.com/business/archive/2017/12/regulations-portable-generators-cpsc-buerkle/547781/>

## FIRE HAZARD

Ironically, in the context of wildfires and power outages, BUGs also pose a fire hazard. From 2009 through 2017, BUGs were involved in 387 fires in California alone, according to state data, an average of 43 fires annually. These fires caused over \$19 million in damage and injured 15 civilians and firefighters. Just over half of the fires were caused by generator equipment failure, while the rest involved user error of some kind. The bulk of the fires were in houses or outdoors, burning nearly 3500 acres of crops and wild lands.<sup>64</sup>

While the OSFM fire data is not detailed enough to say why the generators were being used, there have been anecdotal reports of BUGs causing fires during the 2019 PSPS outages. For example, El Dorado County Fire Chief Lloyd Ogan told the Chronicle that his department responded to three generator-caused fires during the October 2019 outages, including one started by a 90-year old man in Nevada County when he ran his 30-year old generator next to his garage.<sup>65</sup>

The fire risk of BUGs is so high that this year the CPSC required safety recalls for almost 250,000 generators sold by Honda, Yamaha, and Firman due to their potential to leak fuels and start fires.<sup>66</sup>

An additional risk is posed by the fuel stored on site for the generators. Cans of gasoline and propane are extremely flammable, even explosive. A standard 5 kilowatt generator could consume around 18 gallons of gasoline during a 24 hour period. Getting more gasoline during a power outage can be difficult, due to high demand, traffic problems due to blacked-out stoplights, and the real possibility that the gas station may also be without power and unable to pump gas. As a result, people will store more fuel on site, increasing the risk.

“The longer we do this, shutting power off, the more we’re going to roll the dice on the additional risks that exist,” Fire Chief Ogan said. “We have traded one risk for a whole new set of risks.”

## Fossil Fuel Backup Generators Are Dangerous



### CARBON MONOXIDE POISONING

They kill 80 Americans annually and send 20,000 more to the emergency room



### FIRE HAZARD

They cause an average of 43 fires a year in California



### AIR POLLUTION

They pollute far more than cars, triggering asthma and increasing cancer risk.

64 Data from the Office of the State Fire Marshal’s (OSFM) California Incident Data & Statistics Program. Additional wildfires were classified by CalFire only as “electrical malfunctions,” which could include generator-related incidents. CalFire is working to adopt a more detailed reporting system.

65 Mallory Moench, San Francisco Chronicle, “During PG&E outages, generators caused fires, carbon monoxide poisoning,” November 14, 2019, <https://www.sfchronicle.com/california-wildfires/article/During-PG-E-outages-generators-caused-fires-14833601.php>

66 Consumer Product Safety Commission, Recall database, accessed November 2019, [https://www.cpsc.gov/Recalls?combine=generator&field\\_rc\\_date%5Bdate%5D=01%2F01%2F2018&field\\_rc\\_date\\_1%5Bdate%5D=](https://www.cpsc.gov/Recalls?combine=generator&field_rc_date%5Bdate%5D=01%2F01%2F2018&field_rc_date_1%5Bdate%5D=)

**FIRES INVOLVING BACKUP GENERATORS IN CALIFORNIA, 2009-2017**

PROPERTY CATEGORY	NUMBER OF FIRES	PROPERTY AND CONTENT LOSSES	ACRES BURNED	FIREFIGHTER INJURIES	CIVILIAN INJURIES
Outside, special property	132	\$2,838,975	447	0	0
Residential	124	\$5,068,244	139	4	6
Storage	39	\$560,924	0	2	1
Industrial, Utility, Defense, Agriculture, Mining	33	\$6,160,368	2,828	0	0
Business, mercantile	23	\$1,306,035	0	2	0
Health care, detention, correction	14	\$2,212,301	0	0	0
Other	10	\$117,500	3	0	0
Manufacturing	4	\$502,000	1	0	0
Assembly	3	\$15,000	0	0	0
None given	2	\$30,000	2	0	0
Undetermined	2	\$259,000	0	0	0
Educational	1	\$100,000	0	0	0
<b>Total</b>	<b>387</b>	<b>\$19,170,347</b>	<b>3,419</b>	<b>8</b>	<b>7</b>

Source: Office of the State Fire Marshal's (OSFM) California Incident Data & Statistics Program, CalStats data warehouse.



## AIR POLLUTION

Air pollution is another major source of harm from BUGs. During power outages, BUGs can run for many hours, often in close proximity to people. While air regulators issue permits for stationary BUGs with strict limits on emissions during testing, those limits do not apply when the generators are running during emergencies -- precisely when they run the most. Portable BUGs do not require permits at all, but new ones must meet emission standards set by the California Air Resources Board (CARB) and the US EPA.

### BUGs typically emit three categories of pollutants:

- **Criteria pollutants and precursors**, including carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), particulate matter (PM-10 and PM-2.5), nitrogen oxides (NO<sub>x</sub>), and volatile organic compounds (VOCs). These emissions can cause death, exacerbate lung disease, and contribute to smog.
- **Hazardous air pollutants (HAPs)**, including acetaldehyde, acrolein, benzene, formaldehyde, toluene, and xylene. These pollutants can cause irritation of the eyes, ears, nose and throat, headaches and nausea, and damage to the liver, kidney and nervous system, as well as cancer.
- **Greenhouse gases (GHGs)**, including carbon dioxide (CO<sub>2</sub>) and methane.

Large diesel generators, such as those used by businesses and other large customers, are the biggest pollution risk. Diesel soot is the number one airborne carcinogen in California, and the state's most significant toxic air pollution problem. CARB estimates that running a one-megawatt diesel engine with no pollution controls for only 250 hours per year

would result in a 50 percent increase in cancer risk to residents within one city block.<sup>67</sup>

A typical standby diesel generator produces 25-30 pounds of nitrogen oxides per megawatt hour of power generated, a rate that is 50 to 60 times the NO<sub>x</sub> pollution from a typical California gas-fired power plant. Given that many regions of the state are out of compliance for state and federal standards on ozone and particulates, increases in pollution could lead to additional health impacts and regulations on business.<sup>68</sup>

"I've been reading about how people were going to buy diesel backup generators, and that is so much the opposite of where we're trying to go," said California Energy Commission Vice Chair Janea Scott, at a July 2019 workshop.<sup>69</sup>

While an individual generator may pose a relatively small emissions problem on its own, the risk is compounded when many homes or business owners resort to generators during outages. "Imagine if you are in a large metropolitan area like Los Angeles or the Bay Area and you have hundreds or thousands of these engines kicking in," says Dr. Laki Tisopulos, executive officer of the Ventura County Air Pollution Control District. "All of a sudden you have many localized sources of pollution that are spewing carcinogens right where we breathe. It can be next door to a school, a hospital."<sup>70</sup>

The state Air Resources Board has estimated that 125,000 BUGs were operated during the October 2019 PSPS events. From only 50 hours of operation, the BUGs produced an estimated 166.4 tons of NO<sub>x</sub>, 19.4 tons of particulates, and 8.9 tons of diesel particulates.

The diesel particulates, they said, were equivalent to

67 Santa Barbara Air Pollution Control District, "Do You Really Need a Diesel Generator?" accessed December 2019, <https://www.ourair.org/do-you-really-need-a-diesel-generator/>

68 CARB, Area Designations Maps / State and National, as of October 24, 2019, <https://ww3.arb.ca.gov/desig/adm/adm.htm>

69 David Krause, California Energy Markets, "State Regulators Voice Concerns About Uptick in Diesel Generator Sales," August 2, 2019, issue No. 1550, [https://www.newsdata.com/california\\_energy\\_markets/](https://www.newsdata.com/california_energy_markets/)

70 John Flesher, Associated Press, "California power shutdowns raise air pollution worries," October 12, 2019, <https://apnews.com/1e3a4ce2027648a7aef417444fba29e5>

driving 29,000 heavy duty diesel trucks on California roadways for a month, or 87 million total miles of travel.<sup>71</sup>

***The state Air Resources Board found that fossil fuel backup generators running during the October 2019 power outages created as much pollution as 29,000 heavy duty diesel trucks driving on California roadways for a month.***

## BOOMING SALES

Despite the many public health and safety risks of BUGs, sales appear to be shooting up. Generac, a major supplier of home standby generators, says their California business is booming, with in-home consultations up by fourfold and sales three times higher than a year ago. The company has hired sales reps and opened a storefront and warehouse in the Sacramento area. Generac CEO Aaron Jagdfeld told investors, “We don’t see it slowing down, we really don’t.”<sup>72</sup>

A spokesman for industry leader Briggs & Stratton added, “I don’t think this is going to be an opportunity that goes away. I think it’s one that’s going to be building over time.”

In the face of heavy demand for generators during the outages, CARB issued an emergency waiver to allow the sale of BUGs that don’t meet California emission

standards.<sup>73</sup> While the order is temporary, for just the last two months of 2019, it will compound the pollution problem as those generators will operate for many years to come.

The boom is also being felt with big customers, who are turning to large generators to maintain power. Data centers are an especially big user of diesel BUGs. A set of three data centers in Silicon Valley has requested permits to install a total of 142 large diesel BUGs with a total capacity of 385.5 megawatts, larger than a typical utility-scale power plant. The CEC said they expect permit applications from a total of eight data centers in Santa Clara and San Jose by the end of 2019.<sup>74</sup>

***Three data centers in Silicon Valley have requested permits to install a total of 142 large diesel BUGs with a total capacity of 385.5 megawatts, larger than a typical utility-scale power plant.***

Unfortunately, the Air Resources Board and the Energy Commission collect only sporadic statewide data on the numbers and locations of stationary backup generators. In 2001, the ARB estimated there were 26,000 diesel Stationary Offroad Engines (SOREs) in California, including 19,659 BUGs.<sup>75</sup> ARB currently has 12,805 portable diesel generators (above 25 hp) registered in the Portable Equipment Registration Program (PERP), but doesn’t track other generator types.<sup>76</sup>

71 California Air Resources Board, “Emission Impact: Additional Generator Usage Associated with Power Outage,” January 30, 2020, [https://ww2.arb.ca.gov/sites/default/files/2020-01/Emissions\\_Inventory\\_Generator\\_Demand%20Usage\\_During\\_Power\\_Outage\\_01\\_30\\_20.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-01/Emissions_Inventory_Generator_Demand%20Usage_During_Power_Outage_01_30_20.pdf)

72 Leticia Miranda, NBC News, “As California burns, generator companies make a power grab,” November 6, 2019, <https://www.nbcnews.com/business/business-news/california-burns-generator-companies-make-power-grab-n1076611>

73 CARB, “California State of Emergency (October 27, 2019): Sale, Offer for Sale, and Importation of U.S. EPA Certified Residential-Type Generators into California,” Advisory #297, October 31, 2019, <https://ww2.arb.ca.gov/resources/documents/advisory297>

74 David Krause, California Energy Markets, “CEC Reviewing Silicon Valley Data Center Diesel-Generator Applications,” September 13, 2019, issue No. 1556, [https://www.newsdata.com/california\\_energy\\_markets/](https://www.newsdata.com/california_energy_markets/)

75 B. Freeman, Electric Power Research Institute, Demonstration of a NOx Control System for Stationary Diesel Engines, for the California Energy Commission, CEC-500-2005-129, July 2005, <https://ww2.energy.ca.gov/2005publications/CEC-500-2005-129/CEC-500-2005-129.PDF>

76 California Air Resources Board, “Emission Impact: Additional Generator Usage Associated with Power Outage,” January 30, 2020, [https://ww2.arb.ca.gov/sites/default/files/2020-01/Emissions\\_Inventory\\_Generator\\_Demand%20Usage\\_During\\_Power\\_Outage\\_01\\_30\\_20.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-01/Emissions_Inventory_Generator_Demand%20Usage_During_Power_Outage_01_30_20.pdf)

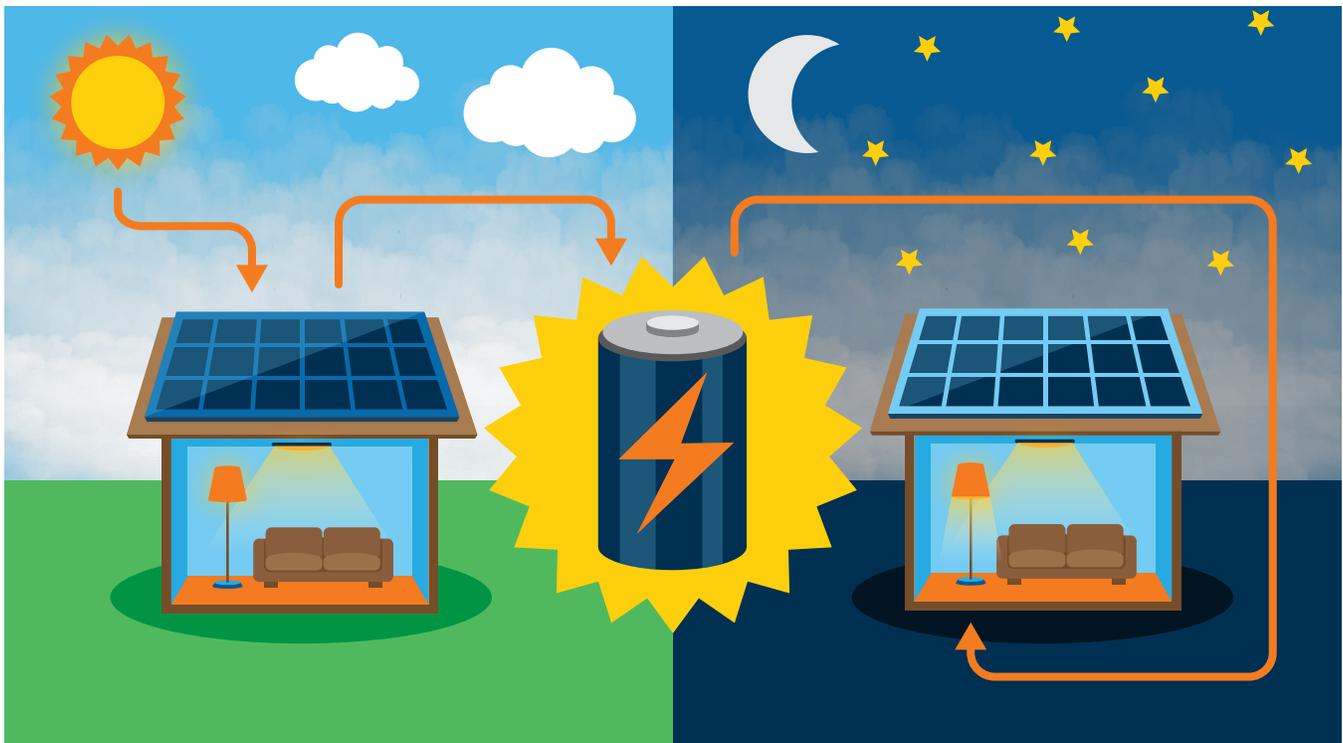
## CLEAN AND EQUITABLE SOLUTIONS

Continuing to bear the costs and risks of power shutoffs is unacceptable. Yet making a fully fireproof grid would take many years and cost billions of dollars. (It would also be chasing a moving target, as climate change makes California increasingly prone to fire.) Dirty backup generation poses unacceptable risks to health and safety, exacerbates inequities, and moves us backward on progress toward clean energy.

Fortunately, new technologies and strategies are available that can meet many needs at once: contributing to a safer and cleaner grid as well as protecting customers from the impacts of outages. While California is a global leader in solar power, with

over a million customer-owned systems, it is also in the vanguard of the emerging field of energy storage. Distributed solar + storage creates cost effective synergies for a very wide range of applications, from streetlights to urban microgrids.

These systems can also save money, even compared to grid power. Solar prices have fallen to less than \$3 per Watt installed, and can beat retail electricity prices in at least 20 states.<sup>77</sup> Battery prices have fallen 87 percent since 2010, according to Bloomberg New Energy Finance, and are expected to fall another third by 2023.<sup>78</sup>



*How resilient solar works as a backup during a power outage: When the grid goes down, an automatic switch moves the system into “island mode.” In the daytime, the sun powers some or all of the building’s power needs and recharges the battery. At night, the battery supplies power to the building or critical loads. As long as the sun shines, the cycle repeats.*

<sup>77</sup> Mike Munsell, Greentech Media, “GTM Research: 20 US States at Grid Parity for Residential Solar,” February 10, 2016, <https://www.greentechmedia.com/articles/read/gtm-research-20-us-states-at-grid-parity-for-residential-solar>

<sup>78</sup> Bloomberg New Energy Finance, “Battery Pack Prices Fall As Market Ramps Up With Market Average At \$156/kWh In 2019,” December 3, 2019, <https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/>

Together, distributed solar and storage create “resilient solar.” When the grid is functioning, resilient solar provides clean energy and energy services that reduce air pollution, lower customer costs, and improve grid reliability. If the grid goes down, resilient solar can provide backup energy for critical power needs indefinitely, if sized correctly and the sun shines. (Critical power needs are those the customer considers essential for daily functioning, which can vary.) The ability to provide clean backup power day after day without refueling makes resilient solar an excellent solution, especially for medically vulnerable customers, low-income households and communities of color, and the critical facilities that provide services during emergencies.

***When the grid is functioning, resilient solar provides clean energy and energy services that reduce air pollution, lower customer costs, and improve grid reliability. If the grid goes down, resilient solar can provide backup energy indefinitely, if sized correctly and the sun shines.***

Unlike gasoline and diesel backup generators, resilient solar is clean, quiet, and safe. Even better, resilient solar has a financial payback, while BUGs do not, creating the opportunity to get “resilience for free,” as one report described it.<sup>79</sup>

Plus, by building on the massive progress already made in solar, we can rapidly deploy storage to create resilience. Among the 1 million solar rooftops on homes and businesses are almost 2,000 schools with solar, schools that are often used as emergency community shelters. About 9,000 low-income

households have gone solar with help from the Single-family Affordable Solar Housing (SASH) program, plus 500 apartment buildings through the multi-family program (MASH).<sup>80</sup>

In short, for customers who want backup power during power outages, resilient clean energy is the most reliable, safest, and cleanest solution, as well as the most affordable if you look beyond just the upfront purchase cost (see financial comparison on p. 43). It can come in all sizes, solving problems from small to large, from individual stoplights to whole communities and campuses.

#### WHAT IS A MICROGRID?

**The term microgrid is catching on, but it is not always clearly defined. Broadly, a microgrid is an interconnected set of electricity loads, generation, and storage that can operate while connected to or disconnected from the larger grid. The term can be used to describe many configurations, everything from single road signs to whole towns.**

**In this report, we use microgrid more narrowly to refer to a small grid -- a cluster of buildings -- rather than a single building or load. We use solar + storage or resilient solar to refer to solar-powered microgrids serving single buildings or loads.**

<sup>79</sup> Lew Milford, Robert Sanders, and Seth Mullendore, Clean Energy Group, Resilience for Free: How Solar+Storage Could Protect Multifamily Affordable Housing from Power Outages at Little or No Net Cost, October 2015, <http://bit.ly/Resilience-For-Free>

<sup>80</sup> CPUC, California Distributed Generation Statistics, accessed December 2019, <https://www.californiadgstats.ca.gov/>

## SMALL-SCALE SOLUTIONS: STREETLIGHTS AND STOPLIGHTS, CELL PHONE TRANSMITTERS, AND PORTABLE SOLAR + BATTERIES

In times of crisis, streets and phones become critically important. Thousands of people can be evacuating an area, driving to safe places, while calling for help or trying to reach loved ones to ensure they are safe. Yet these systems are also uniquely vulnerable to power outages, posing the risk of mass chaos.

Streetlights and stoplights are typically grid connected, and only some stoplights have a few hours of battery backup. Cell phone transmitters failed widely during the PSPS events; only some have BUGs, which can be hard or impossible to refuel in an emergency.

As streetlights and stoplights have migrated to high-efficiency LED lights to save money, it has become possible to take them off-grid, powered solely with a solar and battery system. Not only does this improve reliability and public safety, and cut energy bills, it also cuts installation costs by eliminating the need for grid connections. These solar lights make the most sense along evacuation corridors and at high priority intersections, but they can also improve public safety by lighting neighborhood meeting spots.

Cell phone transmitters use considerably more power than lights, between 5 and 20 kilowatts, around the clock. While all-solar transmitters are uncommon, many developing nations are moving to off-grid hybrid systems that combine solar with batteries and a diesel generator.<sup>81</sup> The solar becomes the primary power source, with the BUG as a backup for extended cloudy periods. This results in greatly reduced fuel consumption, time savings, and more flexibility in siting.

While small portable backup generators can be a viable -- albeit dangerous, noisy, and polluting -- solution for homeowners, they are not practical for the millions of Californians who live in apartment buildings, retirement homes, or dormitories. The equivalent among clean technologies is a portable battery plus solar panels.

Small batteries, often sold with portable solar panels, are an increasingly popular choice for camping and recreational vehicles, since they are quiet and don't require refueling. The batteries can also be used as an indoor energy source during outages, where unlike with BUGs, they create no risk of carbon monoxide poisoning.

Portable solar+storage systems come in many sizes, from pocket-sized solar cell phone chargers to a 40- or 60-pound lithium-ion battery with portable



Solar street lights

81 Dr Thomas Hillig, Energy Post EU, "Onsite solar and storage powers off-grid telecom towers," March 19, 2019, <https://energypost.eu/onsite-solar-and-storage-powers-off-grid-telecom-towers/>

solar panels that can power household appliances including fridges, and even trailer-mounted systems for powering remote industrial loads.<sup>82</sup>

## MEDIUM-SCALE SOLUTIONS: HOMES AND BUSINESSES, SCHOOLS, CRITICAL FACILITIES

Solar and storage systems can power individual buildings, from homes and businesses to schools and critical facilities. The success of distributed solar power in California points to a big opportunity to rapidly improve the resilience of the whole grid – just add batteries.

### HOMES

While solar power has become common in California, even mandatory for many new homes beginning in 2020,<sup>83</sup> a typical distributed solar system without storage is required to shut down when the grid goes down, to protect line workers. To provide power during outages, a system must be able to “island” itself by disconnecting from the grid while still powering the house. It can then supply power to the home while the sun shines, or with a battery that can store the power for use after dark. Depending on the size of the solar + storage system relative to the power needs of the home, it is sometimes hooked up just to “critical circuits” in the house, powering only the most necessary things.

One couple prepared for outages was Derek and Dorothy Krause of Oakland. Derek is a retired deputy chief of the San Ramon Valley Fire Protection District. Earlier this year, the Krauses installed a solar



*Derek and Dorothy Krause check the utility panel for the solar energy and backup system installed at their home in Oakland, Calif. on Tuesday, Oct. 22, 2019. Source: Paul Chinn, San Francisco Chronicle*

and battery system on their home, which got them through the October power outages.

The Krauses pay about \$150 a month for the system, about the same as their previous electric bill. “We have to be self-sustaining even when the power system like this is intentionally shut off,” Derek told the San Francisco Chronicle.<sup>84</sup>

While over one million customer-sited solar systems have been installed in California, only a small portion of these have batteries. Solar is a clear cost-saver, but batteries have only recently dropped in price enough to be competitive, largely due to the scale-up of electric car manufacturing. Battery prices have

<sup>82</sup> See for example: <https://www.solarelectricsupply.com/remote-industrial-solar/raps-rd-solar>, <https://www.goalzero.com/> and <https://www.earthtechproducts.com/portable-power-.html>.

<sup>83</sup> California Energy Commission, Press release: “Energy Commission Adopts Standards Requiring Solar Systems for New Homes, First in Nation,” May 9, 2018, [https://ww2.energy.ca.gov/releases/2018\\_releases/2018-05-09\\_building\\_standards\\_adopted\\_nr.html](https://ww2.energy.ca.gov/releases/2018_releases/2018-05-09_building_standards_adopted_nr.html)

<sup>84</sup> Mallory Moench, San Francisco Chronicle, “PG&E outages boost interest in solar, backup batteries,” October 23, 2019, <https://www.sfchronicle.com/california-wildfires/article/PG-E-outages-boost-interest-in-solar-backup-14554384.php#photo-18482521>

fallen 87 percent in the last decade as Tesla and other electric car makers ramp up production.<sup>85</sup> Over 13,000 residential customers have gotten battery rebates through the state's Self Generation Incentive Program (SGIP) in the past three years.<sup>86</sup>

And while there are almost 10,000 solar systems serving low-income customers, no rebates have been given out under the SGIP Equity budget to encourage batteries in low-income housing. In response, the CPUC has revamped the Equity budget and created the Equity Resiliency budget, as discussed later in the report.

Batteries provide customer value in a few ways: by allowing commercial customers to reduce demand charges; by shifting consumption from higher priced on-peak periods to lower priced off-peak times; and by providing backup power during outages. The most value can be gained when these services are “stacked.”

They can also provide value to the grid. Recently, utilities and the grid operator CAISO have begun paying for “ancillary services” from distributed batteries, such as capacity, ramping, and voltage and frequency support. A company pays distributed battery owners to take over control of the batteries, with certain constraints, and then sells those services to CAISO and distribution utilities.<sup>87</sup>

East Bay Community Energy, Peninsula Clean Energy and Silicon Valley Clean Energy are planning to buy energy capacity to support the deployment of 30 MW of clean local energy plus storage to reduce

the impacts of power shutoffs, beginning in 2020. The three Bay Area community choice aggregators (CCAs) want the projects split between single-family homes and multifamily and small commercial customers, with at least 20 percent sited in low-income and disadvantaged communities.<sup>88</sup>

Solar marketers are reporting strong interest in battery sales, both with new solar installations and as retrofits to existing solar systems. “There is almost no other event like [an outage] to spur interest in solar systems,” said Solaria CEO Suvi Sharma.<sup>89</sup>

## SCHOOLS

Schools represent possibly the largest and most efficient immediate opportunity to provide resilient solar to communities. The voter-approved Clean Energy Jobs Act (Proposition 39) K-12 Program allocated more than \$1.5 billion over five years to 2,189 Local Educational Agencies across the state to improve facilities and help lower energy bills.<sup>90</sup> California leads the nation with 1,946 solar schools hosting 489 MW of generation capacity, as of November 2017.<sup>91</sup>

Prop 39 also supported installation of 65 battery storage systems at schools. While Prop 39 funds have been fully spent, some schools are installing batteries for both the financial benefits and the resilience benefits.

The Santa Rita Union School District, which serves about 3400 kids near Salinas, many of them Latino and from farm worker and other low-income families,

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85 Bloomberg NEF, “Battery Pack Prices Fall As Market Ramps Up With Market Average At \$156/kWh In 2019,” December 3, 2019, <https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/>

86 Center for Sustainable Energy, SGIP Program Statistics, as of November 26, 2019, <https://sites.energycenter.org/sgip/statistics>

87 California ISO, Distributed energy resource provider, accessed February 2020, <http://www.caiso.com/participate/Pages/DistributedEnergyResourceProvider/Default.aspx>

88 See CCA Request for Proposal at [https://ebce.org/wp-content/uploads/Final\\_Joint\\_LSE-Distributed\\_RA-RFP\\_with-Addenda-12\\_6\\_2019.pdf](https://ebce.org/wp-content/uploads/Final_Joint_LSE-Distributed_RA-RFP_with-Addenda-12_6_2019.pdf)

89 California Energy Commission, Proposition 39 K-12 Snapshot (Revised September 2018), [https://ww2.energy.ca.gov/efficiency/proposition39/documents/Prop\\_39\\_Snapshot.pdf](https://ww2.energy.ca.gov/efficiency/proposition39/documents/Prop_39_Snapshot.pdf)

90 California Energy Commission, Proposition 39 K-12 Snapshot (Revised September 2018), [https://ww2.energy.ca.gov/efficiency/proposition39/documents/Prop\\_39\\_Snapshot.pdf](https://ww2.energy.ca.gov/efficiency/proposition39/documents/Prop_39_Snapshot.pdf)

91 Solar Foundation, Generation 180, and the Solar Energy Industries Association, Brighter Future: A Study on Solar in U.S. Schools, 2nd Edition, November 2017, <https://www.thesolarfoundation.org/solar-schools/>

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*Santa Rita Unified School District in Salinas. Source: Santa Rita Unified School District*

is one such school that installed solar and batteries without the use of Prop 39 funds. About 90% of students qualify for free or reduced lunch. Power outages have long been a problem there, due to the constrained grid in the Monterey Bay area. While school leadership considered diesel generators at first, they decided instead to install solar + storage at six school campuses.<sup>92</sup>

A finance company, Generate Capital, owns the systems and sells power to the District under contract. The storage can discharge for up to 7 hours, while the solar will recharge the storage every day, making the system able to provide power indefinitely, sunlight permitting.

Because the middle schools are designated emergency shelters, the microgrid allows community members to sleep in the gym, get medical care, and charge their devices during outages. The kids can also attend school during long power outages and continue receiving free meals, an important service to the community.

## CRITICAL FACILITIES

Reliable power is especially important for “critical facilities” that provide emergency services or would create huge public safety disruptions if they failed.

As mentioned in section 2, there are tens of thousands of such facilities in California, ranging in size from emergency radio transmitters to sewage treatment plants. The California Energy Commission has funded demonstrations of solar and storage microgrids at critical facilities around the state.

One such demonstration was in Fremont, which added solar + storage systems to existing diesel BUGs at three fire stations. Each consists of solar on a parking lot canopy, batteries, and an energy management system that controls the system automatically. During an outage, the solar + storage system provides at least three hours a day of power for critical loads.

A four year trial period recently ended, and the project is now fully operational. It has saved Fremont

<sup>92</sup> Santa Rita Union School District, press release, “Solar Plus Storage Microgrid Kickoff Event,” May 14, 2018, <http://sruesd-ca.schoolloop.com/file/1516177487510/1442471980548/2697312800308938586.pdf>.

\$32,000 in utility bills already, and will save another \$215,000 over ten years, along with cutting carbon dioxide emissions by around 80,000 pounds per year.<sup>93</sup>

Another big saver is the Mountain View-Los Altos High School District (MVLA), in the heart of Silicon Valley. The school district went solar in 2011, installing enough panels to meet half its energy needs. To cut utility demand charges they later installed 1.08 MWh in batteries, saving \$86,000 per year. The battery system is owned and operated by ENGIE Storage, resulting in no capital outlay by the school district, and the monthly fee is less than the bill savings. The campuses also have 28 electric vehicle charging stations and participate in demand response programs, cutting power when requested (and paid) by PG&E.<sup>94</sup>

One emerging type of critical facility is a “community resilience hub.” This idea was pioneered in Baltimore, Maryland, and the Urban Sustainability Directors Network (USDN) is working with local governments around the country to replicate it. Community resilience hubs are typically existing neighborhood spaces, such as a community center, multifamily housing, or a church, that already function as a gathering place for community members. They are improved to enhance community connectivity and coordinate resource distribution and services before, during, or after a natural hazard event. A key element of their conversion to hubs is the installation of a resilient clean energy system to provide backup power.<sup>95</sup>

## LARGE-SCALE SOLUTIONS: MICROGRIDS, CAMPUSES, AND TOWNS

Solar and storage, along with other distributed energy technologies, can provide energy resilience for clusters of buildings, campuses, and even whole towns. Military bases, for example, have been using microgrids for decades, though typically using diesel BUGs.

Microgrids can be entirely off the grid, like the one on Alcatraz Island in San Francisco Bay, or they can be connected to the grid and able to “island,” or function separately, as needed.

One notable project is at the Blue Lake Rancheria, on tribal land in the Humboldt Bay area. Blue Lake sits at the junction of three tectonic plates and is subject to heavy rainstorms, forest fires, and frequent power outages. A few years ago, with help from the Schatz Energy Center at Humboldt State University, the tribe put together a microgrid by adding solar, batteries, and smart controllers to their existing diesel backup generator.<sup>96</sup>

The microgrid serves tribal government offices, a hotel and casino, electric vehicle charging, a convenience store and gas station, and energy and water systems. The Rancheria also serves as an American Red Cross emergency evacuation site.

During the October PSPS events, the County Department of Health and Human Services asked the tribe to set aside a block of rooms in the hotel for people who needed power for medical devices. “We ended up providing six to eight rooms for those

93 East Bay Community Energy, “Power Shutoffs To Prevent Wildfires Put A Premium On Energy Resilience,” October 8, 2019 <https://ebce.org/power-shutoffs-to-prevent-wildfires-put-a-premium-on-energy-resilience/>. Lisa Krieger, San Jose Mercury-News, “Here’s how some Bay Area businesses and residents circumvented the PG&E power blackout,” October 17, 2019, <https://www.mercurynews.com/2019/10/12/why-fremont-firefighters-could-focus-on-saving-lives-not-the-pge-shutdown/>

94 ENGIE Storage, Press release: “California’s Mountain View Los Altos High School District Becomes the First US High School District to Combine Intelligent Energy Storage and EV Charging,” June 23, 2015, <https://www.engiestorage.com/californias-mountain-view-los-altos-high-school-district-becomes-the-first-us-high-school-district-to-combine-intelligent-energy-storage-and-ev-charging/>

95 Urban Sustainability Directors Network, Resilience Hubs, accessed December 2019, <http://resilience-hub.org/what-are-hubs/>

96 Schatz Energy Research Center, Humboldt State University, “Blue Lake Rancheria microgrid,” <http://schatzcenter.org/blrmicrogrid/>

types of critically health-compromised people,” said Jana Ganion, sustainability director for the tribe. The Department credited the Rancheria with saving their lives.<sup>97</sup>

***The microgrid at the Blue Lake Rancheria was credited with saving lives during the 2019 power outages.***



*Blue Lake Rancheria. Source: Schatz Energy Center*

The Blue Lake Rancheria microgrid drew an estimated 13,000 people since they had one of the few gas stations in the county that could pump gas, ice for people to put in their refrigerators, and lights and shelter for kids to do homework. They were even able to save the lives of fish hatchlings, as they kept the pumps running for their fish hatchery.<sup>98</sup>

“When we looked at energy, we had to make sure it was clean and sustainable,” says Arla Ramsey, tribal vice-chair. “We wanted to become self sufficient, so that if we lose power and the grid goes down we can still be up and running.”<sup>99</sup> Because the system runs primarily off solar, the tribe can generate and use its own power on-site indefinitely. The tribe is planning to double the size of the solar and battery systems within a year.<sup>100</sup>

Perhaps the most ambitious existing microgrid in California serves all of Borrego Springs, a town of about 3,400 people in the Anza-Borrego Desert about 90 miles east of San Diego. Summers there are extremely hot, making power outages dangerous, and because it lies at the far end of a long transmission line, the town has suffered frequent power outages.

Borrego Springs’ turn to a microgrid was spurred by a local calamity, a 2007 wildfire that took out its transmission line. After the fire, San Diego Gas & Electric won an \$8 million grant from the U.S. Department of Energy to build a demonstration microgrid in the community. The system can power all of Borrego Springs for several hours during the day and designated critical loads at night.<sup>101</sup>

97 Sonia Wraich, Humboldt Times-Standard, “Blue Lake Rancheria becomes a hub of services during outage,” October 11, 2019, <https://www.times-standard.com/2019/10/11/blue-lake-rancheria-becomes-a-hub-of-services-during-outage/>

98 Humboldt State University, Humboldt State Now, “Microgrid Provides Critical Services During Outage (w/ Video),” October 11, 2019, <http://now.humboldt.edu/news/blue-lake-rancheria-microgrid-provides-critical-services-during-outage/>

99 Siemens, “When you control your own energy, you control your future,” (video), <https://www.youtube.com/watch?v=6Fcl4CHKh7g>

100 Peter Maloney, Microgrid Knowledge, “Life Won Thanks to the Blue Lake Rancheria Microgrid,” November 11, 2019, <https://microgridknowledge.com/blue-lake-rancheria-microgrid-outages/>

101 Hilal Katmale, Sean Clark, Laurence Abcede, and Thomas Bialek, Borrego Springs: California’s First Renewable Energy Based Community Microgrid, February 2019, California Energy Commission publication number CEC-500-2019-013, <https://ww2.energy.ca.gov/2019publications/CEC-500-2019-013/CEC-500-2019-013.pdf>

In September 2013, when lightning and flooding knocked out the same critical transmission line, the utility islanded the microgrid and directed electricity to serve the town’s essentials: a gas station so people could fuel up their cars, a library serving as a cool zone for people experiencing heat stress, and full power for an elderly housing community. About 24 hours after the outage began, the utility was able to restore the entire town’s connection to the main grid.

An important point to remember about resilient clean energy systems of all sizes, including those on individual homes, is that during non-emergency times they act as part of the wider power system. In doing so, they reduce emissions from fossil-fueled power plants, cut peak demand on the grid, save energy, reduce load on transmission and distribution lines, and avoid investments in central power plants.

The complex UC San Diego microgrid is the quintessential example of a grid partner, powering

and heating most of the campus and adjusting demand when San Diego Gas & Electric needs help balancing the system. It does this through a variety of distributed energy technologies, including gas cogeneration, solar, batteries, and 4,000 remotely-controlled thermostats.<sup>102</sup>

PG&E is working on developing “pre-connected resilience zones,” essentially an electric circuit connecting critical loads in a town that would enable temporary portable generators to be quickly plugged in during outages. Their first, in the Napa County town of Angwin, was expected to be finished by the end of 2019, but PG&E may develop as many as 40 in all.<sup>103</sup> Presumably PG&E would own and dispatch gas-fired or mobile diesel generators during an outage, which have the shortcomings previously noted. The zone would not have any use apart from PSPS events, nor would the community gain the financial and environmental benefits of a clean microgrid.

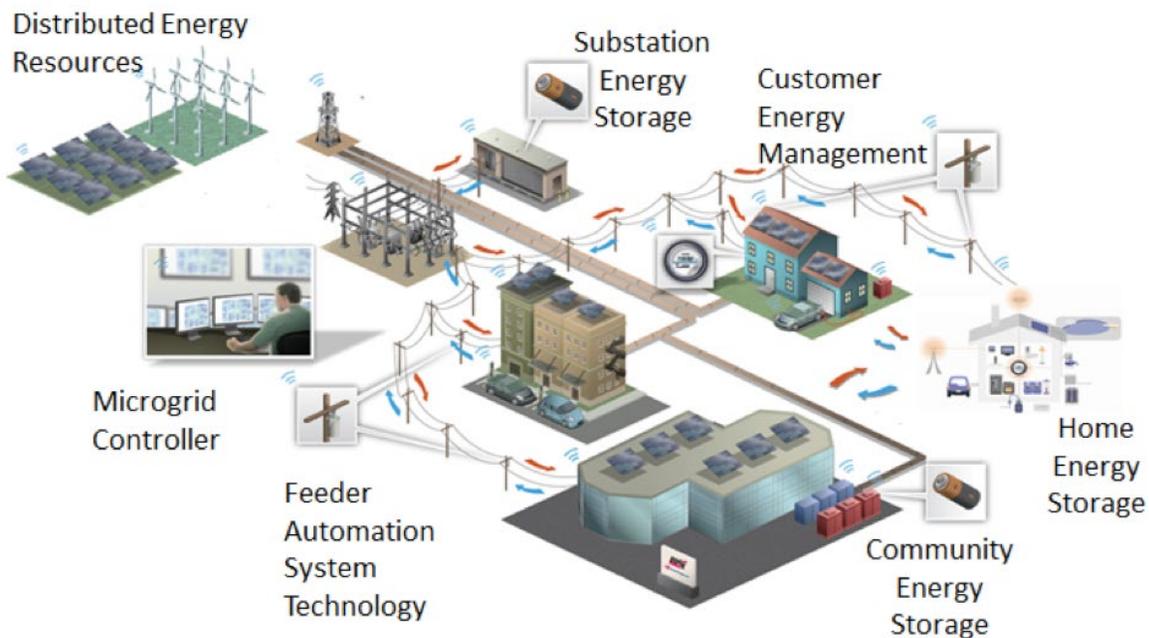


Illustration of Borrego Springs microgrid. Source: San Diego Gas & Electric

102 Bentham Paulos, Greentech Media, “UC San Diego Is Building the ‘Motel 6’ of Microgrids,” May 19, 2014, <https://www.greentechmedia.com/articles/read/byrom-washom-master-of-the-microgrid>

103 Elisa Wood, Microgrid Knowledge, “PG&E May Speed Development of 40 Microgrids Following Power Shutoff,” October 21, 2019, <https://microgridknowledge.com/pge-microgrids-wildfire/>

## EMERGING: VEHICLE-GRID INTEGRATION

As new energy technologies continue to improve and fall in price, they are creating new opportunities for clean energy resilience.

Perhaps the biggest opportunity will be in using electric vehicles as part of the grid. Electric vehicle batteries are essentially the same as stationary batteries, though much larger, and can provide many of the same services when they are parked and plugged in.<sup>104</sup>

California has an official goal of putting five million EVs on the road by 2030, to cut emissions from transportation. Transportation accounts for 41 percent of statewide carbon emissions (the largest single source), plus the majority of NOx and particulate emissions that cause smog and health impacts.

Electric vehicles can affect the power grid when they charge, of course, increasing power demand. But they can also serve as batteries on wheels, discharging into the grid as needed. Through “vehicle-grid integration” or VGI, parked cars can become a major part of the power system.

The numbers illustrate the potential. Current EVs on the market have an average battery capacity of 57 kWh.<sup>105</sup> Assuming that continues to rise over time, to 75 kWh, five million cars will have an energy capacity of 375,000 megawatt-hours, equal to half of average daily power consumption in California.<sup>106</sup>

As the CPUC has pointed out, “electric vehicles have three main characteristics that make them an attractive grid resource.” First, a plugged-in vehicle can react quickly to commands to charge or discharge the battery, increasing operational flexibility for grid operators. Second, EVs often have on-board timers and monitors that can be accessed and controlled via the internet, such as with smartphone apps. So they are ready to communicate.

And lastly, vehicles are not actually used much. CPUC cites travel data showing that a typical car is parked for 96 percent of its life. While it may spend 10 percent of that time charging, the rest is available for other uses. And considering that a battery can represent as much as 60 percent of the cost of the vehicle, car owners may be quite interested in recouping some of their investment by selling battery services.<sup>107</sup>

State energy agencies, including the CPUC, CEC, CARB, and CAISO, are developing policies that support vehicle-grid integration. They have established a Joint Agency VGI Working Group featuring agency staff, car and electric companies, and other stakeholders, to focus on “identifying, capturing, and scaling the value of VGI.”<sup>108</sup>

A simpler application is to integrate the vehicle with a home, known as “vehicle to home” or V2H. V2H is already used in Japan, where Nissan has sent fleets of their electric LEAF to power community shelters in response to grid outages caused by typhoons and earthquakes. A number of companies are working to develop V2H capabilities in California, with pilot

104 A Tesla Powerwall 2 battery has a capacity of 13.5 kWh, while the average electric vehicle battery is 57 kWh.

105 Electric Vehicle Database, Useable battery capacity of full electric vehicles, accessed December 2019, <https://ev-database.org/cheatsheet/useable-battery-capacity-electric-car>

106 Energy Information Administration, California Electricity Profile 2017, <https://www.eia.gov/electricity/state/california/>. Total annual retail sales of 257 million MWh divided by 365.

107 Adam Langton and Noel Crisostomo, Energy Division, California Public Utilities Commission, Vehicle - Grid Integration: A Vision for Zero-Emission Transportation Interconnected throughout California’s Electricity System, March 2014, [https://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/Utilities\\_and\\_Industries/Energy/Energy\\_Programs/Demand\\_Side\\_Management/EE\\_and\\_Energy\\_Savings\\_Assist/CPUCEnergyDivisionVehicleGridIntegrationZEVSummit.pdf](https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/CPUCEnergyDivisionVehicleGridIntegrationZEVSummit.pdf)

108 Gridworks, Vehicle Grid Integration Working Group, accessed December 2019, <https://gridworks.org/initiatives/vehicle-grid-integrationwg/>

projects expected in 2020.<sup>109</sup> When not used for backup power, V2H can provide the same multi-purpose value stack as a stationary battery.

Some EV owners have resorted to a low-tech solution, connecting an inverter to the small “coach battery” that provides power to the cabin and headlights. The inverter converts the 12 volt DC power from the battery to 110 volt AC that can run household appliances. As the coach battery is depleted, it is recharged by the much larger “traction battery” that moves the car. While not optimal, it does provide indirect access to the 64 kWh traction battery, equal to the output of five Tesla PowerWall batteries.<sup>110</sup> The same can be done with the 12-volt starter battery of a gasoline car, with the battery recharged by idling the car. While this is just as inefficient as a BUG, the emission controls on a car result in much less pollution than comes from a BUG, which typically lack any emission controls.<sup>111</sup>



*Nissan's Vehicle to Home. Source: Nissan*

<sup>109</sup> Justin Gerdes, Greentech Media, Will Your EV Keep the Lights On When the Grid Goes Down?, November 8, 2019, <https://www.greentechmedia.com/articles/read/will-your-ev-keep-the-lights-on-when-the-grid-goes-down>

<sup>110</sup> Jim Lazar, Regulatory Assistance Project, personal communication, November 18, 2019.

<sup>111</sup> Jason Torchinsky, Jalopnik, “How To Power Your Home With Your Car,” October 29, 2012, <https://jalopnik.com/how-to-power-your-home-with-your-car-5955850>

## SIDEBAR: FINANCIAL COMPARISON OF SOLAR + STORAGE VS. BUGS

While much of the attention paid to backup power options focuses on the initial cost, a “lifecycle” cost comparison shows that solar + storage can be a financial winner compared to a fossil fuel backup generator (BUG).

While both a BUG and a solar + storage system can provide power during outages, the real financial difference is what they do the rest of the time. A solar + storage system provides value every day by

generating electricity, cutting demand charges for commercial customers, and shifting consumption from expensive on-peak hours to cheaper off-peak hours. Studies have shown that solar also adds about 4 percent to the sales value of a home.<sup>112</sup>

A BUG does nothing when the grid is working. High fuel costs and low efficiency make it much more expensive than grid power, not to mention the maintenance and the testing it needs to stay reliable, which adds to the cost. For larger systems, air pollution permits limit the hours of operation.

### Benefits of Resilient Solar vs. Fossil Fuel Backup Generators

Solar + Storage	Fossil Fuel Backup Generator
 <ul style="list-style-type: none"> <li>• Provides value every day</li> <li>• Fueled by the sun</li> <li>• Quiet and clean</li> <li>• Eligible for tax credits and incentives</li> <li>• Little maintenance</li> <li>• Often cheaper than grid power</li> </ul>	 <ul style="list-style-type: none"> <li>• Runs only during outages</li> <li>• Requires gasoline, diesel or natural gas</li> <li>• Polluting, noisy and dangerous</li> <li>• No tax credits, limited incentives</li> <li>• Requires regular maintenance</li> <li>• More expensive than grid power</li> </ul>

112 Sarah Mikhtarian, Zillow, “Homes With Solar Panels Sell for 4.1% More,” April 16, 2019, <https://www.zillow.com/research/solar-panels-house-sell-more-23798/>

For commercial customers that face demand charges, payback periods for solar + storage systems can be as short as six years, according to Rocky Mountain Institute. Adding storage to solar can actually improve the economics compared to solar alone.<sup>113</sup>

The simplest proof of the superiority of solar + storage is that companies are offering monthly contracts, with no money down, at a price lower than retail utility rates. If going solar + storage saves money, then the system's ability to provide power during an outage is effectively free for the customer, once incentives are figured in. Buying grid power plus a BUG always costs more.

To illustrate this truth, we asked EnergySage to help us compare the cost of power over 20 years for a home with solar + storage to a home with a BUG.<sup>114</sup> EnergySage runs an online marketplace, allowing solar shoppers to receive solar quotes from local installers. They have compiled a large database of solar costs, based on actual installation costs and utility rates.<sup>115</sup>

For this comparison, we assume a warm-region California home consuming 8,000 kWh per year, on a standard time-of-use (peak/off-peak) tariff. The solar version of the home has a 5 kW solar system plus two Tesla PowerWall 2 batteries with 27 kWh of storage. The other home has a 3.5 kW gasoline backup generator, connected to the home with a transfer switch, plus a shed for fuel storage.

We look at costs over 20 years, assuming a full life span for the solar system, and replacement of the batteries and the BUG after 10 years. We make a number of conservative assumptions. For example, we assume electricity rates rise at the rate they have over the last ten years, or 1.3 percent per annum, and do not account for inflation. We assume full cost for replacing batteries after 10 years at today's prices even though prices continue to fall, and assume that

current battery incentives are no longer available then. BUG costs were collected by the consulting firm Crossborder Energy.

We assume that the solar house does not export power to the grid, but instead uses surplus daytime power to charge the batteries, which discharge in the evening to serve onsite load. For a house on a time-of-use rate, this has the effect of shifting consumption from peak to off-peak hours, saving an additional \$225 per year, or \$4500 over 20 years. We further assume that the homeowner gets a federal tax credit of 26 percent for integrating the battery with the solar system (worth about \$5700) and qualifies for an SGIP grant of about \$6750 (at 25¢ per Watt-hour).

Lastly, we assume 100 hours of PSPS events (or other power outages) per year, the average amount experienced in 2019 for many PG&E customers.

**The bottom line, as shown in the table, is that the solar + storage home has a 20-year cost that is more than \$22,000 less than the home with the BUG.**

Even without battery incentives, the homeowner still saves \$9,700 over a BUG house. The key is that solar saves \$46,300 on utility bills over 20 years, while peak-shifting with the batteries adds a little more, about \$4,500. If power prices rise faster than inflation, such as at 3 percent per year, the total benefit is even greater. Because most of the costs in both cases are for equipment and not operating costs, the relative costs change very little if there are fewer PSPS events.

113 Ryan Shea and Madeline Tyson, Rocky Mountain Institute, "Yes, Solar Plus Storage is Cost Effective," Microgrid Knowledge, January 8, 2020, <https://microgridknowledge.com/solar-plus-storage-costs>

114 See EnergySage at <https://www.energysage.com/>

115 Public data reports available at <https://www.energysage.com/data>

**TOTAL COSTS OVER 20 YEARS FOR A CA RESIDENTIAL CUSTOMER**

	<b>Whole home solar + storage</b>	<b>Whole home gasoline backup generator</b>
Total purchased electricity costs	\$500	\$51,300
Upfront cost	Solar: \$10,900 Storage: \$19,000 Storage incentives: - \$12,450 Net: \$17,450	\$3,400
Total maintenance cost	\$0	\$1,000
Replacement cost	\$19,000	\$1,800
Total fuel cost (100 hours per year)	\$0	\$1,600
<b>Total cost of electricity + backup capability</b>	<b>\$36,950</b>	<b>\$59,100</b>

Of course, there are many options for backup power, from small to large, temporary or permanent, with varying costs, benefits, and abilities. While the costs and benefits will vary by technology choice and customer, this analysis indicates that for a single-family home in California, solar + storage can easily

be cheaper than a BUG, even without the significant incentives now being provided under the SGIP Equity Resiliency budget. Add in the safety and pollution benefits of resilient solar over a BUG, and it's a clear winner.



## POLICES FOR DEPLOYING RESILIENT CLEAN ENERGY

The wildfires and power shutoffs have raised the public's interest in energy issues to levels not seen since the Enron-induced power crisis of 2000 and 2001. There is a tremendous appetite for solutions. We believe policy action should be guided by these basic principles.

First, the highest priority for public policy should be on protecting the safety of those most at risk, which means prioritizing medically vulnerable customers, low-income households and communities, and the public safety infrastructure. Solar plus storage can protect these priority customers from the worst effects of power outages without the safety risks and public health impacts that fossil backup generators create. Low-income households face a host of barriers to accessing onsite clean energy including low home ownership rates, insufficient access to capital, and language and access barriers, so overcoming those barriers to provide them with resilient clean energy requires targeted policy solutions.<sup>116</sup>

Second, for those who are more affluent and better able to purchase resilience without financial assistance, the policy tasks are to continue existing supportive policies, to point people away from dirty energy resources, and to maximize the societal benefit of their clean investments. We can ensure that clean energy is deployed in ways that help everyone. While our current policies aim to deliver affordable, clean, and reliable energy, we need a greater emphasis on equity, resilience, and public safety.

Third, we need to stay on the clean energy path we have established, heading for a 100 percent zero-carbon power system by 2045 or before. Considering that climate change is a prime driver of the fire-prone conditions we face, and that dispatchable clean energy is already often cheaper than new gas-fired

generation, it would be unacceptable to abandon that pursuit.

## POLICY NEEDS AND OPPORTUNITIES

While California has long been a leader in promoting clean energy, with some of the most ambitious and effective policies in the world, the threat of wildfires and power shutoffs highlights the need for a new statewide focus. We must prioritize resilient clean energy deployment, along with our other clean energy and emissions reduction goals.

Resilient solar is a uniquely scalable and effective resource for delivering reliability and resilience, in addition to environmental and cost-saving benefits. There is enormous opportunity to advance policy that will support resilient solar as a means for reducing wildfire risk and the need for power outages, while at the same time reducing the harm that power outages inflict on Californians.

### To realize the benefits of resilient clean energy, we recommend the following policies.

- ❑ Maintain and expand distributed clean energy policies
- ❑ Focus on medically vulnerable customers
- ❑ Focus on low-income customers and communities
- ❑ Focus on critical facilities and schools
- ❑ Provide state financing for local infrastructure
- ❑ Take microgrid R&D to the next level
- ❑ Integrate energy resilience into emergency planning and response

<sup>116</sup> See for example California Energy Commission, SB 350 Barriers Study, December 2016, at [https://ww2.energy.ca.gov/sb350/barriers\\_report/](https://ww2.energy.ca.gov/sb350/barriers_report/)

## MAINTAIN AND EXPAND DISTRIBUTED ENERGY POLICIES

### KEY RECOMMENDATIONS

- **Maintain distributed energy policies**
- **Include solar + storage in grid planning as “non-wires” alternatives**
- **Eliminate barriers to microgrids**
- **Enable batteries to participate in grid markets, and capture multiple values**

First, do no harm. Solar and storage can be at the center of an energy resilience strategy, but only if they continue to be supported by foundational policies. For distributed solar that means fair policies on net metering and retail rates; avoiding discriminatory solar customer fees and charges; an easy permitting and interconnection process; and extra support for low-income households and disadvantaged communities. A number of California municipal utilities have moved to end net metering and assign large new fees to solar customers recently, which will make it harder for their customers to install resilient solar. This is the wrong direction.

Storage, a technology that is less mature than solar, is supported by two main commercialization policies: financial incentives and mandates. The Self Generation Incentive Program (SGIP) has promoted a variety of distributed energy technologies since 2001. In the last three years it has paid about \$60 million for battery incentives, evenly split between residential and commercial customers. As of November 2019,

the residential incentives have resulted in 13,265 installations with a capacity of 88 megawatts, with another \$27 million in residential rebates pending. Commercial customers had installed 699 systems totaling 180 MW of capacity; an additional \$98 million of rebates was pending.<sup>117</sup>

In 2018, the legislature extended SGIP through 2025, adding up to \$800 million for storage and other emerging clean energy technologies.<sup>118</sup> In 2019, the CPUC revised SGIP to better help low-income customers. SGIP had offered an Equity budget for low-income storage projects since 2017, but had seen no applications for funds. The new rule raised incentive levels for the Equity program, but also created a new Equity Resiliency budget for low-income customers and critical facilities in high-risk fire zones, with an initial budget of \$100 million. Both programs pay higher incentive levels than the rest of SGIP, enough “to fully or nearly fully subsidize the installation of a storage system.”<sup>119</sup>

In January 2020, the CPUC shifted another \$513 million, or 63 percent of the total remaining SGIP budget through 2024, into the Equity Resiliency budget. The agency also expanded eligibility for that budget to customers who had experienced two or more PSPS events regardless of income, and to broaden the definition of eligible critical facilities to smaller markets, as well as independent living centers and food banks. Funding for the shift would come from the budget for commercial and industrial installations, which would drop from 52 percent to only 12 percent of the budget.<sup>120</sup>

Storage also benefits from legislative mandates (such as AB 2514 and AB 2868) that utilities deploy

117 Center for Sustainable Energy, SGIP Program Statistics, as of November 26, 2019, <https://sites.energycenter.org/sgip/statistics>

118 Sen. Wiener, SB700: Self-generation incentive program, approved by Governor Brown, September 27, 2018, [https://leginfo.ca.gov/faces/billTextClient.xhtml?bill\\_id=201720180SB700](https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB700)

119 CPUC, “Decision Establishing a Self-generation Incentive Program Equity Resiliency Budget, Modifying Existing Equity Budget Incentives, Approving Carry-over of Accumulated Unspent Funds, and Approving \$10 Million To Support the San Joaquin Valley Disadvantaged Community Pilot Projects,” Rulemaking 12-11-005, September 18, 2019, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M313/K975/313975481.PDF>

120 Jeff St. John, Greentech Media, “California Finalizes Plan Shifting Key Energy Storage Incentive Toward Blackout Resilience,” January 21, 2020, <https://www.greentechmedia.com/articles/read/california-finalizes-plan-shifting-key-energy-storage-incentive-toward-blac>



hundreds of megawatts of both utility-scale and customer-sited storage.<sup>121</sup>

Thanks to these policies, California has one of the healthiest markets for distributed solar and storage in the world, and is reaping huge benefits in the form of clean air, more than 76,000 family-wage jobs, and growing prosperity as people invest in their own clean energy supply.<sup>122</sup>

There are still some gaps in current distributed energy policy, however.

Utilities are required to assess their grid investment needs each year and identify “non-wires alternatives,” such as distributed energy resources and microgrids, that can displace investments in transmission and distribution systems. The urgency of wildfires and PSPS calls for being more aggressive with non-wires alternatives, such as considering the frequent deenergization or removal of very high risk lines in fire areas and difficult terrain. In some situations,

community microgrids are likely to provide cheaper and more certain means to improve safety and reliability than reinforcing power lines in very high risk fire areas, not just during outages but at all times. While additional transmission will be needed in the state to achieve our ambitious clean energy goals, the grid planning process should entertain bold alternatives to power lines where possible.

One especially egregious grid policy that needs reform is known as the “over the fence” rule.<sup>123</sup> The rule prohibits non utilities from sharing power between properties that are not immediately adjacent but are nearby (such as across a street). The City of Berkeley tried to develop a microgrid to power critical government facilities during emergencies, including a police station, school, and city hall. The project, known as the Berkeley Energy Assurance Transformation (BEAT) microgrid, received \$1.5 million in grant funding from the CEC. But due to the over the fence rule and other barriers raised by PG&E, the project was blocked.<sup>124</sup>

<sup>121</sup> K&L Gates, Lexology, “California Energy Storage Update - What’s In the Latest Procurement Plans?”, April 27 2018, <https://www.lexology.com/library/detail.aspx?g=a570a50b-a210-4e0e-a807-19b5ad5c5868>

<sup>122</sup> Solar Foundation, Solar Jobs Census 2018: California factsheet, <https://www.thesolarfoundation.org/solar-jobs-census/factsheet-2018-ca/>

<sup>123</sup> Public Utilities Code Section 218(b), <https://codes.findlaw.com/ca/public-utilities-code/puc-sect-218.html>

<sup>124</sup> City of Berkeley, Berkeley Energy Assurance Transformation (BEAT) Project, Case Study, June 30, 2018, [https://www.cityofberkeley.info/uploadedFiles/Planning\\_and\\_Development/Level\\_3\\_-\\_Energy\\_and\\_Sustainable\\_Development/BEAT\\_Case\\_Study.pdf](https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/BEAT_Case_Study.pdf)

Adopted in the 1980s, the over the fence rule has long been obsolete as technology and markets have evolved. Writing a decade ago, attorney Tim Lindl said “The over-the-fence rule protects a regulatory consensus that no longer exists ... and makes grid reliability worse instead of better.”<sup>125</sup>

The time is ripe for reforming this rule, for example allowing community microgrids to share power more easily if there is a public health or safety benefit to doing so. With clean microgrids, “It’s like we have a high schooler stuck in the sixth grade,” State Senator Henry Stern told the Washington Post. “We’ve got a mature technology stuck in a far less mature regulatory system.”<sup>126</sup>

SB 1339, authored by Senator Stern and enacted in 2018, directed the CPUC to develop a standardized interconnection process for microgrids, as well as appropriate rates and tariffs, by December 1, 2020, and a rulemaking proceeding (R.19-09-009) is underway.<sup>127</sup> To encourage microgrid deployment before the next fire season, the CPUC should issue a decision by April to eliminate existing interconnection and other practical barriers to the rapid installation of clean microgrids serving customers individually behind the meter, including critical facilities. In a later phase, the CPUC should make tariffs available for microgrids serving multi-user configurations.

Another policy gap on resilient clean energy is in monetizing the multiple values that batteries offer. In addition to creating benefits for customers, batteries can also help the local distribution grid (operated by local utilities) and the power system as a whole (operated through CAISO markets). RMI, the energy think tank founded by Amory Lovins, has identified

13 different values that batteries can provide.<sup>128</sup>

Depending on where a battery is located on the grid and how it is operated, it can “stack up” multiple values. But customer-owned batteries have a hard time capturing multiple values, due to outdated energy agency program rules about distributed energy resources.

For example, East Bay Community Energy (EBCE) and other Bay Area CCAs have an innovative plan to purchase energy capacity or “resource adequacy” (RA) services from over 30 MW of distributed solar plus storage located on residential and commercial buildings, including the homes of low-income customers. These resilient solar systems would not only provide energy capacity for the grid, but could be used as backup power by the hosting customers during power outages.<sup>129</sup> However, current RA programs for distributed energy at CAISO must be modified to allow DG solar a level playing field, and to be fully compensated for the RA value they provide. Alternatively, the CEC could allow Load Serving Entities (LSEs) to submit demand forecasts that account for distributed battery resources that are scheduled during peak periods. This would lower the LSEs peak demand and therefore its Resource Adequacy requirement. Allowing distributed solar and storage to supply RA to LSEs would be a significant step towards encouraging aggregations of small systems into a Virtual Power Plant (VPP) that serves as a grid resource.

125 Tim Lindl, “Letting Solar Shine: An Argument to Temper the Over-the-Fence Rule, *Ecology Law Quarterly*, Vol. 36:851, 2009, <https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=1912&context=elq>

126 Scott Wilson, “Amid shut-off woes, a beacon of energy,” *Washington Post*, January 1, 2020, <https://www.washingtonpost.com/climate-solutions/2020/01/01/amid-shut-off-woes-beacon-energy/?arc404=true>.

127 CPUC, Order Instituting Rulemaking Regarding Microgrids Pursuant To Senate Bill 1339, September 19, 2019, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M314/K274/314274617.PDF>

128 Garrett Fitzgerald, James Mandel, Jesse Morris, and Hervé Touati, RMI, *The Economics of Battery Energy Storage*, 2015, <https://rmi.org/insight/economics-battery-energy-storage/>

129 Jeff St. John, Greentech Media, “An Inside Look at a Groundbreaking Solar-Storage Procurement in California,” November 21, 2019, <https://www.greentechmedia.com/articles/read/inside-california-community-energy-providers-groundbreaking-solar-storage-p>

## FOCUS ON MEDICALLY VULNERABLE CUSTOMERS

### KEY RECOMMENDATIONS

- **Get better information on vulnerable customers and their needs**
- **Develop solutions and strategies to serve medically vulnerable customers during outages**
- **Provide funding and technical support to medical and social service agencies**
- **Get public and private health insurers to cover backup energy equipment**

As noted in *Home Healthcare In the Dark* by Clean Energy Group and Meridian Institute, “emergency preparedness for electricity-dependent residents is typically limited to informational materials” from public health agencies, rather than providing backup power solutions. Knowledge about who and where the medically vulnerable are, how to reach them in an emergency, what their energy needs are, and programs to ensure they are prepared is incomplete.<sup>130</sup>

Serving medically vulnerable customers poses a unique challenge, due to the wide variety of needs and living situations, difficulty in rapid communications due to language and access barriers, and the safety threat that lack of power can create for these customers. Utilities are not necessarily in a position to deliver on this task. Only public health agencies and support organizations have the reach and connections to serve them, but they will need funding and technical partners to succeed. The PSPS is, after all, shifting risks from utilities to customers and agencies; funding should also shift to help deal with the risks.

One foundational priority should be getting better information on medically vulnerable customers in



California. Discrepancies between health provider lists of “electricity dependent” people and utility lists of customers on Medical Baseline rates -- and those who are on no list -- need to be cleared up. This task should include establishing categories of energy vulnerabilities to get insight on their risk during PSPS events. The data must be kept up to date and actionable for utilities and local public health agencies.

Equally important, policymakers should work to ensure that all medically vulnerable customers have the clean backup power they need to stay healthy, safe and comfortable during extended outages. Those who are renters and apartment dwellers could use portable options that can work inside their homes, if their landlords don’t take the initiative to install more permanent resilient clean energy. PG&E is developing a one-year, \$5 million pilot project with the California Foundation for Independent Living Centers to supply batteries and other help to up to 500 medically vulnerable people in Northern California. This could be a model, if successful, though it would need to be greatly expanded and well-advertised to be truly effective.<sup>131</sup>

<sup>130</sup> Marielle Mango and Annie Shapiro, Resilient Power Project, *Home Healthcare In the Dark*, June 2019, <https://www.cleanegroup.org/ceg-resources/resource/battery-storage-home-healthcare/>

<sup>131</sup> Catherine Ho, San Francisco Chronicle, “PG&E may pay \$5 million for batteries, hotel vouchers for people with disabilities,” October 24, 2019, <https://www.sfchronicle.com/california-wildfires/article/PG-E-may-pay-5-million-for-batteries-hotel-14557799.php#photo-18489494>

To accompany this effort, health providers and energy experts should work with manufacturers to improve the energy performance of their medical equipment, such as standardizing power components and making it easy to change batteries.

The SGIP Equity Resiliency budget, created by the CPUC in September 2019, includes support for customers in fire zones that are on a Medical baseline rate or have a life-threatening risk if electricity is disconnected. But even with the additional funds approved in January 2020, SGIP cannot reach the hundreds of thousands of electricity dependent people in California. To scale up energy resilience, federal, state and private insurance providers like Medicaid and Medi-Cal should allow people with durable medical equipment to include the cost of backup power options in their coverage.

## FOCUS ON LOW-INCOME CUSTOMERS AND COMMUNITIES OF COLOR

### KEY RECOMMENDATIONS

- **Maintain programs that deliver solar to low-income customers and communities**
- **Make sure storage programs like SGIP's Equity and Equity Resiliency budgets reach low-income customers**
- **Prioritize clean energy resilience in on tribal lands**
- **Tighten emission standards for dirty backup generators to protect public health**
- **Ensure affected communities have input to decisions**
- **Retrofit well-used community centers with resilient clean energy to create "community resilience hubs"**

California is a national leader on equitable clean energy policies, supporting solar adoption by low-income households through the Single Family Affordable Solar Homes program (SASH), SASH for Disadvantaged Communities (DAC-SASH), and the Solar on Multifamily Affordable Housing program (SOMAH). Even so, we have much work to do to make distributed solar and storage and their benefits fully available to all Californians.

Grid resilience efforts should pay close attention to the safety of low-income communities and communities of color, who are often impacted "first and worst" by dirty energy systems and power outages. The California Environmental Justice Alliance, in their "Principles for Energy Democracy," call for greater community ownership and involvement in energy decisions, such as through solar and storage deployed to capture multiple benefits.<sup>132</sup> As with all policies aimed at providing clean energy options to these communities and given the substantial storage incentives now available via SGIP, it is important to ensure trusted entities and organizations are involved in outreach and include consumer protection measures to prevent predatory marketing practices.<sup>133</sup> Pending further collaboration with equity-focused allies on how best to advance equity in grid resiliency, below are some initial policy recommendations.

The SGIP Equity budget saw little response to battery incentives, spurring the CPUC to raise incentive levels and create the Equity Resiliency budget. These changes are welcome and timely, but will require a rapid outreach and marketing effort to reach potential beneficiaries to be ready for future PSPS events. The CPUC and the Legislature should closely monitor which categories of customers are actually receiving SGIP Equity and Equity Resiliency incentives and increase funding swiftly if needed, since many types of customers are eligible and millions of Californians are being impacted by outages.

<sup>132</sup> Jose Torres and Mad Stano, California Environmental Justice Alliance, Power to the People: Energy Democracy Now!, November 2019, <https://caleja.org/2019/11/power-to-the-people-energy-democracy-now/>

<sup>133</sup> Best practices for providing clean energy to low-income communities can be found at the Low-Income Solar Policy Guide, a project of Vote Solar and allies, at <https://www.lowincomesolar.org/>

Incentive programs and other policies should place a special focus on creating “community resilience hubs,” by adding solar + storage to existing well-used community centers that aid communities during outages and disasters.<sup>134</sup> Community input about where best to locate these hubs must be considered.

Policy should also focus on deploying resilient clean energy on tribal lands, which are often located in high fire threat districts and which support communities of color. Blue Lake Rancheria, located in Humboldt County, provided a model for success when the casino’s clean microgrid supported the local community during power outages, including keeping a gas station running and housing medically vulnerable people in hotel rooms. Funding and/or technical assistance should be allocated to tribal governments who want to move expeditiously to install clean microgrids and access SGIP and other funds.

Finally, we must protect public health, including for the many people in low-income communities and communities of color who have asthma and other respiratory problems, by tightening emissions regulations for diesel and gasoline backup generators. Current policy assumes the generators will only be used in emergencies, so are lax about emissions during power outages. But if outages are going to be a recurring feature of fire season, BUGs are going to be used far more often. Regulators should anticipate many more hours of operation and require more stringent pollution controls.

## FOCUS ON CRITICAL FACILITIES AND SCHOOLS

### KEY RECOMMENDATIONS

- **Provide financing and technical assistance for local deployment of clean resilient energy systems, starting with high-risk fire and PSPS zones**
- **Focus on battery deployment in schools that already have solar; if passed, Prop 13 funds could be used**
- **Mandate that more critical facilities host multiday backup power, and consider resilient clean energy first**

Ensuring the ability of first responders and other critical facilities to protect public safety must be a priority. The SGIP Equity Resiliency budget can be used for critical facilities in or near fire risk zones, but outages and disasters such as earthquakes can happen anywhere. SGIP will never scale up to serve the tens of thousands of critical facilities all across the state that should be prepared for such contingencies.

Moreover, local governments often report they need technical assistance and other help determining which critical facilities are best suited for clean microgrids, putting together financing, issuing requests for offers and getting the projects installed and functioning. State agencies are best-suited to provide this technical assistance, directly or through consultants.

The CEC has successfully demonstrated clean microgrids on critical facilities like the Blue Lake Rancheria and Fremont fire stations, cutting utility bills by 20 to 60 percent while providing energy security. “For the critical facilities it was clear that the

134 Urban Sustainability Directors Network, “Resilience Hubs,” <http://resilience-hub.org/>

resilience aspect of those microgrids really resonated with the end customers, and they saw the value,” the CEC’s David Erne told Greentech Media.<sup>135</sup>

The next challenge is financing resilient clean energy deployment. A pioneer in this area is the City and County of San Francisco, which got a \$1.3 million federal grant to survey and map critical facilities, develop a new software tool, do financial analysis, and then select a dozen facilities as best candidates for deployment.<sup>136</sup> To fund implementation of these projects, the City is working with their capital planning department, speaking with philanthropic donors, and exploring grant opportunities.<sup>137</sup> A state financing tool would rapidly accelerate the process.

Schools are a unique opportunity for rapidly deploying energy resilience. Using the Prop 39 program, almost 2,000 California schools went solar, but only 65 schools installed batteries. Adding storage to solar schools would be a quick and cost effective way to create energy resilient community centers.



Schoolkids in Merced City School District. Source: TerraVerde Energy

Statewide, voters are considering Proposition 13 in March 2020, a \$15 billion facilities bond for schools. Section 41 of the measure includes energy improvements as eligible for funding.<sup>138</sup> If approved, the bond could provide the means to add batteries to solar schools. Sacramento lawmakers also finalizing plans for a \$4 billion climate resiliency bond for the November 2020 ballot, some of which could fund resilient clean energy.

While financing is vital, in some cases mandates may be needed. Cell phone towers, long-term care and assisted living facilities, dialysis centers and other critical facilities without current backup requirements should be required to install a minimum of 72 hours of backup power, with an obligation to consider clean technologies before choosing to use only fossil BUGs.

## PROVIDE STATE FINANCING FOR LOCAL INFRASTRUCTURE

### KEY RECOMMENDATIONS

- **Use the California Infrastructure and Economic Development Bank to provide low-cost financing for local government deployment of resilient clean energy systems**
- **Create public-private venture to finance solar + storage for small businesses**
- **Use IBank to lower the cost of private finance, through loan guarantees**

A common theme for these priority areas is the need for easy, low-cost, and scalable finance. If passed, the new Prop 13 could be a way to deploy resilient clean energy on schools across the state. But there are many thousands of other critical facilities, typically

135 Justin Gerdes, Greentech Media, “Lessons Learned From California’s Pioneering Microgrids,” May 13, 2019, <https://www.greentechmedia.com/articles/read/lessons-learned-from-californias-pioneering-microgrids>

136 Bentham Paulos, Greentech Media, “Resilient Solar: New York and San Francisco Study Solar With Batteries as a Resiliency Solution,” April 24, 2018, <https://www.greentechmedia.com/articles/read/resilient-solar-power>

137 San Francisco Department of the Environment, Solar and Energy Storage for Resiliency (Solar Resilient), <https://sfenvironment.org/solar-energy-storage-for-resiliency>

138 Asm. Patrick O’Donnell, 2019 AB 48, “Education finance: school facilities: Public Preschool, K-12, and College Health and Safety Bond Act of 2020,” (Proposition 13), [http://leginfo.ca.gov/faces/billTextClient.xhtml?bill\\_id=201920200AB48](http://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB48)

owned by local governments, that could be crippled by power outages or other disasters. SGIP storage incentives and a portion of the climate resiliency bond funding, if passed, will not be sufficient to support all of those with financial need. The state should create a scalable financing mechanism dedicated to resilient clean energy for local governments.

A good vehicle could be the California Infrastructure and Economic Development Bank (IBank), which Prop 13 would also use. The IBank has broad authority to issue tax-exempt and taxable revenue bonds, provide financing to public agencies, provide credit enhancements, acquire or lease facilities, and leverage state and federal funds.

In 2015, IBank established the California Lending for Energy and Environmental Needs (CLEEN) Center to invest in clean energy and energy efficiency projects.<sup>139</sup> The Center’s Statewide Energy Efficiency Program (SWEEP) provides financing to municipalities, universities, schools, and hospitals for energy measures, and to cities for LED street light upgrades. While the CLEEN Center has financed over \$1.4 billion for water infrastructure, it has supported only two clean energy projects in the past four years, totaling around \$10 million in loans, neither directly connected to energy resilience.

IBank could also start a public-private partnership to finance solar + storage deployment by small businesses, helping them reduce the cost of outages. IBank has a Small Business Finance Center (SBFC) that offers loan guarantees for small businesses that experience capital access barriers or suffer from disasters. The Disaster Relief Loan Guarantee Program, which provides loan guarantees of up to \$1 million for borrowers in declared disaster areas, was recently revived after many years of inactivity, but has not yet reported any actions.<sup>140</sup> This program could be used to help businesses prepare for and survive PSPS events.

Businesses and local governments can also partner with developers who can provide upfront financing and take advantage of federal tax credits. This “third party finance” strategy is being used for storage installations by schools that went solar with help from the Prop 39 program. Public funds could be used to reduce the cost of finance, through loan guarantees for example. Since resilient power systems create revenue streams through energy savings, it’s possible that revenue bonds could be used, rather than taxpayer supported General Obligation bonds.

## TAKE MICROGRID R&D TO THE NEXT LEVEL

### KEY RECOMMENDATIONS

- **Work on standardizing microgrid designs to drive down costs**
- **Demonstrate full-community or “village power” microgrids as an alternative to wires in dangerous terrain**

Microgrids are still an evolving industry, with a tendency to customize each installation. While the CEC has funded successful demonstrations of clean microgrids, such projects have taken on a new urgency with wildfires and the PSPS. Further research and development should focus on driving down costs, easing deployment, and exploring how microgrids can cost-effectively replace conventional grid solutions.

Researchers at the Schatz Energy Center at Humboldt State University are working on a standardized microgrid design for the 12,000 gas stations and convenience stores in California. Many of these businesses share similar designs and energy needs, so creating an “out of the box” microgrid package has great potential to cut costs, and make sure the stations can pump gas during times of emergency.<sup>141</sup> Peter Asmus of Guidehouse points to the growing

<sup>139</sup> See <http://www.ibank.ca.gov/cleen-center/>.

<sup>140</sup> IBank, Small Business Finance Center, <http://www.ibank.ca.gov/small-business-finance-center/>

<sup>141</sup> Schatz Energy Research Center, <http://schatzcenter.org/microgrids/>.

interest in “modular microgrids,” systems that can be “pieced together like Lego blocks, thereby shrinking design and deployment costs.” Vendors have reported cost savings of 30 percent using standard packages instead of custom designs.<sup>142</sup> Similar standardization research could focus on particular types of critical facilities like schools, fire stations, nursing homes and wastewater treatment plants, among others.

A new round of CEC support should also pursue more ambitious goals of demonstrating fully off-grid communities in fire hazard and vulnerable zones, to enable the removal of problematic power lines. Some of these clean microgrids could connect to existing clean energy resources, such as by adding solar + storage and controls to existing biomass power plants and hydroelectric generators located in remote communities. This “village power” approach is common on islands and remote communities in Alaska; it can also be applied to cut fire risk.

## INTEGRATE ENERGY RESILIENCE INTO EMERGENCY PLANNING AND RESPONSE

### KEY RECOMMENDATIONS

- **Revive local energy planning to ensure communities are ready for power outages**
- **Include energy planning in local hazard mitigation planning**
- **Incorporate clean energy into community preparedness programs like CERT**

The power outages have shown that local governments need to take a much more active role in energy planning, such as by reviving the Local Energy Assurance Plan (LEAP) process. With funding from the 2008 federal stimulus program, about 43 California cities and counties developed LEAPs, to identify critical facilities, determine their energy needs, and establish plans and policies for increasing resilience.<sup>143</sup> Funding for the program ran out in 2013, and it is now dormant.

Some communities put their LEAPs into action, like the small Central Valley city of Visalia. Visalia’s 2012 plan went into detail on the energy needs of critical facilities, both public and private, and identified gaps. In a notable gap, the plan found that seven facilities designated as American Red Cross shelters, despite being deemed “absolutely essential to maintain during an extended energy outage,” had no backup energy supplies. Only one of four radio transmitters used by emergency services had onsite backup power.<sup>144</sup>

In recent years, the Visalia school district installed solar on all schools, to save money.<sup>145</sup> In 2017, the district contracted to install battery storage at five of the schools, a deal expected to save the school district more than a million dollars over the 10-year contract, as well as provide resilient clean energy for disasters and outages.<sup>146</sup>

The foresight of local leaders in Visalia can serve as a model for other communities. The Climate Center is proposing a modernized approach to LEAP, called Advanced Community Energy (ACE) planning, with expanded goals of decarbonization, job creation, and grid support.<sup>147</sup>

142 Peter Asmus, Microgrid Knowledge, “Plug-and-Play Modular Microgrids Gain Market Momentum,” December 30, 2019, <https://microgridknowledge.com/modular-microgrids/>

143 Public Technology Institute, Local Government Energy Assurance Planning, [www.energyassurance.us](http://www.energyassurance.us)

144 City of Visalia, Visalia California Energy Assurance Plan, April 5, 2012, <https://www.visalia.city/civicax/filebank/blobdownload.aspx?blobid=12512>

145 Calley Cederlof, Visalia Times-Delta, “Visalia schools go green,” January 31, 2017, <https://www.visaliatimesdelta.com/story/news/local/2017/01/31/visalia-schools-green-renewable-energy/97312108/>

146 Green Charge, Press release: California’s Visalia Unified School District to Install 1.6 MWh of Green Charge Energy Storage, Santa Clara, Calif. September 28, 2017, <https://www.engiestorage.com/californias-visalia-unified-school-district-to-install-1-6-mwh-of-green-charge-energy-storage/>

147 Clean Power Exchange, <https://cleanpowerexchange.org/advanced-community-energy/>, accessed January 2020.

The California Energy Commission could supply technical assistance to planning efforts across the state, starting in high-risk fire and PSPS zones. Power suppliers, like utilities and CCAs, must be at the table, and local planning, in turn, should guide utility and CCA planning. Once local governments have developed their grid resiliency plans, they could access state financing via the IBank as mentioned above to deploy clean resilient energy, if needed.

The CEC is already required to prepare a state energy assurance plan “with actions to identify and address energy threats or shortages that affect the public health, safety, or welfare.”<sup>148</sup> The most recent plan was developed in 2014, and does not mention the PSPS policy.

Local governments do write Local Hazard Mitigation Plans (LHMPs), to plan for disasters and be eligible for grants from FEMA. Natural disasters can indeed cause major energy disruptions. In a 2014 report, the Association of Bay Area Governments

(ABAG) estimated that a magnitude 7.9 earthquake (comparable to the 1906 earthquake) could knock out electricity supplies for a week and natural gas supplies for up to six months.<sup>149</sup> But LHMPs don’t typically plan for intentional power outages like the PSPS.

In addition to emergency planning, energy resilience can be integrated into emergency response programs. The Community Emergency Response Team (CERT) Program organizes and trains volunteers for disaster preparedness. In some communities, neighborhood CERT groups are given an “emergency cache” of supplies, which can include a gasoline generator and fuel. A better approach is to recruit some of the million homes and businesses that already have solar panels to participate in CERT, to help equip them with batteries, perhaps via SGIP incentives, and have them serve as a resource to their neighbors during an outage.

148 California Energy Commission, State of California Energy Assurance Plan, 2014, <https://ww2.energy.ca.gov/2014publications/CEC-600-2014-006/CEC-600-2014-006.pdf>

149 Lifelines Council of San Francisco, Lifelines Interdependency Study, April 17, 2014, <https://sfgov.org/orr/sites/default/files/documents/Lifelines%20Council%20Interdependency%20Study.pdf>





## CONCLUSION: THE BIG PICTURE

California faces two intertwined threats: the risk of devastating wildfires started by power lines, and power shutoffs intended to prevent the wildfires. While many solutions have been floated, we have focused on distributed energy technologies, chiefly the dynamic duo of distributed solar power + battery storage.

Solar + storage is extremely safe and reliable, increasingly affordable, good for the economy and the planet, and in line with state clean energy policies. We have shown that solar + storage offers solutions in all sizes, from streetlights to fire stations to whole towns, and that capabilities will continue to grow as prices fall. Still, we don't see it as the only answer. Given the scale and urgency of the problem and its many contributing factors, we should and will see a variety of solutions deployed.

We do argue, though, that solar + storage should be given priority as a central element of the state government's response to wildfires and power outages, not just as something that environmentalists like. Even with other solutions like grid hardening, vegetation management and land use reform, planned power outages will be a reality in California for years and maybe decades to come. That's because our power grid is aging, climate change is making weather more extreme and utilities will continue to

be financially liable for damages from fires caused by their equipment. While policymakers can and should seek to make planned outages less frequent, boosting the deployment of resilient clean energy is like an insurance policy, making those outages less harmful to Californians while keeping us moving toward our clean energy goals.

Battery storage in buildings is still nascent, but the growth of electric vehicles is rapidly driving down prices for batteries, whether mobile or stationary. The power shutoffs have triggered unprecedented interest in storage, especially among the million California customers who have already gone solar.

Solar + storage is in many ways better than conventional solutions. It is faster than grid hardening, cheaper than undergrounding, cleaner and safer than fossil backup generators, and it provides value every day, making it ultimately more cost effective than fossil BUGs.

But without clear guidance and direction from policymakers, business-as-usual reactions will lock us into inferior approaches, and set us up for continued risk, expense, and failure. Now is the time for bold action to encourage resilient clean energy.

## APPENDIX

### CASE STUDIES: CLEAN MICROGRIDS PROVIDING GRID RESILIENCY IN CALIFORNIA

A microgrid is an interconnected set of electricity loads, generation, and storage that can operate while connected to or disconnected from the larger grid. Microgrids can be big enough to power whole college campuses or towns, or small enough to power a single home.

California is a national leader in clean microgrids, which rely mostly or fully on renewable power sources. This appendix provides a sample of ten clean microgrids operating or being built around the state. Vote Solar strongly supports removing barriers to the growth of clean microgrids as means of promoting

public safety and resilience, and as a response to growing climate impacts and power shutoffs.

Many, although not all, of these microgrids have been supported by state R&D grants. Since 2009, the California Energy Commission (CEC) has disbursed millions in grants focused on demonstrating microgrids on critical facilities and on microgrids with high levels of renewable energy. Grant funding for the projects has come from the Electric Program Investment Charge (EPIC), a ratepayer-funded energy innovation research program.<sup>150</sup>



Photo: Schatz Center

#### 1. Blue Lake Rancheria Microgrid

**ONLINE DATE:** 2017

The Blue Lake Rancheria is located on tribal land in the Humboldt Bay area. It sits at the junction of three tectonic plates and is subject to heavy rainstorms, forest fires, and frequent power outages.

The Rancheria houses a low-carbon microgrid that provides reliable backup power to tribal government offices, EV charging, a convenience store and gas station, and a hotel and casino. During the power shutoffs of 2019, this microgrid was a valuable resource for the community and provided power credited with saving medically dependent people's lives.

##### Additional Info

<https://schatzcenter.org/blrmicrogrid/>  
<https://schatzcenter.org/2017/10/blue-lake-rancheria-receives-femas-2017-whole-community-preparedness-award/>

150 [https://ww2.energy.ca.gov/research/notices/2019-04-26\\_workshop/presentations/](https://ww2.energy.ca.gov/research/notices/2019-04-26_workshop/presentations/)

## 2. City of Fremont, Fire Stations Microgrids

**ONLINE DATE:** 2015

The City of Fremont won a state grant to develop microgrids at three fire stations. Each microgrid consists of a parking lot canopy photovoltaic system, battery energy storage, and an energy management system that controls the system automatically. During an outage, the microgrid will provide at least three hours a day of power for critical loads. It was designed and installed by Fremont's Gridscape Solutions.

A four year trial period recently ended, and the project is now fully operational. It is expected to save Fremont \$215,000 in utility bills over ten years, along with cutting carbon dioxide emissions by around 80,000 pounds per year.

**Additional Info**

<http://innovation.energy.ca.gov/SearchResultProject.aspx?p=30084>  
<https://www.mercurynews.com/2019/10/12/why-fremont-firefighters-could-focus-on-saving-lives-not-the-pge-shutdown/>



Photo: California Energy Commission

## 3. Stone Edge Farm Microgrid

**ONLINE DATE:** Now operational: developed between 2013 and 2018

During the Sonoma County fires in 2017, the Stone Edge Farm microgrid operated continuously for 10 days while neighbors lost power as a result of wildfires. It again rode through PG&E's Public Safety Power Shutoffs in the fall of 2019.

The microgrid at the farm, spa and vineyard features solar, a fuel cell and hydrogen electrolyzer, a microturbine, and 10 types of batteries, plus offers educational tours. Even when the farm was evacuated, operators continued to manage the microgrid's operation remotely.

**Additional Info**

<https://microgridknowledge.com/microgrid-stone-edge/>  
<https://sefmicrogrid.com/microgrid-systems/components-technologies/>



Photo: Stone Edge Farm

## 4. Santa Rita Union School District Microgrids

**ONLINE DATE:** 2018

Santa Rita Union School District serves about 3400 kids near Salinas, many of them Latino and from farm worker and other low-income families. The district sees power outages fairly regularly because it is rural with a constrained grid in the Monterey Bay area. In 2016, school leadership looked into getting backup power, and while they considered diesel generators they decided to take a cleaner path.

Santa Rita Union installed solar + storage at seven of their schools. The solar savings generated by net metering are being used to repay the cost of the system. The storage can discharge for up to 7 hours, while the solar will recharge the storage every day, making the system able to provide power indefinitely. The middle schools are designated emergency shelters which can be powered by the microgrid.

**Additional Info**

[http://sruesd-ca.schoolloop.com/file/1516177487510/1442471980548/269731280\\_0308938586.pdf](http://sruesd-ca.schoolloop.com/file/1516177487510/1442471980548/269731280_0308938586.pdf)



Photo: Santa Rita Union School District



Photo: City of Santa Rosa

## 5. Laguna Wastewater Treatment Plant Microgrid

**ONLINE DATE:** Still in the interconnection process

In Santa Rosa, Trane US is installing solar and storage at an existing wastewater treatment plant to expand its energy capabilities as a microgrid, including the ability to provide ancillary services to the grid. The project includes solar, storage, and an existing combined heat and power (CHP) plant running on natural gas and biogas from the sewage treatment operations. The project is supported by a grant from the California Energy Commission.

**Additional Info**

<https://www.pressdemocrat.com/news/8305925-181/solar-panels-to-help-power?sba=AAS>



San Diego Gas & Electric Company

## 6. Borrego Springs Microgrid

**ONLINE DATE:** 2015

Borrego Springs is a quaint town of about 3,400 people set against the Anza-Borrego Desert about 90 miles east of San Diego. Summers are extremely hot, and because it lies at the far end of a transmission line, the town has suffered frequent power outages. Borrego Springs' turn to a microgrid was spurred by a local calamity, a 2007 wildfire that took down its transmission line. After the fire, San Diego Gas & Electric won a grant from the U.S. Department of Energy to build a demonstration microgrid in the community. All of Borrego Springs can island for several hours during the day and designated critical loads can island at night.

**Additional Info**

<https://ww2.energy.ca.gov/2019publications/CEC-500-2019-013/CEC-500-2019-013.pdf>



Photo: Greentech Media

## 7. UC San Diego Campus Microgrid

**ONLINE DATE:** In operation for decades, moving more to clean energy recently

University of California at San Diego has developed a microgrid that provides almost all of the heat and power to the campus of the campus of 45,000 people and 450 buildings. It also serves as a research platform for innovative technologies. The campus hosts a variety of battery technologies, supercapacitors, solar panels, fuel cells, used EV batteries, and rapid EV chargers. The campus microgrid is able to serve as a demand response partner with SDG&E, both absorbing and exporting power to the grid.

**Additional Info**

<https://www.greentechmedia.com/articles/read/byrom-washom-master-of-the-microgrid>

## 8. Mountain View-Los Altos High School District Microgrid

**ONLINE DATE:** 2011

In 2011, Mountain View-Los Altos High School District (MVLAD), in the heart of Silicon Valley, installed 1.26 MW of solar to meet half its energy needs. To cut utility demand charges they later installed a 1.08 MWh battery, saving \$86,000 per year. The battery system is owned and operated by ENGIE Storage, resulting in no capital outlay by the school district. The monthly fee is less than the bill savings from the battery system. The campuses also have 28 electric vehicle charging stations.

**Additional Info**

<https://www.engiestorage.com/californias-mountain-view-los-altos-high-school-district-becomes-the-first-us-high-school-district-to-combine-intelligent-energy-storage-and-ev-charging/>  
<https://www.educationdive.com/spons/boosting-school-district-revenue-and-sustainability-with-energy-storage/539805/>



Photo: Cupertino Electric, Inc.

## 9. Humboldt County Airport Microgrid

**ONLINE DATE:** Groundbreaking spring 2020, estimated complete by December 2020

Redwood Coast Energy Authority (RCEA) is partnering with the Schatz Energy Research Center (SERC) at Humboldt State University, PG&E, and the County of Humboldt to build a 7-acre, 2.25 MW solar array and battery energy storage system at the California Redwood Coast – Humboldt County Airport. The microgrid will provide electricity to the airport, a U.S. Coast Guard Air Station, a nearby animal shelter and a few other nearby businesses during power outages.

**Additional Info**

<https://redwoodenergy.org/community-choice-energy/about-community-choice/power-sources/airport-solar-microgrid/>



Photo: Redwood Coast Airport

## 10. Santa Rita Jail Microgrid

**ONLINE DATE:** 2012

Alameda County’s Santa Rita Jail houses 4000 inmates in Dublin, California. The microgrid system, installed by Chevron Energy Solutions, has multiple components, including 1.5 MW of solar, a 1.0 MW molten carbonate fuel cell, five small wind turbines, back-up diesel generators, and a 2 MW/4 MWh lithium ion battery.

**Additional Info**

<https://building-microgrid.lbl.gov/santa-rita-jail>  
[https://www.wisconsin.gov/library/presentations/WIDRC\\_SRJ\\_Pres\\_Lasseter\\_17Apr2015.pdf](https://www.wisconsin.gov/library/presentations/WIDRC_SRJ_Pres_Lasseter_17Apr2015.pdf)



Photo: Lawrence Berkeley National Lab



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