# SOLAR ENERGY & RESILIENT COMMUNITIES

## How does solar energy contribute to building resilient communities?

### A reliable energy source for solar PV system owners:

Centralized grid electricity systems are prone to risk during extreme weather conditions and other emergency situations. Hurricane Sandy, for example, left 8.5 million people across the East Coast without power for several days.[1] In addition to service disturbances, any power outage results in considerable economic damage. A Congressional Research Service study indicates that the inflation-adjusted cost of weather-related outages is approximately $25 to $70 billion annually[2].

Distributed solar PV systems equipped with batteries are a good alternative as they maintain access to electricity during emergency situations. This not only addresses issues related to grid resiliency but also provides many positive environmental outcomes. This can be seen when comparing solar PV life cycle emissions to those of other selected electricity supply technologies. For example, the median emission (gCO2eq/kWh) from rooftop solar PV is twenty times less than coal (41 rooftop solar PV, 820 coal and 490 gas).[3] In addition, solar PV systems not only have significantly lower CO2 emissions that contribute to global warming, but their adoption also reduces air pollutants such as nitrogen oxides, sulfur dioxide, and mercury from fossil fuel electricity generation that have significant impacts on communities' health.[4] In addition, Western Resource Advocates' research on typical water use for electricity generation indicates that solar PV systems, on average, use little water, if any, compared to other energy sources.[5] Reducing dependency on water for electricity generation contributes to building more resilience communities. Finally, unlike other energy sources, solar energy is accessible most places in the country. Based on NREL studies, every community across the US has greater solar potential than Germany which is the world leader in solar power generation. Homeowners in the U.S. with an unshaded, properly tilted orientation and installation can produce enough solar energy to make it a viable energy option. However, it is important to note that having a PV system on-site does not guarantee that a property will maintain access to electric power during an outrage. To perform as a reliable energy source, the PV system must be designed to operate in isolation from the grid. (See box 1)

**Box 1: Characteristics of a Resilient Solar PV System**

For a solar PV system to function in isolation from the grid, the PV system must include both a:[6]

- Storage System: Batteries are the best choice for small PV systems. Community energy storage in conjunction with a microgrid may also be an option for shared solar systems to avoid electricity outage resulted from bigger grid disruption outside of the community.
- Multifunctional Inverter: These types of inverters are capable of monitoring the grid and isolating the solar system if the grid goes down.

In addition, it is important to pick a PV system that meets appropriate standards developed by the International Electrotechnical Commission (IEC) and Underwriter Laboratories to endure extreme weather as well as to have a performance guarantee from the installer.[7]

Note: There are some other options for having a resilient PV besides PV system equipped with battery such as new smart inverters and traditional inverters with emergency plugs. These options can provide backup power for small number of power outlets during an electricity outage.

1. http://www.oe.netl.doe.gov/docs/SitRep13_Sandy-Nor'easter_120312_300PM.pdf
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6. NREL- Distributed Solar PV for Electricity System Resiliency, 2014. Retrieved 5/15/15
7. http://solaroutreach.org/wp-content/uploads/2013/10/Solar

## Increased grid resiliency:

Distributed solar systems equipped with batteries can play an important role in increasing the resiliency of the grid system by reducing peak electricity consumption, providing ancillary services to the grid, and improving power quality.[8] For example, in the case of heat waves where the use of cooling systems can increase peak demand, distributed solar systems can be very useful in grid demand management and in maintaining access to power for customers dependent on the concentrated grid system. Solar systems paired with storage can also provide critical load support to a host building during extreme events with grid outages.

## Positive economic impacts:

The resiliency and environmental outcomes of distributed solar PV systems, coupled with the constantly decreasing cost of solar PV over the past five years, makes it an increasingly attractive alternative to traditional centralized power generation systems. A recent study found that in 42 of the 50 largest US cities, buying an average-sized, fully-financed solar PV system costs less per kilowatt-hour than the cost of electricity from the grid. [9] In addition, solar PV systems with batteries can tap into other financing options. Solar systems equipped with batteries can reduce monthly bills by lowering demand charges (maximum power used during a billing period) for commercial customers options tied to demand management in some regions can offer enough revenue to provide free-of-cost battery systems.[10] For example, a Rocky Mountain Institute study indicates that both the frequency regulation market in PJM territory and the demand charge reduction market for commercial customers in California are profitable for energy storage companies.[11] Considering that the costs of batteries are decreasing, the outlook for other regions may soon be more positive as well. Job creation is another positive outcome that contributes to building more resilient communities. The solar industry is rapidly creating jobs around the country at a rate 20 times faster than the overall economy while paying competitive wages to very diverse demographic groups[12].

8. http://www.nrel.gov/docs/fy15osti/62631.pdf
9. http://nccleantech.ncsu.edu/wp-content/uploads/Going-Solar-in-America-Ranking-Solars-Value-to-Customers_FINAL1.pdf
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## Examples of using solar PV systems to increase resiliency

Standalone PV systems can play a role in maintaining a range of important services during an emergency situation. Although each community defines its critical facilities and equipment differently, they could include emergency operations and first responder stations, hospitals, shelters, water treatment systems, blood banks, gas stations and pharmacies. Critical equipment and infrastructure may include power generators, lighting and communication towers.

Examples of resilient solar applications include:

Solar PV systems for critical facilities: To maintain services during an emergency situation, it is important to equip critical facilities such as hospitals and shelters with standalone PV systems. Generally, equipping public buildings such as schools and libraries with a solar PV system and battery is a smart strategy to increase the community's capacity to cope with an emergency situation. See box 2.

### Box 2: Vermont DPS Electrical Energy Storage Demonstration Program

In 2014, the City of Rutland, Vermont was awarded a grant by the Vermont Department of Public Service and the U.S. Department of Energy to develop a solar-powered microgrid on a brownfield. Using 8000 solar panels and 4 MW of battery storage, the microgrid will provide backup power to a public emergency shelter. Rutland experienced a power outage during Hurricane Irene. This project is a step toward avoiding the same experience in future storms.[12]

Solar-powered infrastructure: Equipping cities' infrastructure, such as water sanitation systems, street lighting, and communication towers, with standalone solar PV systems

12. The solar Foundation-Solar Industry Jobs 214. 2015. Retrieved 5/5/15

can play a critical role in building a resilient community, contributing to the community's ability to bounce back from extreme conditions. See box 3.

### Box 3: Valley Center, CA Municipal Water District

WorldWater & Solar Technologies Corp. developed a 1.1 MW PV system to provide 2.1 million kWh per year for the second largest water provider in San Diego County. This system is also capable of functioning off-grid. [13]

Emergency equipment: Communities spend large amounts of money to purchase backup power generators for emergency situations. Despite the popularity of diesel generators, accessing diesel fuel during emergencies can sometimes be a challenge. In addition, these generators sit idle during non-emergency situations. Using solar PV systems can solve both issues. Communities may also choose to use solar-diesel hybrid systems to serve a specific load, while another smart option is portable solar generators. Solar PV systems also can be used for emergency lighting, battery charge stations, and water purifications systems. See box 4.

### Box 4: Greenpeace Rolling Sunlight PV Truck

After Hurricane Sandy, a Rolling Sunlight PV truck powered a donation center in New York and helped thousands without power to charge their cell phones.[13]

## Conclusion:

The number of Solar PV installations is growing fast. In 2014, 32 percent of all new electric-generating capacity in the U.S. came from solar, and solar PV installation grew 30% compared to 2013.[14] However, the solar PV market is still young with potential for growth as the cost of batteries declines and policy makers consider incentivizing consumers to adopt battery systems and to recognize the benefits to grid systems of solar with storage capabilities. The benefit of coupling PV systems with batteries to increase community and grid resiliency is an opportunity not to be missed.

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13.http://www.businesswire.com/news/home/20070829005221/en/WorldWater-Develops-Project-San-Diego-Countys-Valley#.VbawK_lVikp

14. http://www.seia.org/research-resources/solar-market-insight-report-2014-q4