+ E-BOOK

Microgrids

The Green Way to Increase Resiliency and Reduce Energy Costs

9 MINUTE READ

A Clean-Energy Solution to Costly Power Outages

The U.S. Department of Energy estimates that power outages cost the American economy $150 billion annually. This includes the cost of business disruptions and lost product, as well as emergency fuel and operations and maintenance services. There's also an environmental cost in the form of greenhouse gas (GHG) emissions from diesel generators, which contribute to a company's carbon footprint.

With the increase of extreme weather events and grid instability around the country, power outages are becoming a greater risk to private and public interests. It's a particular concern in wildfire areas, such as in California, where public utilities proactively cut electricity as a precautionary measure during fire conditions. So how can a corporation, academic institution, or public entity protect itself from the impact of widening outages while limiting financial and environmental impact? The answer is a renewable microgrid. In this publication, we'll explain what a microgrid is, how it works, and the benefits it brings to organizations like yours.

What Is a Microgrid?

A microgrid is an effective way to mitigate the operational, environmental, and financial impact of outages — but what is it exactly? At PowerFlex, we define a microgrid as an electric system comprised of loads and at least two sources of generation where one or more is renewable. The system is interconnected with the utility and can operate either in parallel with or in isolation from the larger power grid.

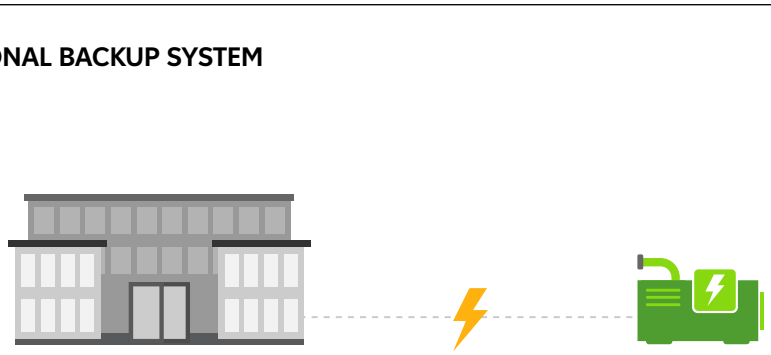
When a microgrid is operating independently from the utility, it's said to be "islanded." It's this islanding capability that makes a microgrid resilient against power outages. In essence, a microgrid gives you the best of both worlds: When the utility grid is operational, you can leverage renewable assets like solar and battery energy storage to limit your utility usage, thereby reducing your energy costs and environmental impact. When the utility grid goes down, these assets remain operational to help provide your facility with critical power.

How Microgrids Differ from Traditional Backup Systems

While microgrids share some similarities with traditional backup power systems, there are several important distinctions.

In a **traditional backup power setup**, circuit breakers switch critical infrastructure over to an emergency diesel generator (genset) when the power goes out. The generator runs all day for as long as the blackout lasts, throttling up and down as onsite power demand necessitates. This is extremely energy and cost inefficient and puts wear and tear on the asset. It's akin to driving your car through start-stop traffic: You're expending more fuel and creating more carbon emissions than you would if you were traveling at highway speed for a shorter amount of time, plus you're putting more stress on your engine.

What's more, if a grid-connected renewable asset like a solar array is present, it will shut down along with the utility grid during a blackout and will not be available to generate additional power for your facility. This is actually by design, and is done as a safety precaution to protect utility repair crews from coming into contact with energized lines.



Results

- High fuel costs
- Inefficient generation
- Genset wear & tear
- GHG emissions

TRADITIONAL BACKUP SYSTEM

←

Domaine Carneros
Napa, CA

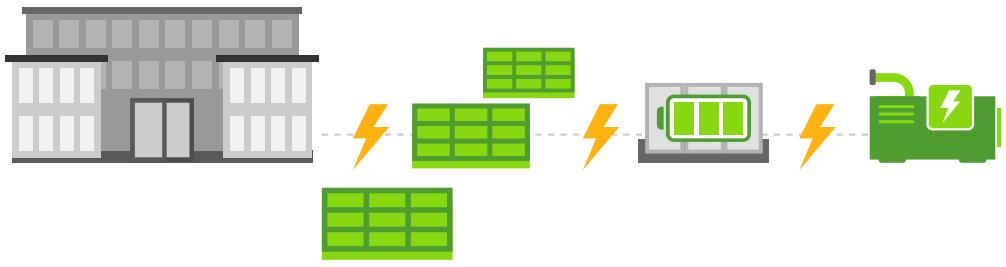
The system comprises a 243 kW-DC solar photovoltaic system, a 280 kW / 538 kWh battery energy storage system (BESS), and 4 Level-2 Electric Vehicle (EV) chargers onsite.

In a **microgrid system**, we're able to leverage utility-grid-connected solar and energy storage assets in conjunction with a diesel generator to provide reliable backup power in a manner that is more cost effective, energy efficient, and environmentally friendlier than using a generator alone. When utility power fails, an energy management system (EMS) initiates smart switches that isolate the facility's electrical infrastructure from the utility grid and powers down non-critical infrastructure in order to conserve energy (a strategy called "load shedding"). In contrast to a traditional backup power setup, solar and battery storage systems continue to operate and provide power to critical infrastructure. When solar and battery power run low, the diesel generator kicks in to provide energy.

Results

- Reduced fuel costs
- Extended fuel supplies
- Increased genset lifetime
- Reduced GHG emissions
- Solar + storage operate during outage as well as during normal grid operations

MICROGRID SYSTEM

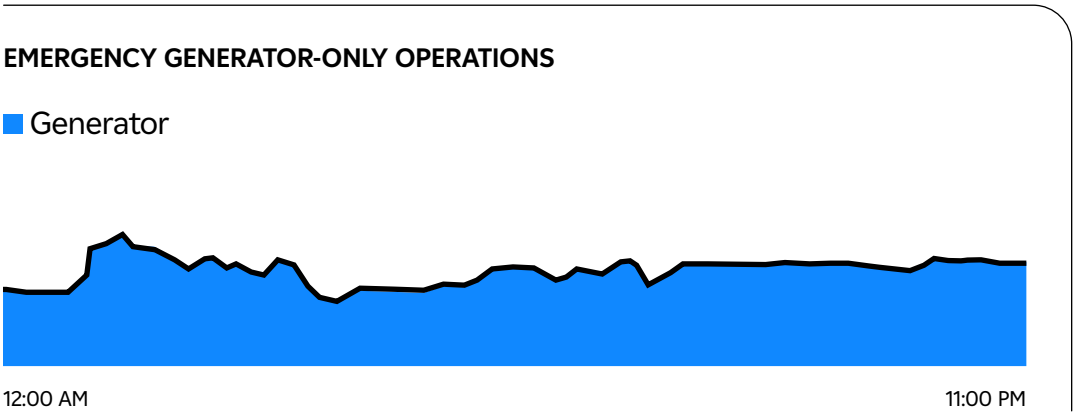


How Does a Microgrid Work?

Let's dig deeper into how exactly this combination of a solar array, an energy storage system, and a backup generator works to improve a facility's emergency operations. We'll go layer by layer, beginning with the generator and then adding storage and solar.

Diesel Generator

As we've already covered, a diesel generator alone is a highly inefficient and dirty way to power a facility during a blackout. The generator runs 24 hours a day at only about 25% of its peak efficiency — constantly ramping up and down as onsite power needs fluctuate. This results in high fuel costs, machinery wear and tear, and a negative environmental impact due to greenhouse gas emissions.



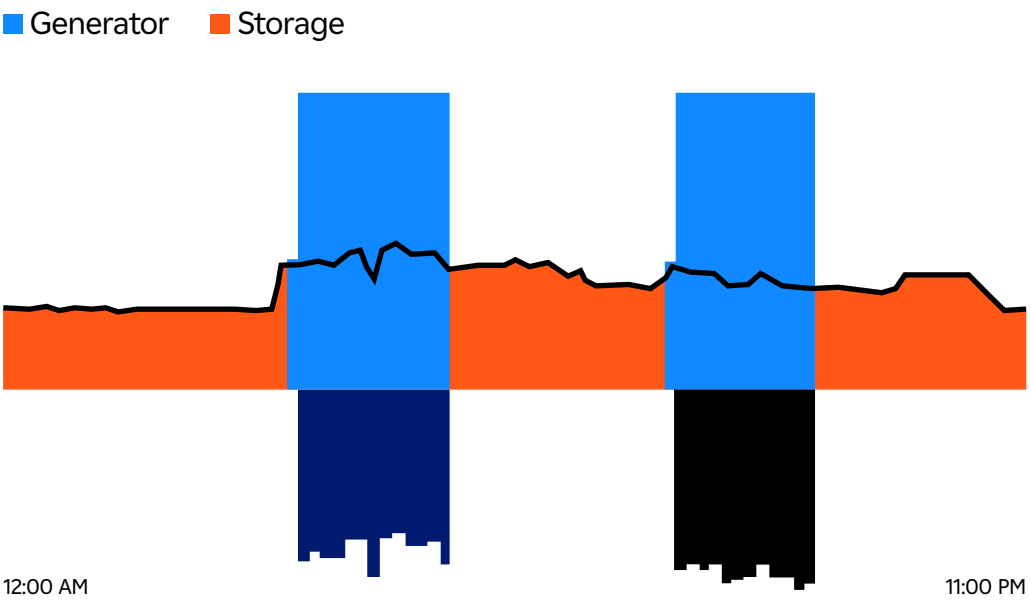
But instead of removing a generator completely when installing a microgrid, resulting in removal costs and lost investment in the asset, we combine it with renewable technologies that optimize its performance.

Adding Battery Energy Storage

Adding battery storage to a genset in an islanded microgrid greatly improves efficiency during a power outage. The battery reduces strain on the generator by powering building load with stored energy for about 2 to 4 hours at a clip before needing to be recharged. Once the battery has been drained, the generator switches on to power essential loads and to recharge the battery. The key difference is now the generator runs at 100% power while the battery varies the speed at which it charges in order to allow the generator to run at a flat rate as it powers the building load. In this capacity, the battery is acting as the "balancing asset," where it's balancing the energy generation with the building's consumption.

Most grid-connected battery systems aren't intended to sustain a facility on their own during an outage, but are instead sized to maximize utility savings during normal grid operation. The system stores energy for use during times of day when electricity rates are highest and shaves a facility's peak energy usage to save on utility demand charges.

STORAGE AND EMERGENCY GENERATOR OPERATIONS

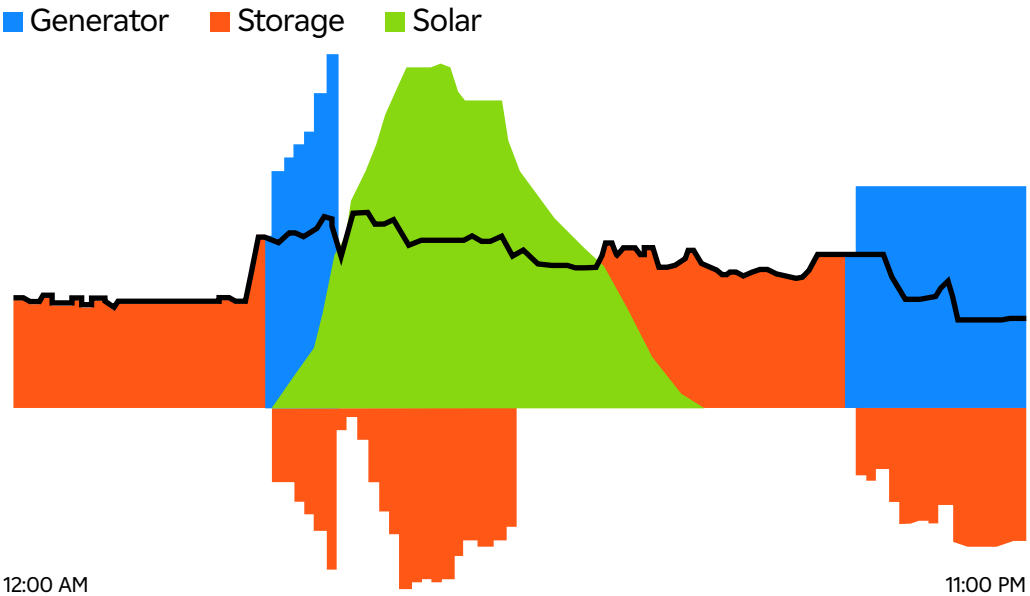


When the battery is recharged, the generator turns off, and the battery goes back to powering the building load until it is depleted once more. This setup decreases generator runtime while increasing its efficiency. Since the generator is on only intermittently — and running at full power for the duration it's operational, as opposed to throttling up and down to meet demand — users can conserve expensive diesel fuel and reduce harmful GHG emissions.

Adding a Solar Array

Layering on a solar energy system decreases generator runtime even more. Before the sun comes up, the facility is powered by battery energy. Like before, once the battery is depleted, the generator turns on in order to power the facility as well as recharge the battery. But now as the sun rises, the solar production kicks in “underneath” the generator (which is still running at a maximum, constant rate) and the excess energy after the building load is fulfilled recharges the battery.

SOLAR, STORAGE & EMERGENCY GENERATOR OPERATIONS



Thanks to the added energy that the solar system is providing, the generator needs to run for a shorter time before it switches off. Solar energy continues to power the facility throughout the day, with excess energy going to recharge the battery. As solar tapers off once the sun starts to set, the battery takes over until it runs out of power, at which point the generator kicks back in at full capacity to power the facility and recharge the battery. This process is repeated until utility power is restored.

In Summary: Microgrid Advantages

Eliminates Productivity Losses

Companies equipped with microgrid technology can remain online during utility power outages, potentially avoiding tens of thousands of dollars in lost productivity per incident.

Incorporates Existing Infrastructure

Microgrids don't replace your existing backup power system; they work with it — integrating your diesel generator with renewable assets like solar and energy storage.

Reduces Genset Uptime

Instead of running a diesel generator 24 hours a day at about a quarter of its peak efficiency, microgrids leverage solar and storage to help maximize generator health and productivity.

Reduces Fuel Costs & Extends Fuel Supply

Running a generator less often means expending less fuel — which is a critical advantage when fuel shortages and price hikes strike during blackouts.

Reduces GHG Emissions

Integrating solar generation and energy storage lessens overall reliance on the genset, allowing a facility to greatly curtail its GHG emissions during blackout periods.

Microgrids in Action

Now that you've got a better grasp on how microgrids work, let's look at how the technology is put to work for the financial and operational benefits of public and private enterprises.

Here are a few standout projects that PowerFlex has executed in conjunction with our parent company, EDF Renewables.

Domaine Carneros

Napa Valley winery Domaine Carneros had been hard hit by public safety power shutoffs due to the threat of wildfires. The estate was forced to run on diesel during these extended power outages and dealt with fuel shortages. To ensure continuity of operations during these emergencies, Domaine Carneros turned to PowerFlex to implement a microgrid on the property. Now the winery can leverage a 250-kilowatt (kW) carport and rooftop solar system and a 280-kW/540-kilowatt-hour (kWh) battery in conjunction with its existing generator. This has resulted in a 65% reduction of GHG emissions during outages and has doubled onsite fuel reserves from 3 days to 7 days. Domaine Carneros now enjoys $70K in annual utility savings, amounting to an estimated $1.5 million in lifetime savings.

Domaine Carneros
Napa, CA

Port of San Diego

With a 700-kW rooftop solar system and a 700-kW/2,400-kWh battery storage system, the microgrid we installed at the Port of San Diego is designed to be 100% renewable for multiple days during a power outage. There is enough solar production to sustain the facility all day as well as charge the battery, which provides power overnight. While there is an emergency diesel generator on site, the combination of the solar array and battery energy storage system eliminates the need for it. The Port has enjoyed $1 million in utility savings so far, proving the microgrid's worth not only as a sustainable solution but a cost-cutting measure as well.

San Diego, CA

Contact us at PowerFlex to start exploring how a renewable microgrid can help increase your energy resiliency and sustainability while reducing operating costs.

Get started today _→

About PowerFlex

PowerFlex, an EDF Renewables affiliate, is a clean technology solutions company making the transformation to carbon-free electrification and transportation possible.

Our onsite intelligent energy management platform, PowerFlex X, monitors, controls, and optimizes onsite clean energy assets — solar, storage, EV chargers, and microgrids — and reduces overall energy costs through adaptive algorithms that maximize distributed energy resources.

PowerFlex is the second-largest installer of commercial rooftop solar and the fourth-largest network of Level 2 EV chargers in the U.S. Our solar and storage projects offset 70,000 tons of CO2 each year, while our 10,000+ EV chargers were responsible for offsetting 13,000 tons of CO2 in 2022.

MORE WAYS TO GET IN TOUCH

sales@powerflex.com

powerflex.com

(650) 469-3392

15445 Innovation Dr.
San Diego, CA 92128

powerflex
EDF Renewables

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