

Microgrid myths

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(accurately)
design and sell a
microgrid

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Photo courtesy of Solar Island Energy.

Microgrid myths

Microgrids can provide reliable, cost effective power – just don't fly too close to the sun in your proposals

By Marc Lopata, PE

Much of my time at work involves helping folks understand how they can improve their energy and financial performance using microgrids.

That is mostly solar energy and batteries and energy efficiency. But sometimes we also integrate wind turbines, ice energy storage, flywheels, fuel cells, and other bleeding edge technologies. The

overwhelming number of those projects are small island communities that are burning diesel fuel to make electricity, and we displace most of that diesel fuel with solar energy.

Along with other practitioners, we are making microgrids mainstream. We are still in the early adopter phases, and accurate knowledge is key to moving to mainstream adoption.

Is your client a business owner using high-precision manufacturing with robotics and 3-D printers? One of their primary concerns probably is power quality from the utility grid. Or maybe your client's business is cold storage, and they're similarly concerned about losing the grid and their inventory because of an outage. This same concern might resonate with hospitals, military bases, data centers, and

other electricity users that need reliable electricity and can't tolerate the lights going out. Or maybe your client lives or works somewhere with no grid at all.

These are all reasons to consider using a microgrid to provide reliable electricity. But is a microgrid worth it? That depends on the financial or non-financial benefits that make sense to your client, whether that is a return on investment or keeping lights on at night so people can read and cook without burning fires in their homes.

Just like any technological advancement, there are misconceptions about microgrids. This article will explain a few of them, mostly as they relate to small island communities. But they would still apply to those other microgrid use cases.

What's a microgrid?

Ask five experts and you might get five answers. I like to keep things simple, so how about this:

- A group of electricity users relatively close to each other.
- The ability to generate and store energy to use it when needed.
- The generation and storage assets may be centralized or distributed around the various users (nodes) of the microgrid, and they are cen-

trally controlled to manage overall performance.

- There also may be the desire to connect to, or disconnect from, a public utility grid based on financial, reliability, or other drivers.

Can you still call your one building by itself a microgrid? Of course. There's no microgrid police. Fundamentally, we are referring to the technology that enables the above bulleted items, not whether an application takes advantage of them all.

Myth 0: Microgrid technology is the key

Let's get this out of the way first. Two important steps will make all the difference in whether a microgrid is successful.

First is an accurate base-load profile. How much energy does the microgrid site use every year, every day, every hour? Ultimately, this hourly data, an "8760 data set," will be needed. Whether you get that from a data logging system or synthesize it (guess) from singular, long-term metrics will affect the success of the project. For instance, we sometimes get a client that tells us, "We spent \$500,000 on diesel fuel last year." Can we create a load profile from that? Yes. Will it be accurate? Maybe. GIGO (Garbage In / Garbage Out) applies here.

Second is the energy efficiency of the

microgrid. This is like dieting, and no one likes to do it for the same reasons. Lighting and operations usually are easy targets. Other energy efficiency efforts become more complex and costly and are usually not as good financial metrics — but it is still important to consider them all because it is much more expensive to make a kWh with a microgrid than to reduce consumption. Energy efficiency likely requires another article to itself.

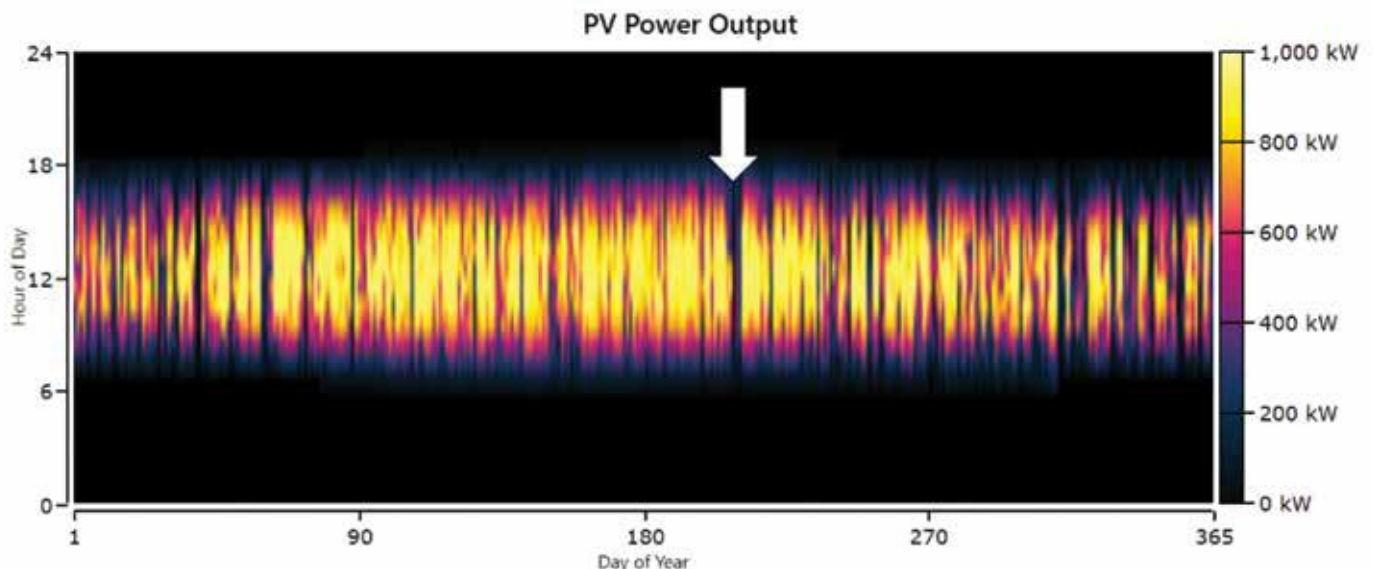
Myth 1

A solar energy microgrid can make 100% of your electricity from solar only

This statement is true mostly in two limited use cases.

1. The users say it is OK that when the batteries are depleted, the lights will go out.
2. The project has a huge budget, no expectation of financial performance, and no limitations on land area.

The military or wealthy landowners will tell you that use case No. 2 is the way they operate. But it is my experience that most folks aren't happy when the lights



- ▲ This is the energy and power produced by a solar energy system over the course of a year. The brighter the color, the more power and energy the solar is producing. The white arrow points to a spot in July without much production for a few days.

go out, and/or they do not have abundant land or money, and they are actually concerned about financial performance.

If an industry is to grow, isn't financial sustainability just as important as other benefits? Yes, the early adopters, bless their hearts, are more focused on proof of concept and do have abundant budgets. But to get to mainstream, we have to deliver performance that will drive a typical client to invest.

Here's a thought exercise to help understand this myth. Consider making all of your electricity with PV on a sunny day. If it were sunny every day where you live, and you needed the same amount of electricity every day, it would be easy to design that 100% offset microgrid.

But that isn't the case. Do you live in the Caribbean? Phoenix? Colorado? Clouds exist everywhere sometimes. It even rains in Southern California.

For those once-in-a-while cloudy days, you would have to pretty much double the size of the PV and ESS to remain 100% renewable. If it happens to be cloudy two days in a row, then the PV and ESS would need to be three times the original size. And so on.

At some point, the economics and business case for land use don't work so well. If it is cloudy one day a month, is it worth

it to double the size and cost for 12 cloudy days a year? How about if it is cloudy one day a week? Or how about if there's also a spike in energy usage on a cloudy day? The site could get to the point where the solar just can't meet the demand, and the lights go out.

Refer to the graph on p. 37. Here is the energy and power produced by a typical solar energy system over the course of a year. The calendar day is the X-axis along the bottom from January to December. The time of day is vertical on the Y-axis going from morning to night. The brighter the color, the more power and energy the solar is producing.

The variability is because of clouds mostly but also temperature. Obviously, the sun isn't shining at night, and that is why the night hours are black. But the sun power isn't consistent during the sun hours either. The white arrow points to the end of July and it looks like there isn't any production there for a few days. This would be the same if the site was using wind turbines. Sometimes the wind doesn't blow.

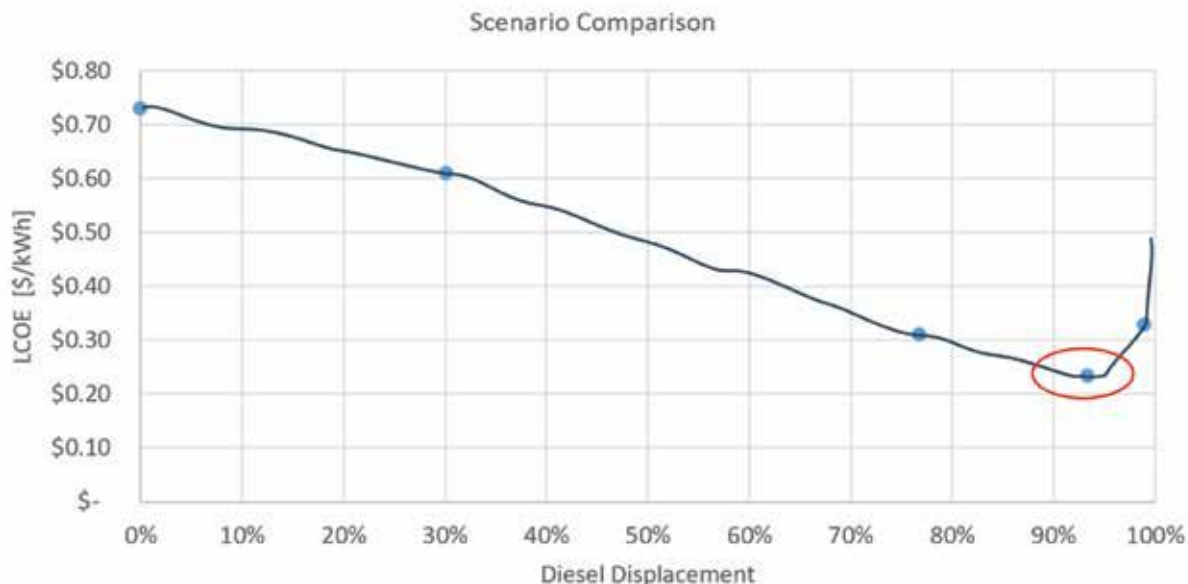
Levelized Cost of Energy (LCOE) is a key microgrid metric. It is the cost of energy from the microgrid considering all the costs and all the energy produced. That includes the initial capital investment,

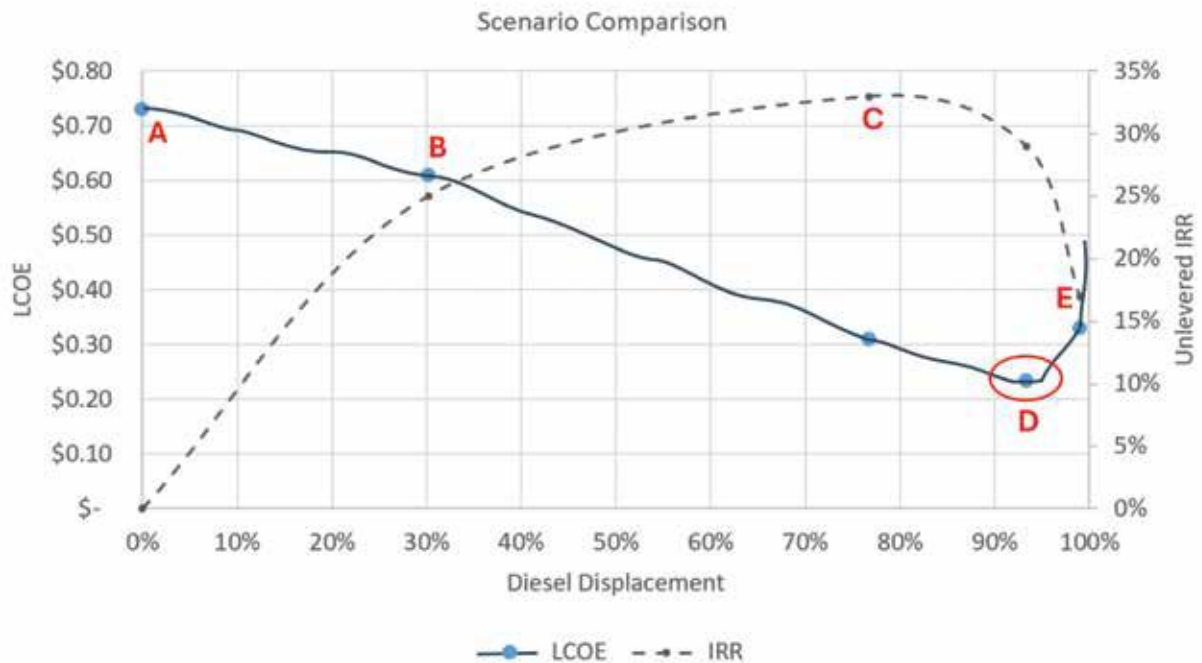
plus all future costs. The future costs are maintenance (for everything), replacing equipment when its warranty expires, overhauling engines, and of course, fuel. Then, all the future costs are discounted to today's dollars. (If you aren't sure what that means, look up "present value of a cash flow stream.")

Once the total net present cost is calculated, divide that by the total energy produced over the project lifecycle. That results in a cost per unit of energy, or \$ per kWh.

Below is a graph of the LCOE vs. increasing percentages of fossil fuel or utility offset. In this example, the lowest LCOE (LLCOE) is around \$0.25/kWh and that happens at around 93% diesel displacement.

The left side of the curve is electricity sourced the same old way using your favorite fossil fuel or utility supply. Moving to the right increases the displacement or offset of fossil fuels by solar energy. A hypothetical 100% diesel offset would be the far-right side of the curve where it is moving at a sharp vertical. These days, with the price of fuel and utilities, the sweet spot often turns out to be around 90% of fossil-fuel displacement. Aiming higher than that can double the land area





required for the solar array and double the cost of energy because of those strings of cloudy days. Oversizing PV and ESS to this degree also means a lot of “excess energy” on sunny days that can’t be used and an investment in assets that aren’t making any returns.

In Myth 2, we will see a typical site that uses 1,000 kWh a day on average. The LCOE microgrid for a typical fuel cost is 240 kWdc of PV and 700 kWh of ESS. That offsets around 90% of the diesel fuel. If we instead aim for 100% diesel offset, that is 500 kWdc of PV (2x the LCOE investment) and 1,800 kWh of ESS (2.5x the LCOE investment). The LCOE microgrid has excess energy of about 9%, meaning that over the course of a year, 9% of the energy is wasted. **The 100% solar microgrid has about 55% excess energy.** That is a hard financial pill to swallow.

Getting to that 100% renewable point definitely makes the cost of energy higher. It also requires more space for the PV array (or more wind turbines). Energy efficiency definitely helps, but even after accounting for an energy diet, it is more practical and cost effective to meet demand on those high-demand and cloudy days using the backup generators or the grid.

Myth 2

Energy from a microgrid is more expensive and is a bad investment.

This analysis requires some expertise with an ordinary accountant’s income statement. If you are evaluating microgrids for your clients, you should understand your way around an income statement and be prepared to talk about it with your client’s CFO. Usually, microgrid projects start with educating the owner, and then the same drill with the CFO.

Atop this page is the graph from Myth 1 on p. 38, but with another curve added to it. The original solid line is the LCOE. The point where the LCOE bottoms out, at the red circle, is the LLCOE. That is where the present cost of all the equipment, materials, labor, and everything else for the life of the project, is divided by the total energy produced, and hits the lowest consistent number with no increase over time.

The new curve in the graph, the dashed line, is the return on the investment, or internal rate of return (IRR). That is the overall investment return, not including bank financing.

A picture tells a thousand words, but here are the words just in case: This is an analysis for a diesel-fueled genset. The cost for energy using the genset alone (Point A) is around \$0.72 per kWh of electricity in this example. That includes primarily the cost per gallon for fuel and how many kWh of energy come from each gallon. That might be \$0.30 to \$0.50 per kWh depending on the fuel cost. Then, adding to that the lesser cost for maintenance (such as oil changes and repairs) and replacement of the machinery at the end of its life. That usually is \$6 to \$12 per hour of operation.

Doing that arithmetic, the cost for diesel electricity might be \$0.50 to more than \$1 per kWh depending on the circumstances. For a microgrid in an area with a public utility company, that data point is the cost of electricity from that utility. Different metric, same sort of analysis.

Point B is adding solar-only to the fossil-fuel plant. It’s a long explanation, but adding solar only still requires the genset to operate continuously. That means the financial improvement comes only from fuel reduction. Adding solar by itself can usually displace 12% to 30% of the total energy generation.

Point C looks like the best IRR but only

displaces about 78% of the fuel. It has the highest IRR because the initial capital investment is lower.

Point D is the microgrid LCOE at around \$0.25 per kWh, or about 1/3 of the cost for the genset. That “present cost” in the LCOE calculation includes all the costs for fuel, operating and maintaining the gensets (because fuel and the other costs are still required for the last 7% of energy), plus the operation and maintenance and lifecycle replacement of the microgrid parts and pieces.

Lastly, **Point E** is that mythical 100% renewable power plant. The cost starts to go up sharply because the sizes for solar and battery go up sharply as does the cost for everything else. This doesn’t even include the cost of the land.

Looking at the investment return — the IRR for the diesel power plant is zero. Fossil fuels make electricity, and that electricity does useful work, but the plant never pays for itself. In fact, there are ongoing costs for maintenance and replacement that make the investment return even worse.

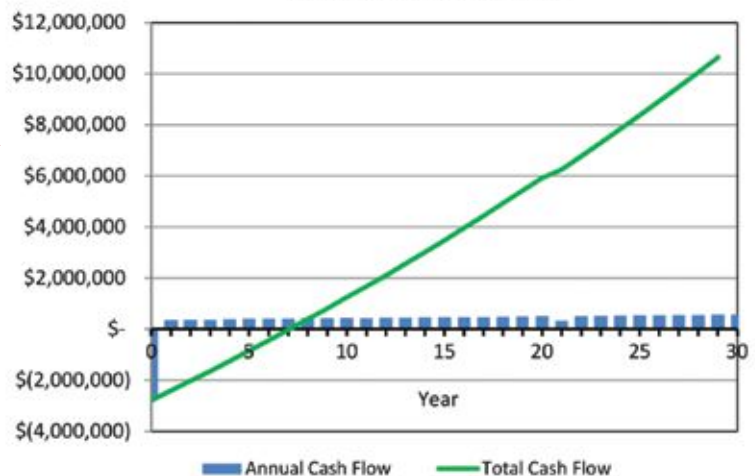
As the solar penetration, or diesel displacement, increases (moving to the right) — the IRR goes up. At its highest point, the IRR is more than 30%. Some of our clients tell us that the financial performance of the microgrid is better than the performance of their core business!

Other fossil fuels might result in a lower LCOE. A utility source could also be cheaper. But the graph still looks the same with different numbers on the Y axis.

Figures 1 and 2 show more financial performance metrics. **Figure 1** is a cashflow graph for this typical microgrid generated from that income statement. This is using diesel fuel and outside the U.S., so there are no U.S. taxes. **Figure 2** shows the cost of energy over time. The microgrid electricity is shown as a “levelized” cost of energy and is a straight line for the life of the system. Unlike the cost of energy from a genset that goes up almost every

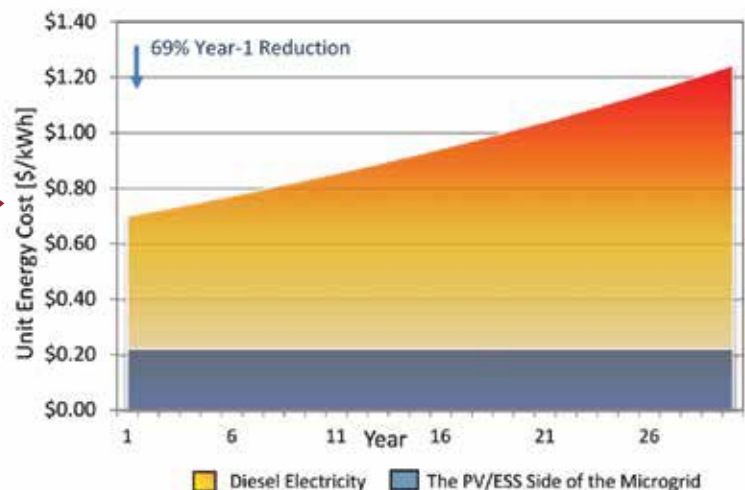


Figure 1: Investment Cash Flow



Levelized Cost of PV Electricity = \$ 0.22 USD / kWh

Figure 2: Electricity Cost Over Time



year (because of inflation), the LCOE is calculated as a consistent cost for the life of the project.

Of course, that will vary with the delivered cost of the fuel. The Table on p. 41 shows the effect on the LLCOE scenario with different fuel prices. This is for a site that uses about 1,000 kWh a day on average over the course of a year. Note that a 100% offset is practically never the LLCOE.

When you start this conversation with your microgrid clients, it is a good idea to ask these questions. And don’t be shy, because your client’s team will usually

appreciate the direct approach.

- What is your budget?
- What criteria do you look at to make financial investment decisions?
- What are the specific numbers you want to see for those criteria?

For instance, maybe they use straight-line payback (most people do) and they want to see a 7-year payback. You can use your handy income statement and plug in the cost of their usual energy and the cost of the project and get information that will

	A	B	C	D	E	F	G	H	I
	Fuel [\$ / gal]	LLCOE Sizing		Microgrid Offsets		LCOE [\$ / kWh]		Financial Performance	
		PV kWDC	ESS kWh	Fuel	Runtime	Microgrid	Diesel Only	Payback	IRR
1	\$ 2.00	95	160	49%	46%	\$ 0.25	\$ 0.28	7.5	12%
2	\$ 3.00	140	305	64%	62%	\$ 0.32	\$ 0.42	8.6	11%
3	\$ 4.00	200	600	84%	83%	\$ 0.35	\$ 0.56	7.7	12%
4	\$ 5.00	225	660	88%	87%	\$ 0.37	\$ 0.70	6.5	15%
5	\$ 6.00	240	700	90%	89%	\$ 0.38	\$ 0.85	5.6	18%
6	\$ 7.00	255	700	91%	91%	\$ 0.39	\$ 0.99	4.9	20%
7	\$ 8.00	265	710	93%	92%	\$ 0.41	\$ 1.13	4.4	23%

This table is the Lowest Levelized Cost of Energy (LLCOE) for each fuel-price scenario. The Levelized Cost of Energy (LCOE) for the optimized microgrid is in column F. The Cost of Energy from diesel fuel alone with no PV or ESS is in column G.

make the CFO want to hug you. Or at least thank you for being a straight shooter.

Looking at the table above, you can see that the payback goes below 7 years when fuel price hits \$5 a gallon. That is about where fuel prices are now in the Caribbean. If you want to compare this to utility costs in the U.S. and include incentives, that's just a little different analysis.

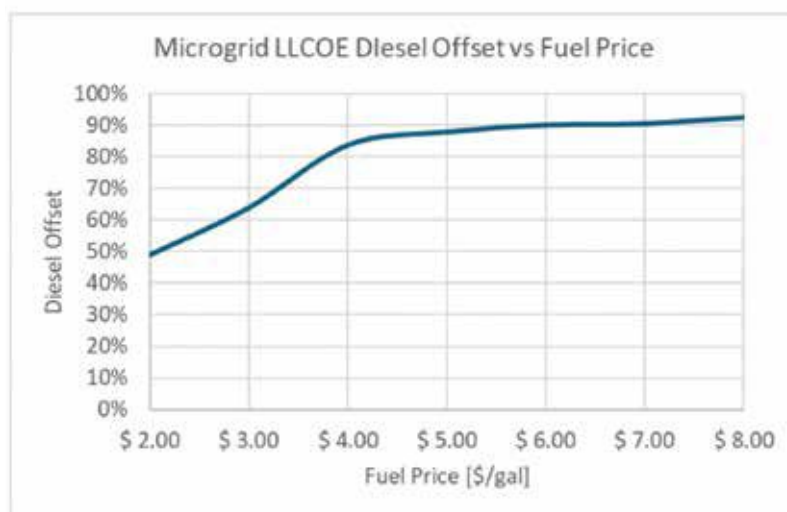
Still awake?

This article doesn't touch on the financial benefits of not losing power. That is a little more complex and you would need to discuss with your client to quantify the impact of a power outage that could be avoided with a microgrid.

Besides pure financial performance, please remember the urgent and important environmental benefits.

Yes, waiting two or three years to implement that microgrid project or installing solar on your roof will surely result in better pricing for equipment. That is the benefit of a market economy. Solar panels now cost less than 10% of what they cost 20 years ago. And they are also more efficient.

That said, if you search the Solar Island Energy website for an article on whether to buy solar now or wait, you will see a similar boring financial analysis that shows it is a much smarter financial decision to pull the trigger today. Even if someone gives you the solar panels FOR FREE in 2-3 years, it still wouldn't be as good of an investment as buying the system today.



That is because you would lose the 2-3 years of a better bottom line.

Also, please remember that the value to our children's children is best "monetized" today. The "present value of carbon reduction" is better than money in the bank.

Myth 3

Unit-cost estimates are all the same.

One of the first questions when planning a project always is what does a microgrid cost? That is like asking a builder to give you a cost for a new house without defining bedrooms, bathrooms, and all the other details. It's going to be a wide range with lots of assumptions.

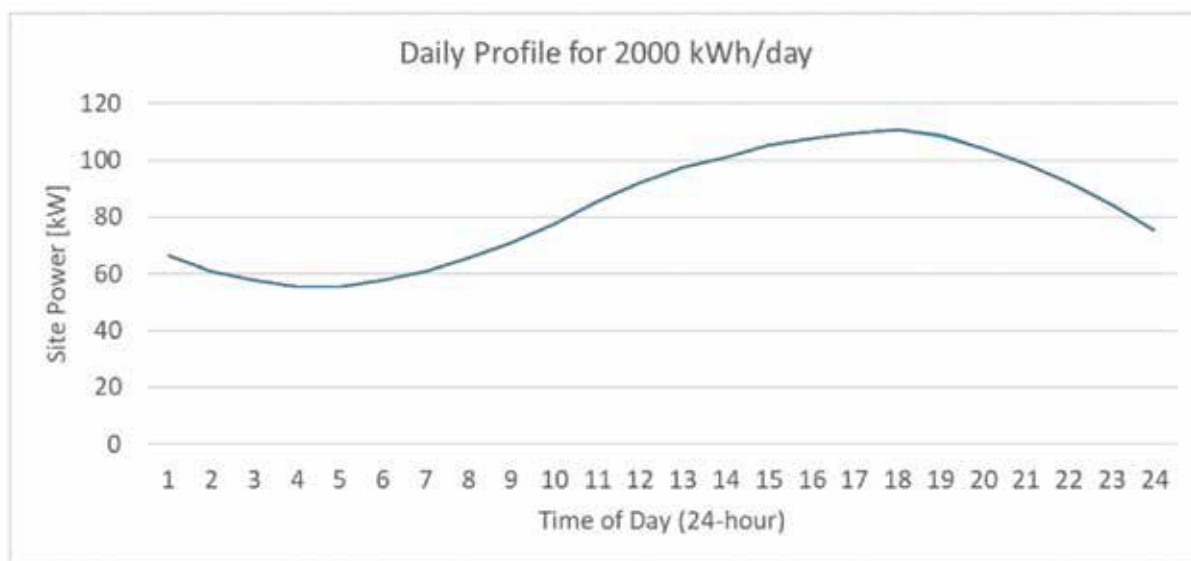
This myth is reinforced by the U.S.

Department of Energy in their 2024 Microgrid Overview. This report states that a microgrid should cost \$2,000 to \$5,000 per kW of power capacity (including the ESS and everything else). Wow! That's a range of 250% — certainly not very precise.

The DOE report notes this was a 2018 baseline. Increasing that 3% a year for inflation would make it closer to \$2,500 to \$6,000 per kW or \$2.5M to \$6M per MW.

That is a reasonable, albeit wide range. The question is: what does that really mean in kW or MW?

- Is it the peak power of the load?
- The average capacity over the course of a year?
- The actual equipment cost not considering the load?



As it turns out, that is for the construction cost for the project equipment, and not for either measure of the load. And there's a big difference!

Here's an example. Let's look at a typical project that uses an average of 2,000 kWh a day of energy, like this graph. That is 730,000 kWh/year. This will change over the seasons and occupancy but let's keep it simple as an average assuming every day and month is the same. The peak power in this generic daily profile is about 110 kW. The average power is 80 kW.

Then, let's assume the unit cost is the midpoint of the DOE's statement, or \$4,000 per kW. Someone using that DOE metric might conclude that the peak power is 110 kW, so the microgrid should cost 110 kW x \$4,000 per kW, or about \$440,000 for the project. Someone else might use the average continuous power of 80 kW and estimate \$320,000 for the same project.

Those numbers characterize the load, but not the size of the microgrid. A microgrid to support that power profile would have to be much larger — closer to

500 kW of DC power (with an ESS around 1,000 to 2,000 kWh of energy capacity). That would generate around 90% of the annual energy, and the remainder would be produced by thermal assets, whether on the site or from the grid.

That microgrid is about \$2 million using the DOE's metric. That is 4 to 6 times what someone might assume from looking at the peak or average power and applying the DOE's Myth Metric.

Something to remember about that DOE cost range is it doesn't necessarily include upgrades to the electrical system, site preparation, or replacing generators (if this is an off-grid site). Also, traditional fuel generators often are part of a microgrid to provide energy for a small fraction of the year. But let's ignore those costs.

Here's a summary of our example indicative of BCN costs (that's Back of Cocktail Napkin) for this 2 MWh/day project. The actual project scope is probably close to 500 kWdc of PV and 1,500 kWh of ESS, and then about 10% of the annual energy provided by either a diesel generator or the grid.

- Actual estimate based on PV size to service the load = 500 kW-DC x **\$4,000 per kW** = \$2M.
- Converting to a peak power metric = \$2M / 110 kW = **\$18,000 per kW**.
- Converting to an average power capacity metric = \$2M / 80 kW = **\$25,000 per kW**.

These three calculations will end up at the same \$2 million project budget, but the calculation is very different. The DOE report is not clear, but they're talking about the first bullet.

Before departing this myth, I will point out that the DOE report does a better job with its metric on the cost of engineering. The engineering for a microgrid is much more involved and complex. The DOE suggests 10% of the project cost for engineering, and I think that is a fair baseline but probably a little high.

The best way to help your microgrid project succeed is to do as much of the engineering up front as you can afford before you start spending big money on equipment. Unit costs can be deceptively low or high and are not bankable.

Myth 4

The generators will run the same amount of time every day

When you tell your client that a microgrid will offset 90% of their genset electricity, it is the same as telling them that a PV system will offset 90% of their grid electricity. Some days the PV or the microgrid will offset 100% with energy to spare, and some days it will be much lower.

Going back to the logic exercise from Myth 1, if the sun shines the same every day, and the load was the same every day, the percentage of solar electricity and fossil-fuel electricity would be the same

every day. It would be nice to plan for the old generator (or grid) to switch on and off at roughly the same time every day.

But that isn't so. When the weather is sunny, and the load is light, the generator (or grid) will run less. Sometimes the site will run on solar energy for days at a time. But if the weather is cloudy and/or the load is high, then the generator or grid will run more. Sometimes for days at a time.

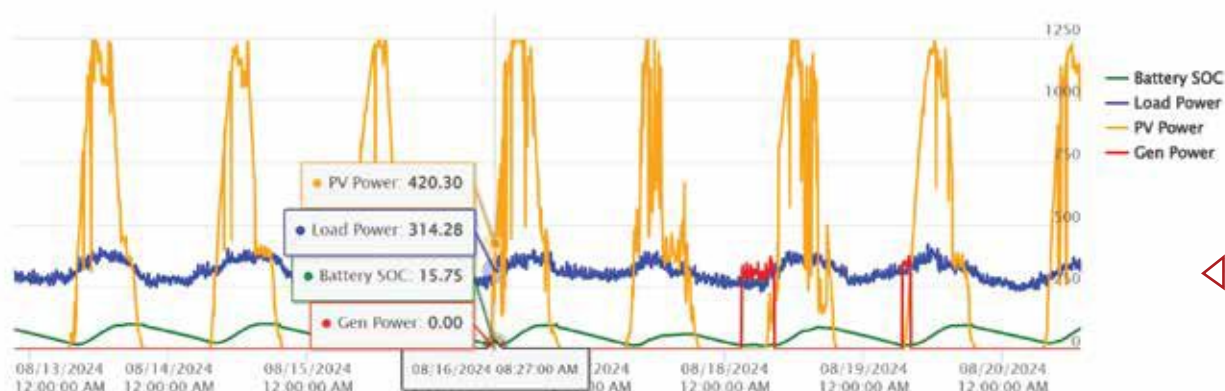
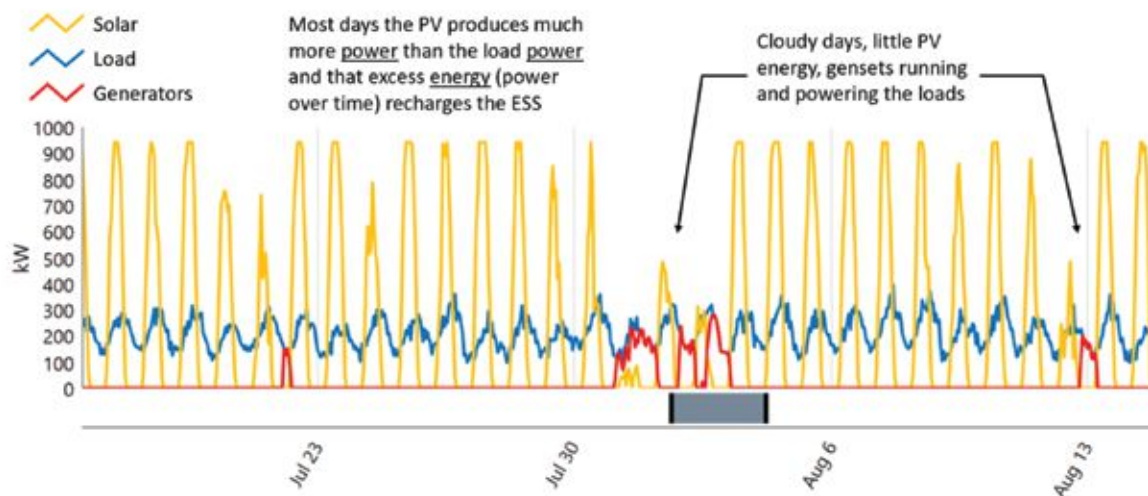
Over the course of a year, the modeled performance and actual performance should be close to each other. The weather isn't ever exactly like the historical database, and the load profile is never completely accurate.

The top graph below is the model performance for a microgrid in the Bahamas for a one-month period. In this graph,

there are many days in a row where the generators are not running at all. Then there are 3 days in the model at the beginning of August when the generators are running most of the time because the model data set shows the weather is cloudy. That is shown by the orange PV curve being so puny for those three days. The smaller the PV curve in the model, the more clouds the model assumes for that day, and the less extra energy is available for recharging the ESS batteries.

The bottom graph below is what the site looks like in real life (IRL). The colors are the same, but the picture is different — this is the real site compared to the simulation above it. This data is from August 2024, the hottest month of the year. Again, this site is aiming for 90+% of

Here is the model performance for a microgrid in the Bahamas for a one-month period.



its electricity from the sun.

You will notice that the real data has a green curve on it. That is the battery state of charge (SoC) curve. You can see that the green SoC curve is going from its daily minimum at night when the ESS is powering island loads to its maximum when the PV power is greater than the load power.

In this real-life case, the generators didn't run at all for more than a week. Ten days of peace and quiet. That is way more than 90% offset for those 10 days, but again, it balances out over the course of a year.

The fluctuations in the orange PV power curve happen when clouds go over the site. That is the same in both graphs, although one is a simulation and the other is IRL. You may also notice the flattened areas at the end of a sunny day like August 14. That is where the PV has produced so much energy that the ESS is fully charged and there is nowhere to put that PV energy. When this happens, the microgrid controller automatically turns down, or "curtains" the PV power to match the load power. This is the "excess energy" referred to in Myth 1.

Myth 5

A microgrid eliminates costs and effort needed to maintain the energy system

This depends on whether this microgrid will be operating with the grid or off grid. A microgrid includes some big pieces of capital equipment: a PV system and an ESS primarily. These systems have ongoing maintenance and replacement costs. You as the developer or installer should include these costs in your financial proforma that you are providing to your client.

If you are not doing this already, you might consider assuming the power electronics will fail the day after their

warranty expires. You can build this in as a reserve account payment every year or assume the owner will finance the replacement when required. You will need to make an educated, but justifiable, guess as to the future cost. A safe bet might be half of the initial equipment cost, and installation labor increases of about 2% a year.

Modeling it as the owner taking a loan from their bank to pay for the replacement will provide better financial performance than a reserve account. This includes the PV inverters and the ESS bi-directional converter (inverter/rectifier, or storage inverter, or whatever you call it).

If the microgrid is grid tied, there won't be much savings of existing maintenance cost, just added cost. The PV system would be about what you modeled it at today — maybe a few dollars per kW per year. Same for the ESS. Be sure you include the extended warranty support and monitoring plan from the ESS manufacturer. If the ESS manufacturer doesn't have that sort of plan and support, you might want to deal with another company that does. The ESS and controls certainly will have glitches along the way, and you want to make sure someone is covering your back when that happens.

For an off-grid system, possibly running now on a diesel generator plant, the maintenance will be different than what is required for the genset, but there are many offsetting savings and improvements. Those costs are the primary drivers behind the financial performance of a microgrid — much less fuel purchased, fewer engine overhauls, and so on.

The onsite maintenance added for a microgrid includes washing the solar panels, cleaning air filters every so often, checking battery health periodically, and making sure everything is ready for hurricane season or other periodic bad weather.

We also like to see the project team check the system every morning at the same time. That will make it easier to

recognize anomalies before they become problems. Like every morning at 9 a.m., check the weather and adjust setpoints if desired, check the battery health, the PV production, the daily energy cycle capacity.

Most of the microgrid maintenance is easily done by reasonably skilled site personnel. Usually, the tasks are detailed in the operating instructions for the equipment.

Compare this to the workload of the original thermal power plant. Fossil-fuel generators require some level of mechanical skill for everything from changing the oil to figuring out why it didn't start today. Often that includes figuring out if the diesel plant ran out of fuel (yes, that even happens to utility companies). That work is still required, but the big difference is how often that work has to be done.

Oil changes might be stretched from once a week to every few months. Along with that goes the reduced disposal of that waste oil and the risk of spilling motor oil or fuel oil on the ground or in the ocean or river.

Engine overhauls or replacements usually have to be done every 2 years when the engines run continuously. Engine overhauls for a microgrid are stretched to 15 to 20 years. Considering that overhaul cost is usually half the cost of replacement, that is a huge benefit to the microgrid financials.

The biggest operating expenses for the microgrid will be lifecycle replacement of batteries (if you are using a battery plant to store energy) and insurance. Battery prices keep coming down, and my thoughts are the cost for batteries will drop at least 50% by the time the warranty runs out. There also will be more effective and more economical ways to recycle the batteries. Typically, insurance costs \$1 to \$1.50 per \$100 of insured value, so you can do the arithmetic yourselves. Make sure your financial models include lifecycle



▲ Solar Island Energy plants this sea purslane to help manage the vegetation growth around the PV array and reduce ongoing O&M costs.

replacements and insurance estimates.

Managing the vegetation growth around the PV array is another to-do item. Trees may start shading the array within a year if the array was cut into tropical scrub forest. The photo above is sea purslane we typically plant in plugs around a new PV array. This photo is 8 months after planting the plugs. Within 2 years, the whole array field will be filled with this hearty groundcover. But maintenance staff will still need to patrol the array area to pull weeds that grow upwards and climb the racking posts. Sheep are also popular for controlling grasses that are planted around the racking tables in places with soil instead of rock.

Last thing I will mention in the realm

of maintenance is the responsibility and performance of the pre-existing or legacy electrical system. A microgrid won't fix the problems that might already be screwing up the energy delivery and reliability. If part of a grid is turned into a microgrid and there are problems with transformers or grounding that impair its reliability, those problems will not magically go away. Someone will have to figure out the cause and fix them. And until they are fixed, you will certainly get blamed for anything and everything that happens to the legacy systems!

Overall, the maintenance effort and costs are much lower with an off-grid microgrid. But the power plant staff usually are happy to learn about new technology

and clean air filters instead of changing engine oil and cleaning up oil spills.

Marc Lopata is president of Solar Island Energy. He is a licensed Professional Engineer and NABCEP-certified PV Installer and Inspector. His portfolio as engineer-of-record, owner's agent, or onsite construction supervisor includes over 700 solar projects, 20 utility PV and battery projects and 80 microgrid and energy storage projects. He has been a technical advisor to the World Bank, contributing author to both "Solar Under Storm" manuals, and a peer reviewer on hurricane survivability for the National Renewable Energy Laboratory. Solar Island Energy works mostly with island communities that make electricity by burning diesel fuel; helping them implement solar energy microgrids and energy efficiency improvements.