SCALE MICROGRIDS

Stuck Waiting for Power, This California Cold Storage Facility Skipped the Line with a Microgrid

Origo Cold Storage Microgrid Case Study

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Executive Summary

Agricultural cold storage facilities are a vital part of the food supply chain in the United States. But when these energy-intensive facilities are built, or when existing facilities need to expand, they can face challenges from long utility interconnection delays. Even after they are connected to the grid, they are vulnerable to blackouts caused by increasingly frequent extreme weather events, which can result in food spoilage.

Microgrids are emerging as a uniquely versatile solution to these challenges, offering agricultural cold storage facilities a faster, cheaper, more resilient, and more sustainable alternative to relying on the utility grid. The off-grid microgrid developed by Scale Microgrids for a cold storage facility owned by Origo Investments and operated by Amond World in Madera, California, exemplifies these benefits.

- **Rapid Deployment:** The microgrid was deployed at least 6-18 months sooner than a potential grid interconnection, allowing Amond World to begin operations quickly.
- **Resilience:** Origo's microgrid safeguards against blackouts caused by extreme weather or energy shortfalls. This gives the region's farmers peace of mind and ensures that their inventory maintains freshness and quality, helping to maximize their profits.
- **Cost savings:** Electricity costs are the largest operating expense for cold storage facilities, driven primarily by refrigeration needs. Origo's microgrid significantly reduces their energy costs, with savings of up to 30% compared to utility power.
- **Sustainability:** With its rooftop solar array and on-site battery storage, Origo's microgrid lowers the facility's carbon footprint by about 40%.
- **Future-proof:** The microgrid can be expanded as Origo's operational needs evolve. For example, it is designed to accommodate electric vehicle chargers in anticipation of large-scale electrification of commercial fleets.

Microgrids can offer these advantages for a wide variety of commercial, industrial, and agricultural facility operators struggling with grid interconnection delays, looking to enhance energy resilience, reduce their energy costs, or cut carbon emissions – or all of the above. Scale Microgrids offers turnkey solutions to meet these needs with no upfront cost.

What is a Microgrid?

A microgrid is an integrated system of on-site distributed energy resources, typically including solar panels, battery storage, a generator, and controls.

For many large businesses, microgrids can provide cost, reliability, and sustainability improvements compared to the utility grid. A microgrid also often offers a faster and less expensive alternative to utility service capacity upgrades at existing facilities, while allowing new facilities lacking a grid connection to bypass long utility interconnection queues entirely.

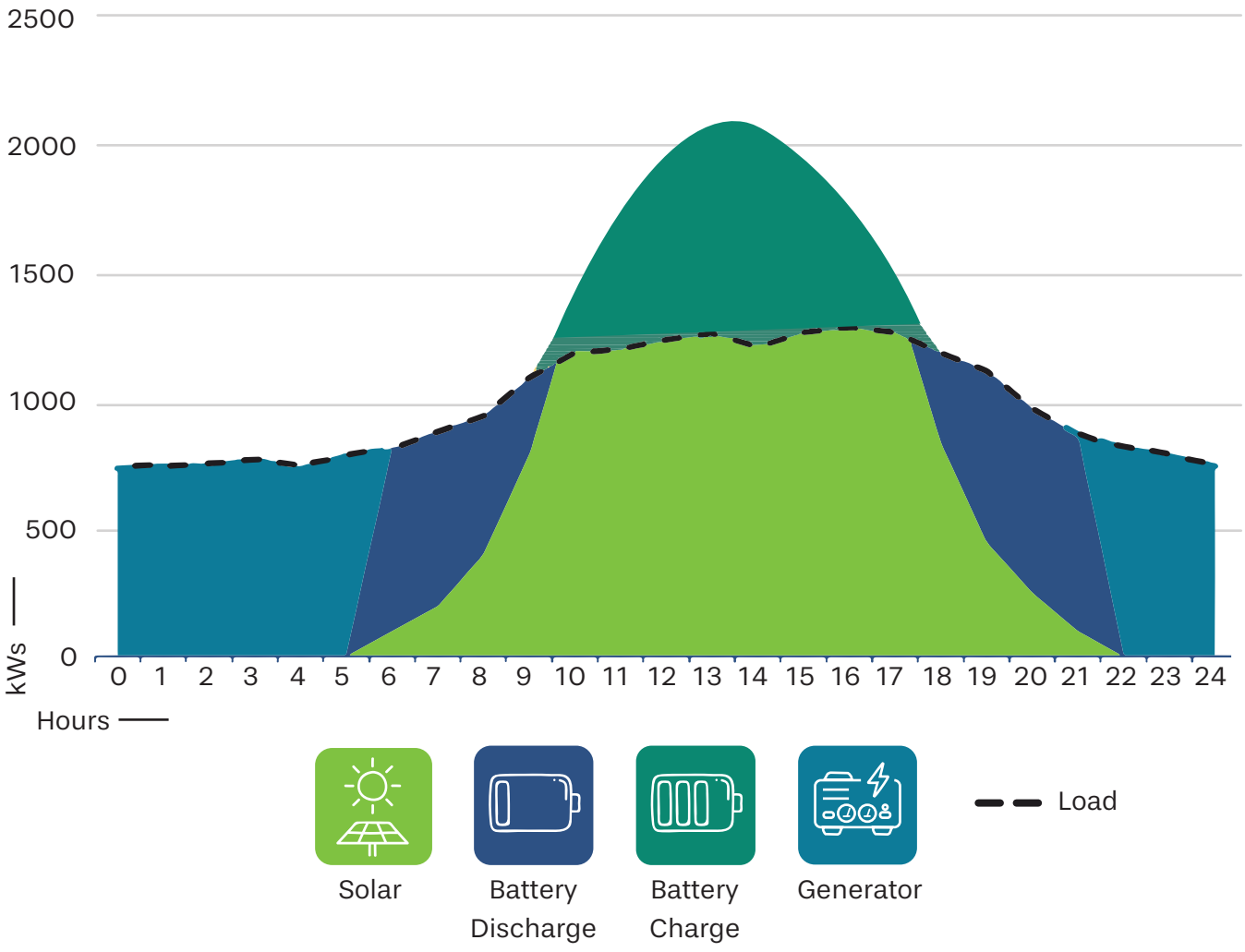

Figure 1. How a microgrid meets facility electricity demand

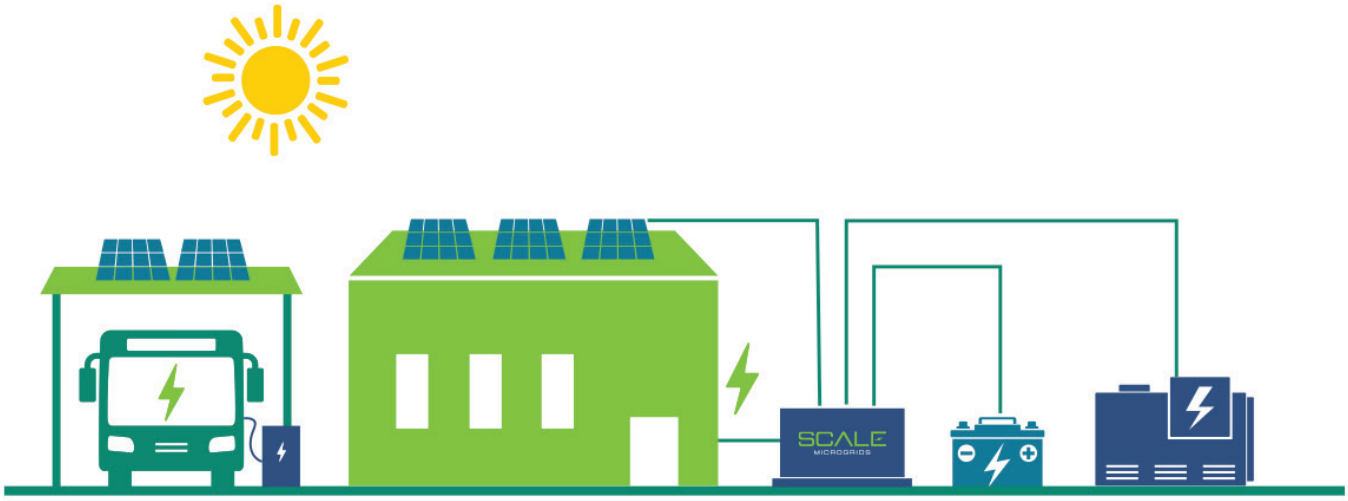

Figure 2. Scale Microgrids' microgrid system

Grid-Connected vs Off-Grid Microgrids

Microgrids may either be integrated with utility service in a grid-connected configuration or operate entirely independently as an off-grid microgrid. Both grid-connected and off-grid microgrids can offer cost, resilience, and sustainability advantages, but in most cases a business will choose between these two options based on their facility's location and the cost and time required to connect to the grid.

Grid-Connected Microgrids

Grid-connected microgrids are integrated with existing utility service to provide optimized cost and sustainability benefits, while also maintaining the ability to disconnect or "island" from the grid to power critical operations during utility outages. Grid-connected microgrids allow greater flexibility in system design as well as opportunities for additional revenues from participation in utility demand response and virtual power plant programs.

Off-Grid Microgrids

Off-grid microgrids are typically built in areas that are either far from electricity transmission and distribution infrastructure or where grid capacity is constrained, resulting in long delays and costs for utility interconnection. The ability to bypass utility grid limitations entirely can be a game-changer, although off-grid microgrids also require greater on-site capacity and system redundancy because of the need to meet all of a facility's electricity requirements.

Benefits of Microgrids

For a growing number of commercial, industrial, and agricultural businesses, utility grid service is becoming too expensive, too unreliable, too polluting, or all of the above. Long wait times for utility service interconnection or upgrades are also leading to costly delays to operations. Microgrids can address any and all of these challenges with on-site systems tailored to meet the needs of individual end-users, making them a uniquely versatile energy solution.

Rapid Deployment

Many utilities are struggling to keep up with the pace of new demand on the grid, leading to long queues for the interconnection of new facilities or site capacity expansions for existing facilities. Wait times of 18 months or longer are increasingly common in some utility territories, which can result in costly delays for new or growing businesses.

In contrast, **microgrids can be developed and begin powering facilities in under 12 months**. By taking charge of their energy, businesses can bypass interconnection queues and start operations sooner.

Cost Savings

A microgrid typically incorporates on-site solar power generation that provides significant cost savings compared to utility tariffs, which include costs for expensive fossil fuel-fired power plants as well as costs for long-distance transmission and distribution infrastructure. In addition to saving on electricity costs today, microgrids also lock in energy costs by minimizing or eliminating exposure to future utility rate increases.

Grid-connected microgrids offer additional opportunities for cost savings through the use of battery storage and optimized microgrid controls, which allows for load shifting to hours of the day when electricity is cheapest as well as peak energy management to avoid excess demand charges. Beyond these savings, grid-connected microgrids can potentially generate revenues through participation in utility demand response programs and virtual power plants.

Regardless of whether a facility is connected to the grid, fully financed "microgrid-as-a-service" options can make these cost savings even more appealing by **eliminating up-front capital costs** and allowing the facility's microgrid provider to manage operations and maintenance.

Resilience

Between fast-rising demand, growing generation supply constraints, and the steadily-increasing frequency of extreme weather events like wildfires, severe storms, and heat waves, the US electricity grid is facing unprecedented reliability challenges. As a result, over the past decade the average annual **duration of power outages experienced by US homes and businesses has increased by over 50%**.

These increasingly-frequent disruptions to power supply as well as power quality can pose a major challenge for businesses that require 100% uptime for their operations, including cold storage facilities. Even an hour-long power outage or drop in voltage can cause operational disturbances, and extended blackouts can lead to costly inventory losses.

Microgrids dramatically enhance resilience by integrating multiple layers of energy assets, typically including on-site solar and battery storage, dispatchable generation for backup, and advanced controls to ensure critical operations always stay online. Off-grid microgrids may include additional measures to allow for incorporation of emergency generators as a failsafe.

Sustainability

Microgrids can often deliver reductions in greenhouse gas emissions of 30% or more compared to relying exclusively on the utility grid. These environmental benefits are becoming more valuable over time, as a growing number of businesses – and their customers – set increasingly-ambitious sustainability goals.

By utilizing zero-emission solar energy to meet a significant portion of energy demand, microgrids directly reduce a facility's carbon footprint. Grid-connected microgrids can deliver additional indirect emissions benefits by drawing from on-site battery storage during hours of high demand on the utility grid, reducing or eliminating the need to fire up highly-polluting fossil fuel peaker plants.

Finally, because centralized grid systems send electricity over long distances, they suffer from transmission losses of about 5% on average. By producing and storing electricity for use on-site, microgrids avoid these losses and further lessen the need for fossil fuel generation.

Future-Proof

Microgrids provide a flexible platform for additional energy upgrades down the road, allowing businesses to future-proof their plans in case utility delays persist over the long term.

For example, if a business decides to transition its fleet to electric vehicles (EVs), a microgrid can meet new charging demand without having to wait for a utility service upgrade. Off-grid microgrids can also be connected to the grid if and when utility capacity becomes available.

Microgrids thus represent a true "no regrets" strategy for facility operators looking to address grid challenges today while preserving the flexibility to respond to the challenges (and opportunities) of tomorrow.

Case Study: Amond World Cold Storage Facility

The Amond World cold storage facility is taking full advantage of the unique advantages of a microgrid. Amond World is the operating partner for Origo Investments, a commercial property developer buildling a state-of-the-art 500,000 square foot refrigerated cold storage facility in the Madera Airport Industrial Park in California's Central Valley. Faced with grid interconnection delays and mounting grid reliability and cost concerns, Origo decided to power their facility with an off-grid microgrid designed and built by Scale Microgrids.

Central California's Need for Cold Storage

Central California is a national and global agricultural powerhouse, with revenues from agriculture reaching $51 billion in 2021. The state is renowned for its nut production and particularly almonds, with 7,600 farms producing over 2.9 billion pounds of almonds annually to supply about 80% of global demand.

However, this highly-productive sector of California's economy also faces a major challenge. Nut crops have a short harvesting window, typically between August and October. Yet this seasonal supply must fulfill year-round global demand, putting pressure on farmers and processors to quickly sell their crops – often at reduced post-harvest prices, contributing to annual revenue volatility.

Crops can lose

10-15%

of their water weight in the first 30 days without proper storage

Cold storage facilities offer a solution, storing crops in temperature- and humidity-controlled conditions to maintain freshness. However, limited cold storage capacity is difficult to secure for many small- and medium-sized farms in particular, and today 1.3 billion pounds of California's almonds are stored outdoors despite vulnerability to spoilage, insects, fungus, and mold.

The need for more cold storage capacity for the Central Valley's farmers is clear, but utility interconnection for facilities in rural areas is a persistent and growing problem. The refrigeration requirements of these facilities make them very energy-intensive, leading to long wait times and high costs to connect to the utility grid. For example, PG&E, the region's electric utility, informed Origo that they would be unable to get power for two to three years.

Bypassing PG&E Interconnection

Instead of waiting in PG&E's queue, Origo turned to Scale Microgrids to help the facility "skip the line" with an off-grid microgrid system to supply its entire energy needs.

Scale will be able to meet Amond World's need for energy independence with an off-grid microgrid featuring 2,400 kW of solar, 2,400 kW and 4,800 kWh of battery storage, and two 1,200 kW low-emission dispatchable generators. The first phase of the microgrid was designed and built in less than 18 months, allowing Amond World to start their operations at least 6 months sooner than if they had waited for PG&E — a major boon to the area's farmers.

In addition to saving time, the off-grid microgrid gave Origo the flexibility to locate their facility at the "first mile," close to where crops are grown and harvested. This enables local farmers to store their crops as quickly as possible after harvest, which helps retain their quality and water content. This is crucial for a crop that can lose 10-15% of its water weight in the first 30 days without proper storage. Since nuts are sold by weight, this is directly tied to revenue losses for nut producers.

This is in contrast to most cold storage facilities today, which are located close to urban areas where it's easier to connect to the grid. The trade-off is that these facilities are located far from agricultural regions and farmers, who overwhelmingly live in rural areas.

Cost Savings From Day One

Microgrids offer substantial energy savings for agricultural cold storage facilities, where refrigeration-related operations account for over 75% of total energy costs. These facilities require nearly 25 kilowatt-hours (kWh) of electricity per square foot and face rapidly rising electricity prices, with increases of almost 45% in recent years in some regions.

Amond World's microgrid provides electricity **cost savings that range from 10% to 30%** compared to a grid-connected cold storage facility, with savings increasing at higher loads. These energy savings are achieved by leveraging low-cost on-site solar generation with advanced controls, which optimize the charging and discharging of the site's battery system to minimize runtime for the more expensive dispatchable generators.

The facility also drives cost savings with predictive energy management systems that can analyze and anticipate fluctuations in weather in the region, adjusting the facility's energy use accordingly. For example, the software can temporarily idle the system without compromising temperature control, thanks to the building envelope's ability to insulate and retain coolness.

Multiple Layers of Resilience

Grid reliability challenges can be particularly acute in rural and agricultural regions like the Central Valley, where distribution infrastructure is often older and less robust than in urban areas.

This is particularly problematic for cold storage facilities, which have high energy demand requirements and must maintain 100% uptime for their refrigeration and humidity control systems.

All of Origo's electricity is supplied by its off-grid microgrid, allowing it to be completely independent from the grid and resilient to disruptions. Origo's microgrid incorporates three levels of redundancy:

01

Rooftop solar array and battery storage

2,400 kilowatt (kW) of solar arrays take advantage of Central California's abundant sunlight, while 2,400 kW/4,800 kilowatt-hour (kWh) of battery storage allows this energy to be stored for later use. With an expected load of 200–250 kW, the solar and battery will be able to power the facility for 12–18 hours a day, allowing it to be powered primarily by renewable energy the majority of the year.

Even in the winter, when days are short, the facility can run largely on the combination of solar and batteries. The low outdoor temperature combined with the thermodynamically efficient insulation in the building's envelope allows for reduced energy requirements to maintain optimal temperature and humidity in the winter.

02

Low-emission dispatchable generators

Four 1,200 kW low-emission dispatchable generators are also installed for use when solar and storage are insufficient to meet the facility's needs. The San Joaquin Valley Air Pollution Control District has granted permits for these generators, ensuring that their emissions are under required limits.

The generators provide enough electricity to power the entire facility when needed. In normal circumstances, the generators alternate every few hours to allow for maintenance. Still, if there is a sudden spike in the electricity demand, they're designed to be able to run simultaneously.

03

Exterior plug for temporary generators

In the extremely unlikely case that all of these on-site systems fail, the facility is also equipped to allow an external generator to be brought from off-site to be plugged into the switchgear, enabling the facility to maintain an uninterrupted power supply.

Sustainability Leadership

The ability to power most of the facility's needs from solar energy delivers significant emission reductions, and the highly-efficient dispatchable generators ensure that emissions are minimized. As a result, Origo's CO2 emissions are about 40% lower than a typical grid-connected cold storage facility, establishing it as a leader in the industry.

30% lower CO_2 emissions

Ready for the Future

Origo's microgrid system is designed to produce more power than the facility needs, giving it flexibility for future facility expansions or the adoption of new technologies. For example, in recognition of the emerging trend towards electric vehicle adoption, the infrastructure could be optimized to charge electric trucks while they load, unload, and wait at the facility.

Because Scale's microgrid systems are modular, they can be rapidly expanded to match a facility's growing operational requirements. And, if Central California's distribution grid capacity is expanded in the future, Origo's microgrid can be interconnected with the utility grid to further optimize energy costs and resilience.

Conclusion

Microgrids are emerging as a vital solution for agricultural cold storage facilities. These integrated energy systems address the challenge of long interconnection queues, which are a significant barrier in agricultural regions like California's Central Valley. The ability of microgrids to be rapidly deployed offers a stark contrast to the years-long wait times for utility grid connections.

Energy resilience is another key benefit of microgrids, particularly in the face of increasing power outages due to extreme weather and energy supply challenges. Microgrids also provide a cost-effective solution for energy-intensive operations like cold storage facilities, where refrigeration accounts for a substantial portion of energy costs. And, in addition to saving on energy costs, the low-cost solar generation included in most microgrid configurations can deliver significant emissions benefits that are increasingly valued by businesses and their customers.

The Amond World facility in Central California's Madera Airport Industrial Park is a prime example of microgrid applications in agriculture and cold storage. Origo avoided the delays of grid interconnection and ensured a faster, more predictable start to operations. The facility's proximity to agricultural areas offers additional advantages for farmers, including enhanced crop quality and reduced losses during transportation. Its microgrid, equipped with solar panels, battery storage, and low-emission generators, delivers a robust and sustainable energy solution with three levels of redundancy to guarantee continuous power supply.

Finally, the microgrid is designed with the future in mind, with capacity to support facility expansions or electric vehicle charging as well as the flexibility to connect to the grid if capacity becomes available. This forward-thinking approach positions Origo as a leader in smart, sustainable energy, showcasing the transformative potential of microgrids for the agricultural sector and large energy-consuming businesses more broadly.

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