Onsite Energy Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY
Western

Case Study

Hawai‘i Island Retreat

Background

Hawai‘i Island Retreat, a 20-room eco-boutique sustainable hotel, opened its doors in 2008. Nestled on 40 acres in North Kohala, one of the Big Island's most diverse areas, the retreat facility occupies 15 acres, serving rooms, restaurants, gardens, communal activity spaces, and a spa. The retreat serves groups throughout the year and hosts various day events for local organizations such as schools, non-profits, hospitals, etc. The facility also contains a farm with cows, goats, chickens, an apiary, and various fruits and vegetables. Hawai‘i Island Retreat is starting to process foods, like chocolate, dehydrating fruits, canning, freezing, and oil extraction from cacay nuts. There is a plan for expanding this area, requiring a new electrical system with a larger capacity. Hawai‘i Island Retreat serves as a community center to sustainably preserve Hawai‘i’s culture, traditions, local flora, and fauna.

Due to its remote location, almost two miles from the closest distribution pole, the facility operates on 100% onsite renewable energy generation from solar photovoltaic (PV), solar thermal, a wind turbine, and a battery energy storage system (BESS), and an emergency generator.

Rationale

At the time Hawai‘i Island Retreat planned opening doors in the early 2000s, there were significant challenges to electrification in a remote area of Hawai‘i. Located at the tip of North Kohala, its closest distribution pole was miles away, and estimates for grid connection in this area were approximately $100,000. This circumstance represented a huge investment for the facility regarding electrification costs, time-consuming installation, and the construction of infrastructure. In examining their options, the facility owners opted for a whole off-grid system integrating solar PV, solar water heaters, a wind turbine, and a BESS to supply their facility. The cost to build this was similar to the cost to build the infrastructure required for grid connection.

Project At-A-Glance

SITE

Location: Kapa‘au, Hawai‘i

Sector: Hospitality

Facility Size: 60 acres

Generation Capacity: 26 kW of PV and 155 kWh of battery energy storage system

TECHNOLOGY SOLUTIONS

Solar PV: 26 kW rooftop array

Wind: 6 kW wind turbine

BESS: 155 kWh / 155 kW

IMPACT (2015–2024)

Energy Savings: 405,420 kWh

Cost Savings: $120,000

Emissions Reduction: 370 metric tons of CO_2

Resilience: No power outages due to large onsite BESS; no reliance on utility grid

ENERGY EQUITY

- Educational demonstrations of clean energy technologies
- Reforestation projects

FINANCIAL

Total Cost: $100,000 initial investment; $50,000 in equipment replacement over 20-year period

Incentives/Tax Credits: N/A

Financing Mechanism: Savings and loans

Approach & Implementation

Over time, the system has evolved to meet the retreat's needs. Periodic expansion and equipment improvements have been needed as the equipment approaches end of life.

Initially, a smaller solar PV system for electricity, coupled with a solar water heating system for pools and showers, and lead batteries, was installed. Then, a 6 kW wind turbine was added to the system, and the battery bank was expanded to 155 kWh. As the retreat grew, more solar panels were added to meet growing demand, to a total capacity of 26 kW. With the maintenance of the wind turbine and batteries, this installation was able to operate for about ten years. The maintenance of the solar PV and solar thermal system is minimal since the retreat relies on rain to wash away debris. As the retreat's needs have grown, so have the systems that support them.

While most equipment that is reaching end of life is replaced, high maintenance costs have prevented the wind turbine from generating power. Due to its proximity to the ocean, salt corrosion continues to be a concern for batteries and wind turbine components. The battery bank had to be replaced around ten years after the initial installation, and the batteries were replaced with another set of lead batteries. Due to advances in battery technology, the retreat will be replacing its current battery bank with more efficient Lithium-ion batteries.

The solar PV system charges the batteries during the day, and their stored energy is utilized at night when the PV system is not producing electricity. Because the site is completely off-grid, all power needs are supplied by the batteries. The new batteries are more efficient in charge/discharge than current batteries and have a longer expected life cycle. The solar panels have also seen minimal degradation and will be evaluated for servicing or replacement in the next five to ten years. The wind turbine required extensive maintenance of its components, and the retreat decided to make it inoperative.

The systems installed at Hawai'i Island Retreat have raised awareness of onsite energy resources for Hawai'i and other visitors. The retreat's ability to combine different resources and types of energy solutions has allowed it to maintain its operations without being at the mercy of grid outages. Since Hawai'i Island Retreat is completely off-grid, its battery storage system was sized to be capable to sustain seasonal production and the growth in demand when the retreat is full. Being off-grid, the pressure to keep all equipment functioning properly is even more important. Equipment replacement is a necessary action, and the retreat can update older systems as needed, providing higher efficiencies and generation outputs and experimentation with new technologies. Lastly, they are early adopters of new technological advances and implement them as they come out to the market because they need to replace old equipment.

Hawai'i Island Retreat

6 kW wind turbine located on the island's property

Results

Hawai‘i Island Retreat has not experienced electric outages, a major concern and occurrence in the Hawaiian Islands. A well-tough combination of technologies has allowed the retreat to operate its business without interruption for about 15 years since it opened its doors. The combination of different technologies has allowed the retreat to be self-sustainable, covering all electrical needs, and has developed resiliency for the retreat.

The high cost of electrification in this remote part of the island has allowed for a favorable return on investment for all the equipment needed. The return on investment has been consistent for different components, making this installation a financially-sound decision.

26 kW rooftop PV system that supports the retreat’s electricity needs

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Community Benefits

The Hawai‘i Island Retreat has brought many benefits to the community. Its storage systems show how a facility can remain operable independent from the power grid. The retreat also brought economic growth to the area since it had been abandoned before. It has helped create temporary jobs for system installations and maintenance.

Sustainability-focused education programs are held on the retreat.

Since its inception in 2008, Hawai‘i Island Retreat has promoted and served as an educational venue for clean energy technologies and a cultural preservation space. The retreat holds local hula classes every week and about 3-8 other more significant day events around the year, such as fundraising events, school anniversaries, and local hospital retreats. In each of these activities, the host talks about sustainability at the retreat, and seeing the system firsthand helps visitors absorb the benefits of onsite energy.

The area has been reforested by Hawai‘i Island Retreat, which has increased the flora and fauna. The retreat staff has planted about 150 trees throughout the years, in addition to a vegetable garden and livestock on the property. There are 90 fruit trees, 50 cacao trees, 15 bananas, 15 flowering and exotic trees, and 14 ulu trees. One can find papayas, pineapple, sweet potatoes, squash and pumpkins, lettuce and Swiss chard, and some other seasonal greens in the vegetable garden. Lastly, the farm has 20 goats, 40 sheep, and 30 cattle. These crops feed the retreat staff and are part of a food-to-table initiative.

Lessons Learned

Many areas in the Hawaiian Islands are still far from the grid, making it difficult to access electricity. Some populations are being left behind due to the high cost of electrification in remote areas. Electricity outages are common in the Islands, and due to their remote location, there is a great need to create resiliency. Cold food storage facilities and hospitals are especially at risk of high losses in the case of outages.

There were few wind turbine or solar installation policies at the time of construction, so getting permits for these onsite energy technologies was slow. A general push from the central government and technological advances have shifted the market, and that reality has changed. Although permitting onsite energy technologies in Hawai‘i can be slow, the process is much clearer with policies in place and a clearer path for permitting onsite technologies.

The initial investment for an off-grid system, coupled with the high cost of operations and maintenance, can deter the pursuit of these technologies. Still, analysis after analysis has shown that they can have favorable payback periods. In remote areas such as Hawai‘i Island Retreat, these technologies represent the only available options, and having a combination of various technologies has enabled the retreat to be functional.

The Aeolic system had a higher-than-expected maintenance cost, which caused periods where it needed to be shut down. They were forced to have the unit unused because of the high maintenance cost. Battery systems reach their end of life, so periodic reinvestment in them is necessary. As technology has evolved in this area, the newer batteries last longer, outputting less waste to the community.

Contact Information

The 10 U.S. Department of Energy Onsite Energy Technical Assistance Partnerships (TAPs) help industrial facilities and other large energy users integrate the latest onsite energy technologies. For more information on this project and/or the services of the Onsite Energy TAPs, use the QR code or contact us at OnsiteEnergy@ee.doe.gov.

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