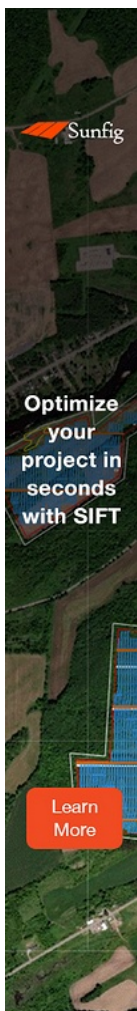




Solar installers scale dormant volcano to power astronomical research

By Billy Ludt | January 27, 2021



Keck Observatory has been in operation for nearly 30 years atop Maunakea, a dormant volcano and highest point in Hawaii. The twin telescopes are arguably the best place to go for astronomical observation in the Northern Hemisphere. At an elevation of 13,796 ft, stormfronts regularly pass below the horizon, and the skies above the Pacific Ocean are clear of light pollution.

Given these conditions, why not put a solar array up there, too?

But, not, a future specialist at the Keck Observatory, considered the possibility of a construction project to install a solar array at that site. Duke Energy's subsidiary REC installed a 100-kW array at the company's headquarters in Raleigh, North Carolina, which is a couple of miles down the mountain from the telescopes and was

exempt from the extensive permitting process for construction projects on Maunakea.



Significant astronomical research has been conducted at the W.M. Keck Observatory since its first telescope was built in 1993. W.M. Keck Observatory

A new challenge was accepted. Through the gamut of design, permitting, engineering and installation requirements, Keck Observatory now hosts a 137-kW solar array between its twin telescopes.



Putting solar atop a volcano

Keck Observatory's first telescope was built in 1993. Since its inception, the site remains an often-used asset for groundbreaking space research, with each telescope booked out months in advance by astronomers and students from affiliate universities. For example, in October, UCLA professor Andrea Ghez was awarded the Nobel Prize in Physics 2020 for her research at Keck Observatory on the existence of a supermassive black hole in the Milky Way galaxy.



A technician team at Keck Observatory keeps the infrared telescopes running, replacing aging structure with newer lighting, motors, air dryers and variable-frequency drives. Adding solar to a place where the stars were the stars was part of that upkeep.

"It's a responsibility to the science community to provide the telescope to be ready for them to use at our mission during the day is to make sure everything's good to go for them," Devenot said.

The array installed between the Keck telescopes is technically a smaller footprint than its sibling system at the observatory's headquarters, but it produces more power both at an equipment level and from higher UV light from the elevation. REC Solar, which was brought back for this second project, found the system performing at 115% efficiency in that environment. The array supplies 15% of Keck Observatory's electricity. It was sited far enough from either tower to prevent ice falling from the telescopes from landing on the solar modules. The modules were laid flat to minimize resistance from high wind speeds atop the volcano.

The array itself is made of 332 LG NeON 400-W modules, SMA Sunny Tripower 30-kW inverters and a custom-designed foundation and structure, the latter using SnapNrack channels and clips atop a galvanized steel frame.

The roof surface turned out to be a major design element for the array. The roof surface between the Keck I and II telescopes is EPDM covered by cinder from the dormant volcano. Removing the rock by hand for the initial installation took days, Devenot said. Installers brought a mini-excavator to Maunakea to carefully remove the cinder.

"You have what you call an inverted membrane roof system, and it's unique, probably the only one in Hawaii," he said. "But someone had the foresight back when they designed the facility to do this and it's amazing, because the cinder acts like an insulator from both the weather conditions and the UV from attacking the EPDM."

And it works. After 27 years under that cinder, according to inspection, the EPDM appeared brand new. To maintain the roof's integrity, the solar system is ballasted with steel plates that are either 150 or 275 lbs and



"To me, the biggest challenge and risk we had for the project was how to attach the panels to the roof," Devenot said.

Additional risks during installation resulted from the environment and altitude. The solar contractors worked for about four weeks in the atmosphere, which at nearly 14,000 ft level cuts oxygen quality by about 30%, which could result in hypoxia.

The installation crew was housed at the Center for International Astronomy on Maunakea to acclimate to the climate, and they were provided with emergency supplies. The environment might be ideal for solar panels, but installers had to be aware of UV exposure, low humidity and strong winds that could reach hurricane speeds.

"Keeping people healthy and safe up there was the primary concern," said Lucas Shield, project manager with REC Solar. "We had supplemental oxygen on hand, made sure everybody took regular breaks and were always drinking water."

There was no cell phone use allowed up there because it interferes with telescope equipment. So, we had check-ins with everybody, but no cell phones created a logistical issue because you can't just drive up the mountain to go grab some equipment."

Climbing the permitting mountain

Construction projects on Maunakea fall under the jurisdiction of the Office of Maunakea Management and the Department of Land and Natural Resources. The dormant volcano holds a significant place in Native Hawaiian culture, and groups have protested the potential construction of the "Thirty Meter Telescope" that would join 13 others already in the mountain's Astronomy Precinct.

New construction on the volcano isn't common and must pass certain requirements at environmental, aesthetic and cultural levels. The addition of the solar array alone went through years of meeting discussions,



REC Solar installed a 137-kW solar system between the twin telescopes at W.M. Keck Observatory atop Maunakea, a dormant volcano and the highest point in Hawaii. Mark Devenot/W.M. Keck Observatory

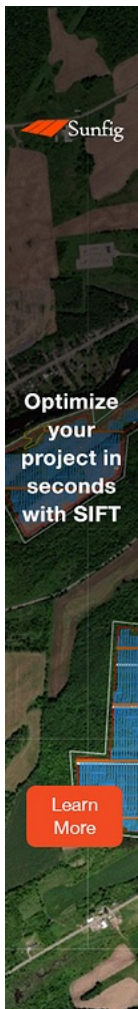




arranging a lease agreement and getting permission from local utility Hawaiian Electric to export power. All the heavy equipment used on the mountaintop project also had to be approved.



The observatory and accompanying solar array reside at nearly 14,000 ft above sea level, where UV exposure is pronounced, wind speeds are derated and atmospheric pressure causes a 40% drop in oxygen levels. Mark Devenot/W.M. Keck Observatory



doesn't expect solar projects to be installed for the Keck Observatory on Maunakea permitting temperamental and lack of

argued that Maunakea is the tallest mountain on the planet, if it's measured from its base located level. However, the solar array can't claim to be installed at the highest elevation on the planet — nation belongs to a 4-kW system in the Himalayas — but it is the largest one to be installed at this

tem might have been seen by some as a challenge or outside of our usual work scope," said er Licciardi, senior director of project delivery at REC Solar, "but it was fun for us."

UT THE AUTHOR



Billy Ludt



Comments



Semper Solaris

January 27, 2021 at 6:52 pm

...d be an experiment in terms of Solar that will either show us new value or bomb very hard. I think the
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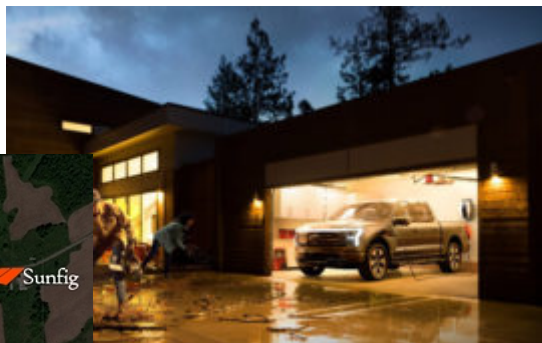
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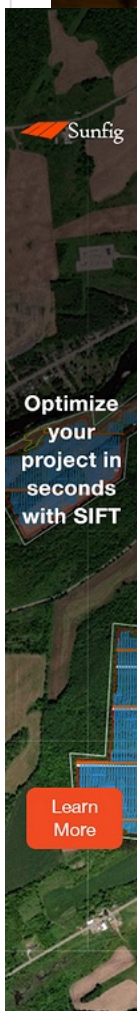
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