



KAUPUNI VILLAGE:

A closer look at the first net-zero energy affordable housing community in Hawai'i



Hawai'i initiative embraces sustainability

For more than a thousand years, native Hawai'ians practiced sustainability as a way of life. Deeply rooted in respect for the land, air, and water, these ancient cultural practices made this beautiful Pacific archipelago a bustling, self-sustainable community.

Today the Hawai'ian Islands are still bustling but are far from being self-sustainable. In fact, Hawai'i is the most oil-dependent state in the United States with more than 95% of its energy supplied by imported fossil fuels. This makes its economy extremely vulnerable to oil price fluctuations, and residents and businesses continually struggle with sky-high energy costs.

The Hawai'i Clean Energy Initiative (HCEI) was launched in 2008 as a partnership between the state of Hawai'i and the U.S. Department of Energy, and has grown to include many other government and private stakeholders committed to achieving 70% clean energy by 2030.

Hawai'i's clean energy goals are some of the most aggressive in the United States and have helped position the state as a nationwide leader in clean energy.



Fast Facts: Kaupuni Village

- Located in Waianae Valley, Oahu
- Consists of 19 single-family affordable homes and a community resource center
- All homeowners are native Hawai'ians
- Construction costs for the average home in Kaupuni Village: \$303,000, including the solar photovoltaic (PV) system
- The median home price in Oahu: \$600,000
- With subsidies from the federal Native American Housing Assistance Self Determination Act, families in Kaupuni Village paid approximately \$260,000 for a 4-bedroom home and \$212,000 for a 3-bedroom
- Each home is designed for maximum energy efficiency and utilizes renewables to reach net-zero energy performance.
- Energy efficiency measures in a Kaupuni Village home reduced energy consumption more than 40% over a standard-built baseline home.



Partners rally on ground-breaking community

One of Hawai'i's outstanding accomplishments in its multi-pronged efforts toward energy independence is Kaupuni Village—the first net-zero energy affordable housing community in the state. It has achieved the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Platinum designation.

The Kaupuni Village project is a prime example of local partners working with federal technical and financial assistance to integrate energy efficiency and renewable energy technologies in an application with local impact and replicable lessons learned.

Led by Hawai'ian Home Lands Trust and its partners—with assistance from the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL), Kaupuni Village took shape in the Waianae Valley in Oahu. The dedication was held April 2011, and residents moved in the following month.

The land was provided by the Department of Hawai'ian Home Lands (DHHL), and homeowners were selected from a waiting list of native Hawai'ians for whom DHHL is committed to helping attain home or land ownership.

“As a modern version of an ancient Hawai'ian village, Kaupuni is rooted in our culture,” said Albert “Alapaki”

Nahale-a, chairman of the Hawai'ian Homes Commission and a native Hawai'ian who was born and raised on Hawai'ian homesteads. “We turned to our kupuna (ancestors) and our Hawai'ian values in shaping the foundation of Kaupuni's design and philosophy—malama 'aina (take care of the land) in developing its green features and kaiaulu (community) in creating the community spirit of the project.”

Comprised of 19 single-family homes and a community center, the uniqueness of Kaupuni Village is not only that the structures are built to be net-zero energy, but that the entire community was envisioned as a fully self-sufficient and sustainable environment in keeping with traditional Hawai'ian cultural practices known as ahupua'a, where everything needed to live sustainably is provided from the local ecosystem.

“The driving force behind Kaupuni Village was for it to be a sustainable community,” said Kosol Kiatreungwatana, NREL's Kaupuni Village technical lead. “We applied modern technologies to create housing that supports the traditional Hawai'ian values of sustainability and environmental stewardship.”

A perfect pairing: energy efficiency and sustainability

Each of the high-performance homes incorporates energy efficiency and renewable energy technologies to

reach net-zero energy usage. From the south-facing orientation of the houses and their roof angles to the pervious concrete driveway to capture runoff and reduce the urban heat island effect, no detail was spared to make the homes as efficient as possible.

Each home was designed to have at least 40% lower energy consumption than the baseline, which is minimally 2006 International Energy Conservation Code (IECC) compliant. Energy efficiency is achieved through a variety of measures, including:

- Optimal building envelope design
- ENERGY STAR® appliances
- High efficiency lighting and daylighting with good solar control
- Natural ventilation
- High efficiency air conditioners
- Solar water heating.

A PV system on each house provides the renewable electricity to make the home net-zero energy.

Sustainable features throughout the community include maximizing open space, incorporating native species, water-wise landscaping, edible gardening, hydroponics, and aquaculture. Nearby Ka'ala Farms, which was a partner in the project, has held workshops for residents on how to construct traditional dry boxes used for drying fish as well as how to raise tilapia, and grow their own fruits and vegetables.

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Net-Zero Energy By Design: A Kaupuni Village Home

Solatube Lights
Natural light in interior spaces

Fiber Board Siding
Housing construction made from recycled materials

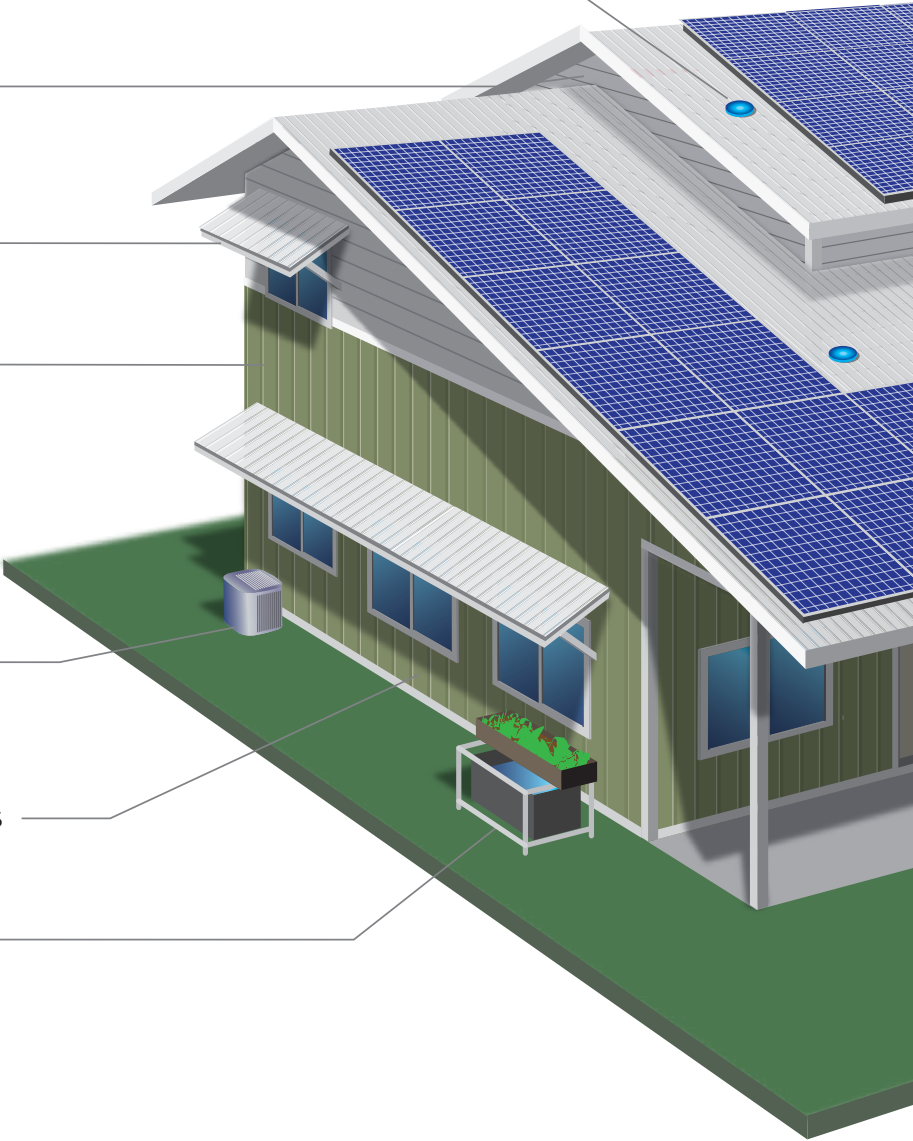
Shaded High Performance Glazing
Reduces heat gain through windows

Well Insulated Exterior Walls and Roof
Reduces heat gain through exterior wall and minimizes cooling costs

High Efficiency Appliances
All appliances are Energy Star® compliant

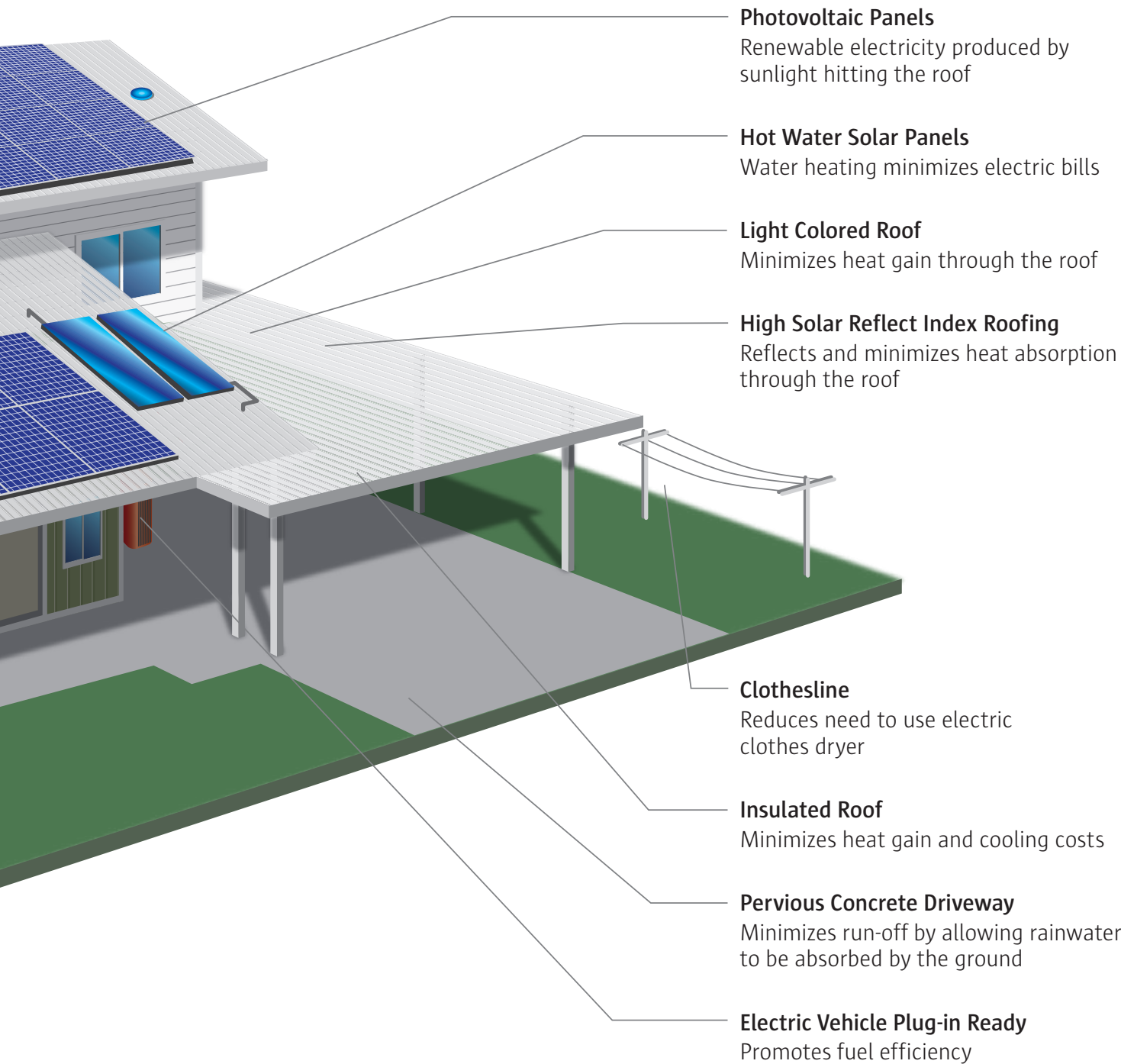
Low Volatile Organic Compounds Finishes
Provides a healthier indoor environment

Aquaponics
Enables homeowners to raise fish and grow vegetables for food



Project Partners

- Alcon & Associates
- Department of Hawai'ian Home Lands
- Group 70 International
- Hunt Building Company
- Hawai'i Chapter of the U.S. Green Building Council
- Hawai'ian Electric Company
- Ka'ala Farms
- Kamehameha Schools
- State of Hawai'i's Department of Business, Economic Development and Tourism
- University of Hawai'i
- U.S. Department of Energy/ National Renewable Energy Laboratory
- U.S. Department of Housing and Urban Development



Photovoltaic Panels
Renewable electricity produced by sunlight hitting the roof

Hot Water Solar Panels
Water heating minimizes electric bills

Light Colored Roof
Minimizes heat gain through the roof

High Solar Reflect Index Roofing
Reflects and minimizes heat absorption through the roof

Clothesline
Reduces need to use electric clothes dryer

Insulated Roof
Minimizes heat gain and cooling costs

Pervious Concrete Driveway
Minimizes run-off by allowing rainwater to be absorbed by the ground

Electric Vehicle Plug-in Ready
Promotes fuel efficiency

Illustration by Raymond David, NREL. Adapted by NREL from an architectural drawing by Group 70 International

“ Anyone can save energy, save money, and save water. Start by changing your lightbulbs, make a planter box, recycle. The little things add up. Simply ask, ‘What can I do?’

— KEALA YOUNG, KAUPUNI VILLAGE HOMEOWNER



A personal story: Kaipuni Village family takes sustainable living to heart

For years Cyrus and Keala Young longed for their own home where they could raise their three young daughters.

The Youngs, top left, pictured with their godson, had been on the waiting list for the DHHL since 2007 for the opportunity to purchase a home as part of the department’s mission to provide a permanent land base for native Hawai’ians.

“I set a goal for myself that we would have a home by the time I turned 30,” said Keala Young, an early childhood educator who was 26 at the time she applied to the DHHL program. “I knew it seemed impossible, but we were determined to raise our girls in a home that we owned.”

When DHHL contacted the family in 2009 about a proposed net-zero energy, sustainable housing development in Oahu for low-income families, Keala was excited but a little anxious.

“I was not too knowledgeable about what it meant to go green,” she said. “But the more we learned about it, we thought, ‘We can do this.’”

The Youngs were thrilled when they were selected to be one of 19 families to be given the opportunity to purchase a home in Kaipuni Village.

Since moving into their new home in May 2011, the family has taken to sustainable living like a fish to water.

“Everything we do now, we consider the land and how we impact it,” Keala Young said. “Our new home has brought us back to our traditional Hawai’ian values and the old way of life.”

Like other Kaipuni Village homeowners, the Youngs conserve energy by optimizing their high-performance home, but their new lifestyle is firmly rooted in ancient practices of sustainability and goes far beyond the solar PV panels that Keala Young describes as “gold to me.”

“We grow our own vegetables. We raise our own fresh-water tilapia,” she said. “We are passionate about net-zero living. There is so much pride in our home and our community. We feel we can be an example to others.”

Cyrus Young has so fully embraced green living that he quit his job as a truck driver to open his own business selling the solar panels that now line his roof. He also has built his own traditional Hawai’ian dry boxes to dry a local small fish called Opelu that he also hopes to turn into a business.

“It has changed my lifestyle but my husband’s even more so,” Keala said. “He never thought he would be teaching our daughters the old ways that his father taught him. I can’t think of a better gift to our children.”

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Kaupuni Village’s Hale Kumuwaiwai (community resource center) is a central gathering spot where residents can produce and prepare their own foods, share knowledge, and enjoy group activities.

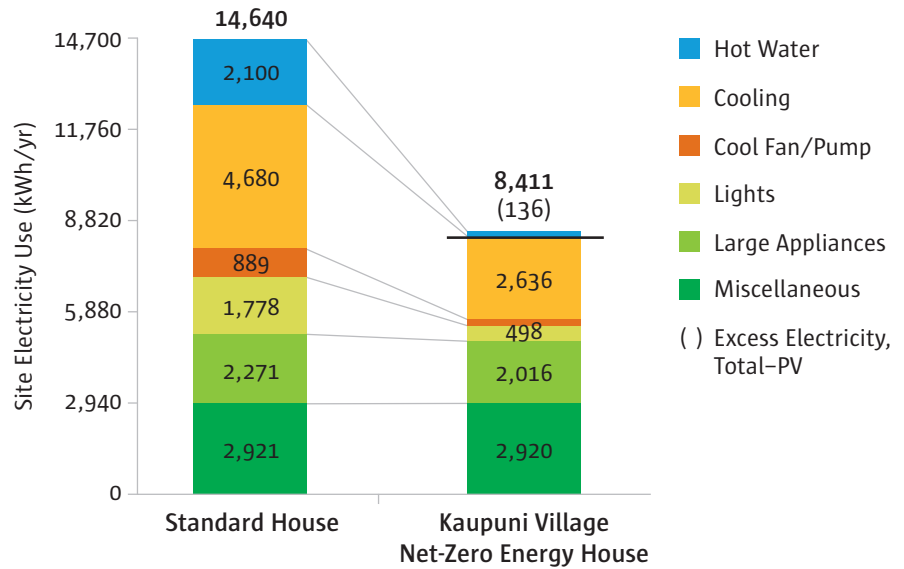
The Kaupuni Village project supports DOE’s goal to change the landscape of energy demand in homes and buildings through energy productivity and increased use of clean, secure energy.

Net zero, by design

The most cost-effective energy reduction in a building occurs during the design process. With technical assistance from DOE and NREL at the outset, the Group 70 International design team developed a design that departs significantly from conventional utilization and construction practices. A net-zero energy home design reduces energy use through appliances and lighting, effective building envelope insulation, and high performance glazing with optimal overhangs/eaves. Water heating is done by using solar water heating. Solar daylighting is achieved with solar tubes while efficient compact fluorescent lighting is used at night.

Excess electricity created during the day by the PV system is sent to the utility grid. In the evening and at night, the home then draws electricity back from the grid. And while the homes include central air conditioning, they were designed to minimize its use by taking advantage of shading and proper ventilation.

“Homeowner education has been critical,” Kiatreungwattana said. “You can have the best design and best construction, but it won’t work unless the residents know how to use energy efficiently.” Homeowner education was given at the community center in November 2011 by DHHL, Hawai’ian Electric Company, Hunt Building Company, and NREL. It was a successful event with more than 40 participants from the community.



This NREL chart shows energy usage of a standard house vs. a net-zero energy house in Kaupuni Village.

Homeowners can monitor their energy use through an electric net energy meter, which registers electrical flows in either direction. The benefit is residents are offered the opportunity to live an energy-efficient lifestyle and only pay the utility company a minimum connection charge of \$16 per month.

A new way of life

Kaupuni Village homeowner Ui Keliikoa couldn’t be happier with her miniscule monthly electric bill.

“That’s a huge highlight of my life,” says the 38-year-old director of development who shares her home with her mother Denice. “In my old home, the bill was at least \$350 a month for utilities. The \$16 that I pay is hard to believe.”

Like her neighbors, Keliikoa has attended training with NREL experts to learn best practices and how to optimize the technologies for net-zero energy living in these high-tech homes.

In addition to drying her clothes on a clothesline, she takes advantage of cool breezes to minimize the use of air conditioning and has become a huge proponent of solar PV, even encouraging her family, friends, and co-workers to invest in solar panels.

“It has really opened our eyes to what is possible,” she said. “I want to make

sure I make the most of my home and share that information with other people.”

Net-zero energy projects on deck

Kaupuni Village is one of many new energy-efficient residential and commercial developments in which DOE and NREL are providing technical expertise, design assistance, and validation. Among them is the upcoming Kalaeloa project, which is sited near the former Barber’s Point Naval Air Station in Oahu. On the Kalaeloa project, NREL is working with the Hawai’ian Community Development Authority to develop a unique mixed-use net-zero energy community that will include 300 multi-family housing units as well as commercial spaces.

Because of the bigger challenges in making multi-family housing achieve net-zero energy usage, Kalaeloa will be a prototype to prove market and financial viability of such developments, said NREL’s Jeff Bedard, who is the project manager.

“We are trying to radically shift the market and show this can be done,” Bedard said. “Kalaeloa will not only be net-zero energy, it will be targeted for net-zero water and net-zero waste—which will be a first in Hawai’i.” The project is expected to break ground in 2014.

“ The synergy between the project partners was key to Kaupuni Village’s success. We had a common goal so that made for a strong collaboration.

— KOSOL KIATREUNGWATTANA, NREL



Lessons Learned

Kaupuni Village is a prime example of local partners working with federal technical and financial assistance experts to integrate energy efficiency and renewable energy into an affordable housing community. Here are the top takeaways from the project:

1. The concept of net-zero energy is achievable and replicable in a residential community.
2. Good energy analysis and energy efficiency planning should take place early in the design process because of the difficulty in making changes later. Such changes can add significant costs to a project, including time, labor, and materials.
3. Collaboration between the design team, government entities, local partners, and residents is critical to project success.
4. Incorporate energy efficiency first and fill the gap with renewable energy to achieve net-zero energy goals. In the Kaupuni Village model, energy efficiency measures reduced energy consumption more than 40% over baseline. This resulted in a significant reduction in the need for renewable energy to achieve net zero.
5. The exchange of knowledge between homeowners accelerates adoption of energy-wise habits and fosters shared values.
6. Homeowner education and continuing reinforcement of energy efficiency practices provided by the utility, the contractor, and technical experts is important to creating and sustaining energy consumption awareness.
7. Much like vehicle mileage is dependent on how people drive, energy consumption performance in a net-zero energy house is driven by homeowner behavior. Based on ongoing monitoring of energy usage in the Kaupuni Village community, there was a variation of energy usage from home-to-home due to individual homeowner behavior. However, the community overall continues to achieve net-zero energy performance.

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