Madeira



Sustainability

SUSTAINABILITY

ENERGY

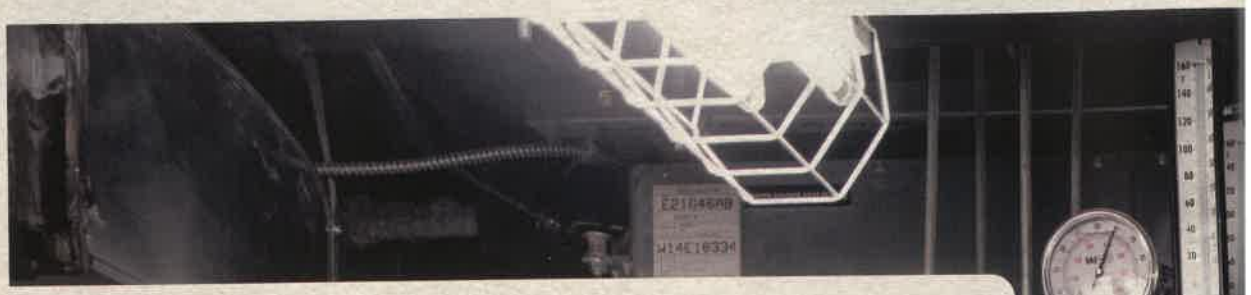
NET ZERO

SOLAR

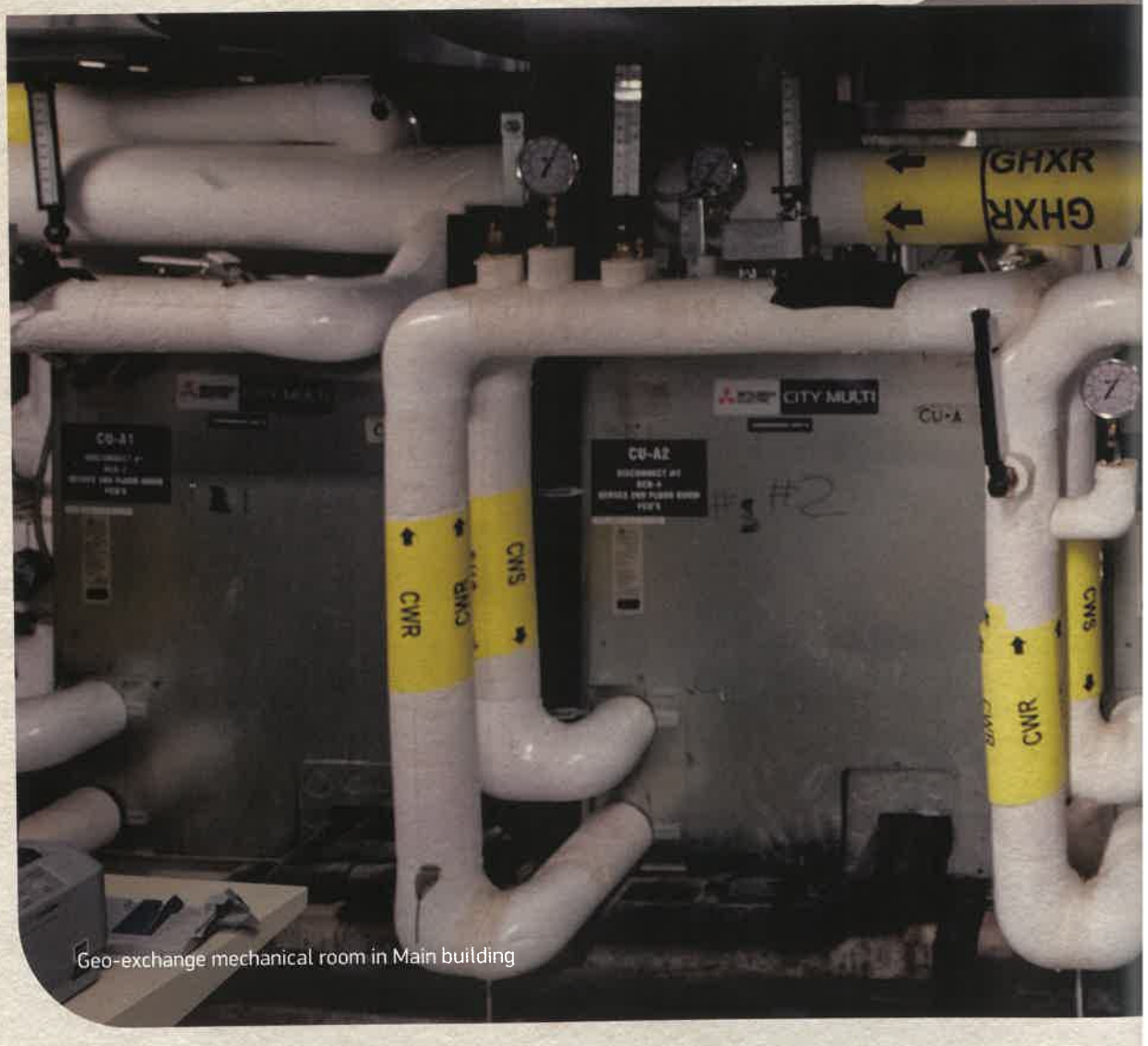
GEO-EXCHANGE

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A *Campus* BUILT



How Madeira Is Advancing Environmental Sustainability



Geo-exchange mechanical room in Main building

for the FUTURE



From cutting-edge energy systems to new opportunities for student-driven impact, Madeira's campus is already engaged in sustainability.

A QUIET LEADER IN SUSTAINABILITY

At first glance, Madeira's 376-acre campus feels timeless, with rolling hills, wooded trails, and a beautiful, serene pond. But beneath that natural beauty lies something less visible: one of the most energy-efficient school campuses of its kind.

"As we were evaluating Madeira's facilities, we uncovered something pretty remarkable," said Ken Shultes, Senior Advisor from The Stone House Group, a leading facilities and sustainability consulting organization. "Madeira's energy consumption is 33% more efficient than the average of its peers schools."

THE SYSTEM BENEATH THE SURFACE

Much of that efficiency comes from a powerful but largely unseen system: a geo-exchange network that connects six buildings across campus. This system uses the earth itself to regulate temperature by drawing upon stable underground conditions to heat and cool buildings far more efficiently than traditional HVAC systems.

"Geo-exchange is about 70% more efficient than conventional systems," Shultes explained.

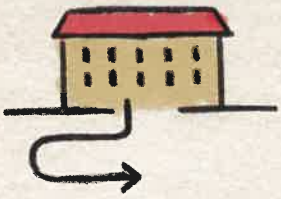
Combined with other upgrades, such as high-efficiency variable refrigerant flow (VRF) systems in key buildings, over half of Madeira's campus square footage is powered by an advanced, energy-efficient infrastructure.

And that matters. On most campuses, heating, cooling, and hot water account for roughly 75% of carbon emissions. By rethinking how buildings operate, Madeira has already addressed the biggest piece of the sustainability puzzle.

GEO-EXCHANGE: HOW IT WORKS

Geo-exchange systems heat and cool buildings by transferring heat to and from the earth, depending on the season. This renewable system is 70% more efficient than standard systems, saving Madeira money and reducing carbon emissions.

SUMMER COOLING



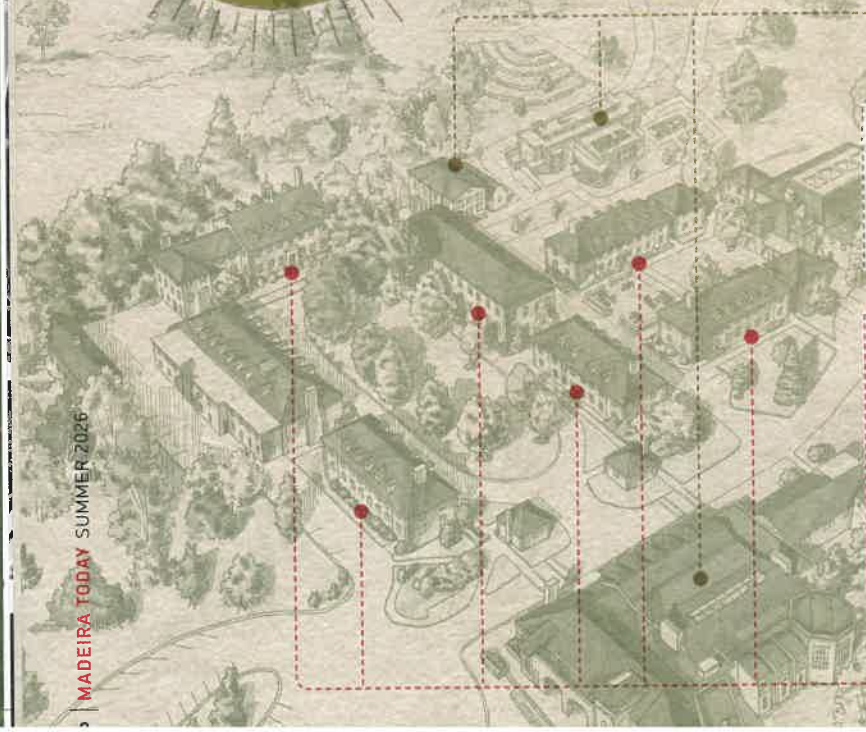
Heat transfers from the building to the earth.

WINTER HEATING



Heat transfers from the earth to the building.

OVER HALF OF MADEIRA'S CAMPUS IS POWERED BY HIGHLY-EFFICIENT SYSTEMS



VARIABLE REFRIGERANT FLOW (VRF) BUILDINGS

Madeira has three buildings connected to highly efficient VRF systems (L–R): **The Annex, STEAM Center, Student Center**

GEO-EXCHANGE BUILDINGS (L–R):

Geo-exchange is 70% more efficient than traditional systems. Madeira has six buildings connected to the underground system that draws on stable earth temperatures to regulate energy usage (L–R): **Main, West Dorm, Schoolhouse I, East Dorm, North Dorm, South Dorm**

DOING THE HARD THINGS FIRST

What makes Madeira's story particularly compelling is how it has approached sustainability. Many institutions begin with "low-hanging fruit." This includes projects like switching to LED lighting, which is relatively inexpensive and quick to implement.

Madeira has done that work, but it has also gone further. "The harder projects are things like geo-exchange systems," Shultes said. "They cost more upfront, and they're more complex. But over time, they're absolutely worth it."

These long-term investments reflect a mindset that goes beyond short-term gains—one that is focused on lifecycle impact, long-term savings, and environmental responsibility.

The geo-exchange system uses the earth itself to regulate temperature by drawing upon stable underground conditions.

A COMMITMENT TO SUSTAINABILITY

Sustainability at Madeira isn't just about infrastructure, it's also about education. The vision for sustainability starts at the top, and Head of School **Christina Kyong** embraces the responsibility for preparing our students and stewarding Madeira's beautiful campus. "My vision is to make sure that our students are getting the skills and knowledge to navigate the world as they launch, and that learning includes how to live in a world that is physically changing every minute. Climate change, natural ecological shifts in the landscape, alternative energy sources, and food and water scarcity are all things that they will have to navigate in the future."



Kyong strives to incorporate sustainability education into programming and classwork. "We have to prepare our students to be able to ask the right questions to help them become citizens of the world. We must begin that work while they are here, and, in order to do so, we need to be leaders in taking care of our beautiful 376 acres."



DID YOU KNOW?

- Heating, cooling, and hot water typically account for 75% of campus carbon emissions.
- Madeira has addressed these lead sources through the installation of high-efficiency systems.

These long-term investments reflect a mindset that goes beyond short-term gains.




Wastewater treatment systems

MADEIRA'S CAMPUS: A LIVING CLASSROOM

- Processes 20,000 gallons of wastewater on campus daily
- Provides opportunities for student research and data collection
- Supports integration into science and environmental coursework

CAMPUS AS A LIVING CLASSROOM

From its on-campus wastewater treatment plant to its forested landscape and river ecosystem, the School has a unique opportunity to turn everyday systems into learning experiences.

Each day, the campus processes approximately 20,000 gallons of wastewater on site, a system most schools never see, yet one that Madeira students can experience directly.

"It's a perfect learning opportunity," Shultes said. "Most places send wastewater somewhere else. At Madeira, it happens right here on campus."

The same is true for energy, water, and land use, systems that are often invisible but deeply impactful. By making them visible, Madeira can help students understand not only what sustainability is, but also how it works in the real world.



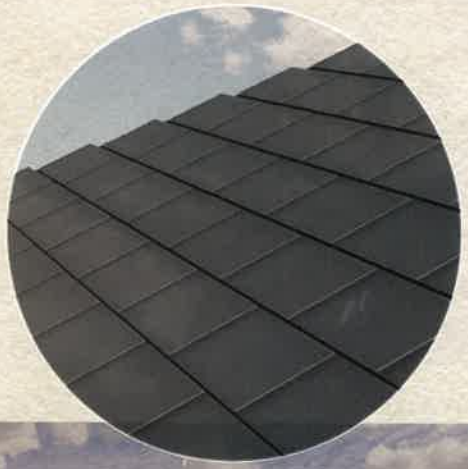
POWERING THE FUTURE: A NET-ZERO EQUESTRIAN CENTER

Madeira's commitment to sustainability isn't only about what has already been built; it's also shaping what comes next. "We need to be thinking about how each of our buildings can be as environmentally sustainable as possible," said Kyong.

The School recently approved plans for an innovative solar-integrated roof to crown the new Equestrian Center; an advancement that will make the building highly energy-efficient. Unlike traditional solar panels that sit atop a roof, this system is fully integrated into the building itself. The roof *is* the solar array.

"It's not a typical setup," Shultes explained. "The panels are essentially built into the roof structure itself."

The impact is significant: The system is expected to generate enough energy to offset all of the building's electricity use, effectively making it a net-zero building for electricity.





New Equestrian Center rendering with solar innovation

FIRST SCHOOL IN VIRGINIA TO INSTALL INTEGRATED SOLAR ROOF

SOLAR ROOF SPOTLIGHT

- Madeira is first school in the state to install an integrated solar roof
- Solar capability is integrated into roof surface (rather than sitting on elevated panels)
- Designed to offset 100% of building electricity use
- Integrated solar roof contributes to a highly energy-efficient building





METAL-BACKED SOLAR SHINGLES

- 2-in-1 solar generating metal roof
- Runs flush with the roof for a cohesive look
- Minimal back ventilation required (~2")
- No rack or ballast system needed

It's a natural fit for a facility that is already designed with efficiency in mind. Much of the Equestrian Center, particularly the stable areas, does not require traditional heating and cooling, reducing overall energy demand from the start.

While the integrated solar roof required careful financial consideration due to higher upfront costs, its long-term benefits, both environmental and operational, align with Madeira's broader approach to sustainability: investing in solutions that matter over time.

"It was so future-thinking when Madeira installed the geo-exchange system in 2014. That has helped us save money and steward our land. And the solar roof will do the same," said Kyong. "I hope that, as we continue to renovate and address the needs of our campus master plan, we continue to look at ways to save money and the environment. That is good planning and will future-proof our campus as well."



SOLAR ROOF PROVIDES TEACHABLE MOMENTS

Madeira will be the first school in Virginia to have the integrated solar roof to power the net-zero building. Kyong has involved students in this important message. "I want our students to see that we are being great stewards of our campus. This presents a valuable learning opportunity to collect data on kilowatt hours (kWh) savings, explore the science behind the solar roof, and examine how this alternative energy source benefits the larger community. These are all teachable moments for our students."

EQUESTRIAN CENTER WILL GENERATE MORE ENERGY THAN IT NEEDS TO OPERATE

KILOWATT HOURS (kWh) PER YEAR, ESTIMATED:

SOLAR ROOF PRODUCTION:	+ 250,000
BUILDING CONSUMPTION:	– 186,000–220,000
ENERGY SURPLUS:	**+ 30,000–64,000**

The integrated solar roof will generate enough energy to power the equivalent of 25 houses, which is beyond the Equestrian Center's needs. The excess energy will be exported to the grid.

Source: The Stone House Group

By generating enough energy to offset all of its electricity use, the new Equestrian Center will be a net-zero energy building.

– KEN SHULTES





STUDENTS ASSIST WITH USGS RESEARCH ON CAMPUS

The spirit of hands-on environmental learning is already happening across campus. Recently, students collaborated with a team of scientists from the United States Geological Survey (USGS), conducting research near Black Pond. The researchers were studying the history of extreme flooding along the Potomac River and how centuries of land-use changes, including deforestation and reforestation, have altered the river's behavior over time. During the visit, students received an impromptu field lesson on sediment coring, flood deposits, and the geological history of Black Pond itself, which was formed thousands of years ago by the same erosive forces that shaped Great Falls. The collaboration also opened the door to future opportunities for Madeira students to participate in field-based research and environmental analysis alongside working scientists.

BY THE NUMBERS

Energy efficiency advantage over peer schools	33%
Efficiency gain from geo-exchange system	70%
Percent of campus using high-efficiency systems	>50%
Gallons of wastewater processed daily	20,000

Source: The Stone House Group



"Madeira is 33% more energy efficient than its peer school average usage."

– KEN SHULTES

THE NEXT FRONTIER: CULTURE AND EVERYDAY IMPACT

While Madeira has excelled in large-scale infrastructure, the School has clear opportunities for improvement in daily habits and campus-wide culture.

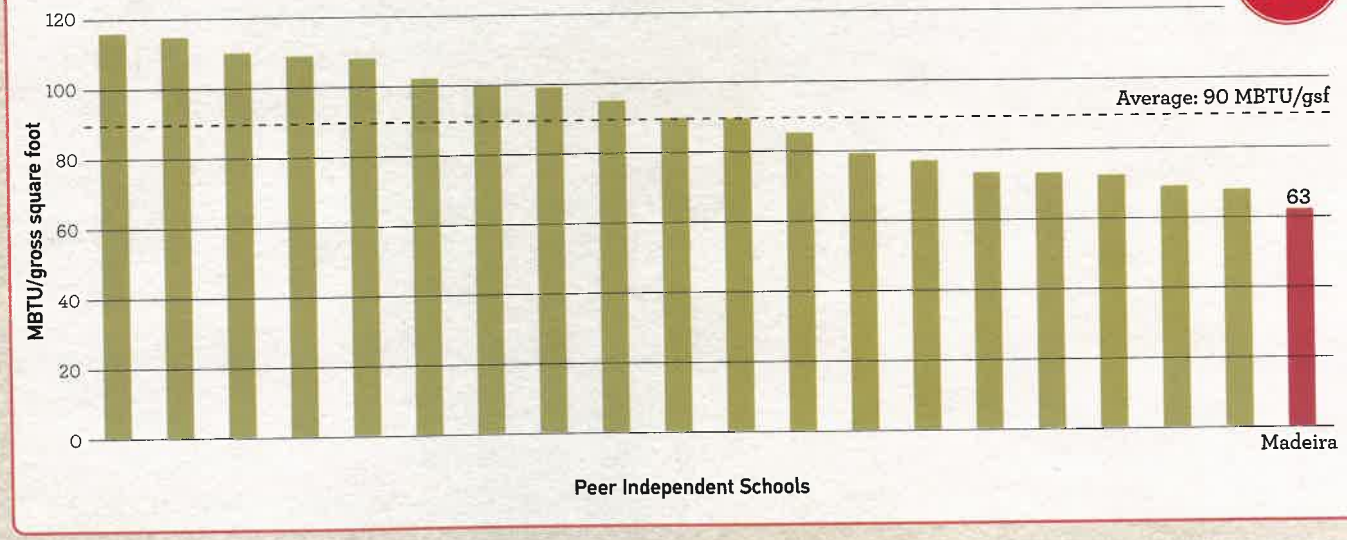
"We've done some of the harder things," Shultes said. "But we have further opportunities."

Shultes would like to complete a full greenhouse gas inventory. "It's really a data collection exercise," he said. "Once you understand your energy use, you can translate that directly into carbon emissions."

Such an inventory would allow Madeira to benchmark its performance against peer institutions, quantify its already strong environmental impact, set future sustainability goals with clarity, and, most importantly, it would help tell a story that is already unfolding. "We'd have a huge head start," Shultes noted.

Shultes sees an additional opportunity to further improve Madeira's environmental impact by focusing on areas such as recycling and waste reduction, composting (especially in the dining hall), and sustainable purchasing practices. In fact, he estimates that a majority of campus waste could be diverted from landfills with the right systems and awareness in place.

MADEIRA HAS THE LOWEST ENERGY CONSUMPTION AMONG ITS PEER SCHOOLS



Source: The Stone House Group, 2026 data

7 WAYS MADEIRA IS EMBRACING SUSTAINABILITY IN ITS FACILITIES

1. Solar panels for clean electricity
2. Geo-exchange heating & cooling
3. Energy-efficient lighting
4. Sustainable waste management
5. Electric vehicle (EV) charging stations
6. Partnering with sustainability initiatives
7. Energy audits & certifications



> "The biggest impact is what students take with them. If they understand this, they can go out and apply it everywhere."
>
> – KEN SHULTES



LOOKING AHEAD: FROM CAMPUS TO COMMUNITY IMPACT

As Madeira continues to think about sustainability, the opportunity extends beyond campus operations. Students could play a direct role, participating in data collection, analyzing energy use, or even helping build a greenhouse gas inventory as part of coursework.

"The biggest impact is what students take with them," Shultes said. "If they understand this, they can go out and apply it everywhere."

It's an idea that aligns perfectly with Madeira's broader mission: empowering students not just to learn, but to lead.

A STORY WORTH TELLING

Madeira's sustainability story is not one of future ambition; it's one of present reality and untapped potential. The systems are in place. The impact is measurable. The opportunities for growth, both operational and educational, are clear. What comes next is making that story visible.

