

SBIR/STTR TRANSITION PROGRAM

SPOTLIGHT

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Makai Ocean Engineering: Leveraging the Power of the Ocean and SBIR to Achieve Phase III Success

By Julie Scuderi

Situated on the beautiful island of Oahu, just a short distance from Honolulu, Hawaii, Makai Ocean Engineering is well positioned to harness the ocean's immense potential for renewable energy and other applications—and that's exactly what the company has been doing since its founding in 1973.

Makai's expertise lies in submarine cables, ocean energy and marine pipelines, and subsea technologies such as underwater vehicles, buoys, communications systems and general marine engineering and R&D. The company has a long and successful history with the Navy Small Business Innovation Research (SBIR) program, with the agency investing early on in one of the company's patented innovations: ocean thermal energy conversion (OTEC).

OTEC harnesses electricity by using the temperature difference between deep cold ocean water and warm tropical surface waters, and has the capacity to produce four times the electricity needs of this planet. After the Navy took an interest in OTEC, many other investors soon followed, including Lockheed Martin and other companies around the world. OTEC provided the perfect foundation to base many other SBIR-derived technologies from, including its Thin Foil Heat Exchanger (TFHXTM). Makai's work in OTEC also benefitted another technology that Makai has pioneered: seawater



Courtesy of Makai Ocean Engineering

Makai Research Pier in Waimanalo, Hawaii.

air conditioning (SWAC).

SWAC uses a naturally occurring cold water reservoir to cool the air. Cold water is drawn from the ocean through a deep-water intake pipe to a cooling station, where a heat exchanger is used to cool a fresh water loop that then transfers the cold water between buildings and residences, which then cools the air in those buildings. SWAC uses many of the same components as OTEC: heat exchangers, deep seawater pipelines; and seawater pumps. Makai has worked on numerous SWAC projects worldwide, including two projects for the U.S. Army and Navy in the Pacific and Indian Oceans.

“While OTEC itself has not yet been built

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commercially, our work surrounding OTEC has opened other doors for Makai and allowed us to become the world leader in several commercial markets, while we continue to de-risk and pursue the advancement and eventual commercialization of OTEC,” says Hermann Kugeler, Business Development Manager at Makai. “Through our work on OTEC and related technologies, Makai has become known as the premier engineering firm for designing large diameter pipelines and SWAC systems. OTEC has also been the catalyst for other new technologies Makai has developed, such as the Thin Foil Heat Exchanger™, that has since found applications in seawater cooling systems, and several military vehicle applications being funded through Air Force and Army SBIRs.”

Makai’s biggest success to date is its MakaiLay and MakaiPlan products, used by over 80% of subsea cable ships worldwide. Since 98% of international telecommunications travel through subsea cables on the ocean floor, the quality of both the cables and the means to install them are critical in the success of worldwide communications. When the Navy sought a means to improve the way these cables were laid on the ocean floor in 2000, Makai responded, and the resulting technology not only led to a Phase III project with the Navy, but also a worldwide commercial product that has garnered close to \$36 million in Phase III revenue.



With OTEC and MakaiLay—Navy SBIR-derived technologies—enjoying the kind of worldwide success most small businesses only dream about, it’s easy to think Makai would just continue to ride the waves of its resulting success. But instead, the company continues to innovate.

Makai is currently working on its heat exchanger technology, which once again focuses on harnessing the energy created from thermal

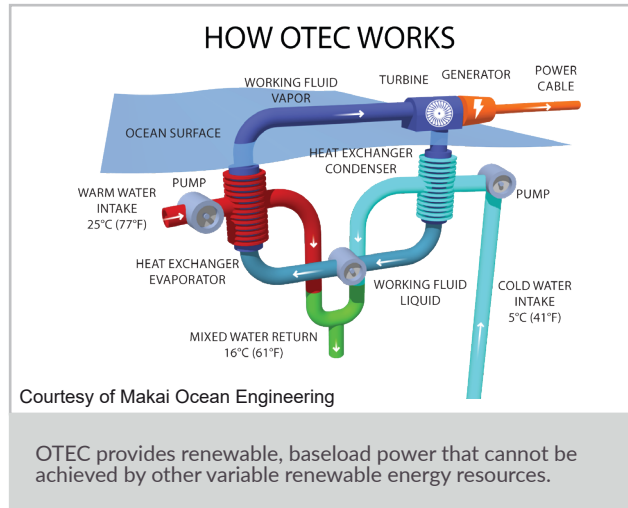
differences in the ocean’s temperatures. Funded by the Office of Naval Research (ONR) since 2009, with additional funding by both the U.S. Army and Air Force, Makai was recently awarded the Manufacturing Assistance Grant from the State of Hawaii, Hawaii Technology Development Corporation (HTDC) to support the additional testing needed to bring the technology to the commercial market. Makai has built and installed a commercial prototype of its TFHX™ in an algae facility at the Hawaii Ocean Science & Technology (HOST) Park by NELHA. This commercial prototype has been installed and operational at the facility for over two years. This technology has many potential applications, including in vehicles, advanced weapons systems, lasers, power propulsion systems, or anything with a high heat load that would benefit from a more efficient cooling system and optimization of size weight and power (SWaP).

“We attended Sea-Air-Space in 2021 and it was a great opportunity to pitch the technology and find additional Navy

applications,” says Ingrid Hillhouse, director, heat exchanger marketing and strategies at Makai. “We ended up connecting with a large prime contractor and they are very excited.”

Another opportunity to showcase its newest technologies came in 2021 when Makai presented at the Department of Navy Virtual Forum for SBIR/STTR Transition focused technology events. At the NAVSEA event, Makai unveiled its Distributed Temperature Sensing Tow Cable (Contract N68335-19-C-0522)—a tow cable system that can accurately measure, in real-time, the distributed seawater temperature along the length of the cable when towed from a surface ship. Makai developed a method of embedding an optical fiber into tow cables, allowing the fiber to measure seawater temperature from the tow platform using its distributed temperature sensing technology. This system provides critical information to topside vessels that will improve accuracy of seawater temperature measurements throughout the upper portion of the water column. Makai’s system provides a seawater temperature accuracy of less than 0.5° C. This accurate, real-time, truth data will assist with on-board operations. Makai’s system also leverages existing tow cable deployment hardware and removes the need for expendable bathythermographs.

“Makai’s Distributed Temperature Sensing Tow Cable provides valuable seawater temperature data resolution unmatched



by competing technologies, with little modification to current systems,” says Hermann. “We believe this system will be another transitional and commercial success for our team due to the numerous potential markets and applications including the Navy and oceanographic vessels and buoys, among others. Makai is now working on a Phase III SBIR to transition this capability to the fleet.”

Based on its continued success, Makai is posed to deliver more great innovations in the years to come. Of course, leveraging the power of the ocean is a far more tangible goal when you can first leverage the power of a great team, and that’s exactly what Makai has done all these years.

“Our team is made up of problem solvers; we approach the toughest problems in unique ways. We’re always asking: ‘How can we do this?’” says Hillhouse. When discussing the TFHXTM development, she says, “We use the thinnest materials in the world, then come up with innovative ways to join the materials that nobody has thought of before. That’s the entrepreneurial spirit of our team; our passion.” For more information, visit Makai’s website at www.makai.com.

