

LOCKHEED MARTIN



OCEAN THERMAL ENERGY CONVERSION

Renewable, clean and reliable power for energy needs of today and tomorrow

OCEAN THERMAL ENERGY CONVERSION

Presenting a 21st Century Solution Based on a 40-Year Legacy

At the heart of what makes Lockheed Martin unique is the commitment to taking on the hardest challenges and finding ways to solve them. We have always been about pushing boundaries of what's possible to protect what matters most.

Ocean Thermal Energy Conversion (OTEC) is a technology solution that directly addresses the key concerns of energy security, global warming, pollution and depletion of non-renewable fossil resources. OTEC provides a clean, reliable energy solution for many areas of the world.

In geographical areas with warm surface water and deep cold water, the temperature difference can be leveraged to drive a steam-like cycle that turns a turbine and produces

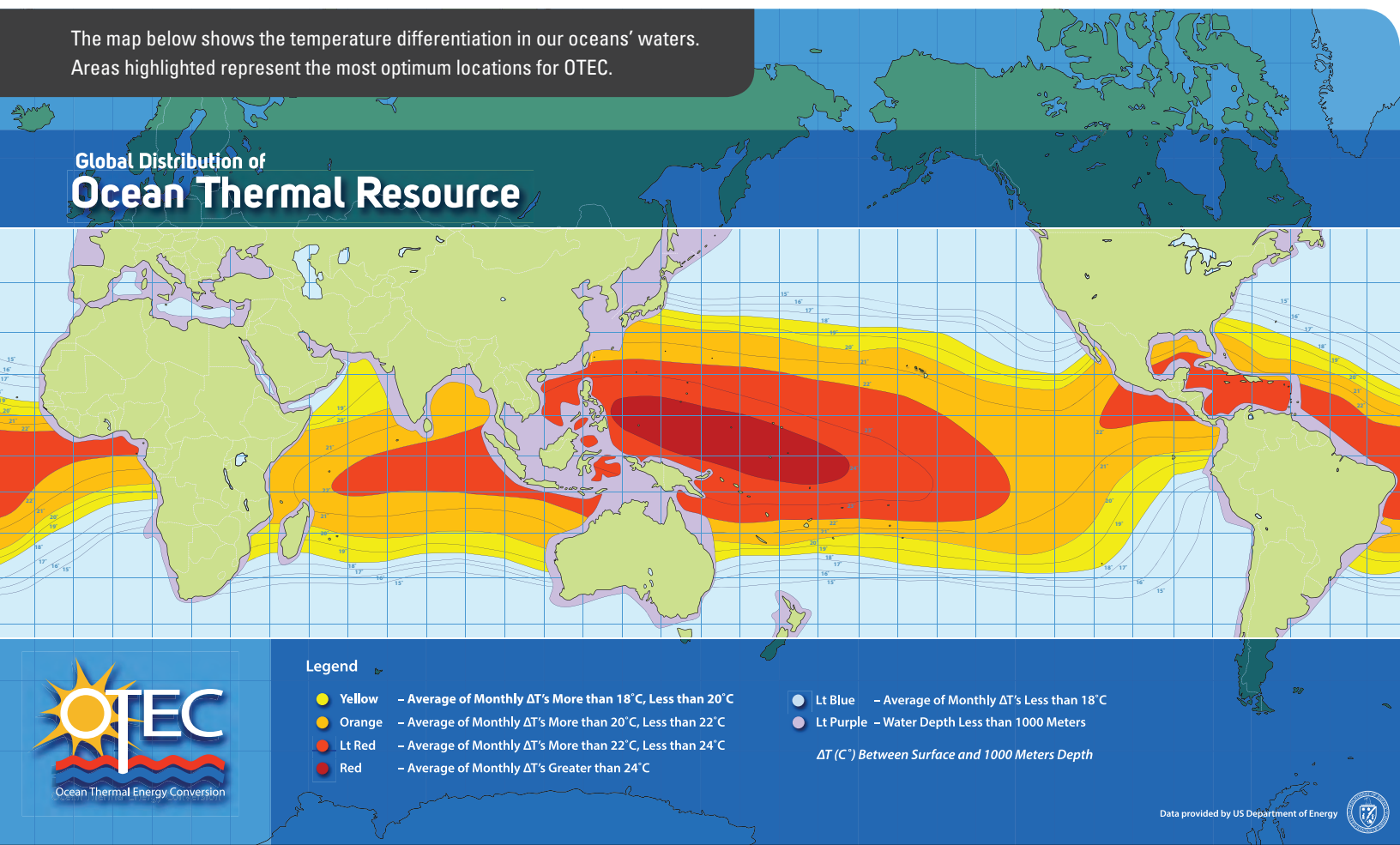
power. This temperature difference is the primary “fuel” for OTEC. Warm surface seawater is pumped through a heat exchanger, vaporizing a low boiling point working fluid to drive a turbine generator, producing electricity. Deep sea water is pumped through another heat exchanger, condensing the vapor. The liquid working fluid is returned to the first heat exchanger, and the cycle continues. This process is very similar to that used in steam power plants today, just at a different temperature

and pressure. The major components of an OTEC system include large heat exchangers, seawater pumps, turbine generators, a floating platform and mooring, a long cold water pipe and a power cable. The OTEC system is also adaptable to land based facilities.

In the mid 1970s, Lockheed Martin worked with the National Science Foundation to develop a conceptual design for OTEC. Following the design, the Lockheed Martin team went on to build Mini-OTEC, a

The map below shows the temperature differentiation in our oceans' waters. Areas highlighted represent the most optimum locations for OTEC.

Global Distribution of Ocean Thermal Resource



demonstration system off the coast of Hawaii. Mini-OTEC remains the world's only floating OTEC system to generate net power.

Since then, Lockheed Martin has continued to mature and validate the critical technologies necessary to allow OTEC to serve as an economically viable energy source.

Providing a Vast, Clean, Reliable Energy Option

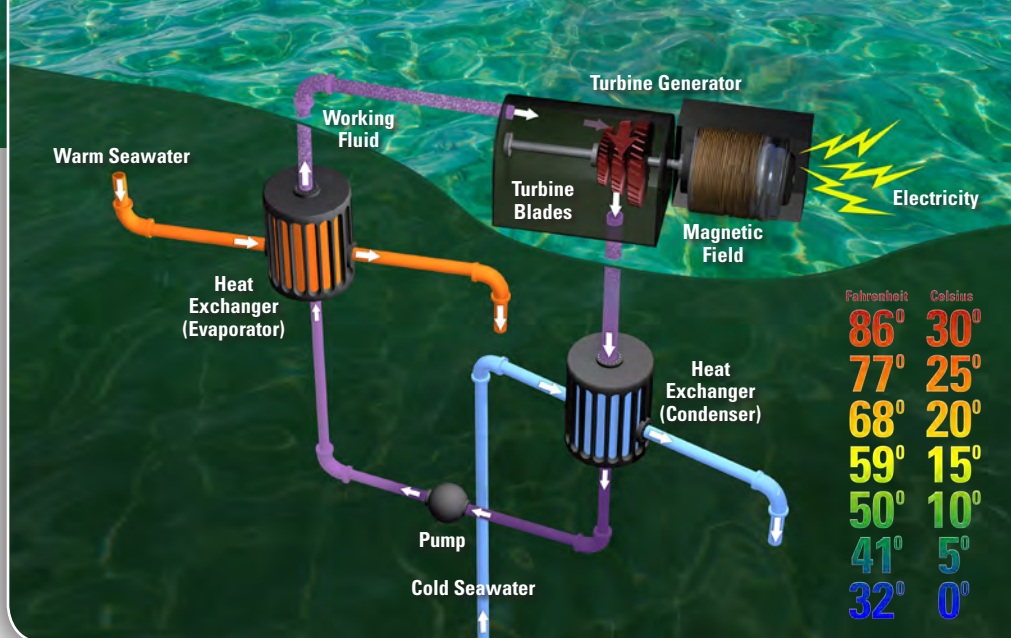
► **Vast, Untapped Renewable Resource** – The world's oceans cover more than 70% of the earth's surface, and over 80% of the sun's energy is stored and replenished every day within surface waters. This is the equivalent of 4,000 times the energy used in the world per day.

► **Clean** – OTEC does not burn fossil fuels. Once developed, it is free of pollution, with zero carbon emissions.

► **Reliable** – OTEC is a baseload power source, available 24 hours a day, seven days a week, providing a great advantage over intermittent (albeit important) renewable technologies.

Addressing Technology Challenges

Lockheed Martin has brought together a world-recognized team



to pursue the commercialization of OTEC. Through disciplined systems engineering and analysis, the team has identified and mitigated the key

risks. Leveraging technology and skills from across the corporation, as well as from the offshore industries, the team has made critical advances in technologies related to the cold water pipe and heat exchangers.

OCEANS COVER MORE THAN 70 PERCENT OF THE EARTH'S SURFACE, MAKING THEM THE WORLD'S LARGEST SOLAR COLLECTORS. AT LOCKHEED MARTIN, WE'RE HARNESSING THE POWER OF THE SUN TO GENERATE ELECTRICITY.

Partnering to Provide Power

In the past several years, the Lockheed Martin team, through internal investment, as well as U.S. Navy and Department of Energy contracts, has developed a conceptual design for an offshore OTEC facility. Currently, the team is working with Reignwood Group to develop a land-based OTEC facility.

Lockheed Martin is a technology and system provider in the quest for renewable energy.



CCBJ award

Winner of Climate Change Business Journal (CCBJ)'s 2013 Business Achievement Award. The CCBJ honors companies for doing what it takes to build a sustainable business in the climate change industry.



Environmental Leader Award

Named 2014 Product of the Year during the second annual Environmental Leader Product & Projects Award competition.



BlueSky Award

The Lockheed Martin and Reignwood Group OTEC project received the prestigious 2014 BlueSky Award from the United Nations Industrial Development Organization (UNIDO).

Lockheed Martin Corporation

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