

**HEARING BEFORE THE  
COMMITTEE ON  
ENVIRONMENT AND PUBLIC WORKS  
UNITED STATES SENATE**

**On**

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**PRESENTATION BY**

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PRESIDENT**

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# OCEAN POWER TECHNOLOGIES, INC.

An aerial photograph of a large body of blue water. In the foreground and middle ground, there is a grid-like array of approximately 20 white, circular powerbuoys. A thin, dark line representing a transmission cable runs from the buoys towards the right side of the frame, where it meets a sandy beach and some green vegetation. The sky is a pale blue with some light clouds.

## MISSION

*Manufacture and worldwide sale of a new, proprietary system to produce low-cost, non-polluting electrical power from wave energy.*

**OPT Power Station Comprising Array of Powerbuoys™ and  
Transmission Cable to Shore**

## **Ocean Power Technologies, Inc.**

Ocean Power Technologies, Inc. ( OPT ) is a privately-held energy technology company supplying intelligent wave power electrical generation systems to utilities, independent power producers and the public sector. OPT is capitalizing on the increasing demand for low cost electricity, the need for distributed generation and the awareness of new environmentally sensitive power generation technologies. OPT is offering its customers a tested, leading edge, proprietary product which generates non-polluting electricity in a reliable and cost-effective way.

### **OPT HAS DEVELOPED AND TESTED THE FIRST COMMERCIAL WAVE POWER GENERATION SYSTEM IN THE USA**

OPT s product is a scalable wave energy conversion system which is based on the integration of patented technologies in the areas of hydrodynamics, electronics, conversion mechanics and computer control systems. It has been designed and tested to operate in variable wave regimes and to survive severe storm conditions.

OPT believes that its wave power generation system is unique in that:

1. The system is a modular buoy-based product in which the modules are relatively small and hence relatively inexpensive to build and install compared to large wave energy generation systems
2. Regular low cost maintenance will permit a lifetime in excess of 30 years since the system is constructed from rugged buoys, marine quality hydraulics and proven conventional moorings, anchoring and underwater transmission power cable
3. The modular nature of the system allows for simple installation and easy scale-up, as well as immediate income, as the power buoys are incrementally brought on-line
4. The cost of electricity produced by the system is highly competitive against conventional sources of power, as well as other renewable energy sources

OPT s system trials include multiple tests in the US Navy s wave tank facility near Washington, DC, as well as operation of a unit off the coast of New Jersey for 11 months. Over that period, the ocean system produced power in varying conditions, and survived several major storms and a hurricane with waves as high as 30 feet. Based on the successful testing of the system, the Company has come to be regarded by independent experts as the world leader in buoy-based wave power generation devices.

### **OPT HAS SIGNED ITS FIRST COMMERCIAL CONTRACTS**

After successfully testing the complete wave power system, OPT has received its first commercial contracts for wave power generation systems. These include a 1 MW power station for a U.S. Navy base in Hawaii, a grid-connected power station of up to 10 MW for a utility in Australia, and a demonstration system for the State of New Jersey.

**OPT COMMANDS STRONG COST ADVANTAGES RELATIVE TO COMPETING SOURCES OF ELECTRICITY GENERATION**

The total operating cost of generating power from an OPT wave power station is projected to be 3-4 ¢/kWh for 100MW systems and 7-10¢/kWh for 1MW plants. These total costs per kilowatt hour include maintenance and operating expenses, as well as the capital cost of the equipment, over a 30-year lifetime.

**Comparison of Total Operating Cost  
(cents/kWh)**

	<b>Secondary Power (1 MW)</b>	<b>Primary Power (100 MW)</b>
OPT System	7-10	3-4
Fossil Fuel	N/A	3-5
Wind	10	5-6
Diesel	12-100	N/A
Photovoltaic (Solar)	25-50	10-15

While the capital cost of OPT s system is relatively more expensive at the secondary power level, the cost is competitive at the large scale 100 MW level compared to traditional fossil fueled systems.

**Comparison of Capital Cost Only  
(Dollars/kW)**

	<b>Secondary Power (1MW)</b>	<b>Primary Power (100MW)</b>
Coal Plant	N/A	1,500-3,500
Fuel Cells	5,000	N/A
Microturbines	Low	N/A
Wind/Solar	8,000	4,000
Other Wave Systems	45,000	N/A
OPT	6,200*	2,300**

\*20 unit cluster of 50kW units

\*\*500 unit cluster of 200kW units

Note: This data is based on OPT projections of detailed costs for 100 MW systems. Coal-based power plant costs are based on operating cost information from various utilities analysts, and Resource Data International, Inc.

As noted, while OPT s power plant equipment is at a somewhat higher projected purchase price per kilowatt than existing conventional power plant, the total cost per kilowatt hour over the life time of the plant is much lower. This is because the OPT Power Systems require no fuel, and maintenance operations are lower in cost (based on standard buoy maintenance procedures promulgated by the US Coast Guard).

## WAVE ENERGY COMPARED TO WIND AND SOLAR ENERGY

OPT s systems have other advantages when compared to the leading renewable energy sources:

Type	Energy Density	Predictability	Availability	Potential Sites
Wave Energy	High	Predictable in most sites	80 — 90%	Virtually unlimited
Wind Energy	Low	Unpredictable - except in limited number of sites	20 — 30%	Very limited
Solar Energy (Photovoltaic)	Low	Unpredictable - except for medium number of sites	20 — 30%	Medium number of sites

Source: Independent analysts, US Department of Energy, and various periodicals.

## OPT S TECHNOLOGY

*OPT is the world s leader of wave energy generation systems*

- Wave energy is the most concentrated form of renewable energy
  - Widespread throughout the U.S. and other parts of the world
  - Close to population centers
  - Predictable and dependable, and can be fed into the power grid or stored
  - Environmentally sound and non-polluting: no exhaust gases, no noise, no visibility from shore
  - Scalable to high capacity power stations (100MW+)
  - 100 square miles of ocean area off coast of California is estimated to be capable of producing all of California s electrical power
  - Significantly decreases US dependence on imported oil
  
- Availability factor of 90%, compared to wind and solar availability factor of 20-30%
  
- OPT s system captures wave energy in a simple and cost-effective manner
  - Proprietary system

- Innovative design allows for easy installation and maintenance
- Efficient at low and variable speed operation suited for natural energy sources

— Highly modular system enabling lower costs, reduced construction and commissioning period, and ease of expansion or reduction of power capacities. Conventional power stations must be built on a large scale to be economical, making them vulnerable to failure and difficult to maintain. Furthermore, the modular, scalable nature of OPT's systems enables the power capacity planned to avoid resource commitment until it is justified by actual demand.

— For conventional power plants, the footprint of the plant superstructure, surrounding grounds and additional facilities such as fuel unloading areas, waste settling ponds, etc. can occupy up to two square miles of expensive real estate for a 100<sup>o</sup>MW site. A comparable OPT power plant would occupy less than 1 square mile of effectively free ocean surface out of sight from the shore.

— Conventional power plants are based on a small number of large generators. Unscheduled maintenance and equipment down-time can significantly diminish capacity output and negatively impact costs. OPT's power generation systems are based on a large number of small generators and the effect of equipment down time or unscheduled maintenance on single units has a minimal effect on capacity output.

## OPT POWER WAVE STATION PHYSICAL PARAMETERS

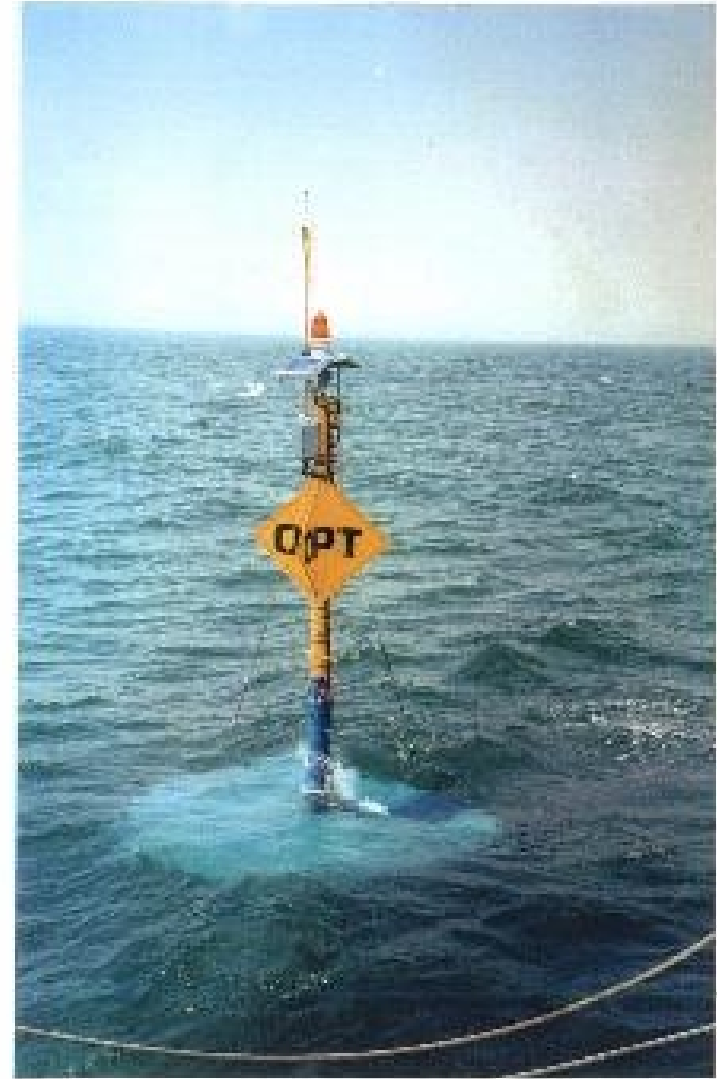
(Based on nominal 6-foot wave height)

Based on Nominal 6-Foot Wave Height				
Station Capacity Megawatts	Quantity OPT Units Deployed	Surface Area Acres	Min./Max. Ocean Depth Feet**	Offshore Distance Miles (Typical)
1	20	5	100-300	0.5-5.0
5	50	25	100-300	0.5-5.0
10	100	50	100-300	0.5-5.0
50	200	240	100-300	0.5-5.0
100	500	480	100-300	0.5-5.0

Note: 640 acres equals 1 square mile  
\*\*Power output is reduced in ocean depths of less than 100 feet. Mooring costs increase significantly for depths greater than 300 feet.

*OPT's wave energy generation system is based on a smart, modified ocean-going buoy designed to capture and convert wave energy into a controlled mechanical force which drives the OPT electrical generator*

- The rising and falling of the waves causes the buoy like structure to move freely up and down. The resultant mechanical stroking is used to drive the electric generator
- The generated AC power is converted into high voltage DC and is transmitted ashore via an underwater power cable
- The OPT device is a proprietary, smart system as the buoy sensors continuously monitor the performance of the various subsystems and the ocean environment, so as to efficiently convert the random wave energy into electrical power
- In addition, the OPT system includes sophisticated techniques for automatically disconnecting the system in very large waves, and automatically reconnecting when the waves return to normal regime



**OPT Powerbuoy™ Being Deployed and in Operation Off Coast of New Jersey**

## **MODULARITY**

- Power Module  
Generator and Electronics
  
- OPT Power Unit  
Buoy-like structure containing power modules, hydraulics
  
- OPT Power Station
  - a) Array of power units, electrically coupled
  - b) Increase or decrease capacity as demand requires
  - c) Fast installation and commissioning

## **ENVIRONMENTAL ADVANTAGES OF OPT s POWER GENERATION SYSTEMS**

- No fuel - absence of CO<sub>2</sub> emissions, radiation and particulate matter pollution.
- No waste or disposal requirements, and no danger of spillage or other environmental damage.
- No noise pollution.
- No visual pollution.
- No negative impact on marine life. In fact, can encourage growth of marine life.
- Reduces shoreline erosion.

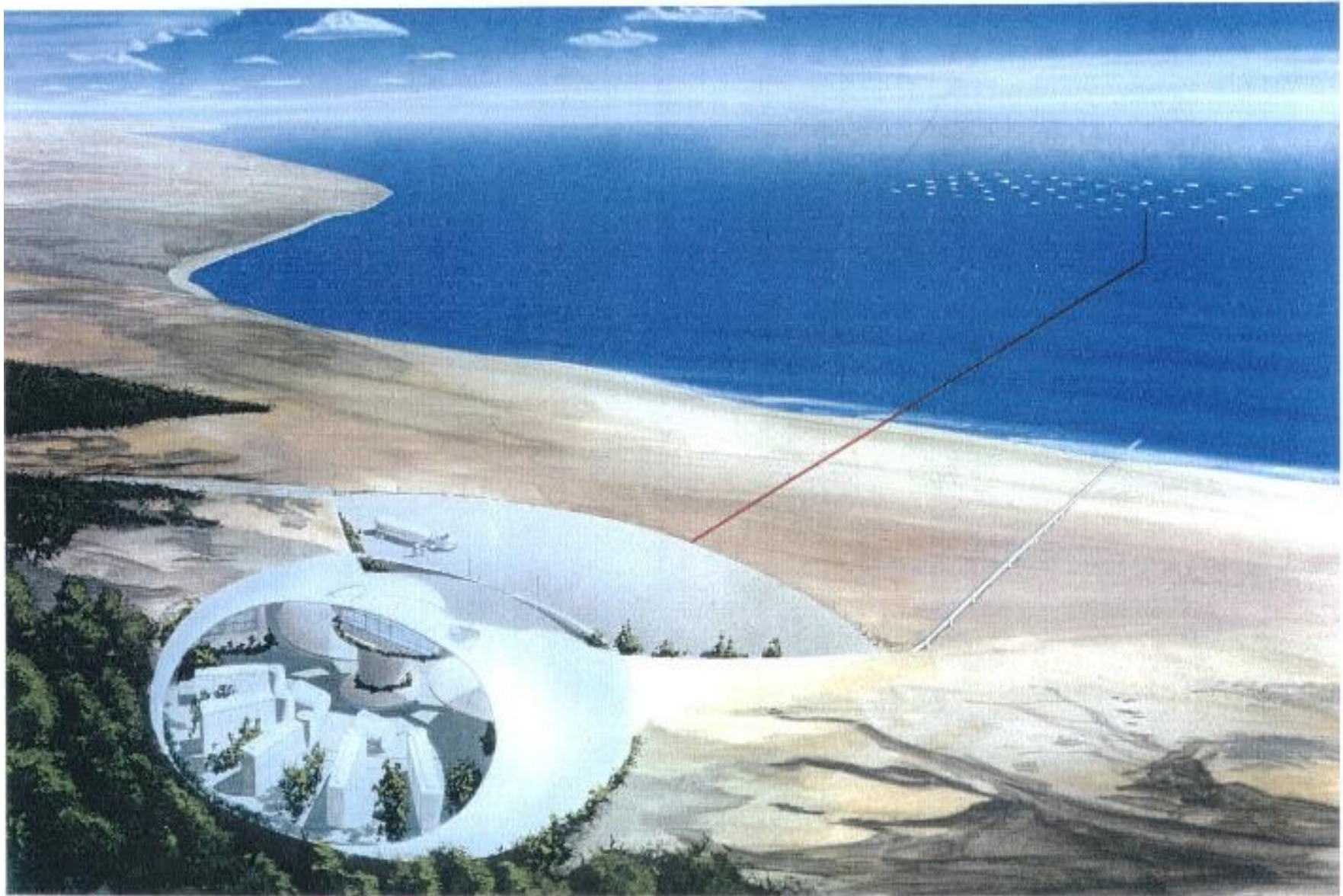
## **PRODUCT APPLICATIONS**

- Primary Power Plants — Grid power and distributed power generation
- Secondary Power Systems — Remote locations, mini-grid installations, off shore platforms. Generally, these are systems with overall capacity up to 1 MW
- Desalination Plants — OPT-generated low-cost electricity converts sea water into fresh water
- Water Treatment Plants
- Natural Resource Processing / Refinement Plants
- Hydrogen Production — Low cost, OPT-produced power would be used to separate sea water into hydrogen and oxygen
- Autonomous Underwater Vehicles
- Remote, Ocean Environment Sensing
- Navigation Aids

## **SUPPORT FROM UNITED STATES GOVERNMENT**

OPT has received significant support and encouragement from the U.S. Government from these sources:

- Office of Naval Research - U.S. Navy  
Small Business Innovation Research (SBIR) Program
  
- Defense Advanced Research Projects Agency (DARPA) — U.S. Department of Defense  
Broad Agency Announcement (BAA) Program  
Small Business Technology Transfer (STTR) Program
  
- Support from the Congressional Delegations of New Jersey and Hawaii



**Proposed Desalination Plant Powered By Offshore OPT Power System**