Career currents

Exploring Today's Energy Careers with the NEED Project Vol. 2, No. 2 December 2006

Sink or Swim? This Offshore Job goes Deep Underwater.

Commercial Divers work below the water's surface. Offshore diving opportunities include the inspection, installation and repair of offshore oil drilling platforms and other offshore structures worldwide. At the onset of their offshore career, commercial divers enter a short apprenticeship with a major dive company. After a year or two, they have the opportunity to "break out" as surface supported divers.

Tasks and Duties

- Test for cracks on the legs of oil rigs at sea.
- Cut and weld steel using underwater welding equipment, jigs and supports.
- Inspect and test docks, ships, buoyage systems, plant intakes and outflows, and underwater pipelines, cables, and sewers, using closed circuit television, still photography, and testing equipment.
- Install, inspect, clean, and repair piping and valves.
- Operate underwater video, sonar, recording, and related equipment to investigate underwater structures.
- Perform activities related to underwater search and rescue, salvage, recovery, and cleanup operations.
- Perform offshore oil and gas exploration and extraction duties such as conducting underwater surveys and repairing and maintaining drilling rigs and platforms.
- Set or guide placement of pilings and sandbags to provide support for structures such as docks, bridges, cofferdams, and platforms.
- Take test samples and photographs to assess the condition of vessels and structures.
- Drill holes in rock, and rig explosives for underwater demolitions.

Career Currents provides educators and students with resources to introduce energy careers. Each issue of *Career Currents* focuses on a different sector of the energy industry. No single issue is meant to be all-inclusive to either the sector profiled or all careers in energy. This issue focuses on careers offshore.

Credit: NOAA

Working below the surface, offshore commercial divers use scuba gear to inspect, repair, remove, or install equipment and structures. They conduct tests and experiments, rig explosives, and photograph structures and marine life. These divers are guiding a sub-bottom profiler, allowing researchers to view objects buried in sediment.

Education

Seventy-seven percent of commercial divers have college degrees. Twenty-one percent have some college experience, and two percent have high school diplomas or less education.

National Earnings and Employment Data

According to the Bureau of Labor Statistics, entry level commercial divers earn $30,100 per year, while experienced divers earn $47,770. In 2004, there were 2,900 people working as commercial divers. Currently, 34.6 percent of commercial divers are self-employed.

Information from the Centers for Ocean Sciences Education Excellence. For more information on a career in commercial diving, visit their website, www.oceancareers.org.

In This Issue

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A list of NEED sponsors is available on our website and in our annual report.

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Educators may reproduce articles and activities for classroom use.

NEED welcomes your questions, comments, and suggestions. Please contact info@need.org.

Sponsor Spotlight: MMS

The Minerals Management Service (MMS), a bureau in the U.S. Department of the Interior, is the federal agency that manages the nation's natural gas, oil, renewable energy resources, and mineral resources on the outer continental shelf (OCS). This includes supervision of oil and gas leasing, development, and production. The agency also collects, accounts for and disburses more than $8 billion per year in revenues from federal offshore mineral leases and from onshore mineral leases on federal and Indian lands.

The program is national in scope and headquartered in Washington, DC. It includes two major programs, Offshore Minerals Management and Minerals Revenue Management. The Offshore program, which manages the mineral resources on the OCS, comprises three regions: Alaska**,** Gulf of Mexico**,** and the Pacific**.**

The MMS is also responsible for the production of other minerals offshore, such as using sand and gravel for coastal restoration projects.

In its role as steward, MMS ensures that oil and gas development is conducted in an environmentally safe, fiscally responsible, and technologically innovative manner. It also is responsible for the development of offshore renewable energy, such as wind and wave projects. The MMS's long history of expertise in energy development, environmental protection, and conservation of natural resources makes it the obvious choice to manage alternative energy and use. The MMS is actively working to establish this new renewable energy program for federal waters.

Source: Minerals Management Service, www.mms.gov.

The offshore areas of the United States are estimated to contain significant quantities of energy resources in yet-to-be-discovered fields. MMS estimates that oil and gas resources in undiscovered fields on the OCS total 86 billion barrels of oil and 420 trillion cubic feet of gas. These volumes represent about 60 percent of the oil and 40 percent of the natural gas resources estimated to be contained in remaining undiscovered fields in the United States.

Offshore Energy Information & Career Resources

Energize Your Future Career with Shell Oil Company's New Website

Explore careers in the energy industry at Shell Oil Company's new educational website, "Energizing Your Future with Shell," www.shell.com/us/energizeyourfuture.

In the energy industry, there is an anticipated shortage of technical workers due to the pending retirement of the baby boomers and the declining number of students pursuing technical careers. Designed to develop students' interests in engineering, geosciences and process technology, Shell created a new educational website for teachers and students.

"Energizing Your Future" offers teachers interactive classroom activities, reproducible worksheets, lesson ideas and links to other energy-related resources. For students, there are games, quizzes, puzzles and mini-movies along with information about energy careers.

Looking towards the future, the educational website also focuses on alternative energy sources in the section "Tomorrow's Energy, Here Today," which teaches students that the future of energy will be diverse, including conventional oil and gas, as well as unconventional oil and gas, and renewable sources that include wind, solar and hydrogen.

Explore Over 50 Ocean-Related Careers

Looking for the perfect ocean-related career? Visit the Centers for Ocean Sciences Education Excellence (COSEE) website, www.oceancareers.org, to explore the possibilities.

On this website, you can explore over 50 ocean-related careers, find a college, university or training center that specializes in ocean-related education, find professional societies that can provide career guidance and scholarships, and search for internships and jobs.

The website also provides short profiles of people working in each ocean-related career, describing tasks and duties, education and salary for each job, and a detailed listing of job requirements, work activities, and knowledge and skills required.

For careers that require a vocational certificate, two-year associate degree, or four-year bachelor degree, search for educational institutions by state, types of degrees offered, or area of study.

Ocean Science Journal

The Minerals Management Service's *Ocean Science* is a journal highlighting the science and technology used by MMS. View issues of the *Ocean Science* journal online at www.gomr.mms.gov/homepg/regulate/environ/ocean_science.

Scholarship Opportunities for Marine Enthusiasts

The Marine Technology Society is offering scholarships for high school seniors who have been accepted to a full-time college and are planning to study a marine science, engineering, or technology field. Applications are due by April 15, 2007. Download scholarship applications at: www.mtsociety.org/education/student_scholarships.cfm.

Additional Resources

- American Association of Petroleum Geologists - www.aapg.org.
- The Bureau of Labor Statistics offers young people an opportunity to explore a variety of careers at www.bls.gov/k12/index.htm.
- At the Canadian website, www.centreforenergy.com, click on "Careers in Energy" for descriptions of occupations in the energy industry, including management, professional, technical, sales and service, trades and laborers.
- The Junior Engineering Technical Society website, www.jets.org, includes resources, newsletters, articles, and activities about engineering and technology careers. JETS' April 2006 newsletter explores careers in ocean engineering. Read interviews with some extreme engineers at www.jets.org/newsletter/0406/index.htm.
- The Marine Technology Society - www.mtsociety.org.
- Minerals Management Service - www.mms.gov.
- National Oceanic & Atmospheric Administration (NOAA) - http://oceanexplorer.noaa.gov. Explore ocean careers and the undersea environment with scientists by clicking "oceanAGE careers."
- Oil Rig Jobs - www.oil-rig-jobs.com.
- Society of Petroleum Engineers - www.spe.org.

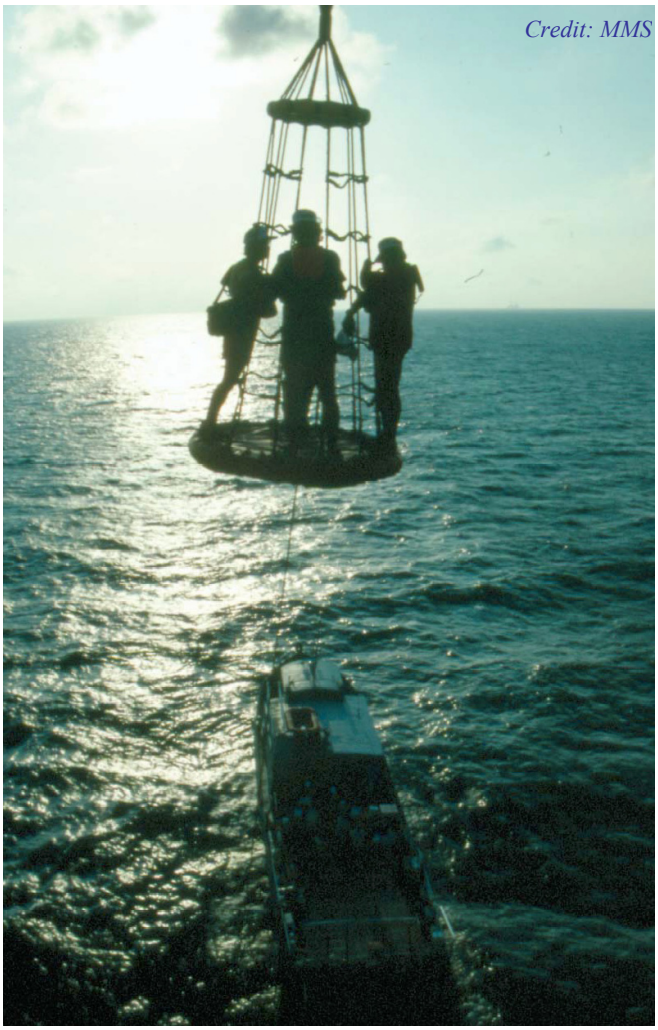
A Good Read

Ship of Gold in the Deep Blue Sea, by Gary Kinder, tells the story of how an ocean engineer, Tommy Thompson, discovered one of the richest treasures ever found on a sunken ship. The ship, the Central America, went down in a hurricane in 1857, sinking thousands of feet into deep ocean, hundreds of miles off the coast of the Carolinas. No one had every worked so deep at that time to recover gold and archeological artifacts from a shipwreck. Thompson's expedition recovered gold coins, bars and nuggets, plus steamer trunks filled with clothes, newspapers, books, journals and even an intact cigar sealed under water for 130 years. This fascinating book will show you how ocean engineering was used to solve problems that seemed insurmountable.

Career Opportunities in the Offshore Energy Industry

If you're interested in engineering as a career and also have an interest in the 70 percent of our planet covered in water, you can combine these passions into a rewarding and interesting profession – ocean engineering.

- **Acoustical Engineers** use sound waves as "eyes" in the ocean. They develop equipment and instrumentation that use sound waves to identify objects of interest in the ocean. For submariners, transducers and transponders allow the identification and location of objects in sea water where the visibility is zero.
- **Civil Engineers** design and supervise the construction of ports, harbors, tunnels, dams, bridges, and levees. Civil engineering, considered one of the oldest engineering disciplines, encompasses many specialties. The major specialties are structural, water resources, construction, environmental, transportation, and geotechnical engineering.
- **Chemical Engineers** apply the principles of chemistry to solve problems involving the production or use of chemicals and biochemicals. They design equipment and instrumentation for measuring the health of the oceans. Chemical engineers apply principles of chemistry, physics, mathematics, and mechanical and electrical engineering. Some may specialize in particular chemical processes, such as oxidation or polymerization. Others specialize in particular fields, such as materials science, or in the development of specific products.
- **Computer Hardware/Electronic Engineers** research, design, develop, test, and oversee the installation of computer hardware, such as printed circuit boards and mother boards, and supervise their manufacture and installation. Computer hardware engineers work exclusively with computers and computer-related equipment. The hardware might be in submersibles, buoys, or other marine equipment.
- **Electrical Engineers** design, develop, test, and supervise the manufacture of electrical equipment. Some of this equipment includes electric motors; machinery controls, lighting, and wiring; and radar and navigation systems.
- **Software Engineers** develop the computer language that allows the electronics to work correctly. They write code using computer language that enables sensors to measure ocean attributes, such as current, salinity and density. Software also provides the instructions for underwater robotics to move correctly.
- **Marine Engineers** apply knowledge from a range of fields to the entire design and production process of all water vehicles. Workers who operate or supervise the operation of marine machinery on ships and other vessels also may be called marine engineers or, more frequently, **Ship Engineers**.
- **Materials Engineers** are involved in the development, processing, and testing of the materials used to create a range of products. They work with metals, ceramics, plastics, semiconductors, and composites to create new materials that meet certain mechanical, electrical, and chemical requirements. They may, for example, be interested in making materials that are lightweight, affordable, and able to withstand the extreme pressure of the deep ocean.
- **Mechanical Engineers** work collaboratively with other engineering disciplines to design and build equipment and instrumentation for the oil and gas industry, ocean science, and ship building. Mechanical engineers deal with structural issues in design, such as the sizing of components and the integrity of the mechanisms. They work closely with manufacturing engineers to insure that designs can be manufactured and fabricated correctly at reasonable cost.



Credit: MMS

Ocean Engineers help **Oceanographers**, **Marine Biologists**, professionals in the oil and gas industry, **Archaeologists**, the **U.S. Navy** and **Coast Guard Personnel**, and other ocean specialists by designing and creating the instruments and equipment they use. Whether it's the cables that anchor an oil-drilling platform to the ocean floor, sophisticated underwater imaging equipment that photographs the drilling process, or the platform itself, ocean engineers are involved in every aspect of marine instrumentation, devices, and processes. Here are just a few examples:

- Use remotely operated vehicles (ROVs)—unoccupied, highly maneuverable underwater robots operated by people aboard surface vessels that are used, for example, to recover treasures from shipwrecks, repair oil platforms, and conduct research on marine life.
- Design portable light systems for illuminating the deep ocean that can be moved around the seafloor by ROVs.
- Design buoys with sensing devices for determining the size of waves by gauging the weight of the water columns passing over them (useful in detecting tsunamis).
- Design technology that allows scientists to measure the depth of columns of water (called *bathymetry*) from the air in order to map the ocean floor.
- Design instruments that communicate with satellites to determine the amount of melting of polar ice.
- Design materials for submersibles that can withstand extreme pressure.

With a career in marine technology or engineering, you may be involved with policy making, inventions, helping improve people's lives, and helping save the oceans. You may travel to all seven continents and have the opportunity to meet people and learn about cultures all over the world. You may find yourself working in the lab, at sea, or even on Capitol Hill.

Not interested in engineering? There are many additional offshore energy careers opportunities available.

Submersible Technicians inspect, maintain, and rebuild equipment for underwater remote-operated vehicles (ROVs). They diagnose and repair hydraulic, pneumatic and safety gear, as well as test submersible vehicles for operation and emergency situations. They work with **Marine Scientists** and **Engineers** who play a large part in the latest discoveries in marine technology. They work on sea vessels and in the deep ocean. Ocean travel is required, with some extended trips. To work as a submersible technician requires at least a two-year degree in marine technology, or related field.

Environmental Toxicologists conduct research, tests, and experiments to measure toxins in the water. On the job, they do field work to collect samples, run toxicity tests, enter and interpret data, write reports, and present their findings. They work with **Marine Biologists** and **Environmental Scientists** to detect and eliminate contaminants in the water. They spend time in the field — in various marine environments — and in the lab. To work as an environmental toxicologist requires at least a two-year degree in marine technology, environmental technology, or related field.

Marine Electronics Technicians evaluate, test, and repair the systems and equipment used on ships. At sea, they maintain computer networks, repair electronic oceanographic equipment, and install new equipment to meet research needs. They work with a team of marine scientists on board a ship. In the event of an instrument failure, they determine the problem and fix it. Ocean travel is often required. To work as a marine electronics technician requires at least a two-year degree in marine technology or related field.

Additional careers in energy, mineral research, exploration and extraction include:

- **Geological Data Technicians**
- **Geological Sample Test Technicians**
- **Geophysicists**
- **Marine Geologists**
- **Oil and Gas Derrick Operators**
- **Oil and Gas Roustabouts**
- **Petroleum Engineers**
- **Petroleum Pump System Operators**
- **Pipe Fitters**
- **Wellhead Pumpers**
- **Wind Installation Technicians**
- **Wind-Resource Assessors**

Sources: Centers for Ocean Sciences Education Excellence, www.oceancareers.com, The Bureau of Labor Statistics, and The Junior Engineering Technical Society, www.jets.org.

During the launch or recovery of any submersible, the crew carefully listens to instructions as directed by the **Dive Supervisor**.

Offshore Sources of Energy

The variety of energy sources found within our country's outer continental shelf and deep within the world's oceans offer vast possibilities for people interested in offshore careers in an energy field. Some key offshore energy resources include oil and natural gas, methane hydrates, wind, and waves.

Oil and Natural Gas

According to legend, Atlantis is a fabled island in the Atlantic that sank beneath the sea. In reality, however, Atlantis is one of the most exciting Gulf of Mexico oil and gas projects in history. Discovered in 1998, the Atlantis field is located approximately 298 kilometers (185 miles) south of New Orleans. The Atlantis production platform sits in water at a record depth of 2,156 meters (7,074 feet). The field is the third largest ever discovered in the Gulf.

Atlantis will be developed utilizing two facilities, a production and quarters (PQ) facility and a separate drilling facility. Impressive as its depth and reserves potential are, Atlantis is garnering attention for other reasons too. Scientists, **Geologists**, and Research & Development teams from around the world will watch as Atlantis is moored. That operation, which began in the third quarter of 2006, utilizes relatively new technology to locate and extract the oil and gas resources from thousands of feet below the seafloor.

Initial Atlantis development is based on reservoir images available during discovery and appraisal. However, significant hydrocarbons in the field sit beneath salt formations, making them harder to image. BP is applying new seismic imaging technology and has recently completed the world's deepest and largest full field ocean bottom seismic acquisition. This will provide improved definition of the full reservoir potential and help increase the reserves and enhance the long-term development plan.

A rig was custom built for Atlantis, part semisubmersible drilling rig and part construction vessel. Rather than focus on just drilling, completions, and installation of well trees, the Atlantis team designed the Development Driller II (DD2) with the ability to install piping and heavy equipment that rest on the bottom and interconnect wells.

The Atlantis production facility, the PQ, is equipped with the longest continuous wire mooring ropes ever built, and the platform will be anchored in place by 12 large suction piles embedded in the ocean floor to hold it in place. How much oil and gas will this mammoth unit yield? Atlantis production design capacity is 200,000 barrels of oil per day and 180 million cubic feet of gas.

Another exciting aspect of Atlantis is that the oil and gas produced will move through the Mardi Gras Gas Transportation System, the highest capacity deepwater pipeline system ever built. When complete, the five main lines and two smaller lines from Atlantis will transport half of the current deepwater production at depths of more than 7,000 feet in the Gulf. With diameters of up to 30 inches, Mardi Gras pipeline capacity is more than 1 million barrels of crude oil and 1.5 billion cubic feet of natural gas per day.

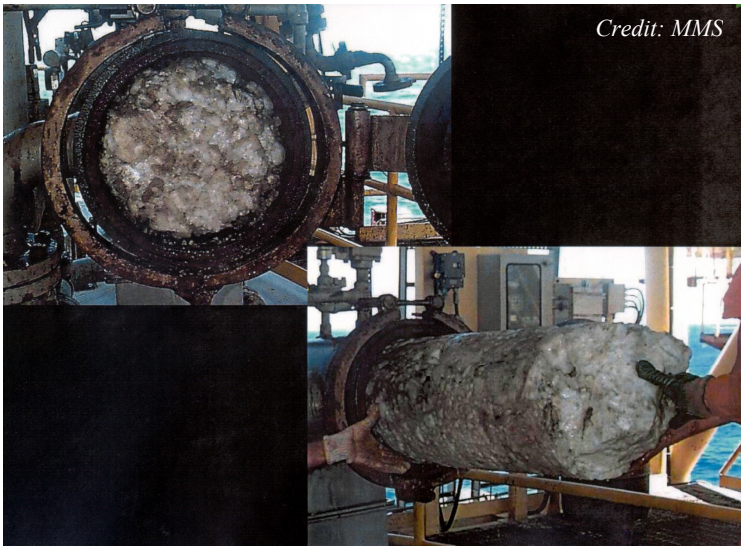
Credit: MMS

BP's semisubmersible platform, the Atlantis, will begin production in 2007.

Methane Gas Hydrates

Under the enormous pressures and cold temperatures at the bottom of the ocean, methane gas dissolves. The molecules of methane become locked in cages of water molecules to form crystals. These crystals look like ice, and they cement together the ocean sediments. In some places a solid layer of crystals, called methane hydrate, extends from the sea floor down hundreds of meters.

Hydrates concentrate 160 times more methane in the same space as free gas at atmospheric pressure. Scientists are assessing the safety concerns associated with the development of hydrates and managing projects to predict and eliminate hydrates in deep water operations.



Methane hydrate can become a hazard by blocking pipelines and interfering with oilfield operations.

Methane within the ice matrix of a gas hydrate will burn when lit.

The Power of the Wind

Wind and waves from Hurricanes Katrina and Rita caused devastating destruction along the Gulf Coast and contributed to disruption of oil and gas production and distribution. These same winds and waves, in more moderate form, may help us reduce the nation's reliance on foreign energy resources.

The use of the wind has some enormous advantages. The wind is free; it belongs to no country, state, or individual. There is no foreseeable wind shortage for the future. Plus, the production of usable energy from the wind is cost-effective and free of pollution and greenhouse-effect gases.

The technology for harnessing the wind for society's use has been around for centuries. But the idea of offshore wind farms for energy production is relatively new, having first been envisioned in 1972. Europe has taken the lead in construction of offshore wind farms with 17 farms constructed since 1991. The optimal location for wind farms offshore is deeper water, where the increased wind speed produces eight times the power of turbines in more shallow water. Turbines constructed in shallow water on concrete or steel are unsuitable for deeper water. The technology does not currently exist for producing suitable foundations for the turbines at greater depths. Alternate systems such as floating foundations are being investigated and may prove to be viable.

Inspecting an offshore windfarm, Arklow Bank, Ireland.

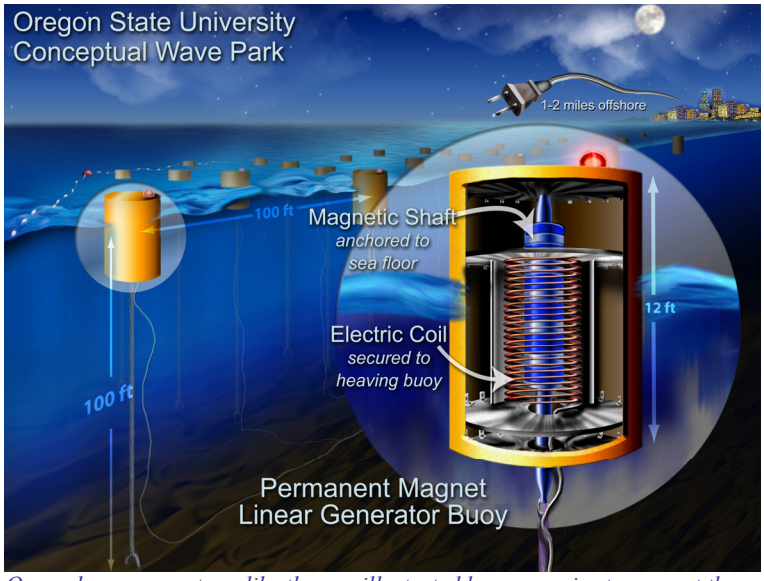
Electricity from wind farms at greater depths must also be transmitted a longer distance, adding to the cost of energy. However, the increased speed of the wind at locations farther from shore may offset higher transmission costs. Several proposed wind projects are currently in the planning and permitting phases: the Cape Wind project off Massachusetts and the Long Island Offshore Wind project off the shores of Long Island.

Source: Minerals Management Service, www.mms.gov

Wave Energy

Whether witnessed as destructive waves, gently rolling swells or mesmerizing rhythms along the shoreline, the sea's energy is immense. In fact, experts estimate that just 0.2 percent of it, in the form of waves, tides, salinity and more, could power the entire world. Although the technology is 15-20 years behind that of wind energy, ocean power is a promising, clean energy source that is more predictable, available and energy-dense than wind.

Led by professors Annette von Jouanne and Alan Wallace, engineers at Oregon State University (OSU) are developing ways to harness the ocean's energy and use it to produce electricity using buoy systems that can generate power just by floating in the ocean's undulating swells.



Ocean-buoy generators, like the one illustrated here, promise to convert the movement of waves into energy. Voltage is induced when waves cause coils located inside the buoy to move relative to the magnetic field of the anchored shaft. This process generates electricity.
Credit: Nicolle Rager Fuller, National Science Foundation

One such system, located one to two miles offshore, is a **permanent magnet linear generator buoy**. An electric coil surrounds a magnetic shaft inside the buoy. The coil is secured directly to the buoy and the magnetic shaft is anchored to the seafloor. When waves cause the coil to move up and down relative to the fixed magnetic shaft, voltage is induced and electricity is generated.

Each buoy could potentially produce 250 kilowatts of power, and the technology can be scaled up or down to suit a variety of energy needs. A fleet of about 200 such buoys could power the business district of downtown Portland.

Source: Nicolle Rager Fuller, National Science Foundation, www.nsf.gov.

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