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Ocean Energy and related Technological Advances

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Seas and oceans are endowed with vast reserves of renewable energy. Marine renewable energy takes the form of kinetic energy (winds and currents), potential energy (tidal amplitude), mechanical energy (waves), thermal potential (vertical temperature gradients) or even osmotic pressure (horizontal gradients of salinity)……The transferability of solutions from other sector, as well as the development of new technologies and materials could impact significantly on the speed of development of future emerging technologies for ocean energy for countries and territories that have extensive maritime areas, renewable marine energy can make a significant contribution to low-carbon electricity production in the energy mix.

Over 70 percent of the Earth is covered by water. The ocean is subject to the impact of wind, tides and ocean currents and thus carries with it large quantities of energy. The ocean is an enormous source of energy. Presently, a number of technologies aimed at harnessing this potential have been investigated and are at different stages of development including tidal and marine energy, wave energy, difference of temperature and salinity energy. The different forms of ocean energy also have relatively little impact on the environment.

There are two broad types of ocean energy:

a. mechanical energy from the tides and waves, and
b. thermal energy from the sun's heat.

Ocean energy is classified as:

1. **Wave energy:**It is generated by converting the energy of ocean waves (swells) into other forms of energy (currently only electricity). There are many different technologies that are being developed and trialled to convert the energy in waves into electricity.

Solar energy from the sun creates temperature differentials that result in wind. The interaction between wind and the surface of water creates waves, which are larger when there is a greater distance for them to build up. Wave energy potential is greatest between 30° and 60° latitudes in both hemispheres on the west coast because of the global direction of wind. The wave energy sector is reaching a significant milestone in the development of the industry, with positive steps towards commercial viability being taken.

At a simplified level, wave energy technology can be located near-shore and offshore. Wave energy converters can also be designed for operation in specific water depth conditions: deep water, intermediate water or shallow water. The fundamental device design will be dependent on the location of the device and the intended resource characteristics.

2. **Tidal energy: generated from tidal movements**. Tides contain both potential energy, related to the vertical fluctuations in sea level, and kinetic energy, related to the horizontal motion of the water. It can be harnessed using technologies using energy from the rise and fall of the tides or by technologies using energy from tidal or marine currents.Conversion of tidal energy into electricity has been widely investigated and can be compared to the technology used in hydroelectric power plants. In fact, electricity is generated by water flowing into and out of gates and turbines installed along a dam or barrage built across a tidal bay or estuary. More recently, technologies for exploiting wave and currents energy have been developed and tested on small-scale and, for a limited number of cases, on a large scale.

3. **Ocean thermal energy**: This form of energy is generated by converting the temperature difference between surface water and water at depth into useful energy. Ocean thermal energy conversion (OTEC) plants may be land-based, floating or grazing. The technologies related with the difference of temperature and of salinity are at an early stage of development. With Ocean Thermal Energy Conversion (OTEC), the difference of temperature between cold, deep seawaters and warm, shallow waters creates a thermodynamic cycle, which can be used for producing electricity.

   Water typically varies in temperature from the surface warmed by direct sunlight to greater depths where sunlight cannot penetrate. This differential is greatest in tropical waters, making this technology most applicable in water locations. A fluid is often vaporized to drive a turbine that may generate electricity or produce desalinized water. Systems may be either open-cycle, closed-cycle, or hybrid.

4. **Osmotic Energy**: At the mouth of rivers where fresh water mixes with salt water, energy associated with the salinity gradient can be harnessed using pressure-retarded reverse osmosis process and associated conversion technologies. In the case of salinity gradients, the difference in salinity between seawater and fresh water creates a pressure difference which can be exploited to extract energy.

The world's first marine energy test facility was established in 2003 to kick start the development of the marine energy industry in the UK. The European Marine Energy Centre (EMEC), based in Scotland has supported the deployment of more wave and tidal energy devices than at any other single site in the world and is at the forefront in the development of international standards for marine energy, and is forging alliances with other countries, exporting its knowledge around the world to stimulate the development of a global marine renewables industry.

Technological advances in Ocean Energy

1. Float or Buoy Systems that use the rise and fall of ocean swells to drive hydraulic pumps. The object can be mounted to a floating raft or to a device fixed on the ocean bed. A series of anchored buoys rise and fall with the wave. The movement is used to run an electrical generator to produce electricity which is then transmitted ashore by underwater power cables.

2. Oscillating Water Column Devices in which the in-and-out motion of waves at the shore enters a column and force air to turn a turbine. The column fills with water as the wave rises and empties as it descends. In the process, air inside the column is compressed and heats up, creating energy. This energy is harnessed and sent to shore by electrical cable.

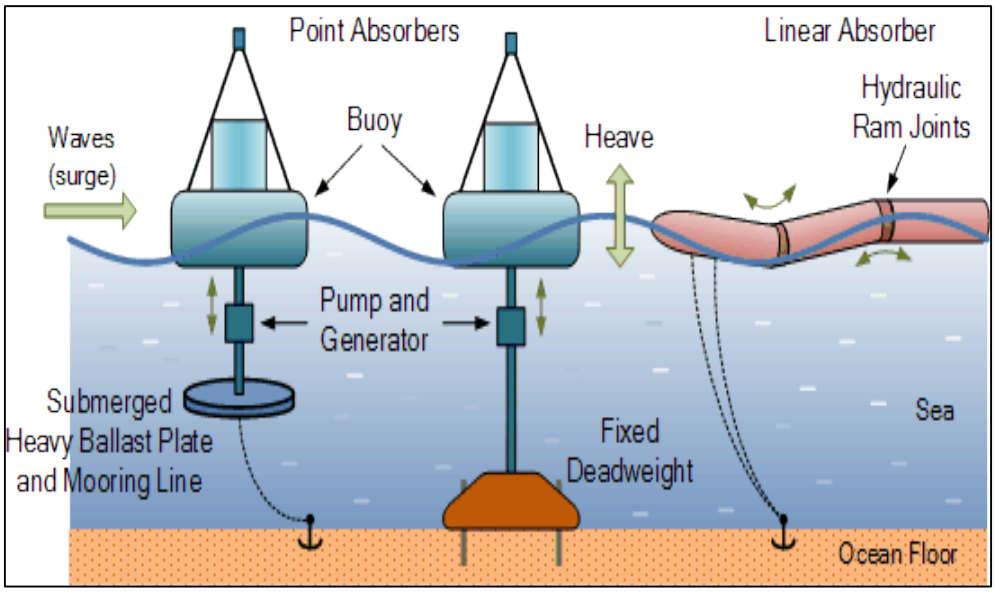
3. Tapered Channel rely on a shore mounted structure to channel and concentrate the waves driving them into an elevated reservoir. Water flow out of this reservoir is used to generate electricity using standard hydropower technologies.

Some of the Ocean Energy initiatives in India

The Government of India has vigorously stepped up its effort to reach the objectives to contemplate its Renewable Energy and climate change objectives post-2022, it is opportune to explore all possible avenues to stimulate innovation, create economic growth and new jobs as well as to reduce our carbon footprint. India has a long coastline with the estuaries and gulfs. The Ministry of New and Renewable Energy (MNRE)Govt. of Indiamakes endeavours for development of new technology and considers the various options available to support its deployment. Basic R&D is being looked after by the Ministry of Earth Sciences through its specialised agency known as National Institute of Ocean Technology, Chennai. MNRE intends to support demonstration projects of proven technologies and as approved by expert committee constituted by MNRE.

- In 2000 NIOT Goa, launched a programme to conduct study on technologies for producing high quality clean drinking water and energy from the ocean. The objective was to generate 2 - 3 lakh litres per day freshwater using the Low Temperature Thermal Desalination technology by 1 MW OTEC Power Plant. But it was dropped due to difficulties in installations.
- In 2010 Kalpasar Tidal Power Project at The Gulf of Khambhat was identified as a promising site for tidal power generation by UNDP Expert.
- In Jan 2011, the state of Gujarat announced plans to install Asia's first commercial-scale tidal current power plant; the state government approved the construction of a 50 MW project in the Gulf of Kutch.
- In 2014 Atlantis Energy proposed to install and develop 50-200 MW Tidal stream based power plant at Gulf of Chambey.
- Furthermore, the Government of India made OTEC- Ocean thermal energy conversion a priority in India, OES informed, by including the plans to build an OTEC plant to power a 100 m3/day desalination plant in Kavaratti in its new Financing Program (2017-2020).
- In addition, the Indian Navy is investigating the feasibility of an OTEC plant in Andamans in the Bay of Bengal, with the technical support of National Institute of Ocean Technology

(NIOT).OES, also known as the Technology Collaboration Program on Ocean Energy Systems is an intergovernmental collaboration between countries, operating under a framework established by the International Energy Agency, with the aim to advance the global development of ocean renewable energy sector. India joined OES early in 2016, gaining access to advanced research & development teams and technologies across the world.



Wave Energy Device

Seas and oceans are endowed with vast reserves of renewable energy. Marine renewable energy takes the form of kinetic energy (winds and currents), potential energy (tidal amplitude), mechanical energy (waves), thermal potential (vertical temperature gradients) or even osmotic pressure (horizontal gradients of salinity). An integrated systems approach is required to develop successful marine energy systems; highlighting collaboration with industry and engagement with original equipment manufacturers from the early stage of development are the major recommending factorsSystem capabilities and requirements should be properly defined and made transparent to increase the effectiveness of future emerging technologies development and applicability to ocean energy technologies.The transferability of solutions from other sector, as well as the development of new technologies and materials could impact significantly on the speed of development of future emerging technologies for ocean energyfor countries and territories that have extensive maritime areas, renewable marine energy can make a significant contribution to low-carbon electricity production in the energy mix. This is particularly the case with islands that are not interconnected with continental networks, in addition to conventional production.

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Bibiography:

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