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Ocean Energy and Development

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Abstract:

An incredible store of energy is given by the ocean which covers more than two-third part of our earth. The waves of the oceans and seas give huge quantities of clean energy. Ocean energy is also known as marine energy is that sort of energy which is carried out by the waves of ocean, tides, salinity and different temperatures difference. Ocean energy plays a significant role in the system of future energy. As India has a long seashore, therefore, ocean energy has attracted increasing interest. For many years, technologies harnessing energy from the ocean have been discussed. To ensure the technology of ocean energy many numbers of mechanism and initiatives have been put which in short-term become cost- competitive, in order to exploit the benefits. This paper gives an overview of the various technologies used for the extraction of ocean energy and the present stage of this research in the arena of ocean energy with their impacts on the environment. This paper also discussed or highlights the area of research gaps exists and the efforts for future implementation on ocean energy.

Keywords: *Ocean Energy, Impacts, Technologies, Marine Energies*

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Introduction

In the world full of competition, every nation wants to be in the league of developed countries by rapid growth. The ecological disequilibrium and malicious effect caused by fast industrialization and increasing population can't be ignored. For the developing countries like India which stand 6th in the world in terms of energy consumption, the dependence on a single technology or resource to fulfill all the energy needs is undoable and unreasonable. (Dhingra, Rijul, et al. 2014)

Oceans have an incredible amount of energy and the main form are tidal energy, thermal energy, ocean current and wave energy. To provide a renewable energy around the world, ocean energy has the potential. Generally, ocean energy can be separated into 6 dissimilar source and features: ocean current, ocean wave, tidal range, tidal current, and salinity gradient and ocean thermal energy. India being a humid country, a continual variation in temperature is exists between surface water and the deep ocean. This ascent can be used to produce fresh water and power concurrently. To generate electricity to powerhouse, industries and transport the energy can be created from the motion of water in the ocean which produces a huge stock of kinetic energy, or energy in motion. Coastal areas can receive electricity at low cost because the production of energy is from the ocean. The terminology marine energy shields both the wave powers – tidal power and power from surface waves, acquired from the kinetic energy of huge bodies in moving water.

If we included all the sources like solar, tidal, geothermal and wave India has around 150GW or more than 150GW. Only about 22% of renewable energy potential is generated in the country like India which has such a vast potential. From all the thermal energy sources like coal, oil and natural gases the total capacity installed in India is around 300GW. The commitment of reduction of carbon emission and the concern related to fuel has amplified in latest times. The focus of Indian government is moved toward the advancement and security of renewable energy sources, which will benefit the country in attaining the safety of energy, dropping carbon footprint and decreasing the most adverse environmental impacts. (Reji Shaji, 2014)

Tidal Energy

Tidal energy sometimes also refers to tidal power. It is the power which is attained by the energy, seized during the motion in the water bodies during Open Ocean current and tides. Tidal energy is divided into two procedures:

- Tidal barrage technique
- Tidal current technique

Tidal Barrage Technique:-

A huge dam-like construction is made through the opening of bay or inlet in a huge tidal range, which consists of tidal barrages. With the tides, the measure of water changes and a variance in height grows through the barrage. The flow of water is permitted along the barrage via turbines. Turbines can deliver power during the withdrawing tide, or the flood tide or during both the tides. The most mature and oldest technology is represented by the tidal barrages. In the world, there are numerous commercial plants up to 240 MW in dimension. Many new studies and developments for this kind of plant are also proceeding in many parts of the world. The considerable investment cost related to the construction and anxieties over contrary ecological effect make the skill somewhat unpleasant in divergence to tidal current machineries.

Tidal Current Technique:-

In the tidal current technique, machines are located directly "in stream" and energy is generated with the help of flow of water. It represents a different approach to extracting energy from tides. In this dam like structure is not used. A large number of technologies are available for mining the energy from marine streams, comprising horizontal and vertical-axis turbines. Others also include ventures and vacillating foils.

For fixing the tidal current devices there is a variety of method in place, comprising seabed affixing via gravity base or driven loads, as flow as well as floating platforms fixed in place.

The amalgamation of services applied by the gravitation pull of the moon and the sun and rotation of the earth, tides are generally generated. Different tidal energy is produced by the relative motion of these three bodies which will affect the range of tides. By some local effects like funneling, reflection, resonance and shelving the substantially of tidal range can be increased. By making a tank and basins behind the barrage and transitory tidal waters

along turbines in the barrage, energy can be extracted.

The three sides of India is enclosed by sea, its perspective to connect tidal energy has been acknowledged by the Government of India to extract the energy two types of energy system are used:

a. Kinetic energy: this energy is from the motion water of rivers, tides and open ocean currents.
b. Potential energy: this energy is from the gradient difference in height between the high and low tides.

The technique of kinetic energy is turning out to be more prevalent to generate energy from tidal currents, because it is said that it does not damage any ecological set up as much as barrage or dams do. (Yadav, 2015)

Advantages of Tidal Power:-

- The system is easy to operate and maintain
- It does not create any type of pollution
- Less term operation lifetime of a plant
- The vulnerable coastline is also protected from floods and strong waves.
- The energy supply by this system is nonpolluting and supply of energy is exhaustible.
- It does not emit greenhouse gases.

Ocean Wave Energy:

Ocean currents are unidirectional, slower but continuous as compare to tidal current. Ocean currents are driven by the latitudinal distributions of winds and ocean circulation of thermohaline. In this, the current operation is strongly close to the surface. From the surface of waves or from the pressure fluctuation below the surface, ocean energy is taken. The conversion of motion of wave into usable mechanical energy is used to generate electricity. Wave energy has the potential to be a much greater resource than tidal power. Wave energy performs the finest in a minor figure of extremely promising locations. (Sharma and Sharma, 2013)

To convert the energy of wave into the form of useful energy many technologies are adopted. Some technology is very costly and many variables are needed to converse ocean energy into valuable work or electricity. In these variables, the methods include the interaction of waves with water depth (intermediate, shallow, and deep) as well as respective motion (surging, heaving, and pitching) and distance from the shore (offshore, shoreline, near shore). A well-ordered process of floating devices needs large movements which further can be attained by resonance or by latching, that is, withhold/release of moving parts until potential energy has gathered. For extracting energy from wave various variety of methods have been established. The diverse system does not only employee various techniques for seizing the energy but various methods are also diploid to for converting it into electricity.

The forms of wave energy transformation methods may be categorized into the following ways:

- Oscillating water column (OWC)
- Absorber system
- Overtopping devices
- Inverted pendulum devices

Oscillating Water Column (OWC):

For transforming fluid power into rotatory motorized power, air turbines are almost entirely by the Oscillating water column (OWC) type wave energy device. OWC is a closed chamber in which the chamber is open at the bottom and with the help of one more air turbine, it is open to the air. As the waves are influenced on the OWC device the level of water within the chamber changes it increases and decreases, expanding and compressing the air and then it will drive through the air turbine. Then at a time when the direction of air converses midway by every single wave, the method for resolving the airflow is needed and the system which has multiple numbers of turbines should be used with one-way valves. The most favorite method which is currently used involves the use of self-rectifying turbines which will spin in a single direction irrespective of the direction of airflow. The design which is most widespread is known as Wells Turbine, which implicates airfoils with proportionally molded fixed at the 90˚ to the air flow. The flywheel motion of the turbine also offer some energy stowage and the general output of an air turbine is extremely variable.

Absorber Systems

Point Absorber: A freely floating buoy whose mass and buoyancy should be certain contains the basic design of a point absorber. When the wave came in contact it will cause buoy to experience comparative motion against an orientation which is fixed; this can

be used to fix the linkage to the seabed, flat damper plate which remains stable or with another buoy with different frequency of resonance. For harvesting this energy the linear generator is the straightest method, it simply transforms the rectilinear motion amidst the buoy and orientation straight into electricity.

A piston holding series of long-lasting magnets and stator comprising of spirals organized in tube-shaped system around the piston is the basic form of linear generators. In this one part of the point absorber, oscillating or the restrained portion should be associated to the piston and another will be the stator, which will bring the complication of the power take-off system down to a minimum. The main disadvantages of this design are the cost of the permanent magnet is quite high and there is no any type of provision for the storage of energy to smooth the output. In the linear generator, the output of energy diverges suggestively over time so there is always a need for rectifier- inverter.

Directional Absorber: The floats of the directional absorber are similar to point absorbers, but directional absorber has their finest competence for only one direction and convert wave power from other directions.

In point absorber buoys and in other energy converter designs mechanical and many other systems which take-off the power are used. The mechanical system of power take-off have many methods in which for converting vertical motion into rotation worm gears or rack-and-pinion type systems are used and for conversion of oscillating rotation into unidirectional rotation clutch-flywheel or rectifying systems are used.

By definition, mechanical systems require a reasonable number of moving parts, which can offer the high efficiency of conversion or permit for simpler generators (rotational instead of linear) to be used. On the design of the system, the storage capabilities of the system depend.

Pressurized hydraulics is one of the most popular methods of power take-off for a great number of wave energy devices.in this 30 surveyed system is used either in open-loop configuration or in a closed-loop system. The devices that are based on horizontal movements or pitching this method of power take-off is the best suited not only for point absorber buoys but also for the variability of other devices.

Overtopping Devices

To store the seawater in a wager that contains the warhead reflectors arms are generally used in overtopping devices. Therefore to generate electric power and to run water turbines the static head is used. In many different types of water turbines, the most common choice is low head “Kaplan” type turbines. In this energy storage are provided by the reservoir and the head and flow rate of the turbines will change with the reservoir drain and seals for making smooth power output more tough. In the technology of the turbine, the advantage of their own overtopping devices has already in use in the hydropower industry for a extensive time.

Inverted Pendulum Devices

An inverted pendulum is a device that uses a lever arm or buoyant float, which is usually attached to the seabed. When the wave is passing over an inverted pendulum device, cause it to pitch back and out, which will further activate the power take-off system like hydraulic pumps.

Impacts of Marine Energy:

Environmental Impacts – In the activities of manufacturing, maintenance, decommission and operation of ocean energy devices shows numerous impacts on the ecosystem. Before the deployment of the ocean, energy government needs to vigorous understanding the effects on the environment. The decision of environmental implications is taken according to the Environmental Impact Assessments (EIA) in which the Life Cycle Assessments (LCA), are used to quantify and identify the effect of industrial harvests on the environment.

Due to alteration in flow patterns sediment dynamics, wave structures in ocean wave and tidal current technique, direct impact contain benthic society, entanglement of marine mammals, fishes, turtles, and seabirds. In the area of environmental influences, future research needs to be absorbed on localized ecological influences including sedimentation, electromagnetic field effects, flow alteration and modification in the habitat of the generation device.

- **Tidal current –** Due to alteration of water flows, sediment dynamics, and configuration of the substrate, the tidal current affects the benthic habitats. A study shows that the installment of

the tidal array, benthic ecosystems and impacting on bed morphology is observed during the change in sediment dynamics. Which will also impact on the faunal and floral species of marine animals. In this fishes will experience discomfort and distress. But in the review of Fried et al. it is concluded that there is very less literature which shows that the underwater operations of tidal energy stream devices will cause raised the levels of morality to pelagic creatures like marine mammals and fish. Another critical issue related to tidal energy is noise disruption in turbulent water which will affect the particularly marine mammals.

- **Ocean Wave –** It is proved that the installation of a wave energy converter range can knowingly change in the inter-array and surrounding wave field. The impact of ocean energy converter also includes noise and vibration, space competition, disturbance to biota and habitation, pollution, change in water quality. A lower collision risk to offshore wind devices should be represented by the wind devices which could result in the risk of underwater collisions for diving birds. (Http://Www.energybc.ca)

Socio-economic Impacts

Socioeconomic impact addresses the impact of development on society and the local population of the country. Many issues like well-being, quality of life to employment, economic and income authority, etc. should be addressed. Due to graphic influences and reduction of admission to space-specific topics gave negative effects for the other user of the marine environment. Therefore both the positive and negative influences of ocean energy need to be studied to support evidence-based plan production.

Social Impacts is the study of the social impact of ocean current, the main impact which is usually addressed is job creation. On global and national level the future potential for employment in this sector is estimated. Other social impacts include the reduction of carbon dioxide gas, which generally gives positive as well as negative influences on local communities and marine operators. It is also seen that the impacts of ocean current are problematic to enumerate, comprising enhancements to prevailing substructure, improved awareness as a result of study and advancement in wave and tidal, energy security improvements, health, and quality of life. (Uihlein and magagna, 2015)

Future Development

In order to meet our objective for energy security, polluting fossil fuels, reducing dependence on finite and to combat climate change, there is a need to exploit as many as natural resources which is available and sustainable resources within our planet as possible. One of the most deployed technologies is tidal and wave technologies which also gathered the most commercial interest. For the future development, the interest in the technology is increasing over time and many tidal projects are coming in upcoming years.

From the Indian Ocean Rim Association member state countries no large deployments can be seen but India the member of IORA announces a development of two wave energy plants in Andaman and Nicobar islands, an OCET (20 MW) and wave energy plant which is of 30 MW. According to global data United Kingdom (Scotland) is leading in the deployments of the tidal energy technologies. With a total capacity of projects 2700 MW tidal barrage project the IORA's dialogue partner, United Kingdom is leading for future deployments which would be operational by 2026. There is also a relation between technologies deployment rates and cost, the more deployments of ocean energy technologies, the more cost reduction which results in deploying much more ocean energy technologies (https://Sustainabledevelopment.un.org).

Conclusion: In the power of the renewable source of energy ocean energy plays significantly. The demand for new renewable technologies noticeably shows a shift in preference towards the technologies like biomass, wind, ocean, geothermal hydropower, solar photovoltaic and many other as a source of energy. For the fast developing countries like India, the source of ocean energy is very important to fulfill the need for energy. In the ocean, the energy resources are vast which can light more than, present and anticipated India’s demand for electricity. The technology of ocean offers CO2 emission-free power and permit energy independence. Another important area where research is needed to be focused is on the influences of ocean energy on the economy and social environment. In the area of operation and maintenance, there is a need for lots of improvement. Ocean energy is becoming one of the most frequently emerging technology which has the potential to enhance the renewable energy technologies in India.

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