Renewable Energy By Tidal Wave : An Overview

Dr. Valsson Varghese[a], Prof. A.M.Badar[a], Prof. R.V.R.K.Prasad[a], Mrs.S.Valsson[b]

[a]Department Of Civil Engineering, Kdk College Of Engineering, Nagpur, Maharashtra, India.
[b]Smt M.M. College Of Architecture, Lad College, Nagpur, Maharashtra, India.

Abstract

India has a vast supply of renewable energy resources, and it has one of the largest programs in the world for deploying renewable energy products and systems. Indeed, it is the only country in the world to have an exclusive ministry for renewable energy development, the Ministry of Non-Conventional Energy Sources (MNES) created in 1992. Since its formation, the Ministry has launched one of the world's largest and most ambitious programs on renewable energy. Based on various promotional efforts put in place by MNES, significant progress is being made in power generation from renewable energy sources. Recently MNES was renamed the Ministry of New and Renewable Energy. An attempt to highlight an overview of the renewable energies by Tidal Wave, its uses and advantages are presented. We look at the current status of renewable markets in India, the energy needs of the country, and production, and we assess whether India can power its growth and its society with renewable resources. A comparative review of renewable energy sources is presented and conclusions are outlined.

KEYWORDS : Renewable Energy, Tidal Wave, Solar Energy, Wind Energy,, Bio Energy, Hydro Energy

Introduction :

Renewable energy sources also called non-conventional energy, are sources that are continuously replenished by natural processes. For example, solar energy, wind energy, bio-energy - bio-fuels grown sustainably), hydropower etc., are some of the examples of renewable energy sources.

A renewable energy system converts the energy found in sunlight, wind, falling-water, sea-waves, geothermal heat, or biomass into a form, we can use such as heat or electricity. Most of the renewable energy comes either directly or indirectly from sun and wind and can never be exhausted, and therefore they are called renewable.

However, most of the world's energy sources are derived from conventional sources-fossil fuels such as coal, oil, and natural gases. These fuels are often termed non-renewable energy sources. Although, the available quantity of these fuels are extremely large, they are nevertheless finite and so will in principle 'run out' at some time in the future

Renewable energy sources are essentially flows of energy, whereas the fossil and nuclear fuels are, in essence, stocks of energy

Various forms of renewable energy

1. Solar energy
2. Wind energy
3. Bio energy
4. Hydro energy
5. Geothermal energy
6. Wave and Tidal energy

Specifically, 3,700 MW are currently powered by renewable energy sources (3.5 percent of total installed capacity). This is projected to be 10,000 MW from renewable energy by 2012.

The key drivers for renewable energy are the following:

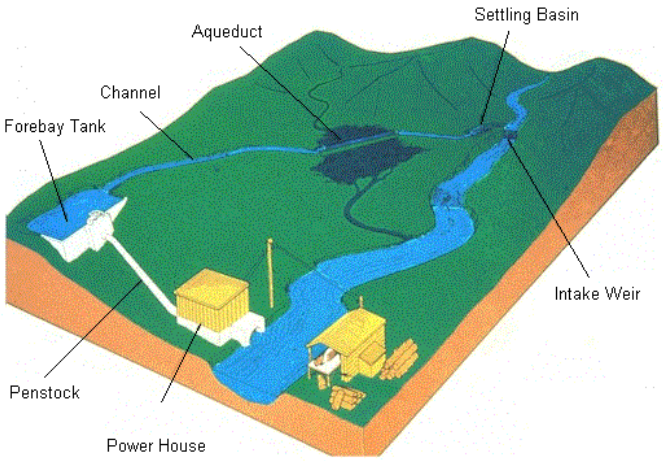
- The demand-supply gap, especially as population increases
- A large untapped potential
- Concern for the environment
- The need to strengthen India's energy security

- Pressure on high-emission industry sectors from their shareholders
- A viable solution for rural electrification

Let's look at the renewable energies – hydro, solar, wind, biomass and Tidal

Hydro Power

The hydroelectric power refers to the energy produced from water (rainfall flowing into rivers, etc). The potential energy of falling water, captured and converted to mechanical energy by waterwheels, powered the start of the industrial revolution.



Wherever sufficient head, or change in elevation, could be found, rivers and streams were dammed and mills were built. Water under pressure flows through a turbine causing it to spin. The Turbine is connected to a generator, which produces electricity. (*Source: http://www.mapsofindia.com/maps/india/annualrainfall.htm*)

In India the potential of small hydro power is estimated about 15,000 MW.

Solar Energy

The energy produced from Sun rays is the solar energy. Because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C – 27.5 °C. This means that India has huge solar potential. India receives solar energy in the region of 5 to 7 kWh/m2 for 300 to 330 days in a year. This energy is sufficient to set up 20 MW solar power plant per square kilometre land area. Source: http://www.mapsofindia.com/maps/india

Wind Energy

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. This heating is higher at the equator and lowest at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power. Now wind power is harnessed to generate electricity in a larger scale with better technology. India has been rated as one of the most promising countries for wind power development, with an estimated potential of 20,000 MW.

Biomass Energy :

Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by-products from the wood industry, agricultural crops, raw material from the forest, household wastes etc.

Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. Its advantage is that it can be used to generate electricity with the same equipment that is now being used for burning fossil fuels. Biomass is an important source of energy and the most important fuel worldwide after coal, oil and natural gas. Bio-energy, in the form of biogas, which is derived from biomass, is expected to become one of the key energy resources for global sustainable development. Biomass offers higher energy efficiency through form of Biogas than by direct burning

The most successful forms of biomass are sugar cane bagasse in agriculture, pulp and paper residues in forestry and manure in livestock residues.

India is very rich in biomass. It has a potential of 19,500 MW (3,500 MW from bagasse based cogeneration and 16,000 MW from surplus biomass). Currently, India has 537 MW commissioned and 536 MW under construction.

Tidal Energy

Tidal electricity generation involves the construction of a barrage across an estuary to block the incoming and outgoing tide. The head of water is then used to drive turbines to generate electricity from the elevated water in the basin as in hydroelectric dams. Barrages can be designed to generate electricity on the ebb side, or flood side, or both. Tidal range may vary over a wide range (4.5-12.4 m) from site to site. A tidal range of at least 7 m is required for economical operation and for sufficient head of water for the turbines.

Ocean Energy

Oceans cover more than 70% of Earth's surface, making them the world's largest solar collectors. Ocean energy draws on the energy of ocean waves, tides, or on the thermal energy (heat) stored in the ocean. The sun warms the surface water a lot more than the deep ocean water, and this temperature difference stores thermal energy.

Estimates of Potential Capacities from Renewable Energy Sources (in MWs)

Source	Approx. Potential
Biomass energy	19,500
Solar energy	*20000*
Wind energy	*47000*
Small hydropower	*15000*
Ocean energy	*50000*

(Source: India Ministry of Non-Conventional Energy Sources)

India has over 17 GW of installed renewable power generating capacity is greater than the current total installed energy generating capacity of India.

Development of Grid-connected Renewable Power in India (in MW)

	Achieved In		**Process**	**Anticipated**	**Targets**
Five-year Plan	By the End of the 9th Plan (cumulative installed capacity)	10th Plan (*additions* during plan period)	Anticipated in the 11th Plan (*additions* during plan period)	By the End of the 11th Plan (cumulative installed capacity)	By the End of the 13th Plan (cumulative installed capacity)
Years	Through 2002	2002–2007	2007–2012	Through 2012	Through 2022
Wind	1667	5415	10500	17582	40000
Small Hydro	1438	520	1400	3358	6500
Biomass	368	750	2100	3218	7500
Solar	2	1	1000	1003	20000
Total	3475	6686	15000	25161	74000

(Source : Government of India Planning Commission. "Eleventh Five Year Plan—2007-12." p. 387.)

Tidal Energy in Electric Generating Systems

Introduction

The earth is filled with almost 75% water and it is conceivable that tides based on this pollution free source of energy would be very cost-effective for generating electricity. Tides are originated from the motions of the earth, the moon and the sun. Tidal energy exploits the natural rise and fall of coastal tidal waters caused mainly due to interaction of gravitational fields of the sun and the moon. The gravitational attraction of the moon and the sun affect tides on earth. The

magnitude of this attraction depends on the mass of the object and its distance away [1]. The moon has the greater effect on earth despite of having a smaller mass than the sun because it is so much closer.

The gravitational force of the moon causes oceans to bulge along an axis pointing directly at the moon. The rotation of the earth causes the rise and fall of tides. When the sun and the moon are in line their gravitational attraction on the earth combine and cause a “spring” tide. When they are positioned at a right angle from each other, their gravitational attraction pulls water in different directions, causing a “neap” tide. Some coastlines may have high tides up to 11 meters and in some cases such as those in the Bay of Fundy located in Atlantic Canada, tides could reach as high as 17 meters.

Due to the high investment in setting up the project, a typical tidal power project is expected to break even between 8 and 12 years after commissioning. Despite the long gestation period to make it commercially viable, tidal power has unparalleled environmental advantages.

Tidal current power uses turbines to harness the energy contained in the flow of ocean tides. It is unique as like tidal movements, power output is highly predictable and sustainable with zero visual impact and the turbines are completely submerged. Tidal power is like putting a wind turbine subsea and the turbine rotors rotate slowly, causing very little environmental impact to marine flora and fauna.

Tidal Energy Resources

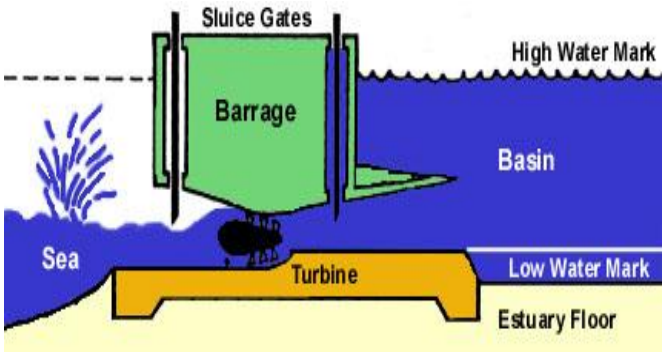
To convert tidal energy into electricity requires a dam or "barrage" across a tidal bay or estuary. Preferably the best tidal sites are at a bay which has a narrow opening, thus reducing the length of dam. At certain points along the dam, gates and turbines are installed. When there is an adequate difference in the elevation of water on two different sides of the barrage, the gates will be opened and the hydrostatic head causes water to flow through turbines, turning electric generators to produce electricity. Electricity can be generated by water flowing both into and out of a bay. There are two high and two low tides each day. Electricity is generated from tidal power plants every twelve hours. Tidal power is a relatively unexplored resource. Sites that add up to 12,500 MW (48 TWh per year) in Europe alone have been noted. Many sites have average

capacity factors (e.g., average output versus rated peak output) of 40 to 60 percent. Since tides are predictable, energy extraction times for planned base load power can be scheduled and energy capture rates could be much better than that of other intermittently available resources.

Tidal energy is an abundant renewable resource and is pollution free. It can be produced every day and 365 days a year. Tidal energy's peak output coincides with peak energy demand which makes it a useful source of energy.

Electricity from Tides

Tidal power production applies the same principles as hydroelectric power generation, except that tides flow in both directions and generators are designed to respond to two directional water flows. The simplest generating system for tidal plants is the ebb generating system (Figure 2), which involves a dam, known as a barrage across a bay or estuary. Sluice gates on the barrage allow the tidal basin to fill on the incoming high tides and to exit through the turbine system on the outgoing tide (known as the ebb tide). Two way generation systems, which generate electricity on both the incoming and ebb tides are also possible. Accordingly, flood generating systems generate power based on incoming tides which are less favored than ebb generating systems.



The following types of turbines are used for tidal power generation.

- Bulb Turbine
- Rim Turbine
- Tubular Turbine

Some Tidal Projects Around the World

Annapolis Tidal Generation, Bay of Fundy, Canada : The Annapolis Tidal Generating Station was completed in 1984. This facility has the distinction of being the first and only modern tidal plant in North America. Bay of Fundy is the home to the world's highest tides. Tides, which can sometimes reach 21 feet in height, rise and fall every 12 hours and 25 minutes in harmony with the gravitational forces of the sun, the earth, and the moon. The electricity generated is 30 million kWh/year - enough to power 4,000 homes.

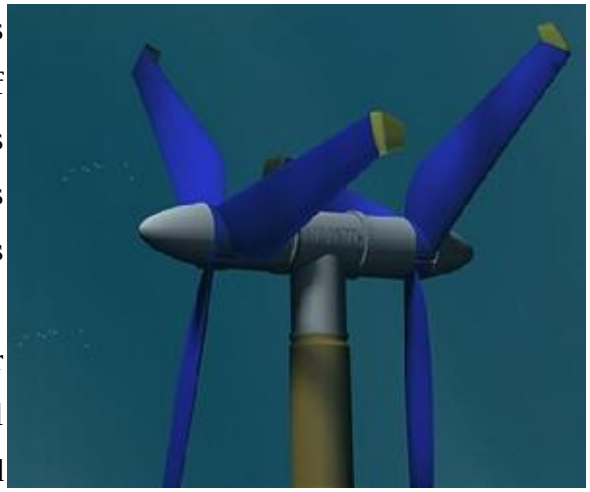
La Rance Project , France: The Rance tidal power plant, generating 240 MW, is the largest operating tidal facility in the world, far bigger than the next largest, the Annapolis facility (20 MW) in Canada. The enclosed estuary of the Rance River in Brittany has a surface area of 22 km^2 and very large tides with 13.5 meter difference between high and low tides during the equinox. This hydroelectric plants operates some 479 hydroelectric power plants of various sizes & capacity a combined installed capacity of 23300 MW,

Severn Estuary Project, England: The Severn Estuary is located between Wales and England in south-west Britain. It is a very large estuary with mud-flats, rocky platforms, and islands. The seabed is rock and gravel with sub-tidal sandbanks. Due to its classic funnel shape which is unique in UK, Severn has the second largest tidal range in the world after Bay of Fundy in Canada.

India set to get Asia's First Tidal Power Plant

There are many sites on which tidal energy studies are going on around the world.

With the proposed commissioning of a 50-Mw tidal power project off the coast of Gujarat in 2013, India is ready to place its first "seamark" that will be a first for Asia as well. London-based marine energy developer Atlantis Resources Corporation, along with Gujarat Power Corporation Ltd, has signed a memorandum of understanding (MoU) with the Gujarat government to start this project. The cost for the plant is expected to be in the vicinity of Rs 750 crore. This plant is also is expected to be scaled up to 250 MW.



Timothy Cornelius, CEO, Atlantis Resources Corporation, said with just about 2 Giga watt of tidal power installations in the world today, this is a completely new and uncharted power sources with immense potential. "Tidal power today is what wind energy was 10 years back," he said.

The power off taker would be Gujarat Power Corporation. The final cost of power per unit will be determined at the completion of front-end engineering and design (FEED) phase, but was expected to be competitive when compared to the large solar power projects planned for development in Gujarat.

The project is currently owned by Atlantis and GPCL and project equity participants will be sought at the completion of FEED phase.

Late last year, Atlantis became the turbine supplier to the largest planned marine power project in the world, MeyGen, a 378-Mw tidal power project in the Pentland Firth in Northern Scotland.

Current estimates suggest 15 per cent of the world's power demands can be met by tidal current power sources, while the estimates for India are currently around 5 per cent of its annual demand for power.

It is only an estimate, but it could be certainly more than 5 per cent, inclusive of wave power and tidal power, from what we know now. However, resource investigation has just begun and with so much coast line, I would expect this number to increase significantly.

Sea water, which is 832 times denser than air, gives a 5 knot ocean current more kinetic energy than a 350-km an hour wind, thus allowing ocean currents to have a very high energy density. Accurate predictions of tidal current movements also make this one of the most predictable and, therefore, reliable sources of renewable energy available today.

(http://business-standard.com/india/news/india-set-to-get-asia%5Cs-first-tidal-power-plant)

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