



## **Wind, Wave and Tide Energies to Meet Power Demand by Coastal Tourism Industry along Tamil Nadu Coast**

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### **Abstract**

Aesthetics, environment, recreation, religious places and other aspects of Tamil Nadu coast are enticing local and foreign tourists alike. The coast has 4000 years of continuous cultural history. Tamil Nadu coastal areas are important tourism spots. Chennai Marina coast is the second largest beach in the world. In all these beaches occur varieties of activities like those of theme parks, resorts, beach sports and shops, besides places of worship. Consequently, considerable amount of electric power is required for these activities to occur. Demand for power is ever growing. Still, in some pockets of beaches are without power supply. Now, local sourcing of renewable energy to meet the demand is a viable option. In this study, authors try to identify and assess locally available renewable energies that can be used to meet the demand. Along coastal Tamil Nadu wave, tidal, wind and solar energies can be considered.

### **Introduction**

Tamil Nadu situated on the south east of Peninsular. It lies between 8° 04' N latitude and the 78°0' E longitude. Geographically, Tamil Nadu is located on the eastern side of the Indian Peninsula between the northern latitude of 8°5' and 13°35' and the eastern longitude of 76°15' and 80°20'. The Tamil Nadu coast consist have sandy beach, rocky shore, beach dune so the Tamil Nadu coast most tourist attract area. Tourism industries to provide the lot of facilities such as theme parks, sports, beach festivals, beach ridings, shopping centers, food shop and odd vendors also included. These are the facilities possible to the developed beach only in Marina beach not for all the beaches. Still some beaches not have electricity facilities. So the renewable energies it helps to develop the coastal tourism. The coastal based renewable energies sources are solar energies, wind energies, waste energies, and tide and ocean wave energies. These are all the sources of renewable energies. In these renewable energies definitely will help to tourism development.

## Study Area

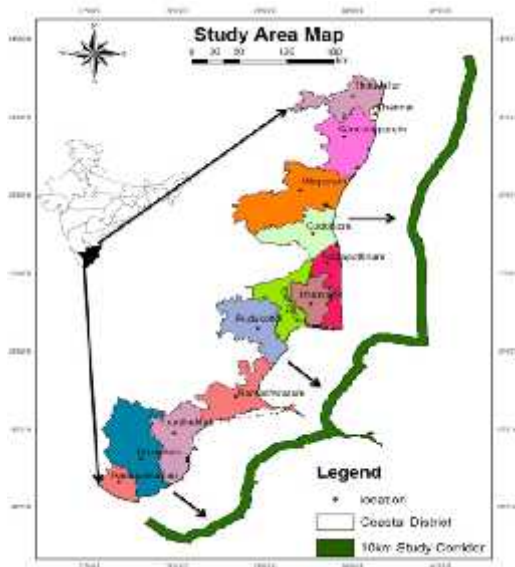
Tamil Nadu coastal length is 1076km there are 13 coastal districts (Fig.1.) and 800,000 active fishermen population are there. Exclusive Economic Zone around 1.9 lakh Sq.km it's covering the Coromandel coast, Plak Bay, Gul of Manar and part of the west Coast of India (Coastal Tourism in Tamil Nadu). Over the past century, 55 cyclones crossed in Tamil Nadu (Saurabh Saurabh Dani). Tamil Nadu its reaches the daily temperature maximum 43°C and the minimum daily temperature seldom falls below 18°C. The average tidal range is about 1m, the effect of which is not dominant along the Tamil Nadu coast compared to the other stretches of the coast of India.

The annual ocean wave height ranges between 0.4m and 0.6m. The entire Tamil Nadu coast of Tamil Nadu consists of alluvium and beach sand overlying sedimentary formation such as laterite, lime stones, clay and stones etc.

## Tourism in Tamil Nadu coast

Tourism is world's largest industry and fastest growing economic sectors. Estimated to have provide the 3.5 trillion dollars and almost 200 million jobs globally in 1999 (Burke et al. 2000). The tourism industry in India generated in 1989-90 direct employment of 5.5 million persons and another 8 million who were employed indirectly. Tourism in Tamil Nadu is not a new event because it's a ancient culture and weal to innumerable aesthetic and temples, mosques and churches scattered all over the Especially Tamil Nadu coastal region. Tourism is a major role to give the direct and indirect employment and it very support to the foreign money exchange. Tourism is Development Corporation it declared some of coastal areas as "Special Tourism Area" (STA), because it projected as the areas such as development of tourism brings is bountiful benefits, in terms of foreign exchange, modernization and infrastructure creation. There are lot of tourist are arrival in Tamil Nadu every year. Now the tourist is choosing in Tamil Nadu as their best choice of tourist destination.

Fig.1. Study Area



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Industry along Tamil Nadu Coast

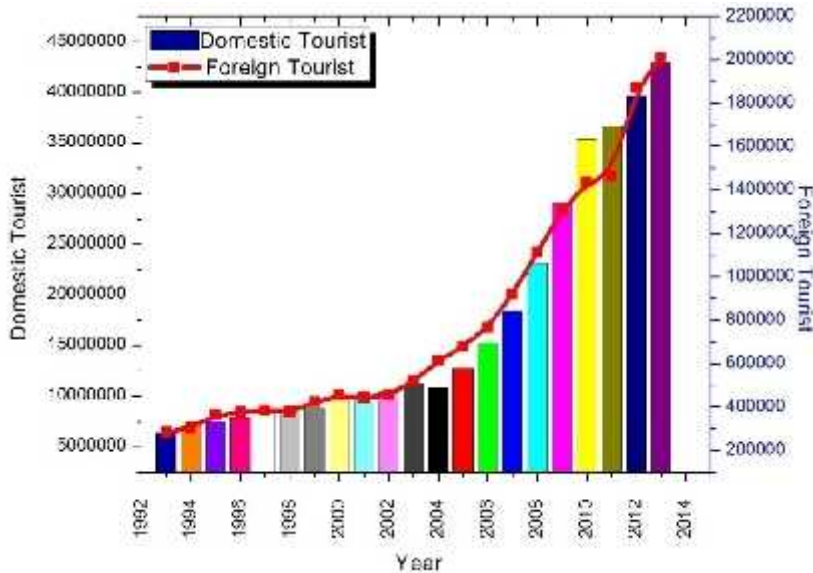
**Tourist arrivals**

Tamil Nadu coast have a rich diversity and it's attract the touristic people. So people can get joy, relief, entertainment, recreation from tourism activity and become fresh and energetic. The growth rates of foreign tourist arrival in Chennai is 9.7%, and that of the other coastal districts are as follow: Mamallapuram = 7.8%; Pitchavaram = 18.3%; Poompuhar = 19.6%; Nagore = 16.4%; Velankanni = 14.8%; Rameshwaram = 6.2%; Tiruchendur = 10.8%; Kanniyakumari = 8.8%; and Domestic tourists is Chennai = 7.8%; Mamallapuram = 7.6%; Pitchavaram = 24.2%; Poompuhar = 16.4%; Nagore = 20.8%; Velankanni = 12.5%; Rameshwaram = 9.4%; Tiruchendur = 11.1%. Kanniyakumari = 7.3%.

Poompuhar is the first place for tourism growth level. Because, Poompuhar is one of the important historical and archaeological sites. The growth level of Poompuhar is 19.6% and the second highest growth level is Pitchavaram with 18.3%. Pitchavaram, the second largest Mangrove forest in the world, is located near the Chidambaram district and is one of the unique eco-tourism spot in South India (Tamil Nadu tourism, 2009). The highest growth level in domestic tourist place is Pitchavaram with 24.2% and the second one is Nagore with 20.8%.

**Table: 1. Number of Tourist Arrivals in major tourist spot in Tamil Nadu coast during 1993-2015**

Tourism spot	Domestic Tourists	Foreign Tourists
Chennai	147288562	11265215
Mamallapuram	25009005	2770658
Pitchavaram	1426249	34622
Velankanni	18026993	182832
Nagore	15282452	79614
Poompuhar	896918	50798
Rameashwaram	63734311	158437
Kanniyakumari	39953831	1672766
Tirichendur	48101003	318101
<i>Source: Tamil Nadu Tourism Department, Chennai-2.</i>		



**Fig. 2. Pilgrimage and tourist centers in Tamil Nadu coast and distribution level of foreign and domestic tourist arrival along the Tamil Nadu coastal area from 1993 to 2015.**

**Electricity Demand on Tamil Nadu and its Tourism place.**

Over the last few years, Tamil Nadu has been facing massive power deficits. According to the CEA, the state was expected to have a power deficit of around 18% in 2010-2011(power sector in Tamil Nadu, 2011). As the result of this state is now facing the huge power cuts. So it's affect to the normal life and affects the industrial, agricultural and tourism industry. The Tamil Nadu tourism consume the over electricity, that is Tamil Nadu Tourism attractions like theme parks, resorts, water sports, shopping centers, and games these are all depends upon the electricity. Especially in Chennai have 30 amusement parks of which six are spread over 50 or more acres. The amusement parks, resort, hotels, and shopping centers it takes a lot of electricity. In the future to meet the lot of electricity demand on coastal tourism industries. So we search the alternative energies. The alternative energies definitely will help to our coastal tourism.

**Renewable energy resource need to Coastal tourism**

The coasts have a lot of resource such as wind, sun shine, tide and ocean wave. Using these resources to convert the electrical energies. They are solar energies, wind energies and tidal energies and ocean wave energies. These all are the resources to help during the electricity demand. The International Energy

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Agency estimates a 15-20% of the total energy supply contribution from renewable energy by 2010, up from 10% in 1999 (International Energy Agency, 2015). Renewable energies are easily available and renewable. So we have to use the local resource of renewable energy and control the electricity demand.

### **Solar energy**

Solar energy is one of the renewable energy and the sun radiates  $3.58 \times 10^{26}$  joules of energy every second (Ajaoet al, 2005). In this solar energy reliability of the electric power supply from renewable energies is usually higher than from conventional energy sources (Green 2003). It is also the most important of the non-conventional sources of energy because it is non-polluting and, therefore, helps in lessening the greenhouse effect (Dave 2007). Solar make a efficient use of solar energy some of the solar devices are solar light, water pumping, solar cooker, solar hot water systems, solar pond, photovoltaic systems and power tower. Photovoltaic power panel is a device that produces electrical energy when illuminated by a source of light. Tamil Nadu has reasonably higher solar radiation (5.6-6.0 kWh/sq.m) with around 300 clear sunny days in a year (Government of Tamil Nadu 2012). The receives an average hourly radiation of 200 MW/km<sup>2</sup>, so the solar is a very important and currently underutilized, energy resource in India (Lalwani, et al 2011). This natural strength inspired the State to come up with a policy to promote solar energy development. Solar power panel averagely to produce an electricity range is 4.06 W/m<sup>2</sup>. It is very helpful for coastal tourism electricity demand.

### **Wind Energy**

Wind is a very important source of energy utility for electricity around the world. The wind power potential is generally good along the entire coastal areas, i.e., mean annual speeds are above 6m/s and power exceeds 200 W/m<sup>2</sup> (Department of Minerals and energy, 2002). The growth of alternative energy in India has a enormous and wind energy to most effective solution to the problem of depleting fossil fuels, coal, greenhouse gas emission, environmental pollution and etc. The first wind electric generators started in 1986 and power gained in during the early 90's and again achieved huge growth during the years 2001-2006 (Government of Tamil Nadu 2012). With the installed capacity of 19 GW of wind energy, renewable energy sources currently accounts for 12.5% that is 27.5 GW of India's overall installed power capacity (Government of Tamil Nadu Report 2012). As on 31.3.2012, the installed capacity of wind power has produced to 6,970 MW and an

addition of 6000 MW. Normally wind blows in Tamil Nadu state maximum speed ranges between 8.5 and 6.5 this wind speed it's enough to produce electricity. Tamil Nadu has high wind potential due to the tunneling effect during South West Monsoon. The wind installed capacity of the state is 7134 MW, which is a whopping 40% of the country's total wind installed capacity. This makes wind the single largest power generation technology in Tamil Nadu in terms of installed base. Wind energy can produce in one day averagely  $0.86 \text{ W/m}^2$ . In some coastal areas windmills are located in places near Kanyakumari, Radhapuram and muppandal in Aralvoimozhi pass. Tamil Nadu total wind potential is 5374 MW and the installed capacity is 5901 MW up to March 2011. The wind season in Tamil Nadu is normally between May and September.

### **Tidal Energy**

The technology that is used to produce electricity using the difference between the low and high tides is very similar to the one used on the generation of electricity on the traditional hydroelectric power plants. Although not yet widely used, tidal power has potential for future electricity generation. Tides are more predictable than wind energy and solar power. Among sources of renewable energy, tidal power has traditionally sufficiently high tidal ranges or flow velocities, thus constricting its total availability. Minimum tidal range between 4.7 and 5.5 normally it produced an electricity range is maximum amount of up to 18000 MW potential power. Average tidal range is about 1m the effect of which is not dominant along the Tamil Nadu coast compared to the other stretches of the coast of India. But on the contrary, as Tamil Nadu coast belongs to micro tidal category and as the tidal difference is not enough tidal energy could not be considered as an option local support of power.

### **Summary**

In this study, try to indentify and asses local available renewable energies that can be used to meet the demand. Along the coastal Tamil Nadu wave, tidal, wind and solar energies can be considered. As per another study, Chennai to Kanniyakimari total solar energy potential is  $39.43 \text{ KWh/m}^2$  per day. One hour of full sun provides  $1000 \text{ W/m}^2 = 1\text{KWh/m}^2$ . So, solar power can be tried. Along coastal Tamil Nadu wind blows at the speed of  $39.33\text{W/m}^2/\text{day}$ . Translation of this wind speed into electrical power generation amounts to  $5.75 \text{ W/m}^2/\text{day}$ . It is also possible that at places renewable energies can be combined. Tidal power will not be an option for local power as the tidal difference is less than the minimum tidal requirement.

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S. No.	Station	Temperature(°c)	Solar power potential (kwh/m2/d)	Wind speed M/s	Wind potential W/m <sup>2</sup>
1	Chennai	30	5.24	8.50	0.653
2	Kanchipuram	29	6.72	3.70	0.219
3	Cuddalore	26	4.06	7.59	0.876
4	Nagappattinam	30	6.64	7.00	1.205
5	Rameshwaram	28	6.79	8.50	1.917
6	Thoothukudi	27	6.32	6.25	0.767
7	Kanniyakumari	29	5.89	5.40	0.547

**Table 2. Renewable Energies and its power potential ranges in Tamil Nadu Coast.**

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