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Need for Ocean Energy Policies in India for Future power requirements

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ABSTRACT

To counter the challenges of climate change and energy security, policy makers and governments around the world are promoting the development of sustainable energy. Expected to grow as the fastest economy in the world, import dependent Indian economy is expected to import more oil in the near future. India's oil imports have increased substantially every year thus draining huge amount of foreign exchange reserves($ 149 Billion in 2014-15) of the country(MoPNG, 2016).Energy from Ocean, especially OTEC (Ocean Thermal Energy Conversion), offer several advantages and considered to promote and sustain energy security. OTEC offers a solution to the energy crisis. Much of the work is not done in India with regarding to Policy or Technology. OTEC can be considered keeping in the view of increasing demand for unreliable renewable energy and energy sources. This paper provides a summary of how OTEC can be a possible solution to India's power sector major challenges such as low CUF, fossil fuel import charges, land requirement, water requirement, R&R issue, intermittency, back up of base load in case of solar and wind, additional job opportunity etc.The need for an OTEC policy in India is explained by the data and learning from European countries.

Keywords: Ocean Energy; OTEC, Indian Power sector, Policy.

INTRODUCTION:

India is a growing economy. Energy is the vital input for the economy to grow and sustain. To support the growth of the economy, the Indian energy sector also needs to grow. The total capacity of Electrical energy production in India in July 2016 was 304 GW(CEA, 2016). Of these, 69% were fossil fuel power stations, 14% hydroelectric, 2% nuclear and 14.5% renewable energy(CEA, 2016). The energy mix is expected to be same for a considerable future. The path is hardly sustainable due to continued dependence on fossil fuels (especially Coal and Oil) for electricity generation capacity. On the same way excessive dependency on oil imports is a demerit repetition. If India failed to protect its environment, it would pose a huge economic and ecological challenge. For the overall development, India needs to adopt renewable sources for power generation(Pode, 2010).India‘s coal resources are of low calorific value and of high ash content. (NREL, 2010).The main life line of India Oil and gas reserves are also in short supply. The demand for oil has galloped unabated (NREL, 2010). Oil imports have increased burden to Indian Economy by draining huge amount of foreign exchange reserves ($ 149 Billion in 2014-15) of the country (MoPNG, 2016).

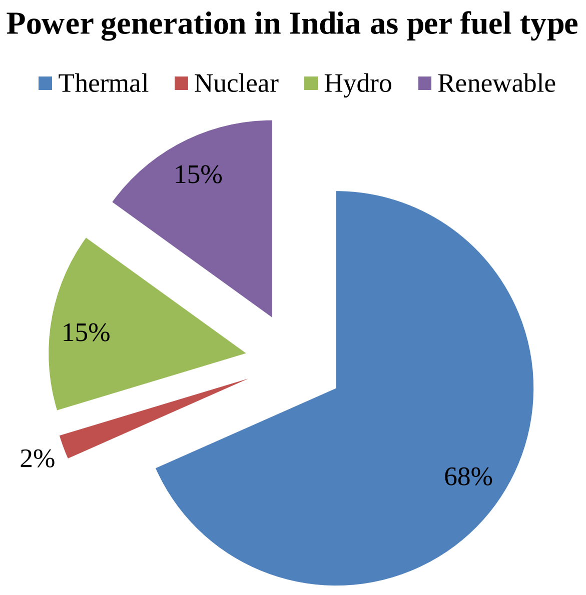
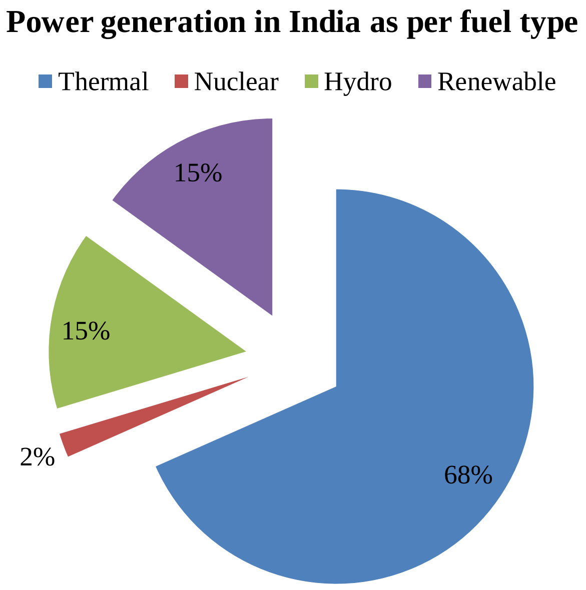


Figure 1: India's primary energy demand by fuel type.



As evident in
Figure 1,renewable energy sources (RES) portion of India‘s overall energy production is 44 GW, equivalent to 21% of 304 GW installed generating capacity. (MNRE, 2016).Due to this trend, and to reduce emission and fuel oil import India would have to accelerate its renewable energy program. The problem multiplies due to nature of RE in India. As RE projects are land intensive which is becoming the major bottleneck for the development of energy projects in India. Several countries like USA, UK, Canada, France, Portugal, Ireland, and South Korea have proactively tapped the ocean energy potential to reduce their dependence on fossil fuels(OES, 2014). India has to quickly exploit its vast coastline (over 7000 Kms) for producing power from its oceans. Usha Rao & Kishoreobserved that parameters for diffusion is correlated to composite policy index (Usha Rao & Kishore, 2009). Hence, for the development of OE in India, a strong policy is a must. India's renewable energy generation progress for the last decade is impressive. But the contribution of energy from ocean (tidal, wave, OTEC) is non-existent in India(MNRE, 2016).

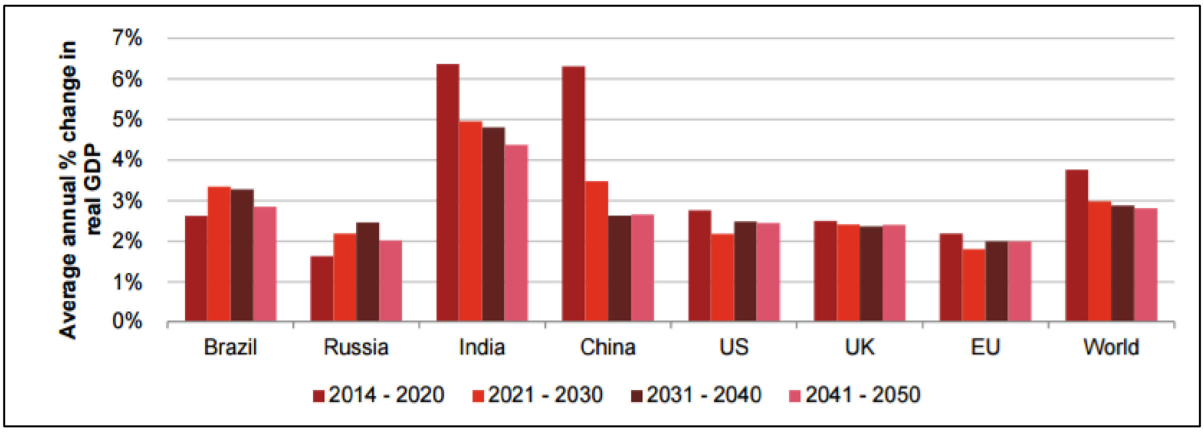


Figure 2: Projected Growth Profile of Major economy.

LITERATURE REVIEW:

The EU is currently at the forefront of ocean energy technology development, and currently hosts more than 50% of tidal energy and about 45% of wave energy developers (Magagna & Uihlein, 2015). To date, the majority of ocean energy infrastructure such as ocean energy test centers and deployment sites are also located in European waters as shown in **Error! Reference source not found.** (JRC, 2014).

In order to support the growth and development of the ocean energy sector, in January 2014 the European Commission(EC) launched the Blue Energy Communication (EC, 2014), which has highlighted the expected contribution of ocean energy in Europe, as well as setting a framework for the development and uptake of the ocean energy technologies by 2020 and beyond. The main output expected from the Ocean Energy Forum is to feed the development of a strategic roadmap defining targets for the industrial development of the sector and a clear timeframe for its implementation (Magagna & Uihlein, 2015). The second phase (2017–2020) of the action plan foresees possibly the creation of a European Industrial Initiative (EII) for Ocean Energy, as already put in place by other renewable sectors (e.g. wind), within the SET-Plan framework (MacGillivray, Jeffrey, Hanmer, Magagna, Raventos, & Badcock-Broe, 2013).

Policy support will be crucial for the development of the ocean energy industry as estimates for initial demonstration projects indicate the cost of electricity will be above €300/MWh (Boust, 2010). (Dalton, et al., 2015)is of view that the cost of OE development is much higher than land-based RE developments due to a variety of reasons. These include, the assortment of specialized tools and equipment required to install devices, and the limited capacity of the supply chain to provide materials and services (Green & Vasilakos, 2011).In discussing the supply chain for the offshore industry in Europe, (Green & Vasilakos, 2011).identify a “limited production volumes of equipment and parts” and therefore limited installation vessels and long queues from device component suppliers. Interestingly, there are difficulties in the offshore supply chain in Europe, despite the majority of the world’s renewable energy devices being located there, and the long history of industry development. Denmark, for instance, began actively promoting offshore energy since the 1970’s (Sovacool et al., 2008). Generally, any shortages in supplying device components, connection systems and construction materials can impact on project timelines and turn profitable projects into losses (Mott MacDonald, 2011).The UK, and other European nations have already completed national level studies in supply chain gaps in renewable and OE (DTI, 2004; Wells & McConnell, 2011; EquiMar, 2011b).

(Prassler & Schaechtele, 2012)have shown how policy support instruments determine the financial attractiveness of offshore energy farms in several European countries. Several factors such as permit procedures, grid connectivity and environmental clearances combined to influence the perception of risks by investors in ocean energy projects which in turn influenced the quantum of investments in the sector.As per (O’Hagan, 2012)regulatory and consenting procedures are still hailed as significant barriers to OE energy development. Developers have repeatedly called for better streamlining of requirements, quicker decision-making and more guidance on perceived problematic elements such as Environmental Impact Assessment (EIA) (O’Hagan, 2012). (Wragg, 2010)explains how the Marine Energy Action Plans provided a different approach to targets. Rather than setting a specific installed capacity, it takes the view that by 2020 the UK ocean industry anticipates and fully expects to be deploying marine energy arrays at a scale of 100 MW (Wragg, 2010).When considering policy development (Wragg, 2010) argued that the most important progress, with regards to facilitating the deployment of renewable energy, has been made through the provision of legally binding government targets for renewable energy production. Bergek and Jacobsson (2003) identified a four-strand approach to German policy which they considered to be the reason for the success of renewable energy sector in Germany. Foxon (2005) have articulated the need for a multifaceted policy that responded to the unique needs of the different stages of evolution of the renewable technology. Wolsink (2000) has concluded that major renewable producing countries in the Europe enjoyed high degree of public support which probably led to higher deployment of renewable energy thereby feeding into the other positively. This has also helped OE to grow in EU. (Portman, 2010)stressed on policies towards research funding for the development of OE. She is of opinion that overall, poor data on the resourcepotential of ocean energy has hinderedwidespread support for policies thatcould jumpstart marine renewable energy initiatives and hence, more research fundingneeds to go into understanding thescale of ocean energy as a resourceand disseminating this information (Portman, 2010).

(Wragg, 2010)mentioned that initially the OE industry in the UK had challenges mainly due to the uncertain policy environment, addressing them and were the main reason that UK is widely acknowledged to be the world leader in the rapidly developing marine energy industry (Green & Vasilakos, 2011)compared the policy support that existed for offshore energy among a few European countries. Krohn et al. (2009) calculated the electricity generation costs from onshore and marine energy and concluded that generation of electricity from offshore power projects were at least 50% costlier compared to the costs from on shorefarms. (Dalton, et al., 2015)is of opinion that several financial metrics may be employed to quantify the economic viability of an ocean energy project (Dalton, et al., 2015).However, critical mass and advancement in technology will reduce the cost of electricity from OE projects.

(Swider, et al., 2008)compared the costs of grid connection in seven countries in the Europe and concluded that cost of construction of evacuation infrastructure for offshore energy parks were prohibitively high and would be a show-stopper for the growth of OE if the state expected the developer to invest in grid connectivity. (Colander & Monroe, 2011).agreed that grid connectivity is a major issue for OE development. In order to more equally distribute OE and to reduce the high costs of radial lines (which may be several kilometers from shore), it has been suggested that developing simpler, centralized and less costly grid connections is important to more rapid technology diffusion (Colander & Monroe, 2011).. The authors also suggested that to accelerate the growth of OE, the cost of grid connection must be borne by the grid operator and not by the project developer. These costs can then be socialized over the population, factoring the grid connection costs in the tariff. Burer and Wustenhagen (2009) suggested that the state and policy makers needed to have deep appreciation for the risk-reward perception of project developers so that appropriate policies can be tailored to meet the expectation of the project developers. That according to the authors was the best way to increase private sector investments to meet renewable energy targets.

(Prassler & Schaechtele, 2012)argued that national policy and local geographic site conditions in the country affected profitability of offshore energy farms. Introduction of geographic conditions was a novel in this research work as local conditions like distance from the coast, water depth at the farm and wind speeds determined the cost and output of the farms and hence the profitability. (Green & Vasilakos, 2011)also mentioned water depth and distance to the shore were the most important factors driving the investment costs of offshore energy farms. EEA (2017) has shown that as the distance to the coast increases, it increases the cost of the construction, at deeper waters. Also, the installation cost increased as more sophisticated vesselswere needed to install foundations at greater water depth (EEA,2017). (Alishahi, Moghaddam, Parsa, & Sheikh-El-Eslami, 2012)proposed a different method fortailoring incentives for investment planning in competitive electricity markets, as different methods of structuring incentives have bearing on the investment strategies. Fixed incentives like feed-intariff gives a stable, albeit lower returns and has found favor withseveral developers because of the certainty of the income, while variable incentives like renewable certificates helps generate electricity when it is needed most (Alishahi, Moghaddam, Parsa, & Sheikh-El-Eslami, 2012).

As Europe faces a renewable energy target of 20% (EREC, 2009) and 21% of electricity production from renewables by 2020 , although OE energy systems are at a much earlier stage of development but could provide a significant contribution to European and global electricity supply (IEA, 2013). A portfolio of electricity generating technologies with low carbon emissions that include nuclear, offshore wind, wave, tidal range, OTEC and tidal stream are expected to be required to meet these targets (Dalton, et al., 2015).

Riding onthe generous policies to grow OE sector, EU islikely to achieve its long-term plans of 188 GW of OEenergy by 2050 (EU-OEA, 2015) mainly supported by France and UK, which shallfurther increase the contribution of OE of EU farms(Kaldellis et al., 2011).

Hence, Learning from a variety of international experiences can contribute a lot. Based on the experiences of other countries, particularly in Europe, with the right policies in place (Portman, 2010),India’s interests in the ocean energy sector can be served by devising a robust policy for ocean energy considering greater technological advances, continued cost reduction, and streamlined permitting.

METHODS:

- Based on the literature review and qualitative method is followed. Research methodology aims to finalize the activities of research design and data collection procedure which are as listed below:
- During the latter half of 20th century interest in qualitative research has increased. As management is social science, with this back ground qualitative research is taken in to consideration.
- Now the qualitative method is used for this research, the next question is approach.

So the Research Methodology followed is Qualitative in nature on conceptual and analytical method.

DISCUSSION:

Electricity requirement in India-Projections:

The Indian economy is expected to grow by 8% annually in the near future. By 2050 it is expected to become largest populated country having biggest GDP as per Purchasing Power Parity (Bhambu, 2015)(Figure 2). India's total population is expected to be 165 crores from 125 crores now(Bhambu, 2015). Figure 3shows the population pyramid of India in 2015 and 2050. The basic aim of generation sector is to have production mix as per need and availability of resources ensuring maximum efficiency with low carbon emission, abundant supply and environmental sustainability in cost effective manner (Kumar, 2017). The present power generation and expected power generation mix in 2050 can be shown in the Fig-4 given below.

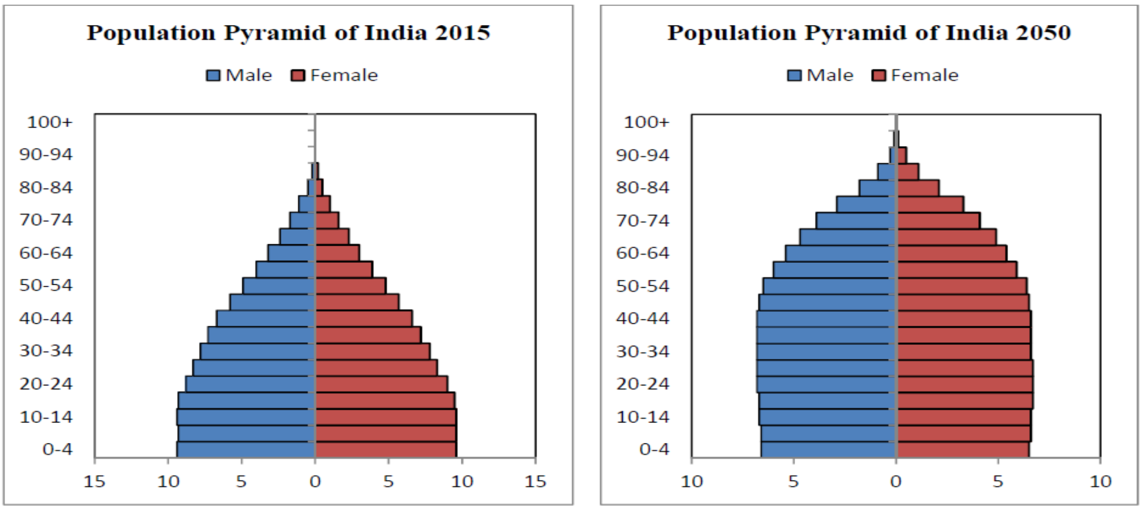


Figure 3: Population Pyramids of India in 2015 and 2050(Projected)

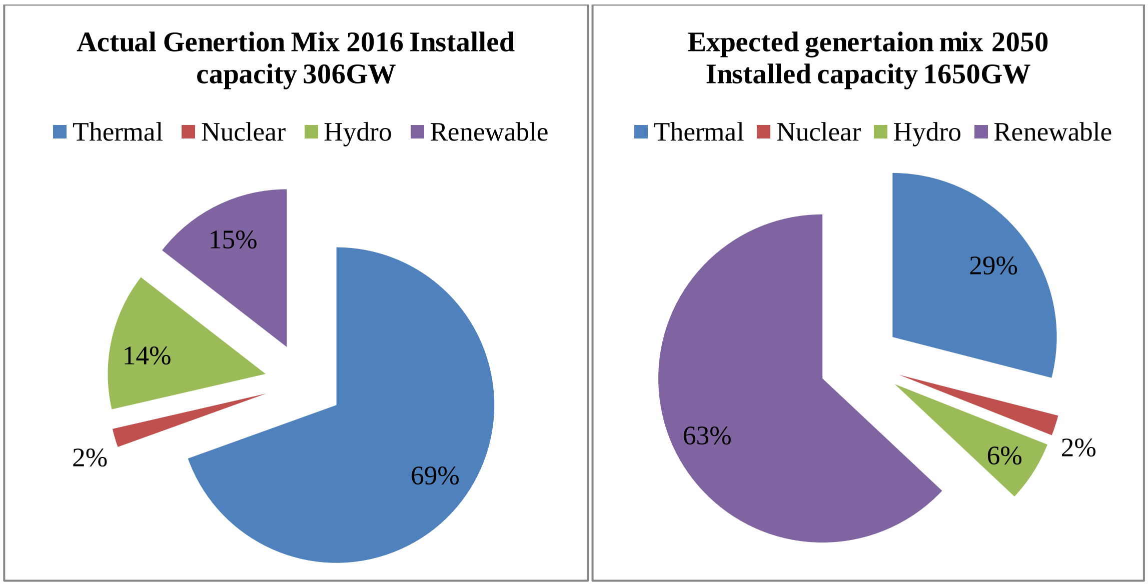


Figure 4: Generation Mix of Electricity in India

Today, for each 1% of economic growth, India needs around 0.8% of additional energy (Shimi & Reji, 2013).India needs to increase its installed capacity to 1650 GW in 2050 (Kumar, 2017)from 306 GW at present so to cater to such a huge population with increased use of per capita electricity consumption. This means that over the next 33 years, India would have to install five times as much capacity as it has been able to install over the last 70 years (306 GW).

Table 1: Projected electricity demand by sector and generation.

	2000	2013	2020	2030	2040	2013-2040 Change	2013-2040 CAAGR
Demand	376	897	1351	2241	3288	2390	4.9%
Industry	158	375	565	904	1277	902	4.6%
Residential	79	207	329	647	1115	908	6.4%
Services	46	133	207	332	450	318	4.6%
Transport	8	15	20	24	30	14	2.5%
Agriculture	85	160	222	324	401	241	3.5%
Other energy sector	0	6	8	10	13	7	2.7%
T&D Losses	155	220	313	452	613	393	3.9%
PG own use	40	82	107	160	229	147	3.9%
Gross generation	570	1193	1766	2848	4124	2930	4.7%

Correlation between poverty reduction and electrification in India:

As per the latest estimate, per capita consumption of electricity in India galloped to 957 kWh (Singh, 2015), it is still very less when compared with the estimates of per capita consumption of 1200 kWh in China and 13,300 KWh in USA (MoP-GoI, 2015). As per IEA report electricity demand in India is expected to rise to almost 3 300 TWh by 2040 at 4.9% CAGR(

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Gross generation	570	1193	1766	2848	4124	2930	4.7%

) (IEA, India Energy Outlook, 2015). While the Indian government plans for “Power for all”, it is forecasted that 60 million people will not have access to electricity in 2030 due to increase in demand coupled with population growth (

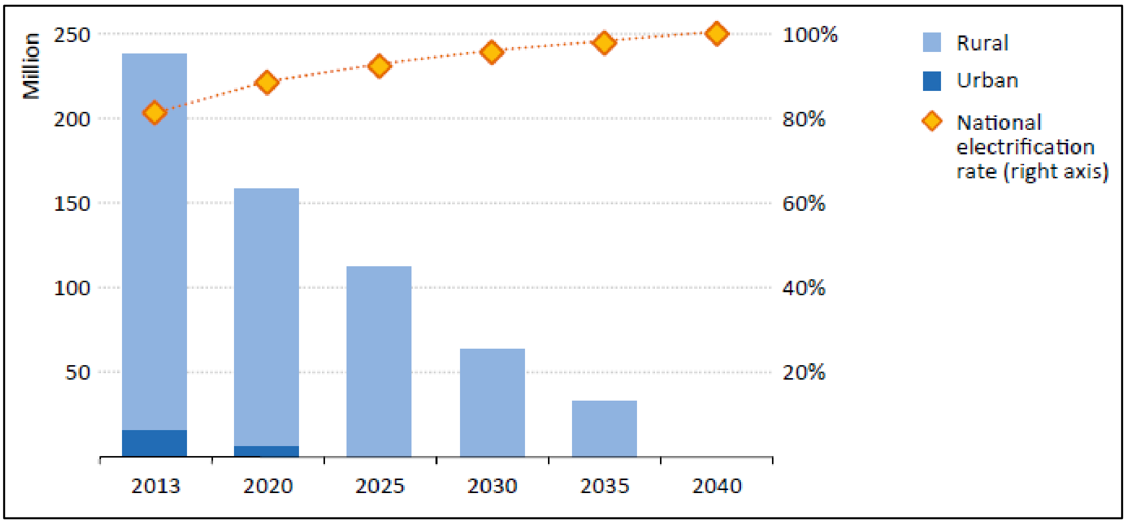

Figure 5) (IEA, India Energy Outlook, 2015).

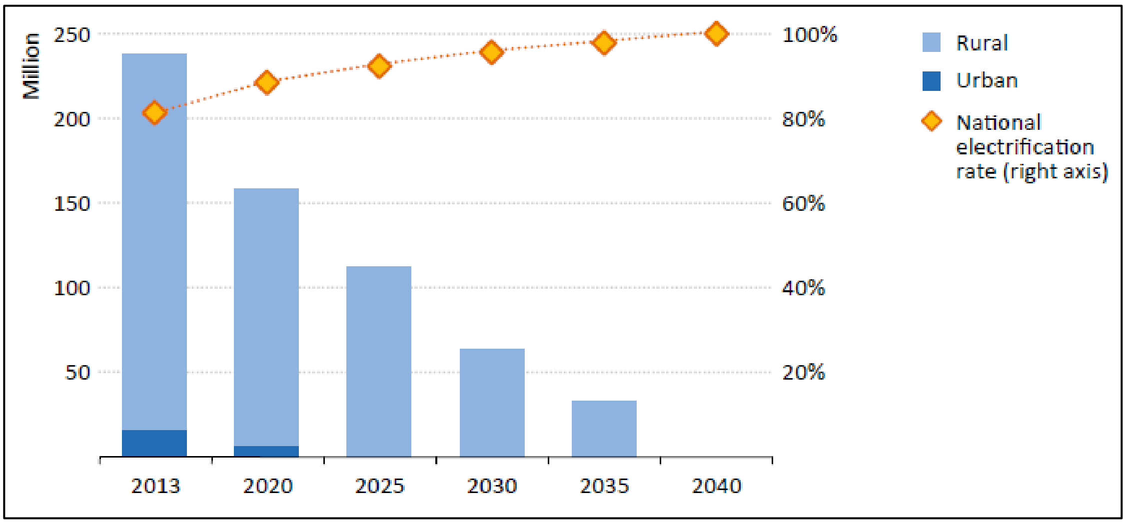

Figure 5: Projected Population without access to electricity and electrification rate in India

As per Srivastava &Rehman "low levels of energy consumption and energy and economic activities are critically linked". And population living below the poverty line in reduces developing countries such as India as we move from a low level of electrification to higher levels(Srivastava &Rehman, 2015). Also, there is high correlation between economic growth and energy consumption. In energy demand has almost doubled since 2000 in line with GDP growth. The amount of energy required in India to generate a unit of GDP is slightly lower than the global average (IEA, 2015).

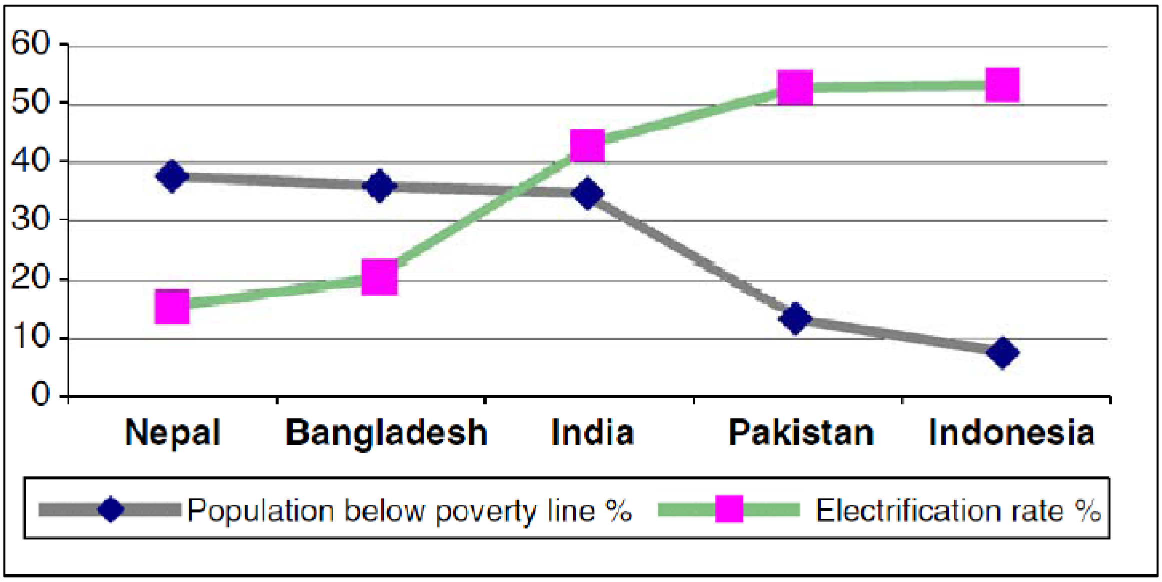

Figure 6: Correlation between electrification and poverty reduction in select Asian countries

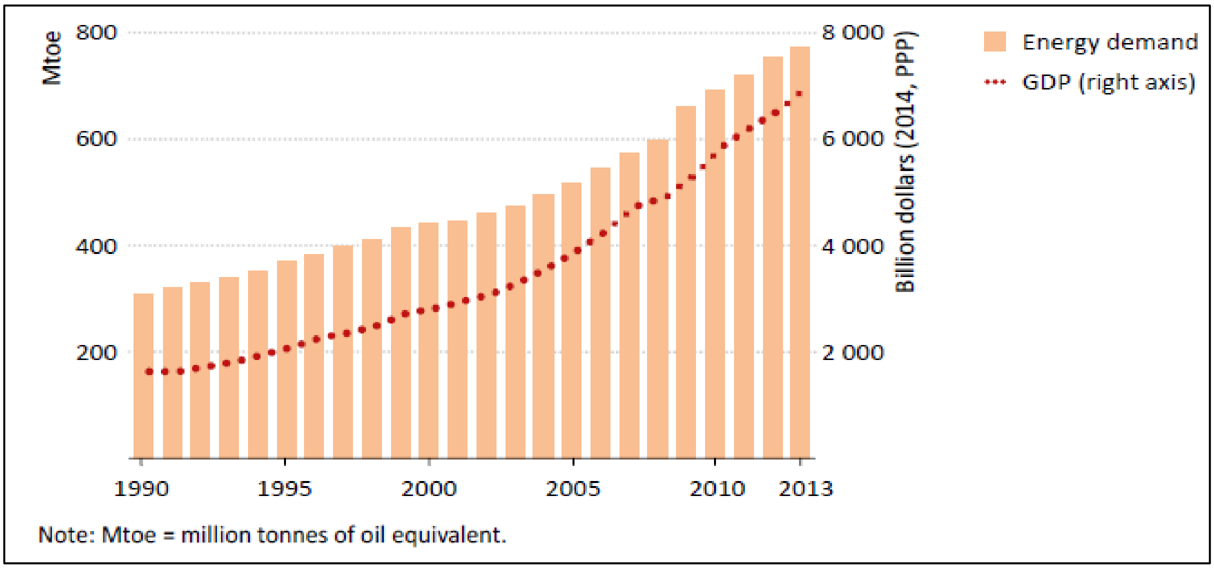

Figure 7: Comparison of primary energy demand and GDP growth in India.

Environment impact due to India's current energy plan:

There are many factors contributing to growth of electricity market in India. The major factor is population growth along with economic growth. Population growth and economic growth drives to high demand, increase in per capita consumption of electricity. "Power for all" and "Make in India" initiatives of the government further contributed to growth of electricity market. From **Figure 8** and the previous trends in India, even in 2040 Thermal power plants (TPP)will hold a dominating share of electrical energy generation until a much reliable source of electricity production comes into picture.

The downside to all the growth is that along with GDP growth, CO_2emissions grow at a faster rate as shown in the Figure 9. Thus further puts a phenomenal strain on the resources such as water needed to generate electricity. If this trend continues, as per IEA, by year 2040,CO2 emissions in India from fossil fuel based power plants would become second-largest emitter from power generation plants in the world (IEA, 2015).

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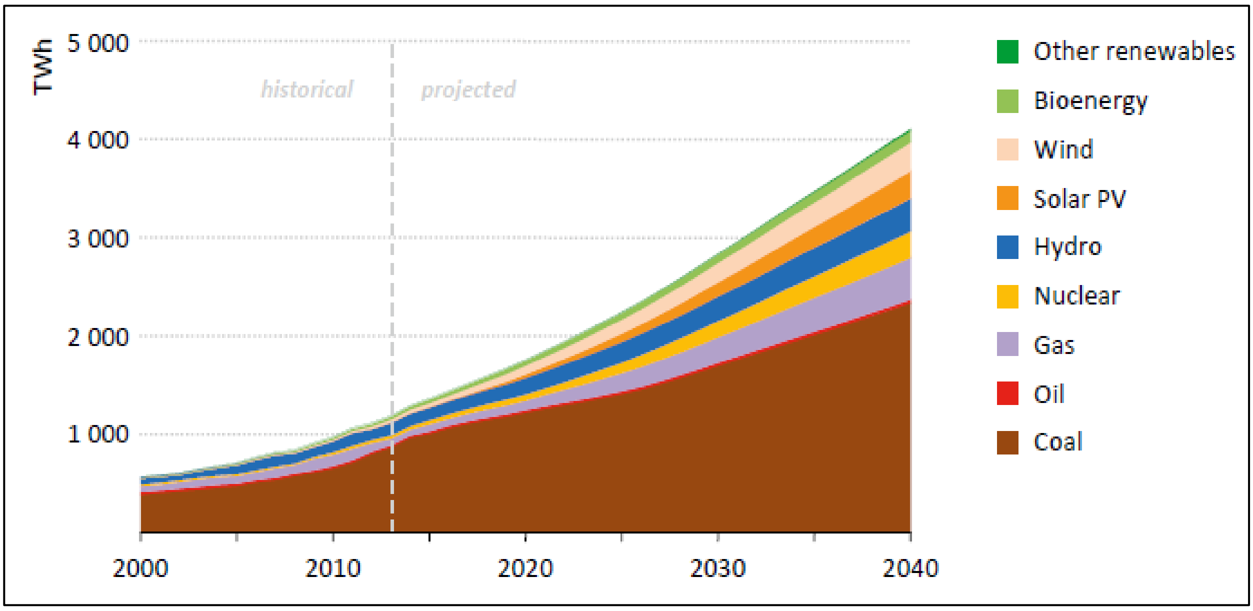

Figure 8 : Projected power generation in India till 2040

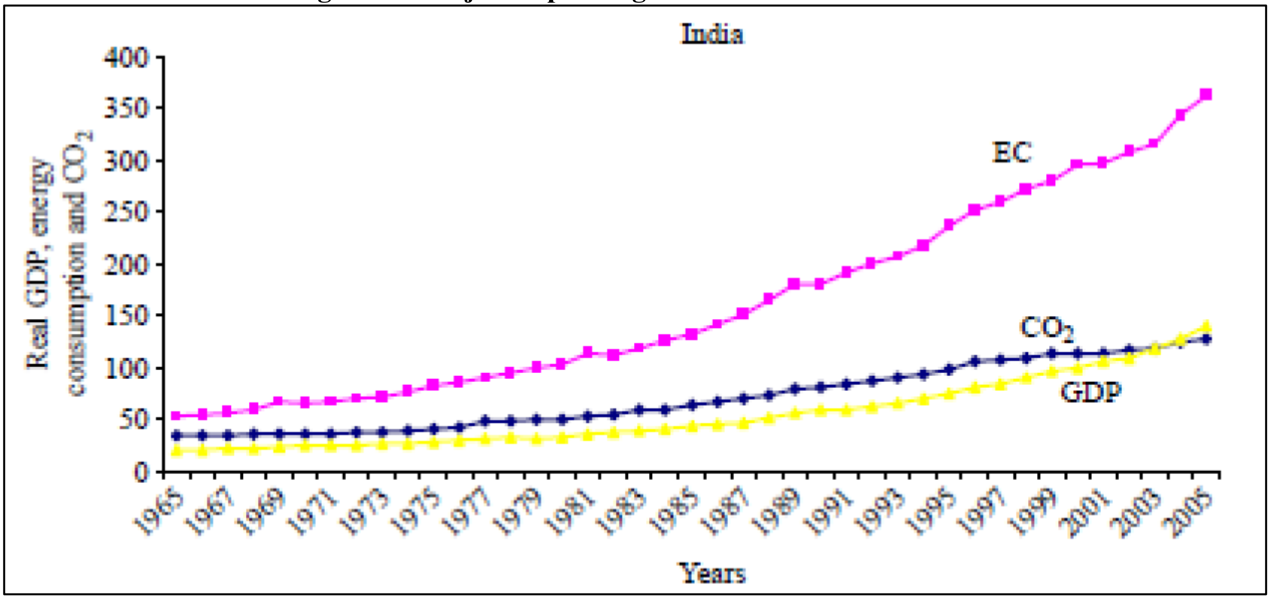

Figure 9: Economy, energy consumption and carbon emission in India

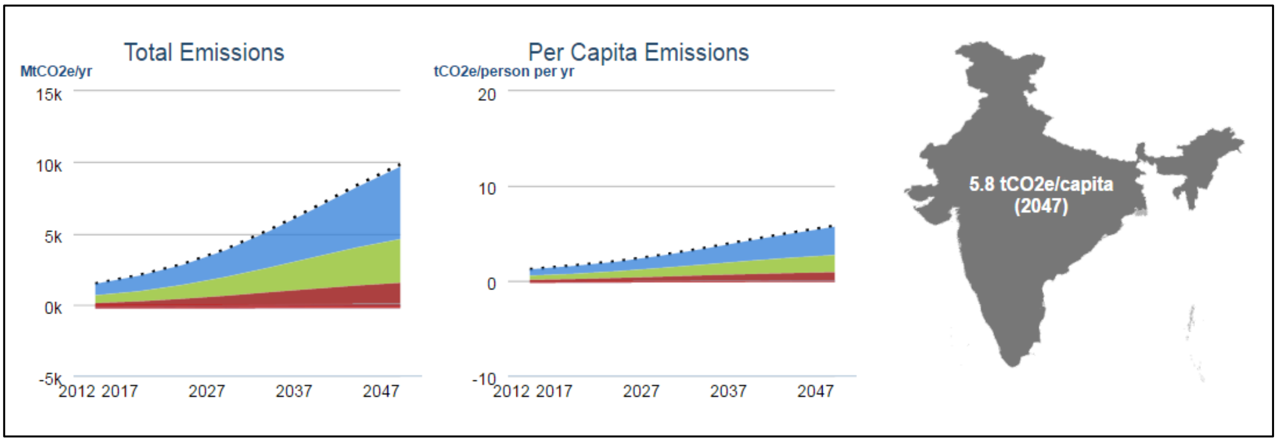

Figure 10: Total and Per capita emission projected growth in India

Additional resources requirement for renewable generation in India:

This necessitates additional resources for renewable generation for India. The basic requirement generation mix as per need and availability of resources ensuring maximum efficiency with low carbon emission, abundant supply and environmental sustainability in cost effective manner (Greenpeace, 2016).

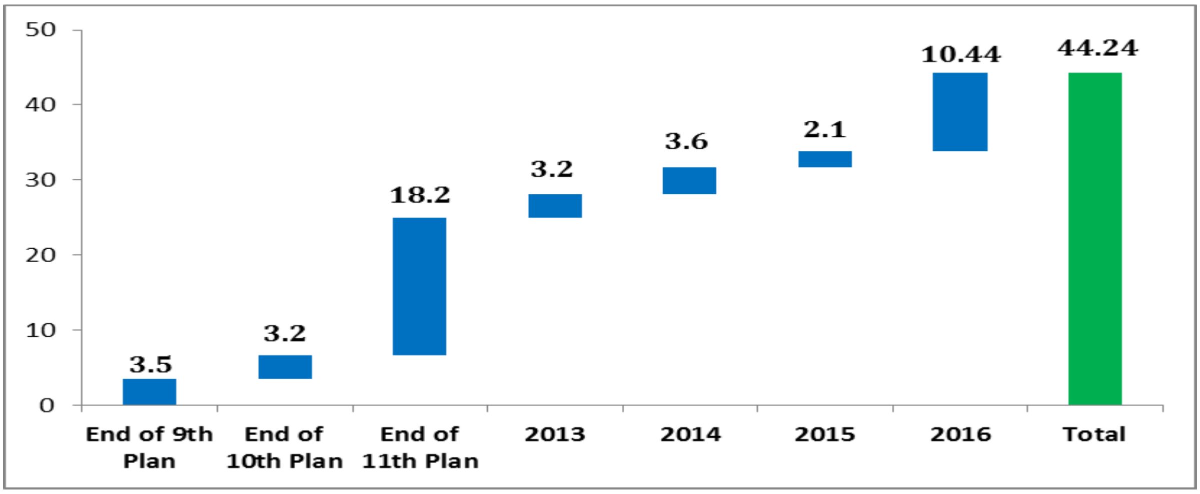

Figure 11: Trend of Renewable Capacity Addition (GW) Analysis by researcher.

As it can be observed from Figure 11, So far, renewable energy portfolio development in India has grown at a steady speed from 3.5 GW in FY 2002 to ~44 GW in FY 2015.

This has been possible due to various support mechanisms ,programs and initiatives schemes both at the Central and state Government level(CRISIL, 2015).The Central Government has the targeted RE capacity addition of 175 GW by the year 2022 which includes 100 GW from solar, 60 GW from wind, 5 GW from small hydro-power and 10 GW from bio-power.(MNRE,2016).This means that over the next 6 years, India would have to install 3 to 4 times the capacity as it has been able to install over the last 70 years (44 GW) since independence. To achieve this India needs to look for additional resources. Achieving the remaining capacity addition target, will require a long-term and supportive investment environment (MNRE, 2016).

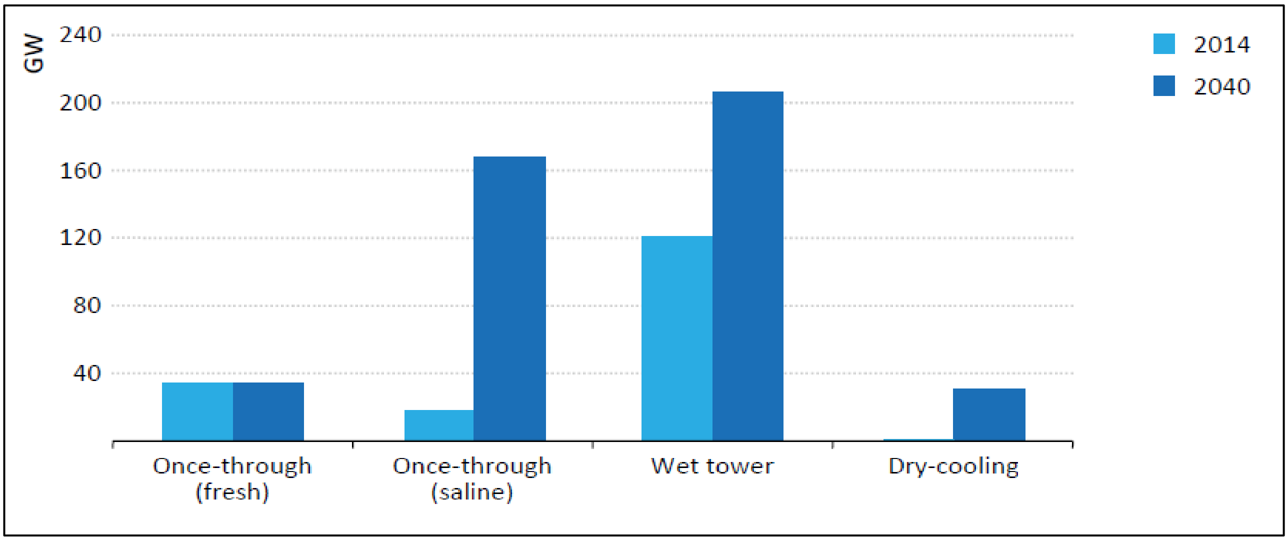

Figure 12: Projection of different types of cooling system planned till 2040.

Water Stress in India:

While India plans to achieve prosperity in all the sectors, it’s still not able to resolve some of the basic necessities of its citizen. Children are the worst suffers as every year, 140,000 die from diarrheal diseases in India (IEA, 2015). These diseases affect education and also result in loss of work days which is estimated at 180 million person days annually. Adding to this the annual economic loss is estimated at Rs.112 crores.(IEA,2015).

Table 2: Projections of Water demand for power sector in India

Category	2010	2025	2050

	(Economic Growth)		**(Economic Growth)**		**(Economic Growth)**	
	Low	**High**	**Low**	**High**	**Low**	**High**
Solar/wind	0.00	0.00	0.01	0.01	0.04	0.04
Gas based	0.02	0.02	0.06	0.07	0.18	0.22
Nuclear	0.29	0.36	1.13	1.38	3.68	4.50
Thermal	2.81	3.43	7.85	9.59	28.71	35.07
Hydropower	15.00	15.00	22.00	22.00	30.00	30.00
Total	**18.10**	**18.80**	**31.10**	**33.10**	**62.60**	**69.80**

Source: NCIWRD, 2016 considering 0.001 BCM/100MW & based on data from various estimates (Verma& Phansalkar, 2007).

The renewable water resource in India is 1,130 cubic meters per capita in 2013. India has now passed over the value of defined threshold for “water stress”.(1,700 cubic meters per capita).India’s water resources are further strained due to highly inefficient patterns of water use in the agricultural sector along with population growth. The problem multiplies as more than 70% of India’s thermal based power plants, are located in water stressed areas(WRI, 2014). As per the National Commission on Integrated Water Resources Development (NCIWRD) and the standing sub- committee of Ministry of Water Resources (MoWR), Government of India, indicate two different projections in water demand by the power sector which can be observed in
Table .

Power plants in India consume a high amount of water for running of cooling system and critical steam cycles. Dry-cooling system is rarely being implemented in India. To supply for the projected demand of water requirement by power plant, India needs to look at the sources of supply of water for solution. The water supply from different river sources in Indiaare justsufficient for drinking water requirement and the domestic needs. As per, IEA, 2015 the trend is likely to be the same in 2040.Fig below projects, installed power generation capacity by cooling technology and sub-catchment area in selected regions of India, 2040 (IEA, 2015).

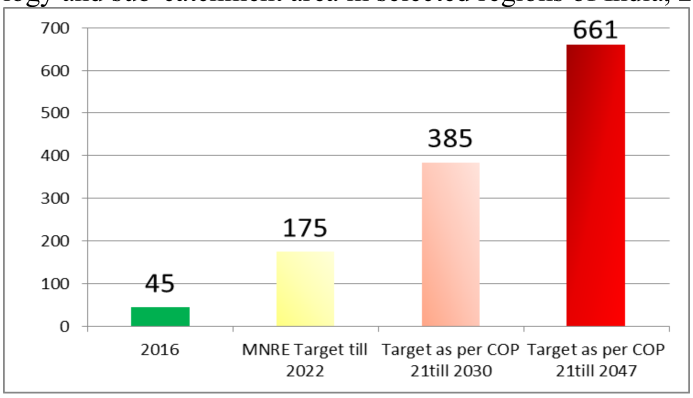

Figure 13: India’s Target for RE till 2047 (GW)

RENEWABLE ENERGY POWER GENERATION IN INDIA:

India plans to achieve about 40 percent cumulative power generating capacity from renewable energy resources by 2030as per COP 21INDC submission. Government of India has also on an ambitious plan to achieve 175 GW of RE capacity addition by 2022(MNRE, 2016). While this itself looks ambitious, going a step forward if India needs to achieve the desirable RE mix of by

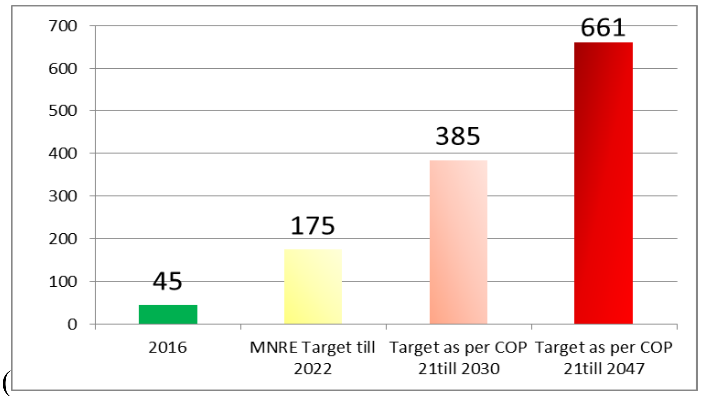

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Figure 13), a strategic approach is required by Indian electricity sector to achieve its targets by 2047. Aggressive target of energy trilemma of energy security, energy equity and environment sustainability and not just contribution from onshore based RE sources. More offshore energy which in spite of huge potential, still not present in India is to be encouraged.

LIMITATION OF GROWTH OF WIND ENERGY AND SOLAR GENERATION IN INDIA:

As per (CRISIL, 2015) the growth of renewable energy cannot depend just on wind farms and solar and for the following reasons;

- Frequent changes in policies have resulted in varying fluctuations in capacity addition.
- Adequate intra-state transmission systems is not available for states with high potential.
- Land is a State subject in India and the acquisition policies differ from state to state. Which reelected in deterred some projects.
- Weak financial health of state run Discoms which resulted in delayed payments to wind IPPs.
- Enforcement of RPO, limited availability of contiguous parcels of land ,nature of wind sources on land which is un predictable(CRISIL, 2015)
- Competing uses for land from other infra projects and potential land litigations.

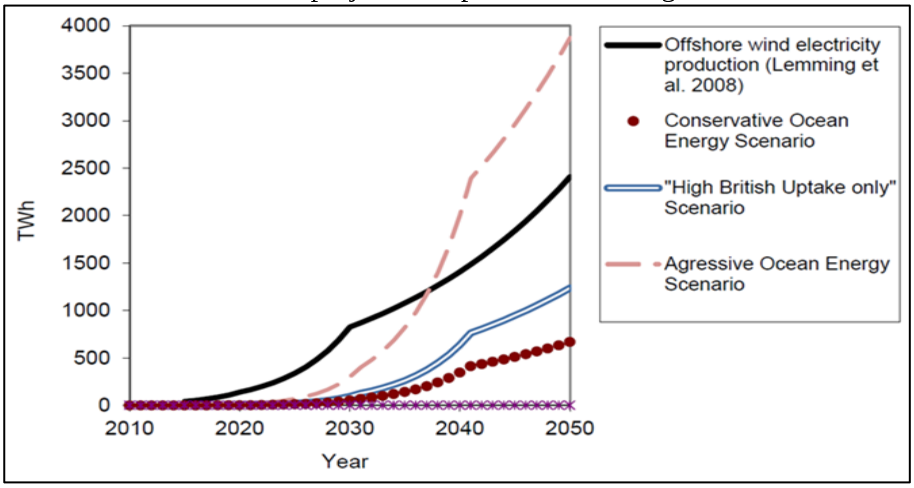

Figure 14: Ocean energy growth forecast in the UK.

Multi functionality and advantages of Ocean Energy:

Ocean energy in world: A total of nearly 500 MW of ocean energy are installed in the World, with consented projects of 350 MW. As of now Europe is the largest market for Ocean energy, with over 248 MW installed, accounting to more than 50% of the installed capacity of the World (OES, 2015). Further Europe can expect to install up to 188GW of Ocean Energy projects by year 2050(OES, 2015).Globally, there is potential to develop 748 GW of ocean energy by year 2050 as per the IEA's 'Ocean Energy Systems: International Vision Report' (2011) estimates, which by year 2030 could create 160,000 direct jobs. Also adding to this can save up to 5.2 billion tons of CO2 emissions by year 2050(OES, 2011).In Europe, UK alone is planning to generate 1.2GW of energy from Ocean by 2020(OES, 2015).

As the research till date on Ocean energy gives a glimpse of advantages such as,

- Ocean energy is renewable source with emission-free operation
- As the fuel input Zero, inflation free operation is completely achieved.
- Ocean energy provides electricity on a continuous (no intermittent) basis.
- It has a high CUF capacity utilization factor of around 90%(IRENA), 2014).
- Proven and matured technology which is being used in European countries (IRENA), 2014).
- Flexible operation combined with rapid adaptability to meet peak demands so as to increases stability and reliability of grid.
- OTEC plants can also produce fresh water and air-conditioning through seawater district cooling (SDC)
- Fresh water production alongside electricity production isvery much needed for countries like India facing water scarcity.

OCEAN ENERGY POTENTIAL IN INDIA:

It is well known that Oceans cover about 70 percent of the earth's surface and its energy potential is enormous which can be tapped in various forms such as wave, tidal, marine current and thermal gradient etc. India has a long coastline with the estuaries and gulfs. A variety of technologies are currently under development around the world to harness this energy in the forms including thermal gradients (180,000 MW), waves (40,000 MW), tides (9000 MW) (MNRE, 2016).India, even though has all the necessary ingredients for development of Ocean energy it needs to formulate a comprehensive policy.
India has a long coastline of about 7500 km and along with about 336 islands in Bay of Bengal and Arabian Sea. If at least 50% of this potential can be developed by 2050 it can contribute to 114500 MW of power generation capacity(Bhambu, 2015).The sector has potential to grow, reduction in carbon footprint ,fueling economic growth, and creating jobs along the coast and also in inlands along its total supply chain. The Gulf of Kutch in Gujarat on the west and Gulf of Cambay have the maximum tidal range of 11 m and 8mwith an average tidal range of 6.77 m and 5.23 m respectively ((Barpatragohain, 2015);(Raju & Ravindran, 1997)As per MNRE, the identified economic power potential is about 8000MW with nearly 1200 MW in the Gulf of Kutch, 7000MW in the Gulf of Cambay, and about 100 MW in the Sundarbans and Gangetic delta in West Bengal (MNRE, 2016).

CURRENT OE DEVELOPMENT IN INDIA:

In 1980, India started with a 20MW OTEC plant off the Tamil Nadu coast. Subsequently in 1984 a 1 MW Rankine cycle floating plant preliminary design was also completed (Yadav, 2016).In 1983 further experimentation continues with other technologies like 150 kW wave energy project at Thiruvananthapuram (Kerala).Government of India in 1997, proposed to build a 1 MW OTEC plant(Yadav, 2016)(Raju & Ravindran, 1997).India researchers have been exploring the participation of international expertise for development of this project. With the help of Saga University in 1998 based on the bathymetric profiles and temperature, the optimization of the closed loop system was done (Sharma & Sharma, 2013). In the year 2000 NIOT Goa, launched a program to conduct study on 1 MWOTEC Power Plant for producing electricity and 2-3 lakh liters freshwater per day butit was dropped due to difficulties in installations (Sen & Das, 2015).In 2010for a Tidal Power project, UNDP expert identified the Gulf of Khambhat, Kalpasar as a potential site (Sen & Das, 2015).In 2011, Gujarat government announced to set up a 50 MW OE project in the Gulf of Kutch(MNRE, 2016).For demonstration projects, GoI also announced up to 50% of the project cost as financial incentives. In 2014, a 50-200 MW tidal stre
am project was proposed at Gulf of Chambey by Atlantis Energy. (Sen & Das, 2015).If ocean energy can be utilized to generate its potential capacity as illustrated in Figure 15, India can plan for remaining 229 GW out of 661GW capacity additions from rest of RE sources.

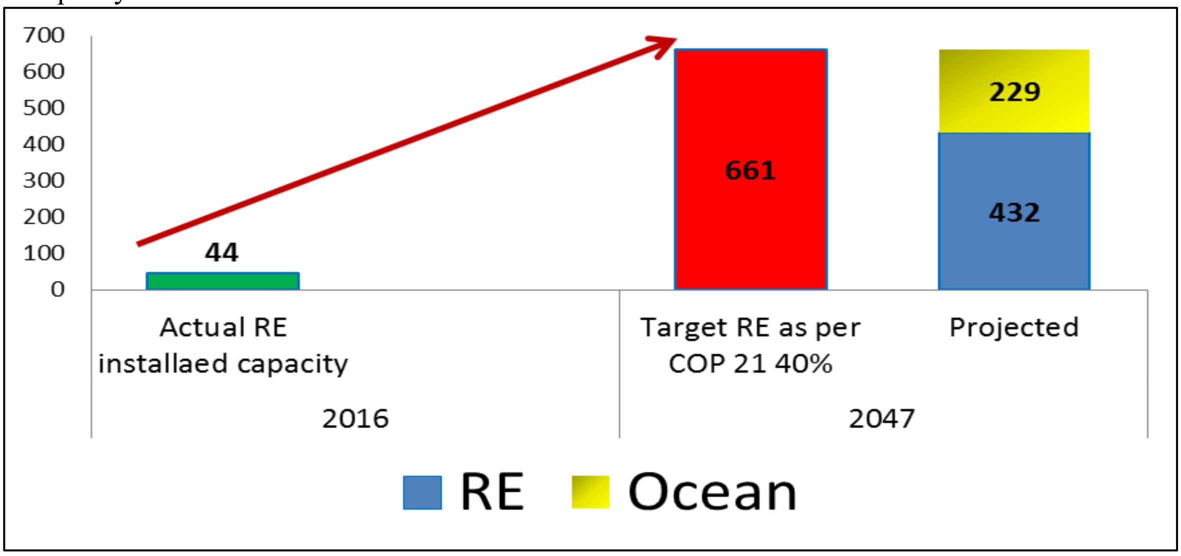

Figure 15: India's revised target for RE through 2047 (GW)

RESULTS THROUGH DISCUSSION:

Obstacles and barriers of OE projects development in India:

The single biggest barrier in India is lack of a dedicated OE policy. While, there is potential ready market along with financial institutions willing to lend, enthusiastic project developers, network of leading manufacturers of the world in India. The second problem is one cannot go into the sea to setup a wave, tidal, OTEC plant as the land territory belongs to the State and Central Government depending upon the Political map of the nation

The policy of OE should cover the dedicated areas for harnessing OE from the seas (after allowing shipping channels, fishing, defense lanes etc.).

The tariff to be paid for OE power includes fixed costs and variable costs. Fixed costs include constructing of evacuation infrastructure, Cost of capital, depreciation.

Allocation of benefits, subsides, incentives can be in line based on the generations from the project so as to retain the investor confidence.

CONCLUSION:

Based on several literatures reviewed which are highlighted in this paper, have supported the need for policies for renewable energy sector in general and Ocean energy in particular. Researchers have highlighted the need to have different policies tailored so as to meet the requirements of different sources of renewable energy. The progressive policies adopted by those countries uniquely in European way brought success in adoption of ocean energy. India has undertaken several steps for the growth of renewable power. However a robust ocean energy policy to accelerate the development of Ocean Energy utilization is missing. Hence it is important to involve various stakeholders of India and to study on what are the key drivers unique to Indian context, so as to grow ocean energy in the country.

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