Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

A STUDY ON ELECTRICITY DEMAND AND RENEWABLE RESOURCES IN INDIA

Varun Kumar Choudhary[1], Dr. Kalyan Kumar Guine[2]

[1] *MBA Scholar, Department of Management, Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur, India*
[2] *Professor, Department of Management, Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur, India*

Abstract — *India is the 3rd largest consumer of energy in the world. Globally, natural gas contributes approximately 24% to the primary energy mix.1 However, in India; natural gas has a nominal share of 6.5% market share. As a part of its "Intended Nationally Determined Contributions" (INDC), India has committed to reducing its carbon emissions intensity to GDP by 33%–35% by 2030 from 2005 level.2 To meet this commitment while at the same time supporting its economic growth trajectory, India needs to add cleaner sources of energy to its fuel mix. Renewable energy sources and technologies have potential to provide solutions to the longstanding energy problems being faced by the developing countries. The renewable energy sources like wind energy, solar energy, biomass energy and fuel cell technology can be used to overcome energy shortage in India. To meet the energy requirement for such a fast growing economy, India will require an assured supply of 3–4 times more energy than the total energy consumed today. The renewable energy is one of the options to meet this requirement. India is increasingly adopting responsible renewable energy techniques and taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future. In India, from the last two and half decades there has been a vigorous pursuit of activities relating to research, development, demonstration, production and application of a variety of renewable energy technologies for use in different sectors. In this paper, efforts have been made to summarize the availability, current status, major achievements and future potentials of renewable energy options in India. The paper deals with the demand of electricity in India also.*

Keywords-*Energy Demand, Renewable Resources, Electricity Demand.*

I. INTRODUCTION

Less than 300 years of modern industry and consumerism will have exhausted fossil resources that accumulated over 150-200 million years. The depletion of petroleum resources, along with concerns about the warming of the planet by human activities, makes it urgent to shift dependence from fossil resources to renewable energy. Like other natural resources, energy resources are also renewable as well as non-renewable.

A) Renewable Energy Resources:
Renewable energy resources are mostly biomass-based and are available in unlimited amount in nature since these can be renewed (i.e. regenerated in natural process) over relatively short period of time. Renewable energy sources are inexhaustible, i.e. they can be replaced after we use them and can produce energy again and again. These include, firewood (or fuelwood) obtained from forest, petroplants, plant biomass (as agricultural wastes like bagasse), animal dung, solar energy, wind energy, water energy (hydro-electrical, ocean wave and tidal energy), and geothermal energy etc. These can reproduce themselves in nature and can be harvested continuously through a sustained proper planning and management.

B) Non-renewable (Exhaustible) Energy Resources:
Non-renewable energy resources are available in limited amount and develop over a longer period of time. As a result of unlimited use, they are likely to be exhausted one day. These include various fossil fuels including petroleum products, coal and natural gas and nuclear energy. Nuclear energy is mainly obtained from the nuclear fission of the uranium and thorium. The global resources of fossil fuel and uranium and thorium are limited and will be eventually be depleted. Moreover, use of fossil fuels for energy has negative environmental consequences, such as air pollution, global warming, acid rains and oil spills. Thus, it has been become essential to minimize the use of fossil fuels and to replace them with renewable resources.

Electricity is prime mover of Indian economy
Electricity is the prime mover of growth and is vital to the sustenance of a modern economy. The projected growth of the Indian economy depends heavily on the performance and growth of the power sector. It is the endeavor of the Government to ensure that agriculture, industry, commercial establishments and all households receive uninterrupted supply of electricity at affordable rates. The electricity sector in India had an installed capacity of 199.87 Gigawatt (GW) as of March 2012, the world's fifth largest. Captive power plants generate an additional 31.5 GW. Thermal power plants

constitute 66% of the installed capacity, hydroelectric about 19% and rest being a combination of wind, small hydro, biomass, waste-to-electricity, and nuclear. India generated 855 BU electricity during 2011-12 fiscal year.

In terms of fuel, coal-fired plants account for 57% of India's installed electricity capacity, compared to South Africa's 92%; China's 77%; and Australia's 76%. After coal, renewal hydropower accounts for 19%, and natural gas for about 9%. In December 2011, over 300 million Indian citizens had no access to electricity. Over one third of India's rural population lacked electricity, as did 6% of the urban population. Of those who did have access to electricity in India, the supply was intermittent and unreliable. In 2010, blackouts and power shedding interrupted irrigation and manufacturing across the country.

The per capita average annual domestic electricity consumption in India in 2009 was 96 kWh in rural areas and 288 kWh in urban areas for those with access to electricity, in contrast to the worldwide per capita annual average of 2600 kWh and 6200 kWh in the European Union. India's total domestic, agricultural and industrial per capita energy consumption estimate vary depending on the source. Two sources place it between 400 to 700kWh in 2008–2009. As of January 2012, one report found the per capita total consumption in India to be 778 kWh.

India currently suffers from a major shortage of electricity generation capacity, even though it is the world's fourth largest energy consumer after United States, China and Russia.The International Energy Agency estimates India needs an investment of at least $135 billion to provide universal access of electricity to its population.

The International Energy Agency estimates India will add between 600 GW to 1200 GW of additional new power generation capacity before 2050.This added new capacity is equivalent to the 740 GW of total power generation capacity of European Union (EU-27) in 2005. The technologies and fuel sources India adopts, as it adds this electricity generation capacity, may make significant impact to global resource usage and environmental issues.

India's electricity sector is amongst the world's most active players in renewable energy utilization, especially wind energy. As of December 2011, India had an installed capacity of about 22.4 GW of renewal technologies-based electricity, exceeding the total installed electricity capacity in Austria by all technologies.

India's network losses exceeded 32% in 2010 including non-technical losses, compared to world average of less than 15%. Both technical and non-technical factors contribute to these losses, but quantifying their proportions is difficult. Some experts estimate that technical losses are about 15% to 20%, A high proportion of non- technical losses are caused by illegal tapping of lines, but faulty electric meters that underestimate actual consumption also contribute to reduced payment collection. A case study in Kerala estimated that replacing faulty meters could reduce distribution losses from 34% to 29%.

Key implementation challenges for India's electricity sector include new project management and execution, ensuring availability of fuel quantities and qualities, lack of initiative to develop large coal and natural gas resources present in India, land acquisition, environmental clearances at state and central government level, and training of skilled manpower to prevent talent shortages for operating latest technology plants.

For the past two decades, India has had to face increasing deficit in power supply, both for meeting its normal energy requirements as well as its peak load demand. The problem is acute during peak hours and summers, and necessitates planned load shedding by many utilities to maintain the grid in a healthy state. The average all-India shortages in 2009-10 were at 10 per cent in terms of normal energy requirement and about 13 per cent in terms of peak load.

With the shortage at both the normal and the peak levels, Indian power industry does not exhibit much cyclicality. Further, with assured returns, the margins of players and their profitability is almost independent of the economic cycles. Electricity is the most important component of primary energy. India’s electricity consumption has grown at an average rate of 7.3 per cent during the period 2002-07 to about 577.9 TWh. Consumption has increased at a faster rate since 2002-03, reflecting buoyant industrial demand. Industrial consumers are the largest group of electricity consumers, followed by the domestic, agricultural and commercial consumers, in that order. India’s per capita electricity consumption increased from 178 kWh in 1985-86 to 704.4 kWh in 2007-08. Over the period, 2001-08, per capita consumption has increased at an average rate of 4.45 per cent. It is still much lower compared to the international standards.

II. ELECTRICITY DEMAND IN INDIA

Electricity demand at peak load and at normal load is mentioned below in table. In past ten years normal energy shortfall is regularly increasing, in 2003-04 it was 7.1 % and in 2008-09 it was 11.1% of demand. Peak load energy shortage is also high. Indian economy is one of fastest growing economy of world. As economy is growing energy demand is also growing to meet industrial demand.

Table 1: Electricity Demand and Supply

FY	Energy				Peak Demand			
	(MU)				(MW)			
	Demand	Availability	Shortage	%	Demand	Met	Shortage	%
2002-03	545,983	497,890	48,093	8.8	81,492	71,547	9,945	12.2
2003-04	559,264	519,398	39,866	7.1	84,574	75,066	9,508	11.2
2004-05	591,373	548,115	43,258	7.3	87,906	77,652	10,254	11.7
2005-06	631,024	578,511	52,513	8.3	93,214	81,792	11,422	12.3
2006-07	693,057	624,716	68,341	9.9	100,715	86,818	13,897	13.8
2007-08	737,052	664,660	72,392	9.8	108,866	90,793	18,073	16.6
2008-09	777,039	691,038	86,001	11.1	109,809	96,785	13,024	11.9
2009-10	830,594	746,644	83,950	10.1	118,472	102,725	15,747	13.3
2010-11	861,591	811,100	50,491	5.9	152746	137013.2	15732.84	10.3

Table 2: Electricity demand projection at different growth rate

Energy Requirement					Peak Demand			Installed Capacity Required	
(Billion kWh)					(GW)			(GW)	
GDP growth at	6.00%	8.00%	9.00%	6.00%	8.00%	9.00%	6.00%	8.00%	9.00%
2011-12	1097	1,097	1,097	158	158	158	199	199	199
2016-17	1407	1,524	1,586	203	220	228	255	276	288
2021-22	1804	2,118	2,293	260	305	330	327	384	416
2026-27	2267	2,866	3,219	327	413	464	411	520	584
2031-32	2850	3,880	4,518	411	560	651	517	704	820

Dependence of Electricity demand on GDP growth rate

Electricity is prime mover of growth rate. As industrialization grows power demand also grows to maintain higher production rate. By analyzing past 20 years data, shows that growth in electricity demand is varies as per GDP growth rate and we got following relationship between electricity demand and growth rate-

$Y = 29167X + 227827$

Where Y= Electricity Demand

X= GDP growth rate

Also electricity demand projection was done for GDP growth rate of 6%, 8% and 9% for next 20 years at falling elasticity of electricity.

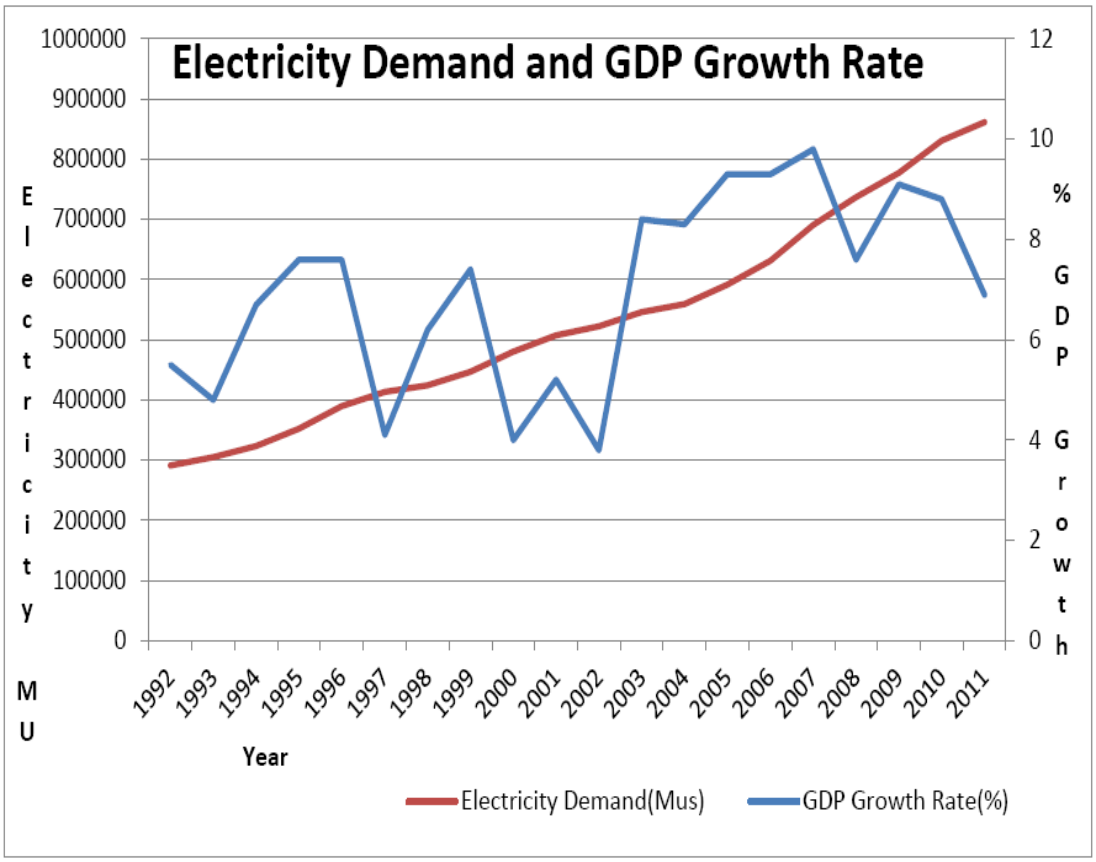


Figure 1: Electricity Demand and GDP Growth Rate

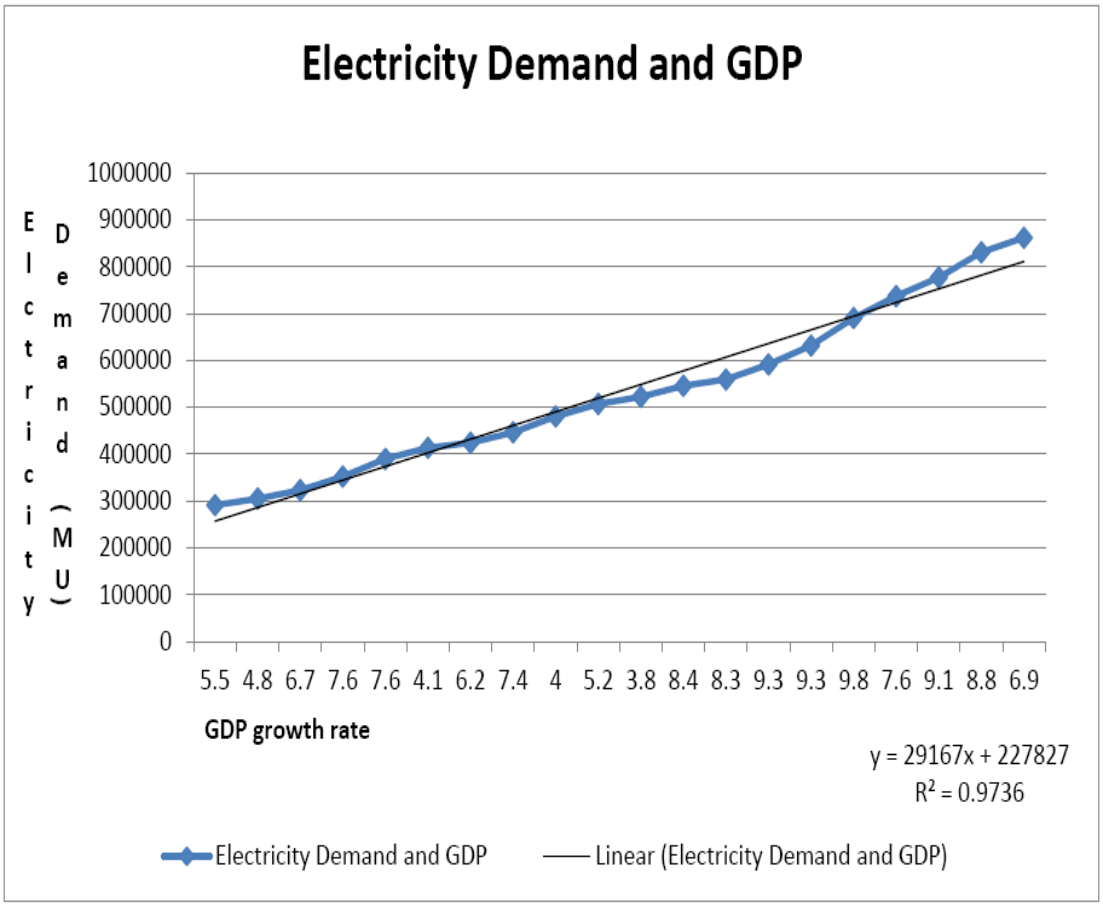
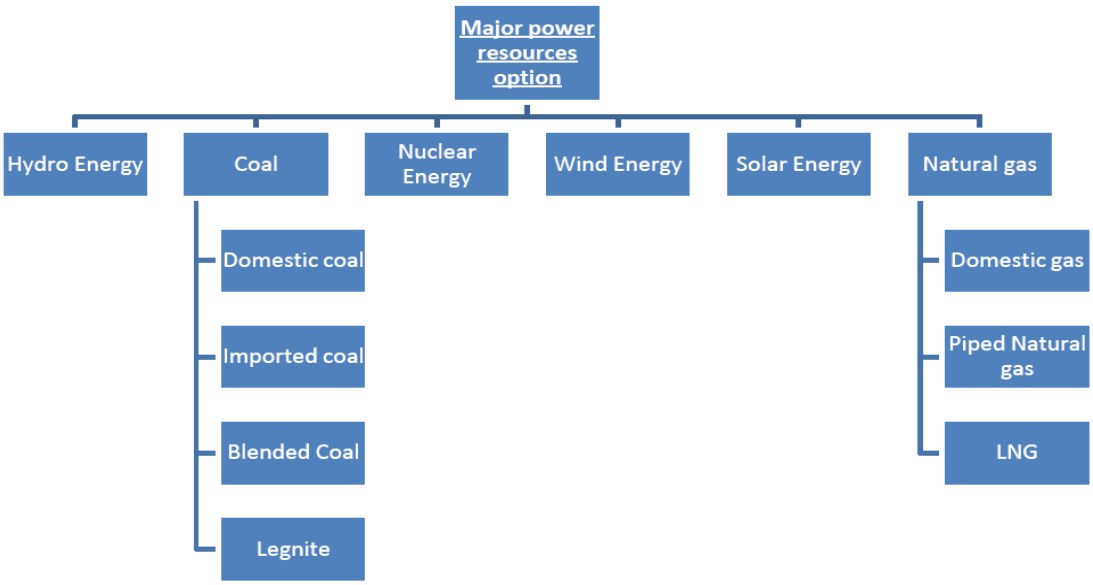
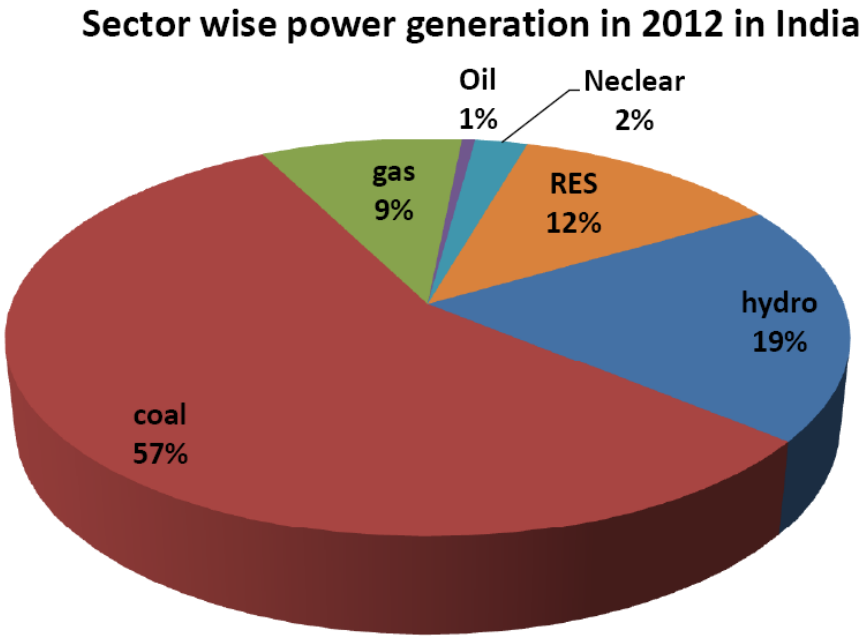


Figure 2: Electricity Demand and GDP

Major available resources for electricity generation





The 17th electric power survey of India report claims-

- Over 2010–11, India's industrial demand accounted for 35% of electrical power requirement, domestic household use accounted for 28%, agriculture 21%, commercial 9%, public lighting and other miscellaneous applications accounted for the rest.
- The electrical energy demand for 2016–17 is expected to be at least 1392 Tera Watt Hours, with a peak electric demand of 218 GW.
- The electrical energy demand for 2021–22 is expected to be at least 1915 Tera Watt Hours, with a peak electric demand of 298 GW.

III. RENEWABLE RESOURCES IN INDIA

India's population of more than 1028 million is growing at an annual rate of 1.58%. As fossil fuel energy becomes scarcer, India will face energy shortages significantly due to increase in energy prices and energy insecurity with in the next few decades. Increased use of fossil fuels also causes environmental problems both locally and globally. The economy of India, measured in USD exchange-rate terms, is the twelfth largest in the world, with a GDP of around $1 trillion (2008). GDP growth rate of 9.0% of India for the fiscal year 2007–2008, makes it the second fastest big emerging economy, after China, in the world. There is a very high demand for energy, which is currently satisfied mainly by coal, foreign oil and

petroleum, which apart from being a non-renewable, and therefore non-permanent solution to the energy crisis, it is also detrimental to the environment. Thus, it is imperative that India obtains energy security without affecting the booming economy, which would mean that the country must switch from the nonrenewable energy (crude oil and coal) to renewable energy.

Table 3: Status of renewable energy resources in India

New & Renewable Energy
Cumulative deployment of various Renewable Energy Systems/ Devices in the country as on 30/04/2012

Renewable Energy Program/ Systems	*Target for 2012-13*	**Achievement during April,2012**	**Total achievement during 2012-13**	**Cumulative achievement up to 30.04.2012**
I. POWER FROM RENEWABLES:				
A. GRID-INTERACTIVE POWER (CAPACITIES IN MW)				
Wind Power	*2500*	36.65	36.65	17389.31
Small Hydro Power	*350*	5.75	5.75	3401.06
Biomass Power	*455*	16.00	16.00	1166.10
Bagasse Cogeneration		7.50	7.50	1992.73
Waste to Power -Urban	*20*	-	-	89.68
-Industrial		-	-	-
Solar Power (SPV)	*800*	37.72	37.72	979.00
Total	***4125.00***	**103.62**	**103.62**	**25017.88**
B. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MW$_{EQ}$				
Waste to Energy - Urban	*20.00*	1.20	1.20	102.95
-Industrial				
Biomass(non-bagasse) Cogeneration	*60.00*	2.50	2.50	385.00
Biomass Gasifiers - Rural	*1.50*	-	-	16.12
Industrial	*10.00*	-	-	134.09
Aero-Genrators/Hybrid systems	*0.50*	-	-	1.64
SPV Systems (>1kW)	*30.00*	-	-	85.21
Water mills/micro hydel	*2.00(500 Nos.)*	-.	-	1877 Nos.
Total	***126.00***	**3.70**	**3.70**	**725.01**
II. REMOTE VILLAGE ELECTRIFICATION				
No. of Remote Village/Hamlets provided with RE Systems	-	-	-	-
III. OTHER RENEWABLE ENERGY SYSTEMS				
Family Biogas Plants (No. in	*1.25*	-	-	45.09

Solar Energy in India

Solar water heaters have proved the most popular so far and solar photovoltaic for decentralized power supply is fast becoming popular in rural and remote areas. More than 700000 PV systems generating 44 MW have been installed all over India. Under the water pumping program more than 3000 systems have been installed so far and the market for solar

lighting and solar pumping is far from saturated. Solar drying is one area which offers very good prospects in food, agricultural and chemical products drying applications.
The Jawaharlal Nehru National Solar Mission (JNNSM) has set ambitious targets for power generation from solar energy in India. The Mission aims to have about 10 GW of grid-connected solar power plants by 2022. The mission is divided into 3 phases and the targets for grid-connected solar PV plants for each phase are-

Table 4: 3 Phase for grid-connected solar PV plants

Phase 1	2010-2013	500 MW
Phase 2	2013-2017	1,500 MW
Phase 3	2017-2022	7,000 MW
Total		10,000MW

In addition to the JNNSM, several state governments have separate solar policies (Rajasthan, Gujarat and Karnataka) and many other state governments (Tamil Nadu, Maharashtra, Andhra Pradesh etc) are drafting solar policies on their own. Apart from this, the Renewable Purchase Obligation (RPO) is expected to drive the growth of the solar PV power generation sector. India is densely populated and has high solar insulation, an ideal combination for using solar power in India. Much of the country does not have an electrical grid grid, so one of the first applications of solar power has been for water pumping; to begin replacing India's four to five million diesel powered water pumps, each consuming about 3.5 kilowatts, and off-grid lighting. Some large projects have been proposed, and a 35,000 km² area of the Thar desert has been set aside for solar power projects, sufficient to generate 700 to 2,10 Gigawatts.

The Indian Solar Loan Program, supported by the United Nations Environment Program has won the prestigious Energy Globe World award for Sustainability for helping to establish a consumer financing program for solar home power systems. Over the span of three years more than 16,000 solar home systems have been financed through 2,000 bank branches, particularly in rural areas of South India where the electricity grid does not yet extend. Launched in 2003, the Indian Solar Loan Programme was a four-year partnership between UNEP, the UNEP Risoe Centre, and two of India's largest banks, the Canara Bank and Syndicate Bank.

Announced in November 2009, the Government of India proposed to launch its Jawaharlal Nehru National Solar Mission under the National Action Plan on Climate Change with plans to generate 1,000 MW of power by 2013 and up to 20,000 MW grid-based solar power, 2,000 MW of off-grid solar power and cover 20 million sq. meters with collectors by the end of the final phase of the mission in 2020. Also, TERI's Lighting a Billion Lives Campaign started in 2008 aims to replace kerosene and paraffin lamps with CFLs to provide off-the-grid lighting to villages and thus ease the load on the power grid while at the same time provide the people with safe, non-polluting light at night. So far, it has provided 35,000 CFLs to 640 villages in 16 states in India and also about 500 CFLs in Myanmar. This campaign has reportedly benefited 175,000 people.

Wind Energy

In progress are wind resource assessment programme, wind monitoring, wind mapping, covering 800 stations in 24 states with 193 wind monitoring stations in operations. Altogether 13 states of India have a net potential of about 45000 MW. The development of wind power in India began in the 1990s, and has significantly increased in the last few years. Although a relative newcomer to the wind industry compared with Denmark or the United States, India has the fifth largest installed wind power capacity in the world. In 2009-10 India's growth rate was highest among the other top four countries. As of 31 March 2011 the installed capacity of wind power in India was 16078 MW, mainly spread across Tamil Nadu (6007 MW), Maharashtra (2310.70 MW), Gujarat (2175.60 MW), Karnataka(1730.10 MW), Rajasthan (1524.70 MW), Madhya Pradesh (275.50 MW), Andhra Pradesh (200.20 MW), Kerala (32.8 MW), Orissa (2MW), West Bengal (1.1 MW) and other states (3.20 MW). It is estimated that 6,000 MW of additional wind power capacity will be installed in India by 2012. Wind power accounts for 6% of India's total installed power capacity, and it generates 1.6% of the country's power. India's wind atlas is available. The worldwide installed capacity of wind power reached 197 GW by the end of 2010. China (44,733 MW), US (40,180 MW), Germany (27,215 MW) and Spain (20,676 MW) are ahead of India in fifth position. The short gestation periods for installing wind turbines, and the increasing reliability and performance of wind energy machines has made wind power a favored choice for capacity addition in India.

Suzlon, an Indian-owned company, emerged on the global scene in the past decade, and by 2006 had captured almost 7.7 percent of market share in global wind turbine sales. Suzlon is currently the leading manufacturer of wind turbines for the Indian market, holding some 52 percent of market share in India. Suzlon's success has made India the developing country leader in advanced wind turbine technology.

Table 5: Wind Power projects in India

Power Plant	Producer	Location	State	Total
Vankusawade Wind	Suzlon Energy Ltd.	Satara Dist.	Maharashtra	259
Cape Comorin	AbanLoyd Chiles Offshore	Kanyakumari	Tamil Nadu	33
KayatharSubhash	Subhash Ltd.	Kayathar	Tamil Nadu	30
Ramakkalmedu	Subhash Ltd.	Ramakkalmedu	Kerala	25
Muppandal Wind	Muppandal Wind Farm	Muppandal	Tamil Nadu	22
Gudimangalam	Gudimangalam Wind Farm	Gudimangalam	Tamil Nadu	21
Puthlur RCI	Wescare (India) Ltd.	Puthlur	Andhra	20
LamdaDanida	Danida India Ltd.	Lamda	Gujarat	15
Chennai Mohan	Mohan Breweries &	Chennai	Tamil Nadu	15
Jamgudrani MP	MP Windfarms Ltd.	Dewas	Madhya	14
Jogmatti BSES	BSES Ltd.	ChitradurgaDist	Karnataka	14
PerungudiNewam	Newam Power Company	Perungudi	Tamil Nadu	12
Kethanur Wind Farm	Kethanur Wind Farm	Kethanur	Tamil Nadu	11
Hyderabad APSRTC	Andhra Pradesh State Road	Hyderabad	Andhra	10
Muppandal Madras	Madras Cements Ltd.	Muppandal	Tamil Nadu	10
PoolavadiChettinad	Chettinad Cement Corp.	Poolavadi	Tamil Nadu	10
Shalivahana Wind	Shalivahana Green Energy.	Tirupur	Tamil Nadu	20.4

Tidal Energy

• Tides generated by the combination of the moon and sun's gravitational forces
• Greatest affect in spring when moon and sun combine forces
• Bays and inlets amplify the height of the tide
• In order to be practical for energy production, the height difference needs to be at least 5 meters
• Only 40 sites around the world of this magnitude
• Overall potential of 3000 gigawatts from movement of tides

India set to get Asia's first power plant

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. 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," said Cornelius. The power offtaker 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 company said. 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," said Cornelius. 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.

Nuclear Energy

The global nuclear industry is moving forward at a brisk pace, only slightly slowed by the Fukushima accident. The International Atomic Energy Agency's most realistic estimate is that 90 new nuclear plants will enter service by 2030. Ten new nuclear plants went online over the past two years.

The home of more than one billion people, India has had one of the world's fastest-growing economies over the past decade. During this same time frame, the country has made big strides in increasing its capacity for nuclear generation of electricity. India now envisages increasing the contribution of nuclear power to overall electricity generation capacity from 3.2% to 9% within 25 years. By 2020, India's installed nuclear power generation capacity will increase to 20,000 MW. India now ranks sixth in terms of production of nuclear energy, behind the U.S., France, Japan, Russia, and South Korea. There are now 439 nuclear reactors in operation around the world in over 30 countries, providing almost 16% of the world's electricity.

Given the emphasis on rapid expansions in the Indian nuclear power industry, it is imperative to bring the Indian know-how and resources together with global nuclear skills and experience to introduce a new dimension to the upcoming nuclear power projects. Looking at all above important issues, UBM India is bringing its 4th International Exhibition and Conference from 25 to 27 September 2012 at Mumbai. The exhibition and the concurrent summit will be an excellent global networking opportunity for the exhibitors, visitors and delegates. It will provide an opportunity for all companies showcase their nuclear expertise and know-how and identify business opportunities in the Indian market. Presently Nuclear power is the fourth-largest source of electricity in India after thermal, hydroelectric and renewable sources of electricity. As of 2010, India has 20 nuclear reactors in operation in six nuclear power plants, generating 4,780 MW while seven other reactors are under construction and are expected to generate an additional 5,300 MW. In October 2010, India drew up "an ambitious plan to reach a nuclear power capacity of 63,000 MW in 2032", but "populations around proposed Indian NPP sites have launched protests, raising questions about atomic energy as a clean and safe alternative to fossil fuels". There have been mass protests against the French-backed 9900 MW Jaitapur Nuclear Power Project in Maharashtra and the 2000 MW Koodankulam Nuclear Power Plant in Tamil Nadu. The state government of West Bengal state has also refused permission to a proposed 6000 MW facility near the town of Haripur that intended to host six Russian reactors. A Public Interest Litigation (PIL) has also been filed against the government's civil nuclear program at the Supreme Court. Despite these impediments the capacity factor of Indian reactors was at 79% in the year 2011-12 as against 71% in 2010-11. Nine out of Twenty Indian reactors recorded an unprecedented 97% Capacity factor during 2011-12. With the imported Uranium from France, the 220 MW Kakrapar 2 PHWR reactors recorded 99% capacity factor during 2011-12. The Availability factor for the year 2011-12 was at 89%.

Bio-mass Energy

Bio-energy contribution to the total primary energy consumption in India is over 27%. Indeed, this is the case for many other countries, because biomass is used in a significant way in rural areas in many countries. However, the contribution of biomass to power production is much smaller than this - currently, biomass comprises only about 2650 MW of installed capacity, out of a total of about 172000 MW of total electricity installed capacity in the country (May 2011). India is the pioneer in biomass gasification based power production. While gasification as a technology has been prevalent elsewhere in the world, India pioneered the use of biomass gasification for power production. As a result, prominent Indian solution providers in biomass gasification are implementing their solutions in other parts of the world. EAI estimates the total installed capacity of biomass gasification based power production in India will be about 140 MW, out of a total of about 2600 MW of biomass based power (cumulative of grid connected and off grid). Of the total, biogas based power generation has the share (about 1400 MW), followed by combustion-based biomass power production (about 875 MW).

While biomass gasification currently contributes little to power production, EAI foresees significant growth for this sector in future.

Waste Resource

Every year there is an estimated 30 million tons of solid waste and 4,400 million cubic meters of liquid waste generated in urban areas of India alone. The problems caused by solid and liquid wastes can be significantly mitigated through adoption of environment-friendly waste-to-energy technologies. These technologies hold the promise of reducing quantity of wastes and in addition, generate a substantial quantity of energy from them, and greatly reduce pollution of water and air. In spite of the unquantifiable level of benefits, they are still not seen as an attractive business opportunity. The reason for this is the lack of understanding about the various (technology/process) options available and long term viability of the waste to energy projects. We at EAI have been researching the waste to energy industry for the past few years and have developed a thorough understanding of the various technology options and their viabilities. Diverse business opportunities along the value chain, the global scenario and the market segment for each of the waste to energy technologies are well known to us and we are poised to provide a balanced opinion about waste to energy industry.
can provide extensive research and consulting assistance for value generation from the following types of waste: Industrial solid waste Municipal solid waste Hazardous waste Industrial liquid waste Sewage and Fecal Waste Agro and crop waste We can also provide customized inputs for value and energy generation based on the following processes: Anaerobic digestion Pyrolysis Gasification Combustion Fermentatio

Limitation of Renewable energy resources in India

- Renewable energy often relies on the weather for its source of power that is unpredictable and intermittent.
- Solar power is dependent on availability of sunlight. Thus the availability of power fluctuates from zero to maximum every day.
- The current cost of renewable energy technology is also far in excess of traditional fossil fuel generation.

IV. CONCLUSION

The study described in this paper of the current demand of electricity and various energy sources in India. Energy security, economic growth and environment protection are the national energy policy drivers of any country of the world. There is considerable work going on in several countries to develop Solar Energy as a clean and alternative source of energy. The need to boost the efforts for further development and promotion of renewable energy sources has been felt world over in light of high prices of crude oil. A critical part of the solution will lie in promoting renewable energy technologies as a way to address concerns about energy security, economic growth in the face of rising energy prices, competitiveness, health costs and environmental degradation. According to NAPCC other sources of renewable energy would be promoted. Specific action points that have been mentioned include promoting deployment, innovation and basic research in renewable energy technologies, resolving the barriers to development and commercial deployment of biomass, hydropower, solar and wind technologies, promoting straight (direct) biomass combustion and biomass gasification technologies, promoting the development and manufacture of small wind electric generators, and enhancing the regulatory/tariff regime in order to main stream renewable energy sources in the national power system. Accordingly, increased focus is being laid on the deployment of renewable power that is likely to account for significant share in the electricity-mix by 2032. Alternate fuels, essentially bio-fuels, are proposed to be progressively used for blending with diesel and petrol, mainly for transport applications.

REFERENCES

[1] International Energy Agency IEA. Key world energy statistics. Available at: http://www.iea.org/Textbase/nppdf/free/2006/Key2006.pdf [Accessed: 07/06/2007].
[2] World Energy Outlook. International energy agency; 2008. http://www.worldenergyoutlook.org/2008.asp.
[3] REN21, Renewables 2007 global status report. http://www.ren21.net/pdf/.
[4] REN21, Renewables 2009 global status report. http://www.ren21.com.
[5] S.K. Varuna and Singal, Review of augmentation of energy needs using renewable energy sources in India, Renewable and Sustainable Energy Reviews 11 (2007), pp. 1607–1615.
[6] Planning Commission, Govt. of India—September 1995 & September 1996 Projections to 2020–2021.
[7] Subramanian V. Renewable energy in India: status and future prospects. Ministry of New and Renewable Energy; November 2007.
[8] GOI. Tenth Five year plan 2002–2007, planning commission, New Delhi. Available at: http://planningcommission.nic.in/aboutus/committee/wrkgrp11/wg11_ renewable.pdf.
[9] Urja Akshay. Newsletter of the Ministry of New and Renewable Energy, Government of India; October 2008. http://mnes.nic.in/akshayurja/sept-oct-2008-e.pdf.
[10] Report- The planning commission of India, Integrated Energy Policy (2006), Page no.-20
[11] Paper- Brian O'Keefe (2012), Exxon big bets on Shale gas, Page no.- 43
[12] Paper- Crish Rumely et. All (Dec. 2007), Natural gas in India, prospects for LNG imports, Page no.- 27

[13] http://www.cea.nic.in- "Monthly executive report", (06/2012) Central Electricity Authority, Ministry of Power retrieved on 5 June 2012 from http://www.cea.nic.in/reports/monthly/executive_rep/jun12/8.pdf
[14] Paper – Shivanand Kanevi, Energy security and India (8 Jan. 2012)
[15] "Inventory of coal resources of India", (2011) Ministry of Coal retrieved on 7 May 2012 from http://www.coal.nic.in/welcome.html. "GDP growth annual" (n. d.) The World Bank from http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG .
[16] Paper - Simpson, Lori Allison, Massachusetts Institute of Technology. Technology and Policy Program, The suitability of coal gasification in India's energy sector (2006)
[17] Paper- Abrahm Lustgarten, Nicholas and ProPublica, EPA-Natural gas fracking linked to water contamination, (Dec. 09)
[18] India 2009. Energy Publication Division. Ministry of Information & Broadcasting Government of India; 2009.
[19] O. Senneca, Kinetics of pyrolysis, combustion and gasification of three biomass fuels, Fuel Process Technology (2006), pp. 87–97.
[20] T.V. Ramachandra, G. Kamakshi and B.V. Shruthi, Bioresource status in Karnataka, Renewable and Sustainable Energy Reviews 8 (2004), pp. 1–47. Article | PDF (451 K) | View Record in Scopus | Cited By in Scopus

