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Impact of Renewable Energy Consumption on Economics in India

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Abstract Energy is the major source for the economic development of any country. In recent years, India energy consumption has been increasing at a relatively fast rate due to population growth and economic development. Energy plays substantial role in economic, hence relationship between energy consumption and economic growth is an important issue for economists. Renewable Energy (RE) has been identified as a key tool to counter climate change and enhance energy security. In India growth of the economy places heavy demand of electric power, Presently Coal-based power generation is characterized by local and regional environmental degradation as well as greenhouse gas emissions, leading to climate change. Thus, there is need for enhance energy security along with reducing greenhouse gas emissions. Renewable energy is one of the environmentally friendly sources of energy and effectiveness of growth economic, in this article will be show that an effects of RE for economy in India.

Keywords Renewable Energy, Economics, Energy Consumption, Development of economy

1. Introduction

Today, energy production and benefit accounting for two third of the world's greenhouse-gas emissions GHG [5], there has been global works towards shifting the available fossil fuel based energy systems to low-carbon technologies, including renewable energy technologies (RET) like solar, wind, hydro and biomass. International Energy Agency (IEA) has measured that towards limiting the temperature rise to two degree centigrade (450 ppm, or, ppm scenario by 2050) [32], the total installed capacity of renewable energy sources for electricity production needs to be augmented 3770 GW by 2035. This shall require annual investments of over US $550 billion in climate change mitigation and adjustment technology [11].

India is the fourth largest energy consumer in the world after the United States, China and Russia [18]. As of March 2013, the per capita total electricity waster in India was 917.2 kWh [10]. Electricity waster in India is expected to rise to around 2280 Bkwh by 2021–22 and around 4500BkWh by 2031–32 [9]. India's energy waster has been increasing comparatively fast rate due to increase in population and living standard as well. Current centralized energy planning of India is mainly dependent on thermal power plant for energy need and its percentage share is near about 70% of total installed capacity of power plant [17]. The reasons for according renewable energy may vary in case of developed and developing economies. Developed nations are promoting clean energy technologies due to their heightened sensitivity towards the environment and being mandated under the various international climate conventions like the United Nations Framework on Climate Change, or, UNFCCC [16]. On the other hand, the reasons for developing economies to advocate renew able energy technologies include enhancement of their energy security (reduction in energy imports), besides bridging the energy deficit and enabling energy access to the masses through decentralized systems in form of lifeline energy services like cleaner forms of basic lighting devices (solar lanterns) and cooking systems (biogas plants).

India has its own sets of reasons for pursuing a low-carbon growth direction. This includes largeshare of fossils in its energy supply chain (over 80% share of coal based power in the grid) [8], leading to high levels of greenhouse gas (GHG) emissions, making it the fourth largest emitter globally [22]. It is also promoting renewable energy in decentralized formats to enable energy access to the un-electrified/ under-electrified rural masses.

It has envisioned 15% of electricity contribution from renewable energy sources by 2020 as against the present share of 6% [29], advocated under the National Acton Plan on Climate Change (NAPCC). The electricity requirement is projected to increase to 1900 Billion units (BU) by the year 2022 [30], from the present levels of about 1100 BU [27]. Hence, over 300 BU of green power would be required as

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against the present levels of 60 BU [19], (fivefold increase). This shall necessitate significant scaling up of RE capacity in similar terms.

Renewable Energy projects are associated with high opposite (capital) cost and lower levels of energy generation (due to limited availability of natural resources like solar radiation and wind velocity), leading to higher cost of energy generation. Besides, they lack the ability to reach economies of scale (due to limited availability of contiguous land area in resource rich regions); most wind and solar projects are limited to not more than few hundred megawatts of capacity.

The developing economies, there are constraints in terms of availability of monetary resources at competitive terms due to competing demands from other sectors like education, healthcare, agriculture and infrastructure. As such, it is of paramount importance that utilization of scare resources is done in the most prudential manner.

Table 1. Power generation Mix of India

Sources	Capacity (in MW)	%Share (Capacity Wise)
Coal	167,708	61
Gas	22,962	8
Diesel	993	0.4
Hydro (Large)	41,997	15
Nuclear	5780	2
Renewables	36.470	13
Total	275,910	100

2. Energy Scenario of India

India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia but is still a power deficit country [12]. Despite tremendous grow thin electricity generation, country continues to face both energy and peak deficit. During the year 2014–15, there would been energy shortage of 5.1% and peak shortage of 2.0% [1]. As the economy grows in coming years the electricity demand will further rise as there is strong correlation between rise in energy consumption and economic growth. India has been putting steady efforts at increasing its energy generation capacity. However, the demand for energy has been continuously out stripping supply. The table given below indicates the region wise installation capacity of different sources of electricity. State- owned and privately owned companies are significant players in India's electricity sector, with the private sector growing at a faster rate. India's central government and state governments jointly regulate electricity sector in India.

Source of Energy:

The Indian power sector is one of the most diversified in the world. The sector has been continuously progressing in generation capacity addition through conventional like Coal, lignite, gas, hydro and nuclear power as well as non-conventional sources like Wind, solar, small hydro and biomass. Total installed capacity of power plant in the country stands at 253.39 GW in which, Thermal power accounts for 69.5%, Renewable energy accounts for 12.5%, Nuclear 2% [13] and Hydro holds a 16% share.

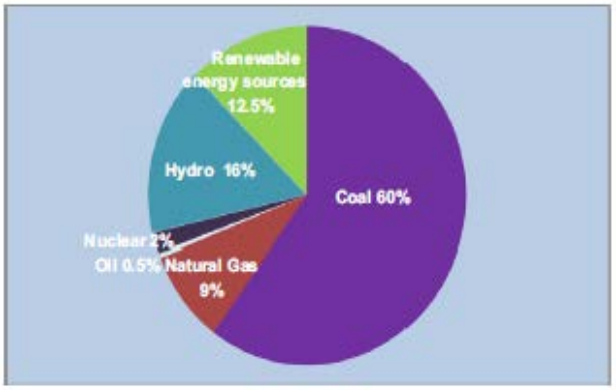


Figure 1. Sources of electricity of India

Table 2. All India Installed Capacity in (MW) of Power

Region	Mode wise break up							
	Thermal				Nuclear	Hydro (Renewable)	RES (MNRE)	Grand Total
	Coal	Gas	Diesel	Total				
Northern region	39481.0	5331.26	12.99	44825.25	1620.00	16598.11	5935.77	68979.13
Southern region	27382.50	4962.78	939.32	33284.60	1320.00	11398.03	13784.67	59787.30
Western region	58859.51	10915.41	17.48	69792.40	1840.00	7447.50	11271.07	90350.97
Eastern region	26527.88	190.00	17.20	26735.08	0.00	4113.12	432.86	31281.06
North-eastern region	60.00	1571.80	142.74	1774.54	0.00	1242.00	256.67	3273.21
Island	0.00	0.00	70.02	70.02	0.00	0.00	11.10	81.12
All India	153570.89	22971.25	1199.75	177741.89	4780.00	40798.76	31692.14	253389.48

3. Renewable Energy

Renewable energy is derived from natural processes that are replenished constantly. India is blessed with a variety of renewable energy sources, the main ones being biomass, biogas, sun, wind, geothermal, tidal and small hydro power. (Large hydro power is also renewable energy in nature, but has been utilized all over the world for many decades, and is generally not included in term new and renewable source of energy). India's electricity sector is amongst the world's most active players in renewable energy utilization, especially wind energy [25]. As of 31 March 2014, India had an installed capacity of about 31.69 GW of non-conventional renewable technologies-based electricity [17].

Table 3. Renewable Energy in India

S.no.	Renewable Sources of energy	Installation Capacity (MW)	% of Share
1	Wind	21136,40	66.7
2	Solar	2631,93	8.3
3	Small Hydro power	3803,68	12
4	Biomass power	4120,13	13
5	Total	31692,14	100

Why Need of Renewable Energy:

Climate change is one of the primary concerns to go with renewable energy. The current and foreseeable coal crisis at the domestic front, coupled with greenhouse gas emission such as CO2, CH4, CFCs, halons, N2O, ozone and proxy acetyl nitrate [4], which are responsible in the atmosphere for trapping heat radiated from Earth's surface and ultimately raising the surface temperature rethinking and restructuring not only India's but world's.

Power infrastructure and energy dependencies. The increasing global temperature and energy requirement in the end shift India's need to sustainable and economically efficient renewable energy resources along with improved energy efficiency measures. There are huge amount of potential available in the renewable energy system which can be explored and harnessed to meet the energy demand. The potentially most important environmental problem India is facing alarming challenges to build up its energy infra-structure to meet its economic and social targets due to increasing demand of electricity.

1) Wind Energy:

In terms of wind power installed capacity, India is ranked 5th in the World. The present total installed capacity stands at 21136.40 MW (MNRE). It contributes to around 75% of the grid- connected renewable energy power installed capacity [20]. Today India is a major player in the global wind energy market. Tamil Nadu, Maharashtra, Karnataka, Rajasthan, Gujarat are the key states which have been focusing on wind energy development in India. Initial cost for wind turbines is greater than that of conventional fossil fuel generators per MW installed. Despite the high installed capacity, the actual utilization of wind power in India is low because policy incentives are geared towards installation rather than operation of the plants. This is why only 1.6% of actual power production in India comes from wind although the installed capacity is 8.6% [9, 17]. Lack of wind or high speed of wind affects variability of power generation through wind.

2) Solar Energy:

Among the various renewable energy resources, solar energy potential is the highest in the country. The equivalent energy potential is about 6000 million GWh of energy per year. India lies in the sunny regions of the world. Most parts of India receive 4–7 kWh of solar radiation per square meter per day with 250–300 sunny days in a year [28]. The National Solar Mission targeting 20,000MW grid solar Power, 2000MW of off-grid capacity including 20 million solar lighting systems and 20 million square meters solar thermal collector area by 2022 is under implementation [2].

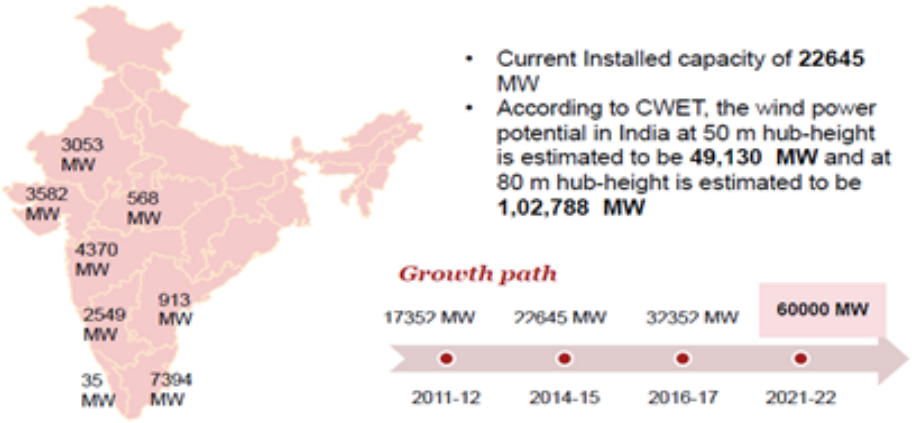
3) Small hydro Energy:

Hydro projects in India, which are under 25MW incapacity, are classified as “small hydropower” and considered as a “renewable” energy source. The sector has been growing rapidly for the last decade. SHP is by far the oldest renewable energy technology used to generate electricity in India. The current total installed capacity of small hydro power plants is 3803.68MW [17]. The energy of running water has been exploited for many years. However, Hydro projects can be un reliable during prolonged droughts and dry seasons when rivers dry up or reduce in volume.

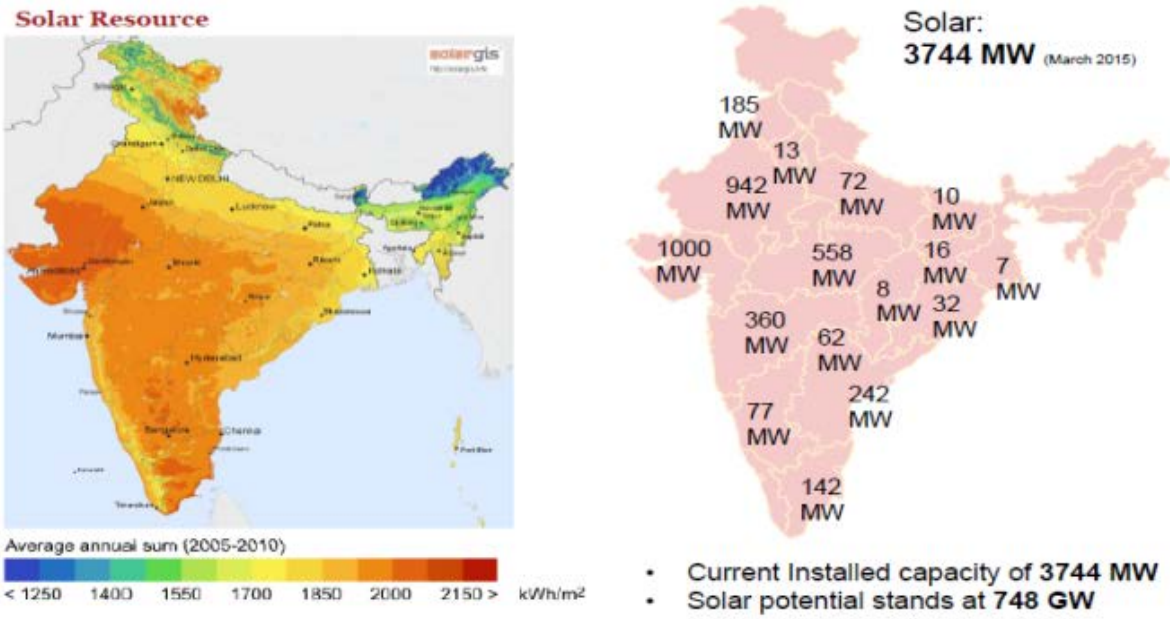
4) Bio Mas Energy:

Renewable source of energy other than hydro power energy, solar, wind and geothermal sources, currently provide only a small fraction of global energy use. The most prevalent source of energy is bio mass. Bio mass is biological material derived from living, or recently living organisms. It most often refers to plants or plant-based materials which are specifically called lignocellulosic bio-mass [24]. Biomass include wood, logging wastes and sawdust, animal dung and vegetable matter consisting of leave, crop residues and agricultural waste. According to the CEA, India had at least 3.4GW of utility-based installed capacity in biomass power and bagasse-based cogeneration plants as of mid-2013. India's Ministry of New and Renewable Energy reports the country has 18GW of potential biomass electricity generation capacity and 5 GW of potential bagasse-based generation. A large amount of biomass used for electricity generation comes from bagasse (cru- shed sugarcane or sorghum stalks), which can be used in combustion-powered generators. In India, the bio mass programmes are mainly targeted to meet the needs of rural and remote areas and have helped in reaching electricity to the interior un-reached section of the population. Globally, bio mass fuels accounts for 13% of total energy requirements. Bio mass is one such source that can be used to provide sustainable supply of the required energy through bio gas, vegetable oil, bio diesel, producer gas, and by directly

burning the bio mass. Bio mass can be con- verted in to suitable form of energy through different conversion technology. Bio mass power generation in India is an industry that attracts investments of over Rs.600 crores every year, generating more than 5000 million units of electricity and yearly employment of more than 10 million man-days in the rural areas [26].



Scheme 1. Wind Energy in India



Scheme 2. Solar Energy in India

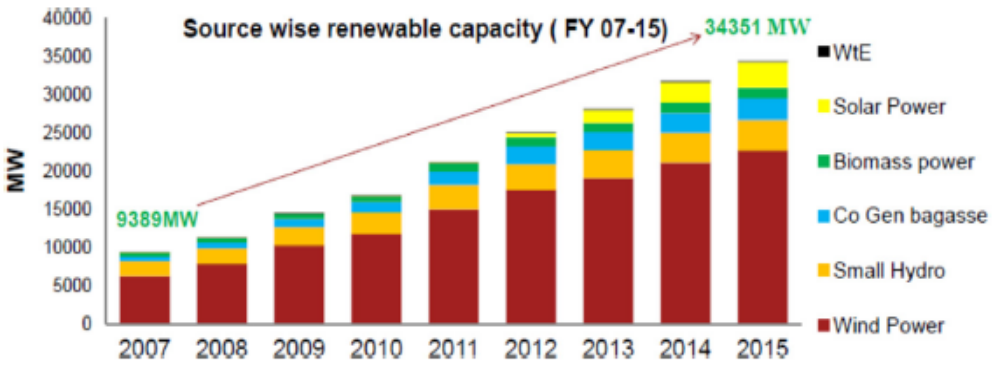


Figure 2. Renewable Energy in India

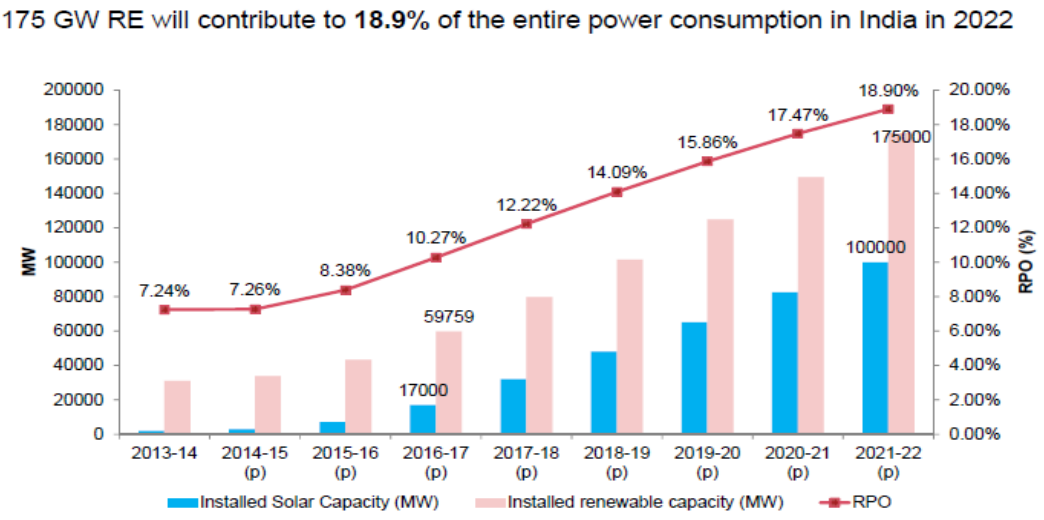


Figure 3. Renewable Energy future in India

4. Renewable Energy Policy

International Renewable Energy Agency (IRENA) has defined the following mechanisms as key policy instruments which have been adopted across the globe in varying formats [7]. Each of them has been tagged with the applicable policy/regulation as valid in the case of India [14].

A) Grant/subsidy

It is the monetary assistance that helps in reducing the initial investment in a project to enhance its viability and the same is not required to be paid back. The Government of India provides subsidy under various schemes to promote the use of renewable technologies till they attain commercial status.

B) Accelerated depreciation

Allows investments in renewable projects to be fully or partially deducted from tax obligations or income; it is a kind of production tax credit. Depreciation up to 80% can be claimed in lieu of investments made in solar and wind energy projects in India [21].

C) Tax concessions/exemptions

Enables reduction in tax outgo on profits earned from renewable projects. Infrastructure projects (including conventional power and renewable power sectors) are exempted from payment of Income tax for 10 consecutive years within the first 15 years of their commissioning. However, they are required to pay Minimum Alternate Tax MAT (present rate of MAT is 20.81%). For remaining years, the company has to pay corporate tax (present rate is 33.99%) [15].

D) Preferential tariff

Utilities are bound to purchase power generated from RE projects at a fixed price for a specified number of years. In case of India, the price is determined by the respective state electricity regulatory commission (SERC), or central electricity regulatory commission (CERC) as the case may be [35].

E) Renewable purchase obligations

Designated consumers (distribution utilities and large power consumers) are required to procure a certain percentage of their total power consumption from RE sources. This can be in terms of actual purchase of RE power, or by way of tradable green certificates.

In India, the renewable energy certificates (REC) can be sold and purchased through the energy exchanges [34, 33].

5. Economic Viability of Renewable Energy

Table 4. Levelized cost of electricity Production

Energy source	Levelized cost of electricity production (Rs./kWh)
Coal/natural gas	2.2-2.6
Wind	2.75-3.5
Biomass	3.5-5.0
Solar PV	10-12
Solar CSP	8-10
Small hydro	2.2-3
Large hydro	2.3-3.2
Diesel generator sets	13-15

The initial capital cost of installation is higher in most of the renewable sources except hydro. But the cost of operation and maintenance is comparatively cheaper than thermal or nuclear power plants. Also since the cost of fuel is none for renewable energy sources. With increase in prices of coal, gas and other fossil fuels renewable sources will become comparable or cheaper than conventional power sources and will thus become economically viable. Levelized cost of electricity production (LCOE) of

renewable energy technologies varies by technology, country and project, based on the renewable energy resource, capital and operating costs and the efficiency/performance of the technology.

a) Future of Renewable Energy:

India, with its increasing population and limited natural resources for full fill its energy requirements, needs to maintain its momentum of growth and this can be made possible only by opting available energy options. Renewable energy is the best option. Shortage of fossils fuel and awareness towards global warming enhance the clean energy production. Therefore use of renewable sources increasing gradually in coming years [23, 3].

b) Financing and fiscal incentives:

Renewable energy technologies require large initial capital investments, making the levelized cost of generation higher than it is for many conventional sources. The availability of financing options shall play an important role in increasing the share of renewable energy in India. The MNRE provides financial incentives for various renewable energy programmes. These include interest and capital subsidies. In addition, soft loans are provided through IREDA and also through some of the nationalized banks and other financial institutions for identified technology [31].

c) Promotional centre in Renewable energy:

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for the development of new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. India is one of the first countries to establish a separate Ministry for New and Renewable Energy (i.e. MNRE) at the central level.

A number of institutions have been created in India for promotion of renewable energy. Institutions like Solar Energy Centre, Indian Renewable Energy Development Agency (IREDA), Centre for Wind Energy Technology (C-WET), Alternate Hydro Energy Centre (AHEC), Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE) have been playing a critical role for facilitating the installation of renewable energy in the country. At the State level, State Nodal Agencies (SNAs) were set up to carry out MNRE's mandate and implement projects/programmes [3].

6. Conclusions

Developing economies have set ambitious Renewable Energy capacity addition targets to reduce energy exportation on estimate of their growing and developing economy.

It was estimated that the emissions of greenhouse gas can be reduced from 4% to 45% in the upcoming years of 2020. These include up to 14% by replacing coal with renewable energy.

India has sufficient potential of renewable energy but combination of the right technology and correct human behaviour is needed because every technology have their own limitation, then having peoples readiness to accept of Renewable Energy.

India will can be use many of these tools innovatively to achieve an impressive growth in its Renewable Energy sector with a high impact on the ground (green power generation) and a low dependency upon financial support.

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