Research Paper

Volume : 2 | Issue : 11 | November 2013 • ISSN No 2277 - 8179

Management of Renewable Energy Resources in India

Economics

KEYWORDS : Energy, Renewable Energy, Grid, Off-grid.

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ABSTRACT

This paper tries to analyze the Renewable Energy Resources Management in India, which is an alternative source of energy to conventional energy. It tries to focus power from renewable energy management like Grid-Interactive Renewable Energy Power and Off-Grid/Distributed Renewable Energy Power and Renewable Energy Awareness Programmes in India. The methodology of data is based on Secondary Data, Published from the Ministry of Renewable Energy Resources in India, for the period 2001-2002 to 2012-2013 and has used statistical tools like Mean, Compound Growth Rate, Percentage, and Standard Deviation with Graphical representation. The major finding of the study found that, more power is being generated from the wind energy, but more consistent energy is solar energy and waste-to-energy. The power energy generated from grid interactive renewable energy source is high to compare Off-Grid Renewable Energy Power. To conclude, Renewable Energy Sources are using Multi-dimensional ways like Power generation, Cooling, Cooking, Pumping, heating etc., therefore it is better than conventional energy sources because conventional energy sources are insufficient energy sources and also create environmental problems. So the alternative sources of energies are made use for to protect environment, benefit to consumers, solve the problem of electricity generation and achieve the growth and development in the economy.

Introduction:

Energy basically comes from natural resources and it has been major source for all sectors. From the economic point of view, Energy an important element of the infrastructure sector has to be ensured its availability on sustainable basis, and it is the basic element of human civilization and an essential input for economic development. According to economists, Energy is an input of economic processes and is an intermediate good whose demand falls under the category of derived demand. Energy is absolutely necessary for economic development, economic growth, sustainable development and standard of living. Energy was never in such demand and essential requirement of our daily lives; it needed to provide lighting, heating, air conditioning, cooking, and transport and to power all the technologies in the family home or business location. Therefore, it is created to improve the quality of life and increasing opportunities for economic and social development.

The conventional energy source is being increased consumption and supply day by day. It has an impact on price and production because conventional energy lot of necessary at present days. But, it's created environment pollution problems and too much expenditure on setting up infrastructure and management, and also faced the scarcity of conventional energy sources. Therefore lot of conventional energy sources are importing at present days. Its impact and increased the outflow of foreign direct investment. Therefore supply of conventional energy source faced lot problems, so more and more nations are interested to use different types of renewable energy sources. Therefore renewable energy more advantage and popular compared to conventional energy sources.

Renewable Energy is one of the alternative sources of energy that has become very important and relevant at present day. Renewable energy can be used without using fossil fuels and can be renewed and sustained but were as it is not possible through non-renewable energy. They are being used in agriculture, industry and social service sector. Renewable energy can be used again and again without depleting and they are eco-friendly, low cost, preserve the nature, reduction of health problems. Hence renewable energy sources are crucial for sustainable human life and it has helps to emit carbon dioxide, and combat climate change. Therefore renewable energy has positive effect on the environment, house owners and businesses. They mainly use for power generation from the sources of renewable energy.

Theoretical Background of Energy and Renewable Energy:

Energy Economic Theory is mainly based on economic development, economic growth, energy demand, energy supply, consumption, utilization, cost and benefit analysis, production, market structure, conservation of energy sources, technology development and standard of living. The modern economists have theorized and highlighted the vital role of energy in the process of economic development and energy is direct and predictable relationship between energy consumption and economic development.

William Nordhaus has worked the efficient allocation of energy resources, he has tried to work out the competitive price of oil, and so did many others – a quick search for "backstop technology" it was clearly not a fossil fuel it could have been nuclear fusion or solar or wind energy. The only economic role it played was in setting an upper limit to the price of fossil energy, an endpoint for the price path of an exhaustible resource.

The Economic Noble Prize Winner Malthus said that scarcity of resources, with limited resources and always growing population, Malthus describes an unsustainable system in which population always grows faster than subsistence levels on earth. In the Malthus in theory, some economists have argued that, natural resources are insufficient on earth. Therefore energy conservation and environmentally safe alternatives help preserve our natural resources. One of the existing problems today that may give Malthusian thinkers a valid argument is the dwindling global level of oil. It cannot be as readily or easily reproduced. It takes an extra ordinary intricate series of events in nature to produce fossil fuels. The solution to this energy question would be to find alternatives. There have been great advances made in the field of renewable energy sources. Alternative sources include solar, water, wind, and biomass. Solar cells, along with wind and hydro generation can supply sufficient amount of electricity to average home, while biomass fuel such as alcohol and methane can serve the purposes of transportation fuels.

General theory of economics is efficient depletable energy resources supply. This theory says, resources are heterogeneous, with mining costs that vary systematically over time with depletion of resource deposits, and that resources can be augmented through exploration and development. Moreover, a complete theory must account for the high degree of capital intensity of the extractive sector and the implications of this in terms of potential constraints on productive capacity. Depletable energy resources supply mean, a present value of current and future net revenue that accrue over time from a sequence of production decisions.

Objectives:

- To analyze the grid power generated from renewable energy in India.
- To examine the off-grid power generated from renewable energy in India.
- To study on renewable energy awareness programmes in India

Methodology:

The study is based on secondary data only. The study has made use of statistical tools like Mean, Compound Growth Rate, Percentage and Standard Deviation to find out the Growth and seen that power is generated at a consistent level. This paper has focused only on Power Energy from Renewable Energy Sources, like Grid interactive and Off-Grid Power Generation from Renewable Energy and Renewable Energy Awareness Programmes in India, in this data collection during the period of the years of 2001-02 to 2012-13 only for time series data. Secondary data was collected from MNRE Annual Reports and Planning Commission Documents.

Renewable Energy in India:

India is a major energy producer and consumer. On February 10, 2011 India's global ranking in terms of energy use is 5th rank. The world total primary energy consumption is 510.551 Quadrillion Btu and total primary energy production is 508.869 Quadrillion Btu at 2010(International Statistical Data). Therefore, the gap between the primary energy consumption and production is 1.682QBtu. It's mean the shortage of production to at present population. India's energy demand continued to rise inspite of slowing global economy. In India, total energy consumption in 2010 was 21.91QBtu which became 23.61 in 2011. There is increased energy consumption at 1.7QBtu. Because, the effect of population growth, technology improvement and standard of living etc. Then, total energy production in 2010 was 15.29QBtu which became 16.014QBtu in 2011(International Statistical Data). In India, production is very less but consumption was increased. There is shortage of energy, the gap between the consumption and production (Shortage of production) in 2010 was 6.62QBtu which became 7.6QBtuin 2011. Therefore, the shortage production in India is increased year to year. That purpose Govt. of India to promoting to Renewable Energy Sources.

In World renewable electricity net consumption and generation in 2009 was 3868.265Billion kilowatt-hours, which became 4167.199 Billion kilowatt-hours. The total biofuels consumption in 2010 was 1772.208thjousand barrels per day which became 1819.805 thousand barrels per day in 2011(International Statistical Data). There is renewable energy consumption increased year to year because of scarcity of conventional sources of energy.

India's energy profile provides Energy as an important input for economic development. Since exhaustible energy sources in the country are limited, there is an urgent need to focus attention for the development of renewable energy sources and use of energy efficient technologies. The exploitation and development of various forms of energy and making energy available at affordable rates is one of India's major thrust areas. The country is blessed with various sources of non conventional energy and the efforts of Ministry of Non-conventional energy sources will promote viable technologies that can reach the benefits of such sources to the poorest people in the far-flung regions of the country. The renewable energy sources are solar energy, wind energy, biomass energy, tidal energy, geothermal energy and waste to energy. In India, renewable energy generation as of March 2013, the total grid-interactive power is 2,380.31MW and total off-grid is 89.782MW and other renewable energy systems like family biogas plants is 0.77(no. in lakh) and solar water heater is 0.91(million meter square).

Renewable energy has been an important part of India's energy planning commission. The renewable energy source in the change to sustainable energy base was recognized in the early 1970s. It was establish the department of Non-Conventional Energy Sources in 1982, which was the upgraded to the Ministry of New and Non-Conventional Energy Sources (MNES) in 1992 subsequently renamed as Ministry of New and Renewable Energy (MNRE). This is the only such ministry in the world. MNRE is the Nodal Ministry of the Government of India at the central level for all are relating to new and renewable energy. This Ministry has started many reasons. That is, solve the rural electrification problem, solve the problem of power generated in urban areas, industries, commercial purpose and transportation and also solve the environment problems. Therefore India is richly endowed with renewable energy resources like solar, wind, biomass, hydropower, waste-to-energy, geothermal energy etc.

Solar energy means in economics view; demand and consumption from solar power. Solar energy is, at present has great development opportunities in India. In India receives solar energy over 5000 trillion kWh/year, which is far more than the total energy consumption of the country. It is mainly use for power generated from PV cells; it is economically viable as also a more favorable solution for many small/ medium power application, solar water heater, cooking and agriculture field to use irrigation purpose etc. It is non-polluting and to helps reduction the greenhouse effect. Wind energy used to generate electricity. India ranks 5th is the world is respect of wind power capacity and it holds great importance because of its physical and geographical features like, hilly areas, large costal belts and large desert areas. The benefit of wind energy is that it is fully pollution free and is eco-friendly too. It is the most effective way to conserve the energy and prevent the environment. The economically wind energy is development and growing the power energy. As of 31 march, 2012 the installed capacity of wind power in India was 17352.66MW, mainly spread across the states like Tamil Nadu (6987.58MW), Maharashtra (2733.30MW), Karnataka (1933.50MW), Rajasthan (2070.65MW), Gujarat (2966.28MW), Andhrapradesh (245.55MW), Madhyaprades (376.40MW), Kerala (35.10W). Biomass power of generation, it's created to low conservation of non renewable energy sources. Most important are the lack of internalization of external costs in power generation and effective policies to improve energy security and reduce carbon dioxide emissions. It reduces the economic and environmental attractiveness of biomass. Biomass system perceived to offer benefits sufficiently valued by society, including, national security, greenhouse gas mitigation, local economic development and waste reduction. Hydropower Energy is also called as water energy. It is used in the power generating flowing rivers. It is renewable, in expensive, non-pollutant and also yields multiple benefits. Hydropower electricity is an inflexible in terms of location. Co-generation energy can meet both power and heat needs; it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption.

This paper tries to analyse only Power Generation from Renewable Energy Source in India, Power Generation from Grid interactive and Off-grid Renewable Energy Source in India and Renewable Energy Awareness Programmes in India.

Power Generation from Renewable Energy Source in India:

The Government of India is expending on energy sector, because demand for energy has increased significantly in recent year. Energy being capital intensive in India requires large investment to be made for meeting the growing demand for energy. The expenditure on energy sector during successive five year plans. In the 11th plan period energy allocation was Rs. 8,54,123 crore (23.4%).

The power generation from renewable energy sources is classified into two groups one is grid-interactive renewable power energy and the other is off-grid renewable power energy. The renewable energy potential capacity is more important. Because, it's creates storage of the power generation and can develop the technology.

Volume : 2 | Issue : 11 | November 2013 • ISSN No 2277 - 8179

Table 1.1: Grid-Interactive from Renewable Energy Power Generated (In Mega Watts)

Year	Wind	Small Hydro	Co-genea-tion / Biomass Power	Solar Power	Waste-to-Energy	Total
2001-02	1507	1423	358	82**	17.1	3387.1
2002-03	1702	1463	468	107	25	3765
2003-04	2483	1603	613	151	41.5	4891.5
2004-05	2980	1693	727	40	5.5	5445.5
2005-06	1453.9	1747.98	867.53	37.26	6.05	4112.72
2006-07	1881.1	157	344.47	0.18***	6.05	2388.8
2007-08	1529.52	140.61	213.63	0.8	15.75	1900.31
2008-09	2397.48	384.06	426.4	0.8	3.82	3212.56
2009-10	682.5	129.25	385.47	7.01	7.99	1212.22
2010-11	2258.59	394.66	462.63	20.09	7.5	3143.47
2011-12	2023	257.5	430.5	445.55	1.2	3157.75
2012-13	1282.25	156.98	429.2	505.48	6.4	2380.31
Total	22180.34	9550.04	5725.83	1397.17	143.86	38997.24
Percent-age	56.99	24.55	14.71	3.38	0.37	100
CGR	-2.40	-20.94	-2.24	-0.01	-15.64	-5.78
Mean	1848.36	795.83	477.15	116.43	11.98	3249.77
Stdev.*	622.28	707.85	178.44	174.71	11.45	1207.42

Source: Annual report from Ministry of Renewable Energy in India
Note: *indicated standared of deviation
*** indicated solar power generated 20MW/sq.km(2001-02 up to 2005-06)**
****indicated solar power generated 50MW/sq.km (2006-07 up to 2012-13)**

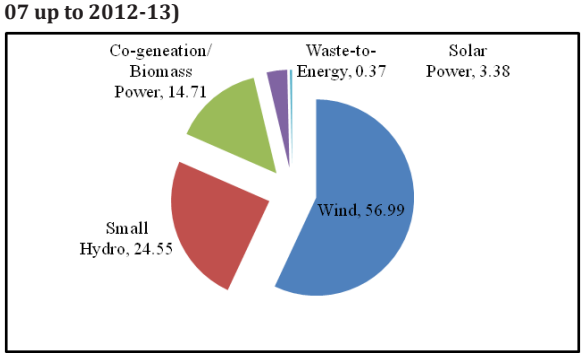


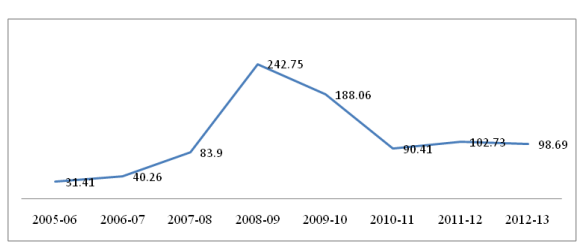
Chart 1.1: Grid-Interactive from Renewable Power Energy

Table 1.1 and Chart 1.1 shows that, Grid-Interactive from Renewable Energy Power Generated in India (achievements of the power generation from renewable energy), for the period of 2001-01 to 2012-13, from the Renewable energy sources. The total energy generated during the overall period wind was 22180.34MW, Small Hydro was 9550.04MW, Biomass/ Co-generation was 5725.83MW, solar power was 1397.17MW and Waste-to-Energy was 143.86MW. The compound growth rate is found to be negative growth rate. It indicates that growth rate of renewable energy is ongoing project and implementation of programmes in India. The mean value of wind energy was1848.36, small hydro was 795.83, Biomass/Co-generation was 477.15, solar power was 116.43 and Waste-to-Energy was 11.98. The best renewable energy power generated from the sources is wind energy with 56.99 percentag and standard deviation is 622.28. Wind energy is better than remaining renewable energy sources. But solar power and waste to energy is more consistency renewable energy sources.

Table 1.2: Off-Grid Power Generated from Renewable Energy (In Mega Watts)

Year	Biomass/ Cogeneration	Biomass Gassifier	Energy Recovery from waste	Solar PV Cell	Total
2005-06	11.5	7.87	11.3	0.74	31.41
2006-07	22.8	5.98	11.3	0.18	40.26
2007-08	60.7	10.68	12.4	0.12	83.9
2008-09	75.78	156.37	10.36	0.24	242.75
2009-10	39.79	133.28	14.7	0.29	188.06
2010-11	61.19	6.72	21.27	1.23	90.41
2011-12	51.89	12.53	27.31	11	102.73
2012-13	60.59	6.69	13.82	17.59	98.69
Total	384.24	340.12	122.46	31.39	878.21
Percent-age	43.7	38.7	14	3.6	100
Mean	48.03	42.51	15.30	3.9	109.77
CGR	19.72	1.21	9.71	81.15	16.27
Stdev.*	21.76	63.48	5.94	6.64	71.71

Source: Annual report from Ministry of Renewable Energy in India
***indicated Standard deviation**



Graph 1.2: Off-Grid Power Generated from Renewable Energy

Table 1.2 and Graph 1.2 analysed that, Off-Grid Power Generated from Renewable Energy in India, during the period of 2005-06 to 2012-13. The off-grid power generated from the renewable resource is biomass energy, biomass gassifier, energy recovery from waste and solar photovoltaic cell. This table clearly shows off-grid power generated growth rate has increased year to year. Therefore the compound growth rate positively increased. Because the project of off-grid generated has successfully. The best energy generated sources is biomass gassifier, its compound growth rate was found to be 19.72, biomass gassifier was 1.21, energy recovery from waste was 9.71 and solar photovoltaic cell was 81.15. The standard deviation was 21.76, 63.48, 5.94 and 6.64 respectively. The more consistent off-grid renewable energy power is found to be solar photovoltaic cell.

Table 1.3 Renewable Energy Awareness Programme in India

Year	Energy Parks*	Aditya Solar Shops*	Battery Operated Vehicles*
2006-07	493	260	255
2007-08	504	269	270
2008-09	516	269	270
2009-10	513	302	305
2010-2011	514	302	305

Source: Annual report from Ministry of Renewable Energy in India
***indicated: cumulative achievement**

Table 1.3 and Graph 1.3 identified that, renewable energy awareness programme has positively increased growth and also development energy programmes. In this case energy park growth rate has increased than remaining energy programme. These programmes are to create energy awareness to society. Its impact of standard of living has made economically strong and controlled the environmental pollution and also solves the rural electrification problems.

Conclusion:
Renewable energy systems are not only commercially, it is also economically viable. It is an alternative source of energy which is sustainable, eco-friendly, preservation of nature, reduction of health problems. Therefore renewable energy sources are using Multi-dimensional ways, like Power generation, Heating, Cooling, Cooking, Pumping, transportation, etc. so it is better than conventional energy sources because conventional energy sources are insufficient energy sources and also create environmental problems. The problems faced for the promotion of renewable energy include higher initial cost of the system. However, Government of India has initiated survey, policy, programmes for the implementation of renewable energy because less utilization of conventional energy and more utilization of renewable energy in power generation, fuel generation etc, and its helps for longer sustainability and with low cost of power generation in the long run.

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