

Conventional Sources of Energy in India

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Abstract— Most of the power generation in India is carried out by conventional energy sources, coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission. This focuses the solution of the energy crisis on judicious utilization of abundant renewable energy resources. This paper reviews the renewable energy scenario of India. It begins by describing the importance of renewable energy and its advantages over fossil fuels. It gives an overview of the renewable energies in India while evaluating the current status and the deployment of each of these technologies to date in India. It also reviews the multi-criteria assessment of different renewable energy and draws out vital conclusions. It is based on the secondary information collected from various mass media including internet, various reports and other International Institutions.

Key words: Renewable Source, Power Generation, Installed Capacity

I. INTRODUCTION

The World Energy Forum has predicted that fossil-based oil coal and gas reserves will be exhausted in less than another 10 decades. Fossil fuels account for over 79% of the primary energy consumed in the world, and 57.7% of that amount is used in the transport sector and are diminishing rapidly [1]. The exhaustion of natural resources and the accelerated demand of conventional energy have forced planners and policy makers to look for alternate source. For a vast country like India which stands sixth in the world in terms of energy consumptions, the dependency on a single resource or technology to carry out all energy requirement while tackling issues related to environmental impacts and fuel supplies is impractical and undoable [1]. Therefore incorporating non-carbon emitting resources have become an integral part to attain sustainability and cut down burden on fossil fuel reserves. Seeing India’s domestic market and large number of investors, country is ideally placed to take benefit from what renewable energy sources can offer. The variations in climatic zones provides ample amount of wind, sunlight, water flow rate which have enormous potential to undergo growth to energy sector and can be an alternative to fossil fuels. If given full support by the government, India can establish itself as world leader in judiciously using its resources of business and private investors for expanding renewable energy. Focusing on clean energy and seeing its enormous potential, renewable energy is likely to become the foundation of India’s energy sector. The key drivers for renewable energy are [2],

- Environmental concerns
- Beef up India’s energy security
- Pressure from shareholders on high emission industry sectors
- A practical solution for rural electrification

In present scenario, India is one of the largest consumers of fossil fuel such as crude oil, coal etc. This uncontrollable increase in use of Non-renewable energies such as fossil fuel, oil, natural gas has led to fluctuation of demand & supply. This leads us to the uncertainty of the future of Non-renewable energies. Having a negative Energy Balance for decades, India is forced to purchase energy from other countries to fulfill the needs of the entire country. The advancement of renewable energy resources will accelerate the development of the energy sector in the country so that it can meet its growth aspirations.

II. WHY ARE RENEWABLE SOURCES BETTER THAN OIL RESOURCES?

A broad comparison between renewable sources of energy and oil resources based on some factors is given below, see Table I. It indicates that renewable resources are the future for the country in the energy sector and there is a need to completely unleash the potential of these resources.

	Renewable sources of energy	Oil reserves
1. Availability	They are abundant in nature	Oil reserve are limited in nature
2.Regeneration	Can be regenerated; Inexhaustible resource	Ore is drained, can't be regenerated
3. Emission	Zero Emission	Release Greenhouse Gases
4. Environmental effect of use	There is no adverse effect on Environment. The whole system is pollution free	Harmful to the Environment
5. Transportation	Used where it is available and transported where needed	Has to be transported from its source site for further processing, exposing the environment to pollution from accidents
6. Distribution	Evenly distributed in world	Uneven distribution which leads to flow gap and price fluctuations
7.Development	Leads to more sustainable development I.e.	Lesser sustainable development

	more jobs opportunities	
8.Storage	Need storage between production and consumption	Portable form of energy. Easy to store
9.Climate change	Depends on alteration of climate	Do not depend on weather modifications
10.Area	Large amount of land is required	No large geographical area is required
11. Geo-political implications	Reduces our reliance on oil safe guarding national security.	Over reliance on oil as a resource can undermine a country's security
12. Cost	High capital and maintenance cost	Cost of producing is low since they are naturally available. They are cheap to transform from one form energy to other.

Table I: Deference between Renewable Energy and Oil Resources

III. RENEWABLE ENERGY SCENARIO IN INDIA

A. Hydro

Falling rainfall can be a very good indicator for people to judge those areas where water can be readily available to be used to produce energy from it. This kind of energy produced from water is known as hydroelectric energy. These hydroelectric power plants can then be implemented in such regions of heavy rainfall. There are 12 major such plants in India- 3 in Bihar, 2 in Andhra Pradesh and one in Punjab, Uttaranchal, Karnataka, Uttar Pradesh, Sikkim, Jammu and Kashmir and Gujarat each.

B. Biomass

One third contributor of energy to India is biomass with a potential of 22,536MW – [5] which comprises of solid biomass, which is an organic, non-fossil material of biological origins. Biogas which is principally methane and carbon dioxide is produced by anaerobic digestion of biomass and combusted to produce heat. Currently, India has 3697MW [6] installed capacity. Following is a list of some States with most potential for biomass reduction: Andhra Pradesh (200 MW), Bihar (200 MW), Gujarat (200 MW), Karnataka (300 MW),

Maharashtra (1,000 MW), Punjab (150 MW), Tamil Nadu (350 MW), Uttar Pradesh (1,000 MW) [7].

C. Solar

India being situated between the tropic of cancer and the equator, has an average temperature of 25°C – 27.5°C [7] and receives 260-300 clear sunny days per year making it the best solar resource in the world. India has an installed power capacity of 1686 MW, making it sixth largest consumer in the

world. Major plants are located in Gujarat, Rajasthan, Jodhpur, Tamil Nadu and Orissa.

D. Wind

Electrical energy and mechanical energy can also be produced by wind energy. India has 19051 MW of installed capacity and ranks 5th and has a potential of utilization up to 102772MW. Some of the major wind energy plants are located in Tamil Nadu (7160MW), Gujarat (3093MW) and Maharashtra (2976MW).

E. Geothermal

One energy source that has not been exploited at all, is the geothermal energy, which is an enormous, underused heat and power resource that is clean, reliable and home grown. [8] With growing dependence on coal and with increasing environmental problems, India will soon have to start exploiting this source of energy which has a potential of about 10000 MW [9]. Chhattisgarh government has decided to establish the first Geothermal Power Plant of the country in Tattapani area of the Balrampur district with the help of NTPC.

F. Nuclear

Nuclear power stands fourth in electricity generation in India after thermal, hydro and wind. India stands ninth in the world in terms of number of operational nuclear power reactors and has 20 nuclear reactors in operation in six nuclear power plants, generating 5,780 MW; also seven nuclear reactors are under construction. India's electricity generation is expected to reach 20,000 MW by 2020. The Biggest Nuclear plant in India is located in Tarapur, Maharashtra, 1400MW, followed by Rawatbhata in Kota Rajasthan, 1180 MW and Kaiga Karnataka, 880 MW. Kudankulam, Tamil Nadu of 2000MW, India's biggest power plant is under construction.

G. Ocean

There is a huge potential of tidal and marine energy in India which can be produced from ocean. For the tidal energy potential- locations are the Gulf of Cambay and the Gulf of Kachchh on the west coast with max tidal range-8m to 11m and average range- 5m to 7m. The Ganges Delta, Sunderbans West Bengal too has good locations for small scale tidal power development. The tidal power potential in India is 8000-9000 MW- 7000 MW [10] in the Gulf of Cambay, 1200 MW in the Gulf of Kachchh and less than 100 MW in Sunderbans. And for the marine energy potential- along the 6000 Km of coast is about 40,000 MW. A British tidal energy company, Atlantis Resources, is expected to set up a tidal power plant with the capacity to generate over 50 MW in the Gulf of Kutch with construction already started in early 2012.

Criteria	Wind	Hydro	Biomass
1. Efficiency (%)	30[10]	80[10]	1[10]
2. Land requirement	High	Very high	Extremely high
3. Approx. Potential for India (MW)	102772	84000	22536
4. Electricity cost (c/kWh)	7	8	14

5. Installed capacity (MW)	19051	38748	3697
6. Work Qualifications	Low	Moderate	Low
7. Carbon Dioxide(kg)	.02	.04	1.18
8. Independent of electricity generation	Very High	High	High
9. Turnkey Cost	Low	Very high	Low
10. Social and Individual Risks	Low	High	Low
11. Construction time	Low	Very high	Moderate
12. Waste Generated	No waste	No waste	Some waste
13. Energy source	Inexhaustible	Inexhaustible	Developed by keeping in mind the availability of biomass
14. Operation and Management costs	Very Low	Low	Very Low
15. Necessity of participative decision making process	Low	Very HIGH	Low

H. Challenges in Power Generation by Solar Energy:

The generation of power from solar energy is greatly unfeasible due to the high cost involved. Autonomy of electricity generation is very high for wind, solar, biomass, etc. but is questionable in case nuclear energy because fuel sometimes comes from other countries and hydro where projects on rivers flowing through more than one nation have certain risks. Energy source for wind, solar, geothermal and ocean are inexhaustible whereas for biomass and nuclear power, it is exhaustible. Necessity of participative decision-making processes is pretty high in cases of nuclear and hydro power as risks for the stakeholders involved are high. It's pretty low in case of other sources. Operation & management costs are high for nuclear power whereas nearly all other have comparatively low O&M costs.

I. Environmental sustainability: renewable energy and climate change

To sustain economic growth and raise living standards, energy shortages could be met by increasing supplies. But there are two other important considerations: environmental sustainability and social development. The current pattern of economic growth has caused serious environmental damage – polluting the air, creating large quantities of waste, degrading biological systems and accelerating climate change – with many of these effects coming from the energy sector. At the same time, it is also vital to consider the impact on social development. The lack of access to energy services aggravates many social concerns, including poverty, ill health, unemployment and inequity. In modern economic sectors one of the main sources of energy is oil. Although the world's largest oil consumer is still the United States, four Asian countries are not far behind; China comes second, Japan third, India fourth and the Republic of Korea sixth.

IV. INITIATIVES AND STEPS FOR DELIVERY AND OUTREACH

A. District Advisory Committees (DACs)

These Committees have led to the creation of an effective renewable energy promotion network the grass-root level that will also help in integration of renewable energy schemes with those of other development departments. To date, 550 DACs have been setup in 550 districts of the country.

B. Akshay Urja Shops (Renewable Energy Shops)

Akshay Urja Shops were launched to cover all districts of The country to ensure easy availability of such systems/devices. It is expected that the common man will embrace renewable energy technologies in a big way for augmenting energy needs of cooking, lighting and motive power from these shops.

C. Rajiv Gandhi Akshay Urja Diwas (Rajiv Gandhi Renewable Energy Day)

The birth anniversary of former Prime Minister, late Shri Rajiv Gandhi on 20th August 2006 was observed as 'Rajiv Gandhi ' Akshay Urja Diwas' all over the country is organized to increase awareness on a mass-scale at National, State and District levels.

D. Akshay Urja Newsletter (Renewable Energy Newsletter)

A bi-monthly newsletter titled 'Akshay Urja' was started With focus on national/international renewable energy developments, technological developments, manufacturer's details, renewable energy education, etc.

E. Renewable Energy Clubs

A scheme has been evolved to promote the study Of renewable energy through the setting up of RE Clubs In AICTE recognized/ approved Engineering Colleges/Technology Institutions all over the country to educate and sensitize young and future scientists on various aspects of new and renewable energy.

V. CONCLUSIONS

Energy security, economic growth and environment protection are the national energy policy drivers of any

country of the world. 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 9 around 5% 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. Finally, renewable energy provides enormous benefits and can contribute significantly in the national energy mix at least economic, environmental and social costs and it is expected that the share of renewable energy in the total generation capacity will increase in future.

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