Renewable Energy in India : Rays of Hope

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Prologue

The Author has given an extensive round-up of the Renewable Energy Scenario in India, bringing out the Growth and Prospects in this almost infinite and clean energy area.

Deepak Gupta, who is in the Indian Administrative Service, and heads the crucial Ministry of New & Renewable Energy, brings out how, even though India will continue to depend on conventional energy sources, the development and use of Renewable Energies is likely to have a significant impact on energy availability and pollution control. He reiterates that we have no option but to make massive investments in clean and environment friendly renewables, and in this, Solar Energy has a major role. The role of renewable energy in inclusive growth and following a low-carbon path is vital for India; and this paradigm shift should take place as a national endeavour by all stake-holders. There is still 'a ray of hope' – we pray.

- Editor

Background

In the last six decades, India's energy use has increased 16 times and the installed electricity capacity by 84 times. In 2008, India's energy use was the fifth highest in the world.[1] However, India as a country suffers from significant energy poverty and pervasive electricity deficits. In recent years, India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development, even though the base rate may be somewhat low. With an economy projected to grow at 8-9% per annum, rapid urbanization and improving standards of living for millions of Indian households, the demand is likely to grow significantly. As per the estimates made in the Integrated Energy Policy Report 2006, if the country is to progress on the path of this sustained GDP growth rate during the next 25 years, it would imply quadrupling of its energy needs over 2003-04 levels with a six-

1. IEA Key World Energy Statistics 2010.

fold increase in the requirement of electricity and a quadrupling in the requirement of crude oil (Table 1).[2] The supply challenge is of such magnitude that there are reasonable apprehensions that severe shortages may occur.

Table 1: Primary Energy Requirement Projections 2031-32

(in million tonnes of oil equivalent - mtoe)

Year	Hydro	Nuclear	Coal	Oil	Natural Gas	TPCES	TPNCES	Total
2011-12	12	17	257	166	44	496	169	665
2016-17	18	31	338	214	64	665	177	842
2021-22	23	45	464	278	97	907	181	1089
2026-27	29	71	622	365	135	1222	183	1406
2031-32	35	98	835	486	197	1651	185	1836

Source: Integrated Energy Policy, Report of the Expert Committee (2006), Planning Commission.

TPCES: Total Primary Commercial Energy Supply

TPNCES: Total Primary Non-Commercial Energy Supply

Although in recent years availability of power has both increased and improved, demand has consistently outstripped supply, and substantial energy and peak shortages of 10.1% and 12.7% respectively prevailed in 2009-10. Although peak deficit has declined from 16.6% in 2007-08, in most parts of the country, demand peaks are also 'shaved off' on account of lack of adequate supplies.[3] There are also various estimates of 25000 to 35000 MW of power being produced by diesel generation to meet the deficits.[4]

Electricity shortage is not the only problem. Its spread is an equally serious issue. More than 40% of the population has little or no commercial energy access for their living and livelihoods.[5] Others with access often have to cope with poor and erratic availability. This not only deprives them of basic human need for quality of life

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2. Integrated Energy Policy, Report of the Expert Committee (2006), Planning Commission.
3. Central Electricity Authority Online URL: http://www.cea.nic.in/power_sec_reports/Executive_Summary/2010_04/25-26.pdf, 9 Dec. 2010.
4. As per Central Electricity Authority (CEA) estimates by March 2004, aggregate 1 MW and above distributed generation capacity was 18740 MW. The captive power generating systems below 1 MW sold by various manufacturers from 1990 to 2004 were of the order of 23000 MW. Considering the demand and growth trends, the figure of 35000 MW appears to be a very conservative estimate.
5. The 61st round of National Sample Survey Organization survey: Energy Sources of Indian Households for Cooking and Lighting, 2004-05.

but also constraints generation of productive activities and incomes and employment in rural areas, which itself has become a critical factor in India's future development process. Further, the little supply that comes in such areas forces people to depend on use of kerosene for lighting and diesel for powering irrigation pumps and small enterprises. Both these impose further financial burdens on the economy because of high levels of subsidy and add to the problems of energy security.

In an attempt to bridge the gaps and to leapfrog to a higher growth rate, ambitious targets have been set for the conventional power sector (78700 MW for 11th Plan, around 83000 MW for 12th Plan and around 100000 MW for 13th plan period) and all out efforts are being made to achieve them.[6] However, problems are beginning to occur in each sector of conventional power. Mining and import of coal are both facing problems, especially since huge quantities are required. Logistics and transport issues are also emerging. Large hydro projects are also facing problems – largely related to environmental issues and some to project execution in difficult areas along with attendant issues of building long transmission lines. Both natural gas and nuclear power capacity building continue to face their own problems, in the context of the huge targets proposed. Environmental and climate change threats are getting more acute and project clearances more difficult to get. In spite of many policy and infrastructural initiatives, which are now of high priority, it appears unlikely that quantities required to achieve the projected conventional power capacity will actually be available. The question is what would be the quantum of shortfall.

In the above backdrop, therefore, it could reasonably be expected that there could be substantial and worrisome slippages in creating conventional power capacities over the next two decades and even in the long term. How will then the consequent energy requirements be met or shortages be dealt with? It is almost inevitable that this would lead to more consumption of diesel, furnace oil and kerosene. In a situation where we are currently importing more than 80% of the country's needs, and internal reserves unlikely to improve this percentage, serious problems of energy security would arise. Moreover, these may entail rising financial burdens of import and internal financial burdens of subsidies, which are already controversial. It is, therefore, imperative that substantive measures be taken to reduce their consumption for energy purposes as also reduce consumption drastically in personalized urban and long-distance freight transport.

If energy shortages persist it is difficult to expect much improvement in energy access. India has an ambitious programme of rural electrification, viz., Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY). However, even though this may provide grid connectivity to many uncovered areas (still leaving substantial numbers

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6. Projections for Capacity addition/ Generation from conventional power during 11th and 12th Plan as per 11th Plan proposals of the Ministry of Power; Capacity addition during 13th plan broadly in line with the Integrated Energy Policy Report of Planning Commission projections.

unconnected), actual supply of electricity through the grid would remain both constrained and unpredictable. Providing energy access and energy security for the poor would, therefore, continue to be a major issue and problem. Solutions to this simply have to be found which no longer appear possible from conventional sources.

It is clear from the above that India's need for secure, affordable, and environmentally sustainable energy has become one of the principal economic and development challenges for the country. It is also evident that while energy conservation and energy-efficiency have an important role to play in the national energy strategy, renewable energy will become a key part of the solutions and is likely to play an increasingly important role for augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon developmental path.

Growth of Renewable Power

The development of grid interactive, renewable power has essentially taken off with the Electricity Act, 2003 [7] followed by the National Electricity Policy 2005 and the Tariff Policy 2006.[8] These set up percentages for obligatory purchases of renewable power by State of Rajasthan, a system of preferential tariffs for which norms have been prescribed by Central Regulation and facilitating issues related to provision of connectivity etc. A new experiment with Renewable Energy Certificate has also been launched in November 2010.[9] Shortage of power and high rates for market purchase of power enabled setting up of high tariffs for renewable power.

The Government has been promoting private investment in setting up of projects for power generation from renewable energy sources through an attractive mix of fiscal and financial incentives, in addition to the preferential tariffs being provided at the States level. These include capital/interest subsidy, accelerated depreciation and nil/concessional excise and customs duties. In addition, Generation Based Incentives have also been introduced recently for Wind Power to attract private investment by Independent Power Producers not availing Accelerated Depreciation benefit and feed in tariff for Solar Power.

During the last several years the share of renewable power installed capacity has been constantly increasing. In fact renewable grid capacity has increased more than 5 times, from 2% to around 11% in only 8 years, and is contributing about

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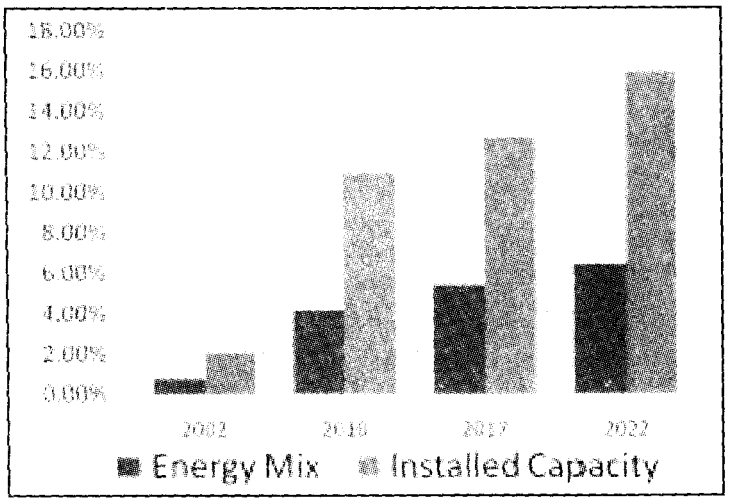
7. Electricity Act 2003 Notification may be seen at : http://www.powermin.nic.in/acts_notification/electricity_act2003/pdf/The%20Electricity%20Act_2003.pdf.
8. Ministry of Power online URL: http://www.powermin.nic.in/acts_notification/electricity_act2003/pdf/Tariff_Policy.pdf
9. Ministry of Power online URL http://www.powermin.nic.in/JSP_SERVLETS/jsp/newsdis.jsp.

4.13% to the electricity mix. The high level of penetration of renewable power in India compares favourably with that of the EU and far exceeds that of the US .[10] During the first three years of the 11th Plan period, this has been 6560 MW, while the conventional power capacity added has been 22302 MW. The Ministry of New and Renewable Energy (MNRE) has ambitious plans to have an installed capacity of about 72000 MW by 2022 which is likely to be about 16% of the installed capacity by then. In terms of electricity mix, this would be about 6.4% rising from the current value of about 4% (Figure 1).

Fig. 1 : Renewable Energy Growth Trends and Projections



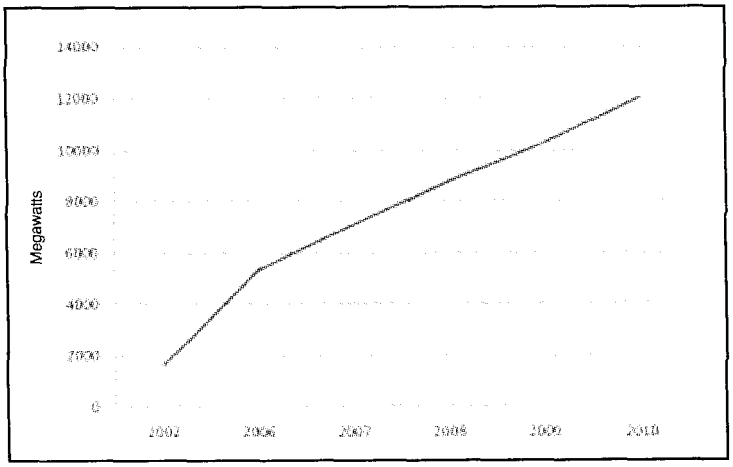
In the larger area of grid power, the Ministry (MNRE) is experimenting with setting-up of smaller plants between 100 KW – 3 MW connected to the distribution grid through 11 kV feeder. It is expected that small plants would reduce the transmission losses by 5-7% with respect to large capacity plants of 50-100 MW size and improve both voltage and frequency at the tail end. It would also help in further transmission of electricity downwards. The same approach is being planned for biomass based power plants of upto 2 MW capacity too as the logistics of fuel management would become much more manageable and more environment friendly. It is envisaged that hundreds of such plants will come up in the next few years thus improving the transmission infrastructure from biomass and solar photo-voltaics (PVs). Such a role can only be played by renewable sources.

The wind power programme of the Ministry of New and Renewable Energy (MNRE) is the fastest growing renewable energy programme and is almost entirely

10. REN 21 Renewables Global Status Report 2010.

coming through private sector investments. India has a potential of around 48500 MW. With a capacity addition of 12800 MW, it contributes to around 75% of the grid-connected renewable energy power installed capacity. The major wind power capacity is in the states of Tamil Nadu, Gujarat, Maharashtra, Karnataka and Rajasthan. An ambitious target of 9000 MW was set for the 11th Plan, of which 5715 MW has already been achieved up to September, 2010. The effort is to do 2000 MW or more annually.

Figure 2: Wind Power Capacity in India, 2002-2010



Power is also generated by utilization of biomass like agro-waste in the form of straws, stalks, stems and fines; agro-industrial processing residues such as shells, husks, deoiled cakes, wood from dedicated energy plantations and bagasse from sugar mills for power generation using combustion technology. The total estimated biomass power potential is about 22000 MW of which 2437 MW has been commissioned.

The Ministry (MNRE) has the mandate for developing micro/ mini/ small hydropower plants up to 25 MW station capacity. The estimated potential for power generation in India from such plants is about 15000 MW from 5718 identified sites. So far over 760 small hydropower projects aggregating to 2803 MW have been set up in various parts of the country and 285 projects of about 940 MW are in various stages of implementation.

Among the various renewable energy resources, India possesses a very large solar energy resource. Most parts of the country are blessed with good sunshine. Therefore, solar energy will be very important for the country. A very ambitious Jawaharlal Nehru National Solar Mission (JNNSM) has been launched with a target of 20000 MW grid solar power and 2000 MW off-grid target by 2022. Cost reduction would be very critical and a major objective of the Mission is to reach grid parity by

2022. The target for Phase-I up to March 2013 is to have 1100 MW of grid and 200 MW of off-grid respectively.[11]

Off-grid Renewable Power Programme

It needs to be underlined that for two major reasons Indian renewable energy priorities are different from that of the developed countries. Firstly, and most importantly, it provides energy access to large rural populations including those in inaccessible areas and meeting unmet demand in many other areas. Perhaps the remoter areas can get electricity only through renewable sources. Secondly, there is another important unrecognized consequence attribute of off-grid applications. In one way or the other, they replace fossil fuels and can make a significant contribution to reduction in their consumption which is so important from the point of view of energy security. For instance, rural lighting replaces kerosene, a biogas plant or solar cooking system replaces cooking gas, solar PV replaces diesel or furnace oil in various areas. Renewable energy can also competitively meet the process heat as well as power requirements of a large number of small and medium enterprises as well in areas which use lot of diesel for power generation. Thus, Renewable Energy should not be seen only, or even primarily so, in the context of grid related power. Its great strength and potential also lies in its ability to generate power in decentralized and distributed mode which has advantages of production at consumption points and does away with land and environment related concerns and problems. This area generally remains largely unexplored or unexploited or even discussed.

A new policy framework has been put in place for rapid up-scaling of off-grid programmes in an inclusive mode. The programmes are now being implemented through multiple channel partners including renewable energy service providing companies, financial institutions including microfinance institutions, financial integrators, system integrators, industry and programme administrators. In order to sustain satisfactory performance and generation of output in the envisaged energy forms, a flexible funding approach has been adopted with a bouquet of instruments including support in the form of capital subsidy, interest subsidy, viability gap funding etc. This apart, the Ministry (MNRE) provides full financial support for undertaking pilot and demonstration projects through manufacturers and other organizations for demonstrating new and innovative applications of renewable energy systems.

The greatest potential area of off-grid relates to solar technologies. These include solar water heating systems, home lighting systems which include solar lanterns, solar cooking systems, solar pumps and small power generating systems. Under the Solar Mission, it has been proposed to cover 2000 MW equivalent by 2022

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11. Jawaharlal Nehru National Solar Mission Resolution, Ministry of New and Renewable Energy, online URL http://mnre.gov.in/pdf/resolution-jnnsm.pdf.

which includes all the above, except solar water heating systems for which there is a separate target of 20 million sq. metres. Within the off-grid component, there is a separate target of covering 20 million rural households with solar lights.[12] This includes coverage under the Remote Village Electrification Programme where largely solar lighting is provided to villages where grid is unlikely to go and which is almost entirely funded by Central grants. In addition, in other areas where grid is available but power supply is of an erratic nature, solar lighting is financed through loans given through rural banks. These have very ambitious targets. However, the aspiration goals of the Ministry (MNRE) would raise the bar by another 2000 MW in the same period; specifically targeting reduction in consumption of fossil fuels where solar power, even at current costs, could be somewhat competitive after getting some government support. This could be made possible by covering niche areas like solar-powering of telecom towers, large scale use by industrial establishments in the manufacturing sector where diesel generating sets have been installed for partly mitigating daytime use of diesel, increased coverage in areas like Ladakh where diesel is the prime source of energy generation, etc. This would require support of other institutions and industries. Naturally, the rising costs of oil and the lowering of cost of solar would play a catalytic role.

An extension of off-grid relates to rural electrification. Over 40% of the country's population currently does not have energy access. This has become a major problem and inspite of large investments under the RGGVY for rural transmission, it has been found increasingly difficult to provide this access, especially in certain identified areas. Biomass based solutions are possible. They are relatively more viable commercially and can be implemented in market mode with some Government support. Already about 150 villages have been covered through mini grid by rice husk based gasification systems in Bihar. Pilot projects are under preparation for using pine needles in Himalayan pine forests. Lantana weed in the forests areas of Central India and possibilities of dedicated bamboo plantations are also being examined. Pilot projects from solar to find suitable business models have also been carried out in several villages. These will, however, require substantial Government support or financial support which may come as grants through some fund or the other to meet the initial capital cost. In hilly areas water mills and micro-hydel plants are being promoted. To satisfy the unmet demand, the Ministry (MNRE) would like to cover about 10,000 villages from biomass-based systems and over 1000 villages from solar power up to 2022. These achievements could make a huge dent in the critical issues relating to energy access.

There are two important developing areas using concentrating solar technologies. First for steam generation and used mainly for cooking, laundry and process heat applications. The World's largest system for cooking in community kitchen has been installed at Shirdi in Maharashtra to cook food for 20,000 people

12. *Ibid.*

per day and is saving around 60,000 kg of LPG every year.[13] The Ministry (MNRE) would like to cover at least 1000 large solar cooking systems by 2022. All areas including large institutions like hostels, hospitals/medical colleges, military/para-military establishments, industrial organizations, wherever large number of meals are cooked, are the targets. Essentially, these will reduce the consumption of cooking gas. Wherever such systems are set up, the hope is that the institutions would process the kitchen waste to produce biogas which would also be used in the kitchen for cooking purposes.

The other area is their use for cooking/refrigeration/air conditioning. A few such systems are operational in the country as pilot projects. Several research and development projects have also been initiated to reduce costs and increase efficiencies. This will be a future focus area as successful commercialization will bring huge power savings.

Another important area of off-grid relates to rural cooking. Family size biogas plants and improved cook-stoves, both at the level of individual households or the community are the options available. About 4.27 million family size biogas plants are currently installed in India, although the estimated potential is around 12 million. This is an important programme leading to reduction in drudgery among the rural women and girls engaged in collection of fuel wood and reduction in the rate of deforestation and getting many health benefits, apart from providing organic fertilizer. As far as cook-stove is concerned, the biggest problem relates to inefficient combustion of biomass and the inability of large number of people to spend money on processed fuels for improved cook-stoves because traditionally available biomass is used free of cost. A large number of community size cookstoves currently use substantial amount of fire wood. A pilot project has been launched to test the efficiency and marketability of improved community size cook-stoves, so that the consumption of fire wood is reduced. Simultaneously, a pilot project is being contemplated to test sustainable delivery models for household improved cook-stoves. MNRE has also started the process of upgrading biomass cook-stove test centres as well as developing modified standards for various improved cook-stoves.

Almost 40% of the total energy is utilized in the building sector.[14] As urbanization is growing rapidly, this sector will create a great demand for energy in the future. A green building designed through solar passive concepts and including active renewable energy systems can save substantial conventional energy apart from generating energy for meeting various requirements in different seasons. Keeping

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13. CNN coverage Shirdi Solar cooking system online URL: http://edition.cnn.com/video/data/2.0/video/tech/2010/02/21/kapur.india.green.temp.cnn.html.
14. Energy Balances of Non-OECD Countries (2007 edition), as quoted in Country Report on Building Energy Codes in India, IEA, 2007. URL:http://www.asiapacificpartnership.org/pdf/BATF/country_report/PNNL_(2009)_Country_Report_India.pdf.

in view our climatic conditions, a National Rating System - GRIHA (Green Rating for Integrated Habitat Assessment) has been developed which is suitable for all types of buildings in different climatic zones of the country. It is expected that the Rating system will promote the design and construction of green buildings in the country. Moving beyond buildings, the Ministry (MNRE) is making attempts to develop green campuses. The Government of India has already decided that all its new buildings would henceforth mandatorily conform to 3* or 4* GRIHA ratings. A new scheme on 'Development of Solar or Green Cities' has been launched to encourage and assist the Urban Local Bodies in assessing their present energy consumption status, set clear targets for upto 10% reduction in projected demand, and prepare action plans to generate energy through renewable energy sources and conserve energy utilized in delivering urban services. A mission approach is being attempted in this area of sustainable habitats.

It is estimated that installation of 1000 domestic solar water heaters, can result in peak-load saving of 1 MW. Mandatory provisions, therefore, are being made to make solar water heating mandatory in buildings and sectors where hot water demand is met by electricity or other sources. Large scale deployment of this mature renewable energy technology will not only reduce utility costs but would also result in substantial savings of electricity and fossil fuels.

The growth of renewable energy in India has largely been led by the private sector. Ernst and Young ranked India the fourth most attractive country for renewable energy investment in the world, only behind the United States, China and Germany. As per an estimate, in 2009 the total financial investment in clean energy in India was ₹ 135 billion.[15] Apart from this, Indian Renewable Energy Development Agency (IREDA) and other public sector agencies are also actively funding renewable energy projects. The opportunities are only increasing.

Conclusion

In view of these tremendous possibilities and increasing concerns related to climate change, we simply have to invest in clean and environment friendly renewables, which, because of their plentiful indigenous availability and suitability in meeting various diffused and decentralized needs and having low gestation periods, have the potential to provide both a framework for inclusive growth and an alternative low emission energy development pathway for the country. Renewable energy is experiencing vibrancy all across but there is a long way to go and many barriers to cross. The Ministry (MNRE) is working hard to help this strategic and paradigm shift to take place, but clearly this must be a national endeavour, including all sectors of industries and many Ministries of Govt. of India and this also requires a fundamental change in our collective mind set.

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15. Global Trends in Sustainable Energy Investment 2010 – Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency, UNEP SEFI and Bloomberg New Energy Finance, 2010; p. 8.