

Overview of Renewable Energy Potential In India

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Abstract— India has a vast supply of renewable energy resources, and it has one of the largest programs in the world for deploying renewable energy products and systems. Indeed, it is the only country in the world to have an exclusive ministry for renewable energy development, the Ministry of Non-Conventional Energy Sources (MNES). Since its formation, the Ministry has launched one of the world's largest and most ambitious programs on renewable energy. Based on various promotional efforts put in place by MNES, significant progress is being made in power generation from renewable energy sources. In October, MNES was renamed the Ministry of New and Renewable Energy. Specifically, 3,700 MW are currently powered by renewable energy sources (3.5 percent of total installed capacity). This is projected to be 10,000 MW from renewable energy by 2012.

Index Terms— renewable energy, Non-Conventional Energy, renewable energy sources.

I. INTRODUCTION

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale

such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. In recent years, India has emerged as one of the leading destinations for investors from developed countries. This attraction is partially due to the lower cost of manpower and good quality production. The expansion of investments has brought benefits of employment, development, and growth in the quality of life, but only to the major cities. This sector only represents a small portion of the total population. The remaining population still lives in very poor conditions. India is now the eleventh largest economy in the world, fourth in terms of purchasing power. It is poised to make tremendous economic strides over the next ten years, with significant development already in the planning stages. This report gives an overview of the renewable energies market in India. We look at the current status of renewable markets in India, the energy needs of the country, forecasts of consumption and production, and we assess whether India can power its growth and its society with renewable resources.

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II. REPLACEMENT OF CONVENTIONAL FUELS WITH THE RENEWABLE RESOURCES

Renewable energy replaces conventional fuels in four distinct areas : electric generation, hot water/space heating motor fuels, and rural (off-grid) energy services²

- **Power generation.** Renewable energy provides 19% of electricity generation worldwide. Renewable power generators are spread across many countries, and wind power alone already provides a significant share of electricity in some areas: for example, 14% in the U.S. state of Iowa, 40% in the northern German state of Schleswig-Holstein, and 49% in Denmark. Some countries get most of their power from renewables, including Iceland (100%), Norway (98%), Brazil (86%), Austria (62%), New Zealand (65%), and Sweden (54%).¹
- **Heating.** Solar hot water makes an important contribution to renewable heat in many countries, most notably in China, which now has 70% of the global total (180 GWth). Most of these systems are installed on multi-family apartment buildings and meet a portion of the hot water needs of an estimated 50–60 million households in China. Worldwide, total installed solar water heating systems meet a portion of the water heating needs of over 70 million households. The use of biomass for heating continues to grow as well. In Sweden, national use of biomass energy has surpassed that of oil. Direct geothermal for heating is also growing rapidly.
- **Transport fuels.** Renewable biofuels have contributed to a significant decline in oil consumption in the United States since 2006. The 93 billion liters of biofuels produced worldwide in 2009 displaced the equivalent of an estimated 68 billion liters of gasoline, equal to about 5% of world gasoline production.

III. ENERGY TRENDS IN INDIA

To better understand the current situation in India and the future of the renewable energies market, it is important to look at the trends in energy consumption, growth of the current grid, and the availability of transportation and equipment used there.

a) Energy consumption and production up to 2005 : Since the 1980's, and still currently, India has encountered a negative balance in overall energy consumption and production. This has resulted in the need to purchase energy from outside the country to supply and fulfil the needs of the entire country. The Government is more sensitive to renewable

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energy potential and has started to put reforms and projects, incentives and legislation in place to convince investors and companies to make the shift.

b) The breakdown of energy sources for power production of India in 2005 :

India is a large consumer of coal, which makes up more than 57% of its total consumption. However, more than 1/3 of energy consumed comes from renewable resources, predominantly from large hydropower. India relies heavily on coal energy to produce electricity. A strong second is hydro power, followed by natural gas. The consumption of all renewable energies represents fully one third of the total consumption.

c) Distribution of the different kinds of plants and lines of transportation

India relies principally on coal for 57% of total energy consumption. As we can see on the map, coal production is extensive and is located in central and north-eastern parts of the country. Hydro power plants are distributed along the west coast from the southern tip to about ¾ the way up the coast, in the extreme north, and some in the east from rivers flowing from the Himalayas. Except for the fact that the gas and products line don't extend, the country has the largest railway network in Asia and the second largest in the world under a single management. Roads are taking developmental changes to the most remote corners of the country.

IV. GOVERNMENT REGULATIONS

India is one of the countries most involved in developing the use of renewable energies and is trying to make the opportunity for investors more attractive than costly.

a) Financing Sources and Incentives :

To promote renewable energy technologies in the country, the government has put in place some subsidies & fiscal incentives. The Indian Renewable Energy Development Agency has

been set up under Ministry for Non-Conventional Energy Sources and is a specialized financing agency to promote and finance renewable energy projects.

Following is a short list of new measures:

- Income tax breaks
- Accelerated depreciation
- Custom duty/duty free import concessions
- Capital/Interest subsidy
- Incentives for preparation of Detailed Project Reports (DPR) and feasibility reports

More details are as follows:

- 100 percent income tax exemption for any continuous block of power for 10 years in the first 15 years of operations
- providers of finance to such projects are exempt from tax on any income by way of dividends, interest or long-term capital gains from investment made in such projects on or after June 1, 1998 by way of shares or long-term finance

- accelerated 100-percent depreciation on specified renewable energy-based devices or projects
- accelerated depreciation of 80 percent in the first year of operations
- interest rate subsidies to promote commercialization of new technology
- lower customs and excise duties for specified equipment
- exemption or reduced rates of central and state taxes.

Ministry for Non-Conventional Energy Sources mix of fiscal and financial benefits:

- 2/3rd of the project cost subject to a maximum of Rs. 2.00 crore per 100 KW for procurement of modules, structures, power conditioning units, cabling etc. to the implementing agency. The balance cost on land, extension of grid lines, transformers, civil works, foundation and erection and commissioning, etc. is met by the implementing agency.
- Up to Rs. 1.0 lakh for the preparation of Detailed Project Report (DPR) for the grid interactive SPV power projects.
- 2.5 percent of its share of project cost, subject to a maximum of Rs. 5 lakhs for performance evaluation, monitoring, report writing, etc. to the State Nodal Agency.
- Interest subsidy of up to 4 percent to Financial Institutions including IREDA, Nationalized Banks etc. for captive power projects of maximum capacity 200 KW by industry.

b) Environmental Legislation

2001 Energy Conservation Act

- Focus on energy efficiency
- Standards and labeling
- Designated consumers requirements
- Energy conservation building codes
- Energy conservation fund
- Bureau of Energy Efficiency

2003 Electricity Act

- Combined several existing pieces of legislation
- Intended to accelerate growth of power sector
- Targets additional 10 percent from renewable by 2012 (1000 MW/year capacity)
- Competitive market-based
- Features include:
 - National Electricity Policy
 - Deregulation of generation and captive generation
 - Public ownership of transmission companies
 - Open access in transmission
 - Freedom for distribution licenses
 - Establishment of State Electricity Regulatory Commissions
 - License-free generation and distribution in rural areas

Provisions and activities impacting the power sector:

- Elimination of ceiling on foreign equity participation
- Streamlining the procedure for clearance of power projects

- Establishment of the Central Electricity Regulatory Commission
 - Formulating an action plan to set up the National Grid
- State reforms impacting the power sector:
- unbundling the State Electricity Boards (SEB) into separate generation, transmission and distribution companies
 - privatizing the generation, transmission and distribution companies
 - setting up independent state electricity regulatory commissions
 - making subsidy payments for subsidized categories of customers by state governments
 - making tariff reforms by state governments
 - enabling legislation and operational support extended to the SEB/utility
 - improving operations of SEBs, particularly with regard to better management practices, reduction of transmission and distribution losses, better metering and reduction of power theft.

V. GENERAL FORECASTS FOR THE NEXT DECADES

Around the world, a growing number of nations have recognized the economic, social, and environmental benefits of renewable energy and are enacting tax incentives and other policy measures favorable to renewable technologies. In Germany, Japan, Spain, and a handful of other countries, clear government commitments to renewable energy and strong, effective policies have overcome barriers and created demand for these technologies, leading to dramatic growth in renewable industries and driving down costs:

a) The electricity consumption and generation forecasts of India as part of the emerging economies:

Growth in net electricity consumption is expected to be most rapid among the emerging economies of the world, including India. According to the EIA, the annual average increase will be about 4.0 percent from 2002 to 2025. Emerging economies are projected to more than double their net electricity consumption, from 4,645 billion kilowatt hours in 2002 to 11,554 billion in 2025. The projected growth in net electricity consumption for emerging market economies is driven in large part by gross domestic product (GDP) and population growth assumption. Because of the links between reliable electricity supply, GDP growth, and living standards, many of the nations with emerging economies are attempting to increase access to reliable electricity supply.

b) Projected energy consumption of India for 2030:

Currently, 45 percent of households in India do not have access to electricity. New legislation has set a target of electrifying all households by 2010. As in the past, the ongoing challenge in providing electricity is the ability of the poor to pay. India announced plans in March, 2005, to continue subsidizing electricity consumption for rural and poor households that use less than 30 kilowatt hours per month.

VI. CONCLUSION

India is a nation in transition. Considered an "emerging economy," increasing GDP is driving the demand for additional electrical energy, as well as transportation fuels. India is a nation of extremes. Poverty remains in areas with no energy services, while wealth grows in the new business hubs. Coal fired generation currently provides two thirds of the generation capacity, and hydropower supplies the other third. Yet, India is blessed with vast resources of renewable energy in solar, wind, biomass and small hydro. In fact, the technical potential of these renewables exceeds the present installed generation capacity. Unique in the world, India has the only Ministry that is dedicated to the development of renewable energies: the Ministry of New and Renewable Energy. This bodes well for the acceleration of renewable development throughout the nation -- both to meet the underserved needs of millions of rural residents and the growing demand of an energy hungry economy.

The development and deployment of renewable energy, products, and services in India is driven by the need to decrease dependence on energy imports sustain accelerated deployment of renewable energy system and devices expand cost-effective energy supply augment energy supply to remote and deficient areas to provide normative consumption levels to all section of the population across the country. And finally, switch fuels through new and renewable energy system/device deployment. In a report on the Indian economy by Deutsche Bank, in which countries were ranked by attractiveness for outsourcing and off-shoring, India came in #1, well ahead of China. India is currently experiencing strong economic growth, while at the same time attempting to extend modern power services to millions still in poverty. Expanding electrical capacity is essential. Renewable energy remains a small fraction of installed capacity, yet India is blessed with over 150,000 MW of exploitable renewables.

Tapping India's wind, solar, biomass, and hydro could bring high quality jobs from a domestic resource. Extending the electric grid between all states, and ultimately between neighbor nations will expand international trade and co-operation on the subcontinent.

This report is meant only as an overview in hopes that it will encourage even more rapid and extensive development of the renewable energy resources on the Indian subcontinent.

REFERENCES

- [1] "Overfishing". National Geographic. Retrieved 2013-01-06.
- [2] **Jump up**^ COUNCIL REGULATION (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy. Retrieved 2013-01-05.
- [3] **Jump up**^ "Text of the United Nations Convention on the Law of the Sea: Part V". Retrieved 2012-05-01.
- [4] **Jump up**^ Lu Hui, ed. (16 August 2006). "Pollution, overfishing destroy East China Sea fishery". *Xinhua on GOV.cn*. Retrieved 2012-05-01.
- [5] **Jump up**^ "Most Penguin Populations Continue to Decline, Biologists Warn". Science Daily work=Science News. Sep 9, 2010. Retrieved 2013-01-05.
- [6] **Jump up**^ Rural Science Graduates Association (2002). "In Memorium - Former Staff and Students of Rural Science at UNE". University of New England. Retrieved 21 October 2012.

- [7] **Jump up**[^] Gold, M. (July 2009). What is Sustainable Agriculture?. United States Department of Agriculture, Alternative Farming Systems Information Center.
- [8] **Jump up**[^] "FAO World Agriculture towards 2015/2030". Food and Agriculture Organization. 2003. Retrieved 2013-01-06.
- [9] **Jump up**[^] Committee on 21st Century Systems Agriculture (2010). *Toward Sustainable Agricultural Systems in the 21st Century*. National Academies Press. ISBN 978-0-309-14896-2.
- [10] "WBCSD Water Facts & Trends". Retrieved 2009-03-12.
- [11] **Jump up**[^] Stricker, Julie. "Energy experts to discuss Alaska's 'stranded' renewable resources Read more: Fairbanks Daily News-Miner - Energy experts to discuss Alaska's 'stranded' renewable resources".
- [12] **Jump up**[^] "Arguments for and Against Renewable Resources".
- [13] **Jump up**[^] Sawin, Janet. "Charting a New Energy Future." State of the World 2003. By Lester R. Brown. Boston: W. W. Norton & Company, Incorporated, 2003.
- [14] **Jump up**[^] "Exergy (available energy) Flow Charts". "2.7 YJ solar energy each year for two billion years vs. 1.4 YJ non-renewable resources available once."
- [15] **Jump up**[^] Buchan, David. *The Rough Guide to the Energy Crisis*. London: Rough Guides, 2010. Print.
- [16] **Jump up**[^] "Energy Sources: Solar". *Department of Energy*. Retrieved 19 April 2011.
- [17] **Jump up**[^] "How Geothermal energy works". Union of Concerned Scientists. Retrieved 2013-01-06.
- [18] **Jump up**[^] Turcotte, D. L.; Schubert, G. (2002). "4". *Geodynamics* (2 ed.). Cambridge, England, UK: Cambridge University Press. pp. 136–137. ISBN 978-0-521-66624-4.
- [19] **Jump up**[^] Cataldi, Raffaele (August 1993), "Review of historiographic aspects of geothermal energy in the Mediterranean and Mesoamerican areas prior to the Modern Age", *Geo-Heat Centre Quarterly Bulletin* (Klamath Falls, Oregon: Oregon Institute of Technology) **18** (1): 13–16, retrieved 2009-11-01
- [20] **Jump up**[^] "Energy Resources: Geothermal power". Darvill.clara.net. Retrieved 2013-01-06.
- [21] **Jump up**[^] B.N. Divakara, H.D. Upadhyaya, S.P. Wani, C.L. LaxmipathiGowda (2010). "Biology and genetic improvement of *Jatropha curcas* L.: A review". *Applied Energy* **87** (3): 732–742. doi:10.1016/j.apenergy.2009.07.013.
- [22] "Biomass Resources for Energy and Industry". Retrieved 2012-12-03.
- [23] **Jump up**[^] [1] Retrieved on 2012-04-12.
- [24] [^] Jump up to:^{a b c d} Frauke Urban and Tom Mitchell 2011. Climate change, disasters and electricity generation. London: Overseas Development Institute and Institute of Development Studies