
*Journal of Advances in Science and Technology*

*Vol. VII, Issue No. XIV, August-2014, ISSN 2230-9659*

# ENERGY POTENTIAL AND EFFICIENCY OF INDIA: A CASE STUDY OF RENEWABLE ENERGY

AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

www.ignited.in

Journal of Advances in Science and Technology
Vol. VII, Issue No. XIV, August-2014, ISSN 2230-9659

# Energy Potential and Efficiency of India: A Case Study of Renewable Energy

**Ms. Aseem Sharma**

Sr. Lecturer, Physics Department

***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.***

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## INTRODUCTION

Indian tribes and Alaska Natives in the United States (hereafter "tribes") are well positioned to take advantage of renewable energy development opportunities as a result of the vast amount of land and energy resources controlled by tribes. Tribes are actively exploring new business models to own and invest in energy assets, and to develop and produce power, either for consumption by their own people or for economic development purposes as a commodity for sale to utilities and industry on the wholesale power market. The goal of this Handbook is to provide tribal leaders and tribal members with concepts and strategies to assist them in understanding renewable energy project development, how best to protect tribal assets, preserve tribal sovereignty and, if the tribe chooses to do so, partner with non-tribal entities for financing and project development.

Renewable energy potential in Indian country is even more significant. NREL has estimated that there is the potential for about 535 billion kWh/year of wind energy alone available on Indian lands in the contiguous 48 states, which is equivalent to 14 percent of current U.S. total annual energy generation. NREL estimates that there is also 17,600 billion kWh/year of solar energy potential on Indian lands in the lower 48 states; this amount is equivalent to 4.5 times the total U.S. electric generation in 2004.[5] In addition, Indian Country will continue to play a growing role in transmission infrastructure throughout the nation.

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.

India is home to a vast supply of renewable energy resources and boasts one of the largest programs for deploying renewable energy products and systems in the world. In fact, India was the world's first country to have an exclusive ministry for renewable energy development, the Ministry of New and Renewable Energy Sources. India initiated its renewable energy program in 1981 with the establishment of the Commission for Additional Sources of Energy, which was later converted into the Ministry of Non-Conventional Energy Sources (MNES) in 1992 and renamed the Ministry of New and Renewable Energy (MNRE) in 2006.

## ENERGY EFFICIENCY AND RENEWABLE ENERGY

The Indian economy has grown rapidly over the past decade. The rapid economic growth has been accompanied by commensurate growth in the demand for energy services that is increasing the country's vulnerability to energy supply disruptions. This vulnerability is not unlike that observed in the US and China, which too import an increasing share of their oil and gas requirement.

India relies on indigenous coal, and to a lesser extent oil, to meet its energy demand. While the country has had large reserves of coal, it now imports over 15% of its coal supply, relies on imported oil for more than 75% of its oil needs, possesses limited natural gas

reserves while importing 30% of total supply, and faces chronic electricity shortages. The gap between electricity supply and demand in terms of both capacity (i.e. kW) and energy (i.e. kWh) has been shifting annually in India. The extent of shortage reported by India's Ministry of Power (MOP) in its Annual Report for 2007-08, has increased from 7% to 10% (energy) and from 11% to 17% (capacity) in the last five years.2 The inability of the electricity grid to supply reliable power, particularly to business consumers, has prompted increased use of captive power generation that often uses diesel fuel. The rising demand for petroleum products is expected to be met through imports. India has discovered new natural gas resources in offshore areas, which will reduce its projected dependence on the imports of this fuel. Coupled with deteriorating coal quality, India's energy situation is likely to worsen its vulnerability to volatile fuel prices in a tightening world oil and gas market.

These vulnerabilities are being addressed through diversification of energy imports, the development of indigenous fossil and renewable energy sources, and, last but not least, reduction of the intensity of energy use of the Indian economy. In this report, we focus on ways to stretch India's existing energy supply capacity by making energy use more efficient. The increased efficiency will permit energy companies to meet their demand obligations, and energy-short businesses to increase production that will result in higher tax payments to governments at all levels. Similar to the energy efficiency potential, India's wind energy potential has been reassessed during the past year and the new estimates yield generation capacity that is several times the overall existing generation capacity in the country. More efficient use of energy and renewable electricity generation thus has the potential to reduce the nation's vulnerability in both the imported fuels and electricity markets.

Efficiency improvement also has the potential to boost economic growth that can result in higher tax revenue for the government. An analysis of the electricity efficiency potential for India shows that efficiency improvement in combination with new supply can eliminate electricity shortages at the same investment level as for a business-as-usual electricity supply scenario.

Economic analyses of energy efficiency, including demand response (DR)9, technologies often portray these as being cost-effective when compared with supply alternatives. Since they reduce energy use and/or shift peak energy use to off-peak hours they also eliminate deleterious environmental consequences and vulnerability to supply disruptions. A key question often posed in earlier studies of energy efficiency is if the technologies are cost effective should their market penetration be higher than commonly observed in developed and developing countries.

Accelerated shift to energy efficient appliances in designated sectors will be enabled through innovative measures. These products would be made more affordable. This target would be achieved by DSM measures, supported with CDM financing wherever possible. The initiative includes the following activities: National CDM Roadmap, Programmatic CDM, Standards and Labeling, Public procurement, Technology program, Energy Conservation Building Code (ECBC), ESCOs Promotion, Capacity building and information, and Policy transparency.

## 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. Since thermal generation is based on burning coal or oil, increases in CO2 emissions, which damage the environment and affect global warming, accompany this growth. As the graph below shows, it also increases the dependence on imports, which will continue into the future unless the policy changes.

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. As we will demonstrate later, the Government is more sensitive to renewable energy potential and has started to put reforms and projects, incentives and legislation in place to convince investors and companies to make the shift.

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. This is a significant figure, and we will see later that this sector has a great future.

## RENEWABLE POTENTIAL

India is the 4th largest country with regard to installed power generation capacity in the field of renewable energy sources and much is waiting to be discovered by it. Wind, Hydro, Biomass and Solar are main renewable energy sources. India has tremendous potentialities to harness the much-needed energy from renewable sources and considered as one of the ideal investment destinations for renewable energy equipment manufacturers and service providers.

Wind energy has posted the highest growth. India could become top player in world's solar market.

India intends to provide a reliable energy supply through a diverse and sustainable fuel mix that addresses major national drivers. These include security concerns, commercial exploitation of renewable power potential, eradication of energy poverty, ensuring availability and affordability of energy supply and preparing the nation for imminent energy transition.

The country has an estimated renewable energy potential of around 85,000 MW from commercially exploitable sources: Wind, 45,000 MW; small hydro, 15,000 MW and biomass/bioenergy, 25,000 MW. In addition, India has the potential to generate 35 MW per square km using solar photovoltaic and solar thermal energy.

The Government of India has outlined ambitious capacity expansion and investment plans for the eleventh five year plan period (FY 2007- FY 2012). It has proposed an addition of 15,000 MW of Renewable Energy generation capacities during the period. Wind Power projects form 70 percent (10,500 MW) of the proposed capacity addition, while Small Hydro Projects (SHP) accounts for 9.3 per cent (1,400 MW). The total investments on development of RE during the plan period is expected to be about USD 2 billion.

India has a commercially viable renewable potential of around 85,000 MW, which includes wind potential of 45,000MW, small hydro of 6,000 MW and 25,000 MW of biomass/bio-energy. Further, the country has the potential to generate 20 MW per sq. km. using solar photovoltaic and solar thermal energy.

The latest Ernst & Young's Renewable Energy Country Attractiveness Indices, which rank countries based on regulatory environment, fiscal support, unexploited resources, suitability to different technologies and other factors determining renewable energy growth in a country, has ranked India fourth on its All Renewable Index (ARI). India's consistent top-grade ranking in the ARI over the past few years is further testimony to the country's appeal as a renewable energy investment destination.

Factors such as energy security, the power-generation potential of various renewable sources, environmental concerns, and the availability of mature and indigenous technologies for select renewable sources are among the key imperatives for renewable energy to play a more pivotal role in India's energy mix.

These factors, along with existing power shortages in the state, have prompted the government, both at the Central and State level, to recognize the importance of developing renewable energy sources and formulating policies and measures to develop the renewable energy value chain.

The Electricity Act 2003 provides the overall framework for promoting and sustaining the growth of renewable energy sources in India. It contains several provisions to promote the accelerated development of power generation from non- conventional sources, such as directives to the central and state regulator to determine tariffs for renewable energy sources and to set renewable purchase obligations (RPOs) as a percentage of total electricity consumption in the area of a distribution licensee. It also provides that the State Electricity Regulatory Commission (SERC) would promote the generation and co-generation of electricity for renewable sources through suitable measures for connectivity with the grid.

## CONCLUSION

Future growth in energy demand will place considerable stress on India's ability to garner domestic and imported energy supplies. Continued energy shortages and environmental pollution, particularly in urban areas, may be exacerbated, and the country may continue to be vulnerable to potential oil and gas supply disruptions, and to the volatility of petroleum crude prices. Exclusive dependence on supply sources would aggravate the energy security risk posed by such disruptions. Energy efficiency offers a cost-effective solution to overcoming this risk that is almost entirely within the control of the Indian government and private sector. Building capacity to plan and implement energy efficiency programs will help advance India's energy security and mitigate the local environmental and global warming impact of unbridled energy growth, specifically coal. Improving the country's energy productivity will require a concerted effort by all sectors.

Renewable energy offers a substantial potential for generating electricity. Due to the rapid expansion of wind power plants over the past five years, renewable energy is the fastest growing component among all the power generation sources. Combined with potential growth of solar power plants renewable energy can also contribute to the elimination of electricity shortages, reduction of local pollution and carbon emissions from conventional power plants. Policies that promote faster growth of wind energy, development of new transmission grids, and ways to integrate renewable sources into the grid are being worked on and hopefully will be set up soon to accelerate wind penetration.

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 150,000MW of exploitable renewables.

It makes sense to the authors that all efforts and investment should consider accelerating these sustainable energy resources before committing to the same fossil fuel path as western nations. The fossil fuel strategy will surely bring price volatility from dwindling supplies and added pollution from carbon combustion.

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.

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