RENEWABLE ENERGY IN INDIA: ISSUES AND PROSPECTS

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Abstract

The notion of a green economy has become a core of policy debates in recent years as it provides a way out to the multiple crises that the world has been facing in recent years –the climate, food and economic crisis. The concept of green economy carries the promise of a new economic growth paradigm that is responsive to the earth's ecosystems which is the need of today. India recorded 62% rise in investment in renewable sector according to the Renewables 2012 Global Status Report published by the Renewable Energy Policy Network. India was the fifth largest investor in renewable energy in 2011 after China, US, Germany and Italy and has the sixth largest capacity in the world (excluding hydro). The Ministry of New and Renewable Energy said that a significant quantum of the investments made in 2011 came through the FDI route. India ranks sixth among the world's 20 leading economies in attracting funds for clean energy projects. Clean energy investment in India, has increased 600 percent since 2004, supported by national policies. The objective of this paper is to provide an overview of the status of Energy Efficiency (EE) and Renewable Energy (RE) in India by analysing associated opportunities, risks, present status and the role it can play in Economic Development in the present scenario (taking GDP as a proxy for Economic Development). Hence if this scenario continues India will be a global leader in renewable energy sector. Little twist, assistance and optimistic view can go a long way in this trend along with policy changes, which will attract more FDI through this route.

Key Words: Renewable Energy, FDI, economic development, technological revolution, energy investment

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SECTION I: INTRODUCTION

Climate Change has been attributed to alteration in the composition of the global atmosphere due to the growing greenhouse gas emissions on account of the growing human activities and this is in addition to natural climate variability observed over comparable time periods. Due to diminishing and depleting fossil fuels, intensifying prices of conventional category of fuel and the unfavourable ecological effects from use of fossil fuels, renewable energy is budding as one of the most important areas of technological advancement. Energy is a basic stipulation for endurance and a significant factor affecting economic progress and employment. Energy crisis has pinched the attention of policy makers, planners, due to the impact of availability and cost of energy on economic growth, industrial production, employment, etc. The majority of developing countries depend heavily on bio resources. Deforestation and desertification and resulting natural calamities due to extensive mining and extraction of mineral ores for generation of power are threatening and frightening. Traditional energy sources and subsistence pattern of agriculture thus famished the rural sector of biomass fuels. At the same time more efficient sources of energy are needed for sustainable development. The term sustainable development was invented by the UN Bruntland committee to illustrate a development, which satisfies the needs of the present without conciliation the ability of future generations to convene their own needs. Its purpose is to cope with the development related environmental degradation. When expansion and development takes place in observance of environmental consideration in mind we track the very significant theory of "sustainable development". On the contrary if the developmental planning is short sighted completely ignoring the environmental damages then it severely affects the ecological balance thereby making Planet earth unstable. Rapidly increasing population and unmatched resource capacity makes it challenging to maintain environmental quality and economic progress. Further damage to the environment can be arrested by emergent consciousness, acquaintance about origins and outcomes of environmental squalor and degradation, shifting attitude and technologically advanced skills. The path of achieving the sustainable development is difficult but the, the globe leaders have strong-willed to achieve this global goal of Sustainability. The progress in this direction is quite evident in the form of spreading consciousness, which is clearly glimpsed in the form Earth Summit (Rio '92), taking

up voluntary program for sustainable development especially in developing countries that are practicing strict legislation and trappings to control further environmental degradation.

Globally, India is the fourth largest emitter of Green House Gases (GHGs), although its per capita emission is relatively less compared to west and the global average. We have to timely respond to this scenario mainly because of rising population which needs to be pulled out of low income trap, which will decidedly increase its emission levels. We are likely to enter into a vicious circle of global warming and the catastrophic natural changes i.e. changes in polar ice, disruption of natural air and sea currents etc. The biggest challenge before the developing countries is how to reconcile growth ambitions with climate sustainability. From traditional perception, embracing of climate change agenda will append high costs to our economies. This leads to the biggest challenge and concern as to can we uphold and sustain it? From an alternate angle there is a big opening and prospects for us.

The present study is an attempt to review the availability, current status and future potentials of renewable energy. To achieve the objectives of the study, the paper is divided into 7 sections. Section I gives an introduction of the current scenario of renewable energy in India. A comprehensive review of existing literature is given in section II. Section III gives a comprehensive detail of renewable energy scenario in India. Section IV gives insights on role of Clean Development Mechanism (CDM) to promote renewable energy followed by section V that discusses the importance of FDI in renewable energy sector and its status. Section VI examines the impact of rebound effect on energy production and usage. The VII section suggests recommendations to boost renewable energy sector. References are entailed in last section.

SECTION II: REVIEW OF LITERATURE

Renewable energy in India has assumed great importance in recent years in because of rise in energy consumption, high reliance on coal to meet domestic energy demand, heavy dependence on imports for meeting demand for petroleum and volatility in world oil market. By shifting to renewable sources of energy, we can achieve energy independence, mitigate climate change, develop rural areas, improve health and reduce expense on pollution related ailments. India ranks fourth in the world in terms of total installed capacity of wind energy. India has the world's largest small gasifier programme and second largest biogas programme. Demand for solar water

heaters is also gaining momentum. Small hydro has been growing in India at a slow but steady pace. Installation of the technologies like improved cooking stoves (ICSs) and solar photovoltaic (PV) systems are also gaining impetus. In spite of many successes, the overall growth of renewable energy in India has remained slow. Global pressure, targets for greenhouse gas emission reduction, oil crisis, growth of rural electrification program, and import of hydropower from neighbouring countries may boost the future prospects of renewable energy in the country (Bhattacharya et al., 2009, Kumar et al., 2010). Renewable energy gadgets for domestic and industrial applications such as solar water heaters, solar cookers, dryers, wind energy, biogas, biomass gasifier, improved cook stoves and biodiesel have the potential to mitigate greenhouse gas emissions (Panwar et al., 2011). With the inception of National Solar Mission (NSM) also termed as 'Solar India', India has made considerable progress in solar power generation. Approximately 58% of the geographical area in India potentially represents the solar hotspots in the country with more than 5kWh/m2/day of annual average Global insulations (Ramachandra et al., 2011). On the basis of wind frequency distribution, the coastal and dry arid zones of Karnataka have good wind power potential in India (Ramachandra et al., 2003).

SECTION III: TRENDS OF RENEWABLE ENERGY IN INDIA

India is considered to be one of the prevalent market places for clean technologies with the advantages of low manufacturing and development cost. The question is how to reconcile growth ambitions with climate sustainability. From traditional perspective, adoption of climate change agenda will add costs to our economies. This leads to the concern – can we sustain it? From an alternate perspective there is a big opportunity for us. The sustained economic growth is placing immense pressure of demand on its energy resources in India. There are severe imbalances of demand and supply which necessitates the Indian Government to increase its energy supply. Nearly 80 % of demand of oil is fulfilled by county's imports which can be a matter of serious concern with regard to future prices of oil. There is a substantial risk of not being able to utilise the installed thermal capacity due to shortages in fossil fuels. Dependence on imported oil is increasing. It is anticipated that in the coming years the supply of indigenous coal will sharply fall owing to production and logistics constraints. Significant rise in reserves and production of gas can meet the power needs only at small levels. The rapid rise in world population,

developmental needs and greed of human beings has led to alteration of eco systems, increase in number of natural calamities and degradation of water quality. Many hydro projects have changed the river eco systems, changing flows of water and fragmented channels. It has harmed the fisheries, and degraded the water quality. Owing to these conditions, India faces severe energy supply constraint.

There are many factors which have lead to rise in demand for energy like rapid increase in population economic growth, developmental needs, increasing prosperity and rise in the access to energy. Owing to these factors, there is an emerging energy supply and demand imbalance. As per Central Electricity Authority Report, there is a shortage of 12.9 % in 2012 which was 10.3% on 2011. This shortage scenario has lead to rise in the usage of Diesel and furnace oil in all the sectors including commercial, industrial and institutional. This situation has to be arrested as soon as possible as this is leading to enormous rise in cost by way of subsidy and increasing dependence on the imports. This situation is further magnified because of lack of electricity in the rural areas because of which there is rising use of Kerosene oil. This leads us to conclude that India was and is persistently facing a lack of access to energy and continuous supply and demand imbalances.

Renewable energy can make a significant contribution in the economy. It is now considered as the main part of the solution to nation's energy and is no longer called as alternative energy. In all categories of renewable energy, India is ranked as 5th in the world with 15691.4 MW Grid connected and 367.9 MW off-Grid Renewable energy based power capacity (The Potential for renewable energy in India, 2012). Grid-interactive renewable power projects based on wind, biomass, hydro and solar are mainly driven by private investments supported by constructive tariff policy regimes established by State Electricity Regulatory Commissions (SERC). Distributed/decentralized renewable power projects (Off-Grid Power) using wind energy, biomass energy, hydro power and solar power are being established to meet the energy requirements of isolated areas which are not likely to be electrified in near future (www.mnre.gov.in). The main objectives of the programme are to support R&D, make such systems more reliable and cost-effective and strengthen manufacturing base. According to Ernst and Young's Renewable energy attractiveness Index, India is considered among top 5 destinations worldwide for solar energy development. As per World Bank Studies, India has 150

GW of Renewable Energy Potential in the form of wind, Hydro power, biomass, solar energy, Co-generation and waste energy.

A comparison of potential and installed capacity of major sources of Renewable energy is shown in following table and figure:

Table I: A comparison of potential and Installed Capacity of Renewable Energy Sources - 2012

Sources of Energy	Installed up to 31.01.2012	Potential
Wind	16179 MW	45000 MW
Solar	482 MW	50000 MW
Biomass	3547 MW	30000 MW
Small Hydro	3300 MW	15000 MW

Source: Energetica India

Wind energy accounts for 70 percent of renewable energy generated in India. Wind turbines have short Gestation period, greater reliability, low operating and maintenance cost which make them a favoured choice for capacity addition. India is at fifth position in terms of wind energy generation following China, US, Germany and Spain. India has the potential of generating 48,561 MW of wind power out of which only 14158 MW is being generated till March 2011. Government of India has set up Indian wind Energy Association, Indian Wind Turbine Manufacturers Association, Indian Wind Power Association and Center for Wind Energy Technology (C- WET) to foster Production, Research, Testing and Certification in the area of wind power generation.

The hydro power refers to the energy produced from rainfall flowing into rivers. By good water management and storage continuous electricity generation can be done throughout the year. Hydro power plant can be installed in areas that receive good rainfall. In India, Projects for generation of hydro power up to 25 MW station Capacities are classified as small Hydro power projects and come under the preview of Ministry of New and Renewable Energy. Their estimated power generation potential is estimated at more than 15000 MW. However, the installed capacity till March 2012 is only 3200 MW. The Ministry is encouraging development of Grid-interactive and decentralized commercial projects of small hydro both in the public as well as private sector. Ministry is also promoting renovation, modernisation and up gradation of

water mills through research and development. Water mills operate on two technologies: high – head systems and Low head Systems. The potential for hydro power is concentrated in North and North Eastern states that receive heavy rainfall like Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram and on the west coast between Mumbai (Bombay) and Mahe. In States like Uttarakhand, hydro power projects can be set up on irrigation canals (Meisen, P., 2010).

India is gifted with vast potential of Solar Energy because of its location between the Tropic of Cancer and the Equator. Most of the parts of India have about 310 to 340 sunny days in a year which implies that India is receiving approximately 5,000 trillion kWh per year energy with most parts receiving 4-7 kWh per sq. m per day. There are two technology routes for conversion of solar radiation into heat and electricity; solar thermal and solar photovoltaics. Solar also provides the ability to generate power on a distributed basis and has short gestation period. Solar is the most secure among all sources, as it is abundantly available. Solar energy, if captured effectively has the potential to meet the entire country's power requirements. Presently, the Grid connected capacity stands at 481.48 MW while the estimated solar energy potential is 50000 MW.

Bio power is produced from agricultural residues, agro-industrial residues and plantations and urban & industrial wastes. It can be classified into 4 categories; Biogas, Biomass power / biogases cogeneration, Biomass Gasifier and Urban & Industrial wastes.

Biogas is manufactured using by anaerobic digestion of animal waste, cattle dung, other loose and leafy organic matters/ wastes waste from forest, rural based industries (agro/food processing) and kitchen wastes organic fertilizer. Biogas plants provide energy for cooking and electricity generation and organic fertilizer. It has the potential for providing sustainable livelihood development as well as tackling local (land, air and water) and global pollution. MNRE has initiated Biogas based Power Generation Programme (BPGP) to promote this route of power generation, in the range of 3 kW to 250 kW.

Biomass can be converted into liquid fuels, called "bio fuels". Bio fuels may be used as an alternative transportation fuel. The two most common types of bio fuels in use are ethanol and biodiesel. Ethanol can be produced by a process called gasification. In Gasification, biomass is converted into synthesis gas using high temperatures and a low-oxygen environment. This gas is

a mixture of hydrogen and carbon monoxide. The synthesis gas also referred to as "syngas," can then be chemically converted into ethanol and other fuels. Ethanol is used as blending agent with gasoline to increase octane and reduce carbon monoxide and other smog-causing emissions. Some Flexible Fuel Vehicles are designed to run on E85 which is an alternative fuel with much higher ethanol content than regular gasoline. Government of India recently mandated the blending of 10 percent ethanol in 90 percent gasoline. This has created approximately 3.6 billion-litre demand for ethanol in the entire country. This significant demand growth creates tremendous manufacturing opportunity for the ethanol industry. Biodiesel is made by mixing alcohol (usually methanol) with any vegetable oil, animal fat, or recycled cooking grease. It is used as an additive (generally 20%) to reduce vehicle emissions or directly as a renewable alternative fuel for diesel engines.

Geothermal is energy generated from heat stored in the earth. Immense amount of thermal energy is generated and stored in the Earth's core, mantle and crust. This heat can be drawn from hot water or steam reservoirs deep in the earth that are accessed by drilling; geothermal reservoirs located near the earth's surface, and the shallow ground near the Earth's surface that maintains a relatively constant temperature of 50°-60°F. Geothermal energy is at present contributing about 10,000 MW over the world and India's small resources can augment the above percentage. Studies carried out by the geological survey of India have observed existence of about 340 hot springs country. These are distributed in seven geothermal provinces along the west coast in Gujarat and Rajasthan and along a west south west-east-northeast line running from the west coast to the western border of Bangladesh (known as SONATA). They are most productive in a 1500 km stretch of the Himalayas. The resource is little used till now but the Government has ambitious plans to increase the total installed capacity.

Hydrogen energy is at early stage of development. Ministry of New and Renewable Energy has funded research projects on different aspects of hydrogen energy technology development. India is the member of the International Partnership on Hydrogen Economy (IPHE) set up in Washington, DC in November 2003. Future challenges to India includes lowering cost of hydrogen and improving production rates from different methods, development of compact and inexpensive storage capacity, establishment of hydrogen network, development of hydrogen

fuelled IC engine and efficiency improvement of different type of fuel cell systems. The road map envisages taking up of research, development and demonstration activities in various sectors of hydrogen energy technologies and visualized goals of one million hydrogen-fuelled vehicles and 1000MW aggregate hydrogen based power generation capacity to be set up in the country by 2020.

Government of India has launched National Action Plan on Climate Change (NAPCC) to enhance the renewable energy generation capacity in the country and some incentives are also given by Central Government to encourage the development of new renewable energy projects. Central Government has put in place significant tax incentives like 80 percent (earlier 100 percent) depreciation in the first Year, concessional Import duty on wind turbine parts, excise duty reliefs, sales tax exemptions, loans through Indian Renewable Energy Development Agency (IREDA) and Income Tax Holidays for ten years. Indian Renewable Energy Development Agency Limited (IREDA) is a Non Banking Public Limited Government company set up in 1987 to promote, develop and extend financial assistance to renewable energy projects. Ministry of New and Renewable Energy along with IREDA and National Renewable Energy Laboratory (NREL) is responsible for promoting renewable sources of energy like wind energy, solar energy, biomass and waste energy and small hydro energy.

SECTION IV: PROMOTING PROJECTS USING ALTERNATIVE ENERGY THROUGH CLEAN DEVELOPMENT MECHANISM (CDM) ROUTE

The clean development mechanism (CDM) of the Kyoto Protocol has been set up to assist developing countries in achieving sustainable development by promoting greenhouse gas emission reduction projects, that generate emission credits (certified emissions reductions, CERs) for industrialized countries. The CDM promotes responsible investment by developed countries in the developing ones. It allows greenhouse gas emission reduction projects to take place in countries that are signatories to Kyoto Protocol and have no emission targets under the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol. An enterprise in industrialized country can gain Certified Emission Reductions (CERs) by investing in clean technologies in developing countries. The investment has to go through the stringent

criteria prescribed by the UNFCCC CDM Executive Board which includes Sustainable development in terms of environment, society and economy. Additionally, all expansions must be according to CDM, host country approval and Environmental Impact Assessment (EIA). A number of countries are taking advantage of the CDM. For the recipient developing countries, this can boost returns on projects by up to 12% for wind, hydro and geothermal projects and by 15–17% for biomass and municipal waste projects (UNEP). Indian enterprises have already committed investment to generate more than 379 million CERs. Worldwide investments are being made to generate CERs.

SECTION V: FDI IN RENEWABLE ENERGY SECTOR

Electricity demand is growing @ 8% annually. Capacity addition of about 92,000 MW is required in the next 10 years to meet this demand. RE projects have Low gestation periods and give quick return. India is generously endowed with RE resources like solar, wind, bio-mass materials, urban and industrial wastes and small hydro resources. Favourable government policies, large number of financing options available for capital equipment, increasing awareness among industry makes India a very attractive location for FDI in renewable energy development. The Government of India has permitted 100% foreign direct investment (FDI) in the renewable energy sector and has put in place constructive policies to attract foreign companies in the sector. According to statistics provided by The Ministry of New and Renewable Energy, India ranks sixth among the world's 20 leading economies in attracting funds for clean energy projects. Major global companies that have started exploring the Indian renewable energy market are: Abengoa, eSolar, GE, Sharp, Siemens, Sun Technics (ConergyGroup), Vestas, IBC Solar, Fidelis Energy, Gamesa, BP, Applied Materials, 3TIER, Enercon, Du Pont. An investment of more than Rs. 4900 crore has been received as foreign direct investment equity inflows in the renewable energy sector since 2008.

SECTION VI: REBOUND EFFECT

In developing countries with unmet demand for energy, there is a rebound effect. Innovations in technology to improve the efficiency of energy-using appliances and systems may lead to decrease in implicit price of energy and increase in consumption of energy and its impact on environmental because of 'rebound' or 'take-back' effects. Consumers may buy more products and/or choose models that are bigger, more powerful and have more features. Thus just

promoting technical innovation in appliances to increase energy efficiency may not lead to reduced energy consumption and emissions. To control demand for energy, efficient technology has to be supplemented with appropriate pricing policy, taxation or regulation (Greening et al., 2000, Roy, 2000 and Herring et al., 2007).

Although energy consumption/capita is low in Asian Countries, energy/GDP is high for India. There is need for improvement in efficiency in energy consumption and to use present energy resources judiciously without contributing to carbon emissions to have surplus energy for more productive uses and to increase GDP per capita (Ramachandra, 2011).

SECTION VII: RECOMMENDATIONS

- At present new renewable energy generators have to compete with old nuclear and fossil fuelled power stations. Old power stations produce electricity at marginal costs because consumers and taxpayers have already paid the interest and depreciation on their original investments. A right framework of policies and initiatives can give the present energy generators a big push and encouragement.
- Political support is needed to create a level playing field for old and new players. This process would contribute to sustainable economic growth, high quality jobs, technology development, global competitiveness and industrial and research leadership which is the need of today.
- Companies, Governments or countries should work in collaboration and share technology and coordinate their actions to produce renewable energy. There should be more events like Rio so that such entities get a platform to share their developments in renewable energy sector. To ensure that the commitments are fulfilled, timelines should be specified and the results should be reported (Schmidt et.al. 2012).
- Recognizing the enormous potential of RE technologies, the GOI must come out with more attractive tax benefits, simplified permit procurement, reduced number of required governmental authorizations and unrestricted levels of foreign direct investment in the ownership of renewable energy projects, and must promote sustainable commercial projects using renewable energy, especially for the areas in which there is a big potential like Gujarat, Kerala, Madhya Pradesh, Maharashtra and Tamil Nadu. This road is less travelled and needs more exploration in terms of policy regimes.

- The GOI must also give some encouragement in terms of exemptions/reductions in the excise tax duty on the manufacture of renewable energy systems and devices like flat plate solar collectors, solar water heaters and systems, Solar PV cells, windmill systems, and any specially-designed devices which operate those systems (e.g., including electric generators and pumps running on wind energy, bio gas plants and bio gas engines, etc.); The GOI provides "soft" loans on favourable terms to manufacturers and users of renewable technologies through the Indian Renewable Energy Development Agency (IREDA) and some of the Indian nationalized banks and other financial institutions for some identified technologies/systems in renewable energy sector.
- The renewable energy industry is identified as a 'priority sector' by the Reserve Bank of India (RBI) to obtain loans from banks; and The GOI provides a facility for third party sales of renewable energy power.
- Another area which needs to be worked upon is large-scale development of RE in which there is risk involved in technology adoption; distortions in energy market and easy availability of conventional energy with established networking arrangements; stiff competition from subsidized conventional energy and its universal applicability; lack of large scale production facilities; high capital investment and marginal commercial viability; lack of marketing mechanisms; lack of trained manpower.

We have to cope with all these challenges and allow more FDI in renewable sector for sustainable development to give a big push to the Indian economy and take maximum advantage of this sector on the path of sustainable development.

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