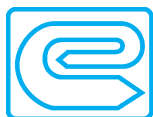


EXIM BANK: RESEARCH BRIEF

NEW RENEWABLE ENERGY IN INDIA: HARNESSING THE POTENTIAL



January 2011

EXPORT-IMPORT BANK OF INDIA

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No. 58

INTRODUCTION

There has been an increasing realisation on enhancing the use of renewable energy as a primary instrument for achieving the twin objectives of energy sufficiency and climate change mitigation. With India becoming globally more responsible in its endeavour towards sustainable development, the possibility of renewable energy becoming a cornerstone for meeting the country's future energy requirements are significantly high. The key drivers that would further India's cause to promote the use of renewable energy include energy security, climate change, and opportunities in the carbon market.

RENEWABLE ENERGY: A GLOBAL PERSPECTIVE

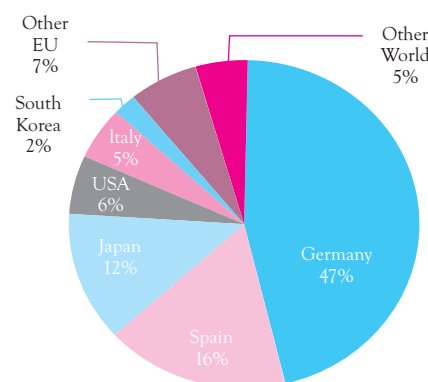
An analysis of the new renewable energy technologies, viz., solar photovoltaic, wind and biomass, indicates a clear shift in global preference towards these technologies as sources of energy, especially in generation of electric power. Many governments have realized the strategic long-term importance of renewable power generation and have placed it at the core of their economic growth plans. This is reflected in recent power generation statistics, wherein renewable sources accounted for 47% (140 GW) of all types of new generating capacity added to the world's grids (about 300 GW) cumulatively during 2008 and 2009. The increasing importance accorded to renewable energy among international business can further be corroborated by the fact that the total investment in renewable energy capacity in 2009 amounted to US\$ 150 bn – nearly 40% of annual investment in the upstream oil and gas industry, which was a little over US\$ 380 bn. In terms of international trade, global exports of renewable energy supply related products amounted to US\$ 284.8 bn, exhibiting an average annual growth of 20.8% during the 5-year period 2004-2008. Germany

was the largest exporter with exports in 2008 aggregating US\$ 40.3 bn, followed by China (US\$ 37.4 bn), USA (US\$ 26.9 bn), Japan (US\$ 24.6 bn), France (US\$ 11.6 bn) and Italy (US\$ 11.5 bn). In terms of imports, USA was the largest importer in 2008 (US\$ 35.2 bn), followed by Germany (US\$ 27.1 bn), China (US\$ 25.8 bn), Spain (US\$ 14.4 bn) and South Korea (US\$ 9.8 bn).

Photovoltaic Industry

The global photovoltaic (PV) market has been growing at over 40% per annum in recent years, with global PV installations in 2009 being almost six times the 2004 figure. Thin film's share of the global market increased from 14% in 2008 to 19% in 2009 for PV cells, and from 16% to 22% for PV modules. The global cumulative PV capacity (grid-connected and off-grid installation) reached 25 GW in 2009. The addition in grid-tied PV capacity alone in 2009 is estimated to be 7 GW with off-grid accounting for 3GW- 4GW. More than half of the new installations in 2009 (grid connected) were in Germany, which continued to be the country with the largest solar PV electricity capacity amounting to 9.8 GW in 2009 (47% share), followed by Spain (with 3.4 GW capacity), Japan (2.6 GW) and USA (1.2 GW). Global exports of PV panels/modules amounted to US\$ 43.2 bn in 2008, recording an average annual increase of 35.7% during the 2004-2008 period. PV panels/modules represented a share of 37.2% in global exports of US\$ 116 bn of solar energy related goods and components. Germany and China were the two main players in both export and import of PV panels/modules in 2008. India's exports of PV panels increased from US\$ 85 mn in 2004 to US\$ 529 mn in 2008 (1.2% share in global exports), making it the 15th largest exporter. In terms of import, India was ranked 20th with total imports amounting to US\$ 420 mn in 2008 as against US\$ 45 mn recorded in 2004.

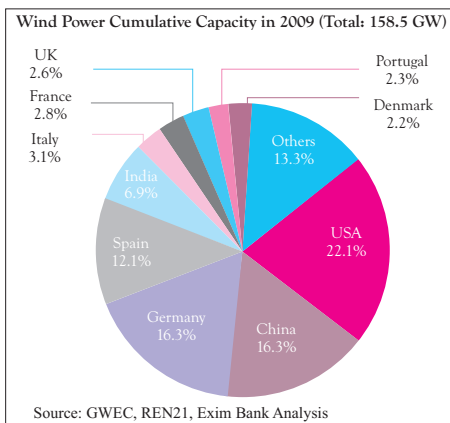
Solar PV Existing Capacities (Grid-tied),
Top 6 countries, 2009 (Total: 21 GW)



Source: REN21, Exim Bank Analysis

Wind Energy Sector

The global cumulative installed capacity of power generated from wind energy increased from 40 GW at the end of 2003 to 158 GW at the end of 2009, with the annual installed capacity increasing from 8.2 GW in 2004 to 38.3 GW in 2009, thereby recording a CAGR of 36%. The additional capacity of 38.3 GW for wind power in 2009 was the highest among all the renewable technologies, an indication of the sector's potential. USA maintained its position as the largest market of wind power globally with a cumulative installed capacity of 35.1 GW in 2009, followed by China (25.8 GW), Germany (25.8 GW), Spain (19.2 GW), and India (10.9 GW). In terms of international trade, world exports of wind turbines quintupled from US\$ 1.1 bn in 2004 to US\$ 5.3 bn in 2008. Germany overtook Denmark as the largest exporter of wind turbines in 2008 with exports aggregating US\$ 2004 mn compared to Denmark's exports of US\$ 1250 mn. India, which had negligible exports of wind turbines in 2004 (approx. US\$ 1 mn) increased its exports phenomenally to US\$ 651 mn to emerge as the third largest



exporter in 2008 (compared to its 12th rank in 2004). In terms of imports, USA was by far the largest market with imports of wind turbines shooting up from mere US\$ 64 mn in 2004 (5.6% share) to US\$ 2679 mn (39.7% share) in 2008.

Biomass Sector

The use of biomass as a source of energy for both power generation and heating as also for transportation has been increasing across the globe. World biomass power capacity (excluding electricity generated from municipal solid waste or industrial waste) amounted to 54 GW by the end of 2009. EU remained the top region with electricity capacity from biomass aggregating 16.0 GW in 2009. Within EU, the main countries included Germany (biomass power capacity of 4 GW,) and Spain (0.4 GW). Power generated from biomass has also increased significantly in many developing countries. China's capacity increased 14% in 2009 to 3.2 GW, while India, which generated 1.9 TWh of electricity with solid biomass in 2008, had a biomass power capacity of 1.5 GW in 2009. By the end of 2009, India had installed 835 MW of solid biomass capacity fuelled by agricultural residues (increase of about 130 MW in 2009) and more than 1.5 GW of bagasse cogeneration plants (up by nearly 300 MW in 2009, including off-grid and distributed systems).

THE NEW RENEWABLE ENERGY SECTOR: REFLECTIONS FROM THE INDIAN MARKET

India is the fifth largest primary energy consumer, and the fourth largest petroleum consumer globally. Rapidly growing economic and social development coupled with increasing population has spurred increased energy consumption across all the major sectors of the economy. The current power generation mix (as at end July 2010) in India is dominated by coal with a share of 53.2% (87.1 GW) followed by large hydropower (22.6% share; 37.0 GW) and gas (10.6%; 17.3 GW).

Renewable energy sources rank fourth with an installed capacity of 16.4 GW. Although the country continues to rely on coal as the primary energy source, its share in installed capacity has declined from 59.3% in end March 2003 to 53.2% in end July 2010. As opposed to this, the share of renewable energy sources has shot up from a mere 1.5% to 10.0% during the same period. The importance accorded by the Government to renewable energy can be assessed from the fact that India remains the only country in the world having a Ministry exclusively dedicated to renewable energy, viz. Ministry of New and Renewable Energy (MNRE). A capacity of about 17.1 GW grid-interactive power generations from various renewable energy sources had been installed by end January 2010 against a target of 12.3 GW for the 11th Five Year Plan.

Based on the products identified as being related to new renewable energy, India's exports aggregated US\$ 3.4 bn as against imports of US\$ 4.2 bn in 2008. Although there is a trade deficit, exports of renewable goods, on an average, have increased at a faster pace than imports during the 2004 to 2008 period. Germany was India's largest trading partner for the identified renewable goods and equipments in 2008 (two-way trade of US\$ 1219 mn) followed by China (US\$ 1059 mn). USA, Spain, Japan, Italy and Brazil were India's other major trading partners for renewable goods in 2008. From an export perspective, USA was India's largest export destination with exports totaling US\$ 597 mn in 2008 (17.6% share) – an appreciable average annual growth of 84.3% during the 2004-2008 period. As far as imports are concerned, China emerged as the most important source for India's renewables with imports from the country amounting to US\$ 1016 mn in 2008, up significantly from US\$ 132 mn in 2004. In terms of the product basket, the most actively traded renewable energy goods by India in 2008 was PV panels/modules with amount traded being US\$ 949 mn in 2008, more than six fold increase over the 2004 level of US\$ 158 mn.

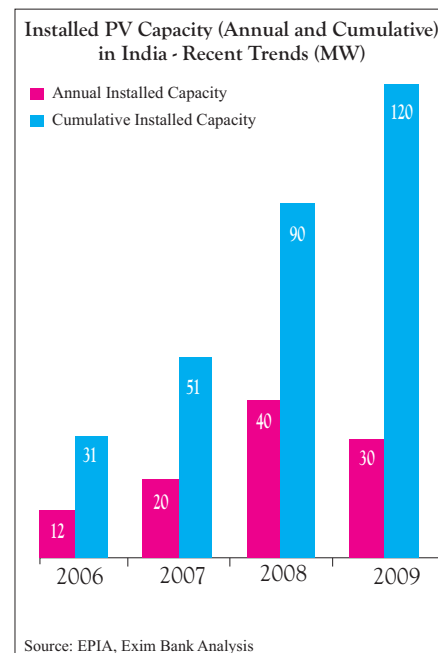
Photovoltaic Industry in India

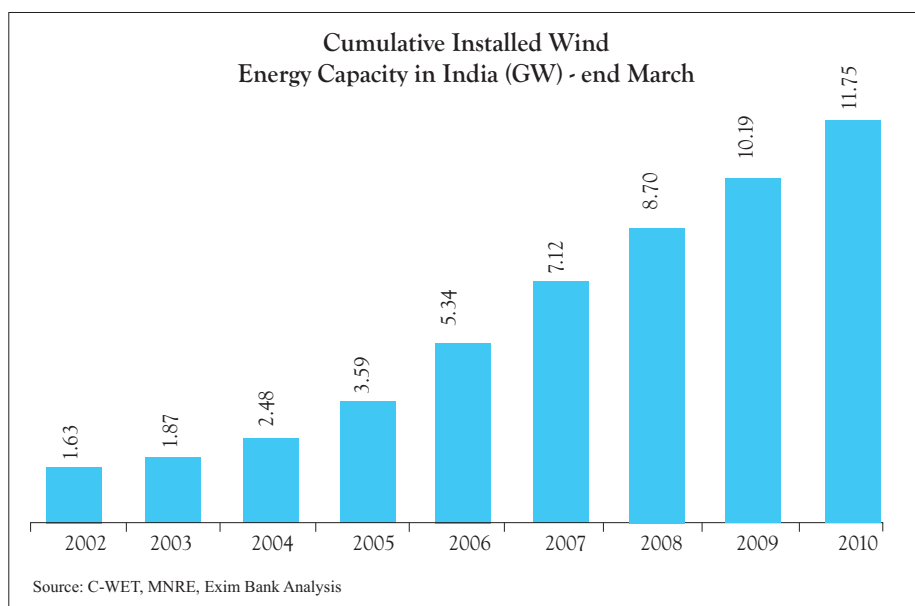
With a large proportion of power generated from photovoltaics being off-grid, and given the large number of small solar systems involved, the total installed PV capacity in India can at best only be an estimation. Estimates suggest that around 30 MW of new PV capacity was installed in India in 2009 taking the total cumulative PV capacity to 120 MW. In terms of the value chain, the total solar cell manufacturing capacity in India is estimated to have touched 175 MW, while the total PV module manufacturing capacity was estimated

to have reached 240 MW in 2008-09. The value chain of PV industry in India comprises four major segments, viz. silicon and thin film manufacturers; solar appliance manufacturers; engineering, procurement and construction players; and project developers. The solar PV technology in India is dominated by crystalline silicon with 90% of PV modules manufactured in the country using this technology, while only 10% of PV modules are manufactured using Thin Film or amorphous silicon technology. PV panels/modules was the largest item exported by India in 2008 under the PV and related goods category with exports aggregating US\$ 529 mn - more than six-fold increase over 2004. While Spain was the largest export destination contributing 40%, Germany was the biggest source of imports accounting for 38% of India's total imports of PV panels/modules in 2008.

Wind Energy in India

India, with a large peninsular belt, and two-season monsoon, has significant potential in generating wind energy. Apart from onshore generation, India also has potential for tapping offshore belts for wind energy. The total wind power installed capacity reached 11.75 GW as at end March 2010, up from 1.63 GW in 2001-02, thereby registering a healthy average annual growth of 28.6%. The country added 1564.7 MW to the installed capacity in 2009-10 as against 1484.0 MW in 2008-09. The geographic dispersion of wind farms in India has been gradually witnessing a shift. With increasing interests in renewables, the dominance of Tamil Nadu (4875.9 MW) has been gradually declining as other states, including Maharashtra (2071.6 MW), Gujarat (1864.6





MW), Karnataka (1506.9 MW) and Rajasthan (1091.7 MW) have started to catch up. Analysis of India's trade reveals that wind turbines was the single largest product traded by India in the wind energy sector in 2008 with total trade aggregating US\$ 653 mn, of which almost the entire amount (US\$ 651 mn) was for the purpose of exports. USA was the largest export destination for wind turbines (31% share) followed by Brazil, Australia, Portugal and Spain.

Biomass Energy in India

Biomass is an important energy source for power generation, especially in developing countries like India. For the last 15 years, biomass power has become an industry attracting annual investment of over Rs.1000 cr, generating more than 9 GW of electricity per year. Blessed with ample sunshine and rains, India offers an ideal environment for biomass production. A target for addition of 1,700 MW capacity, comprising of 500 MW of biomass power projects and 1,200 MW of bagasse cogeneration projects, has been proposed during the 11th Plan period. In addition, 400 MWe energy power from industrial and municipal waste and 100 MWe of distributed renewable generation for power and heat has been proposed which include biomass resources. By June 2010, the cumulative biomass power/bagasse cogeneration based power capacity had reached 2312.6 MW, which comprised 901.1 MW of biomass power projects and 1411.5 MW of bagasse cogeneration projects. The year 2009-10 witnessed a significant increase in biomass power / bagasse cogeneration capacity addition of 384 MW (125 MW biomass projects and 259 MW bagasse cogeneration projects). With the present utilization pattern of crop residues, the amount of surplus biomass materials is about

150 million tonnes, which could potentially generate about 18,000 MWe of power. Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal have potential for setting up biomass based power projects of 100 MW or above.

RENEWABLE ENERGY- A FUNDING PERSPECTIVE

One of the major constraints inhibiting the realization of the potential of renewable energy is availability of capital. Inability of firms in obtaining finance for renewable energy projects has often been seen as a strong deterrent to investments in many countries around the world, including India. The main hurdle in investment in renewable energy remains the high up-front costs, particularly for installing equipments. To some degree, strengthening capacity building, promoting enabling environment, developing policy frameworks, and improving demands for renewable energy technologies (RET) can help in mitigating the steep transaction costs and create markets. Such capacity building initiatives are a prerequisite to stimulate investments in the renewable energy sector.

In the context of India, a well constructed policy support mechanism by the Governments, both at the centre and at the state levels, including fiscal incentives, is crucial for the success of renewable energy programs. Such mechanisms are required to help support increased incentives in RET by shifting the investment paradigm of energy sector away from the typically undervalued investment costs of fossil fuels. Given the barriers, innovative finance mechanisms could lead the

way to increase the demand for investments in RET, and generate a sustainable market for the deployment of RET. The success of the usage and the proliferation of RET would only be possible through a two pronged strategic approach (a) sound financial support mechanism; and (b) constructive policy initiatives enabling enhanced investment in the sector.

Financial Support Mechanism

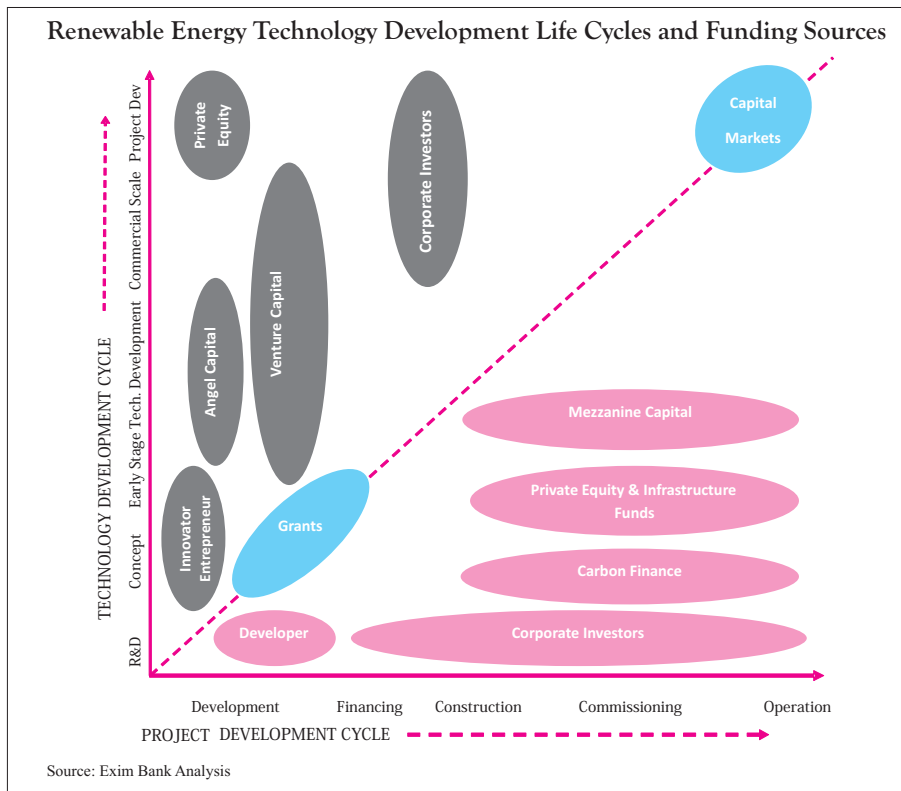
Financing methods in the RET sector have mostly been conventional debt and equity products. However, of late, financing mechanism of renewable energy has become a mainstream activity with various innovative financing modes having been introduced at different stages of evolution of the RET - from concept to its commercial use.

The development and commercial viability of RET is an expensive affair since significant costs are incurred at both the stages. Equipment manufacturers, construction contractors, integrators/assemblers (those who bundle technologies together into an integrated package) and service providers are all integral players in the RET sector. Their innovations, expertise and performance are critical in making RET a commercially viable sector. The risks associated with financing development of such technologies are high, especially given that the sector is largely at its nascent stage and the commercial utilization of technologies is still to pick up. In spite of these deterrents, given the opportunities this industry offers for sustainable growth, the players in this sector have been successful in devising means and mechanisms to finance its growth, at different stages of the technology and project development cycle of this industry.

Investor groups which have been proactive in undertaking possible interventions at various stages of technology development and project development cycles of the renewable energy sector are - the innovator entrepreneurs, developers, angel investors, venture capital, private equity, infrastructure funds and mezzanine capital, apart from the capital market.

Policy Initiatives

Policy initiatives remain the backbone for the success of RET. As the sector requires huge amount of capital, a conducive policy oriented ambience is expected to encourage greater investments into the sector. In a country like India, which is a highly value-conscious mass market, public is unlikely to pay substantial premiums for goods/services tagged "clean," especially in the near future. In such a scenario, clean energy projects may not be sustainable



without government support, primarily in the form of capital infusion. This can be done in a number of ways, from sanctioning grants (reduces initial investments costs), introducing tax credits (to reduce capital or operating costs), including low interest loans and grants (lowers capital recovery requirements), to introducing green purchasing targets (which may help to create a market pull by committing to buy green power for their operations) in the country, apart from bringing in renewable portfolio standards and feed-in-tariff.

Multilateral Financing Mechanisms

Many multilateral financial institutions across the globe have taken steps to facilitate investments and promote renewable energy by providing special credit lines and funds. There are several multilateral programmes of cooperation that aim at increasing the utilization of renewable sources of energy in the context of climate change mitigation. Today, all major multilateral agencies are incorporating environmental consideration in their programmes. Although the share of financial assistance from these institutions is not as big as bilateral aid or private sector investment, they can still play a pivotal role in promoting international cooperation in the new emerging mechanism. Demand is increasing for

multilateral financing because these institutions offer loans for a longer period unlike commercial banks which would typically offer a loan with a maturity of no more than 5-7 years.

SUMUP

The electricity generated from renewable energy sources accounted for 25% of global power capacity, and 18% of global power production in 2009. During the same year, renewable energy sources accounted for 60% of newly installed power capacity in Europe, and more than 50% in USA. The sustainable energy investment in 2009, including generation from renewable sources and energy efficiency projects, indicates the determination of countries across continents, including developing countries, to transform the financial and economic crisis into an opportunity for green investment.

It is estimated that the newly-installed capacity from renewable sources in the world as a whole could increase by over 50% in a couple of years. This could be achieved through innovative financing and incentive mechanisms. Favourable policies are already in place in more than 100 countries; however, to maintain the upward trend in renewable energy growth,

policy efforts need to be taken up to a higher level in these countries, and need to be introduced in the remaining countries, thereby encouraging massive scale up of renewable technologies.

India has been at the forefront of renewable energy technology with the country being amongst the first in the world to have a full fledged Ministry catering to this niche sector. However, the success level is relatively low as compared to China, who has moved ahead within a short span of time. India, unlike many countries in Europe, has a distinct advantage in generating energy from all the three emerging renewable energy technology fields – photovoltaic, wind, and biomass – which need to be leveraged suitably so as to harness their potential. Appropriate mechanisms could be created to overcome the barriers at the early stage of project development, while simultaneously creating enhanced deal flow for later stage private and foreign institutional investors.

The contents of the publication are based on information available with Export-Import Bank of India and on primary and desk research through published information of various agencies. Due care has been taken to ensure that the information provided in the publication is correct. However, Export-Import Bank of India accepts no responsibility for the authenticity, accuracy or completeness of such

Note: 1 crore : 10 million

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