www.SETatWork.eu

Country Profile for INDIA

Prepared by: *TERI, India*

Prepared: *January 2009*

Published: *March 2009 revised November 2009*

Contents

SETatWork is supported by the European Commission under the Seventh Framework Programme (FP7). This publication reflects the author's views. Although the author's best efforts have been made to ensure that the information contained herein is accurate, neither the European Commission, the SETatWork Project Members nor the author are liable for any use that may be made of the information contained herein.

1. Introduction

1.1 SETatWork Country Profiles

This report is one of a set of Country Profiles produced by **SETatWork**. The global society is faced with a huge challenge in order to meet the threat given by global warming. The project **SETatWork - Sustainable Energy Technologies at Work** aims to meet this challenge through the collaboration and partnerships between organisations in EU, Asia and South America, supported by the EU's Seventh Framework Programme (FP7). The activities take place over two years from 1 September 2008 to 31 August 2010.

The aim of this country profile is to provide an overview of the carbon markets in India with a focus on RTD (Research & Technological Development) needs, implementation options and perspectives associated with energy efficiency and savings in the carbon market (short term and medium-long term).

The main target groups of this country profile are companies (financial investors, project developers, technology providers, ESCOs, consultants, etc.), organisations and administrations that are interested in a short overview of relevant information in the development of carbon projects and markets in India. This information will also be relevant for readers from other countries that are interested in an overview of the country as well as for national readers that need to have information on the national developments.

SETatWork Country Profiles can be found online at: http://www.setatwork.eu/countries.htm

1.2 SETatWork Sustainable Energy Technology (SET) Priorities

In each country, companies and organisations were interviewed by SETatWork in order to identify indicative priority rankings for various Sustainable Energy Technologies (SET) and Industrial Sectors. The results of these interviews for each sector can be viewed on the following page: http://www.setatwork.eu/maps/index.html

The SETatWork Priorities for India are shown below. Where data is not yet available, the bar chart columns are left empty.

TARGET INDUSTRIES:

1. CEMENT: Will need more efficient technologies from developed countries.

2. CERAMICS: Can be tapped through programmatic CDM mode.
3. CHEMICAL: Petrochemical industry has very low potential, but chemical offers medium potential.
4. MINING: Requires technological improvements as well as energy efficiency improvement.
5. PAPER: Old plants hold high potential.
6. POWER: High because of supercritical, ultra supercritical and IGCC technologies.
7. OFFSHORE: Mostly MNCs so already efficient, but wind may hold potential.
8. STEEL & IRON: Very high for SMEs and high for normal.

KEY TECHNOLOGIES:

1. POLYGENERATION: Includes Electricity, steam and refrigeration.
2. CERTIFIED ENERGY: For industries specified as designated energy consumers by BEE.
3. UTILITY SYSTEMS: Focus need to be on electricity distribution systems.
4. PROCESS INTEGRATION: For petrochemical and petroleum refining.

2. General Overview

India has been a part of international efforts to address the issues relating to climate change from the beginning. It's commitment to the cause of global environment was more than evident when the then Prime Minister Mrs. Indira Gandhi participated in the Stockholm Conference on 1972, while other states sent their delegates only. Since then India has introduced many legal and policy measures, requiring as well as facilitating environment friendly development.

After independence, India had opted for technology transfer and import substitution policy to achieve both, domestic technological self-reliance as well higher growth trajectory. Thus transfer of advanced and efficient technologies to achieve high growth and rapid industrialisation has been a priority area in India's planning exercise. In the recent decade with an increased emphasis on climate change abatement and adaptation along with the urgency to meet the energy demands have given a new boost to this policy focus on technology transfer.

After 1990 Indian economy began to adopt free market policies and open up for foreign direct investment in various sectors- particularly in industry. The two major objectives being to enhance investment and to facilitate technology transfer. India's business environment constitutes a strong policy environment to promote international collaborations and a strong presence of domestic private sector, willing to take up independent and joint investment in new areas including energy efficient technologies and renewables.

In the present circumstances, when India has been experiencing high growth rates along with a growing international as well as internal pressure to address the associated GHG emissions, EE and renewable energy has come to the centre stage. India launched its National Action Plan on Climate Change in June 2008 that has set for itself 8 missions. Of these 8 missions, two are explicitly concerned with EE and renewable energy (Solar Mission), while other missions on agriculture, sustainable habitat, and water indirectly

highlight the accent on energy efficient technologies. India has also established a Bureau of Energy Efficiency (BEE) to promote energy efficient technologies and practices.

India has set a target for her self to provide power to all by 2012. To achieve this target a rapid capacity installation has been planned. In this increasing role of private sector has been envisioned. However, the public sector is to continue with its dominating presence for coming few years. In terms of technology, technology upgradation, low cost technologies, and promotion of energy efficient gudgets have been emphasized. The need for a decentralised distribution system in rural areas which cannot be reached through central transmision systems, has also been underlined. This would also require technologies which would be efficient in terms of transmission losses.

India's First NATCOM (National Communication) to the UNFCCC, submitted in 2004, provided an inclusive estimate of emissions by sources and removal by sinks of CO_2, CH_4, and NO_2. In 1994, 1228540 Gg (Gigagrams) of anthropogenic GHGs were emitted. CO_2 emissions constituted 65% share of the total emissions. Share of CH_4 was 31% (agriculture sector- 78%, energy sector- 16%, and waste disposal activities- 6%), and share of N_2O being 4% (agricultural sector- 84%, fuel combustion- 7%, industrial processes- 5% and waste- 4%). Sector wise the largest share was of energy sector (61%) followed by agricultural sector (28%), industrial processes (8%), waste (2%) and LULUCF (1%). Removal by sinks was 23533 Gg, resulting in net emissions of 793490 Gg. This constituted 65% of total GHG released.

Facts about India
Area:
total: 3,287,590 sq km
land: 2,973,190 sq km
water: 314,400 sq km
Coastline: 7000 Km

Natural hazards: droughts; flash floods, flooding from monsoonal rains; severe thunderstorms; earthquakes

Population: 1,147,995,904 (July 2008 est.)

Final energy consumption, by sector (2006)
- Industry: 44.4%
- Transport 16.9%
- Residential 13.6%
- Agriculture 7%
- Non-energy usage 8.1%
- Other energy usage 8.6%
- Commercial 1.4%

In sectoral terms, the precise contribution of different sectors varies a little between the official data and the more recent WRI estimates; however the general spread of emissions across different sectors is reasonably consistent[1].

A recently published collation of five modelling exercises (MoEF, 2009) provides a range of estimates for India's future emissions trajectory. Projections of per capita emissions in 2031 range from 2.77 to 5 tonnes CO2, while total emissions range from 4 billion tonnes to 7 billion tonnes CO2. (Only one of the five exercises included methane emissions from agriculture, which is a notable omission since this sector comprised 28% of India's total emissions in 1994).

2.1 The energy sector

The Indian energy sector is complex due to wide variation in lifestyles and use of various energy forms among different section of society. The country's pursuit of its developmental

[1] Where there are discrepancies (for example, in relation to industrial process emissions), these could be the product of either real changes in emissions or different data collection methodologies.

goals and its plans for maintaining high economic growth would inadvertently call for a rapid increase in commercial energy required to fuel the higher levels of economic activity as well as accommodate rising energy aspirations concomitant with higher levels of urbanisation and adoption of modern lifestyles.

On the demand side industry sector is the highest energy consumer followed by the transport and residential sectors. On the supply side, coal, oil and natural gas are the three primary commercial energy sources. Coal is the largest source of energy accounting for a share of 53% in the total commercial energy supply as on ……. (date). Oil and natural gas contribute …. % of and …. % of, respectively. …%of oil is imported and …. %of NG is imported in the form of LNG. Overall, the indigenous resource augmentation and growth in energy supply have not kept pace with the increasing demand and, therefore, India continues to face serious energy shortages. This has led to increased reliance on energy imports to meet the energy demand, and thus increasing the burden on import of oil. Thus, the biggest challenge for Indian energy sector is to reduce its dependence on energy imports.
The electric power generation scenario is given in the tables 1 and 2. It can be seen that coal based electricity production is more than half of the total power generated (Table 2). It is based on sub-critical steam cycle technology. Presently, efforts are being made to put up plants with more efficient technologies such as supercritical and ultra-supercritical steam cycle.

Table 1: Total Installed Capacity (as on 31st December 2008)

Sector	**MW**	**%age**
State Sector	76,035.57	52.5
Central Sector	48,470.99	34.0
Private Sector	22246.05	13.5
Total	**1,46,752.81**	

Table 2: Electricity production by fuel (as on 31st December 2008)[2]

Fuel		**MW**	**%age**
Total Thermal		**92,892.64**	**64.6**
	Coal	76,988.88	53.3
	Gas	14,704.01	10.5
	Oil	1,199.75	0.9
Hydro (Renewable)		36,497.76	24.7
Nuclear		4,120.00	2.9
RES** (MNRE)		13242.41	7.7
Total		**1,46,752.81**	

In table 2, the Renewable Energy Sources (RES) include Small Hydro Project, Biomass Gasfier, Biomass Power, Urban & Industrial Water Power and Wind Energy.

For reducing GHG emissions, augmenting EE and use of renewable energy have a crucial role to play. This is evident in the creation of a separate ministry, the Ministry of Non-conventional Energy Sources (MNES) in 1992, which was renamed as the Ministry of New and Renewable Energy (MNRE) in 2006. Under MNRE following institutions are operating to promote renewable energy in India:

[2] http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp

1. **The Solar Energy Centre (SEC),** which forms a part of the Ministry, is located at Gwal Pahari in district Gurgaon, Haryana and serves as technical focal point for solar energy development.

2. **The Centre for Wind Energy Technology (C-WET),** an autonomous organisation under the administrative control of this Ministry, has been established in Chennai, Tamil Nadu and serves as the technical focal point for wind power development. (Velachery - Tambaram Main Road, Pallikaranai, Chennai - 601 302, INDIA.

3. **The Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE)** is being established as an autonomous institution in district Kapurthala, Punjab.(Adhikhui Village (12 Kms. From Jallandhar),Jallandhar- Kapurthala Road, Punjab.) NIRE will serve as the technical focal point for development of bio-energy, including bio-fuels, and synthetic fuels

The Cumulative performance of the New and Renewable Energy as on 30.09.2008[3] in India is as given in table 3. However, there is a huge potential for advancement and business in this area.

Table 3 *Renewable energy scenario (as on 30.09.2008)*

No.	Sources / Systems	Achievements during 2008-09 (upto 30.09.2008)	Cumulative Achievements
I. Power From Renewables			
A. Grid-interactive renewable power			
1.	Biomass Power (Agro residues)	50.80 MW	656.60 MW
2.	Wind Power	764.80 MW	9521.80 MW
3.	Small Hydro Power (up to 25 MW)	40.15 MW	2220.99 MW
4.	Cogeneration-bagasse	193.00 MW	993.83 MW
5.	Waste to Energy		55.75 MW
6.	Solar Power		2.12 MW
	Sub Total (in MW) (A)	**1,048.75 MW**	**13,450.59 MW**
B. Off-grid/Distributed Renewable Power (including Captive/CHP plants)			
7	Biomass Power / Co-gen.(non-bagasse)	41.70 MW	136.70 MW
8.	Biomass Gasifier	2.42 MW eq.	102.21 MW eq.
9.	Waste-to- Energy	4.36 MW eq.	31.07 MW eq.
10.	Solar PV Power Plants and Street Lights	0.29 MW p.	8.01 MW p.
11.	Aero-Generators/Hybrid Systems		0.72 MW
	Sub Total (B)	**48.77 MW eq.**	**278.71 MW eq.**
	Total (A + B)		**13,729.30 MW**
II. Remote Village Electrification		252/NIL Villages/Hamlets	4237 villages + 1142 hamlets
III. Decentralized Energy Systems			
12.	Family Type Biogas Plants	0.66 lakh	40.32 lakh
13.	Home Lighting System	31,754 nos.	4,34,692 nos.
14.	Solar Lantern	27,360 nos.	6,97,419 nos.

[3] http://mnes.nic.in/

No.	Sources / Systems	Achievements during 2008-09 (upto 30.09.2008)	Cumulative Achievements
15.	SPV Pumps		7,148 nos.
16.	Solar Water Heating - Collector Area	0.15 Mln. sq. m.	2.45 Mln. sq. m.
17.	Solar Cookers		6.37 lakh
18.	Wind Pumps		1342 nos.
IV. Other Programmes			
19.	Energy Parks	18 nos.	516 nos.
20.	Akshay Urja Shops		269 nos.
MWeq = Megawatt equivalent; MW = Megawatt; kW = kilowatt; kWp = kilowatt peak; sq. m. = square meter			

Captive power generation is also promoted in India and is a known phenomenon in the country. The status of various industries in terms of installed capacity, generation and consumption during 2006-07 given in Table 4 is suggestive of the potential for use and deployment of energy efficient technologies in the industry sector as there is clear gap, with few exceptions, between energy generated and energy consumed. This gap can certainly be reduced by a deployment of energy efficient technologies in both, generation as well as consumption sides.

Table 4: *Industry-wise Installed Electricity Generation Capacity, Electrical Energy Generation and Consumption in India (2006-2007)*[4]

Industry	Installed Generating Capacity (MW)	Energy Generation (GWh)	Energy Consumption (GWh)
Aluminium	2222.89	14827.95	12820.46
Automobiles	236.72	316.61	1068.36
Cement	2228.38	7342.88	12022.11
Chemicals	3365.42	14758.47	17248.18
Colleries	196.3	152.72	669.66
Elect.Engg.	383.98	1815.38	2051.57
Fertilizers	1010.48	2898.68	3880.06
Food Products	146.73	99.47	446.45
Heavy Engg.	464.51	2144.83	2649.69
Iron & Steel	3017.41	15268.15	19869.52
Jute	161.46	12.78	11.31
Light Engg.	590.22	891.74	4563.73
Mineral Oil & Petroleum	2267.93	8146.69	7437.28
Mining & Quarrying	140.74	113.99	496.27
Misc.	1421.38	1482.29	4603.91
Non-Ferrous	171.82	862.79	571.96
Paper	1145.22	3815.23	4078.79
Plastic	39.48	130.09	258.96
Rubber	145.38	103.25	722.25
Sugar	1054.69	3102.95	1231.81
Textiles	1923.9	3512.81	9849.43
All India (Non-Utilities)	**22335.04**	**81799.75**	**106551.76**

[4] http://www.indiastat.com/india/ShowDataSec.asp?secid=447231&ptid=112

3. Legislation

3.1 The Legislative Framework

The present legislative framework related to climate change in India consists of a number of Central Acts which include the Environment Protection Act (EPA), 1986; the Water (Prevention and Control of Pollution) Act, 1974; the Water Cess Act, 1977; and the Air (Prevention and Control of Pollution) Act, 1981. It is important to note that all these Acts were introduced after the Stockholm Conference in 1972. The introduction to the Environment Protection Act, 1986 clearly states that it is "[a]n Act to provide for the protection and improvement of the environment and for matters connected therewith. Whereas decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment…"." This Act prohibits the emission of environmental pollutants in excess of prescribed standards (Chapter III, Article 7). The emission standards are set by the Central Pollution Control Board (CPCB) and are monitored by CPCB, Central Electricity Authority (CEA) and various State Boards.

Similarly the Air (Prevention and Control of Pollution) Act, 1981 also refers to the Stockholm Conference. After the Rio Conference, the National Environment Tribunal Act, 1995 and Environmental Impact Assessment (EIA) notification, 1994 (in accordance with the EPA, 1986 provisions) were introduced. The introduction to the National Environment Tribunal Act, 1995 maintains that the "decisions were taken at the United Nations Conference on Environment and Development held at Rio de Janeiro in June 1992, in which India participated, calling upon the States to develop national laws regarding liability and compensation for the victims of pollution and other environmental damages".

The National Electricity Act-2003 (henceforth NEA-2003) was also passed after the Kyoto Protocol. The Act has made the use of supercritical steam cycle technology mandatory for the coal-based Ultra Mega Power Projects (in the range of 4000 MW), as a means to reduce the environmental impacts.

3.2 The National Policy Framework

There are many central as well as sector specific policies in India that provide guidelines on environmental issues. These policies include the National Forest Policy (1988), National Conservation Strategy and Policy Statement on Environment and Development (1992), Policy Statement on Abatement of Pollution (1992), National Agriculture Policy (2000), National Population Policy (2000), National Water Policy, 2002 etc. The National Environment Policy (NEP) of 2006 builds upon all these policies. It may be noted that it coincides with the implementation of the Kyoto Protocol since 2005. The two other important policy measures announced after the Kyoto Protocol are the National Electricity Policy-2003 and the establishment of the Clean Development Mechanism Authority in 2003. The following analyses of the National Environment Policy-2006 and the Clean Development Mechanism Authority show the significant influence of the global institutions of climate change on India's policy on environment.

3.2.1 The National Environment Policy (NEP), 2006

The National Environment Policy-2006 is the latest institutional arrangement that the Indian government has made to address the issues related to environment and global cooperation. The Preamble of NEP-2006 clearly states that India "recognizes the interdependencies among, and transboundary character of, several environmental problems". This policy is "a

statement of India's commitment to making positive contribution to international efforts" in accordance with the "national commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21". The Constitution of India mandates that maintaining a healthy environment is not the state's responsibility alone, but also that of every citizen, which is also stated in the Rio Declaration of 1992.

The main objectives of the NEP-2006, apart from conserving environment, are to ensure intra-generational and intergenerational equity, integration of environmental concerns in economic and social development, efficient use of environmental resources, and resource enhancement for environmental conservation. The policy identifies finance, technology, management skills, traditional knowledge and social capital as the 'resources for environmental conservation'. And Further, as a means to enhance these resources it aims at promoting partnerships between local communities, public agencies, the academic and research community, investors, and multilateral and bilateral development partners (pp. 8-9). This is clearly in line with the guidelines and objectives set out in various international treaties, conventions and protocols as discussed in previous sections. However, the policy does not explain how these 'resources' interact with each other.

3.2.2 National Action Plan on Climate Change (NAPCC)

In July 2007, Prime Minister Manmohan Singh publicly committed to ensuring that "India's per capita emissions never exceed the per capita emissions of the industrialized countries" (GOI 2008a), in effect a commitment to convergence. India is also committed to ensuring that its GHG emissions intensity per unit of economic activity continues to decline, as articulated in the Eleventh Five Year Plan (2007-2012). The National Action Plan on Climate Change (NAPCC), too, includes a target to reduce GHG emissions intensity per unit of GDP by 20% from between 2007/08 and 2016/17 (GOI 2008a).

The NAPCC was released in June 2008, with eight National Missions at its core:

- National Solar Mission
- National Mission on Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Eco-system
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

3.2.3 Bureau of Energy Efficiency (BEE)

The mission of BEE is to institutionalize energy efficiency services, enable delivery mechanisms in the country and provide leadership to the key players involved in the energy conservation movement. The primary goal of the Bureau is to reduce the energy intensity in the economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors. BEE co-ordinates with designated consumers, designated agencies and other organizations and recognize, identify and utilize the existing resources and infrastructure, in performing the functions assigned to it under the Energy Conservation Act. The Energy Conservation Act provides for regulatory and promotional functions[5].

[5] Source: BEE website: http://www.bee-india.nic.in/

The Energy Conservation Act (2001) established a national Bureau of Energy Efficiency (BEE) with the objective of improving EE in various sectors. BEE has developed EE labels for refrigerators and other appliances. The mandatory energy audits of large energy-consuming industries have been enforced. It has also developed demand-side management programs, and has taken steps for establishing benchmarks for energy use by different industries. BEE has successfully registered a programmatic CDM project called the "Bachat Lamp Yojana," which will progressively replace incandescent bulbs in the residential sector with compact fluorescent lamps with the UNFCCC. The price differential will be recovered by the sale of carbon credits. It is estimated that this project will reduce 24 million tons of CO2 annually.

4. Financial market

The financial markets in India are open to carbon markets now. Means to make the financial markets supportive of carbon market in general and CDM in particular are being dwelled over by both the carbon market as well as financial experts.

The structure of CDM provides carbon credits only after the implementation has taken place. As a result banks do not have the incentive to treat the credits as a bankable commodity. This leads to a gap in project financing. Projects that are either bi-lateral in nature or have financial backing are able to overcome this problem. However, projects that are dependent on upfront financing and have high debt-equity ratio face the financing problem. As a result projects that might be having high emission reduction are at times not able to do justice to their justice. Most of the time these projects are innovative projects that are not practices in business as usual scenario. Ideally, they should be supported via CDM for upfront financing becomes a problem.

CDM in India has not captured many projects with high capital costs and long gestation periods that could result in significant long-term mitigation. While international development aid has played a role in financing large-scale, long-term infrastructure projects, for instance in the energy and transportation sectors, they have not explicitly considered GHG mitigation benefits.

At the moment various climate funds are operating in India. World Bank through has a range of funds operating across the world to promote cleaner projects. WB's BioCarbon Fund, Community Development Carbon Fund and Italian Carbon Fund have been successful to finance four projects in India. The number of projects that WB has been able to finance in India despite a strong carbon market clearly highlights that the funds have not been so successful in India. In comparison China has 20 projects financed by WB.

Indian project developer puts his own money into the carbon market as there are not many technologies available for ready transfer. The additionality is proved on the usage of that particular technology. However, there is scope to explore the role that can be played by the funds in India.

At the moment it looks like that the funds can look towards purchasing the credits existing in the market. A clear strategy after COP-15 can be evolved based on the agreement reached. If there is no positive outcome then the sellers will rush to offload their credits, whereas if there is a strong market signal then the sellers will continue to horde their credits and will aim for on the spot trading in hope of high prices.

The project development market is quite competitive and is dominated by some major developers. Despite the fact that the selling is still not aggressive, yet it makes sense to be present in the market and engage oneself with potential sellers as a large number of projects still remain to be tapped. Although exchange based spot trading in CERs has not been possible in India due to various reasons one being the public can't take the ownership of CERs. However the CER derivatives has also not been able take off recording absmally low volumes on the two biggest commodity derivatives exchanges i.e. NCDEX and MCX in the past few months. The spot transactions largely takes place either through brokers like MF Global, aggregators like ecosecurities or auction platforms like Asia Carbon etc.

5. National situation in the carbon markets

This section provides an overview of the carbon markets in India. It details out the progress made out in the Carbon markets in India and the problems facing the growth of the markets. The section also covers the kind of projects entering the Carbon markets from India at the moment.

5.1 CDM opportunities, requirements and SET transfer demand

5.1.1 General overview

As per the World bank report on State and trends of Carbon market 2009, the total value of Carbon market reached US$ 126 Billion in 2008, up from US$ 63 Billion in 2007 (Table 5). The contribution of developing countries by supplying primary CDM credits stands at US$ 6.5 billion. It implies that the share of value that primary CDM credits in carbon market have been able to generate has come down roughly from 10% to only 5% now. The volume has come down drastically from 552 MtCo2e in 2007 to 389 MtCo2e in 2008. Here again the volume share of primary CDM credits has come below 10%. This indicates that the new credit generation is becoming a problem in CDM market. This is a major cause of concern for the carbon market.

Besides the above mentioned factors three other factors have been identified (Capoor and Ambrosi, 2009) for the decline of primary CDM markets. These are:

a. Competition between CDM/JI and AAU/GIS (Green Investment Scheme)

b. Temporary diversion to the secondary market

c. Direct investment in the companies and projects became more important

India is the second biggest contributor to the CDM both in terms of number of projects being registered and number of CERs being issued. China leads the pack by a huge gap at the moment. Although primary CER prices in 2008 were an average of 16% higher at €11.46 (US$16.78), the value of transactions decreased by 12% from 2007 levels to US$6.5 billion (€4.5 billion).However, the price range for the CERs is from US$ 13-22 at this stage due to various market factors

On the other hand the secondary CDM credits have grown exponentially to reach 1,072 in 2008 MtCo2e from 240 $MtCO_2e$ in 2007. This four time increase in volume has witnessed increase in value by almost five times. The existing credits are increasing in value and might be changing hands much too often now. In second half of 2008, a market for options on CERs started to emerge. Hedging, profit-taking, raising cash and arbitrage have been the main drivers of this market segment (Capoor and Ambrosi, 2009)

Table 5: *Carbon market at a glance, Volumes and value in 2007-08*

	2007		2008	
	Volume ($MtCO_2e$)	Value (MUS$)	Volume ($MtCO_2e$)	Value (MUS$)
Project-based Transactions				
Primary CDM	552	7,433	389	6,519
JI	41	499	20	294
Voluntary market	43	263	54	397
Sub total	**636**	**8,195**	**463**	**7,210**
Secondary CDM				
Sub total	**240**	**5,451**	**1,072**	**26,277**
Allowances Markets				
EU ETS	2,060	49,065	3,093	91,910
New South Wales	25	224	31	183
Chicago Climate Exchange	23	72	69	309
RGGI	na	na	65	246
AAUs	na	na	18	211
Sub total	**2,108**	**49,361**	**3,276**	**92,859**
TOTAL	**2,984**	**63,007**	**4,811**	**126,345**

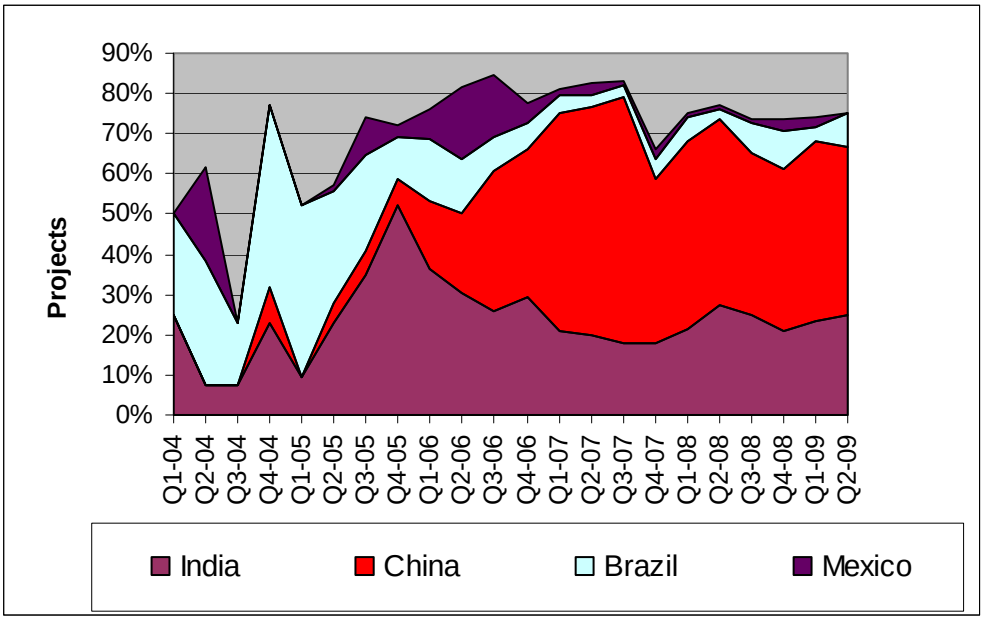
Source: Capoor and Ambrosi, 2009

Further a major chunk of new projects have originated from China which holds a huge chunk of carbon credits at the moment. This implies that other countries are not witnessing a substantial amount of origination activities at the moment. A positive market signal from Copenhagen indicating the willingness to continue with the carbon markets is a must to promote further expansion of carbon markets. The divide related to emission targets and the contributions to be made by developed country parties in terms of finance and technology to combat climate change and support actions of developing countries remain a bone of contention.

The market witnessed temporarily suspension of accreditation for two of the biggest Designated Operational entities (DoEs), namely Norway's DNV and SGS UK for failing to meet the stringency standards expected from the auditors. Such swift measures have clearly indicated that market is working towards making itself stringent and more effective so as to tackle the problems that have been witnessed recently. At the moment this measures are making the DoEs conservative in their approach towards the projects coming for validation. It was felt that such measures will become necessary to ensure that only those projects that are actually additional get benefited from CDM. Such measures have now made the validator conservative in their approach.

There is also a concern that CDM market is limited to very few countries namely China, India, Brazil and Mexico (Figure 1). The current negotiations are trying to address if the distribution of CDM project activities can be distributed in a more uniform manner. However, project activities are only eligible if there are reductions in emissions. And that is only possible if there is some amount of emissions in a country. That is the reason why it might not be possible that small developing countries that have low emission profile might not be able to get benefited by CDM.

Figure 1: *All CDM Projects in the Pipeline in Brazil + Mexico + India + China as a fraction of all projects*

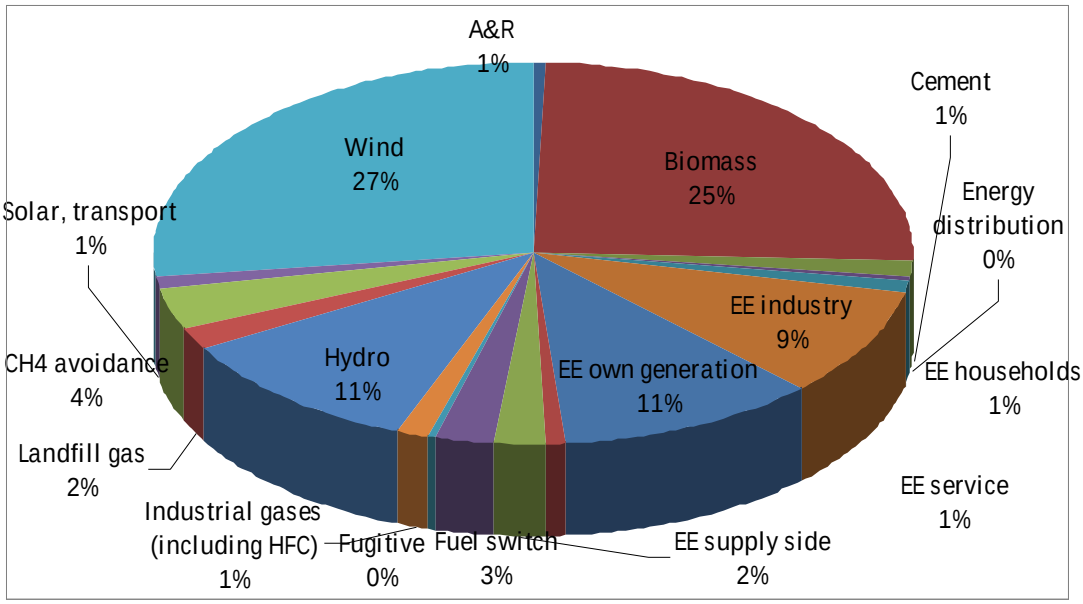


Source: CD4CDM, 2009

5.1.2 CDM in India

India is a party to both the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. India being a non-annex I party, has no binding emission limits under the Protocol. However, India is an active participant in the CDM established by the Protocol. Worldwide, the carbon market has continued to grow over past couple of years.
Indian government and industries had been proactive in their approach to carbon market. This has helped them gain an early mover advantage in CDM. The majority of projects have come from EE and renewable (biomass, wind and small hydro) projects. It is expected that development of replicable wind technology will make it cost competitive with other form of electricity generation and so their number in CDM project cycle will come down in future. Biomass based power generation and co-generation projects are showing a healthy growth.

Figure 2: *Distribution of CDM projects in India by project types.*

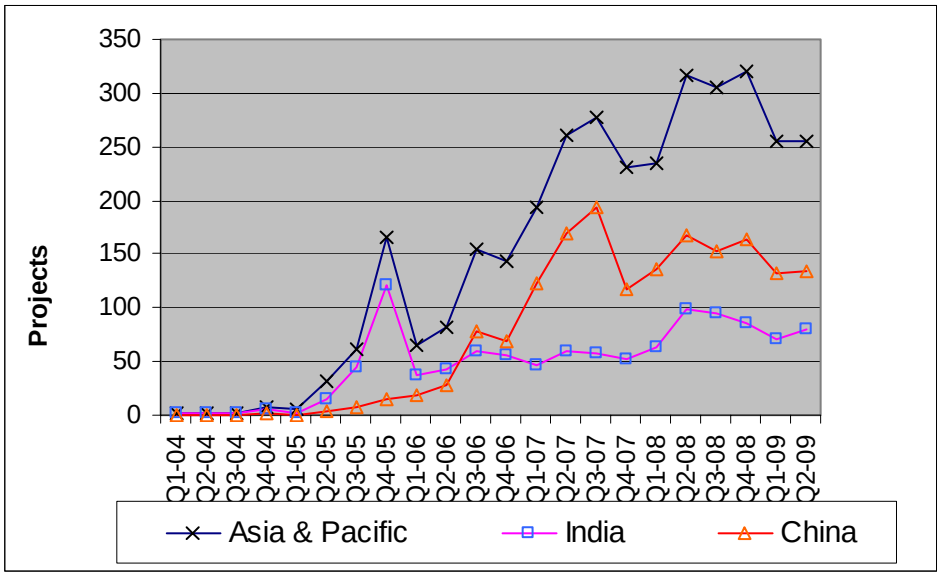


Source: CD4CDM, 2009

A break up of the CDM projects in the pipeline shows various types of projects in India (Figure 2). Clearly Biomass, wind, hydro, EE own generation and EE in industry form a major chunk of the projects accounting for almost 83% of all CDM projects. Almost a fourth of market is covered by EE projects, most of which are EE through own energy generation (waste heat recovery, cogeneration, process optimization etc) and EE in own units (retrofits, technology up-gradation etc.). Most of these projects have been unilateral in nature with little or no technological intervention. Only 4 of the 54 projects registered in India during the first six months of 2009 were bilateral, compared to 19 of 82 in 2008. This trend suggests that although the Indian CDM market is witnessing a revival from the slump witnessed in 2008, the participation of developed countries at the project development stage is diminishing. Especially the industrial EE projects which forms the biggest chunk, but these are small in size. This can be witnessed from their contribution in the Figure 4. However, EE in supply side and own generation have relatively bigger projects. Projects such as solar, transport, energy distribution are numbered despite having a huge potential in the country. State of Maharashtra, Karnataka, Tamil Nadu, Gujarat and Andhra Pradesh have been most active in CDM from India.

With 458 registered projects as on 8th October, 2009 India has the second highest number of projects activities registered under CDM. China leads the project development with 640 projects out of 1,842 projects registered worldwide. Last year has seen India falling behind in Carbon market to China (Figure 3). Project origination from Asia is mainly from India and China.

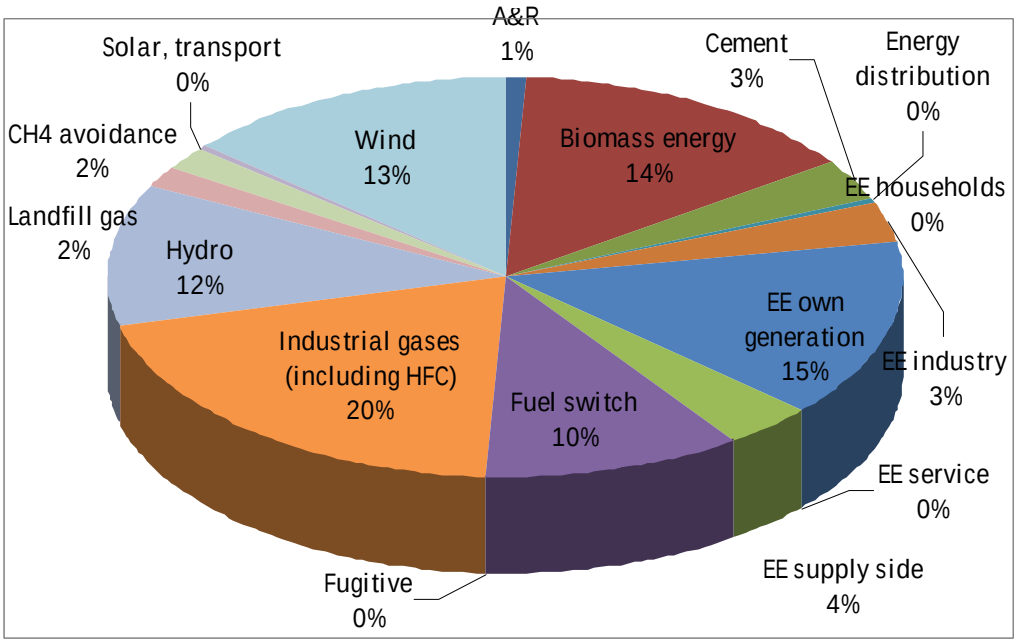
Figure 2: *New project in Asia in the pipeline each quarter*



Source: CD4CDM, 2009

Most of the CERs in India originate from EE own generation, renewable (biomass, wind, hydro), and fuel switch (Figure 3). Industrial gases projects that include HFC though numbered are a major chunk. But there have been almost no new HFC projects from India of late. EE holds a potential in India when it comes to carbon markets. However the projects are small in size as they are mostly unilateral in nature. Similarly Wind and biomass projects though account for 52% of the total projects, are only able to deliver 27% of CERs from India. It clearly indicates that on average the size of Indian projects is small.

Figure 3: *Distribution of CERs in India by project type*



Source: CD4CDM, 2009

Participation of other parties in Indian CDM projects (registered) has come down recently. In the initial stages of CDM the involvement of other parties in the projects was more apparent. The same has come down since mid 2007. The project consultants and participants are feeling that the bilateral projects are better equipped to go through the CDM cycle successfully now. It calls for an opportunity to explore potential partnerships.

The sellers in Indian market have held on to their CERs till now mainly because they are the sole decision makers on how they treat their CERs. Recently the price touched sometimes around 20 Euros before coming down to the current level of 12 Euros. The sellers are waiting for climate change agreement at Copenhagen and are expecting increase in demand if USA joins Kyoto. Till that time the sellers prefer to hold on their CERs. At the moment this looks highly unlikely. However, since the small EE projects do not attract major institutional buyers selling CERs from such small projects becomes difficult.

Programmatic CDM has so far not lived up to expectations. At present, two projects from India feature at the validation stage in the programmatic CDM pipeline (CD4CDM, Sep, 2009). One of these projects has been initiated by a government body, to support a transition from incandescent to CFL bulbs in households. It is possible that a successful example of programmatic CDM will pave the way for more such interventions. It could, for example, provide a boost to the National Solar Mission as well as other off-grid options, especially in rural India. The Bureau of Energy Efficiency suggest, for instance, that programmatic CDM could be used to systematically upgrade agricultural pumps.

5.2 Voluntary market (VER) opportunities and requirements

Over the Counter (OTC) transaction volume from Asian projects increased just over 100% between 2007 and 2008, from 11.1 to 22.7MtCO2e. Like last year, Asia supplied more transacted VERs in 2008 (45%) than any other region. This high market share is due to a large supply of credits resulting from Chinese and Indian pre-CDM registration projects and the relative efficiency of transactions in both countries due to government support.

Of the 22.7 MtCo2e voluntary credits from Asia, India accounted for 61% (13.9 MtCO2e) of credits. Due to increased CDM delays also this figure has increased. The largest voluntary project also came from India at 9MtCo2e. In 2008, 144,640tCO2e changed hands across the exchange at an average price of €3.7/t with the bulk of credits flowing from VCS-validated renewable energy projects in India (Ecosystem marketplace, 2009).

6. CDM companies, requirements and project development in India

Indian Carbon market is a free market with little or very less intervention of Indian Government. The government is involved only at the host country clearance stage of CDM cycle and does not influence any corporate decision of when to sell the CERs and when not to. However, the Indian market possibly has the maximum number of players providing services on all levels of the spectrum.

6.1 CDM – Key stakeholders and installations

The market is witness to players of the international consultancy to local CDM specific consultants. The market has number of buyers providing different structures of the CER sales deals based on the requirements of seller and the type of project. However, the sellers in India are much more informed and it is tough to get the deal closed. Future selling based

on floating as well as fixed price model have been witnessed in the market. Still the market can roughly be divided into three major categories namely:

1. Project developers/Sellers
2. Consultants
3. Buyers/intermediaries

6.1.1 Project developers

India has second highest number of CDM projects and understandably a huge number of such stakeholders. It is difficult to list down a list of key project developers from more than 450 entities having registered CDM project. The numbers of projects currently in pipeline from India easily go beyond thousand. The biggest registered project has annual CERs amounting to 3,833,566 CERs whereas the smallest is with 562 annual CERs only. Some of the project developers having big CDM projects in India are:

- JSW energy limited
- Shree Cement Limited
- Reliance industries
- TATA Industries
- Hindustan Lever Limited

As the project developers are not limited to any specific project type so it is hard to pinpoint any specific sector or company having the biggest potential. The potential is spread across sectors and a lot can be achieved by building bi-lateral and multi-lateral collaborations through CDM.

6.1.2 Consultants:

Consultants are the actors who generally prepare the Project Design Document (PDD) on behalf of the project developers. At times the project developers performs the task of consultants also and develops PDD by own self. The consultants can charge a fixed amount or at times share of CERs for the services provided by them. The market is highly competitive and the price structure is highly customised to meet the demands of the project developers. At the same time the negotiations to finalise the consultants are intense and at times take a lot of time to reach a decision. Some of the major consultants in India are listed in Table 6.

The market is extensively covered by international consulting groups like E&Y and PWC to the extent that the emergence of any other global player has been very difficult in the Indian market.

Table 6: *List of key CDM PDD consultants in India*

S. No	Name of consultant	Office Address
1.	Pricewaterhouse Coopers (PWC) India	PricewaterhouseCoopers Pvt. Ltd. PwC Center 56 & 57, Block DN Sector V, Salt Lake Kolkata 700 091
2.	Zenith Energy Services (P) Limited	10-5-6/B, My Home Plaza, Masab Tank, HYDERABAD-500 028. A.P., (India)
3.	Ernst & Young (E&Y)	1st Floor, Tower A, Building No 8, DLF Cybercity Phase 2 Sector 25 Gurgaon -122002
4.	Deloitte Touche Tohmatsu India	7th Floor, Building 10 Tower B, DLF Cyber Ciity Complex, DLF City Phase II New Delhi 122002
5.	Emergent Ventures India	5th Floor, Universal Trade Tower Gurgaon - Sohna Road, Sector 49 Gurgaon - 122001, Haryana,
6.	Senergy Global	D-33, Defence Colony New Delhi – 110024,
7.	Verve consulting	11, Bramheswar Bagh, Tankapani Road, Bhubaneswar - 751002
8.	EcoSecurities	Unit No 302, Plot No 8, Elegance Tower, NHCC - Jasola, New Delhi
9.	ICF International	Thapar House, 2nd Floor, Western Wing Janpath Lane 124, Janpath New Delhi – 110001
10.	MITCON	MITCON "Kubera Chambers" Shivajinagar, Pune 411 005, Maharashtra (INDIA)
11.	MGM International	MGM India Pvt Ltd, Level 15, Eros Corporate Towers, Nehru Place, New Delhi-19
12.	Cantor CO2e	6-3-252/1/7/B, Erra Manzil, Opp. IIPM Tower, Banjara Hills, Road No 1, Near Taj Deccan, Hyderabad-34

6.1.3 Buyers

Though India is yet to witness an aggressive selling, yet some of the buyers are already present in the market. Some of them aim at projects that need investment upfront and so are ready to enter into an agreement to sell the potential CERs at a lesser price with guaranty. Almost 200 projects of the registered projects have still not sold their CERs (Based on analysis of CD4CDM data). Some of the active buyers in the market are:

- Agrienergy (UK)
- EcoSecurities (UK)
- Noble Carbon
- KfW
- Ecoinvest Carbon (Switzerland)
- ABN AMRO Bank
- Bunge Emission Fund (Switzerland)
- Japan Carbon Finance
- EDF Trading
- Carbon Asset Management
- Evolution markets

As is evident the type of buyers in the market is diverse and is mainly from Europe. Still a huge number of projects remain unsold and present an opportunity for understanding and entering into the market.

6.2 Identification of technology needs in targeted countries

Not much has been done through CDM in terms of technology transfer and thus it has not been able to exploit the full potential. Only 39% of CDM projects till September, 2008 had resulted in some sort of technology transfer (Seres and Haites, 2008). The actual physical transfer of technology is even less as the definition of technology transfer is contentious. The key aim of 'technology transfer' is to bring desirable technologies to market faster. There is no doubt that transferring production rights for low carbon technologies to developing countries could have a significant effect in bringing forward mitigation action. If technologies that are already available in developed nations but are too expensive for developing nations at present could be brought to bear immediately, the long term climate benefits are very significant. There could also be sound economic reasons why it can be of benefit to industrialised countries too, since lower production costs for key mitigation technologies would reduce overall mitigation costs for industrialised countries.

There are two issues relating to technology transfer. The first is technology acquisition, which applies in the case where suitable technologies already exist in parts of the world but are inaccessible to, in this case, India – usually on the basis of cost. In such cases, several options appear to exist for overcoming the IPR impasse, at least from the Indian perspective. These include invoking the WTO's compulsory licensing regime for specific technologies where the public benefit is significant enough, and/or using a global financial mechanism (a technology acquisition fund of some kind) to buy out patents for key technologies (or at least the rights covering a limited domain, such as developing countries).

The second case is where further research and development is warranted, either to advance technologies or make them locally applicable. In this case collaborative R&D can help the transfer. It could also create a 2- or even 3-way sharing of IPR, involving a industrialised country, developing country and possibly a global financial mechanism where supported through such a mechanism. In the 3-way case, the share of IPR could return revenue to the global financial mechanism for re-use. IPR is a complex issue that has not been fully considered by this report. The upcoming "Climate Change: Technology Development and Transfer" conference in Delhi in October 2009, hosted by the Ministry of Environment and Forests, might give more insight into the importance of this as a barrier. The conference will feed into the UNFCCC negotiation process as well.

To enhance energy efficiency in supply sector, power sector has been given a paramount priority. Subsequently, there is an explicit emphasis on clean coal technologies such as integrated gasification combined cycle (IGCC) and Supercritical and Ultra-supercritical technologies as far as building domestic technological capability is concerned. Among the domestically available technologies, a clear preference to small hydro power projects has been given. On the demand side of energy efficiency, transport and building sectors have been singled out as having the substantial potential for energy savings.

Overall, power, transport, buildings, construction and manufacturing are the key sectors that have been identified to promote energy efficiency and renewable energy. As far as technologies are concerned, IGCC, gasification of coal and lignite, supercritical and ultra-supercritical technology, fuel cells, energy efficient buildings and building components, electric vehicles (EVs), hybrid electric vehicles (HEVs), mass transport systems, solar thermal and solar PV, biofuel technologies (particularly the second generation biofuel

technologies), small hydro power and wind power along with nuclear power are among the most discussed technology.

7. R&D Priorities

7.1 General national aspects

Energy efficiency should definitely be promoted as it is one of the focus within the national policy to tackle climate change. Collaboration will necessarily be focused in areas of common interest. From india's perspective, providing electricity to a large chunk of population and renovating the various industrial sectors including a large number of SMEs will be important whereas from EU perspective it will be important to find out means to have cost-effective emission reduction undertaken outside EU that also lead to promoting sustainable development. Areas of collaboration must therefore lie at the intersection of these different objectives.

7.1.1 Relevant Policies, Programmes and Institutions

The following are some of the policy initiatives taken by government of India for technology development:

- *National Action Plan for Climate Change*: Has a focus on eight missions, of which national Solar Mission has the endeavour to have a substantial increase in solar energy in the total energy mix. Enhancing energy efficiency has also been identified as a key component of the National strategy to combat climate change.
- *National Electricity Policy 2005:* Emphasis is on decentralized power generation and distribution which subsequently identifies renewable energy and energy efficient distribution systems.
- *Science and Technology Policy 2003:* One of the most important mandates of the policy is technology development, transfer and diffusion.
- *National electricity Act 2003:* This encourages and stimulates the market of non-conventional energy resources/renewable and cogeneration was promoted. This Act provided a huge boost to the renewable industry.
- *Energy Conservation Act 2001 (52 of 2001):* The Act provides for the legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to embark upon energy efficiency drive in the country.
- *Indian Industry Programme for Energy Conservation (IIPEC): Under IIPEC the task of energy conservation for Textile, Cement, Pulp & Paper, Fertilizer, Chlor-Alkali, and Aluminium*
- *Technology Promotion Development and Utilization Programme (TPDU): an initiative of Ministry of Science and Technology (MoST) to promote development, deployment and diffusion of efficient and environmentally sound technologies (ESTs).*
- *Technology Development Board: aims at accelerating the development and commercialisation of indigenous technology or adapting imported technology to wider domestic application. The board provides financial assistance in the form of equity, soft loans*, or grants

- *Technology Information, Forecasting and Assessment Council (TIFAC)*: an institutional framework for technology diffusion
- *Biomass Power Programme*: It aims at utilization of a variety of biomass materials through adoption of conversion technologies like combustion, pyrolysis, gasification, etc. The country now has more than 700 MW of capacity based on these technologies
- *Biomass Energy and Co-generation (Non-Bagasse) in Industry* : this promotes utilization of biomass (non-bagasse) for the generation of heat energy/power, to be used for captive requirement of industries
- *Biomass Gasifier Program* : Installation of latest versions of biomass gasification technology has lead to increased biogas generation and energy efficiency
- *Accelerated program for promotion of projects for Energy Recovery from Urban Wastes*: proposes attractive incentives in the form of capital subsidy to make urban waste-to-energy projects financially viable and remunerative to promote the adoption of state-of-the-art technologies higher financial assistance available for setting up of demonstration projects.
- *Indian renewable energy development agency (IREDA)*: IREDA's mission is to promote, develop and extend financial assistance for renewable energy and energy efficiency/conservation projects with the motto: "Energy Forever".
- *Bureau of Energy Efficiency:* under the Energy Conservation Act, 2001, the Bureau of Energy Efficiency was established in 2005 with an objective to promote energy efficiency practices among end-users particularly in the manufacturing and building sectors. The BEE is developing various standards such as building codes, incentive, training and awareness programs to promote and facilitate deeper penetration of energy efficient technologies and practices
- *National Biofuel Mission 2003 and Biofuel Policy 2008:* The government of India started its biofuels mission in 2003 and in its National Biofuel Policy, announced on 11 September 2008, an indicative target of 20% blending of biofuels (bioethanol and bio-diesel) by 2017 has been proposed.
- *The Ultra Mega Power Plant Project:* For all coal fired ultra-mega power plants (more than 3500 MW capacity) in India, use of supercritical technology has been made mandatory.
- *The Renovation and Modernisation Program 1985:* This program aims at upgrading the existing thermal power plants with an objective of improving their life as well efficiency of operation.

Keeping the NAPCC in mind it is important that the replicable projects that fall in line with the priorities of NAPCC be targeted. The action plan comprises of eight missions. Considerable R&D work would be required to ensure that the targets aimed at these missions are met. Establishing quantifiable and verifiable emission reductions from each of these missions will also be a priority. Detailed implementation plans under each of the eight missions are expected to be released by the Indian government over the coming months. Two that are of key interest from a mitigation perspective – solar and energy efficiency are already in the advance stages of finalisation.

7.1.2 Mission on Enhanced Energy Efficiency (EEE)

The GoI has rightly chosen EEE as one of its priority missions. It will not only deliver climate change mitigation benefits but will also help in promoting energy security for energy deprived strata of society by reducing the demand and thus the demand for new capacity additions from time to time.

The Mission on enhanced energy efficiency states looks to promote EE in various sectors. The Energy Conservation Act 2001 promotes EE activities and measures and current initiatives are expected to yield savings of 10,000 MW by 2012. Building on this Act, the plan recommends mandating reductions of specific energy consumption in large energy-consuming industries, with a system for companies to trade energy-savings certificates; energy incentives, including reduced taxes on energy-efficient appliances; and financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipalities, buildings and agricultural sectors.

Technology up-gradation is also planned for energy efficiency (EE) improvement in coal-based thermal power generation sector through super critical and ultra-supercritical technology. However, these technologies involve higher capital costs. Hence CDM benefits would be required for each project. R&D would be required to see that all the future projects get these benefits, as the present approved methodology ACM013 sets limits to number of projects which can get CDM benefits.

Box 1: *Barriers for financing energy efficiency projects in India*

Many energy efficiency projects in India originate in the SME cluster, where companies often lack strong balance sheets or creditworthiness. In tight credit markets, accessing financing through traditional routes (such as banks) has become more difficult and has had a strong negative impact on project origination and implementation. Alternative models such as Energy Service Companies (ESCOs) are still relatively new concepts in India, although several new ESCOs were formed in India just this past year and are, perhaps, a sign of things to come. Innovative financing mechanisms are needed to finance the deals that are being envisaged through India's National Action Plan.

The announcement of national level programs such as the *Bachat Lamp Yojana*, a programmatic national level project to replace incandescent lamps with CFLs using CDM as a project mechanism, showed the level of increased interest in energy efficiency marketing in India. Other examples of national programs recently announced include solar water heating in one million households, deployment of five million solar lanterns and two million home solar lighting systems.

India is reportedly considering a trading scheme centered on energy efficiency certificates (that could expand to renewable energy) consistent with national climate change policy. The Government is setting up energy benchmarks for industry sectors and those companies that do not meet the benchmark could buy the certificates under a reward and penalty system. It hopes to reduce energy consumption by at least 25% in energy-intensive sectors such as power and cement.

Source: Capoor and Ambrosi, 2009

World Bank in its state and trends of Carbon Markets report, 2009 has identified barriers for financing energy efficiency projects in India (Box 1). A key element for tacking this challenge is the promotion of energy service companies (ESCOs), which are a vehicle for bringing together finance and innovative energy efficiency technologies in replicable, sustainable business models. With ESCOs still nascent in India, their access to finance is limited as banks are uncertain about the return that these energy saving investments are likely to deliver. The GOI plans to set up a Partial Risk Guarantee Fund to encourage commercial

banks to lend to ESCOs. The fund will serve as guarantee for the loan component to be provided by banks.

Switzerland has established a program of engagement with various industrial sectors to tackle energy efficiency in the SME sector. The model places joint technology development at its core, partnering Swiss engineers with Indian companies to develop, over several years, higher efficiency plant that is suitable for local conditions. There are various components to this approach – an initial technology mapping, of both Indian and world's best technologies; funding of pilot studies to develop and implement improved technologies locally; a training program for technology operators, consultants and manufacturers, in order to foster further development and deployment of the technology in future; and mediation with domestic financial institutions to secure access to the necessary capital to undertake technology upgrades.

7.1.3 Solar Mission

Solar power has emerged as a strong focus for the Indian government. The National Solar Mission aims to promote the development and use of solar energy for power generation and other uses, with the ultimate objective of making solar competitive with fossil-based energy options. Its objectives include the establishment of a solar research centre, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support. Importantly, it also contains a target to install 20 GW of solar generation capacity by 2020, 100 GW by 2030 and 200 GW by 2050.

India expects a significant reduction in the costs to be achieved by scaling up deployment, ramping up domestic manufacturing capacity and by financing research. The implementation of the solar mission will be supported through a slew of incentives such as favourable feed-in tariffs, capital subsidies, tax and depreciation benefits, mandated deployment regulations and other similar measures. Unofficial estimates suggest the cost of implementation would be roughly Rs 100,000 crore (~€15 billion) over a 30-year period starting with roughly €1 billion in the 11th five-year plan (until 2012) and €2 billion in the 12th plan (up to 2017).

For solar technologies to be deployed at a wider scale there is a need to reduce the cost at which current technologies are available to developing countries. The launch of joint research activities on solar, with the prickly issue of property rights adequately addressed, will not make a tangible contribution to the implementation of India's solar mission.

Synergies exist between Indian policies and EU ETS (table 7). These learnings can be helpful to develop future mitigation actions in India, including the PAT scheme mentioned under mission on EEE.

Table 7: *India and EU ETS policies related to energy and climate*

	India	EU ETS
Energy Efficiency	- Domestic market for energy efficiency certificates (PAT) - Measures outside the PAT market (MTEE)	- Mandatory improvement over the 2012-2020 period.
Renewable Energy Sources (RES)	- Mandatory percentage of RES generated electricity in each state.	- Mandatory percentage of RES generated electricity in each state. - Potential trading within the EU
GHG Emissions mitigation	- No absolute targets. Voluntary implementation of relative targets through baseline scenario. - Will of linking domestic instruments to international ones (to get funds)	- Cap and trade system with decreasing number of quotas issued each year - Potential limitation in the use of CER, depending on host country commitment.

Source: Casella and Delbosc, 2009

7.2 RTD assessment of energy efficiency and saving technologies for different types of industry on a national level

The deployment of energy efficient technologies, both, in energy supply sector as well as demand sector, is seen as the key in addressing climate change. In this context the role of 'soft technologies' relating to organisation of production and consumption processes is also important. For instance, a mass consumption of transport services through mass-transport systems, or mass consumption of housing services through energy efficient buildings can save a lot of energy. The role of public behaviour, as soft technology, particularly in organisational set-up was also stressed upon. However the key barriers to the technology development, deployment and transfer in the context of climate change are:

a. **Market failure:** inadequate level of development and deployment of environmentally sound technologies (ESTs) is due to market failure in the form of imperfect information about technologies, their actual long term costs, non-rational prices of environment un-friendly technologies.

b. **Lack of Financial Resources:** High absolute costs of these projects make it necessary that adequate financial resources are available at a reasonable cost so that industry is willing to take the high investment risks.

c. **The issue of IPR:** The issue of IPRs is identified as a major barrier to CCTT (Climate Change Technology Transfer). However, its implications are perceived differently by the industry and policy makers. While for industry the IPR costs are like any other costs associated with entrepreneurial activity, policy makers assign it much greater importance. For industry, IPRs have only cost implications and it does not make much difference if Indian government pay for the additional cost or the government of the country of the origin of technology. On the other hand, for policy makers IPRs constitute not only financial burden but also a hurdle in building technological capability building for through IPRs flow and access of knowledge is prohibited.

d. **Domestic Technological capability:** For industry, commercial technological transfer is most important while for government it's the over all technological advancement of the country that has a clear priority.

e. **Commercial Viability of Renewable Energy and Issue of subsidies:** Most of the fossil fuel based activities are highly subsidized which make them economically attractive as compared to clean and efficient technologies. If the subsidies are rationalized, many of the efficient technologies would be more attractive. This of course requires that the adequate information about these technologies is available freely to the end-users.

f. **Bureaucratic hurdles:** Bureaucratic hurdles in allocation of resources such as land, water, providing for import duties, tariffs etc. and lack of infrastructure are recognised as two important constraints diffusion and deployment of ESTs.

g. **Role of private sector:** Most of the low carbon technologies are in the domain of the private sector and some argue that the role of the private sector in propagating and diffusing these technologies is still not clear, as they have not taken the necessary actions to promote and diffuse these technologies. Although CDM has stimulated private sector to venture into the low carbon market, their contribution is still questioned by some. They argued that in such a scenario the role of a public-private partnership becomes important as it can help overcome the barriers that hinder the diffusion and deployment of clean technologies.

8. Links to Relevant Websites

Name	Address	Description
Ministry of Environment and Forestry	http://moef.nic.in/index.php	The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes.
Ministry of New and Renewable Energy	http://mnes.nic.in/	The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country.
E&Y	http://www.ey.com/global/content.nsf/India/ESS_-_Climate_Change-Advisory_Services	Involved extensively in PDD writing. Has maximum number of CDM projects.
PWC	http://www.pwc.com/extweb/service.nsf/docid/27750D1452D0FD7B852570D2002A9D5F	PricewaterhouseCoopers (PwC) has been working with policy makers and companies since 1997, helping to analyse issues and develop practical solutions for our clients.
EVI	www.emergent-ventures.com/	*Emergent Ventures India* is a leading CDM Consultant facilitating ... *EVI's* expert consultants monitor clean technologies, help in carbon assets management, .
Senergy Global Pvt. Ltd	http://www.senergyglobal.com	Senergy Global is a leading carbon advisory firm in India that offers turn-key solutions in the entire CDM business cycle.
Zenith Energy	http://www.zenithenergy.com/	Zenith Energy is one of the leading organizations in India providing consultancy services in the fields of Renewable Energy, EE, Clean Development Mechanism (CDM) and Environment Management Services.
JSW Energy Limited	http://jswel.net/	JSW Energy Ltd. (JSWEL) is a group company of Jindal South West (JSW) group headed by Mr.Sajjan Jindal. Other companies in JSW are JSW Steel Limited , Jindal South West Mining Limited , JSW Port , Jindal Praxair Oxygen Company Limited (JPOCL), and investment companies.

9. References

BEE (Bureau of Energy Efficiency), 2009. National Mission on Enhanced Energy Efficiency.

http://www.energymanagertraining.com/NAPCC/NMEEEforPublicComments.pdf

CD4CDM, 2009; CDM pipeline updated as on 1st October, 2009

Capoor, K. and P. Ambrosi, 2009. "*State and Trends of the Carbon Market 2009"*, World Bank, Washington, D.C., May 2009

Casella and Delbosc, 2009. *"Financing reduction of GHG emissions in India"*, Mission Climat Working paper No1. January, 2009.

Ecosystem marketplace, 2009, *"Fortifying the Foundation: State of the Voluntary Carbon markets 2009"*, Ecosystem Marketplace and New carbon Finance, 2009

http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp

http://www.indiastat.com/india/ShowDataSec.asp?secid=447231&ptid=112

http://mnes.nic.in/

MoEF, 2009. *"India's GHG Emissions Profile – Results of Five Climate Modelling Studies".* September, 2009

NAPCC, 2008, *National Action plan on Climate Change",* Ministry of Environment and Forestry, India, 2009. Available at http://moef.nic.in/downloads/home/Pg01-52.pdf

Seres & Haites, 2008. *Analysis of Technology Transfer in CDM Projects*, UNFCCC.