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Non-Conventional Energy Development in India-an overview

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India has significant potential for generation of power from renewable energy sources such as Wind, Small Hydro, Biomass and Solar Energy. Special emphasis has therefore, been given to the generation of grid quality power from renewable sources of energy.

Planning Commission of Government of India in its Integrated Energy Policy Report (IEPR) covering all sources of energy including renewable energy sources has highlighted the need to maximally develop domestic supply options and diversify energy sources for sustainable energy availability. It has also projected that renewables may account for 5 to 6 per cent of India's energy mix by 2031-32 and has observed that the distributed nature of renewables can provide many socio-economic benefits for the country, including its rural, tribal and remote areas. Meanwhile, The Ministry of New & Renewable Energy has proposed an outlay of RS.10.4 Million for the 11th Plan period from to 2007-2012 for development of New Bio and renewable energy in the country.

Details of Estimated Renewable Energy potential and Cumulative Achievements in the Country as on 30.09.2007 are as under:-

Sl. No.	Sources/Systems	Estimated Potential	Cumulative Achievements as on 30.9.2007
I.	Power From Renewables		
A.	Grid-interactive Renewable Power		
1.	Bio Power (Agro residues & Plantations)	16,881	560.30 MW ^(a)
2.	Wind Power	45,195	7,660.20 MW ^(b)
3.	Small Hydro Power (up to 25 MW)	15,000	2,014.66 MW ^(c)
4.	Cogeneration-bagasse	5,000	692.33 MW
5.	Waste to Energy (Urban & Industrial)	2,700	55.75 MW
6.	Solar power	-	2.12 MW ^(d)
	Total (in MW)	84,7760	10985.36 MW
B.	Captive/CHP/Distributed Renewable Power		

7.	Biomass / Cogen.(non-bagase)		59.00 MW
8.	Biomass Gasifier	-	86.53 MW
9.	Energy Recovery from Waste	-	20.21 MW
	Total	-	165.74 MWeq.
II.	Remote Village Electrification	-	3332 / 830 villages/hamlets
III.	Decentralised Energy Systems		
10.	Family type Biogas Plants	120 lakh	39.40 lakh
11.	Solar Photovoltaic Programme		
	i. Solar Street Lighting System	-	61,321 nos.
	ii. Home Lighting System	-	3,63,399 nos.
	iii. Solar Lantern	-	5,64,931 nos.
	iv. Solar Power Plants	-	2.18 MWp
12.	Solar Thermal Programme	-	
	i. Solar Water Heating Systems	140 sq.m. collector area	2.00 million sq.m. collector area
	ii. Solar Cookers	-	6.17 lakh
13.	Wind Pumps	-	1180 nos.
14.	Aero-generator /Hybrid Systems	-	608.27 kW
15.	Solar Photovoltaic Pumps	-	7068 nos.

- (a) Although the potential is based on surplus agro-residues, in practice there are several barriers in collection and transportation of such agro-residues to the generation site and biomass power generation units prefer to use fuel-wood for techno-economic reasons. A potential of 45,000 MWe from around 20mha of wastelands assumed to be yielding 10MT/ha/annum of woody biomass having 4000 k-cal/kg with system efficiency of 30% and 75% PLF has not been taken into account. In order to realize this potential a major inter-Ministerial initiative involving, among others, Environment & Forests, Agriculture, Rural Development, and Panchayati Raj would be required.
- (b) Potential based on areas having wind power density (wpd) greater than 200 W/m² assuming land availability in potential areas @ 1 per cent and requirement of wind farms @12 ha/MW, not all of which may be technically feasible and economically viable for grid-interactive wind power. In line with international practice for setting up grid-interactive wind power systems on sites having wpd greater than 300 W / m², potential would be 5000 MW. Further, preliminary surveys do not at this juncture suggest a sizeable grid-interactive offshore wind power potential.
- (c) Technically feasible and economically viable hydro potential is generally accepted at 40% of the total estimated potential. Accordingly, the technically feasible and economically viable small hydro-power potential could be around 6000MW.
- (d) With the establishment of new sugar mills and modernization of existing ones, technically feasible potential is assessed at 5000 MWe, not all of which may be economically viable. Furthermore, several sugar companies/cooperatives are unable to develop bankable projects on account of their financial and liquidity positions.

Not all of this renewable energy potential may be suitable for grid-interactive power for technical and/or economic reasons. Further, estimate excludes potential for solar power, which is dependent on future developments that might make solar technology cost-competitive for grid-interactive power

generation applications. Grid Interactive Energy sources developed so far in India are Solar, Wind, Small Hydro and Bio Energy Development in these categories are discussed here.

1. Solar Energy Generation

India receives abundant radiant energy from the sun because of its location in the equatorial sunbelt of the earth. In most parts of India, clear sunny weather is experienced in 280 to 300 days in a year. Daily average solar energy incident over India varies from 4-7 Kwh per square meter depending on the location. Harnessing of solar energy can be done through two routes eg by direct conversion to electricity and solar thermal conversion as per details given below:-

- (i) Solar Photovoltaic Conversion generation of electricity; uses semiconductors and their hybrids (Silicon, germanium, Gallium, Cadmium, Indium etc) to convert photon energy to DC electricity (solar cells products) for DC or AC electricity based applications.
- (ii) Solar Thermal Conversion: generation of Heat; uses steel, copper, Aluminium to convert photon energy to heat for Air, Water, Oil heating and power generation applications.

Although solar energy use in India is regularly increasing the high initial cost of the solar energy systems is a barrier in its large-scale utilization. The estimated unit cost of electricity from grid connected solar energy plant is Rs.12 -15 per unit, which is very high compared to electricity generated from conventional sources including thermal power and other renewable energy sources such as wind, small hydro and biomass.

A total of 33 grid interactive solar photovoltaic power plants have been installed in the country with financial assistance from the Ministry of New and Renewable Energy. These plants, with aggregate capacity of 2.125 Megawatt peak are estimated to generate about 2.5 million units of electricity in a year.

In view of the high initial cost, at present, solar energy systems are mainly being used for stand-alone applications in lighting, telecommunication, small power requirements, battery charging, water heating and cooking etc. So far around 14 lakh solar photovoltaic systems aggregating to about 110 Megawatt peak solar photovoltaic module capacity have been installed in the country. In addition about 6 lakh solar cookers and about 20 lakh square metre collector area have been installed for solar water heating applications, which is equivalent to about 1400 Megawatt thermal capacity.

Release of funds during the last three years for various solar energy programmes are given below:-

Release of Funds for Solar energy Programmes

Financial Year	Amount of fund released (Rs. in lakhs)
2004-05	21.94
2005-06	49.80
2006-07	44.20

Incentives Announced For Solar Power Generation

India is fast becoming a solar panel manufacturing hub, with some of the major manufacturers feeding solar power-generation markets in Europe. And now, in view of its vast untapped solar energy potential, the Centre has announced an incentive scheme for solar power generation in India.

The new scheme is also an experiment in the way the incentives are structured. For the first time, a generation-linked incentive is being provided. The power company can claim the subsidy calculated on the megawatts it supplies to the state power grid. So far, all incentives for green power have been capital funding or viability gap funding, which may or may not lead to actual power generation. The New and Renewable Ministry will provide financial assistance of Rs.12 per kilowatt hour in case of solar photovoltaic and Rs.10 per kilowatt hour in case of solar thermal power fed to the electricity grid”.

The private sector is expected to invest about Rs 10 billion in solar plants eligible for aid under the scheme in the next five years. Project developers can avail of the incentive at a fixed rate for ten years. The Centre hopes that this will result in the volumes going up, bringing down the prohibitive costs. Solar power is four times more expensive than producing thermal or hydro energy.

Some states like Punjab and West Bengal have already shown interest. Each state is expected to generate up to 10 MW of solar power after the Centre’s announcement, which is over and above what some of the states may offer. The government is focusing on setting up solar power generating units in west and central India, where sunlight is found in abundance.

Although India counts an average of 300 sunny days each year, most of the solar panels produced here are exported, mainly to Europe. Solar power is thriving in Japan, Spain and Portugal. Last year, India exported solar panels that can produce as much as 140 MW to the rest of the world.

2. Wind Power Projects

India’s wind energy sector’s growth has been significant with an aggregate installed capacity of 7660.2 MW as on 30.9.2007. This comprises 225 KW to 1650 Kw unit capacity. State-wise details are shown below:-

State-Wise Wind Power Installed Capacity (As On 30.09.2007)

STATE	CAPACITY (MW)
Andhra Pradesh	122.4
Guarat	806.0
Kamataka	853.2
Kerala	2.0
Madhya Pradesh	57.3
Maharashtra	1622.2
Rajasthan	493.9
Tamil Nadu	3698.9
West Bengal	1.1
Orissa	3.2
Total	7660.2

Tamil Nadu has the highest wind power installed capacity (3698.9 MW) followed by Maharashtra and others.

216 potential sites, having annual mean wind power density of 200 Watt/square meter or more at

50meter elevation, have been identified, which are considered suitable for installation of wind power projects. State-wise information is given as under:-

State-wise details of potential site in the country

Sl. No.	States	Potential Sites (No.)
1	Andhra Pradesh	32
2	Gujarat	38
3	Karnataka	26
4	Kerala	17
5	Madhya Pradesh	7
6	Maharashtra	31
7	Orissa	6
8	Tamil Nadu	41
9	Rajasthan	7
10	Uttaranchal	1
11	West Benaal	1
12	Andaman & Nicobar	1
13	Lakshadweep	8
Total		216

3. Small Hydro Power Programme

The Small Hydro Power (SHP) sector (upto 25 MW station capacity) is moving towards attaining commercial status in the country. SHP projects are increasingly becoming economically viable. It has been recognised that SHP can play a role in improving the energy position in some parts of the country and in particular in remote and inaccessible areas. The gestation period and capital investments are getting reduced in Small Hydro Power Projects.

Potential

- The country has an estimated SHP potential of about 15,000 MW. So far 495 SHP projects with an aggregate installed capacity of 1603 MW has been installed. Besides these, 170 SHP projects with an installed capacity of 569.26 MW are under implementation. A database has been created for most potential sites by collecting information from various sources and the State Governments. As a part of the UNDP-GEF Hilly Hydro Project, a detailed exercise was undertaken to prepare zonal plans for 13 participating states of the Himalayan and sub-Himalayan region. Models have been developed that take into account the regional flow duration curves, geological and seismological data, vegetation cover etc. and the use Geographic Information Systems (GIS) for identification of potential sites. In this regard, a software package has been developed at Alternate Hydro Energy Centre (AHEC), IIT, Roorkee which incorporates regional hydrological models that enable users to rapidly estimate the hydro-power potential and other salient features of potential sites. The database for SHP projects created by New and Renewable Energy Sources now includes 4233 potential sites with an aggregate capacity of 10,324 MW. It was proposed to further strengthen the identification of new sites during the 10th Plan period. The state-wise details of SHP sites identified so far are given below:-

State Wise Details of Identified SHP sites Upto 25 MW Capacity each

Name of State/UT	Identified Number of Site	Total Capacity (in MW)
Andhra Pradesh	289	254.63
Arunachal Pradesh	492	1059.03
Assam	46	118.00
Bihar	92	194.02
Chhattisgarh	47	57.90
Goa	3	2.60
Gujarat	290	156.83
Haryana	22	30.05
Himachal Pradesh	323	1624.78
Jammu & Kashmir	201	1207.27
Jharkhand	89	170.05
Karnataka	230	652.61
Kerala	198	466.85
Madhya Pradesh	85	336.33
Maharashtra	234	599.47
Manipur	96	105.63
Meghalaya	98	181.50
Mizoram	88	190.32
Nagaland	86	181.39
Orissa	161	156.76
Punjab	78	65.26
Rasjasthan	49	27.26
Sikkim	68	202.75
Tamil Nadu	147	338.92
Tripura	8	985
Uttar Pradesh	211	267.06
Uttaranchal	354	1478.24
West Bengal	145	182.62
A&N Island	6	6.40
Total	4,223	10,324.37

- As there is still an unidentified potential of about 5000 MW in the country, a new scheme for providing financial support to States for the identification of new potential sites and the preparation of a perspective plan for SHP development has been introduced. Financial support upto Rs. 30 lakhs will be provided for the estimation of the SHP potential in a State, identification of new potential SHP sites and for the preparation of a perspective plan. Provision of incentives for Detailed Survey and Investigation (DSI) & Detailed Project Report (DPR) preparation was continued under a merged and rationalised scheme. Financial support is being provided up to Rs. 5 lakhs for DPR preparation including survey. The State Governments have been advised to undertake these items of work in order to prepare a shelf of SHP projects. So far survey & investigation and preparation of DPRs of 363 potential sites under this scheme has been supported.

Progress

At the end of the 9th Plan the total installed capacity of SHP projects upto 25 MW station capacity was 1438.89 MW. A capacity of 80.39 MW was added during 2002-03. SHP projects with a total capacity of 84.04 MW were commissioned during the year 2003-04, taking the total installed capacity to 1603 MW. At the end of September 2007 the capacity increased to 2015 MW.

4. Biomass Co-Generation Power

A target for addition of 1,700 MW capacity, consisting of 500 MW of biomass power projects and 1,200 MW of bagasse cogeneration projects has been proposed during XI th plan period i.e. upto 2012. A cumulative biomass power potential of about 18,000 MWe from the surplus agro. residues has been estimated in the country. This has been stated in the National Biomass Resource Atlas prepared by Indian Institute of Science, Bangalore, under a project sponsored by the Ministry. The States of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are having potential for setting up biomass based power projects of 100 MW or above. The biomass power potential in the identified districts of the above States ranges from 10 MW to 100 MW. Sugar mill's having crushing capacity of 2500 Tonnes of cane crushed per day in the States of Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, Andhra Pradesh, Bihar, Gujarat, Punjab and Haryana have an estimated potential of about 5000 MW surplus power generation through optimum bagasse based cogeneration.

The Government is providing incentives for setting up of power generation projects based on biomass and bagasse cogeneration in the form of capital subsidy and fiscal incentives such as accelerated depreciation, relief from taxes and duties, term loans from Indian Renewable Energy Development Agency (IREDA). This apart, policies have been introduced in potential states for wheeling, banking and buy-back of electricity generated from **commercial** biomass power and bagasse cogeneration projects.

5. Integrated Energy Policy Recommendations

5.1 As the country is short of energy resources the need to develop all energy sources including the renewable options is paramount. Our efforts in the past have not been as successful as we would have liked. Many renewables have high initial costs (Table). Often development efforts have been sub-critical and subsidy driven growth did not provide incentive for technical improvement or cost reduction. Also there are externalities of use of renewables, the benefits of which do not accrue to the user.

Capital Costs and the Typical Cost of Generated Electricity from the Renewable Options

Sl. No.	Source	Capital Cost (Crores of Rs/MW)	Estimated Cost of Generation per Unit (Rs./kWh)
1	Small Hydro-	5.00-6.00	1.50-2.50

	Power		
2	Wind Power	4.00-5.00	2.00-3.00
3	Bio-mass Power	4.00	2.50-3.50
4	Bagasse Cogeneration	3.5	2.50-3.00
5	Bio-mass Gasifier	1.94	2.50-3.50
6	Solar Photovoltaic	26.5	15.00-20.00
7	Energy from Waste	2.50-10.0	2.50-7.50

5.2 Renewable energy may need special policies to encourage them. This should be done for a well-defined period or up to a well-defined limit and should be done in a way that encourages outcomes and not just outlays.

- Phase out capital subsidies, which only encourage investment without ensuring outcome, by the end of the 10th Plan linked to creation of renewable grid power capacity.
- Power Regulators must seek alternative incentive structures that encourage utilities to integrate wind, small hydro, cogeneration etc., into their systems. All incentives must be linked to energy generated as opposed to capacity created.
- Respective power regulators should mandate feed-in laws for renewable energy, where appropriate, as provided under the Electricity Act and as are mandated in many countries.
- With the capital subsidy available for improving rural access having become uniform for both remote and grid-connected villages/habitations, MOP and MNEs need to better coordinate the outcomes of RGGVY, MNES's rural electrification programme and the newly developed Village Energy Security program. Similar coordination is also called for between. The rural electrification programs, telecom and road connectivity initiatives and certain social sector programs. Bundling of services is likely to achieve greater access and is more likely to yield sustainable structures that are replicable through separate franchises.

5.3 Price subsidy for renewables may be justified on several grounds. A renewable energy source may be environmentally benign. It may be locally available making it possible to supply energy earlier than when a centralised system can do. It may provide employment and livelihood to the poor.

5.4 The environmental subsidy for renewables should be financed by cess on non-renewables and fuels causing environmental damage.

5.5 Price subsidy should be linked to outcomes. Thus, for example, giving a capital subsidy on wind power plant provides encouragement to set-up a power plant but does not provide additional incentive to generate power. Instead a price premium on feed-in tariff for wind power into power grid ensures outcome for the outlay. For grid connected renewables Regulatory Commissions should provide feed laws to permit renewables to supply electricity to the grid. Regulatory Commissions should ensure that the renewables are given a tariff equal to the avoided cost of generation.

5.6 A premium on feed-in tariff may not benefit a stand alone plant in a remote area. For such a plant, capital subsidy may be required. Such capital subsidy, however, can be linked to the amount of power actually generated, if it is given in the form of Tradable

Tax Rebate Certificates. The rebate claim becomes payable when electricity is generated and linked to the amount of electricity generated. This will also encourage exploitation of better wind sites earlier. The need to keep the certificates tradable arises from the possibility that small generators may not have adequate taxable income to benefit fully from tax rebate. In areas where there is no electricity grid, there should be minimum clearances/permissions required for setting up a Distributed Generation (DG) system. Supply companies! entrepreneurs should be free to set-up micro-grids and recover revenues from customers. This is already provided for in the Electricity Act. Each state should clearly define guidelines to facilitate this.

- 5.7 A critical issue in distributed generation for rural electrification is the cost recovery and the implementation mechanism. Different policy experiments for implementation of DG in different regions should be attempted. The village panchayat aided by the state energy agency and technical experts should decide the appropriate technology option (biogas, bio-mass gasification, wind-diesel, microhydel, bio-oil-engine) for their village. For isolated systems it is beneficial to link the DG system to an industrial load (cold storage, oil mill etc.) to improve its load factor and hence its economic viability. The capital subsidy should be based on the annual generation. This is preferably in the form of an annualised subsidy to be provided based on actual generation. These pilot projects can be set-up by panchayats, independent power producers or renewable energy service companies. A mechanism of bidding can be used to obtain the annualised subsidy level. For example if it is decided to electrify a village using a dedicated producer gas engine and bio-mass gasifier, bids may be obtained from suppliers for the support required annually for the first three years per kWh of actual generation. The project would be given to the lowest bidder. This would require actual tracking of annual generation. This is feasible using existing technologies of remote monitoring and would add only incrementally to the system cost.
- 5.8 An annual renewable energy report should be published providing details of actual performance of different renewable technologies at the state and national level. This would include actual energy supplied from different renewable options, availability, actual costs, operating and maintenance problems. The monitoring should also encompass other parameters like user profile (in order to ensure that government support is indeed going to poor households), livelihood outcomes such as increased income, improved food security and gender impacts. In fact, this is also true for rural electrification, where the monitoring parameter should be not just the number of connections but also the various impacts described above. In addition to monitoring the performance of devices, - the assessment should critically review the programme objectives and the strategy adopted and suggest course corrections as required. Information on any system that is receiving government support should be made publicly available. It is essential to ensure that independent assessment of performance is done for all renewable projects receiving Government funding. This would help in tracking programmes, repeating mistakes and providing mid-course correction.
- 5.9 Apart from the facilities of existing Technology Business Incubators being set-up by OST energy entrepreneurs for renewable energy, energy efficiency or rural energy also need finance. Financial institutions should be encouraged to set-up Venture Capital Funds for energy entrepreneurs.
- 5.10 The following specific policies to promote various renewables are recommended:

- **Mini Hydro:** A detailed survey should be carried out to identify potential sites. Identified sites should be auctioned. For plants which are not connected to grid bid for lowest tariff with a pre-specified premium in the form of Tradable Tax Rebate Certificates should be invited. For village level plants, the entrepreneurs should be encouraged to supply power to meet other requirements such as agro processing and milling. If the plant can feed into a grid, the grid should be required to accept power at the going time of day tariff, and the plant site should be auctioned off for minimum premium in the form of Tradable Tax Rebate Certificates linked to output. The responsibility for investments for connecting to the grid should be fixed in advance before the bidding.
- **Wind Power:** For wind power, site selection is freer than hydro-power and wind plants can be set-up on private land. Thus there may be need to auction only sites on public property. The same two types of auctions may be followed as described above for hydro-power plants.
- **Bio-Diesel:** The production of bio-diesel needs to be encouraged in a way that does not involve undue subsidy and only economic production results. Biodiesel producers also need some assurance of a market. Bio-diesel can be blended up to 10 percent with diesel without requiring any change in vehicle engines. Oil companies should be required to purchase bio-diesel of prescribed quality at the opportunity cost of diesel. As a renewable fuel, the production of which also generates rural employment bio-diesel should not be taxed. Such 100 percent tax exemption is given in many countries such as Germany, Spain, Italy and USA. In addition, the bio-diesel producers should get Tradable Tax Rebate Certificates as a premium for local, renewable and environmentally preferable fuel. The obligation of oil companies to purchase bio-diesel ceases once 10 percent blending is attained. At the same time, since diesel price fluctuates, bio-diesel price should be revised every six months based on a prescribed principle such as the average price of diesel over the past six months or the rate of inflation in other agricultural crops. In addition to attract private parties to set-up transesterification units to produce bio-diesel, government should also announce a Minimum Purchase Price for diesel, in case the price of diesel falls below this. The bio-diesel oil price should be linked with Minimum Support Price (MSP) for oil seeds that transesterification units should pay to the farmers. One could leave it to the private parties to fix this price but an implicit MSP with a promised inflation linkage would help and encourage farmers to plant oilseed-bearing trees such as Jatropha, Karanj, etc., that last for many years. Village community based institutions such as Self-Help Groups (SHGs) particularly of women should be encouraged and provided support to undertake plantations and manage the operations.

Grid Connection and feed in Tariff

One of the function of the state Regulatory Commission is to “ Promote cogeneration and generation of electricity from renewable sources of energy by promoting suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distributing business.”

In compliance with these provision State Electricity Regulatory Commissions orders specifying maximum and minimum renewable energy purchase percentage for distribution

licensees. As an example the percentages for purchase of Wind and Biomass Power by the distributing licenses in Rajasthan as per Regulatory Commissions order are shown below:-

Year	Wind		Biomass	
	Min	Max	Min	Max
2006-07	2.00%	5.00%	0.50%	1.00%
2007-08	4.00%	6.00%	0.88%	1.75%
2008-09	5.00%	7.00%	1.25%	2.50%
2009-10	6.00%	7.50%	1.45%	2.95%
2010-11	6.75%	8.00%	1.75%	3.25%
2011-12	7.50%	8.50%	2.00%	3.50%

Similar orders are to be issued by the SERC'S fixing tariff for Renewable Energy.

6. Ministry of New and Renewable Energy Introduce 3 New Schemes to Promote Renewable Energy

1. Megawatt Size grid Interactive Solar power Plant

- 50 MW solar power projects in XIth plan
- The Ministry will provide generation based incentive upto a maximum of (a) Rs.12/- per kilowatt-hour of Solar Photovoltaic power and (b) Rs.10/- per KWh power grid of solar Thermal power fed into the grid
- Maximum capacity support in a state is 10 MW.
- A developer can set up projects upto a maximum capacity of 5MW in the country
- The developers have to enter into PPA with utility for seeking generation based incentive
- Expected investment from Private Sector is Rs.1000 crore.

2. Programme on Development of Solar Cities

- 60 cities planned to be developed as solar cities in XIth Plan.
- Minimum of one city in each State and not more than 5 cities in a State. City population between 5 and 50 lakhs.
- Master plans to be prepared for energy conservation/generation through renewable and CO₂ emissions reduction
- Financial assistance up to Rs.50 lakhs per city apart from the capital/interest subsidies as per various ongoing schemes of the Ministry.
- Project proposals are to be submitted by the Municipal corporations through the State nodal Agency.

3. Programme on Power Generation from Municipal and Urban Waste

- Power generation from municipal solid waste based on an integrated approach
- 5 projects to be taken up initially
- The Projects will be taken up in Public private partnership mode
- Financial assistance @ Rs.2.00 crore per MW or 20% of project cost, whichever is less, upto Rs.10.00 crore per project

- Project development assistance @ 50% of project cost subject to a maximum of Rs.10 lakhs per project.

**(Source: Indian Renewable Energy Development Agency Ltd. (IREDA)
www.iredaltd.com, www.mnre.gov.in)**

India's Share in CDM

India is the sixth largest emitter of greenhouse gases (GHGs), contributing about 1228 MMTCO₂ i.e.2% of global emissions, which is equivalent to 1.3 tonnes per capita emissions. The largest share of 61% in India is contributed by the energy sector, followed by the agriculture sector at 28%, industrial processes at 8%, municipal solid waste at 2% and emissions from Land Use and Land Use Charges & Forestry (LULUCF) are 1%.

The electricity sector is a prime candidate for CDM projects. Electricity generation in India is largely based on coal, which is one of the largest contributors to GHG emissions. The total investment potential for CDM projects in this sector has been estimated to be about Rs.628 billion (US\$14.6 bn).

Energy efficiency improvement programs in the Indian industry could qualify as potential.

The following table gives the CDM potential in various sectors like Power, Energy Efficiency, Agriculture, Forestry etc. The assessed potential is about 243 Million CERs. The cumulative potential in India, till 2010 in these sectors amounts to 40 billion US Dollars.

CDM Potential in India

S. No.	Sector	Present GHg emissions Million tCO₂/annum	CDM Potential million tCO₂
1	Power	343.9	24
2	Industrial Energy Efficiency	150.674	15
3	Renewable Energy	80.286	90
4	Agriculture & Live Stock	0	35
5	Municipal Solid Waste	12.22	1.2
6	Forestry (Land Use and Land Use Charges & Forestry LULUCF)	14.29	78.17
	Total	601.37	243.37

Present Status of CDM Market in India

Globally already 800 CDM projects are registered with the Executive Board of UNFCCC as of September 2007, and this list is increasing every day. Out of the total registered projects, India has the largest share of 35.25% i.e 282 projects, followed by China 14.5% and Brazil 13.5%. From the present registered projects, the issued CER's amounts to 82.85 Million. The expected CER's from the registered projects until 2012 would be 1050 Million. The Indian projects contribution is about 33 Million CER's/annum amounting to 16%, whereas China is going to have CER's of 470 million/annum with a share of 44%. Share of registered projects by the developed countries and the CER's they are going to generate from the registered projects.

The number of projects registered under CDM are mostly related to Non-Renewable energy

(52.94%), followed by waste disposal (20.64%), Agriculture (7.71%) and followed by Energy efficiency in industries 6.27%). In addition to 800 already registered projects, another 1500 projects are in pipeline. It is expected by 2012 about 4000-4500 projects would be registered under CDM.

Conclusion

With a concerted push and a 40-fold increase in their contribution to primary energy, renewables may account for only 5 to 6% of India's energy mix by 2031-32. This will be totally inadequate and should be substantially increased to at least 25% by 2031-32 for getting to energy independence.

A renewable energy source may be environmentally friendly. It may be locally available thereby making it possible to supply energy earlier than in a centralised system. Grid connected renewables could improve the quality of electricity supply. Further, renewables may provide employment and livelihood to the poor.

However, the subsidies should be given for a well-defined period or upto a well-defined limit. The Committee on integrated energy policy recommends that for promoting renewables, incentives should be linked to outcomes (energy generated) and not just outlays (Capacity Installed).

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