

# ENVIS

## Urban Municipal Waste Management Newsletter

(Sponsored by: Ministry of Environment and Forests, Government of India, New Delhi)



### National Solid Waste Association of India

Reg No. BOM.137/1996 GBBS

Visit us at: [www.nswai.com](http://www.nswai.com)



ENVIS NSWAI

• NINETEENTH ISSUE •

JUNE, 2010

#### FROM THE EDITOR'S DESK

*Open dumping and landfill are the most common practices for municipal solid waste management in India. Both of these processes are known to result in significant greenhouse gases emission, particularly methane that has significantly higher effect on global warming. Clean Development Mechanism (CDM) proposed and operational out of Kyoto Protocol is a project based mechanism which has been developed to curb GHG emission in atmosphere. It is a mechanism for promoting technology transfer and investment from developed countries to the developing countries for projects to reduce the emissions of Green House Gases.*

*The potential CDM mechanisms that are being applied or can be applied in the MSW management sector in developing countries could be wastes-to energy such as capturing landfill gas and generate electricity, anaerobic digestion of organic fraction of wastes, production of biofuel or biogas, composting, incineration, cogeneration as well as minimization of waste volume. This Newsletter is being brought out to create awareness about the CDM Project Cycle, Key Participants and its benefit in Waste Sector with a view to apply this concept on a larger scale in the country.*

#### Clean Development Mechanism in Municipal Solid Waste Sector

Background	2
Clean Development mechanism	2
Municipal Solid waste and Green House Gases generation	3
Solid Waste CDM Methodologies	3
Benefits of CDM	4
CDM Project Cycle	4
CDM Participants	9
Case Study	10
References	12
Upcoming Events	12

## Contents

## Clean Development Mechanism in Municipal Solid Waste Sector

### Background: Kyoto protocol

The Kyoto protocol evolved during the seventh conference of the parties to the UNFCCC (United Nation Framework Convention on Climate Change), at Kyoto Japan in 1997, provides for legally binding targets to the developed countries to collectively reduce their emission to less than 5% of 1990 level by the year 2012. The Protocol came into force in February 2005.

To help developed countries meet their emission reduction targets, the Kyoto protocol provides three flexible mechanisms namely, Clean Development Mechanism (CDM), Joint Implementation (JI) and international Emission Trading (IET). Of these, JI and IET are among the developed countries only while the CDM is between developed and developing countries. Developing countries' interest in participating in CDM lies in the fact that it envisions technology transfer and financial flows to developing countries from developed countries.

**India and Kyoto protocol** India signed and ratified the Protocol in August, 2002. Since India is exempted from the framework of the treaty, it is expected to gain from the protocol in terms of transfer of technology and related foreign investments.

### CDM

The CDM is one of three 'flexible mechanisms' defined under the Kyoto Protocol to the UNFCCC. It allows developed countries to undertake GHG emission reduction (or emission removal) projects in developing countries to counteract their own domestic emissions. Each CDM project generates Certified Emissions Reduction (CER) units, where one CER is equivalent to one tonne of carbon dioxide (CO<sub>2</sub>) or its equivalent for the other GHGs. CER units can be traded or sold, and finally used by industrialized countries to meet part of their emission reduction targets under the Kyoto Protocol.

#### The aims of the CDM

Under the Kyoto Protocol, a CDM project must provide real, measurable and long-term benefits relating to the mitigation of climate change. It must produce a reduction in emissions that would not occur in the absence of the particular project undertaken. The CDM's declared aims are:

- To accomplish the overarching goals of the UNFCCC – namely to prevent dangerous interference with the climate system
- To encourage sustainable development in developing nations, and
- To reduce the cost of complying with the provisions of the Kyoto Protocol for developed nations

Type of projects, which are being applied for CDM and which can be of valuable potential in India are:

- Renewable energy (Wind, Biomass, Solar, Hydro)
- Switching to Alternate Fuels
- Energy Efficiency
- **Waste Management**
- Oil & Gas
- Agriculture
- Carbon Sequestration in Forests

**Municipal Solid Waste and Green House Gases Generation**

Municipal solid waste is a significant contributor to greenhouse gas emissions through decomposition and life-cycle activities processes. Effective mitigation of greenhouse gas emissions is important and could provide environmental benefits and sustainable development, as well as reduce adverse impacts on public health. The waste sector is a significant contributor to greenhouse gas emissions accountable for approximately 5% of the global greenhouse budget (IPCC, 2006). This 5% consist of methane emission from anaerobic decomposition of solid waste and carbon dioxide from wastewater decomposition (IPCC, 2006). The greenhouse gases emissions related to land filling are mainly due to methane and carbon dioxide present in the biogas produced by anaerobic bacteria using as carbon source the biodegradable carbon contained in the waste (IPCC,2006). In particular the disposal of waste in landfills generates methane that has high global warming potential.

**MSW Baseline and Monitoring methodologies for CDM**

The project proponent could develop a new methodology for its project activity or could use one of the approved methodologies by the CDM Executive Board. For small scale CDM projects, the simplified procedures can be used by the project proponent.

**Solid waste Project type**

**Landfill:**

LFG capture/ with or without energy generation

**Composting:**

Methane avoidance

**Controlled combustion, gasification or mechanical/ thermal treatment:**

Methane avoidance

**Wastewater/sludge treatment :**

methane capture (with or without energy generation) or avoidance

**Recycling of waste materials**

**Solid waste CDM methodologies**

Number	Title
ACM 001	Consolidated Methodology for Landfill gas project activities.
AM 0025	Avoided emission from organic waste through alternative treatments.
AM 39	Emission reduction from organic waste water & bioorganic solids by co-composting
AM 57	Avoided emission from biomass wastes through use as feedstock in pulp & paper or bio oil production
AMS III E	Avoided methane from decay of biomass through controlled combustion, gasification or mechanical / thermal treatment.
AMS III F	Avoided methane through controlled biological treatment of biomass.
AMS III G	Landfill methane recovery
AMS III L	Avoidance of methane from biomass through controlled pyrolysis.



- Enhanced public awareness on Solid Waste Management and recycling.
- Improvement in the quality of life of the city.
- Efficient resource utilization
- Contribution to reduction of foreign expenditures (Macro-economic Indicators)
- The increase in life of the dump sites.
- Considerable amount of power to the city.
- Reduction in cost on Solid Waste Management by municipalities.

### 3 Global Benefit

- Foreign Direct Investment (FDI)
- Reduction in emissions of GHG s from dumping grounds which are responsible for Global Warming.
- Project is complying with the Millennium Development Goals

### CDM PROJECT CYCLE

CDM project cycle includes different components of a CDM project and role of major players involved. The graphical representation of CDM project cycle is given on next page:

The CDM Project Cycle involve following Steps:

#### 1. Preparation of Project Design Document (PDD) & Project Concept Note (PCN)

The project proponent needs to submit a PCN and PDD during host country approval in India and PDD is submitted for Validation.

#### PCN

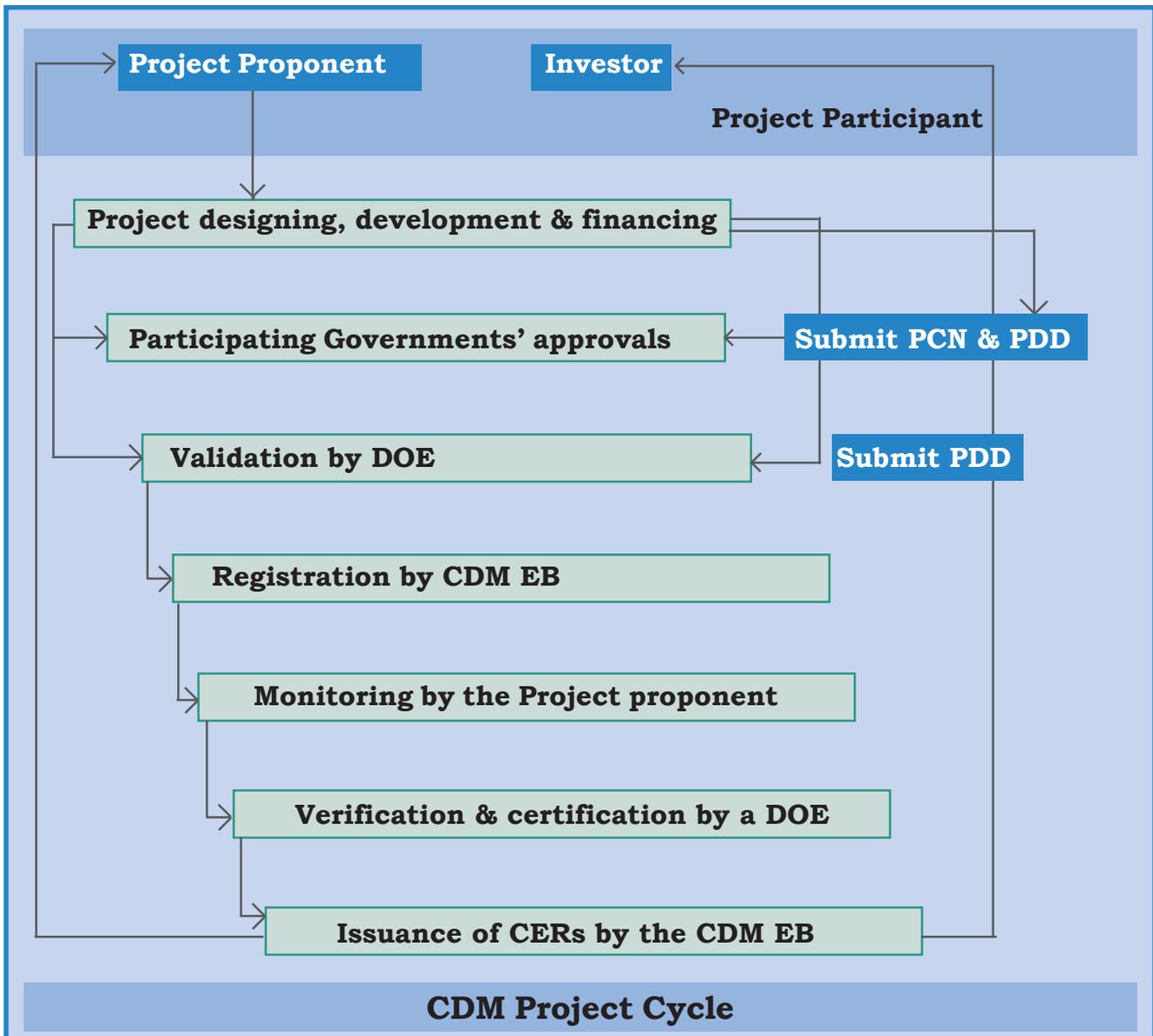
The format for the PCN is provided by the CDM India, Ministry of Environment and Forest on their website. Certain Statutory Clearances are required during PCN as per the Indian Environmental rules and regulations.

### Benefit of CDM in Municipal Solid Waste Management Sector

#### 1. Gaining annual CER revenues for the country

#### 2. Local Benefit

- Safe and better working conditions for the informal sector.
- Better environmental quality(Less odour, leachate, and disease vectors)



PP	Project Proponent
DOE	Designated Operational Entities
EB	Executive Board
PCN	Project Concept Note
PDD	Project Design document
CER	Certified Emission Reductions

**PDD**

The project design document is the basic report which gives the project details, the various stakeholders, the duration, site details or the project boundary for GHG reduction and also estimates the baseline against which the reduction in GHG emission can be

calculated. The estimation of baseline can be based on the fossil fuel, thermal, electrical, mechanical energy replaced by any renewable or less polluting fossil fuel. The PDD also documents the monitoring mechanisms put in place for yearly estimations of GHG reductions

## 2. Approval of the Host Country – Designated National Authority

The PDD once prepared has to get a Host Country Approval via the Designated National Authority (DNA). Obtaining host country approval is a critical step in the CDM project cycle. Without it, a project is not eligible for the CDM.

DNA approval is necessary from both participating countries. For example a CDM project developed between India and Japan the project proponent should obtain the approval from both Indian DNA and Japanese DNA. Each government has different requirements and procedures for the CDM project approval.

The approval letter from DNA should include:

1. The project participants voluntarily participating CDM
2. Project being contributing to the country's sustainable development (Decision 17./COP7)

### National CDM Authority

The Seventh Conference of Parties (COP-7) to the UNFCCC decided that Parties participating in CDM should designate a National Authority for the CDM and as per the CDM project cycle, a project proposal should include written approval of voluntary participation from the Designated National Authority of each country and confirmation that the project activity assists the host country in achieving sustainable development. Accordingly the Central Government constituted the National Clean Development Mechanism (CDM) Authority for the purpose of protecting and improving the quality of environment in terms of the Kyoto Protocol

### Eligible Criteria for CDM India

**Emission Additionality:** The project should lead to real, measurable and long term GHG mitigation. The additional GHG reductions are to be calculated with reference to a baseline.

**Financial Additionality:** The funding for CDM project activity should not lead to diversion of official development assistance. The project participants may demonstrate how this is being achieved.

**Technological Additionality:** The CDM project activities should lead to transfer of environmentally safe and sound technologies and know-how.

### Sustainable Development Indicators.

The CDM projects should also be oriented towards improving the quality of life of the poor from the environmental standpoint.

- **Environmental Criteria :**

This should include a discussion of impact of the project activity on resource sustainability and resource degradation, if any, due to proposed activity; bio-diversity friendliness; impact on human health; reduction of levels of pollution in general

- **Social Criteria:**

The CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people.

- **Economic Criteria:**

Project activity should bring in additional investment consistent with the needs of the people.

- **Technological Criteria:**

Project activity should lead to transfer of environmentally safe and sound technologies that are comparable to best practices in order to assist in up gradation of the technological base. The transfer of technology can be within the country as well from other developing countries also.

**Baselines**

The project proposal must clearly and transparently describe methodology of determination of baseline.

**3. Validation**

Validation is the independent evaluation of the PDD against the UNFCCC's requirements. Validation is conducted by a third party agency known as "designated operational entity" (DOE). Validation can be done at the same time the project being evaluated by DNAs.

**Validation checks:**

- Meeting UNFCCC's participation requirements
- Stakeholders' comments
- Environmental impact analysis or assessment
- Additionality of the GHG emissions reduction
- Baseline and monitoring methodologies

**Designated Operational Entity (DOE)**

Designated operational entities, or DOEs, are domestic or international legal entities that have been accredited by the CDM Executive Board. They are responsible for significant stages of the CDM project development process. The responsibilities include:

**Responsibility of DOE:**

- Validation of CDM activities at the outset of the project
- It verifies emission reduction of a registered CDM project activity
- Making publicly available CDM project design documents
- Receiving public comments on the CDM documents
- Incorporating stakeholder comments
- Verification and certification of CERs during the operation of the project
- Requests the Executive Board to issue Certified Emission Reductions

The same designated operational entity can carry out both the validation (at project outset) and verification (during project operation) only if a specific request is made to the CDM Executive Board.

**4. Registration**

Registration of the project with the CDM Executive Board is the act of formal acceptance of the validated project. The request for registration of a CDM project is the responsibility of the designed operational entity. The DOE submits the validation report and host country approval to the Executive Board for registration. The registration of the project with the Executive Board will be final after a maximum of eight weeks after validation and the submission of the project to the Executive Board, unless a review is requested.

The review by the Executive Board must be related to issues associated with the validation requirements for CDM projects. Until the review is finalized by the Executive Board, the decision for validation is not final and thus the project cannot be registered. Apart from the mandatory registration of the CDM project with the Executive Board, the host country may also require registration of the project. It is advised to check with the designated national authority in the host country for requirements regarding registration of CDM projects.

**CDM EXECUTIVE BOARD**

The CDM Executive Board supervises the CDM and reports directly to the Conference of Parties to the UNFCCC /the Meeting of Parties to the Kyoto Protocol (COP/MOP). The Executive Board was elected at COP-7 and has ten members representing both industrialized and developing countries. The Executive Board is responsible for:

- Making recommendations to the COP/MOP on amendments as well as on further modalities and procedures for the CDM.

- Approving new methodologies related to baselines, monitoring plans and project boundaries; Reviewing simplified procedures and definition of small-scale projects and report to COP/MOP
- Accrediting and suspending of operational entities
- Reviewing accreditation procedures
- Making publicly available proposed CDM activities and all procedures for developing a CDM project
- Developing and maintaining a CDM project registry
- Reviewing project validation and verification reports
- Issuing verified CERs.

## 5. Monitoring

Once the project has been registered, it can be implemented. From the point of implementation on, the project developer needs to start monitoring the project performance, according to the procedures laid out in the validated monitoring plan of the project design document. The monitoring results have to be submitted to a designated operational entity for verification and certification. The project developer is responsible for monitoring the project's performance according to the requirements set out in the validated monitoring plan.

### Verification and Certification

#### Verification

The project developer is responsible for contracting a DOE to carry out the verification process. Verification is the periodic review and ex-post determination of the monitored greenhouse gas emission reductions that have occurred as a result of the CDM project. The DOE verifies the data collected by the developer according to the monitoring plan. The verification process confirms the total number of CERs resulting from CDM projects during a specific period of time. The frequency of verification is

mainly a choice of the project developer, assuming the designated operational entity accepts the decision. Frequent verification increases transaction costs, but also allows for more frequent transfer of CERs.

The DOE shall make the monitoring report publicly available and submit a verification report to the Executive Board. This report is also to be made publicly available. The Executive Board provides a list of DOEs that can be contracted to carry out verification activities on its website at [www.unfccc.int/cdm/dae](http://www.unfccc.int/cdm/dae)

#### Certification

Certification is the written assurance by a DOE that during the specified time period, a project activity achieved the reductions in greenhouse gas emissions as stated and verified, in compliance with all relevant criteria. This process of certification is required for CDM projects. Certification is effectively a form of liability transfer; once the DOE has signed off, any underperformance of the CDM project with respect to the quantity or quality of the CERs is the responsibility of the DOE. Consequently a DOE carry adequate liability insurance. The certification report prepared by the DOE consists of a request to the Executive Board to issue the amount of emission reductions that have been verified by the DOE as CERs adaptation fund.

## 6. Issuance of CER

DOE sends a request to issue CERs to the CDM EB. CDM EB issues the certified amount of CERs within 15 days. This can be stopped by the project proponent or more than 3 CDM EB members requesting for review. When the Executive Board approves the issuance of CERs, the CDM registry administrator, working under the authority of the Executive Board, will forward the CERs into the appropriate accounts. This includes, if applicable, the account for the share of proceeds, for administrative expenses and forwarding the remaining CERs to the project developer, and the 2 per cent of the CERs required to go into the adaptation fund.

## **CDM PARTICIPANTS**

Every CDM projects involves a standard set of key participants. The key participants with specific roles in all projects:

### **Project developer/operators**

The following types of organizations can develop and operate CDM projects.

Governmental bodies (usually, departments of government)

Municipalities

Foundations

Financial institutions

Private sector companies

NGOs

### **CDM investors/CER purchasers**

An investor is an entity that purchases CERs from a CDM project. The investor is usually from an Annex I country and can be a corporation, a government body or non-governmental organization.

### **Host governments and designated national authorities**

CDM host countries also have to specify a domestic institutional body – a designated national authority or DNA –for approving CDM projects.

### **Designated operational entities**

Designated operational entities, or DOEs, are domestic or international legal entities that have been accredited by the CDM Executive Board.

### **The CDM Executive Board**

The CDM Executive Board supervises the CDM and reports directly to the Conference of Parties to the UNFCCC /the Meeting of Parties to the Kyoto Protocol (COP/MOP).

### **Other Stakeholder**

The CDM process cycle calls for two rounds of stakeholder comments. Developers must invite local constituencies who will be affected by a project to review and comment on the project design document before it is submitted for host country approval. Later, subsequent to project approval, the project design document must be posted for 30 days to allow interested parties at the local, national or international level to comment on it.

## Case Study

### Composting of Organic Content of Municipal Solid Waste in Lahore, Pakistan

Lahore has a population of around 10 million and is considered to be one of the 30 largest cities in the world. Due to high population growth and the lack of resources, waste management has become a challenge for the city. Lahore Compost project is a first of its kind project in Pakistan by bringing composting technology to a country where common practice is open dumping of waste and there are no landfills. This project is also the first public-private partnership project in Pakistan on such a large scale in the area of Municipal Solid Waste Management (MSW). This project addresses the need to disposal of solid waste in economically beneficial ways without putting an extra burden on the Lahore city infrastructure. Lahore Compost Limited (LCL) is a joint venture between Saif Holdings Limited (SHL) and the City District Government of Lahore (CDGL). LCL has imported Belgian machinery and composting technology Aerobic windrow type composting is used. The project involves the production of compost from the organic solid waste using state-of-the-art Menart Technology.

### Project Cost and Revenue

### Project Description

#### Methodology Used:

AM0025 version 9 titled “Avoided emissions from organic waste through alternative waste treatment processes”

#### Operational Lifetime:

25 years.

#### Total annual reduction:

78,344 (Tons of CO<sub>2</sub>eq/yr)

#### Economic Viability of the Project:

Internal Rate of Return (IRR):

Without CDM benefits : 13.18%

With CDM benefits : 18.38%  
baseline and monitoring

#### Other Qualitative Benefits:

- The project Produces cheap organic fertilizer which improves per hectare yield. Thus promoting farmers’ income and contributing to economic sustainable development of the region.
- The Project helps in transfer of modern technology (state of art Menart technology) and increases skilled labour opportunities and created about 80 full-time jobs at the project plant.

Total Project Cost	
Description	Amount in US \$
Plant & machinery	2791000.590
Civil work & land development	2481000.228
Furniture & fittings	64000.956
Others	186000.501
<b>Grant Total</b>	<b>5,524,275</b>
<b>Total amount in US \$ (million)</b>	<b>5.5 million</b>
Benefits from the Project	
Activity	Revenue in US\$
Sale of Carbon Credits (@ US\$ 11/tonnes of CO <sub>2</sub> eq)	0.858 million/annum
Sale of 5591 Metric tones Compost/Year (@ Rs.250 per 50 kg bag)	0.94 million/annum
<b>Total estimated annual revenue:</b>	<b>1.798 million</b>

- The project also promote sustainable development of Lahore Municipality by improving the environment quality and demonstrate the commercialized practice of composting that could assist Pakistan’s central and southern regions in meeting the objectives regarding re-use of waste.
- The project has created new economic activities for everyone involved in the value chain.
- The project activity helps in reducing GHG (methane) emission levels in the environment. Additionally it would reduce the amount of waste going into the landfill thus increasing the lifespan of the waste landfill.
- The compost produced by Lahore Compost is far less expensive than locally manufactured as well as imported fertilizer (urea, DAP, etc) and compost. It complements as well as substitutes chemical fertilizer.

**2. Gorai Landfill closure and Gas Capture Project, Mumbai,**

The Gorai site is located in the Western Suburbs of Mumbai. It spread over an area of 19.6 ha and in operation since 1972. The site is adjacent to Gorai creek and is very close to habitation. The daily receipt of MSW was approx 2200 TDP of MSW from Western suburbs wards. After December 2007 MCGM had stopped receiving fresh waste at Gorai. Approximately about 2.34 million tons of waste up to an average height of 26 m was lying at the site. Hence the scientific closure of the site was recommended. The MSW was covered and compacted with C & D waste and thereon covered with linear system comprise with Geo textile liner over C & D layer. A landfill gas recovery system has been installed at the site in order to capture Methane emission in future. To incinerate the landfill gases, enclosed flare system has been provided. The flare system consists of flare burner along with chimney of around 12 mt height.

**Estimate of GHG abatement in tCO<sub>2</sub>eq.**  
752234

**Baseline Methodology**

ACM0001 Version 09: Consolidated baseline And monitoring methodologies for landfill gas project activities. AM0053, Version 01.1: Biogenic methane injection to a natural gas distribution grid

---

Total project Cost	: 503 million Rs
--------------------	------------------

---

Estimated CERs over a period of 10 years	: 1.2 million Rs
--	------------------

---

The Gorai project has received the Host country approval by government of India, MoEF and is in the advance stage of getting registered with UNFCCC as per Kyoto protocol.

**Way forward and Future of CDM in waste sector**

Waste Management is one of the most underutilized sectors. Waste management services have certain common characteristics, they are expensive to set up (associated with high sunk costs), enjoy economies of scale and are consumed on a massive scale. As per these Municipal Solid Waste (Management and Handling) Rules 2000 the Urban Local Body (ULB) is responsible for the management of MSW including collection, transportation, treatment and disposal of MSW. Most Civic bodies are yet to take initiatives to comply with the Municipal Solid Waste (Management and Handling) Rules citing financial constraints. As Municipal Solid Waste management projects have limited budget and revenue. CDM will help in overcoming technological and financial barriers associated with MSW management projects. But there is need of promotion of elimination of Methane from Garbage, effective landfill Degradation and Agro waste to energy project.

**We would appreciate your feedback on this newsletter and welcome you all to contribute articles, news or in any other form pertaining to the Waste Management issues, for publishing in our subsequent newsletters.**

## References

- Clean Development Project Opportunities in India, TERI New Delhi, January 2001
- [http://cdmindia.nic.in/cdm\\_india.htm](http://cdmindia.nic.in/cdm_india.htm)
- The Kyoto Protocol, [http://unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php),
- <http://carbonfinance.org/Router.cfm?Page=FAQ&ItemID=24677#2>
- The Clean Development Mechanism: a user's guide by United Nations Development Program
- <http://unfccc.int/2860.php>
- <http://www.cdmpakistan.gov.pk>
- Bio-remediation of old Landfills-Mrs. Almitra H Patel (*Member Supreme Court Committee for SWM*)
- CARBON TRADING via CERs and VERs By Almitra Patel

---

## Upcoming Events

1. **WASTECON 2010** Boston, Massachusetts, USA - **14-18 August 2010**  
Solid Waste Association of North America (SWANA)  
Website: [www.swana.org](http://www.swana.org) • Email: [info@wastecon.org](mailto:info@wastecon.org)
2. **RWM – RECYCLING AND WASTE MANAGEMENT EXHIBITION 2010** Birmingham, UK  
**14 – 16 September 2010** • Website: [www.rwmexhibition.com](http://www.rwmexhibition.com) • Email: [mark.ram@emap.com](mailto:mark.ram@emap.com)
3. **2010 GLOBAL WASTE MANAGEMENT SYMPOSIUM** - San Antonio, Texas, USA  
**3-6 October 2010** • Website: [www.wastesymposium.com](http://www.wastesymposium.com) • Email: [Florence.torres@penton.com](mailto:Florence.torres@penton.com)
4. **GREEN ENERGY WORLD EXPO 2010** - Organized by GSNA Worldwide  
**14 - 16 October 2010** • website: [www.gsnaworldexpo.in](http://www.gsnaworldexpo.in) • Email: [info@gsnaworldwide.com](mailto:info@gsnaworldwide.com)
5. **Canadian Waste and Recycling Expo 2010** Toronto, Canada  
**3-4 November 2010** • Website: [www.cwre.ca](http://www.cwre.ca) • Email: [cweinfo@usa.messefrankfrut.com](mailto:cweinfo@usa.messefrankfrut.com)
6. **WASTE MANAGEMENT EXPO 2010 (WME'10)**  
Organised by HITEX Exhibition Centre, Hyderabad (INDIA)  
**9 - 12 December 2010** • Website: [www.wmeonline.in](http://www.wmeonline.in).
7. **MUNICIPALIKA 2011** - Municipalika India, Bangalore  
**27,28,29, January 2011** • Email: [info@municipalika.com](mailto:info@municipalika.com)
8. **Waste Expo 2011** - Dallas, Texas, USA  
**10-12 may 2011** • Website: [www.wasteexpo.com](http://www.wasteexpo.com) • Email: [Kimberly.stolfi@penton.com](mailto:Kimberly.stolfi@penton.com)

### Address for correspondence:

National Solid Waste Association of India,  
B-703, Customs Colony A, Military Road, Marol,  
Andheri (E), Mumbai - 400 059. INDIA.  
Phone: 91 22 29207577 • Telefax: 91 22 29202951  
E-mail: [econpcpl@gmail.com](mailto:econpcpl@gmail.com) / [nswai@envis.nic.in](mailto:nswai@envis.nic.in)

### Editor:

Dr. Rakesh Kumar

### ENVIS Core Group:

Dr. Amiya Kumar Sahu, Convener  
Dr. M. V. M. Desai  
Dr. Rakesh Kumar

This Bulletin of ENVIS NSWAI is published by the National Solid Waste Association of India in Mumbai

Visit us at: [www.nswai.com](http://www.nswai.com)