<table>
<thead>
<tr>
<th>S.No</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constitution of the Task Force on Waste to Energy Projects</td>
</tr>
<tr>
<td>2</td>
<td>Terms of Reference of the Task Force</td>
</tr>
<tr>
<td>3</td>
<td>Extension of Term of Task Force on Waste to Energy Projects till</td>
</tr>
<tr>
<td></td>
<td>April 15, 2014</td>
</tr>
<tr>
<td>4</td>
<td>Minutes of the First Meeting of the Task Force held on June 12, 2013</td>
</tr>
<tr>
<td>5</td>
<td>Minutes of the Second Meeting of the Task Force Aug 1, 2013</td>
</tr>
<tr>
<td>6</td>
<td>Minutes of Third Meeting of the Task Force Oct 14, 2013</td>
</tr>
<tr>
<td>7</td>
<td>Minutes of the Fourth Meeting of the Task Force Feb 17, 2014</td>
</tr>
<tr>
<td>8</td>
<td>Minutes of the Fifth and final Meeting of the Task Force May 1, 2014</td>
</tr>
<tr>
<td>9</td>
<td>Salient Features of the MSW Rules 2000</td>
</tr>
<tr>
<td>10</td>
<td>Salient Features of the Plastic Waste (Management and Handling) Rules, 2011</td>
</tr>
<tr>
<td>11</td>
<td>Salient Features of the Draft MSW Rules 2013</td>
</tr>
<tr>
<td>12</td>
<td>Tour Report of Visit to M/S A2Z, Kanpur</td>
</tr>
<tr>
<td>13</td>
<td>Tour report of Visit to M/s SELCO INTERNATIONAL Ltd. Waste Management Plant, Hyderabad</td>
</tr>
<tr>
<td>14</td>
<td>Tour Report of Visit to Bio Gas Plant located at Delhi Secretariat</td>
</tr>
<tr>
<td>15</td>
<td>Tour Report of Visit to Waste to Energy Plant at Okhla</td>
</tr>
<tr>
<td>16</td>
<td>Presentations made during second meeting of the task force on Waste to Energy</td>
</tr>
<tr>
<td></td>
<td>16.1 Municipal Solid Waste - Not a Nuisance To Be Got Rid of Promptly But a Valuable Resource by Dr K S Shivaprasad -MD, Innovision Engineers Private Limited</td>
</tr>
<tr>
<td></td>
<td>16.2 Solid Waste Management Chandigarh by Municipal Corporation, Chandigarh</td>
</tr>
<tr>
<td></td>
<td>16.3 Municipal Solid Waste Management under JNNURM by Ministry of Urban Development Govt. of India</td>
</tr>
<tr>
<td></td>
<td>16.4 Decentralized Waste Resource Management:- Nisargruna experience by Dr Sharad P. Kale Head, Technology Transfer and Collaboration Division, Bhabha Atomic Research Centre, MUMBAI</td>
</tr>
<tr>
<td></td>
<td>16.6 Waste to Energy practices adopted by Ahmedabad City by Dr. Guruprasad Mohapatra, Municipal Commissioner Ahmedabad Municipal Corporation</td>
</tr>
<tr>
<td></td>
<td>16.7 Waste to Energy Technology by Waste Management Association.</td>
</tr>
</tbody>
</table>
17 Presentations made during third meeting of the task force on Waste to Energy

17.1 Waste to Energy Opportunities and Challenges by Dr. Amiya Kumar Sahu-President National Solid Waste Association of India

17.2 De-centralized Waste Management by Ashwin C Shroff - Environ & Biotech Division Excel Industries Limited

17.3 Solid Waste Management of Kolkata by Kolkata Municipal Corporation

17.4 Processing and Disposal of MSW Nagpur City by Shyam Wardhane, Commissioner

17.5 Further on the document submitted to TF -by S Dasappa Indian Institute of Science, Bengaluru.

17.6 Waste Management Scenario in SAIL Steel Plants by SAIL, New Delhi

18 Presentations made during fourth meeting of the task force on Waste to Energy

18.1 W to E in India key issues-Dr N.B. Mazumdar.

18.2 PPP in MSWM in India -Experiences and Lessons- V. Srinivas Chary, Director, Urban Governance , Administrative Staff College of India (ASCI)
OFFICE MEMORANDUM

Subject: Constitution of Task Force on Waste to Energy Projects

Increasing urbanisation and changing lifestyles of people has given rise to generation of large quantities of wastes leading to increased threats to the environment. In recent years, technologies have been developed that not only help in generating energy from the waste but also in reducing the quantity of waste for its safe disposal.

2. To examine the technological aspects of Waste to Energy projects, it has been decided to constitute a Task Force as under:-

Chairman

i) Dr. K. Kasturirangan, Member, Planning Commission

Members

ii) Secretary, Ministry of Urban Development
iii) Secretary, Department of Atomic Energy
iv) Secretary, Ministry of Power
v) Secretary, Ministry of New and Renewable Energy.
vi) Adviser to Deputy Chairman, Planning Commission
vii) Dr. Indrani Chandrasekharan, Consultant, Planning Commission

Experts

viii) Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
ix) Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi

3. The Chairman shall co-opt two more technical members to the Task Force.

4. The Task Force would submit its report within a period of three months.

(Ch.P.Sarathi Reddy)
Director (Infra)
Tele: 011-23096747

To
As per list enclosed
1. Dr. K. Kasturirangan, Member, Planning Commission
2. Secretary, Ministry of Urban Development
3. Secretary, Department of Atomic Energy
4. Secretary, Ministry of Power
5. Secretary, Ministry of New and Renewable Energy.
6. Adviser to Deputy Chairman, Planning Commission
7. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
8. Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
9. Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi
The overall scope of the “Task Force” on waste to energy (W to E) shall encompass integrated waste management and identification and assessment of W to E technologies in the context of the contemporary Indian municipal solid waste (MSW) scenario. The specific terms of reference (TOR) shall be as follows:

1. To examine the technological aspects of W to E projects,
2. Significance of segregation at source vis a vis waste collection and transportation model,
3. Selection of centralized versus decentralized MSW-management models including Scale of operation and quality of wastes,
4. Assessment of the current financing and financial models and propose the potentially sustainable model,
5. Incorporation of integrated waste management and preventive environment management strategies and,
6. Assessment of the prevailing concession Agreements between developer, technology provider and municipalities.
OFFICE MEMORANDUM

Subject: Extension of term of Task Force on Waste to Energy- regarding

The term of the Task Force on Waste to Energy constituted vide the office memorandum of even number dated June 05, 2013 is further extended upto April 15, 2014.

To

1. Dr. K. Kasturirangan, Member, Planning Commission
2. Secretary, Ministry of Urban Development
3. Secretary, Department of Atomic Energy
4. Secretary, Ministry of Power
5. Secretary, Ministry of New and Renewable Energy.
6. Secretary, Ministry of Environment & Forest
7. Adviser to Deputy Chairman, Planning Commission
8. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
9. Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
10. Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi
11. Dr P.U Asnani, Chairman, UMC Global, Ahmedabad
12. Prof Shyam R Asolekar, CESE, IIT Mumbai
13. Dr Avinash B Akolkar, Director, CPCB
14. Dr Sharad Kale, Head, Technology Transfer and Collaboration Division, BARC, Mumbai.
N-14070/08/2013-Infra (Vol II)
Planning Commission
(PPP & Infrastructure Division)

Room No 142, Yojana Bhawan,
Dated February 3, 2014

OFFICE MEMORANDUM

Subject: Extension of term of Task Force on Waste to Energy - regarding

The term of the Task Force on Waste to Energy constituted vide the office memorandum of even number dated June 05, 2013 is further extended upto March 15, 2014.

To

1. Dr. K. Kasturirangan, Member, Planning Commission
2. Secretary, Ministry of Urban Development
3. Secretary, Department of Atomic Energy
4. Secretary, Ministry of Power
5. Secretary, Ministry of New and Renewable Energy.
6. Secretary, Ministry of Environment & Forest
7. Adviser to Deputy Chairman, Planning Commission
8. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
9. Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
10. Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi
11. Dr P. U Asnani, Chairman, UMC Global, Ahmedabad
12. Prof Shyam R Asolekar, CESE, IIT Mumbai
13. Dr Avinash B Akolkar, Director, CPCB
14. Dr Sharad Kale, Head, Technology Transfer and Collaboration Division, BARC, Mumbai.
N-14070/08/2013-Infra (Vol II)
Planning Commission
(PPP & Infrastructure Division)

Room No 144, Yojana Bhawan,
Dated 13th December, 2013

OFFICE MEMORANDUM

Subject: Extension of term of Task Force on Waste to Energy - regarding

The term of the Task Force on Waste to Energy constituted vide the office memorandum of even number dated June 05, 2013 is further extended upto January 31, 2014.

\[ (Gayatri Nair) \\
Deputy Adviser \\
Tel: 011-23042773 \]

To

1. Dr. K. Kasturirangan, Member, Planning Commission
2. Secretary, Ministry of Urban Development
3. Secretary, Department of Atomic Energy
4. Secretary, Ministry of Power
5. Secretary, Ministry of New and Renewable Energy.
6. Secretary, Ministry of Environment & Forest
7. Adviser to Deputy Chairman, Planning Commission
8. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
9. Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
10. Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi
11. Dr P.U Asnani, Chairman, UMC Global, Ahmedabad
12. Prof Shyam R Asolekar, CESE, IIT Mumbai
13. Dr Avinash B Akolkar, Director, CPCB
14. Dr Sharad Kale, Head, Technology Transfer and Collaboration Division, BARC, Mumbai.
OFFICE MEMORANDUM

Subject: Extension of term of Task Force on Waste to Energy- regarding

The term of the Task Force on Waste to Energy constituted vide the office memorandum of even number dated June 05, 2013 is hereby extended upto December 15, 2013.

(Gayatri Nair)
Deputy Adviser

To

1. Dr. K. Kasturirangan, Member, Planning Commission
2. Secretary, Ministry of Urban Development
3. Secretary, Department of Atomic Energy
4. Secretary, Ministry of Power
5. Secretary, Ministry of New and Renewable Energy.
6. Adviser to Deputy Chairman, Planning Commission
7. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
8. Prof. S. Dasappa, Centre of Sustainable Technologies, Indian Institute of Science, Bangalore
9. Mr. Amit Kumar, Director, Energy Environment Technology Division, The Energy Research Institute (TERI), New Delhi
10. Dr P.U Asnani, Chairman, UMC Global, Ahmedabad
11. Prof Shyam R Asolekar, CESE, IIT Mumbai
12. Dr Avinash B Akolkar, Director, CPCB
13. Dr Sharad Kale, Head, Technology Transfer and Collaboration Division, BARC, Mumbai.
Planning Commission
(PPP & Infrastructure Division)

Subject: Minutes of the first meeting of the Task Force on Waste Energy Projects — regarding.

The first meeting of the Task Force on Waste to Energy Projects, which was constituted by the Planning Commission vide OM No. N-14070/08/2013-Infra, Dated June 05, 2013, was held in the Planning Commission on June 12, 2013 under the Chairmanship of Dr. K. Kasturirangan, Member, Planning Commission. The list of participants is placed at Annex-1.

2. Adviser to Deputy Chairman, Planning Commission welcomed the chairman and members of the Task Force and stated that the Finance Minister in his Budget speech had announced financial incentives for waste to energy projects under Public Private Partnership (PPP) mode. He stated that the Task Force has been appointed on the direction of the PMO to give their recommendations on the issues mentioned in the Terms of Reference, especially in the context of private participation.

3. Chairman welcomed the members and stated that with increasing industrialisation, urbanisation and changing lifestyles of people, the amount of solid waste generated in the country has been growing. However, only a small portion of this waste is being processed leading to waste being dumped in open areas which is a cause for concern. He stated that the primary objective of the solid waste management technologies should be to reduce the quantum of solid waste to be disposed off followed by recovery of useful by-products like energy. Further, he stated that international experience in the waste management operations needs to be studied while making recommendations.

4. Secretary, MoUD stated that it is becoming very difficult to develop new dumping yards in the cities due to public opposition. He stated that MoUD has issued a series of guidelines on solid waste management process which includes waste to energy also. He stated that MoUD is funding the waste management projects under
JNNURM where municipal bodies are free to choose the technology for waste processing. Further, he stated that the issues related to solid waste management are different for small and large cities and they should be addressed suitably. Chairman requested the Secretary, MoUD to send a comprehensive Note on this subject to the Planning Commission.

5. Adviser, MNRE made a presentation on the waste to energy scenario in the country including a brief description of projects funded by MNRE. He emphasised that conversion of waste to energy has been the most preferred option in USA and EU and highlighted the various waste to energy technologies available for processing of solid waste. He stated that the solid waste processing plant at Okhla is based on the incineration technology and its performance has been satisfactory. He stated that as the municipal authorities are the main beneficiaries of waste management, they should pay some charges to the waste processing plant on the basis of quantity of waste processed. This would make waste management plants financially viable. Further, he stated that in terms of the Supreme Court’s directive issued in 2007, the Government can take a view on the waste management projects based on the report to be submitted by the experts on the initially commissioned five projects. The chairman desired that a Note on these aspects be made available to Planning Commission.

6. Dr. Dasappa, Professor, IISc made a short presentation and emphasised that while the raw material (wastes) is available in plenty as an assured feed material for energy purposes, economic sustainability is critical for waste to energy programs. He stated that the incineration technology is best suited for plants having power generating capacity in the range of 5-10 MW whereas gasification is suited for small size plants. He stated that the energy conversion efficiency of gasification plants is higher than the incineration plants. He stated that the environmental gains should be accounted while fixing the electricity tariff for waste to energy plants.

7. Joint Secretary, Department of Atomic Energy stated that NISARGRUNA technology developed by the BARC converts solid waste into fuel gas and manure and BARC has already transferred this technology to various private firms. Further, he
stated that a plant based on the radiation technology (SHRI) which has been developed by the BARC is operational at Vadodara and it produces pathogen free and odor free sludge suitable as bio-fertiliser. Chairman suggested that a Note on these two technologies be circulated to all the members before the next meeting. Department of Atomic Energy would send a Note to Planning Commission on this subject.

8. Additional Secretary, Ministry of Power commented that distribution companies view the Renewable Energy Purchase Obligations (RPO) as a burden and among the various renewable energy options, compliance has been good only in solar specific RPO. He suggested that the Task Force should invite the commissioners of at least two municipalities having waste to energy plants to share their experiences.

9. Adviser to Deputy Chairman stated that waste to energy projects should be structured with outcome-based parameters and awarded through competitive bidding and the successful bidder should be given the freedom to select the technology. However, this should be subject to adhering to the emission standards.

10. After detailed discussion, it was decided that in the next meeting of the Task Force,

a) MoUD will make a presentation on their experiences in the waste management sector including technological options for waste management process. MoUD would also provide the details of the projects supported under JNNURM and their status. They would also arrange presentations by municipalities one each from two different states on their experience in this sector;

b) MNRE would arrange a presentation by the JITF Urban Infrastructure Ltd on Timarpur - Okhla Waste Management project;

c) MNRE would submit a position paper on various technologies available for waste management, their scalability, economics and other experiences.
Prof. Dasappa, IISc; Dr. Dhinadayalam, Joint Adviser, CPHEEO; and Dr. A. Kolkar, CPCB would assist MNRE in this regard;

11. It was also decided that the following would be requested to make a presentation in the next meeting.

   a) Waste Management Association, New Delhi on technical and financial aspects of solid waste management in India;

   b) Prof. Kale, BARC on the NISAR GRUNA and SHRI technologies developed by the BARC for solid waste and sewage management;

12. MoEF may be requested to nominate a representative to participate in the Task Force meetings.

13. MoUD, MNRE, IISc, DAE will send the Note desired by the chairman within two weeks.

14. The meeting ended with a vote of thanks to the chair.
LIST OF PARTICIPANTS

1. Dr. K. Kasturirangan, Member, Planning Commission ..... in Chair
2. Shri Gajendra Haldea, Adviser to Deputy Chairman, Planning Commission
3. Shri Sudhir Krishna, Secretary, Ministry of Urban Development
4. Shri Ashok Lavasa, Additional Secretary, Ministry of Power
5. Shri Ravi Mital, Adviser (Infrastructure), Planning Commission
6. Dr., Indrani Chandrasekharan, Consultant, Planning Commission
7. Shri A.K.Dhussa, Adviser, Ministry of New and Renewable Energy
8. Shri KAP Sinha, Joint Secretary, Department of Atomic Energy
9. Prof. S. Dasappa, Centre for Sustainable Technologies, IISc, Bangalore
10. Prof. M. Emran Khan, Professor, Jamia Millia Islamia, New Delhi
11. Shri Major Singh, Member (Planning), Central Electricity Authority
12. Shri M. Dhinadhayalam, Joint Adviser (PHEE), Ministry of Urban Development
13. Shri Ch.P.Sarathi Reddy, Director (Infrastructure)
Planning Commission
(PPP & Infrastructure Division)

Subject: Minutes of the second meeting of the Task force on Waste to Energy Projects – regarding.

The second meeting of the Task Force on Waste to Energy was held in Planning Commission on August 1, 2013 under the Chairmanship of Dr K Kasturirangan, Member, Planning Commission. The list of the participants is placed at Annex-I.

2. Initiating the discussion, Member, Planning Commission welcomed the members and shared the experiences of his recent visits to Municipal Solid Waste Management plant at Kanpur, Bio-gas plant at Delhi Secretariat and Waste to Energy plant at Okhla, New Delhi.

3. Dr. K S Sivaprasad, MD, Bangalore Blended Fuels made a presentation on the Waste to Energy technology developed by him for processing of waste. He stated that this technology has been successfully implemented as a pilot project in Malaysia. The main focus of the technology is on reduction of inerts. It was stated that the innovative part of the technology is the use of moving grate boiler which is comparatively cheaper than the reciprocating boiler grate. He mentioned that this technology is suited to the Indian conditions which is characterised by high moisture and low calorific value waste.

4. Member, Planning Commission requested for information on how this technology would respond to the varying composition of feedstock. It was felt that detailed information was required on the quality of waste and how this technology could be adopted in the light of changing parameters. Further, Adviser to Deputy Chairman requested for details on; (i) whether this system is compliant with air and water quality standards (ii) the approximate capital cost per MW of energy generated (iii) whether any financial guarantee needs to be provided (iv) cost of power per unit (v) sharing of risk between private entity and the Government.

5. Municipal Commissioner, Ahmedabad made a detailed presentation on the waste management practices of Ahmedabad. He stated that solid waste from residential and commercial establishments is being collected from door-door to ensure that waste generated from street sweeping, Construction and Demolition (C&D) debris are not mixed. He stated that the charges from the households/establishments for waste collection are being collected as a part of the property tax. He stated that presently the Collection and Transportation of Waste and its processing are being
dealt through separate contracts. The existing waste processing facilities in Ahmedabad are involved in composting and preparation of Refused Derived Fuel (RDF). However, the Ahmedabad Municipal Corporation has recently awarded two projects for conversion of solid waste to Energy. Further, the processing of C&D waste has been let out to a private operator. It was stated that the bid parameter for award of these projects was the lowest requirement of land and water.

6 Member, Planning Commission requested for a detailed model specifying the economics of the model. Adviser to Deputy Chairman explained that Viability Gap Funding (VGF) assistance from the centre can be explored wherever projects are unviable.

7. Municipal Commissioner, Chandigarh apprised the committee members on the system being followed in the city. In Chandigarh also waste collection is undertaken mostly by the private operators. The municipal corporation of Chandigarh collects around 370 tonnes of waste every day of which 250 tonnes is processed and the rest goes to dumping ground. He stated that no tipping fee is paid to the operator for processing the waste. He mentioned that waste to energy facility may not economically viable for a city like Chandigarh with a population of 11 lakhs.

8 Dr. Indrani Chandrashekhan, Consultant, PC highlighted the fact that rest of the remaining 120 MT of waste cannot directly be sent to the dumping ground as it is against the laid down Municipal Solid Waste Rules (Management and Handling) 2000.

9. Professor Sharad Kale, BARC made a presentation on the ‘Nisarguna’ technology developed by BARC for processing the bio-degradable waste. This technology is based on the process of bio-methanisation and has been used in around 160 projects. The cost of setting up a one tonne plant is roughly around Rs 17-20 lakhs and processing of one tonne waste generates around 50 kg of manure. It was stated that the technology is best suited for decentralised management of biodegradable municipal solid waste. This technology can be used to set up waste management plants of processing capacity 1 MT to 20 MT of waste per day. The land required for processing around 5 MT of waste is around 500 sq m.

10 Adviser to Deputy Chairman requested that the experience of the use of this technology across the country should be brought out. Further, Professor Kale can reflect on the ways in which this model could be used by the private sector to make it a self-sustaining model.

11. The representatives from the Ministry of Urban Development highlighted the importance of source segregation to remove the recyclables from the waste collected at source. Experience of successful models of waste segregation in Singapore and
Tokyo were cited. The working of JNNURM scheme was also explained. It was emphasised that the ministry is also keen on pushing for decentralised solutions and that besides the financial aspects, socio economic issues involved in the processing of solid waste management be also looked into while framing policy measures.

12. The Ministry of Environment & Forest pointed out that the ministry is amending the Municipal Solid Waste (Management and Handling) Rules 2000. Draft of amended MSW Rules 2013 would be notified soon and circulated for comments. The revised rules have specified the responsibilities at different levels. The standards suggested in the rules would be technology neutral. However, the ultimate responsibility lies with the Urban Local Bodies. Member, Planning Commission requested for details on assessment carried out on implementation and status of the rules and whether any database on the same exists. This information could then be dovetailed into the recommendations of the Task Force.

13 The Waste Management Association presented the advantages and disadvantages of different technologies. The output was dependent upon the scale of waste generated. For waste generation of 500 tonnes per day, composting was ideal; for waste generation of 500-1000 tonnes per day, either composting or energy generation could be adopted and for waste generation exceeding 1500 tonnes per day, energy generation was ideal. The use of RDF was highly limited as it can be used only in cement industry. The association also reiterated the importance of segregation of waste at source. Member, Planning Commission requested for a holistic view on the level of toxic gases produced in waste to energy facility. He requested for details regarding the procedure that can be followed for reduction of toxic gas emission.

14 Shri P.U. Asnani emphasised the importance of source segregation and door to door collection of waste. The focus should be on output based incentives. Waste processing can be decentralised but disposal of waste should be at a farther distance. The aim of the policy should be to reduce the amount of waste going to landfill. Mr Asnani pressed the need for integrated waste management technologies as the integrated facility will decrease the cost of transportation of waste and emphasised that also socio economic factors should also be considered while selecting a technology. Two tier technology should be suggested as only 55 cities generate more than 300 tonnes of waste per day. The market for RDF was not well defined. It was suggested that use of RDF in cement industry should be made mandatory. Another option was to explore the possibility of subsidising the use of RDF.

15 Commenting on the technologies available, the representatives of Ministry of Non-Renewable Energy clarified that gasification as a technology is a very recent phenomenon. It is cost effective and is not limited by any lower limit as incineration technique is limited by the capacity of boilers.
16 The representatives of IL & FS highlighted the advantages of different technology and its usage. Pyrolysis/ Gasification technology are very costly and technologies which have emerged recently. The number of plants using Pyrolysis technology is very less. Incineration technique is the most used one. Even though Fluidised Bed Boiler technology has not been a success in Europe, this technology can be successful in India seeing the composition of the waste. China has established 100 waste to energy plants based on Incineration technology. He also mentioned that on an average Incineration plants get an efficiency of 18-22 %, with a maximum reported efficiency of 23 % from a WtE facility in Amsterdam, Netherlands.

17 Adviser, Infrastructure pointed out the need for a financial model of managing the waste processing system. It should start with the collection of waste and end up in generation of compost or fuel. It is important to list out the pre-conditions to make a technology successful. The main components of the cost including the collection cost and capital cost should be clearly stated. It was easier to subsidise capital cost than cost of the output. The Viability Gap Funding and JNNURM grants would also help in making the project viable.

18 Concluding the discussion, Member, Planning Commission stated that the existing database was inadequate but the Task Force needs to highlight both the positive and negative aspects of the accepted approaches. The report of the Task Force should be objective and exhaustive so that the implications of the different approaches are reflected properly. The uncertainties, complexities and concerns in this sector need to brought out clearly. This requires an objective feedback from all participants. He requested all participants to send written reports on various technologies so as to enable the Task Force to take a view.
Annex-I

List of Participants

1. Dr. K. Kasturirangan, Member, Planning Commission
2. Shri Gajendra Haldea, Adviser to DCH, Planning Commission
3. Shri Ashok Lavasa, Additional Secretary, Ministry of Power
4. Shri Susheel Kumar, Additional Secretary, Ministry of Environment & Forest
5. Shri V.K. Chaurasia, Joint Adviser, Ministry of Urban Development
6. Shri A.S.Bhal, Economic Adviser, Ministry of Urban Development
7. Shri K A P Sinha, Joint Secretary, Department of Atomic Energy
8. Shri Ravi Mital, Adviser (Infrastructure), Planning Commission
9. Shri Amit Kumar, Director, TERI
10. Shri Dinesh Chander Pant, TERI
11. Shri P.U Asnani, Chairman, UMC( Global)
12. Shri Guruprasad Mohapatra, Municipal Commissioner, Ahmedabad
13. Shri Sunil Bhatia, Additional Commissioner, Municipal Corporation, Chandigarh
14. Shri Manoj Kumar, Municipal Corporation, Chandigarh
15. Shri A.K. Dhusa, Adviser
16. Shri A.B.Akolkar, Director, CPCB
17. Shri Shyam R. Asolekar, CESE, IIT Bombay
18. Prof S.P.Kale, BARC
19. Shri K.S .Sivaparasad, Managing Director, Innovision Engineers Private Limited
20. Prof P D Grover, Senior Technical Adviser, ILFS
21. Shri Gyan Prakash Mishra, ILFS
22. Shi Sundeep Kumar, Waste Management Association
23. Shri Murali Krishna
24. Shri Rakesh Agarwal, Jindal ITF
25. Shri Amit Bajpai, Jindal ITF
26. Shri Neelesh Gupta, Jindal ITF
27. Ms Indrani Chnadrasekaran, Consultant, Planning Commission
28. Shi Ch. P. Sarathi Reddy, Director, Planning Commission
29. Ms Gayatri Nair, Deputy Adviser, Planning Commission
30. Shahbaz Khan, Young Professional, Planning Commission
Planning Commission  
(PPP & Infrastructure Division)

Subject: Minutes of the third meeting of the Task force on Waste to Energy Projects – regarding.

The third meeting of the Task Force on Waste to Energy was held in Planning Commission on October 14, 2013 under the Chairmanship of Dr K Kasturirangan, Member, Planning Commission. The list of the participants is placed at Annex-I.

2 Dr.K.Kasturirangan, Member, Planning Commission welcomed the participants for the meeting. Member apprised the participants of the previous two meetings of the Task Force and the issues that were discussed in the meetings. This meeting was intended to look further into the issues relating to waste to energy by eliciting views from the participants. It was stated that the agenda of this meeting included a discussion on the structure of the report, the type of inputs required for the report and any further improvements required in this regard. A drafting committee has been formed for writing the report and the views of the members of the Task Force were solicited to prepare the first draft of the report.

3 Adviser to Deputy Chairman suggested that the report of the Task Force could have a chapter on various technologies focussing on the relative advantages and disadvantages of the technologies and also a chapter on the financing and management of the different technologies. The Task Force has been set up primarily to look at Waste to Energy options and there is a need to limit ourselves to this agenda. Further the interpretation of waste to energy was also discussed as to whether it implies only waste to electricity or includes composting also. On this matter, Member stated that this sector is a broad system of interconnected issues and suggested that the structure of the report should be broad. The portions not required could be deleted later but the discussions at committee level should not be restricted to only one aspect and the Task Force should look into the totality of information available. It was also suggested that the report should be brief and simple so that it is useful for the readers and policy makers.

4 Shi Ashok Lavasa, Additional Secretary, Ministry of Power also highlighted that the primary task before this group was selection of technology because government wants to support this sector by providing Viability Gap Funding (VGF). It was suggested that there is a need for a model which allows entrepreneur to use to all the streams of waste
and make a viable project out of it. Restricting the waste management system to waste to electricity generation will deprive the entrepreneur of other sources of revenue.

5 Prof S.Dasappa, Indian Institute of Science, in his presentation described the technological options available for conversion of waste to energy. It was outlined that there is a potential for generation of over 2600 MW of electricity from urban waste in the country and energy recovery could be done through biological and thermochemical conversion process. There is a band of technology specifying the output, residues and emissions and all of the factors should be taken into account for arriving at a decision. There are only a few waste to energy projects in India. Therefore a SWOT analysis of the existing examples should be done highlighting the problems in this area. It was suggested that a criterion should be arrived at towards adopting a technology by analysing the mass and energy balance, aspects related to disposal of residues, value addition from the products and financial aspects. Member suggested that a note on the SWOT analysis may be made available at the earliest.

6 Adviser to Deputy Chairman remarked that only the options available in the country are being explored. There was no analysis of world class practice followed in the rest of the world and the Task Force should not confine to examples in a few cities of India. It was suggested that the discussion of the different technologies available for conversion of waste to energy should be limited to three processes- composting, incineration and gasification. The criterion for the technologies may be set but the option of the choice of technology should be left to the private player. Member suggested for inclusion of more samples for the analysis of available technologies and requested for a framework in which a certain band of technologies will work under certain conditions.

7 Shri A.K.Dhussa, Adviser, Ministry of New and Renewable Energy (MNRE) clarified that a particular technology will apply beyond a certain range. Incineration is used mainly where capacity is higher than 5 MW and Gasification is applicable to 1-5 MW capacity. Among the technological options, incineration is the most widely used as it accounts for 80% of the waste treated all over the world. Biomethanisation has a very specific applicability as it applies to cases where source segregated bio degradable waste is collected and this process does not apply to bulk waste.

8 Shri Ashwin C Shroff, Chairman and Managing Director, Excel Industries Ltd explained the decentralised system of waste management put together and popularised by them in the country. The presentation highlighted the experience of the firm in this sector. It was emphasised that the real solution to the issue of waste management is segregation and treatment of waste at source and there is better recovery of all components of waste if
it is treated at source. It was stated that JNNURM scheme supports mainly large scale projects and has very less focus on small plants. The decentralised waste management system was running successfully in cities like Pune, Goa, Bangalore and Delhi. The model of Pune was explained where the city was divided into different zones and the vegetable waste is treated. The plants mainly produced compost and fuel pellets. He put forth the following proposals for consideration: (i) encourage de-centralized waste management for small cities and hilly states with population less than 1 lakh (ii) allocate a dedicated viability gap funding vehicle for implementation of de-centralized waste management projects in the country and (iii) facilitate financial incentives for Bulk Waste Generators treating waste at source of generation. The representatives of Excel Industries Ltd were requested to send a brief note on the manner in which the plants were being operated and the economics of running a decentralised waste management plant along with the details of cost of per tonne of the product.

9 Member desired to know the percentage of total solid waste which would fall under the category of decentralised waste management system and whether a model is available where both the centralised and decentralised system co-exists forming a composite strategy with the economics of waste management duly addressed. Member commented that there is a need to develop models where the implicit nature of waste is understood clearly and an analysis of the economic viability of centralised, decentralised and hybrid model need to be undertaken.

10 Adviser to Deputy Chairman remarked that it is the question of sustainability of the system. The main challenge is conversion of waste in bigger cities and it’s a more serious concern in bigger cities than in smaller cities.

11 Shri A.K.Dhussa, Adviser, MNRE informed that decentralised systems of energy recovery are mainly funded by municipalities whereas large waste to energy plants are funded by private investment. It was suggested that smaller system needs to be supported by municipalities.

12 Dr A.K Sahu, President, National Solid Waste Association of India (NSWAI) highlighted that incineration process in India has failed because of high capital cost, lack of professionalism and lack of technical availability in construction of the incinerator. The solution lies in adopting a combination of technologies. It was suggested that dry waste should be separated from mixed waste and converted to Refuse Derived Fuel (RDF) and be made mandatory for use in cement plants. It was also suggested to form a Waste to Energy Corporation supported by the Government.
Municipal Commissioner, Nagpur informed that Nagpur city generated 800 tonnes per day of municipal solid waste and it was expected that the quantum would increase to 1790 tonnes by 2041. The composition of waste consisted of 30% of wet organic waste which was converted to compost, 30% of dry organic material which was converted to RDF, 5% recyclables into plastic and rubber items and 18% was sent to landfill. The collection of waste was entrusted to a private operator who undertook door to door collection. A ‘Ghanta Gadi’ would go around the city and collect the waste from houses which are kept in two bags segregating wet from dry waste. The processing of waste was also undertaken through a separate private operator. It was suggested that the option of viability gap funding could be explored by the Municipal Corporation for the proposed waste to energy plant in Nagpur.

The issue pertaining to tariff for the energy generated from waste was also discussed. Additional Secretary, Ministry of Power clarified that for all distribution licensees and independent consumers, there is a Renewable Purchase Obligation (RPO) which is one per cent of the total energy supplied. There is a separate RPO for solar energy and a combined RPO for all renewables. The state regulators have announced a tariff for biomass, wind and other renewable sources. For energy generation from municipal solid waste, tariff is decided on case to case basis as there is no standardisation. It is difficult for a regulator to announce a tariff in this case. It was decided that this issue needs to be discussed separately with the Ministry of Power.

Shri A.K.Dhussa, Adviser, MNRE informed that CERC has issued guidelines for waste to energy plants where the tariff is around Rs 6.50 per unit and states like Punjab and Haryana have already adopted this tariff.

Professor Sharad Kale, Scientist, BARC mentioned that in case of waste to energy plant, synchronisation with the grid is difficult. So a switch over system should be used and the energy should be used for local use like lighting of street lamps. It was also suggested that in smaller cities, incineration option should not be used.

Professor Shyam Asolekar, Indian Institute of Technology stated that the inputs received from various participants were being processed and a rough draft of the report is being completed. It would be possible to meet the deadline set for the draft report. It was mentioned that conversion of waste to energy is not economical below a certain scale. So a typology of technology versus scale has to be worked out and the incremental cost of environment should also be taken into account. Further the composite set of products emerging from the processing of waste needs to be seen. It was suggested that a few
small plants could produce RDF and this RDF can then be used in a larger waste to energy plant.

18 Joint Municipal Commissioner, Kolkata explained that the city generates 4000 MT of waste per day and there was only one plant for processing of the waste. It was stated that not much has been done in waste to energy area but an expression of interest for a project has been floated. The need for central assistance was also emphasised for the waste to energy plant. Member suggested that a model may be developed in the city as the quantum of waste to be treated is huge.

19 Shri S.S.Mohanty, Director (Technical), Steel Authority of India Limited (SAIL) explained the waste management scenario in the townships of SAIL and the waste generated from the steel plant. There were five SAIL townships where the solid waste was collected and processed. The company was formulating to set up waste to energy plants in all the townships. The existing plant in Rourkela steel township (RSP) was explained. The combined quantum of waste from both the steel and civil township in RSP amounted to 400 tonnes per day. The energy generated from the plant was supplied to both the steel township and the civil township. It was learnt that there was huge potential to tap the gaseous emissions generated from steel plants for conversion to energy as one tonne of steel produces 6.5 giga calories of energy. This would not only help in reduction of emissions but also lead to generation of energy.

20 Dr. Indrani Chandrasekharan, Consultant, sought information on the extent to which RDF can be used in steel plants. This information was essential to explore the possibility of use of RDF by large energy consuming sectors/industries like cement, steel etc. It was informed that the steel plants have huge scope to use RDF in place of coking coal and thereby save costs in this process.

21 Member requested that a proposal may be sent by SAIL on the waste management initiatives undertaken by the company and the central assistance required. Adviser to Deputy Chairman commended the practices of SAIL and recommended a model to be developed with the assistance of Planning Commission. It was decided that a separate discussion may be held with SAIL on developing a model for waste management for one township and this model could later be scaled up.

22 Adviser to Deputy Chairman requested the Ministry of Urban Development to provide clarification that the Ministry would grant 20 per cent of funds for PPP projects which have availed 20 per cent VGF support so that the combined central Government support for the project is 40 per cent.
Member concluded the session by stating that the drafting committee may start working on the report and the first draft of the report should be ready by first week of November. The members of the Task Force may send the suggestions directly to the drafting committee. The Task Force should now meet only for the actual business of making the report and it was decided that there was no need for any further presentations.
Annex-I

List of Participants

1. Dr. K. Kasturirangan, Member
2. Shri Gajendra Haldea, Adviser to Deputy Chairman
3. Shri Ashok Lavasa, Additional Secretary, Ministry of Power
5. Shri Ravi Mital, Adviser (Infrastructure), Planning Commission
6. Shri A.S. Bhal, Economic Adviser, Ministry of Urban Development
7. Dr. M. Subbarao, Director, Ministry of Environment & Forests
8. Dr. Indrani Chandrasekharan, Consultant, Planning Commission
9. Prof. S. Dasappa, Center for Sustainable Technologies, IISc, Bangalore
10. Shri Dinesh Chander Pant, Fellow, TERI, New Delhi
11. Prof. Shyam R. Asolekar, CESE, IIT Mumbai
12. Dr. Sharad Kale, Head, Technology Transfer and Collaboration Division, BARC, Mumbai
13. Dr. Amiya Kumar Sahu, President, NSWAI
14. Shri Shyam Wardhane, Municipal Commissioner, Nagpur
15. Shri Shahzad Shibli, Joint Municipal Commissioner, Kolkata
16. Shri S. S. Mohanty, Director (Technical), Steel Authority of India Limited
17. Shri R. Mitra, General Manager, Steel Authority of India Limited
18. Shri Sunil Singal, AGM, Steel Authority of India Limited
19. Shri A. K. Lahiri, Deputy General Manager, Steel Authority of India Limited
20. Shri Ashwin C. Shroff, CMD, Excel Industries Ltd.
21. Shri Saurabh Shah, Vice-President, Excel Industries Ltd.
22. Shri Piyush Prakash, Manager, Excel Industries Ltd.
23. Shri Harshad Gandhi, Consultant, Excel Industries Ltd
24. Shri Mandar Prashana, DGM, Transchem
25. Shri Ashutosh Saxena, National Council for Cement Building Materials
26. Ms Gayatri Nair, Deputy Adviser, Planning Commission
Planning Commission  
(PPP & Infrastructure Division)

Subject: Minutes of the fourth meeting of the Task force on Waste to Energy Projects – regarding.

The fourth meeting of the Task Force on Waste to Energy was held in Planning Commission on February 17, 2014 under the Chairmanship of Dr K Kasturirangan, Member, Planning Commission. The list of the participants is placed at Annex-I.

2 Welcoming the participants to the meeting, Member stated that three meetings of the Task Force have been held in June, August and October 2013 respectively wherein the various models and elements of management of solid waste were discussed and presentations were made by different individuals and institutions. The viewpoints expressed in the meetings have been collated and used for drafting the report as per the Terms of Reference of the Task Force. The agenda of this meeting is to discuss the broad recommendations of the Task Force and the Public Private Partnership (PPP) model.

3. Prof. V.Srinivas Chary, Administrative Staff College India, made a presentation highlighting the experiences of PPP in India and the lessons that could be incorporated in the report. It was explained that there are performance level benchmarks for municipal solid waste management (MSW) that have to be complied with by the Urban Local Bodies (ULBs) and the only way for ULBs to move towards this benchmark is through PPP. There is lack of capacity in the States to meet the benchmarks, especially in the treatment and disposal stage. The presentation outlined that the reasons for failure of PPPs is mainly technical and financial. Poor pre-qualification criteria led to poor selection of vendors and weak transaction advisory support led to improper structuring of the project. Bad partnership and badly designed partnership lead to unsustainable PPPs. There are three models of PPP emerging in the current scenario- user charge model/CDM based financing and zero tipping fee model. The presentation also highlighted the cluster model in Gujarat and Andhra Pradesh. A clear policy framework and direction is required at the State level for PPPs. Prof Chary highlighted that even with project financing models it was difficult for complex PPP projects to take off due to weak institutional capacity at State level. Creation of institutional capacity was required and the example of Andhra Pradesh Solid Waste Management Board was cited.

4 Adviser to Deputy Chairman clarified that the mandate of the Task Force was to recommend a properly structured PPP model. The Ministry of Urban Development also
does not have a clear scheme for PPP. It was basically awarding cash contracts and not PPPs. For providing a right direction to State Government, a right framework and contract was required. It was suggested that departments in State Government may create a nodal cell with 2 to 3 experts to deal with PPP. Shri P U Asnani also supported the idea of creation of nodal cell and suggested that it may be placed in the urban development department. This cell would provide the necessary guidance to the Municipal Authorities.

5 Shri A.S Bhal, Adviser, Ministry of Urban Development informed that there are 53 projects currently being implemented by the Ministry. Out of this, around 11 projects are in Solid Waste Management sector. As far as the Ministry’s approach to PPP was concerned, it implied provision of grants to State Governments to gain private sector participation. Capacity building was also one of the endeavours undertaken by the Ministry and a municipal cadre in JNNURM Phase II was being suggested.

6 Adviser to Deputy Chairman emphasised that under the current disposition only 20% of Viability Gap Funding is provided for a project. In this situation only additional grant based assistance would make SWM projects viable. It was reiterated that Finance Minister had in the Budget Speech stressed on making additional support to be made available for waste to energy projects. The critical issue pertained to financial viability and it was important to determine the extent of financial viability required. Prof Chary was requested to send a note on the amount of support required for waste to energy projects incorporating all other parameters, like tipping fee and user charges, existing in the system.

7 Dr Akolkar underlined that the basic philosophy of technology should be taken care of. The focus was more on economics of the project but the technology part was also important. Adviser to Deputy Chairman suggested that a few output parameters may be provided which are essential to protect public interest.

8 Shri P U Asnani, Chairman, UMC Global, suggested that user fee should not be beyond collection and transportation part of the waste management system. It was pointed out that one of the main reasons for failure of a PPP operator was mixed waste. It is important that the waste collected from households is taken directly to the processing facility. The street sweeping and construction & demolition waste should be kept separate which would improve the quality of waste. Adviser to Deputy Chairman suggested that an integrated waste management model would take care of the mixed garbage problem.

9 Prof S.Dasappa suggested that in the collection of waste it is imperative to ensure that concessionaire covers all the households.
10 Shri V.K.Chaurasia, Joint Adviser, Ministry of Urban Development raised the issue of rag pickers and suggested that they may be integrated into the model. On this issue, Adviser to Deputy Chairman clarified that it would be difficult to address all the issues pertaining to waste management through a single scheme and the matter of rag pickers may be addressed separately.

11 Shri N B Mazumdar made a presentation describing the historical analysis of waste management technologies. The presentation focussed on the reasons for failure of plants in Vijayawada, Koyembedu and Lucknow. It was stressed that the Task Force needs to take into account the learnings from these failures. For successful operation of plants, it was essential that there is a long period of operation, waste characteristics should match technology, proven technology should be considered for large projects and appropriate model document be adopted. Member requested that a note may be sent explaining the reasons for failure of waste to energy projects.

12 Shri P U Asnani explained the set of recommendations suggested by the Task Force. The main recommendation of the Task Force was that for waste to energy projects to be viable, the minimum amount of waste generation required was 500 tonnes per day and so waste to energy plants may be set up in larger cities. The smaller cities may produce RDF which will be a feeder to the large waste to energy plants. The Task Force had a set of recommendations for each group of cities. The main thrust was on waste to energy but it did not preclude other options like composting and RDF being adopted. Prof Chary raised the concern that the recommendations seem to have incentives only for waste to energy systems. It was clarified that support and incentives are available for all options.

13 Shri A.S.Bhal cited the problem of lack of data and poor quality of data in the water supply sector and whether a similar issue existed in the waste management sector as well. Shri P.U Asnani explained that this concern was more serious for MSW as the waste composition has shown drastic changes in the last decade and this factor would affect the choice of technology.

14 Shri N.B Mazumdar suggested that for application of thermal technologies, a minimum of 1000 tonnes should be stipulated instead of 500 tonnes. Technology neutral options would instil an uncertainty in the bid process and support was required by State Government in deciding the structure of the Project. It was also suggested that the system of ragpickers should be abolished and they should be formed as a self help group. Dr Mazumdar also suggested life cycle assessment of waste to energy projects.
15 Prof S. Dasappa suggested that the emission norms to be followed by different technologies should be mentioned. It was clarified that the emission norms are prescribed by the pollution control boards and the technology would be governed by the prescribed norms of the board. Prof Chary was of the opinion that for smaller cities which do not come under the ambit of pollution control boards, the standards should be specified.

16 Adviser (Infra) stated that all State Electricity Regulatory Commissions buy a certain percentage of power from renewable energy sources and prescribe a rate which is higher than the normal purchase rate from other sources. It was clarified that if there is a Change in Law and the environmental standards change, the tariff rates would accordingly be revised. Shri A.K Dhussa explained that most regulators have fixed a tariff of Rs. 6 for energy from MSW.

17 Dr Akolkar suggested that the recommendations of the Task Force should be consistent with the new Draft Municipal Solid Waste (Management and Handling) rules. A system should evolve where the State Governments give clearance for the project so as to reduce delays.

18 Shri A.K Dhussa, Adviser, MNRE, explained that as a follow up of the budget speech, the subject of waste to energy was transferred to Ministry of Urban Development from Ministry of New and Renewable Energy and this Task Force was set up with the mandate to look into waste to energy technologies. However it was felt that this Task Force has not adequately addressed the issue of technologies.

19 Member clarified that the experiences in the waste to energy sector reflected certain gaps and it was found that this could not be delinked from the broader issue of waste management.

20 Prof Emran Khan raised the issue that landfill gas has not been addressed in the report. Shri P U Asnani clarified that the rules in India do not deal with this issue as organic matter is not allowed to filled in landfills and hence the issue of landfill gas doesn’t arise.

21 Member concluded the meeting by thanking all the participants. It was requested from all participants to send a note on the suggestions made by them. The final draft would be ready in two weeks and it would be circulated to all members. It would also be circulated for peer review. Prof Chary suggested that this report may also be circulated to Principal Secretaries of the State Government.
List of participants
Fourth Meeting of the Task Force on Waste to Energy, February 17, 2014
Room No.134, Yojana Bhavan

1. Dr. K Kasturirangan, Member
2. Shri Gajendra Haldea, Adviser to Deputy Chairman
3. Shri Ravi Mital, Adviser (Infra)
4. Shri G.Sai Prasad, Joint Secretary, Ministry of Power
5. Shri A.S. Bhal, Economic Adviser, Ministry of Urban Development
6. Dr. A.B.Akolkar, Director, CPCB
7. Dr. M. Subba Rao, Director, Ministry of Environment & Forest
9. Dr. N.B. Mazumdar, Consultant
10. Prof V.S. Chary, ASCI
11. Shri Mukund Rao, NIAS
12. Shri P.U. Asnani, Chairman, UMC Global, Ahmedabad
13. Prof S.Dasappa, IISc.
14. Prof M.Emran Khan, Jamia Milia Islamia,
15. Shri V.K. Chaurasia, Jt. Adviser (PHEE), Ministry of Urban Development
16. Shri P.D. Grover, Consultant
17. Dr. S.P. Kale, BARC
18. Dr. Indrani Chandrasekharan, Consultant
19. Ms Gayatri Nair, Deputy Adviser
The fifth meeting of the Task Force on Waste to Energy was held in Planning Commission on May 1, 2014 under the Chairmanship of Dr K Kasturirangan, Member, Planning Commission. The list of the participants is placed at Annex-I.

2. Welcoming the participants to the meeting, Member stated that the Task Force is now focussed on the report in its final form and has hugely benefited from the peer review by four experts. Valuable inputs and comments have been provided by Dr. Isher Judge Ahluwalia and Dr M. Ramachandran. Dr R.K Pacahauri and Ms Sunita Narain had also conveyed their broad agreement of the report. It was conveyed to the members of the Task Force that the draft report circulated has been modified in line with the comments received from members and peer review experts.

3. Secretary, Ministry of Environment & Forests (MoEF) cited the issues pertaining to the waste to energy sector. It was stated that segregated waste collection as emphasised in the report was very important. There were instances where waste segregation was taking place at the collection stage but later got mixed up during the landfill stage. It was pointed out that this sector had witnessed a history of non-performance and the experiences of the waste to energy plants at Lucknow, Hyderabad and Timarpur was discussed. The waste to energy plant at Lucknow, a biomethanation plant, had closed down due to financial problems. In case of the Selco plant at Hyderabad, its RDF plant and power generation plant were located at separate places and the power plant was based mainly on bio-mass as the quantity of RDF was very less. The Timarpur plant was also closed down. The power plant of Jindal was the only running plant but it too is mired in many problems as there is no pre-processing of waste. Secretary stressed on the importance of stringent standards for the waste to energy plants as some of the plants are located in populated areas. Imposing of standards would affect the economics of the project as the cost of operations would substantially increase and therefore the incentives to be provided also had to be accordingly raised. It was insisted that performance based incentive may be provided. It was clarified by Member Secretary, CPCB that the norms and standards for the sector were under formulation and presently only three laboratories carried out the testing process. Secretary also stated the provision of composting of waste is a right strategy. However there are only few plants which are operational. The main
problem was that their cost of production doesn’t get covered and they do not have the marketing skills undertaken by chemical fertiliser industries. As it is high in volume, the compost sector requires transport subsidy to make its operations viable. In this context, Shri P U Asnani suggested that marketing of compost may be undertaken by Agriculture Extension Centres. Joint Secretary, Ministry of Urban Development suggested that a Minimum Support Price for compost may also be thought of.

4 Shri P.U. Asnani, Chairman, UMC Global conveyed that all the vital points brought out by Secretary, MoEF have been covered in the report. It has been suggested in the report that street sweeping and debris would be kept separate from the household waste so that the right quality of waste goes into the waste to energy plant. The report also laid stress on the option of performance based subsidy.

5 Secretary, Ministry of New and Renewable Energy (MNRE) pointed out the issue of applicability of new rules to the existing technology in the sector. It was clarified that the new rules would not be applied retrospectively and old plants would be given a different set of norms. It was stated that there was a large role of informal sector in this field. Therefore the social issues and issues of rag pickers need to be addressed and integrated in the report. The Task Force may obtain the list of NGOs operating in this field. Lessons from international experience may also be explored especially cases which are applicable to Indian conditions. It was suggested that the report should provide that in addition to existing incentives approved by the Cabinet, incentives and innovative revenue models by State Government and local Government may also be explored. It was also pointed that availability of funds was a major issue as there was a huge discrepancy between the amount sanctioned by Planning Commission and the amount released by Ministry of Finance.

6 Shri P U Asnani explained that the situation in other countries was quite different as the quantum of dust or debris in the waste was very less. The trend in US and European counties was towards recycling.

7 Joint Secretary, Ministry of Urban Development emphasised the importance of incentives in the sector and marketing of the products. It was pointed out that RDF was being used in the textile industry in Gujarat after receiving clearance from the State Pollution Control Board. Member stated that this may be looked into as the report of the Task Force mentions the use of RDF in three sectors, namely, cement, power and metallurgical industries. Joint Secretary also pointed out that regional clusters may be planned and Ministry of Urban Development may commission a study to identify clusters in each State. Shri P. U Asnani pointed out the report already provides for this. The report
suggests that landfills may be constructed on a regional basis and large cities may take along the cities within a 50km radius for construction of a waste to energy facility. Regional locations have already been identified in Gujarat, Kerala and Tamil Nadu. Prof Asolekar opined that regional clusters would take care of the problem of ‘Not in my backyard syndrome’.

8 Additional Secretary, Ministry of Power enquired whether the cost of associated power plants has been built in the cost estimates provided in Table 20 of the report as it was important for the computation of generation based incentive. It was emphasised that generation based incentive was required as output should ultimately be saleable.

9 Adviser, Ministry of New and Renewable Energy explained that the estimate of Rs. 6 as tariff for power from waste was based on the State Electricity Regulatory Commission’s order for other renewable energy sources. There were three parameters of a project-Tariff, Tipping Fee and Viability Gap Funding. Ministry of Finance has freezed two of the parameters, namely tariff at Rs.6/- and tipping fee at Rs.300/-. The projects are then bid out on the basis of one decision criteria, that is, the amount of viability gap funding required for the project. The subsidy component is limited and not given upfront.

10 The representative from TERI suggested that RDF can be used within the municipalities for cremation. Prof. Sharad Kale clarified that there could be technical problems and this may also lead to environmental hazards.

11 Adviser, MNRE stated that report has evolved in a very effective way and provides the right kind of perspective to waste to energy. The Ministry would be able to successfully demonstrate projects at the end of the year and this report would be the base document to go forward.

12 Dr. Indrani Chandrasekaran explained to the members the comments received from Dr. Isher Judge Ahluwalia and Dr.M Ramachandran. The comments received from Dr. Ahluwalia pertained to awareness drive, source segregation, international experiences, outsourcing, third party evaluation, applicability of smart waste management and regional pooling. These points have been accordingly reflected in the report. Dr. M. Ramachandran’s input was valuable in reconciling the conflicting data. Further the title of the data was also modified to emphasise the focus of the report in the overall context of integrated waste management.

13 Economic Adviser, Ministry of Urban Development pointed out that activities cannot be classified as amenable to be undertaken as PPP and non-amenable to be taken as PPP. Any function which can be segmented can be undertaken in PPP mode. Shri P U
Asnani clarified that the report has suggested that certain activities can be undertaken as PPP and cited the Contract Act 1970 in this regard.

14. Member stated that there are multiplicity of models and various conflicting ideas prevailing in this sector. Member emphasised on the centres of excellence suggested in the report and opined that this should be discussed further. Member discussed the timeline for printing of the report. The report would be given for editing and then for the final printing. Member thanked the Ministry of Urban Development for the support and assistance in the printing of the report. Adviser, MNRE suggested placing a different picture of the Jindal plant on the cover page.

15. Member concluded the meeting and thanked all the members of the Task Force and the Drafting Committee members for their contribution. The report had to stand the test of time and have maximum visibility. Deputy Chairman, Planning Commission had suggested that the report may be circulated to the Chief Ministers of all States. Member suggested the report may be circulated to all stakeholders and a strategy may be devised to circulate it to municipal authorities, institutions, skill development centres and training institutes. Further distribution could also be undertaken through CPCB, Ministry of Non and Renewable Energy and Ministry of Environment and Forest. Member Secretary, CPCB suggested that the report may also be translated to Hindi. It was decided that translation to all languages may be explored for wider dissemination of the report.

16. The meeting concluded with a vote of thanks.
List of Participants
Fifth Meeting of the Task Force on Waste to Energy, May 1, 2014
Room No.134, Yojana Bhawan

1. Dr K. Kasturirangan, Member
2. Shri R. Rajagopalan, Secretary, Environment and Forests
3. Shri Upendra Tripathy, Secretary, Ministry of New & Renewable Energy
4. Shri R.N. Choubey, Addl. Secretary, Ministry of Power
6. Shri Neeraj Mandloi, Joint Secretary, Ministry of Urban Development
7. Shri A.S. Bhal, Economic Adviser, Ministry of Urban Development
8. Shri Shyam R. Asolekar, CESE, IIT, Bombay
9. Shri P.U. Asnani, Chairman, UMC Global, Ahmedabad
10. Dr. A.B. Akolkar, Member Secretary, CPCB
11. Dr. Sharad P. Kale, Scientist, BARC
12. Shri D.C. Pant, Fellow, TERI
13. Dr Indrani Chandrasekharan, Consultant, Planning Commission
14. Ms. Gayatri Nair, Deputy Adviser, Planning Commission
### Provisions of MSW Rules 2000

| Collection of municipal solid wastes | 1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority, namely :-  
   
i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels);  
   
ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas;  
   
iii. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes;  
   
iv. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose;  
   
v. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles;  
   
vi. Horticultural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws;  
   
vii. Waste (garbage, dry leaves) shall not be burnt;  
   
viii. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws.  

2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town.  

3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority. |
| Segregation of municipal solid wastes | In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials.  

The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations. |
### Storage of municipal solid wastes

Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely:

- **i.** Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users;
- **ii.** Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly;
- **iii.** Storage facilities or bins shall have easy to operate design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black;
- **iv.** Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.

### Transportation of municipal solid wastes

Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:

- **i.** The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing;
- **ii.** Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.

### Processing of municipal solid wastes

Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely:

- **i.** The biodegradable wastes shall be processed by composting, vermin composting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards.
- **ii.** Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
| 6. Disposal of municipal solid wastes | Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. |
Plastic Waste (Management and Handling) Rules, 2011

The Ministry of Environment and Forests notified the Plastic Waste (Management and Handling) Rules, 2011 to replacing the earlier Recycled Plastics Manufacture and Usage Rules, 1999 (amended in 2003). These Rules have been brought out following detailed discussions and consultations with a wide spectrum of stakeholders including civil society, industry bodies, relevant Central Government Ministries and State Governments. Some of the salient features of the new Rules are:-

- Use of plastic materials in sachets for storing, packing or selling gutkha, tobacco and pan masala has been banned.
- Foodstuffs will not be allowed to be packed in recycled plastics or compostable plastics.
- Recycled carry bags shall conform to specific BIS standards.
- Plastic carry bags shall either be white or only with those pigments and colourants which are in conformity with the bar prescribed by the Bureau of Indian Standards (BIS). This shall apply expressly for pigments and colourants to be used in plastic products which come in contact with foodstuffs, pharmaceuticals and drinking water.
- Plastic carry bags shall not be less than 40 microns in thickness. Under the earlier Rules, the minimum thickness was 20 microns. Several State Governments in the meanwhile, had stipulated varying minimum thickness. It is now expected that 40 microns norms will become the uniform standard to be followed across the country.
- The minimum size (of 8x12 inches) for the plastic carry bags prescribed under the earlier Rules has been dispensed with.
- Carry bags can be made from compostable plastics provided they conform to BIS standards.

One of the major provisions under the new Rules is the explicit recognition of the role of waste pickers. The new Rules require the municipal authority to constructively engage agencies or groups working in waste management including these waste pickers. This is the very first time that such a special dispensation has been made.

Role of Implementing Authority
The Municipal authority shall be responsible for setting up, operationalization and coordination of the waste management system and for performing the associated functions, namely;

- To ensure safe collection, storage, segregation, transportation, processing and disposal of plastic waste;
- To ensure that no damage is caused to the environment during this process;
- To ensure setting up of collection centres for plastic waste involving manufacturers;
- To ensure its channelization to recyclers;
- To create awareness among all stakeholders about their responsibilities;
- To ensure that open burning of plastic waste is not permitted.
Additional Safeguards
- No carry bags shall be made available free of cost to consumers. The municipal authority may determine the minimum price for plastic carry bags.
- The municipal authority may also direct the manufacturers to establish plastic waste collection centres, either collectively or individually, in line with the principle of

Extended Producers Responsibility'.
- The new Rules have stipulated provisions for marking or labeling to indicate name, registration number of the manufacturer, thickness and also to indicate whether they are recycled or compostable

Following are the major provisions of the rules:-

**Application:** The rules will not apply to the manufacture of carry bags exclusively for export purposes by export oriented manufacturing units against an order for export received by the owner or occupier of the concerned manufacturing unit. This exemption does not apply to any surplus or rejects, left over and the like.

**Definitions:** The important definitions as per the Rules are:
(i.) Act – Means the Environment (Protection) Act, 1986
(ii.) Commodities – Means articles; including but not limited to vegetables, fruits, pharmaceuticals, food grains and the like.
(iii.) Compostable plastics – Means plastic that undergoes degradation by biological processes during composting to yield CO2, water, inorganic compounds and biomass at a rate consistent with other known compostable materials and does not leave visible, distinguishable or toxic residue.
(iv.) Extended Producers Responsibility - means the responsibility of a manufacturer of plastic carry bags, and multi-layered plastic pouches and sachets and the brand owners using such carry bags and multi-layered plastic pouches and sachets for the environmentally sound management of the product until the end of its life.
(v.) Manufacture - means any person who manufactures plastic carry bags or multi-layered plastic pouches or sachets or like.
(vi.) Municipal Authority – Means Municipal Corporation, Municipality, Nagar Palika, Nagar Nigam, Nagar Panchayat, and Municipal Council including Notified Area Committee (NAC) or any other local body constituted under the relevant statutes and, where the management and handling of the municipal solid waste is entrusted to such agency.
(vii.) Virgin Plastic – Means plastic material which has not been subjected to use earlier and has also not blended with scrap or waste.
(viii.) Multi-layered Plastics – Means any material having a combination of more than one layers of packaging material such as paper, paper board, polymeric materials, metalized layers or aluminium foil, either in the form of a laminate or co-extruded structure.
Prescribed Authority –
(i.) The authority for the provisions of these rules related to authorization, manufacture, recycling and disposal shall be State Pollution Control Board and Pollution Control Committee in respect of Union Territory.
(ii.) For enforcement of the provisions of these rules relating to use, collection, segregation, transportation and disposal of post-consumer plastic waste shall be concerned municipal authority.

Conditions –
(i.) Carry bags shall either be in natural shade which is without any added pigments or made using only those pigments and colorants which are in conformity with Indian standards.
(ii.) No person shall use carry bags made of recycled plastics or compostable plastics for storing, carrying, dispensing or packaging food stuffs.
(iii.) No person shall manufacture, stock, distribute or sell any carry bag made of virgin or recycled or compostable plastic, which is less than 40 microns in thickness.
(iv.) Sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala.
(v.) Recycled carry bags shall conform to the Indian standard IS 14534:1998 titled as Guidelines for Recycling of Plastic, as amended from time to time.
(vi.) Carry bags made from compostable plastics shall conform to the Indian Standard: IS/ISO 17088:2008 titled as specifications for Compostable plastics, as amended from time to time.
(vii.) Plastic material, in any form, shall not be used in any package for packing gutkha, pan masala and tobacco in all forms.

Plastic Waste Management:
(i.) Recycling of plastic wastes will be carried out as per rules and regulations stipulated by the Central Government.
(ii.) The municipal authority shall be responsible for operationalization and coordination of the waste management system and for performing the associated functions:
(a.) To ensure safe collection, storage, segregation, transportation, processing and disposal of plastic waste.
(b.) To ensure that no damage is caused to the environment during this process.
(c.) To ensure setting up of collection centres for plastic waste involving manufacturers.
(d.) To ensure its channelization to recyclers
(e.) To create awareness amongst all stakeholders about their responsibilities
(f.) To engage agencies or groups working in waste management including waste pickers.
(g.) To ensure that open burning of plastic waste is not permitted.
(iii.) For setting up plastic waste collection centres, the municipal authority may ask manufactures, either collectively or individually in line with the principle of Extended Producer’s Responsibility (EPR) to provide the required finance to establish such collection centre.
(iv.) The Municipal Authority shall encourage the use of plastic waste by adopting suitable technology such as in road construction, co-incineration, etc. The municipal authority or the operator intending to use such technology shall ensure the compliance with the prescribed standards including pollution norms prescribed by the competent authority in this regard.

Protocols for Compostable Plastic Materials –
Determination of the degree of degradability and degree of disintegration of plastic material shall be as per the protocols of the Indian Standards.

Marking/ Labelling –
  i. Each plastic carry bag and multi-layered packaging shall have the following information printed in English or in the local language:
     a. Name, registration number of the manufacturer and thickness of each bag.
     b. Name and registration number of the manufacturer in case of multi-layered packaging.
  ii. Each recycled bag shall bear a label or a mark “recycled” and shall conform to the Guidelines for Recycling of Plastics.
  iii. Each carry bag made from compostable plastics shall bear a label ‘compostable’ and shall conform to the Specifications for Compostable Plastics.
  iv. Retailers shall ensure that plastic bags and multi-layered packaging sold by them are properly labelled.

Registration of Manufacturers and Recyclers –
  i. Any person manufacturing or proposing to manufacture carry bags and multi-layered plastics shall apply to the State Pollution Control Board (SPCB) and Pollution Control Committee (PCC) for the grant of registration or the renewal of registration.
  ii. And person recycling or proposing to recycle carry bags or multi-layered plastics or any plastic waste shall apply to SPCB or PCC for the grant or renewal of registration.
  iii. No person shall manufacture carry bags or recycle plastic bags or multi-layered plastics unless without obtaining the registration certificate from SPCB or PCC, prior to production.
  iv. The SPCB or PCC shall not issue or renew a registration for manufacturing or recycling units unless the unit possesses a valid consent under the Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981.
  v. Every SPCB or PCC shall take a decision on the grant of the registration within ninety days of receipt of an application that is complete in all respects.
  vi. The registration granted under this rule shall be valid for a period of three years, unless revoked, suspended or cancelled; and registration shall not be revoked, suspended or cancelled without providing the manufacturer an opportunity for hearing.
  vii. Every application for renewal of registration shall be made at least ninety days before the expiry of the validity of the registration certificate.

Explicit Pricing of Carry Bags:
No carry bags will be made available free of cost to the consumers by the retailers. The concerned municipal authority may determine the minimum price of the carry bags.

**State Level Advisory Body:**

i. There shall be a State Level Advisory Body (SLAB) to monitor the implementation of these Rules.

ii. The SLAB shall meet at least once in a year and may invite experts, if necessary.

iii. The SLAB shall consist of one Chairman and six Members (experts in their respective fields).

**Annual Reports:**

i. Each SPCB or PCC shall prepare and submit the annual report to the Central Pollution Control Board by 30th September each year.

ii. The Central Pollution Control Board shall prepare a consolidated annual report and submit it to the Central Government by 30th December each year.
<table>
<thead>
<tr>
<th>Rule</th>
<th>Area Covered</th>
<th>Provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (v)</td>
<td>Definition</td>
<td>The definitions of buffer zone, prescribed authority, waste pickers and municipal solid waste management have been additionally included in the draft Rules.</td>
</tr>
<tr>
<td>4 (1)</td>
<td>‘Prescribed Authority’</td>
<td>A separate provision has been made for the ‘Prescribed Authority’. The prescribed authorities’ viz. MoUD, State Urban Development Department, CPCB, Municipal Authorities, SPCBs/PCCs and their corresponding duties have been prescribed for proper implementation of the Rules. The MoEF shall undertake periodic review of these Rules and MoUD shall co-ordinate and review implementation of these Rules.</td>
</tr>
<tr>
<td>4(2)</td>
<td>Duties of the Municipal authorities</td>
<td>A separate sub-rule has been included for management of municipal solid waste viz. waste collection, segregation, storage, transportation processing and disposal facilities which has to be set up by the municipal authority on their own or through an operator of a facility, which shall meet the various stipulated specifications and standards. The municipal authority shall incorporate the said rules in the Municipal bye laws of all the Urban Local Bodies. The municipal authority shall encourage use of municipal solid waste by adopting suitable technology which may include; composting, vermin-composting, anaerobic digestion with or without energy recovery, co-incineration, or combination of such technologies as appropriate, to make use of municipal solid waste so as to minimize burden on landfill. The municipal authority or the operator of municipal solid waste disposal facility shall seek authorization from the State Pollution Control Board so as to ensure the compliance with the prescribed standards.</td>
</tr>
<tr>
<td>5</td>
<td>Responsibility of Municipal authorities</td>
<td>Municipal authorities are assigned the responsibility for collection, segregation, transportation and infrastructural development for disposal of municipal solid waste; to seek authorization for setting up waste processing and disposal facility including landfills; to ensure compliance with prescribed standards and to seek environmental clearance for setting up municipal solid waste processing and disposal facility including landfills as required under</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>6.</strong></td>
<td>Responsibility of SPCB’s</td>
<td>The role of SPCBs/PCCs have been prescribed for enforcement of the provisions of Rules related to authorization, monitoring of parameters stipulated in the Authorization/Consents to be issued for the municipal solid waste processing and disposal facility including landfills.</td>
</tr>
<tr>
<td><strong>7.</strong></td>
<td>Responsibility of CPCB</td>
<td>The role of Central Pollution Control Board (CPCB) has been prescribed to co-ordinate with State Pollution Control Boards and Pollution Control Committees and for review of any new technology and prescribe standards and guidelines in this regard.</td>
</tr>
<tr>
<td><strong>9 1. (h)</strong></td>
<td>Management of municipal solid waste</td>
<td>The landfill site shall be away from the habitation clusters, forests areas, water bodies, monuments, national parks, wet lands and places of important cultural, historical or religious interests and the distance has to be maintained as prescribed by the concerned State Environmental Impact Assessment Authority (SEIAA) on a case to case basis. The buffer zone shall also be prescribed by the SEIAA, on a case to case basis. The landfill site, as approved by the SEIAA shall be notified by the concerned local government.</td>
</tr>
<tr>
<td><strong>9 6.</strong></td>
<td></td>
<td>The existing dumpsites which are not engineered landfill sites shall be closed down and capped as per the provisions of the said Rules. New Sites for solid waste disposal facility shall be in accordance with the provisions of the said Rules. The transition time for closing of such existing facilities and operational of new facilities shall be decided by the municipal authority in consultation with the State Urban Development Department.</td>
</tr>
<tr>
<td><strong>10</strong></td>
<td>State Level Advisory body</td>
<td>State Level Advisory body has been prescribed under the chairmanship of Secretary-Urban Development with the members from State Department of Environment, CPCB, SPCB, PCCs, Urban Local Bodies and NGOs to monitor the implementation of these Rules.</td>
</tr>
<tr>
<td><strong>11</strong></td>
<td>Annual report</td>
<td>The provision of preparation of Annual report from municipal authority to SPCB/PCC and SPCB/PCC to CPCB and finally a consolidated annual report from CPCB to MoEF and MoUD has been prescribed.</td>
</tr>
<tr>
<td>Schedule-1</td>
<td>Specification of Landfill site</td>
<td>The provisions for site selection criteria, development of facilities at site, pollution prevention, water quality monitoring, ambient air quality monitoring, plantation at landfill site, post care at landfill site have been prescribed.</td>
</tr>
<tr>
<td>Schedule-2</td>
<td>Standards composting</td>
<td>Standards for composting, treated leachates, and operational and emission standards for incineration have been prescribed. Various formats for application for obtaining authorization and annual reports have also been prescribed.</td>
</tr>
</tbody>
</table>
**Status of Municipal Solid Waste Disposal in Kanpur in 2013.**

As per the Municipal Solid Waste (Management and Handling) Rules 2000, the collection, transportation and disposal of solid waste generated is the responsibility of the Nagar Nigam/Municipality. In June 2008, Kanpur Nagar Nigam (KNN) through a process of competitive bidding gave a BOOT (build, own, operate, transfer) contract for collection, transportation, processing and disposal of solid waste to A2Z Infrastructure, a private company, to take care of their responsibility. 46 Acres of land, for a period of 30 years was leased to A2Z Infrastructure to process 1,500 tonnes of solid waste per day. The total project cost was Rs 85 Crore, 30 Crore for Equipment for Collection and Transportation and Rs 26 Crores for Processing and Disposal facility which came from two JNNURM projects, and 25 Crore from the State Government as informed by the company during the Task Force visit on 24th July, 2013.

M/s A2Z Infrastructure was required to set up a tipping platform, a pre-segregation unit, a composting unit, a plastic segregating unit, a briquette manufacturing unit, a RDF (Refuse Derived Fuel) unit, and a sanitary landfill for disposal of the discards. The company was required to collect Garbage from approximately 7 Lakh households, general markets and vegetable markets. (As per M/s A2Z, the shopkeepers refuse to pay the collection charges). Vehicles for transportation which included garbage compressors were bought under JNNURM project. Charges for collection of garbage, was delegated to A2Z. Of the estimated Rs 1.5 Crore user charges, a maximum of Rs 80 Lakhs was only collectable by the company. The garbage was transported to land identified for the facility (a municipal garbage dumping ground) where it was sorted, segregated, converted into low premium quality compost, refuse derived fuel (RDF), interlocking tiles from construction debris for use in footpath paving, and briquette. A2Z Infrastructure, set up a waste-to-energy (WtE) plant (Circulating Fluidized Bed Combustion), in 2011 to produce 15 MW of electricity, using RDF produced inhouse.

On July 24th, 2013, members of the task force on Waste to Energy headed by Dr K. Kasturirangan, Chairman of the task force visited the facility in Kanpur. The team visited the composting, refused derived fuel (RDF) preparation unit and RDF/ fluff boiler generating electricity. Some
of the observations / suggestions/ recommendations are indicated in the Para’s below.

The Waste processing facility was set up in 2008 and augmented in 2011 with a WtE plant, which has only been in operation for the last few months (3) after a long gap due to delay in transfer of funds by the KNN as per DPR. It was indicated by the facility that suspension of operation also resulted from non verification of the ground data given in the Detailed Project Report of the KNN before bidding by the firm. Non availability of Viability Gap funding (VGF) till the operations become self sustainable i.e. at least till 3 years is also felt essential.

During the operational phase of the facility, 60% of garbage (as per A2Z) through door to door collection from habitation at a charge of Rs 30 per household i.e. a total of Rs 80 Lakhs was collected. Total garbage brought to the facility on an average is 1000 tonnes/day against an estimated 1500 tonnes/day and moisture content exceeds 40%. A large number of vehicles including dumpers and compacters were found parked in the facility premise. Currently commercial establishments and markets are not covered, as presently user charges from commercial establishments and markets have not been fixed. A fall in revenue from Door to Door Collection was discernable as there is no mechanism established by the Kanpur Nagar Nigam to penalize the defaulters. KNN/KMC is considering revising charges for non residential establishment and supporting the facility in secondary transport through KMC vehicles. It is felt that the Municipal Authority should also act as a facilitator for organizing proper coordination between the service provider and the citizens.

Of the garbage received at the waste processing facility the compost yield is reported to be around 12-15%. Efforts to augment beneficial microbes in the compost were said to be undertaken to enrich the compost. A large quantity of compost was found lying in the premises. The net realization from compost is around Rs 1.5 /kg, however the facility is of the view that the price should be pegged at Rs 3.00-3.50 / KG to make it commercially viable.
Plastic, cloth, multi layered packaging segregated after composting along with Agri Waste is compacted to produce RDF. A total of 40 % of the garbage is convertible to RDF. The current indicated price of RDF is Rs 1.50/ kg. Till the WtE plant was setup the RDF had no takers and remained accumulated in the facility. It was suggested that NTPC and other coal based thermal plants and cement plants could buy the RDF from facilities that do not have an integrated WtE plant. The segregated Low quality plastics are converted into briquette, market for which is yet to be identified. The company indicated that due to non-availability of required quantity of dry garbage, power generation has been affected and the firm has taken steps to install driers to reduce the moisture content.

In the very initial stage of segregation construction debri is segregated and inter locking bricks are being made. This plant was not in operation at the time of the visit. The inerts left after all the operations was of the order of 5%.

The RSPM (Respirable Solid particulate matter) levels at the plant site were high. The Composting platform was at the level of the perennial river flowing through the facility and draining into Ganga. Site Identification / selection and Allocation of the facility do not meet the norms notified for waste processing facility.

A sanitary landfill facility is being set up. The facility however did not seem to be in operation. Considering that the landfill is at a depth of 8 feet and the Ground Water is also at 8 feet, it does not meet the guidelines and standards in operation for such facility.

Waste processing plants have been classified as a ‘red’ category” industry by SPCBs. Though, the operations being carried out are a source of environmental pollution the issue of categorization of the Waste processing facilities under RED category needs to be addressed.

The team observed that the cost of production of power, compost and RDF is not viable (higher) and does not match rates/ tariffs fixed by the State Governments or by the concerned agencies.
Review by CPCB ZO Lucknow

A joint team of CPCB and UPPCB reviewed status of Municipal Solid Waste Management facility being managed by M/s A 2 Z, Kanpur, on 20.04.2012. The team interacted with Senior Executives of the Company and inspected various process units. Observations and specific issues for improvement were identified as under:

1. Characterization of Municipal Solidwaste processed by the Company is required. The exercise is necessary as the Company has worked out is operational economics, process strategy and overall performance based on a generalized waste characterization which may not necessarily represent waste processed by the Company in the facility at Kanpur.

2. Measures are required for collection of surface run-of in the premises especially in areas where municipal waste is lying on open land. It was further noted that river Pandu (tributary of river Ganga) traverses across the premises of the Company. Taking note of overall topography release and mixing of leachate from waste stockpile into the river can not be ruled out. In order to eliminate this possibility, the Company must ensure that the stock piles are appropriately located. The company must further ensure provision of interlinking network of garland drains in all such areas to integrate leachate and surface run-of.

3. Characterization of integrated leachate / surface run-of be undertaken and provision of treatment of leachate must be ensured.

4. It was noted that there was significant dispersion of waste material from open screens, conveyors and transfer points. In order to restrict their (air borne) dispersion, the Company must ensure that screens are covered, transfer points are closed-telescopic type and conveyors system is provided with sequential close conveyor system.

5. In order to restrict impact of strong wind on to the areas of waste processing and storage the Company must ensure provision of Wind Breaking wall of suitable height all along the upwind boundary of the premises. Further, a thick plantation within and open areas around the premises is required.

6. Organic manure from waste processing is widely applied on-land either by the Company in its own captive land or through its subsidiaries. Considering a risk of biomagnification of pollutants, the Company must initiate a study on evaluating impact of its organic manure on crops and vegetables.

7. The Company has a power generation facility of 15 MW wherein, reclaimed fuel from municipal solidwaste is used as a feed-stock and rice-husk used as auxiliary fuel. Although the Company has provided ESPs as a measure for air pollution control, yet it would be appropriate to provide bag filters as an additional measure considering limitation of ESP for finer dust particles.
8. The Company has provided a captive TSDF for storage of refuse from waste processing. In order to regularly monitor impact on groundwater, a network of minimum three (one in up gradient and two in down gradient of TSDF) piezometers tapping all the productive groundwater bearing structures in the area are required. The piezometers are required to be regularly monitored for static water level and groundwater quality in terms of pH, conductivity, TDS, chloride, nitrate, total coliforms and total heavy metals apart from other area specific parameters.

REFERENCES

1) XIIth Plan, Chapter ‘Environment and Forests’.
Tour report of visit to M/s SELCO INTERNATIONAL Ltd. Waste Management Plant, Hyderabad

As part of the assessment of Waste to Energy plants in India, Dr K. Kastrurirangan, Member, Planning Commission and Chairman, Task Force on Waste to Energy and a team of officers from Planning Commission and Central Pollution Control Board visited M/s SELCO International Ltd. Waste Management plant in Hyderabad on 11th August 2013.

2 A presentation was made by Dr. G.V. Rama Krishna, Chairman and Managing Director (CMD), M/s SELCO International Ltd. and his team followed by a visit to the processing plant and Waste to Energy Plant. M/s SELCO International Waste Processing Plant was one of the first of its kind to be set up in India in 1999. This project was spearheaded as part of the initiative of Department of Science & Technology. The plant started with the production of Refused Derived Fuel (RDF) and it was only in 2003 that it commenced its waste to energy operations producing 6.6 MW of electricity. The waste processing plant was set up in an area of 22 acres and handled 400 tonnes of waste per day. The commissioned capacity of the plant is 1680 tonnes per day. This land is a dumpsite provided by the Municipal Corporation on lease for 30 years. Since permission for setting up the energy generation plant in this site was not granted, separate land of 30 acres, approximately 50 kms away from the processing site, was procured. However in 2010, the plant had to shut down both its processing and power generation plants because of the malfunctioning of the boiler and cooling equipment which made their operations unviable. Recently the unit has revived its processing plant for RDF production after grant of consent to operate by the Andhra Pradesh Pollution Control Board (APPCB) and has obtained orders from cement companies.

3 Explaining the reasons for the shutdown of operations and other issues relating to the municipal solid waste management, the CMD of the firm explained the procedure undertaken by them in waste processing. The Municipal Corporation delivered the waste at the site and the unit paid Rs 10/- per tonne of waste delivered
by the Corporation. The heterogeneous waste received by the unit was dried using solar panel and hot air generators. Segregation of waste was thereafter done using a combination of manual separation and magnetic separator. Through this method inerts such as sand got separated. The organic material which was obtained was dumped adjacent to the plant for composting. No particular process was used for composting. The rest of the waste was shredded and used for producing RDF of 2500 calorific value. It was observed by the team that none of the plants visited so far had reported such a high calorific value for RDF. In general the calorific value of RDF in other plants ranged from 1000-1500.

4 The RDF produced by the waste processing plant was then transferred to the power plant. For power generation, 70% of RDF and 30% of biomass was used. The unit has a Power Purchase Agreement (PPA) with APTRANSCO. The duration of the agreement is 20 years starting from 2003 onwards and the tariff was Rs.4 per unit at the time the plant closed in 2010.

5 In its 11 years of operation, 6 lakh tonnes of waste has been processed. Since 2003, the Waste to Energy plant has produced 160 million units of power. Besides their unit in Hyderabad, the firm was also involved in setting up operations in Jaipur, Chandigarh and Ahmedabad.

6 The reason for closure of their operations in Hyderabad was malfunctioning of boiler and air cooled condenser which made their operations unviable. The maintenance cost of the equipment had increased tremendously. Further non availability of subsidy also affected their financing.

7 The following issues were raised by the unit for consideration of the team

i. Waiver of Rs 20 crore debt from Department of Science & Technology. It was suggested that Rs 15 cr subsidy that was due from the Ministry of New and Renewable Energy could also be adjusted against this debt. For reviving the plant, fresh infusion of Rs 10 cr would be required. But because of the existing debts, it was difficult to raise equity.
ii. Scrapping of the PPA with APTRANSCO. It was stated that APTRANSCO had arbitrarily changed the power tariffs which made their operations unviable. Further Rs 6 cr was due from APTRANSCO. Due to the PPA it was not possible for the unit to sell power to a steel mill adjacent to the plant which was willing to pay Rs 6.6 per unit. It was requested that a system of power tariffs needs to be developed for sustainability of waste to energy projects.

iii. No tipping fee was being given to the unit. Instead it had to pay Rs 10 per tonne of waste delivered by the Municipal Corporation and a new entrant into this field was being given a tipping fee of Rs 570 per tonne of waste disposed.

iv. No market for compost was available. In Chandigarh, the Agreement itself stipulated a ban on selling compost.

v. The equipment especially boilers should be characterised as per the quality of RDF available for processing.

vi. The issue of providing subsidies to plants which had not commenced its operations was also discussed.

8 Member, Planning Commission remarked that the entire system should be seen as Waste to Wealth as waste is processed to useful products like compost, RDF and energy. However, after examining the prevailing waste management systems, it was observed that there was no standardisation of processes. The technologies and systems seen in the various plants were different. He requested CMD, SELCO to suggest a model that will be feasible to take up for operating such kind of projects. Another important matter raised by Member, Planning Commission was the issue of rag pickers. Rag pickers are going to be an integral part of this entire system and the Task Force would explore ways to enhance their skill and establish them as a cadre. It would be very essential to integrate them into the system. For this purpose it was essential to create institutions or centres of excellence. This could be explored through JNNURM scheme. He also emphasised the issue of examining RDF as the end product of entire waste management process. It was suggested that applicable technology should be graded and cities should be categorised into different tiers viz
Class I and Class II. However the ultimate choice of a technology would be left open to the operators of the system. Policies should not be oriented in giving financial sops to promote a technology that is not viable.

9 It was observed by the team that this unit needed government support for revival. The machinery would need to be upgraded. Further chances of resistance from the cluster of houses located near the processing plant are very high.
Visit to Bio Gas Plant located at Delhi Secretariat

Team from Planning Commission led by Dr. K. Kasturirangan, Member Planning Commission and Chairman of Task Force on Waste to Energy visited the Bio Gas plant located in the Delhi Secretariat and interacted with officers from Department of Environment, Government of Delhi and CPCB officials on 31st July 2013.

Government of NCT of Delhi, has, installed a pilot plant based on BARC NISARGRUNA technology for converting kitchen waste/food waste/other organic waste generated within the Delhi Secretariat into Bio-gas. The pilot project was inaugurated by Hon’ble Chief Minister, Delhi on 20.08.2010 on the date of Rajiv Gandhi Akshya Urja Diwas. The bio-gas/cooking gas being produced by the plant is supplied to Delhi Secretariat Canteen which is partial replacement of the use of conventional LPG. The Bio Manure generated after the 1st and 2nd stage of the reactor is used for gardening purposes at secretariat.

The plant is set up at an area of 30 m$^2$ and has a capacity of 0.5 Tonnes / Day. Grow Diesel, a private company is involved in maintenance and operation of the plant for a period of five years. Though the private partner is operating at a cost of Rs 65,000-70,000, they are being paid a fee of Rs 15000 only for monthly maintenance. The plant reduces the waste by 90 % within the facility and only 10% is being taken out, out of which 5 % is manure and 5 % is being sent to landfill.

As informed by the private partner, a plant based on this technology can be set up at an investment of Rs.35 Lakhs per ton of waste generated per day. Segregation of waste is the key factor in such a plant. Daily Gas generation can be up to a level of 80 to 100 m$^3$ per ton of waste. It also produces high quality Bio-manure amounting to 80-100 kgs per ton.

During the presentation, Secretary, Department of Environment suggested that such de centralized technologies should be included in city/town planning and such plants would be of great help in treating waste generated from slaughter house and dairy mandis/markets in Delhi.

Planning Commission team led by Dr. K. Kasturirangan really appreciated the endeavour of the Department of Environment and advocated the use of this technology in residential facilities, hotels, institutions, government offices and a commercial proposal should be formed to enable the use of this technology on a larger level.

Presentation made by Department of Environment, Delhi Government is annexed.
Visit to Waste to Energy plant at Okhla

Team from Planning Commission led by Dr. K. Kasturirangan, Member Planning Commission and Chairman of Task Force on Waste to Energy visited the Okhla waste to energy plant on 31st July 2013.

Okhla waste to Energy Project was initiated in 2007 when Municipal Corporation of Delhi (MCD) and the New Delhi Municipal Corporation (NDMC) decided to implement a ‘16 MW Waste to Energy Project’ on BOOT basis by setting up an integrated municipal waste processing facility at Okhla and Timarpur in New Delhi. The project was an outcome of the continued difficulties faced by the ULBs of Delhi in disposing/treating solid waste. Around 2050 tons of waste (one-third of the total municipal waste generated in Delhi) was targeted to be processed to generate over 16 MW of green electricity. The project cost was estimated at Rs 175 crore (later escalated to Rs 240 crore) with a construction period of two years. M/s Jindal Urban Infrastructure Limited was selected based on the lowest tariff for electricity generated from the project. The company had quoted ` 2.49 per kwh for the first year and a leveled tariff of ` 2.83 per kwh. Project came into operation in January 2012.

Mixed solid waste is being collected and transported by the local bodies and deposited at the doorstep of the plant. The plant has a pit storage capacity of 7 days and is based on the travelling grate incinerator technology. The plant consists of three boilers and they are specially designed for the thermal treatment of low calorific value MSW. The combustion of MSW over the inclined grate of the stocker takes place in following three stages: Preheating of MSW to reduce moisture content; Combustion of MSW on inclined reverse reciprocating grate; complete combustion of any residual fuel in the last section of forward reciprocating grate. The average retention time of the MSW in the boiler is around one hour (varies based on the moisture content and calorific value). The control of the stoker is automated through a dedicated PLC Controller to ensure complete combustion, view of which is available through a furnace monitoring camera. The excess moisture, in extreme weather condition, comes out as steam from stack without affecting pollution control measures.
The plant has been criticized by the local residents. A PIL has been filed in Delhi High Court in 2009 against Okhla Waste to energy plant. The case has since been transferred to National Green Tribunal (NGT) in Jan’13. Two parameters - SPM and Dioxins/ Furans were found beyond range during inspection by CPCB. The plant was immediately taken under maintenance and cleaning. Some damaged bags had been identified and replaced being the reason of higher SPM.

Certain important issues were raised by the Jindal Urban Infrastructure company including the concerns of the garbage not being high quality with very high inert and moisture content which is beyond the prescribed limits and high ash content. This quality of waste effects the functioning of the plant by reducing the efficiency and also damages the filter, thus increasing the maintenance cost. They also pressed the need for evaluating waste to energy projects on the basis of project specific tariff. The private partner also expressed the need to see the waste to energy plants as a separate entity rather than comparing them to power plants. As informed by the company Okhla WTE project is running in Continuous Losses and needs Viability Gap Funding. Project Cost may be audited and Government help is required to support this facility. They also requested the Planning Commission team to look into providing Higher Subsidy/ Incentive from Government on successful implementation of the project.

Dr. K. Kasturirangan, Member, Planning Commission expressed concerns about the high percentage of debri in the final discards to be taken to landfill and the reiterated the need for segregation of the debri and desired the augmentation of the facility be carried out at the earliest. He suggested that MCD and NDMC should be asked to collect and transport debri and other waste separately. He also inquired about the treatment and collection of the moisture in the wet waste. It was clarified that the water drain of wet garbage was collected and treated. Member appreciated the efforts made by the plant to keep the plant odour free and clean. Member emphasised that the air emission measurements including that of Dioxins/Furans and NoX should be shared regularly with the CPCB and DPCC, any discrepancies in the measurements should be sorted out.

**Following observations were also made during the visit:**

i. The facility was in operation and around 1100MT of municipal solid waste was being charged into the waste to energy boilers for
generation of electricity. It was observed that 15-16MW of electricity was being generated at the time of visit. It was reported that the plant was operated close to a PLF of 85% during the last one year and the PLF of preceding month was close to 95%.

ii. There was no odour problem in the plant premises. The odour was limited to the waste reception area which is an enclosed space.

iii. The control panels indicate that the minimum temperature of > 850°C was maintained in combustion zone.

iv. The operator of the facility enumerated the problems being faced due to improper segregation of MSW being received at the waste to energy plant. Mixing of inert construction debris is one of the major problems being faced by the plant.

v. Recent emission monitoring conducted by CPCB has indicated that the facility had some problems in demonstrating compliance to limits prescribed for emission of Dioxins& Furans. The operator of the facility has informed that the results of the monitoring conducted by other labs had shown compliance. They have also informed that the performance of Bag filter house was enhanced by replacing the damaged fabric filters and optimizing pressure drop across bag houses. Further, the operator of the facility had stated that they are in the process of augmenting the pre-processing facilities by adding shredder, de-stoner and plastics separation units, that would enhance the combustion efficiency and further reduction in Dioxins and furans would be ensured.

vi. The operator of the facility has informed that they are planning to install fly-ash bricks manufacturing facility for utilization of fly-ash being generated from the plant by December 2013.

Presentation made by Jindal Urban Infrastructure ltd. is annexed.
MUNICIPAL SOLID WASTE - NOT A NUISANCE TO BE GOT RID OF PROMPTLY BUT A VALUABLE RESOURCE

An aerial view of the Kajang WtE facility
Municipal waste disposal stares at every corporation as a mammoth problem.

If we trace it back to the genesis of the problem, our ancestors who lived in caves ate the flesh and threw the debris around and in due course found that the cave was not habitable and had to move out.

Then dawned the bright idea that the refuse could be dumped in the nearby pit and keep their dwelling clean. This is the first step of garbage disposal taken by man.
Over the millennia despite development in all aspects of life and creating a sea change in the environment, there was a gross neglect of one aspect, that of waste disposal which was following us like a shadow all the time till it reached monstrous dimension and showed its presence, triggering rapid response. This is the scenario today.

Municipal waste being of highly variable composition needs different technological treatments for achieving a sustainable solution for disposal without environmental degradation. Several technologies are under development across the world.
A first look at garbage it seems to be a nuisance to be got rid off promptly. On more critical examination, it reveals that it is a valuable resource from which compostables, recyclables and the much needed energy could be recovered.
Energy recovery needs a thermal process. Garbage in this part of the world is host to myriads of pollutants besides high level of moisture and inerts and low calorific value which inhibit free burning of the combustibles in the garbage.
Addressing all these factors, a technology was developed to prepare a fuel from the waste with the right moisture content and reduced inerts with reasonably high calorific value, conducive for good combustion.
Thus a fuel RDF is prepared for steam generation. This is a high volatile free burning fuel. However, it is contaminated with pollutants which get liberated in combustion and need to be arrested and neutralised. A comprehensive pollution abatement system addresses this issue in three phases, Pre-Combustion, Combustion and Post Combustion phases.
In the pre-combustion phase, in the fuel preparation plant, odour control is effected creating a more hygienic ambience on the operating floor.

Certain components of the garbage which release toxins during combustion are eliminated.
Leachate is treated in the in-house effluent treatment plant and the treated water recycled for plant use.
In the combustion phase, some toxic elements are generated like Dioxin & NOx.

These are effectively controlled by adopting two part combustion and control of residence time and temperature in the furnace.

Also the host of heavy metals are released enabling trapping them at a later stage.
In the post combustion phase, acid fumes like SO2 and HCL are dissolved in wet scrubber, the water bled out continuously treated to precipitate the salts and water re circulated.
Finally as a polishing process, activated carbon is used to ADSORB all heavy metals, remnant dioxin if any, etc. and trapped in a bag filter allowing only clean gas to exit the chimney.

Emission monitoring is done at the stack.
The technology developed in Bangalore is comprehensive enough to address all these issues and enable delivering clean power starting with the polluting garbage.

The first Indian patent was obtained in 1989.
In the U N conference of environment ministers of ASIA PACIFIC region held in Bangkok in 1995 as a follow up of RIO SUMMIT, I presented this technology and was applauded as the best technology developed in this region thus getting the stamp of global recognition.

A private company from Malaysia approached me for a Technical TIE-UP for an RDF power plant there and a joint venture company ‘Core Competencies Sdn Bhd’ was formed and my patent registered in the joint name.

The technology is generic in nature and is adaptable to handle wastes of various compositions in different regions.
A pilot scale plant was set up, and operational & process parameters were established which formed the design basis for a commercial size plant.
Now, a full fledged RDF power plant is processing 700 tons waste per day and exporting 5 Mw power to the national grid. The plant is in operation complying with international emission standards prescribed by E P A since 2009.
The residual solid inerts from the process come out sterilised and are sent out for safe land filling.

The aim is, no contaminated solid, liquid or gaseous discharge from the unit takes place.
<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
<th>Emission Standards set by EPA</th>
<th>Actual Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solid Particulate Concentration</td>
<td>0.015 g/NM³</td>
<td>0.009 g/NM³</td>
</tr>
<tr>
<td>2</td>
<td>Carbon Monoxide</td>
<td>0.125 g/NM³ or Less</td>
<td>0.103 g/NM³</td>
</tr>
<tr>
<td>3</td>
<td>HF</td>
<td>0.1 g/NM³ or Less</td>
<td>0.032 g/NM³</td>
</tr>
<tr>
<td>4</td>
<td>NO, NO₂</td>
<td>0.4 g/NM³</td>
<td>0.006 g/NM³ +</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.051 g/NM³</td>
</tr>
<tr>
<td>5</td>
<td>SO₂</td>
<td>0.2 g/NM³</td>
<td>0.021 g/NM³</td>
</tr>
<tr>
<td>6</td>
<td>Total VOC</td>
<td></td>
<td>0.874 g/NM³</td>
</tr>
<tr>
<td>7</td>
<td>HCl</td>
<td>0.1 g/NM³ or Less</td>
<td>0.018 g/NM³</td>
</tr>
<tr>
<td>8</td>
<td>Cd</td>
<td>0.015 g/NM³</td>
<td>0.0025 g/NM³</td>
</tr>
<tr>
<td>9</td>
<td>Cr</td>
<td>0.05 g/NM³ or Less</td>
<td>0.0081 g/NM³</td>
</tr>
<tr>
<td>10</td>
<td>Pb</td>
<td>0.0014 g/NM³ or Less</td>
<td>0.0003 g/NM³</td>
</tr>
<tr>
<td>11</td>
<td>As</td>
<td>0.025 g/NM³</td>
<td>ND 0.0001 g/NM³</td>
</tr>
<tr>
<td>12</td>
<td>Hg</td>
<td>0.0002 g/NM³</td>
<td>ND 0.0001 g/NM³</td>
</tr>
<tr>
<td>13</td>
<td>TOC</td>
<td>20 g/NM³ or Less</td>
<td>0.209 g/NM³</td>
</tr>
<tr>
<td>14</td>
<td>Dioxin / Furan</td>
<td>0.1 ng-TEQ/NM³ or Less</td>
<td>0.045 ng/NM³</td>
</tr>
</tbody>
</table>
All the energy requirement for operating the unit is derived from the energy dormant in the garbage. No external energy is required.

Electrical energy for operating the plant and heat energy for waste drying amount to around 19% of the energy available in the waste.

By adopting the principle of Co-generation, extraction steam is used for drying waste thus increasing the thermal cycle efficiency from 22 to 36%.
‘Power’, the leading magazine in the power sector published from U S rated this plant as one of six TOP RENEWABLE plants in the world and featured a cover story on this in their Dec 2010 special issue on Renewable energy, the other five units being Geothermal, Solar & Biomass in U S and Wind power & Biomass in EUROPE.
Ours is the only one outside the western world and the only one based on municipal solid waste.
‘Electric power’, the power industry association of U S invited and honoured us with an award in their annual conference held in Rosemont(IL) in May 2011. The award ceremony was featured in ‘India Tribune’, Chicago.
This technology has the unique distinction.

It is developed in INDIA, EXPORTED TO A THIRD COUNTRY Malaysia, successfully operating a plant there, rated as world class by one of the most developed countries in the world, U S A.
There is a distinct difference between MSW and other sources of renewable energy like solar, wind etc. which are readily available for us to pick up at our will or leave them alone. MSW on the other hand is a polluting nuisance and there is a compulsion to be promptly disposed off without damaging the environment. The general practice followed for years, of land filling has certain undesirable effects viz. ground water contamination by seepage of leachate, methane emission for long years contributing heavily to climate change phenomenon. Land fills require vast areas of urban land, a precious asset of rapidly depleting availability.
RATIONALE FOR TIPPING FEE AND ENHANCED ELECTRICITY TARIFF

IN THE FUEL PREPARATION PLANT, ODOUR CONTROL, LEACHATE TREATMENT AND REMOVAL OF CERTAIN TOXIC ELEMENTS ARE EFFECTED INVOLVING CAPEX AND OPEX.

IN THE STEAM GENERATION PLANT, A COMPREHENSIVE POLLUTION ABATEMENT SYSTEM IS INCORPORATED EFFECTIVELY CONTROLLING TOXINS LIKE DIOXIN AND NOx BESIDES REMOVING ACID FUMES LIKE SO2, HCL AND REMOVING A HOST OF HEAVY METALS INVOLVING ADDITIONAL CAPEX AND OPEX.

THE TIPPING FEE AND ENHANCED POWER TARIFF REGIME IS DEVISED TO MEET THIS ADDITIONAL COST.
In the process of disposal, this technology enables recovery of resources like recyclables and energy without environment degradation, a clear value addition besides releasing vast tracts of urban land for land filling.

There is a cost to all this as against the practice of just land filling and the tipping fee regime is devised to meet this cost.
In the power generation process, unlike in the case of fossil fuels RDF, harbours a host of pollutants which when released will do great damage to the environment and public health.

‘Pollution prevention’ is the highlight of this technology.

The pollution abatement system needs additional CAPEX and OPEX requiring an upward revision of power tariff as against a coal based power system.
Essentially, this is a waste disposal project incidentally recovering much needed energy, replacing to that extent fossil fuel, a depleting resource.

A cost benefit analysis will reveal that enormous gains in the realm of environment protection and safeguarding public health outweigh the additional investment incurred.
Waste to energy project sector is not growing as it should in spite of many incentive schemes offered by the Govt.

I will touch up on the waste management initiative taken by the Malaysian Govt.

Responsibility for waste management vests with the Govt. It is operated through the civic authorities.
The tipping fee payment received by the operating company is re imbrued to the civic authorities by the Govt. Central energy commission decides the enhanced tariff for electricity sale and the additional burden is re imbursed to the electricity board by the Govt. The operating company is not in the picture. This scheme has worked well. The public bodies are relieved of the additional burden of these payments in their budget. This will set the ambience for arriving at realistic tipping fee and electricity tariff. The incentive given is after the event. The Govt is not exposed to any risk in paying out the money.
There is a perception in the public domain -- and rightly so -- an expression of concern to the possibility of great damage to public health due to release of toxins like di-oxin, Nox etc. when garbage is burnt. In this technology, garbage is not burnt as such.

A fuel is prepared with characteristics as close to a fossil fuel as possible to generate the requisite furnace temperature.

Certain components of the waste which are prone to generate these toxins during combustion are eliminated during the fuel preparation process.
The furnace configuration permits temperature and residence time control during combustion assisting disintegration of di-oxins to a large extent. Balance di-oxin moves with the flue gas along with the heavy metal vapours, get **adsorbed**, trapped in a bag filter and sent out to a Govt. controlled hazardous waste facility.

This technology developed in India is available for adoption.

K S Shivaprasad.  
Managing Director,  
Innovision Engineers Private Limited.  
+91 875 444 2035  
kodikulamsiva@yahoo.com.sg
Presentation on
Solid Waste Management
Chandigarh
Municipal Corporation Chandigarh
Steps in Solid Waste Management

- Collection of garbage/waste
- Transportation of garbage
- Processing of garbage
- Dumping
- Maintenance of the dumping ground
The 1st step in Management of Solid Waste is collection of garbage and its depositing in the waste bins/collection at collection point/Collection into Tractor Trolleys. The system of collection is as follows:-

<table>
<thead>
<tr>
<th></th>
<th>Sector 2,3,4,5,7,8,9, 10,11, 39</th>
<th>Collected by 10 No. of tractor/ trolleys &amp; one tipper of MCC, as due to large size of houses and large amount of waste/Horticulture waste. It is not remunerative for privately employed collectors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii</td>
<td>Other residential sectors</td>
<td>By 675 No. of door to door collectors but employee privately/by residents/by RWA’s/ NGO’s</td>
</tr>
<tr>
<td>iii</td>
<td>11 Villages</td>
<td>Tractor trolleys.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>iv</td>
<td>Manimajra</td>
<td>By 1 tampoo &amp; 2 trolleys</td>
</tr>
<tr>
<td>v</td>
<td>Commercial establishments, Big Hotels</td>
<td>By tractor trolleys and dumper placers.</td>
</tr>
<tr>
<td>vi</td>
<td>Mandi Waste</td>
<td>By Tractor trolleys of market committee.</td>
</tr>
<tr>
<td>vii</td>
<td>Apni mandi waste</td>
<td>By tractor trolleys.</td>
</tr>
<tr>
<td>viii</td>
<td>Horticulture Waste</td>
<td>By tractor trolleys.</td>
</tr>
<tr>
<td>ix</td>
<td>Gaushala &amp; cattle pond</td>
<td>Cow dung taken by residents own transport.</td>
</tr>
</tbody>
</table>
## Disposal of Garbage

<table>
<thead>
<tr>
<th></th>
<th>Category</th>
<th>Disposal Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Household &amp; Horticulture waste</td>
<td>Household garbage is disposed of at garbage processing plant &amp; horticulture waste directly at dumping ground.</td>
</tr>
<tr>
<td></td>
<td>collected by trolleys of MCC</td>
<td></td>
</tr>
<tr>
<td>ii</td>
<td>Other residential sectors &amp;</td>
<td>To garbage bins &amp; SSK’s then to the Garbage processing plant by dumper placers.</td>
</tr>
<tr>
<td></td>
<td>Commercial establishments</td>
<td></td>
</tr>
<tr>
<td>iii</td>
<td>Villages</td>
<td>Collected by tractor trolleys of MCC then garbage processing plant.</td>
</tr>
<tr>
<td>iv</td>
<td>Manimajra</td>
<td>Collected by tractor trolleys of MCC and to the dumping ground.</td>
</tr>
<tr>
<td></td>
<td>Big hotels &amp; apni mandi</td>
<td>Disposed of by staff of hotel in the garbage bins then disposed of at dumping ground by dumper places.</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>vi</td>
<td>Mandi waste sector 26</td>
<td>Collected &amp; transported by staff of market committee by way of tractor trolleys and disposed of at dumping ground.</td>
</tr>
<tr>
<td>vii</td>
<td>Horticulture waste</td>
<td>Collected by tractor trolleys &amp; employee of MCC and disposed of at dumping ground.</td>
</tr>
</tbody>
</table>
As already covered the garbage is either transported in tractor trolleys or by collecting in garbage bins and then transported to garbage processing plant/dumping ground. The following machinery and staff is deployed.

- Garbage bins: 584
- Dumper places: 44
- Tractor trolleys: 27
- Compactor: 4
- Open trucks: 3
- Three Wheelers: 6
- JCB: 1
- Tippers: 2
- Chain dozer: 2
Each dumper placer has one driver and 1 cleaner and each tractor trolley has one driver along with 3-5 no. of labour to lift MSW.
Average 270 bins are lifted by MCC per day.
Ideally each bin should be lifted daily. The issue shall be addressed later in the presentation. Figures of the garbage generated are as under:

- Total garbage: 370 M.T. per day (approx.)
- To garbage processing plant: 250 M.T. per day (approx.)
- To dumping ground: 120 M.T. per day (approx.)
- Inerts & rejects from Garbage processing plant: 35 M.T. per day (approx.)
Management of Dumping Ground

- The Dumping Ground is located at Dadumajra adjacent to the Garbage Processing Plant. The total area of the dumping ground is 45 acres. The utilization of which is as below:
  - 25 acres has been reclaimed by capping 17 acres and creating a land-fill site in a scientific manner on 8 acres.
The remaining 20 acres area is being used for dumping the rejects/inerts from the Garbage Processing Plant and the waste coming from Sabzi Mandies, Apni Mandies, Big Hotels, villages including villages under the Chandigarh Administration.
Dumping Ground

- The dumped waste is leveled using chain dozers.
- Effective Micro organism and micro nutrient solution is sprayed three times a day over the waste to sanitize and make the garbage odourless.
- A layer of malba/soil is spread over the waste using chain dozers.
# Equipment deployed for maintenance of the dumping site

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JCB for digging &amp; loading of Fresh Soil for spreading on Garbage.</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Tipper for transportation of fresh soil at Dumping Ground.</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Heavy chain Bulldozer for compacting and pushing of garbage in low lying areas.</td>
<td>2</td>
</tr>
</tbody>
</table>
Challenges

- Additional Safai Karamcharis due to rise of population.
- Additional posts of Safai Karamcharis have been proposed as against a requirement of 4700 safai karamcharies as per norms 1 safai karmchari is required per 500 population.

- At present
  - regular: 1650
  - Through Outsourcing: 690
  - Outsourced area: 1034
  - requirement: 1326

- Additional lifting capacity for lifting all garbage daily.
- Purchase of Additional 9 dumper placers, 1 JCB & 2 tippers.
- Segregation of Solid waste of hotels, mandies, villages going to the Dumping Ground.
- Reduction of inerts/rejects from the plant.
Thanks
Presentation on Municipal Solid Waste Management under JNNURM

Ministry of Urban Development
Govt. of India
http://www.moud.gov.in

1 Aug., 2013
Contents

1. Sector Responsibility
2. Urban Population
3. Generation of MSW
4. Major Components of MSW
5. Characteristics of Waste
6. Jawaharlal Nehru National Urban Renewal Mission (JNNURM)
7. JNNURM Achievements
8. Sector wise % of Funds Sanctioned under UIG
9. Sector wise % of Funds Sanctioned under UIDSSMT
10. Waste Treatment Technologies
11. Suitability of MSW Processing Technologies
12. Status of SWM Projects with their Operational Condition under JNNURM
13. Summary of Projects Sanctioned
14. Other Initiatives by Ministry to Improve Sectoral Performance & Service Delivery
   1. Service Level Benchmarks (SLBs) in Sanitation
   2. Guidelines & Advisory Notes
15. Points of Consideration in SWM
   1. Fund Requirement in Urban Infrastructure
   2. Hon'ble Supreme Court Direction
   3. Decision Taken in PMO Meeting
16. Summary
Sector Responsibility

- As per Constitution of India, SWM is a State subject. Thus, the States are vested with the responsibility for planning, implementation of SWM projects including O&M and cost recovery.

- At Central level, MoUD is the Nodal Ministry for urban SWM and is responsible to formulate policy guidelines & programmes and provide technical assistance to the State Govts.

- MSW (Management and Handling) Rules, 2000 notified and administered by the M/o E&F

- M/o New & Renewable Energy is the nodal Ministry for promoting energy from non-conventional sources including waste-to-energy (WTE).
Urban Population

As per Census 2011:

- 377 million i.e 31.2% of the total population live in towns
- No. of towns increased from 5161 in 2001 to 7935 in 2011.
- 42.62% lives in 53 million plus Metros
- Net decadal growth of urban population is more than the rural growth

Projections:
More than 50% of India’s population will be in Urban by 2050
Generation of MSW

- Urban India produces about 1.5 Lakh Metric Tonnes per day (MTPD) of MSW at present.
- About 81% of total MSW is generated in 468 Class-I including Million plus cities.
- Waste collection efficiency ranges between 70% and 90% in major Metro cities. In several smaller cities it is <50%.
- Treatment of MSW is almost absent in many cities except composting and refused derived fuel (RDF) in a limited manner.
Major Components of MSW

Other types of MSW are:

i. Biomedical Waste
ii. Slaughterhouse Waste
iii. Electronic Waste
Characteristics of Waste

- The organic fraction of the major MSW contains bio-degradable matter ranging from 30% to 55%, which can be converted into waste-to-compost, Waste-to-RDF and WTE products.

- The calorific value varies from 800 to 1100 Kcal and moisture content 40% to 50%, whereas current WTE projects require calorific value more than 1400 Kcal and moisture content of <30%.

- WTE projects are still in the initial stages in India and the viability and sustainability of the technology process and projects, is still being established.

- The MSW projects approved under JNNURM envisage the components like primary & secondary collection, transfer station, transportation, integrated SWM facility with composting, RDF & sanitary landfills.
Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

- **JNNURM** launched in 2005 with a view to providing financial assistance to States/cities for creating infrastructure facilities i.e. water supply, sewerage, drainage and SWM etc. for all the cities in the Country including Metropolitan cities, with a reform agenda.

- Under Urban Infrastructure and Governance (UIG), 65 mission cities (35 million+ cities) including State capitals and other heritage cities were eligible for funding and the remaining towns were eligible under Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT).

- GOI grants were higher in respect of UIDSSMT.
JNNURM Achievements

UI G Component
- Total no. projects approved - 566 nos. (Est. cost Rs. 67,835 cr.)
- MSW management projects approved - 46 nos. (Est. cost Rs. 2048 cr.)
- 10 projects completed so far.
- 23 projects developed through PPP (Est. cost Rs. 657 cr.)
- 10 cities are recovering 100% O&M cost, while another 13 are recovering >50%.

UIDSSMT Component
- Total no. of projects approved - 856 nos. (Est. cost Rs. 14,996 cr.)
- MSW management projects approved - 57 nos. (Est. cost Rs. 353 cr.).
- 17 projects completed so far.
Sector wise % of funds sanctioned under UIG

- Water Supply: 33.7%
- Sewerage: 24.1%
- Storm Water Drainage: 13.6%
- Solid Waste Management: 3.3%
- Roads and Flyovers: 13.0%
- MRTS: 8.3%
- Urban Renewal: 0.8%
- Heritage: 0.4%
- Preservation of Water Bodies: 0.2%
- Parking Projects: 1.4%
- Other Urban Transport: 1.2%
- Urban Renewal: 0.8%
- Heritage: 0.4%
- Preservation of Water Bodies: 0.2%
- Parking Projects: 1.4%
- Other Urban Transport: 1.2%
- Urban Renewal: 0.8%
- Heritage: 0.4%
- Preservation of Water Bodies: 0.2%
- Parking Projects: 1.4%
- Other Urban Transport: 1.2%
- Urban Renewal: 0.8%
- Heritage: 0.4%
- Preservation of Water Bodies: 0.2%
- Parking Projects: 1.4%
- Other Urban Transport: 1.2%
Sector wise % of funds sanctioned under UID DSSMT

- Water Supply: 63.82%
- Sewerage: 19.53%
- Drainage: 5.43%
- Solid Waste Management: 2.36%
- Roads & Flyovers: 8.32%
- Preservation of Water Bodies: 0.22%
- Urban Renewal: 0.25%
- Preservation of Soil Erosion: 0.08%
- Parking: 0.002%
- Urban Renewal: 0.25%
Waste Treatment Technologies

**Wealth from Waste**
The Organic fraction of MSW can be profitably converted into Compost (organic manure) and methane gas

**Waste to Compost**
- Aerobic / Anaerobic Composting (Supported under JNNURM)
- Vermi-Composting (Supported under JNNURM)

**Waste to Energy**
- Refuse Derived Fuel (RDF) / Pelletization (Supported under JNNURM)
- Bio-methanation
- Incineration (constrained due to low calorific and high moisture waste)
- Pyrolysis / Plasma Gasification (energy intensive)

**Recycling of Waste**
Recycle materials like paper, cardboards, plastics, polythene bags, metals, glass, etc., to recover useful resource.

**Sanitary Landfills**
Rejects from compost plants, recycling and other inorganic materials are sent to scientifically engineered landfills.
## Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| **Composting** | • Age old established concept for recycling of matter/nutrients to Soil.  
  • Simple and straightforward for adoption, for source separated MSW.  
  • Suitable for organic bio-degradable fraction of MSW | • Suitable for only organic biodegradable fraction of MSW  
  • Around 30-35Kwh energy is consumed per tonne of waste  
  • Operations get hampered during heavy rains  
  • Risk of production of contaminated compost from MSW if entry of biomedical waste, Hazardous industrial waste and other toxic material is not restricted.  
  • The requirement of land is relatively more for open compost plants. | Mechanized plants in large cities such as Mumbai, Delhi, Kolkata, Bangalore, Ahmedabad, Bhopal etc. |
## Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| **Anaerobic Digestion/ Biomethanation** | ✷ Suitable for kitchen wastes and other putrescible wastes.  
✦ A net energy-producing process (100-150 Kwh per tonne of waste input)  
✦ Free from bad odour, rodent and fly menace, free from visible pollution and social resistance.  
✦ Potential for co-disposal with other organic waste streams from industry/ agriculture. | ✷ Suitable for only organic biodegradable fraction of MSW  
✦ Heat released in less, resulting in lower and less effective destruction of pathogenic organisms than in aerobic composting  
✦ Requires waste segregation for improving digestion efficiency (biogas yield) and improving quality of residual sludge.  
✦ The liquid sludge can be used as rich organic manure  
✦ Generally more capital intensive than aerobic composting. | Biomethanation projects for MSW are in initial stages of development and their commercialization is being demonstrated. Solapur 4 MW plant is commissioned. |
### Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| RDF/ Pelletes| • The RDF pellets can be conveniently stored and transported.  
• Can effectively take care of imbalances in input waste feed to power plant.  
• Involves MSW sorting/segregation operations, | • Energy intensive.  
• Not suitable for too wet MSW during rainy season.  
• Distinct possibility of contamination of RDF Fluff/ Pellets, by toxic/hazardous materials, which can not be removed completely from mixed MSW by sorting; not safe for burning in the open / for domestic use. | Technology Information, Forecasting and Assessment Council (TIFAC) of DST had initially perfected the technology of processing MSW to separate combustible fraction and densification into fuel pellets to a scale of 2 tons per hour at Mumbai. Calorific value in excess of 3000 K. Cal. and technology transfer to Mumbai MC (BMC). The same has not been done so far by the BMC. |
## Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| Incineration | • Most suitable for high Calorific value waste, pathological waste, etc.  
• Can reduce waste volumes by over 90% and convert waste to innocuous material  
• Thermal Energy recovery for direct heating or, power generation.  
• Relatively noiseless and odourless.  
• Low land area requirement.  
• Can be located within city limits, reducing the cost of waste transportation and Hygienic process | • Least suitable for disposal of aqueous/high moisture content/low Calorific Value and chlorinated waste  
• High Capital and O & M costs.  
• Skilled personnel required for Plant operation  
• Concern for emission of particulates, SOx, NOx, chlorinated compounds, ranging from HCL to Dioxins.  
• Concern for toxic metals in particulates that may concentrate in ash; need for care in their removal and disposal. | An Incineration plant for 3.75 MW power generation from 300 TPD MSW was installed at Timarpur, Delhi in the year 1987 could not operate successfully due to low Net Calorific value of MSW. Jindal Plant of 16 MW is currently working at Okhla. |
## Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| Pyrolysis/Gasification/Plasma Pyrolysis Vitrification/Plasma Arc Process | • Production of fuel gas/ fuel oil, which replace fossil fuels.  
• Compared to incineration, control of atmospheric pollution can be dealt with in a superior way, in techno economic sense.  
• Nox and SOx gases emissions do not occur in normal operation  
• Plasma Pyrolysis Verifications attractive for disposal of mixed/ hazardous waste. Toxic materials get encapsulated in vitreous mass, which is relatively much safer to handle than incinerator Gratifier ash. | • Capital intensive.  
• Net energy recovery may suffer in case of wastes with excessive moisture and inert content.  
• High viscosity of pyrolysis oil may be problematic for its transportation & burning.  
• Concentration of toxic/ hazardous matter in Gasifier ash, which will need care in handling and disposal. | No such plants has so far come up in India or elsewhere for the disposal of MSW. It is an emerging technology for MSW and yet to be successfully demonstrated for large scale application. |
### Suitability of MSW Processing Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Application</th>
</tr>
</thead>
</table>
| Sanitary Landfills/ Landfill Gas Recovery | • Natural resources are returned to soil and recycled.  
• Least cost option for waste disposal  
• Potential for recovery of landfill gas as a source of energy  
• Highly skilled personnel not necessary. | • Significant transportation costs to far away landfill sites may upset viability.  
• Down gradient surface water can be polluted by surface run-off in absence of proper drainage treatment systems.  
• Inefficient gas recovery process. Balance gas escapes to the atmosphere  
• Large land area requirement.  
• Cost of pre-treatment to upgrade the gas quality and leachate treatment may be significant.  
• Spontaneous ignition/ explosions due to possible build-up of methane concentrations | There is hardly any scientifically designed sanitary landfill site.  
Most of them are crude dumping sites and few can be said to be controlled dumps. Under JNNURM scientifically designed sanitary landfills are coming up. |
<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of the State</th>
<th>Name of the City</th>
<th>Project Title</th>
<th>Date of Approval by CSMC</th>
<th>Approved Cost (Rs. in Lakh)</th>
<th>Estimated Total Waste generation (MTPD)</th>
<th>Waste going to Compost as per Appraised DPR (MTPD)</th>
<th>Waste going to RDF as per Appraised DPR (MTPD)</th>
<th>Inclusion of components of RDF by State</th>
<th>Physical progress as per latest QPR</th>
<th>Is the project (plant) operational (Y/N)</th>
<th>Success of operation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>Vijayawada</td>
<td>Solid Waste Improvement Management Scheme</td>
<td>14-Oct-08</td>
<td>5,805.00</td>
<td>600</td>
<td>150</td>
<td>No</td>
<td>45%</td>
<td>No</td>
<td>Yes*</td>
<td>27%</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Andhra Pradesh</td>
<td>Tirupati</td>
<td>Solid Waste Management in Tirupati Municipal Corporation</td>
<td>12-Mar-12</td>
<td>2,329.00</td>
<td>158</td>
<td>93</td>
<td>No</td>
<td>0%</td>
<td>No</td>
<td>Yes*</td>
<td>85%</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Arunachal Pradesh</td>
<td>Itanagar</td>
<td>Setting up of Municipal Solid Waste Management in a scientific way for capital complex</td>
<td>22-Feb-07</td>
<td>1,104.38</td>
<td>43</td>
<td>22</td>
<td>No</td>
<td>85%</td>
<td>No</td>
<td>Yes*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Assam</td>
<td>Guwahati</td>
<td>Solid Waste Management for Guwahati</td>
<td>22-Jan-07</td>
<td>3,516.71</td>
<td>51</td>
<td>200</td>
<td>No</td>
<td>Yes*</td>
<td>27%</td>
<td>No</td>
<td></td>
<td>Waste to energy (Biomethanation) plant on PPP basis for estimated 6 MW</td>
</tr>
<tr>
<td>5</td>
<td>Bihar</td>
<td>Patna</td>
<td>Municipal Solid Waste Management for Patna town</td>
<td>26-Mar-07</td>
<td>3,695.40</td>
<td>948</td>
<td>450</td>
<td>No</td>
<td>13%</td>
<td>No</td>
<td>Yes*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bihar</td>
<td>Patna</td>
<td>Integrated Solid Waste Management in Patna UA towns - Phulwarishariff, Khagul and Danapur</td>
<td>29-Dec-08</td>
<td>1,155.81</td>
<td>148</td>
<td>70</td>
<td>No</td>
<td>51%</td>
<td>No</td>
<td>Yes*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Gujarat</td>
<td>Rajkot</td>
<td>Strengthening of Solid Waste Management (Phase-I)</td>
<td>14-Jul-06</td>
<td>867.00</td>
<td>400</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
<td>85%</td>
<td>Yes</td>
<td>100%</td>
<td>Waste to compost and waste to RDF through PSP mode</td>
</tr>
<tr>
<td>8</td>
<td>Gujarat</td>
<td>Rajkot</td>
<td>Strengthening of Solid Waste Management of Rajkot</td>
<td>23-Apr-13</td>
<td>4,172.54</td>
<td>426</td>
<td>No</td>
<td>No</td>
<td>0%</td>
<td>No</td>
<td>Yes*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Gujarat</td>
<td>Surat</td>
<td>Upgradation of Solid Waste Management in Surat</td>
<td>26-Mar-07</td>
<td>5,249.72</td>
<td>2575</td>
<td>800</td>
<td>No</td>
<td>Yes*</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td>Waste to energy plant through gasification technique under PPP mode</td>
</tr>
<tr>
<td>10</td>
<td>Gujarat</td>
<td>Vadodara</td>
<td>Solid Waste Management for Vadodara</td>
<td>20-Jul-07</td>
<td>3,098.54</td>
<td>732</td>
<td>300</td>
<td>No</td>
<td>Yes*</td>
<td>82%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Gujarat</td>
<td>Ahmedabad</td>
<td>Solid Waste Management in Ahmedabad</td>
<td>22-Jan-09</td>
<td>11,885.84</td>
<td>2932</td>
<td>1450</td>
<td>1300</td>
<td>No</td>
<td>30%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Haryana</td>
<td>Faridabad</td>
<td>Solid Waste Management Scheme for Faridabad</td>
<td>20-Jul-07</td>
<td>7,351.90</td>
<td>730</td>
<td>350</td>
<td>125</td>
<td>No</td>
<td>75%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Himachal Pradesh</td>
<td>Shimla</td>
<td>Solid Waste Management for Shimla</td>
<td>9-Mar-07</td>
<td>1,604.00</td>
<td>107</td>
<td>60</td>
<td>No</td>
<td>90%</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Himachal Pradesh</td>
<td>Shimla</td>
<td>Sanitary Landfill site for Solid Waste Management plant at village Bhrriyal, Tehsil Dist. Shimla</td>
<td>12-Mar-12</td>
<td>1,050.62</td>
<td>132</td>
<td>No</td>
<td>No</td>
<td>0%</td>
<td>No</td>
<td>Only landfill site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. No</td>
<td>Name of the State</td>
<td>Name of the City</td>
<td>Project Title</td>
<td>Date of Approval by CSMC</td>
<td>Approved Cost (Rs. in Lakh)</td>
<td>Estimated Total Waste generation (MTPD)</td>
<td>Waste going to Compost as per Appraised DPR (MTPD)</td>
<td>Waste going to RDF as per Appraised DPR (MTPD)</td>
<td>Inclusion of components of RDF by State</td>
<td>Physical progress as per latest QPR</td>
<td>Is the project (plant) operational (Y/N)</td>
<td>Success of operation</td>
<td>Remarks</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>15</td>
<td>Jharkhand</td>
<td>Ranchi</td>
<td>Solid Waste Management</td>
<td>21-Feb-09</td>
<td>5,139.43</td>
<td>577</td>
<td>0</td>
<td>35%</td>
<td>No</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td>6 compost plant out of 9 having 5 tpd capacity each are constructed and operational</td>
</tr>
<tr>
<td>16</td>
<td>Jharkhand</td>
<td>Dhanbad</td>
<td>Solid Waste Management</td>
<td>21-Feb-09</td>
<td>5,585.90</td>
<td>688</td>
<td>0</td>
<td>0%</td>
<td>No</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Jharkhand</td>
<td>Jamshedpur</td>
<td>Integrated Solid Waste Management Project for Jamshedpur Urban Agglomeration</td>
<td>17-Feb-11</td>
<td>3,336.24</td>
<td>364</td>
<td>167</td>
<td>60%</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Karnataka</td>
<td>Mysore</td>
<td>Integrated Municipal Solid Waste Strategy</td>
<td>19-Dec-08</td>
<td>2,985.00</td>
<td>560</td>
<td>280</td>
<td>55%</td>
<td>Yes</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Kerala</td>
<td>Thiruvananthapuram</td>
<td>Solid Waste Management</td>
<td>18-Jan-08</td>
<td>2,456.00</td>
<td>333</td>
<td>200</td>
<td>50%</td>
<td>Yes</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Kerala</td>
<td>Kochi</td>
<td>Solid Waste Management for Kochi</td>
<td>5-Mar-07</td>
<td>8,812.00</td>
<td>755</td>
<td>240</td>
<td>10%</td>
<td>Yes</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Madhya Pradesh</td>
<td>Indore</td>
<td>Solid Waste Management of Indore</td>
<td>28-Dec-07</td>
<td>4,324.66</td>
<td>870</td>
<td>420</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Madhya Pradesh</td>
<td>Ujjain</td>
<td>Solid Waste Management in Ujjain</td>
<td>26-Mar-13</td>
<td>3,588.88</td>
<td>225</td>
<td>110</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Maharashtra</td>
<td>Greater Mumbai</td>
<td>Solid Waste Management project</td>
<td>23-Nov-07</td>
<td>17,879.00</td>
<td>7426</td>
<td>3700</td>
<td>No</td>
<td>Yes</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Maharashtra</td>
<td>Pune</td>
<td>Solid Waste Management - Pimpri-Chinchwad</td>
<td>22-Dec-06</td>
<td>7,044.81</td>
<td>864</td>
<td>530</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Maharashtra</td>
<td>Nashik</td>
<td>Solid Waste Management for Nashik</td>
<td>22-Dec-06</td>
<td>5,429.64</td>
<td>800</td>
<td>500</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Maharashtra</td>
<td>Greater Mumbai</td>
<td>Solid Waste Management for Navim BHavan</td>
<td>20-Dec-09</td>
<td>4,986.86</td>
<td>775</td>
<td>500</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Manipur</td>
<td>Imphal</td>
<td>Solid Waste Management for 18-May-07</td>
<td>2,580.71</td>
<td>96</td>
<td>50</td>
<td>10%</td>
<td>No</td>
<td>Yes</td>
<td>Yes*</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Puduchery</td>
<td>Puducherry</td>
<td>Integrated Solid Waste Management for Puducherry</td>
<td>22-Jan-09</td>
<td>4,966.00</td>
<td>380</td>
<td>160</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Punjab</td>
<td>Amritsar</td>
<td>Integrated Solid Waste Management project for Amritsar</td>
<td>21-Feb-09</td>
<td>7,249.00</td>
<td>600</td>
<td>350</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Rajasthan</td>
<td>Jaipur</td>
<td>Solid Waste Management</td>
<td>8-Dec-06</td>
<td>1,319.74</td>
<td>1100</td>
<td>500</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>67%</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Status of SWM projects with their operational condition
## Status of SWM projects with their operational condition

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of the State</th>
<th>Name of the City</th>
<th>Project Title</th>
<th>Date of Approval</th>
<th>Approved Cost (Rs. in Lakh)</th>
<th>Total Waste Generation (MTPD)</th>
<th>Waste going to Compost as per DPR (MTPD)</th>
<th>Waste going to RDF as per DPR (MTPD)</th>
<th>Inclusion of components of RDF by State</th>
<th>Physical progress as per latest QPR</th>
<th>Is the project (plant) operationa l (Y/N)</th>
<th>Success of operation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Tamil Nadu</td>
<td>Chennai</td>
<td>Solid Waste Management of Alandur, Pallavaram and Tamabaram Municipality</td>
<td>19-Jun-08</td>
<td>4,421.25</td>
<td>327</td>
<td>170</td>
<td>No</td>
<td>16%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Tamil Nadu</td>
<td>Coimbatore</td>
<td>Solid Waste Management for Coimbatore</td>
<td>2-Feb-07</td>
<td>9,651.00</td>
<td>730</td>
<td>373</td>
<td>No</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Tamil Nadu</td>
<td>Madurai</td>
<td>Solid Waste Management for Madurai</td>
<td>2-Feb-07</td>
<td>7,429.00</td>
<td>670</td>
<td>300</td>
<td>No</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Tamil Nadu</td>
<td>Chennai</td>
<td>Solid Waste Management for Chennai</td>
<td>2-Feb-07</td>
<td>3,647.58</td>
<td>6554</td>
<td>1280</td>
<td>Yes</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Uttar Pradesh</td>
<td>Kanpur</td>
<td>Municipal Solid Waste Management in Kanpur</td>
<td>Waste 26-Mar-07</td>
<td>5,623.79</td>
<td>1447</td>
<td>700</td>
<td>No</td>
<td>Yes*</td>
<td>100%</td>
<td>Yes</td>
<td>50%</td>
<td>Waste to RDF for captive power plant on PPP basis, presently under suspension and start shortly</td>
</tr>
<tr>
<td>36</td>
<td>Uttar Pradesh</td>
<td>Lucknow</td>
<td>Municipal Solid Waste Management in Lucknow</td>
<td>Waste 5-Mar-07</td>
<td>4,292.37</td>
<td>198</td>
<td>250</td>
<td>No</td>
<td>Yes*</td>
<td>60%</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Uttar Pradesh</td>
<td>Mathura</td>
<td>Municipal Solid Waste Management in Mathura</td>
<td>Waste 8-Dec-06</td>
<td>991.60</td>
<td>177</td>
<td>50</td>
<td>No</td>
<td>Yes*</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Uttar Pradesh</td>
<td>Meerut</td>
<td>Municipal Solid Waste Management in Meerut</td>
<td>Waste 8-Dec-06</td>
<td>2,359.40</td>
<td>554</td>
<td>200</td>
<td>No</td>
<td>Yes*</td>
<td>40%</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Uttar Pradesh</td>
<td>Varanasi</td>
<td>Solid Waste Management on 26-Oct-07</td>
<td>4,867.73</td>
<td>735</td>
<td>375</td>
<td>No</td>
<td>Yes*</td>
<td>70%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Uttar Pradesh</td>
<td>Allahabad</td>
<td>Solid Waste Management for Allahabad</td>
<td>for 22-Feb-08</td>
<td>3,041.49</td>
<td>578</td>
<td>300</td>
<td>Yes</td>
<td>70%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Uttar Pradesh</td>
<td>Agra</td>
<td>Municipal Solid Waste Management in Agra</td>
<td>Waste 5-Mar-07</td>
<td>3,083.99</td>
<td>709</td>
<td>350</td>
<td>Yes</td>
<td>80%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Uttarakhand</td>
<td>Dehradun</td>
<td>Integrated Solid Waste Management</td>
<td>Waste 16-May-08</td>
<td>2,460.00</td>
<td>256</td>
<td>150</td>
<td>No</td>
<td>Yes*</td>
<td>30%</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Uttarakhand</td>
<td>Haridwar</td>
<td>Integrated Solid Waste Management in Haridwar</td>
<td>Waste 22-Jan-09</td>
<td>1,671.53</td>
<td>213</td>
<td>100</td>
<td>No</td>
<td>1%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Uttarakhand</td>
<td>Nainital</td>
<td>Integrated Solid Waste Management in Nainital</td>
<td>Waste 16-Jun-10</td>
<td>931.00</td>
<td>38</td>
<td>24</td>
<td>No</td>
<td>5%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>West Bengal</td>
<td>Asansol</td>
<td>Municipal Solid Waste Management in Asansol Urban Area</td>
<td>Waste 8-Jan-07</td>
<td>4,357.27</td>
<td>666</td>
<td>300</td>
<td>No</td>
<td>Yes*</td>
<td>75%</td>
<td>Yes</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>West Bengal</td>
<td>Kolkata</td>
<td>Municipal Solid Waste Management of Municipal Towns</td>
<td>Waste 22-Jan-07</td>
<td>5,658.53</td>
<td>1017</td>
<td>662</td>
<td>No</td>
<td>100%</td>
<td>Yes</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Component has been implemented by the State in addition to the project approval.
Summary of Projects Sanctioned

- Of the 46 approved projects under the UIG component of JnNURM – all had composting as a method of organic waste stabilization.

- Out of which, 13 projects were approved having waste-to-RDF as one of the treatment components.

- Out of the 13 approved projects, 12 projects were implemented with waste-to-RDF while 1 project (Puducherry) was not implemented.

- 14 projects based on waste-to-RDF are implemented by the State on their own, in addition to the JnNURM project approval.

- In all 26 plants (out of the 46 approved projects) have been implemented with waste to RDF under JnNURM.

- Out of 46 approved projects, 10 projects have been completed.

- 19 out of the 26 plants with waste to RDF are operational.

- The Mission also triggered investments in waste-to-energy sector with 3 projects in Kanpur (trial-testing on), Guwahati (awarded to RAMKY) and Surat (construction started)
1. Service Level Benchmarks (SLBs) in Sanitation

Ministry has formulated a set of Standardized SLBs for urban water supply and sanitation including MSW management as per International Best Practices with a focus to shift from infrastructure to service delivery.

The 13th Finance Commission has made it mandatory for all cities to notify their current performance as well as expected improvements in terms of these benchmarks every year for accessing performance grants.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>2013-14</th>
<th>2012-13</th>
<th>2011-12</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of States</td>
<td></td>
<td>3</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Performance Grant Released under 13th FC (in Rs Cr.)</td>
<td>Based on the notification it is yet to be sanctioned</td>
<td>1,341</td>
<td>571</td>
<td>First year the Performance grant was unconditional</td>
</tr>
<tr>
<td>S. No.</td>
<td>Proposed indicators</td>
<td>Benchmark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Household level coverage of solid waste management services</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Efficiency of collection of municipal solid waste</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extent of segregation of municipal solid waste</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extent of municipal solid waste recovered (qty of waste processed)</td>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Extent of scientific disposal of municipal solid waste</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Efficiency in redressal of customer complaints</td>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Extent of cost recovery in SWM services</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Efficiency in collection of SWM charges (of the revenue billed)</td>
<td>90%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Guidelines & Advisory Notes

- Technology Advisory Group Report on SWM, 2005 (specifies selection of technologies, IEC activities)
- Report on Integrated Plant Nutrient Management, 2005 (To promote city compost from garbage to use as soil conditioner)
- Toolkit on PPP on Solid waste Management, 2012
- Guidance Note: MSW Management on Regional Basis, 2011
The High Powered Expert Committee (HPEC) has estimated investment requirements of Rs. 39.20 Lakh Crore for Urban Infrastructure Services in India at 2009-10 price index during 2012-2031.

The capital expenditure estimated for SWM sector is Rs. 48,582 Crore at 2009-10 price index during 2012-2031.

The Operation & maintenance expenditure estimated for SWM sector is Rs. 273,906 Crore at 2009-10 price index during 2012-2031.
2. Hon'ble Supreme Court Direction

- The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry for promoting waste to energy projects (WTE projects).
- During the hearing held on 15th May, 2007 in the matter relating to the stay on Govt. subsidies for projects on recovery of energy from municipal solid waste, Hon'ble Supreme Court has permitted the Ministry of New and Renewable Energy to go ahead with setting up of 5 waste-to-energy projects to study the viability of such projects.
- Hon'ble Supreme Court also directed that no projects for waste-to-energy be taken up till 5 pilot projects are completed.
- As per the aforesaid direction, the Ministry of New and Renewable Energy formulated “Programme on Energy Recovery from Municipal Solid Waste for Setting-up of 5 Pilot Projects”.
- So far 5 projects have been approved in the cities Bengaluru (1 no.), Hyderabad (1 no.), New Delhi (2 nos.) and Pune (1 no.).
- These projects have to be evaluated MNRE by their technical aspects and viability under Indian conditions.
### 3. Decision Taken in PMO Meeting

- It was decided in meeting on 17.04.2012 at PMO under the chairmanship of Principal Secretary to PM that MoUD would prepare a scheme to promote PPP projects in the field of WTE based on technology validated by the Expert Committee.

- MoUD would obtain the approval of competent authority and launch the scheme by 31st July 2013. The existing MNRE schemes would continue to encourage new technology projects.

- The following were decided in the meeting on 15.05.2013 by the Ministry:
  - Model Profile/Scheme for PPP projects based on WTE will be prepared by DEA and full scale project may be taken only after the Expert Committee set-up by the Planning Commission gives its recommendations
  - MNRE will clarify the status of Hon’ble Supreme Court decision on WTE project including the further course of action by MNRE.
Summary

• The growing generation of MSW in cities poses major problem in processing and disposal of waste.

• WTE as one of the option to solve the problem of MSW is being explored by M/o N&RE by taking up 5 pilot projects to find out the viability of WTE after the direction of Hon’ble Supreme Court.

• MoUD under JNNURM has sanctioned 46 MSW projects based on Composting (bio or aerobic), RDF and Pelletisation (which is used as feed for energy).

• DEA is to develop a Model Profile/Scheme for WTE projects under PPP.

• MoUD would take up full-scale project after the recommendation of the Expert Committee.
Thank you
Decentralized waste resource management: Nisargruna experience

Sharad P. Kale
Head, Technology Transfer and Collaboration Division
BHABHA ATOMIC RESEARCH CENTRE
MUMBAI 400085
sharadkale@gmail.com
8/14/2014

Earth needs your help
PERSPECTIVE
METTERS

WASTE

WEALTH BANK
SEGREGATION IS THE
Plants
Primary producers

CO₂ + H₂O + Sunlight

Animals
Microorganisms
Residues

Human

Biomethanation

CO₂ + CH₄

CO₂ - non-cyclic

Anthropogenic activities

Fossil Fuel

CO₂ - cyclic
ENVIRONMENTAL SUSTAINABILITY AND ECONOMICS

• 1 MT biodegradable waste is going to be 1 to 2 MT food for tomorrow.

• Decentralized plants can substantially reduce transportation costs and associated hazards.

• 1 MT biodegradable waste resource processing through Nisargruna generates
  • employment for 1 person
  • 15-30 Kg fuel (Methane gas)
  • 50-90 Kg manure
Average installation cost for

1. 1-5 MT/day plants would be Rs. 17-20 Lakhs per tonne

2. 10 to 25 MT/day plants would be Rs. 15 Lakhs/MT
Average O&M cost per annum for

1. 1-5 MT/day plants would be Rs. 1 Lakhs per tonne

2. 10 to 25 MT/day plants would be Rs. 0.8 Lakhs/MT
## Space economy in Nisargruna plants

<table>
<thead>
<tr>
<th>Capacity (MT)</th>
<th>Space (M²)</th>
<th>Quantity processed in 30 years (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>9900</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>19800</td>
</tr>
<tr>
<td>5</td>
<td>400</td>
<td>49500</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
<td>99000</td>
</tr>
<tr>
<td>25</td>
<td>2000</td>
<td>247500</td>
</tr>
<tr>
<td>50</td>
<td>4000</td>
<td>495000</td>
</tr>
</tbody>
</table>

Average life of a Nisargruna plant will be 30 years.
• Paying back Nature’s loan

• Improving the environment

• Maintaining the resource recycling in equilibrium

• Improving the health aspects of city and country

• Reducing carbon emissions through
  • Vehicular transportation check
  • Using biogas to replace fossil fuels
  • Stopping the emission of methane at dumps
  • Using manure replacing urea
<table>
<thead>
<tr>
<th>Type of material</th>
<th>No. of plants</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen discards</td>
<td>&gt; 100</td>
<td>Most of the existing plants</td>
</tr>
<tr>
<td>Vegetable market</td>
<td>&gt; 30</td>
<td>Some plants receive mix materials</td>
</tr>
<tr>
<td>Abattoir discards</td>
<td>4</td>
<td>Deonar, Solapur, Kalyan</td>
</tr>
<tr>
<td>Bone protein factory</td>
<td>3</td>
<td>Chandrapur</td>
</tr>
<tr>
<td>discards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle dung</td>
<td>10</td>
<td>Nasik, Chiplun, Pali, Anjangaon, Vasai, Tara</td>
</tr>
</tbody>
</table>
## APPROXIMATE QUANTITY OF MATERIAL PROCESSED AT MAJOR LOCATIONS

<table>
<thead>
<tr>
<th>Location</th>
<th>Material processed (MT)</th>
<th>Location</th>
<th>Material processed (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anushaktinagar</td>
<td>6000</td>
<td>Pandharpur</td>
<td>1000</td>
</tr>
<tr>
<td>Govandi</td>
<td>6000</td>
<td>Kaiga</td>
<td>1000</td>
</tr>
<tr>
<td>Matheran</td>
<td>6000</td>
<td>Cochin refinery</td>
<td>800</td>
</tr>
<tr>
<td>Kalameshwar</td>
<td>1500</td>
<td>Nasik</td>
<td>1200</td>
</tr>
<tr>
<td>Katol</td>
<td>1000</td>
<td>Symbiosis</td>
<td>1000</td>
</tr>
<tr>
<td>TIFR</td>
<td>1000</td>
<td>Symbiosis _2</td>
<td>800</td>
</tr>
<tr>
<td>INS Kunjali</td>
<td>1500</td>
<td>TCS, Thane</td>
<td>600</td>
</tr>
<tr>
<td>Pune (Model Colony)</td>
<td>2000</td>
<td>Alibag</td>
<td>600</td>
</tr>
<tr>
<td>Baramati</td>
<td>1000</td>
<td>Roha</td>
<td>1000</td>
</tr>
<tr>
<td>Nasik</td>
<td>1000</td>
<td>Pune</td>
<td>1000</td>
</tr>
<tr>
<td>Anjangaon</td>
<td>500</td>
<td>Kerala</td>
<td>1500</td>
</tr>
<tr>
<td>Chiplun</td>
<td>500</td>
<td>Thane</td>
<td>2000</td>
</tr>
<tr>
<td>Pali</td>
<td>500</td>
<td>Ankaleshwar</td>
<td>4000</td>
</tr>
</tbody>
</table>
GAS IS USED IN HOSTEL KITCHEN

JUNE 2002
4 MT/day

TRAINING SCHOOL HOSTEL, ANUSHAKTINAGAR
HIRANANDANI ESTATE, THANE

- 5MT/day hotel and vegetable market material
- Area 300 m²
- Biogas for electricity
- December 2005
TCS, THANE

• 1MT/day Food resource from TCS canteen
• Area 40 m²
• Biogas for Kitchen
• June 2009
KALAMESHWAR
MUNICIPAL COUNCIL

- 2MT/day hotel and vegetable market material
- Area 300 m²
- Biogas for electricity (street lights)
- June 2007
Delhi Secretariat

0.5 MT/day Food based

June 2010

Fabricated in steel

Area 30m²

Biogas use in kitchen
Delhi Secretariat Nisargruna plant was inaugurated on August 20, 2010 by Honorable Chief Minister Smt. Sheila Dixit
## Actual Performance of Delhi Secretariat Project from August 2010 to July 2013

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quantization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of resource processed</td>
<td>42000 Kg</td>
</tr>
<tr>
<td>Gas utilized in the kitchen</td>
<td>4150 m³</td>
</tr>
<tr>
<td>Utilizable gas generation per MT of resource</td>
<td>98.8 m³</td>
</tr>
<tr>
<td>Manure generated</td>
<td>3500 Kg</td>
</tr>
</tbody>
</table>
NISARGRUNA PLANT
CAPACITY 2 MT/day
BADDI (Himachal Pradesh)
## Average Atmospheric Temperatures in Baddi for the Year 2010 - 2011 (April 2010 - March 2011)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Month</th>
<th>Maximum (°C)</th>
<th>Minimum (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>April</td>
<td>38 - 44</td>
<td>30 - 34</td>
</tr>
<tr>
<td>2</td>
<td>May</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>June</td>
<td>38 - 44</td>
<td>30 - 34</td>
</tr>
<tr>
<td>4</td>
<td>July</td>
<td>36 - 40</td>
<td>26 - 32</td>
</tr>
<tr>
<td>5</td>
<td>August</td>
<td>36 - 40</td>
<td>26 - 32</td>
</tr>
<tr>
<td>6</td>
<td>Sept</td>
<td>36 - 40</td>
<td>26 - 32</td>
</tr>
<tr>
<td>7</td>
<td>October</td>
<td>25 - 32</td>
<td>18 - 22</td>
</tr>
<tr>
<td>8</td>
<td>November</td>
<td>25 - 32</td>
<td>18 - 22</td>
</tr>
<tr>
<td>9</td>
<td>December</td>
<td>08 - 15.0</td>
<td>3.0 - 6.0</td>
</tr>
<tr>
<td>10</td>
<td>January</td>
<td>08 - 15.0</td>
<td>3.0 - 6.0</td>
</tr>
<tr>
<td>11</td>
<td>February</td>
<td>08 - 15.0</td>
<td>3.0 - 6.0</td>
</tr>
<tr>
<td>12</td>
<td>March</td>
<td>25 - 30</td>
<td>15 - 20</td>
</tr>
</tbody>
</table>
Data collected from Nisargruna plant at Baddi (Resource processed and biogas generation and utilization)

<table>
<thead>
<tr>
<th>Month</th>
<th>Days</th>
<th>Kitchen (Kg)</th>
<th>Cotton (Kg)</th>
<th>Garden (Kg)</th>
<th>Sludge (Kg)</th>
<th>Total (Kg)</th>
<th>Gas M³</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Oct</td>
<td>24</td>
<td>5000</td>
<td>0</td>
<td>0</td>
<td>23400</td>
<td>28400</td>
<td>336</td>
</tr>
<tr>
<td>10-Nov</td>
<td>29</td>
<td>5800</td>
<td>0</td>
<td>0</td>
<td>31600</td>
<td>37400</td>
<td>455</td>
</tr>
<tr>
<td>10-Dec</td>
<td>21</td>
<td>4782</td>
<td>0</td>
<td>0</td>
<td>26250</td>
<td>31032</td>
<td>230</td>
</tr>
<tr>
<td>11-Jan</td>
<td>31</td>
<td>5752</td>
<td>0</td>
<td>0</td>
<td>38750</td>
<td>44502</td>
<td>300</td>
</tr>
<tr>
<td>11-Feb</td>
<td>28</td>
<td>7193</td>
<td>109</td>
<td>0</td>
<td>35000</td>
<td>42302</td>
<td>445</td>
</tr>
<tr>
<td>11_Mar</td>
<td>31</td>
<td>7977</td>
<td>140</td>
<td>150</td>
<td>39706</td>
<td>47973</td>
<td>782</td>
</tr>
<tr>
<td>11_April</td>
<td>30</td>
<td>11800</td>
<td>780</td>
<td>465</td>
<td>41000</td>
<td>54045</td>
<td>1141</td>
</tr>
<tr>
<td>11-May</td>
<td>31</td>
<td>14849</td>
<td>485</td>
<td>125</td>
<td>45205</td>
<td>60664</td>
<td>2000</td>
</tr>
<tr>
<td>11-June</td>
<td>30</td>
<td>15120</td>
<td>410</td>
<td>150</td>
<td>42794</td>
<td>58474</td>
<td>3000</td>
</tr>
<tr>
<td>11_July</td>
<td>31</td>
<td>17253</td>
<td>240</td>
<td>0</td>
<td>54200</td>
<td>71693</td>
<td>3300</td>
</tr>
<tr>
<td>11-Aug</td>
<td>31</td>
<td>19625</td>
<td>0</td>
<td>0</td>
<td>51950</td>
<td>71575</td>
<td>3400</td>
</tr>
<tr>
<td>11-Sept</td>
<td>30</td>
<td>12085</td>
<td>0</td>
<td>0</td>
<td>60200</td>
<td>72285</td>
<td>1880</td>
</tr>
<tr>
<td>11-Oct</td>
<td>31</td>
<td>16680</td>
<td>0</td>
<td>0</td>
<td>49300</td>
<td>65980</td>
<td>2780</td>
</tr>
<tr>
<td>11-Nov</td>
<td>30</td>
<td>17388</td>
<td>0</td>
<td>0</td>
<td>52500</td>
<td>69888</td>
<td>3088</td>
</tr>
<tr>
<td>11-Dec</td>
<td>31</td>
<td>14693</td>
<td>0</td>
<td>0</td>
<td>54250</td>
<td>68943</td>
<td>3326</td>
</tr>
<tr>
<td>12-Jan</td>
<td>31</td>
<td>16474</td>
<td>0</td>
<td>0</td>
<td>47000</td>
<td>63474</td>
<td>2231</td>
</tr>
<tr>
<td>12-Feb</td>
<td>29</td>
<td>12123</td>
<td>0</td>
<td>0</td>
<td>38300</td>
<td>50423</td>
<td>426</td>
</tr>
<tr>
<td>12_Mar</td>
<td>31</td>
<td>1000</td>
<td>0</td>
<td>0</td>
<td>7300</td>
<td>8300</td>
<td>62</td>
</tr>
<tr>
<td>12_April</td>
<td>30</td>
<td>1837</td>
<td>0</td>
<td>0</td>
<td>15200</td>
<td>17037</td>
<td>154</td>
</tr>
<tr>
<td>12-May</td>
<td>31</td>
<td>12071</td>
<td>0</td>
<td>0</td>
<td>12000</td>
<td>24071</td>
<td>744</td>
</tr>
<tr>
<td>12-June</td>
<td>30</td>
<td>18835</td>
<td>0</td>
<td>0</td>
<td>34600</td>
<td>53435</td>
<td>1722</td>
</tr>
<tr>
<td>12_July</td>
<td>31</td>
<td>13062</td>
<td>0</td>
<td>0</td>
<td>19200</td>
<td>32262</td>
<td>1816</td>
</tr>
<tr>
<td>12-Aug</td>
<td>31</td>
<td>18583</td>
<td>0</td>
<td>0</td>
<td>37200</td>
<td>55783</td>
<td>2830</td>
</tr>
<tr>
<td>12-Sept</td>
<td>30</td>
<td>18182</td>
<td>0</td>
<td>0</td>
<td>36000</td>
<td>54182</td>
<td>2468</td>
</tr>
<tr>
<td>12-Oct</td>
<td>31</td>
<td>16360</td>
<td>0</td>
<td>0</td>
<td>33600</td>
<td>49960</td>
<td>2499</td>
</tr>
<tr>
<td>12-Nov</td>
<td>21</td>
<td>10516</td>
<td>0</td>
<td>0</td>
<td>22800</td>
<td>33316</td>
<td>1102</td>
</tr>
<tr>
<td>Total</td>
<td>765</td>
<td>315040</td>
<td>2164</td>
<td>890</td>
<td>949305</td>
<td>1267399</td>
<td>42517</td>
</tr>
<tr>
<td>Month</td>
<td>Waste processed (Kg)</td>
<td>Efficiency of waste handling (%)</td>
<td>Generator working hours</td>
<td>Units generated (KW)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------------------------</td>
<td>-------------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun-10</td>
<td>2810</td>
<td>4.68</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul-10</td>
<td>3600</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug-10</td>
<td>12450</td>
<td>20.75</td>
<td>60</td>
<td>450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep-10</td>
<td>12840</td>
<td>21.4</td>
<td>110</td>
<td>825</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct-10</td>
<td>25530</td>
<td>42.55</td>
<td>129</td>
<td>967.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov-10</td>
<td>23260</td>
<td>38.77</td>
<td>21</td>
<td>157.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec-10</td>
<td>45075</td>
<td>75.125</td>
<td>168</td>
<td>1260</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-11</td>
<td>42250</td>
<td>70.42</td>
<td>212</td>
<td>1590</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb-11</td>
<td>33225</td>
<td>55.37</td>
<td>56</td>
<td>420</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar-11</td>
<td>35365</td>
<td>58.94</td>
<td>49</td>
<td>367.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr-11</td>
<td>44375</td>
<td>73.96</td>
<td>103</td>
<td>772.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May-11</td>
<td>50600</td>
<td>84.33</td>
<td>135</td>
<td>1012.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun-11</td>
<td>28690</td>
<td>47.82</td>
<td>71</td>
<td>532.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul-11</td>
<td>42450</td>
<td>70.75</td>
<td>23</td>
<td>172.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug-11</td>
<td>49140</td>
<td>81.90</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep-11</td>
<td>44678</td>
<td>74.46</td>
<td>19.2</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct-11</td>
<td>55428</td>
<td>92.38</td>
<td>54</td>
<td>405</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov-11</td>
<td>52930</td>
<td>88.22</td>
<td>38.5</td>
<td>288.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec-11</td>
<td>56981</td>
<td>94.97</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-12</td>
<td>55366</td>
<td>92.28</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb-12</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar-12</td>
<td>58020</td>
<td>96.70</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr-12</td>
<td>55761</td>
<td>92.94</td>
<td>31</td>
<td>232.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May-12</td>
<td>56879</td>
<td>94.80</td>
<td>196</td>
<td>1470</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>887703</strong></td>
<td><strong>61.65</strong></td>
<td><strong>1475.7</strong></td>
<td><strong>9365.25</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cochin Refinery Nisargruna biogas plant

- 1MT/day hotel and vegetable market material
- Area 100 m²
- Biogas for kitchen
- March 2009
0.5 MT kitchen based

July 2009

Biogas use in kitchen

Area 100m²
KOTTAYAM MEDICAL COLLEGE

- 2MT/day hotel and vegetable market material
- Area 100 m²
- Biogas for electricity (street lights)
- June 2009
TAJ KOVALAM

- 0.5MT/day hotel and vegetable market material
- Area 50 m²
- Biogas for kitchen
- December 2009
TATA INSTITUTE OF SOCIAL SCIENCES, DEONAR MUMBAI

NISARGRUNA BIOGAS PLANT

CAPACITY 0.5MT/DAY

FOOD WASTE RESOURCE FROM INSTITUTE CANTEEN

INSTALLATION: JANUARY 2011

PROJECT COST: Rs. 12 LAKHS

UTILIZATION OF BIOGAS IN CANTEEN OF INSTITUTE

UTILIZATION OF MANURE IN GARDENS OF THE INSTITUTE
निम्नलिखित नागरिक-व्यवस्थापन विभाग
भारत विनिर्माण केन्द्र, मुंबई यांचे तंग्रलनावर आधारित
निर्ग्रंथन बायोमेस प्रकाश
AN ISO-9001-2008 CERTIFIED
Major hurdles and difficulties

- Mental attitude
- Public apathy for both segregation and understanding significance of waste resource
- ULBs have no designated funds for decentralized waste resource management
- Involvement of NGOs like Stree Mukti Sangahatana (Rag-picker’s associations), though clearly directed by Hon’ble Supreme Court, is minimum.

Policy decisions needed
Fund allocation has to be done
Our eyes can show us what is physical. Our brain tries to derive usable information from what we see. We must train our brain to think laterally. That way we can broaden our horizons of knowledge and scope of work.
Garbage

Resource Management

Sharad P. Kale

Head, Technology Transfer and Collaboration Division

Bhabha Atomic Research Centre

Mumbai 400085

sharadkale@gmail.com

8/14/2014

Earth needs your help
Waste to Energy practices adopted by Ahmedabad City

Dr. Guruprasad Mohapatra, I.A.S.
Municipal Commissioner
Ahmedabad Municipal Corporation
Ahmedabad, an Overview

- 7th Largest Metropolis in India
- Population: 60 Lakh plus (Large Floating Population)
- Area: 466 Sq Km
- Density: 22,473 / km² (58,205 /sq mi)
- 6 Municipal Zones - 64 Municipal Wards (each zone comprising of 10 to 12 wards)
- Ahmedabad generates almost 3800 Metric Tons of solid waste on a daily basis including 300 MT of construction and demolition debris. This waste is collected, transported, treated and disposed according to the Rules. Deploys more than 12,500 employees.
- City is witnessing a major infrastructure boom and population increase. A major center of Education, Manufacturing Industries, the city of Ahmedabad, is globally the 3rd fastest growing city as per Forbes magazine study.
AMC-Solid Waste Management Practices

- Daily collection of 3800-4000 metric tones
- More than 13,000 Street sweepers-1484 km roads area swept on a daily basis. 100% coverage in street sweeping on a daily basis
- Collection from all residential and commercial units under Door / Gate to Dump project, more than 600 vehicles are deployed and daily 1600 metric tons of waste is collected in this manner.
- Identified more than 850 locations as waste collection points where 1050 closed body 7.5 cubic meter M.S. Community storage bins have been provided. AMC ensures that these containers are lifted at least once in a day and daily 1100 metric tons of waste is collected in this manner.
AMC-Solid Waste Management Practices

- AMC has deployed 89 Tipper Trucks, 32 JCB Machines, 33 Bobcat type machines, 120 Hydraulic Dumper Placers, 11 Skip Lifters, 54 Compactors, 4 Dead Animal Vans, 14 Nuisance Tankers, 1 Mobile Court, 60 Tractors, 5 Bull dozers, 3 Wheel dozers, 20 Road Vacuum Sweepers, 24 mini vans and other contactors’ 700 vehicles in all 6 zones on daily basis for efficient cleaning of the city.
- Tendering process is in final stage for GPS - RFID reader - RFID tags based monitoring system for more than 1000 vehicles.
- Started one Transfer Station of about 400 MT Capacity in East Zone-AMC to save on transportation cost, reduce pollution and ease traffic congestion. Five more transfer stations in other zones under construction.
## Waste to Energy

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Daily Treatment</th>
<th>Work Given</th>
<th>MSW converting into</th>
<th>Land Given (Acres)</th>
<th>Agreement Period</th>
<th>Technology Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. UPL Djai Power Ltd</td>
<td>250 Tons</td>
<td>2007</td>
<td>Compost and RDF / Pellets &amp; Fluff</td>
<td>15</td>
<td>25 Years</td>
<td>Windrow Method</td>
</tr>
<tr>
<td>2. Creative Eco-Recycle Port Pvt. Ltd.</td>
<td>800 Tons</td>
<td>2009</td>
<td>Compost and RDF / Pellets &amp; Fluff</td>
<td>12.5</td>
<td>25 Years</td>
<td>Gasification &amp; thermalization Spiritless</td>
</tr>
<tr>
<td>3. Hanjer Biotech Energies Pvt. Ltd</td>
<td>500 Tons</td>
<td>2010</td>
<td>Compost and RDF / Pellets &amp; Fluff</td>
<td>12.5</td>
<td>30 Years</td>
<td>Multi Product Integrated Technology</td>
</tr>
</tbody>
</table>
# MSW Treatment / Processing

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Daily Treatment</th>
<th>Work Given</th>
<th>MSW converting into</th>
<th>Land Given (Acres)</th>
<th>Agreement Period</th>
<th>Technology Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Excel Industries Ltd.</td>
<td>500 Tons (effectively treat daily 250 Tons)</td>
<td>1997</td>
<td>Composting</td>
<td>25</td>
<td>15 Years</td>
<td>Windrow Method</td>
</tr>
<tr>
<td>5. DNP Infrastructure Pvt. Ltd</td>
<td>300 Tons</td>
<td>2012</td>
<td>Construction &amp; Demolition Waste into Various Products</td>
<td>5</td>
<td>30 Years</td>
<td>C &amp; D recycling - neno technology</td>
</tr>
</tbody>
</table>

- DNP Infrastructure Pvt. Ltd has been awarded the project for Design, Construct, Operate & Maintain a daily 300 tons processing plant for Construction & Demolition waste and collection & transportation of such waste from designated locations (24) from city area on Public Private Partnership mode for 30 years.

- AMC has allotted 5 acres land for processing plant. It will be operational in October, 2013 & going to make bricks, tiles & other materials from such waste.

- AMC will get 2.5% royalty on sale value.
Waste to Energy

AMC has received various offers from experienced Companies for processing MSW on PPP mode. AMC has awarded consultancy to Deloitte Touche Tohmatsu India Pvt. Ltd. for Technical, Commercial and Financial Evaluation. The selection process has been completed, two companies have been awarded work for solid waste processing 1000 tons each on a daily basis for 29 years. Agreement has signed and land is allotted to them.

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Daily Treatment</th>
<th>Work Given</th>
<th>MSW converting into</th>
<th>Land Given (Acres)</th>
<th>Agreement Period</th>
<th>Technology Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Abellon Clean Energy Ltd.</td>
<td>1000 Tons</td>
<td>2012</td>
<td>Electricity</td>
<td>13</td>
<td>29 Years</td>
<td>Use European technology and follow European Emission Standards.</td>
</tr>
<tr>
<td>7. A2Z Infrastructure Limited</td>
<td>1000 Tons</td>
<td>2012</td>
<td>Compost and RDF/ Pellets &amp; Fluff</td>
<td>25</td>
<td>29 Years</td>
<td>Multi Product Integrated Technology</td>
</tr>
</tbody>
</table>
Collection, Transportation & Safe disposal of Bio Medical Waste and Hotel / Kitchen Biodegradable Waste

Disposal of Municipal Bio Medical Waste

AMC has contracted the daily collection and transportation of AMC generated bio-medical waste from 4 municipal hospitals, 2 referral hospitals, 64 urban health centers to the incineration plant. The contracts have been given to state pollution control board approved and authorized contractors.

Segregated collection of kitchen waste from Hotels and Restaurants

For collection, transportation and disposal of kitchen waste from hotels and restaurants, AMC has contracted with two agencies. (no cost to AMC, direct charging from generators) Waste collected from such units is transported to composting plant. Currently, more than 1100 units are covered through this system since 2008 and daily average 80 metric tons waste is collected and converted into compost. In future, planning to convert into Gas / Electricity by bio-methanation.
Collection, Transportation & Safe disposal of e - waste & Carcass Waste (under planning)

**e-waste Management**

For effective implementation of e-waste (Management and Handling) Rules, 2011 in Ahmedabad, AMC in coordination with GPCB and with the help of Corporate Sector is planning to establish collection centers for e-waste collection, safe transportation and safe storage / disposal. Consultant firm (Ernst & Young) has prepared a competitive bid document on PPP basis and it is floated now for bidding. Selection process will be finalized in May, 2013.

**Scientific and safe disposal of Carcasses of Animals & Waste from Slaughter House, Fish Market, Meat Market etc.**

AMC is in the process of issuing a competitive Bid for Design, Construction, Operation & Maintenance of a daily 10-15 tons processing plant on Public Private Partnership mode for 30 years with the help of Consultant firm (Ernst & Young) for exploring best suitable technology.
Decentralized Model for Biodegradable waste:

Effective Utilization of Garden / Hotel Kitchen Waste

- AMC started a Pilot Project on Sep 11. Daily Garden, Hotel Kitchen and other Green waste is converted into Organic Manure on PPP mode. A machine with the capacity of converting 200 kgs bio-degradable waste into compost has been put on experimental basis for 60 days to observe the process and effectiveness of the machine. Such small project to convert biodegradable waste to compost is useful for residential societies, big hotels, canteens, etc.

- Recently AMC has awarded work for design, built, operate and transfer of 2 bio-degradable waste convertor machines, each has a capacity of 1 metric ton, at Zoo and at Victoria Garden which will be operational in October, 2013.

- AMC is planning to set up a bio-degradable waste convertor machine / bio gas plant at fruit market for converting 8 to 10 metric tons on a daily basis.
AMC owns nine sewage treatment plants with total installed capacity of 1075 MLD.

Out of nine, two plants are generating Biogas with total 20,000 m³ per day.

Total potential gas output for sale from STPs (720 MLD in recent future) is 50,000 m³ per day.

This biogas can be utilized for various thermal applications through energy generation, including conversion into CNG and sale.
106 MLD UASB type STP

- This plant is generating 10,000 m3/day of biogas.
- Expression of Interest was floated for converting this biogas to electricity through biogas engine.
- Through this project, there is a potential of generating 18,000 kWh per day which will be utilized for making plant self-sufficient in terms of electricity.
Use of Hydropower Screw Generator at 106 MLD STP

- Hydropower Screw Generator can be utilized to generate electricity at the place where head of more than 1 meter and min. Flow of 0.1 m$^3$/sec.
- At 106 MLD STP, head of 3 meter and 4.5 meter are available where this hydropower screw generator of about 20-30 kW can be installed.
- Tender was floated for this and electricity generation potential is around 2.5 lakh kWh per year.
180 MLD ASP type STP

• This plant is generating 10,000 m3/day of biogas.

• Expression of Interest was floated for utilization of this biogas.

• Ten parties were participated in the EOI process and RFP has been issued to these parties for technical and financial offer

• Technologies offered by parties for biogas utilization are
  — Electricity generation through biogas engine
  — Electricity generation through micro-turbine
  — Biogas purification, compression and bottling (CBG)
  — Supply of purified biogas to PNG lines
  — Produce Hythane and use it in automobiles in place of CNG
Secured Engineered Landfill Site

Disposal of Inert Solid Waste- Secured Engineered Landfill Site
(Operational Since 14.10.2009)

Capacity:

11.50 Lakh Metric Tones
(i.e. 1.15 million tons)

Total construction cost of the site:

Rs. 13 Crore

Area: 12.88 Hectares
(32.8271 acres)
Project for Awareness

Started a Project for IEC (Information, Education, Communication) Activities and Awareness Generation among the General Public Towards Cleanliness, Waste Treatment & Waste Disposal

- To form Participatory Committees and conduct Group meetings in the Wards
- Publicity through Television Channels / Local Cable Network
- Advertisement in Newspapers
- Preparation & Distribution of pamphlets
- Preparation & Erecting of Banners
- Preparation & Exhibiting of Awareness Creation slides in Cinema Theatres
- Conducting Street plays
- Organizing of rally involving School & College students
- Imparting Awareness training to Municipal staff and Councilors
- Conducting miscellaneous events
Mobile Court Initiative for Littering & Nuisance

AMC launched country’s first Sanitation Mobile Court on 4th June, 2009 dedicated to contain littering.

1,23,116 cases have been registered and Rs. 4.81 Crore penalty levied from such offenders.
Preparation of Public Health Byelaws

• Classification of waste in 25 categories
• Generators of waste based on their type, 21 categories
• Segregation of waste
• Storage of waste
• Delivery & collection of waste
• Processing & disposal of waste
• Liquid Waste Management
• Prevention of Waterborne, Vector borne and Food borne diseases
• Offences under the bye-laws
• General offenses which is applicable to all the citizens within city limit, (23 in number)
• Enforcement of the provisions
• Schedule of Fines

The byelaws are approved by the Standing Committee and the Municipal Board recently and now under the process of inviting public opinion / suggestions / objections for 60 days.
AMC participated at the Special Event of ISWA World Congress 2011 and agreed on the “Declaration for Zero Waste Ahmedabad” by 2031. AMC has signed a Memorandum of Understanding with UNCRD (United Nations Center for Regional Development, Japan) which is providing technical assistance for developing a “Roadmap for Zero Waste Ahmedabad by 2031”. For this initiative, AMC had a detailed Multi-stake holders' consultation meetings with the help and support from UNCRD Japan and Zero Waste South Australia.
From this potential technical support from UNCRD in developing a “Road Map for Zero Waste Ahmedabad”, AMC will move forward for increasing resource efficiency and reduction of waste, development and implementation of policies for resource efficiency and environmentally sound waste management, development and enforcement of policies, strategies, laws, regulations and also involve continued, new & innovative public-private partnerships among industry, governments, academia and other non-governmental stakeholders aiming to enhance capacity and technology.

This road map contains Ten focus areas which contains 34 Strategic Actions
1. Environmental Protection
2. Health and Safety standards
3. Dedicated Institutional Structures & Governance arrangements
4. Community awareness & ownership
5. Segregation of waste streams
6. Partnerships & Collaborations
7. Sustainable innovative Infrastructure & Technologies
8. Education & Awareness at all levels
9. Investment in 3R Infrastructure (Eco-Towns, Science Parks, Eco-Industrial Zones)
10. Implementation & Systematic Review Process
The Zero Waste concept for Ahmedabad will serve as catalyst for policy changes at National level in realizing resource efficient and zero waste societies in India.

**Hon. Minister for Urban Development, Government of Gujarat** released the roadmap on 12\textsuperscript{th} Jan 2013.

**Download document at:**

Thank You

Dr. Guruprasad Mohapatra, I.A.S.
Municipal Commissioner
Ahmedabad Municipal Corporation

For further information:
visit www.egovamc.com/downloads//Downloads.aspx
Waste to Energy Technology
Planning Commission 1.8.2013
Waste Management Association
Municipal Solid Waste (MSW) has 3 main components.

- Biodegradable matter (green and food waste): 45–50%
- Combustible matter or Refuse Derived Fuel (RDF) (plastic, cloth, paper, woody mass): 20%
- Recyclables (metal, containers etc): 5%
- Inerts/Rejects (post removal of recyclables): 20–25%
## Processing of MSW

<table>
<thead>
<tr>
<th>Component</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodegradable matter</td>
<td>Composting or Biomethanation</td>
</tr>
<tr>
<td>Combustible matter or RDF</td>
<td>Combustion as fuel in a Cement Plant or for production of power in a Waste to Energy plant</td>
</tr>
<tr>
<td>Inerts/ Rejects</td>
<td>Sanitary Landfill</td>
</tr>
</tbody>
</table>
Integrated Approach to Processing MSW

- Processing different components in the MSW stream separately is the best in terms of the usefulness of the by products produced from the waste
  - The Compost produced is an organic fertilizer
    - The organic carbon and micronutrients in Compost are extremely beneficial for soil
    - Burning of wet organic waste does not deliver the required heating value while the nutrients in such waste are lost in the combustion process.
  - The RDF is best used as an alternative fuel
  - The Construction and Demolition (C&D) waste can be converted to useful products.
    - Separate collection and processing of C&D waste is important as otherwise it is mixed with the MSW.
    - Fine residues from such waste cover the combustibles and inhibit combustion in waste to energy facilities as has been borne out by actual experience.
- This approach also lowers the total cost of processing both in terms of capital and operational costs and is most suitable for a country like India.
Integrated Waste Management by Processing Waste

Waste Processing Cycle

Input | Outputs from Processing | Rejects

MSW

Useful Products

- **Compost**
  - bio-degradable waste (food waste, green waste, etc)
  - 15

- **RDF**
  - RDF comprises of Rags, woody mass, paper, plastic etc.
  - 20

- **Recyclables**
  - Glass, Metal etc.
  - 5

- **Moisture (evaporates)**
  - 40

- **Rejects**
  - 20

Rejects are essentially soil and silt

Processing can reduce waste disposal by 80% reducing pressure on scarce land

Source: Internal Estimates
Cost of Processing

- The cost of treatment varies significantly with the treatment. Composting along with sale of RDF to nearby cement plants has the lowest costs. Treatment through Waste to Energy has the highest costs.

- Keeping on mind the overall economics and requirement of land for processing MSW the following grid is recommended based on size of plant. Smaller municipalities normally need a lower cost model.

<table>
<thead>
<tr>
<th>Input Waste (tonnes/day)</th>
<th>Composting/Biomethanation and RDF</th>
<th>Waste to Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 500</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>500 - 1000</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1000 +</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Capital and Operating Costs*

- Composting 100 Tonnes per day facility
  - Capital Cost Rs 6.5 crores
  - Operating Cost Rs 3500/ tonne of Compost Produced

- Composting and RDF 100 tonnes per day
  - Capital Costs Rs 10 crores
  - Operating Cost Rs 3500/ tonne of Compost Produced and Rs 3000/ tonne of RDF produced

- Waste to Energy 1000 tonnes per day facility
  - Capital Cost Rs 180 –200 crores
  - Operating Cost Rs 12/KWh electricity produced

*Note: *Inclusive of profit margin to provide 16% Post Tax Project IRR
Incentives Requested

- **Union Budget 2013**: Government will support municipalities that implement waste-to-energy projects, through different instruments like viability gap funding, repayable grant and low-cost capital.

- NCEF funding to include clean energy through waste to energy projects. Modalities of accessing this 15000 crores corpus for financing WtE projects needs to be defined clearly.

- Output Based Incentives for Compliant Operations preferred as this will ensure processing and because municipalities are unable to afford tipping fee:
  - Support for RDF of Rs 1000/ tonne
  - Support for Compost of Rs 2600/ tonne
  - Electricity Price of Rs 12/ unit

- Tax concessions (Excise/ VAT) on products such as RDF, C&D products. Delhi Government has set an example by removing VAT.

- The existing facilities already set up would also need such incentives.
## Technology Options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Waste Treatment Method</th>
<th>Basic Principle</th>
<th>Desirable range of important waste parameters</th>
</tr>
</thead>
</table>
| 1.     | Thermo-chemical conversion: | Decomposition of organic matter by action of heat | Moisture < 45%  
Organic/VM > 40%  
Fixed Carbon < 15%  
Total inert < 35%  
CV (Net) > 1200 Kcal/Kg |
| A. Incineration | | | |
| B. Pyrolysis | | | |
| C. Gasification | | | |
| 2.     | Bio-chemical conversion: | Decomposition of organic matter by microbial action | Moisture > 50%  
Organic/VM > 40%  
C/N ratio 25–30 |
| Anaerobic digestion/ Bio-methanation | | | |
## WtE Technologies

- **Advantages & disadvantages of various technology options**

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| 1.     | Incineration | - Most suitable for high Calorific Value waste.  
- Units with continuous feed and high through-put can be set up.  
- Thermal Energy recovery for direct heating or power generation.  
- Relatively noiseless and odourless.  
- Low land area requirement. | - Least suitable for aqueous/ high moisture content/ low Calorific Value and chlorinated waste.  
- Excessive moisture and inert content affects net energy recovery; auxiliary fuel support may be required to sustain combustion  
- Concern for toxic metals that may concentrate in ash; emission of SPM, SOx, NOx, chlorinated compounds, ranging from HCl to Dioxins |
## Perceived Advantages & disadvantages of various technology options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Pyrolysis / Gasification</td>
<td>Production of fuel gas/oil, which can be used for a variety of applications</td>
<td>Net energy recovery may suffer in case of wastes with excessive moisture and inerts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compared to incineration, control of atmospheric pollution can be dealt with in a superior way, in techno–economic sense.</td>
<td>If syngas is eventually combusted, dioxins, furans and NOX are still an issue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Syngas is easier to handle, meter and control than MSW</td>
<td>syngas is highly toxic and explosive → safety issues</td>
</tr>
</tbody>
</table>
## Perceived Advantages & disadvantages of various technology options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pyrolysis/Gasification</td>
<td>Homogenous, gas–phase combustion of syngas is easier and can be better controlled</td>
<td>Two–step conversion (gasification + syngas combustion/conversion)–&gt; complexity, cost and reliability issues</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gasification at high pressure enhances the opportunities to increase energy conversion efficiency and reduce costs</td>
<td>Pressurized waste gasification poses formidable challenges and has not been attempted by any technology developer</td>
</tr>
</tbody>
</table>
### Perceived Advantages & disadvantages of various technology options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
|        | Pyrolysis/Gasification    | Syngas can be used, after proper treatment, in highly efficient internally-fired cycles (gas turbines, combined cycles, Otto engines)                                                                | a) Syngas treatment is complex and costly  
b) Due to losses in gasification and syngas clean-up, energy conversion efficiency is low  
c) At the small scale relevant to waste treatment, efficiency of internally-fired cycles is low    |
## Perceived Advantages & disadvantages of various technology options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Anaerobic Digestion</td>
<td>Energy recovery with production of high grade soil conditioner. Less power requirement unlike aerobic composting, where sieving and turning of waste pile of supply of oxygen is necessary. Enclosed system enables all the gas produced to be collected for use.</td>
<td>Heat released is less—resulting in lower and less effective destruction of pathogenic organism than in aerobic composting. However, now thermophilic temperature systems are also available to take care of this. Unsuitable for wastes containing less organic matter</td>
</tr>
</tbody>
</table>
## WtE Technologies

- Perceived Advantages & disadvantages of various technology options

<table>
<thead>
<tr>
<th>Ser No</th>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anaerobic Digestion</td>
<td>Control green house gases emissions</td>
<td>Requires waste segregation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Free from bad odour, rodent and fly menace, visible pollution and social resistance. Modular construction of plant and closed treatment needs less land area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Net positive environmental gains.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can be done at small scale.</td>
<td></td>
</tr>
</tbody>
</table>
**WtE Technologies**

- **Waste disposal Vs energy production**

<table>
<thead>
<tr>
<th></th>
<th>In WtE Plants</th>
<th>In Thermal Power Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale of operations</strong></td>
<td>WtE Projects are smaller, say 3 to 24 MW, resulting in higher per MW cost</td>
<td>Thermal power plants are bigger, say 100 to 2100 MW. Higher the power generation, economies of scale reduces per MW cost</td>
</tr>
<tr>
<td><strong>Fuel Preparation</strong></td>
<td>Full scale pre-processing plant for conversion of MSW into RDF involves higher capital cost. For 1300 TPD MSW to 12 MW power plant it works out to approx 75-100 Cr</td>
<td>Coal Handling Plant (CHP), even a small 25 MW thermal power plant CHP costs approx Rs 3 Cr. Bigger the power plant more economical is the CHP</td>
</tr>
</tbody>
</table>
Waste disposal Vs energy production

<table>
<thead>
<tr>
<th></th>
<th>In WtE Plants</th>
<th>In Thermal Power Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manpower to operate</td>
<td>RDF Plant is manpower intensive, approx 50–60 persons per shift</td>
<td>CHP requires only 4–5 persons to operate in each shift</td>
</tr>
<tr>
<td>Corrosive nature of fuel</td>
<td>RDF being corrosive in nature, equipment used in pre-processing has only 7 years life and needs to be replaced after that</td>
<td>Equipment used in CHP has much longer life, approx 15–20 years.</td>
</tr>
<tr>
<td>Water Treatment Plant (WTP)</td>
<td>Treated sewage water with high TDS results in low CoC (1.5–2), and hence more water requirement. This results in higher cost of WTP</td>
<td>Not so in case of Thermal plant. It is usual to take 6–7 CoC, which reduces water requirement</td>
</tr>
</tbody>
</table>
## WtE Technologies

- **Waste disposal Vs energy production**

<table>
<thead>
<tr>
<th>In WtE Plants</th>
<th>In Thermal Power Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boiler</strong></td>
<td></td>
</tr>
<tr>
<td>RDF being low density fuel, generates more fly ash during combustion. Fly ash acts as catalyst for de–novo synthesis (at 200–450 degrees) for production of dioxins &amp; Furans. In order to reduce formation of dioxin &amp; furan, it is imperative that maximum fly ash is removed before gases cool to the range of 200–450 degrees. This requires multiple pass (tripple) in radiative section of boiler. This results in much bigger boiler for WtE plants.</td>
<td>In thermal plants boilers are single pass boilers, much smaller in size.</td>
</tr>
</tbody>
</table>

A 12 MW WtE boiler weighs around 2600 tonnes, which is 58 TPH. Similar weight boiler in thermal power plant will be roughly 180 TPH, producing approx 35 MW power.
Waste disposal Vs energy production

<table>
<thead>
<tr>
<th></th>
<th>In WtE Plants</th>
<th>In Thermal Power Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flue Gas Treatment</strong></td>
<td>In WtE Plants Flue Gases have many contaminants which need to be treated before discharge in stack. Roughly it requires Rs 1.5 to 2 Cr per MW for Flue Gas Treatment.</td>
<td>Thermal power plants have ESP. ESP for approx 20 MW power plant will cost around Rs 2.5 Cr</td>
</tr>
</tbody>
</table>
Therefore we cannot compare cost of power generation from thermal power plants, which are set up for power generation purpose only with the cost of WtE plants. WtE Plants are primarily for scientific disposal of waste, power generation is an added advantage.

In view of aforementioned facts WtE Projects require support in terms of tariff/support price of RDF. Preferred option is output based support.
WtE Technologies

- Best technology should fulfill following criterion:
  - Lowest life cycle cost
  - Need least land area
  - Limited air and land pollution
  - Produce more power with less waste
  - Cause maximum volume reduction for lower landfill space

- Any one technology may not satisfy all of the above criterion; we need to identify best compromise.
Thank you
Waste to Energy
-Opportunities and Challenges

Presented at Planning Commission of India, 14th October 2013
-Dr. Amiya Kumar Sahu
-(President – National Solid Waste Association of India)
Types of Waste

- Municipal Waste: 60 million T/day
- Industrial Waste: 7.90 million T/day
- Biomedical Waste: 415 T/day
Types of Processes

- Incineration
- Pyrolysis
- Gasification
- Anaerobic digestion
- Landfill Gas recovery
• Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.

• Incineration of waste materials converts the waste into ash, flue gas, and heat.

• The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas.

• The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere.

• The heat generated by incineration can be used to generate electric power.

• Incineration with energy recovery is one of several waste-to-energy (WtE) technologies.
• Minimum temperature of at least 850 C (1,560 F).

• Gaseous emissions in the flue gas includes NOx, SOx, HCl, heavy metals, and fine particles.

• Flue gas cleaning system.

• Air pollution control devices such as Scrubbers, ESP, Bag house filters.
• Pyrolysis is a thermo chemical decomposition of organic material at elevated temperatures (200-300\(^{0}\)C) in the absence of oxygen (or any halogen). It involves the simultaneous change of chemical composition and physical phase, and is irreversible.

• Pyrolysis is endothermic process.
Gasification

- Gasification is a process that converts organic or fossil based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide.

- This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas.

- Biodegradable Waste can also be used to generate energy.
Anaerobic Digestion

• Anaerobic digestion is a series of biological processes by which microorganisms break down biodegradable material in the absence of oxygen.

• The process is used for industrial or domestic purposes to manage waste and/or to produce fuels.

• The process produces a biogas, consisting of methane, carbon dioxide and traces of other ‘contaminant’ gases.

• This biogas can be used directly as fuel or combusted to generate electricity and heat in combined heat and power gas engines or upgraded to natural gas-quality biomethane.
Landfill Gas

• Landfill gas production results from chemical reactions and microbes acting upon the waste as the putriscible materials begins to break down in the landfill.

• Due to the continual production of landfill gas, the increase in pressure within the landfill causes the gas's release into the atmosphere.
Present status in India

Incineration

All failed in India till date not because of the process but because of the following reasons:

a. High capital cost
b. Lack of professionalism
c. Lack of training to the operator
d. Lack of technical availability in construction of Incinerator. The concept itself is misused. Furnaces with simple Flue gas cleaning system is a disaster.

However it is the only alternative process in the urban areas to manage waste in a high tech professional way.

Advantages:

i. It saves space required for Landfill areas and occupies less area.
ii. Waste no longer visible on road and prevents nuisance generated by it.
iii. It recovers energy depending on the Calorific value of the input waste material.
iv. Dry waste can be separated from the mixed waste and can be converted into RDF (Refused derived fuel) which is ultimately used as fuel.
v. RDF should be sent to cement plants and it should be made mandatory for cement plants to use RDF as source of fuel instead of coal as it is done in Israel.
An Gasification plant in Ranjangaon built by Hightech engineers in Solapur is currently non-functional.
Anaerobic Digestion

- Number of trial and errors – few success
- Suitable for food, vegetable, agro and separated biodegradable waste
- It is viable in large scale, 50T/day which can generate 5MW of energy
- The organic wet waste has to be separated from Dry waste
- The liquid waste is converted into Biogas
- This Biogas can be supplied to Industries.

Failure project in Deonar - a.) UPL  
b.) Ramky
Landfill Gas Recovery

- Old Waste dump yards by capping method.

Eg of failure projects

1. Gorai dump in Mumbai
2. Kanjurmarg - Anthony Lara
3. Deonar - a.) UPL
   b.) Ramky
4. Coimbatore

- The new Secured Landfill sites
  i. It requires huge area for landfill in the urban cities which is not affordable.
  ii. Lack of professional skills
  iii. Socio political issues
  iv. High capital cost
  v. After closure of the land the space is not useful for any economic development.
  vi. Logistic issues.
Failure Projects in India

Failure stories in various Waste to energy projects such as Incineration, Gasification, Anaerobic Digestion and Land fill gas recovery

1. Hyderabad
2. Taloja – Mumbai
3. Vijaywada (SELCO)
4. Lucknow – discontinued
5. Okhla – Not successful (Jindal)
6. Deonar – a.) ULP
   b.) Ramky
Things to be done

• Awareness and Education

• Segregation bins at all stages. 
  Household to community even at dumpsite.

• Capacity Building at Waste Management

• Tipping fees is must
• India needs technologists in Waste to Energy instead of academicians / scientists for practical advice.

• Technologists will provide cost-effective and viable project to suit in India. It may be indigenous / and from other developing countries like South Korea, Malaysians, China etc.
Thank You!

NATIONAL SOLID WASTE ASSOCIATION OF INDIA
REGISTRED UNDER THE SOCIETIES REGISTRATION ACT, 1860)
BOM 137/199GBBSD

B-703, Customs Colony ‘A’,
Military Road Marol, Andheri (E),
Mumbai- 400 059
Ph: 91-22-2920 2951
Website: www.nswai.org, E- mail: nswai-env@nic.in
nswaindia@gmail.com
De-centralized Waste Management

Sustainable Path to a Cleaner future

Ashwin C Shroff

October 14, 2013
About Excel

• Committed to the cause of Municipal Solid Waste Management for over 25 years in India

• Pioneers of Centralized MSW Composting

• Provided Composting Technology for over 12 plants across India of capacities between 300 TPD to 700 TPD

• Now providing de-centralized Solid Waste Management solutions using Organic Waste Converters

• Also providing de-centralized Waste Water Treatment solution using Bio Filter developed by its sister company Transchem Agritech

www.excelind.co.in
Commitment to Sustainable Development

- Solid & Liquid Waste Management
- Organic Agriculture, Certification, Contract Farming
- Integrated Crop Management
- Soil and Nutrient Management
- Watershed Development
- Wasteland Development
Learnings and Observations

• Real solution to the menace of garbage in India – segregation and treatment of waste at source

• Better recovery of all components of waste if treated in de-centralized manner

• Not much has changed since MSW Rules 2000 to Draft MSW Rules 2013

• Little to no mention of de-centralized waste management

• JNNURM funding not clearly focused on funding de-centralized SWM Projects
Can De-centralized SWM really work?

Reduced load to the Landfill site

Community Engagement

Productive work for the Urban Poor

YES
A True Sustainable Solution

- Revenue
- Material Recovery at less cost
- Reduction on Environmental Load

- Savings in Transport Cost, Treatment Cost and Need for Landfill by AT-SOURCE treatment
# Case for De-centralized SWM

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Waste Generated in India per annum</td>
<td>60 Million Tons</td>
</tr>
<tr>
<td>Average % of Waste Treated</td>
<td>9%</td>
</tr>
<tr>
<td>Average % of Organic Waste</td>
<td>60%</td>
</tr>
<tr>
<td>Per Capita Capital Investment for SWM</td>
<td>Rs 391</td>
</tr>
<tr>
<td>Annual Per Capita Operations and Maintenance Cost for SWM</td>
<td>Rs 155</td>
</tr>
<tr>
<td>Amount proposed to be earmarked for SWM over 20 years</td>
<td>Rs 48,582 Cr</td>
</tr>
<tr>
<td>Number of large and small cities in India</td>
<td>5191</td>
</tr>
</tbody>
</table>

Source: Report on Indian Urban Infrastructure and Services, March 2011

If 5% of the above fund is mandated to be earmarked for de-centralized waste treatment and made available to ULB’s, the percentage of waste treated will at least double.
Case for de-centralized SWM

• More than 60% of the 5,161 cities in India below population of 1 Lac

• Large Waste – to – Energy Plants good, but not economically viable for small cities and towns

• De-centralized Waste Management should be integral in the overall waste management strategy of large cities

• De-centralized Waste Management feasible for (commercial) bulk waste generators
“The Large Plant Operators tell me that I must club at least 4 cities of our size and then put a combined Waste to Energy Plant”

Gangtok Municipal Commissioner

“The Centralized Plant Operator is refusing to accept organic waste at their site as it hampers the production of RDF. What do I do?”

Chandigarh Dy Municipal Commissioner

“We take pride in being the only city in India without a landfill. We use Organic Waste Converter for our city and are very happy”

Commissioner – City Corporation of Panjim

“We show our SWM initiatives to most ULB’s who visit us and they are the most amazed to see how easy it is to treat vegetable market waste on a de-centralized level”

Dy Commissioner Pune
## OWC for ULB’s

<table>
<thead>
<tr>
<th>State</th>
<th>Cities</th>
<th>Capacities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharashtra</td>
<td>Pune</td>
<td>2 TPD</td>
</tr>
<tr>
<td>Goa</td>
<td>Panjim, Mhapusa, Ponda, Porvarim, Calangute, Nuvem</td>
<td>2 TPD to 6 TPD</td>
</tr>
<tr>
<td>Karnataka</td>
<td>Bengaluru</td>
<td>1 to 2 TPD</td>
</tr>
<tr>
<td>Kerala</td>
<td>Trissur, Thiruvananthpuram</td>
<td>1 TPD to 4 TPD</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>Eluru, Kakinada</td>
<td>1 TPD, 1 TPD</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>Dehradun, Haridwar, Rudrapur, Kashipur, Haldwani, Roorkee</td>
<td>5 TPD, 10 TPD and 20 TPD</td>
</tr>
<tr>
<td>Sikkim</td>
<td>Mangan</td>
<td>0.5 TPD</td>
</tr>
</tbody>
</table>
OWC for Bulk Waste Generators

- Realty: 250
- Industrial Canteens: 150
- Hotels: 100
- Institutions and PSU: 50
- APMC: 25
- Municipal Corporations: 25
- Others (Temples, hospitals, ...): 25

www.excelind.co.in
Our Proposal to Planning Commission

• Encourage de-centralized Waste Management for small cities and hilly states with population less than 1 Lac

• Allocate a dedicated viability gap funding vehicle for implementation of de-centralized Waste Management projects in the country

• Facilitate financial incentives for Bulk Waste Generators treating waste at source of generation
An Introduction to Organic Waste Converter (OWC)

1. Organic MSW
2. OWC Treatment (15 mins)
3. Raw Compost
4. On-site Curing System
5. Matured Compost
OWC60 ~ Shredder ~ Curing System 100kg per day / 100 households
Closing the Loop with Urban Agriculture

Food – Waste – Compost - Food

Dhaniya in single pot

Green chilly in a pot

Mint in hanging basket

Dhaniya, Palak in bamboo basket
Introduction to Garden Waste Pelletizer

Organic Garden Waste → Dryer → Crusher → Blender → Densification → Fuel Pellets → Green Coal

Utilization

www.excelind.co.in
Closing the Loop with Compost Pellets
Waste – To - Energy

- Raw Compost generated from OWC to be pelletized using a Pelletizing Machine
- The Pellets have a good calorific value
- The Pellets to be used for Industrial Boiling or for domestic cooking and heating purpose
De-centralized Bio Filter Technology

Conventional STP/ETP (Activated Sludge Process)

Bio-filtration Technology
MODULAR BIOFILTER PLANT – 25KLD
Excel’s Reputed Clientele
Excel’s Reputed Clientele
WHAT COLOUR IS YOUR GARBAGE?
TOGETHER WE CAN TURN IT GREEN.

PRESENTING THE ORGANIC WASTE CONVERTER FROM EXCEL.

Want to enhance your Green Quotient? We can show you how. Our Organic Waste Converter (OWC) transforms organic waste into odour-free flowable, homogenised raw compost in 15 to 20 minutes. When this is cured further, it gives nutrient-rich, soil enhancing compost which can be used to create terrace gardens, organic kitchen gardens and landscaping—right in the heart of the city! Together, we can create a cleaner, greener, healthier environment. That’s what responsible corporate citizens do.


Excel Industries Ltd.
Ph.: 022 66464209 | Email: owc@excelind.com | http://www.excelind.co.in
Thank You

ENVIＲON & BIOTECH DIVISION
EXCEL INDUSTRIES LIMITED
184-87, S V ROAD, JOＧESHWARI WEST
MUMBAI 400 102 – INDIA
TEL: +91 22 6646 4200

www.excelind.co.in
Features

- Salient information of S.W.M. of Kolkata
- M.S.W. Characteristics
- Waste flow chart
- Current activities in primary collection system
- Segregation at source in two bin system
- Current activities in transportation system
- Stationary Compactors
- Features
- Advantages of Stationary Compactors
- Modern scientific waste compactor station at Southern Avenue
Contd......

- Different processes of collection of solid waste
- Function of compactor
- Transportation and disposal of solid waste
- Conventional method vis-à-vis stationary compactors
- Specification of portable compactors
- Specification of prime movers
- Estimated cost for portable compactor and prime mover
- Estimated cost for modern scientific waste compactor stations
Contd......

- Current activities in disposal system
- Composting plant
- Proposed sanitary landfill site of K.M.C. at Dhapa
- Waste to Energy – Feasibility study
- Proposed sanitary landfill facility
- Closing one dump site at Dhapa and CDM benefit
- Key Challenges
- Way Forward
## Salient information of SWM of Kolkata

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area in square km.</td>
<td>187.33 Sq. Km.</td>
</tr>
<tr>
<td>Population</td>
<td>46 lakhs + 60 lakhs (floating)</td>
</tr>
<tr>
<td>Population living in slums and urban poor</td>
<td>20 Lakhs</td>
</tr>
<tr>
<td>No. of boroughs</td>
<td>15</td>
</tr>
<tr>
<td>No. of wards</td>
<td>141</td>
</tr>
<tr>
<td>Qty. of solid waste generated per capita per day</td>
<td>450 gm.(approx.)</td>
</tr>
<tr>
<td>Total quantity of solid waste generated per day</td>
<td>4000 M.T.(avg.)</td>
</tr>
<tr>
<td>Total no. of community bins/vats</td>
<td>650</td>
</tr>
<tr>
<td>No. of vehicles used</td>
<td>340 (avg.)</td>
</tr>
<tr>
<td>Total no. of trips per day</td>
<td>880 (avg.)</td>
</tr>
<tr>
<td>Total quantity of waste disposed off daily</td>
<td>3800 M.T.(avg.)</td>
</tr>
<tr>
<td>No. of landfill sites &amp; areas</td>
<td>Dhapa (35 ha.) Garden Reach (3.22 ha.)</td>
</tr>
<tr>
<td>Avg. distance of landfill site</td>
<td>20 km</td>
</tr>
<tr>
<td>Total strength of S.W.M. staff (including contractual)</td>
<td>15000 (approx.)</td>
</tr>
</tbody>
</table>
### MSW Characteristics

<table>
<thead>
<tr>
<th>PHYSICAL COMPOSITION</th>
<th>CHEMICAL COMPOSITION</th>
<th>VALUES IN % EXCEPT pH, C/N RATIO &amp; CALORIFIC VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARAMETERS</strong></td>
<td><strong>VALUES IN %</strong></td>
<td><strong>PARAMETERS</strong></td>
</tr>
<tr>
<td>PAPER</td>
<td>6.43</td>
<td>MOISTURE</td>
</tr>
<tr>
<td>TEXTILE</td>
<td>0.35</td>
<td>ORGANIC MATTER</td>
</tr>
<tr>
<td>PLASTICS</td>
<td>5.0</td>
<td>pH</td>
</tr>
<tr>
<td>GLASS</td>
<td>0.94</td>
<td>CARBON</td>
</tr>
<tr>
<td>METALS</td>
<td>0.8</td>
<td>NITROGEN</td>
</tr>
<tr>
<td>COMPOSTABLE MATTER</td>
<td>32.58</td>
<td>PHOSPHOROUS AS P₂O₅</td>
</tr>
<tr>
<td>OTHER WASTE (INCLUDING INERT)</td>
<td>53.90</td>
<td>POTASSIUM AS K₂O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C/N RATIO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CALORIFIC VALUE (K.CAL./KG)</td>
</tr>
</tbody>
</table>
Current activities in Primary Collection System

- Door – to – door collection : 75%
- Other Method of collection : 25%
  (street sweeping, Direct loading collection, etc)
- Only 10% of total primary collection is privatized
- To improve the air quality, K.M.C. has inducted 12 mechanical sweepers of highest quality to sweep the streets of Kolkata.

<table>
<thead>
<tr>
<th>Nos.</th>
<th>Capacity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6 Cu.M.</td>
<td>1.25 crores each incl’d. some spares</td>
</tr>
<tr>
<td>9</td>
<td>4.5 Cu.M.</td>
<td>0.75 crores each incl’d. some spares</td>
</tr>
</tbody>
</table>

- For improvement of primary collection of waste, KMC has taken up a program for introduction of battery operated vehicles in addition to push carts and trash bins.
Segregation of waste at source in 2 bin system

- Source segregation already started initially in 7 wards and to be introduced in 141 wards gradually

- Two bins – one for sorting recyclable wastes like paper, plastic, rubber etc. and other for sorting bio-degradable waste
  - Bio-degradable wastes will be collected by K.M.C mazdoors and disposed at Dhapa landfill site / Compost Plant.
  - Recyclable materials will be collected separately and sent to recyclable units directly by the private contractors / N.G.O.s.
Current status in transportation system

- 60% of waste carried by private vehicles (only manual loading) and 40% by departmental vehicles (manual and mechanical loading)

- 105 Departmental Vehicles run along with 3 Dozers, 8 Pay Loaders, 20 Street watering and washing vehicles, 12 Mechanical Sweepers and 250 Private Vehicles

- 78 sites are planned for setting up of stationary compactors and movable compactors
Mechanical Sweeper

Cleaning Width – 2.6 m.

Cleaning Width – 1.8 m.

Average cleaning speed 10 km. / hour
Street Watering & Washing Vehicles

10 KL. Capacity

8 KL. Capacity
Stationary / Portable Compactor

- It is the most efficient way of collecting, compacting & transporting Waste in Urban Cities.

- When coupled with Hook Loaders, it provides high transport efficiency with low cost.

- With Stationary Compactors, waste can be kept closed during collection and transportation without smoke, dust, sewage leakage or other visual pollution.

- These Compactors use clean electricity as power, which is environmental friendly, economic and pollution-free.
Features

- Portable Compactors can easily be transportable and positioned at any place for refuse collection, compaction & transportation
- Compactors are placed in Waste Compactor Stations related to amount of Garbage generation in the locality
- The precise scissor shaped crusher and precise compaction housing are made of high tensile steel to ensure the lifetime of compactors in severe working condition
Contd......

- Small installation space requirement, simple fundamental construction requirements
- With the intelligent electronic key; only authorized personnel can operate and repair the Compactors
- Conical shaped container ensures an easier discharging of all refuse after compaction
- The patented locking system ensures that no secondary pollution will happen during transport
- Portable Compactors are offered with Tip Cart mechanism to meet the present working system to the best of possibility. These are suitable for manual feeding, wheel barrow feeding and feeding by small 1-2 cum auto tippers
The rib less and thus smooth side-walls of the Container gives a modern appearance for city management drives and even advertisements.

Many messages can be displayed at the LCD screen including volume of waste, operation of the compactor and solutions to the malfunctions.

High compaction force, high waste breaking capacity.

Short cycle time, big compaction chamber, high efficient compaction, high capacity at waste peak time.

Fully automatic operation, including automatic change-over, automatic claws locking and automatic compaction.

Advanced installation technology from Europe, without any ground treatment work, ensures fast and efficient installation.
Advantages of stationary compactors

- Restriction of accessibility of birds, animals and rain water.
- Transport more garbage due to compaction system
- Odorless transportation from compactor station to Dhapa dumping ground.
- Stoppage of rag picking
- No spilling of garbage during transportation.
- No seepage of water during transportation due to water tight system.
- Eradication of open vat
- Facilitates night transportation of solid waste etc. etc.
Modern Scientific Waste Compactor station at 67, Southern Avenue

Portable compactors (4 nos)

Bin cart
Different process of collection of solid waste

Transfer of segregated MSW from hand cart to bin cart
Function of compactor

Auto transfer from bin cart to compactor
Loading of compactor on Prime Mover

Compactor mounted on Prime mover and ready for transportation
Transportation & Disposal of Waste

Prime mover on the way to disposal site

Waste disposed at Dhapa disposal site
Conventional Method Vis-À-Vis Stationary Compactor

8 cum open tipper truck
Specification of Portable Compactor

- Container Volume : 10.5 Cum
- Crushing Chamber : 2.9 Cum
- Capacity : 63 Cum/hr
- Cycle Time : 44 Seconds
- Loading Time : 30 Seconds
- Electrical Motor : 3 KW
- Compaction Force : 230 KN
- Working Pressure : 200 Bar
- Dimension: L = 4880 mm, w = 2250 mm, H = 2040mm.
Specification of Prime Mover

- Manufacturer & Model: Reputed manufacturer with standard design make EURO IV(BS IV) compliant chassis. Details of make/model/specification of the chassis should be mentioned.
  - GVW : Minimum 16 Ton
  - HP : Minimum 130 HP
  - Wheel Base : Minimum 4200 mm
  - Overall length of chassis : Should be between 7500 to 8000 mm
  - Engine : 6 cylinder water cooled direct injection diesel engine
  - Gear Box : 6 Forward & 1 Reverse gear; synchromesh on all forward gears and constant mesh on reverse gear.
  - Both Front & Rear axles should be extra heavy duty type
  - Steering : Should be integral hydraulic power assisted steering
Specification of Prime Mover

- **Frame**: Should be laddered type heavy duty frame with riveted/bolted cross members
- **Suspension**: Semi elliptical leaf spring at front & rear
- **Tyre**: 10.00 X 20 – 16 Ply; Front – 2, Rear – 4, Spare – 1
- **Cabin**: The cabin should have driver seat and 2 no. co-driver seat with two part front view glass window for proper ventilation. There should be 2 emergency lights on both side of top of the cabin. Cabin should be able to tilt.
Movable Compactor

14 Cu.M Movable Compactor with skip container

14 Cu.M Movable Compactor with tip cart
## Estimated cost for portable compactor & prime mover

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Details of item</th>
<th>Unit Cost (Rs. In Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.5 M$^3$ portable / stationary compactor containers</td>
<td>29,00,000/-</td>
</tr>
<tr>
<td>2</td>
<td>Prime mover-chassis mounted hook loader capable of lifting portable compactor of capacity 10.5 m$^3$</td>
<td>38,00,000/-</td>
</tr>
</tbody>
</table>
## Estimated cost for modern scientific waste compactor stations

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Details of item</th>
<th>Unit Cost, (Rs. In Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modern scientific waste compactor stations for one container (including civil works, electrical and mechanical works etc).</td>
<td>18,00,000/-</td>
</tr>
<tr>
<td>2</td>
<td>Modern scientific waste compactor stations for two containers (including civil works, electrical and mechanical works etc).</td>
<td>28,00,000/-</td>
</tr>
<tr>
<td>3</td>
<td>Modern scientific waste compactor stations for three containers (including civil works, electrical and mechanical works etc).</td>
<td>31,00,000/-</td>
</tr>
<tr>
<td>4</td>
<td>Modern scientific waste compactor stations for four containers (including civil works, electrical and mechanical works etc).</td>
<td>37,00,000/-</td>
</tr>
</tbody>
</table>
VEHICLES IN QUEUE FOR WEIGHING

WEIGH BRIDGE 30 TON CAPACITY

GROSS & TARE WEIGHTS RECORDED
Composting Plant

WINDROW FORMATION

TRANSPORT OF DECOMPOSED WASTE THRU BOBCAT TO CONVEYOR BELT
Composting Plant

CONVEYING THRU TROMMEL NO. 1 (65 MM) MESH

CONVEYING THRU TROMMEL NO. 2 (40 MM) MESH

CONVEYING THRU TROMMEL NO. 3 (16 & 12 MM) MESH
Composting Plant

CONVEYING UPWARD & PASSED THRU 4 MM STRAINER

FINISHED MANURE BAGGING IN 50 KGS. HDPE BAG & STORED UNDER SHED
KMC has identified 100 Ha land at Kharambha for proposed Engineered landfill facilities in future.

- Area – 100 Ha.
- Estimated cost – 200 crores.
- Construction period – 2 years.
- Facilities – Access & internal roads, lighting, water supply, weighbridge, fire protection unit, garland drain for leachate collection and transportation, recycling units, gas trapping arrangements, fencing, land scaping and green belt development etc.
Waste to Energy Project is always debatable and a war of opinions among the scientists and technocrats for the Indian wastes. In view of that one internationally renowned consultant, Gartner Lee Ltd. was engaged thru global tender to explore the feasibility of this project for Kolkata City Waste. Their findings are:

- Mass burn technology is the most proven and most economical W.T.E. technology world wide because of their likely hood of technically and financially viability.

- Advanced systems like gasification, pyrolysis & plasma will not be considered for Kolkata city waste as these technologies are still in the development stage and high O.&.M. cost – so not considered.

- Cement factories / any other factories where the RDF can be used are out of Kolkata and more than 300 km. away which leads to high transportation cost – so not considered.
Three options of Mass burn technology forwarded:

Option 1
Mass burn WTE system for maximum waste throughput

Option 2
Mass burn WTE system for a selected waste stream

Option 3
Future mass burn WTE facility for selected waste after implementation of new infrastructure

The report reveals that the low calorific value & high moisture content of the city waste stream would limit the potential of Waste to Energy in terms of energy production and associated revenue generation.
Closing one dump site at Dhapa & CDM benefit

- The dump site will be closed as per M.S.W. Rules.
- Top plateau will be closed with vegetative cover and surface drainage system.
- All activities of CDM Project will be completed before final closure. For this K.M.C has engaged one international consultant Mitsui & Co. Ltd. for exploration of global CDM practices.
- After it is closed, the area will be used for social forestry and open areas will be created for recreation and leisure. Small water bodies / fountains, flower gardens etc. can be added.
Their report reveals

- LFG recovery CDM project at the Dhapa Waste disposal site is feasible
- Initial costs for generation facility will be large compared to the amount of electricity generated
- As a CDM project combustion by a flame system is considered appropriate
- Expected total profit of KMC for the project crediting period (10 years) is 6,66,12,000 INR
Other Alternative recovery processes under consideration at Dhapa dump site

- Existing materials i.e. wastes at the disposal site and clay from Palta water treatment plant can be reused or not. Negotiation with Central Glass & Ceramic Research Institute are on.

- As per report of Gartner Lee Ltd., the mined waste of Dhapa dump site is not suitable as a low permeability cover if such a cover is to be used for final closure.
Key Challenges Faced

- Door to door collection levels of 75%
- Source segregation system at present in 7 wards
- Conversion of all open vats into containerized system (dumper placer) is not possible due to non availability of space and public protest
- Around 80% of the private vehicles were more than 20 years.
- Compost treatment plant is not running with it’s full capacity
- Existing height of the landfill site is ~30mts causing land subsidence and slope failure.
- Landfill does not have any methane recovery system
- Delay in achieving CDM benefit as ELF not yet commissioned
- Low awareness among citizens – After completion of conservancy works, specially in commercial areas, waste is disposed on roads and footpaths
Way Forward

- Continuous Awareness Campaign – To create better waste consciousness among citizens
- Phase wise implementation of segregation of waste at source
- Collection and transportation of 100 % waste from K.M.C. area
- To stop double handling of waste by using modern scientific waste compactor stations or implementation of movable compactors
- Minimization of open vat points by direct loading system / stationary compactors / movable compactors
- Use of stationary compactors of different sizes at vat points – Capacity ranges from 8 to 30 MT. / day
- Construction of an Engineered Landfill site / WTE plant
- CDM Project – Closing of one dump site at Dhapa Landfill Site
THANK YOU
Processing and Disposal of MSW
Nagpur City

Presentation By
Shyam Wardhane, IAS
Commissioner
14/10/2013
Salient Features

• Nagpur city is a second capital of Maharashtra State & is a major hub for Education, Cultural & Business activity.
• The city is having a total area of 217.56 Sq.km. & the present population is 25.00 lakh.
• Nagpur Municipal Corporation is solely responsible for the management of Municipal Waste generated in Nagpur city.
• City presently generates 800 TPD of MSW.
• Presently NMC runs a comprehensive operation of street cleaning, Maintenance of sanitary services, waste collection from various points in the city, waste transportation to Processing plant and Disposal at Bhandewadi.
## Decadal Population & Waste Generation

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Year</th>
<th>Population (Lacs.)</th>
<th>Waste Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2013</td>
<td>25.00</td>
<td>800 -MT</td>
</tr>
<tr>
<td>2</td>
<td>2021</td>
<td>36.90</td>
<td>1107-MT</td>
</tr>
<tr>
<td>3</td>
<td>2031</td>
<td>47.50</td>
<td>1425-MT</td>
</tr>
<tr>
<td>4</td>
<td>2041</td>
<td>59.65</td>
<td>1790-MT</td>
</tr>
</tbody>
</table>
Composition of the Waste

- Wet organic material (30%) - Composting
- Dry organic material (30%) - RDF Pellets (Green Fuel)
- Recyclables (5%) - Plastic, MS and rubber items.
- Refuse (17%) - Non processable (Mainly, soil, sand, debris)
- Residue for land fill site (18%) - Inert to land fill
### Present Scenario

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>25.00 Lakh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>S.W. Generation</td>
<td>800 MT</td>
</tr>
<tr>
<td>3</td>
<td>Door to Door Collection</td>
<td>Ghanta Gadi</td>
</tr>
<tr>
<td>4</td>
<td>Transportation through Operator</td>
<td>M/s Kanak Resources Management Ltd.</td>
</tr>
<tr>
<td>5</td>
<td>Total area of MSW Processing Plant and yard</td>
<td>55 Acres</td>
</tr>
<tr>
<td>6</td>
<td>Processing of MSW through BOT Operator for 12 years since 2009</td>
<td>M/s Hanjer Biotech Energies (Nagpur) Pvt. Ltd.</td>
</tr>
<tr>
<td></td>
<td>a Compost (30%)</td>
<td>240 TPD (selling @ Rs. 1.50 to Rs.2.00 per kg.)</td>
</tr>
<tr>
<td></td>
<td>b Refused Derived Fuel (RDF) (30%)</td>
<td>240 TPD (selling @ Rs. 1.75 to Rs.2.25 per kg.)</td>
</tr>
<tr>
<td></td>
<td>c Plastic Pellets (5%)</td>
<td>40 TPD (selling @ Rs. 22 to Rs.25 per kg.)</td>
</tr>
<tr>
<td></td>
<td>d Inert to land fill (18%)</td>
<td>144 TPD</td>
</tr>
<tr>
<td></td>
<td>e Development of Closure site for accumulated MSW since 1967.</td>
<td>12.00 Lakh MT (Foot print 15.00 Acres)</td>
</tr>
</tbody>
</table>
Municipal Waste Management

Waste Collection

Transportation

Processing

Composting

Recycling of Waste

RDF

Sand

Inert to Landfill
Flow Chart for Processing

1. Weighment of waste at Site
2. Spraying of Bio Chemicals
3. Dumping of Raw MSW at Tipping Floor
4. Segregation
5. Processing of Wet Organics
   - Compost
6. Processing of Dry Organics
   - RDF
7. Processing of Recyclables
   - Plastic Pallets
8. Inerts to Land fill site
Percentage Output of Processing MSW

- Compost: 30%
- Green fuel (RDF): 30%
- Sand/Bricks/Civil Bricks: 17%
- Recyclables: 18%
- Inerts to Landfill: 5%
Policy

- Guidelines of Hon’ble Supreme Court of India. MSW (Management & Handling) Rules, 2002 & MPCB’s guidelines are followed.
- Door to Door Collection
- Transportation in closed containers
- Separation of wet & Dry organic.
- Processing of MSW
- Development of SLF
- Development of Closure site for accumulated MSW since 1967 (12.00 Lakh MT - Foot print 15.00 Acres).
- Developing New sites.
Views Regarding waste to Energy

1) In Nagpur city Dry Organic generation is limited to 30% i.e. 240 MT’s.

2) Minimum quantum of Dry organic required is 500 MT to sustain the energy generation project based on incineration. (1 MW per 100 MT – total 5 MW)

3) Due to inadequate quantum of Dry organic, waste to energy project is not sustainable.

4) However, PMC has commissioned Bio methanation plant for generation of electricity.

5) Nagpur Municipal Corporation is in the process of preparing the DPR on the same lines.
Typical Bio-methanation Process

1. Segregated Wet Organic: 60%
2. Pre-treatment
3. Wet Organic Matter
4. Bacteria Culture
5. Bio-Methanation Tank
6. Biogas
   - Methane
   - Carbon Dioxide
7. Residual Matter
   - Compost
Advantages of Bio-methanation

1) Part of Corporate Social Responsibility (CSR) towards greener and healthier environment.

2) Gas capture helps in reduction of odour emitted by MSW.

3) Helps in addressing the issues of NIMBY (Not In My Bac-Yard) problem for setting-up MSW recycling projects.

4) Reduced landfill requirement from 10% to 20%.

5) Option of using Gas captured for producing power using DG sets.

6) Revenue from two products – gas and Compost, instead of one (i.e. Compost).

7) Improved quality of Compost due to higher nutrient content.

8) Pilot scale plant has been setup in the back yard of commissioner’s bungalow.
Door to door collection
Door to door collection
Door to door collection
Transportation of MSW in closed container
RDF/Green Fuel-Initial stage
RDF/Green Fuel-Final Product
Excavation for Secured Landfill (SLF)
Embankment of Secured Landfill (SLF)
HDPE sheet Liners for Landfill (SLF)
Ready Sanitary Landfill
Closure Site
Thank You
Further on the document submitted to the planning commission

S Dasappa
Indian Institute of Science

Third meeting of the Task force – Oct 14 2013
Typical availability and power potential from municipal solid wastes

- According to a recent estimate, about 50 million tonnes annual of municipal solid waste (0.14 million tonnes per day) is generated every year by our urban population.
- This translates into a potential for generation of over **2600 MW** of electricity from urban wastes in the country typically composed of:
  - Organic matter (Bio-degradable and non-biodegradable) - 35-65%
  - Inert matter - 20-30%
  - Recyclable matter - 5-15%
Energy from MSW can be recovered mainly through

- **Biological**
  - Anaerobic digestion leading to generation of biogas that can be used in engine/turbines for power generation or for thermal applications.

- **Thermochemical conversion processes.**
  - The incineration and gasification are two thermo-chemical processes that can be used for power generation or heat application. Incineration process can use the waste with minimum pre-processing or using Refuse Derived Fuel (RDF) combusted to generate steam for power generation.
Status of MSW Incineration

- Internationally the most widely used waste-to-energy option and commercial plants are available for large capacities using MSW with elaborate flue gas treatment process for emission control.
- Several large capacity systems being attempted in India with pre-processed MSW – one of 16 MW already commissioned whereas two more of 12 and 25 MW are likely to get commissioned within 2013.
  - Very limited experience in India in using MSW directly – the first project installed in Delhi in 1985 had failed due to very low calorific value of MSW.
A Note on Technology Options for Waste-to-Energy in India

For Consideration of the Task Force under the Chairmanship of Dr K Kasturirangan, Member, Planning Commission

By: Prof. S Dasappa, TDC and Mani Anil Dhesa, MNRE

July, 2013
Table of contents

1. Background

2. Technology Options for Waste-to-Energy
   i. Incineration
   ii. Status of MSW Incineration
   iii. Gasification
   iv. Pre-processing of MSW
   v. Status of pre-processing technologies
   vi. Emission Control

3. Thermo-chemical conversion
   i. Biomethanation
   ii. Composting
   iii. Status

4. Biological conversion
   i. Biomethanation
   ii. Composting
   iii. Status

5. Overview

Annexure I: Material and Energy Balance and quantification of Input/output/cost
   i. Biomethanation
   ii. Thermo-chemical conversion

Annexure II: Case studies
   i. 16 MW project for power generation from MSW at Okhla, New Delhi
   ii. 11 MW MSW based project at Gazipur, Delhi
   iii. Biomethanation of kitchen and food wastes
MSW after requisite pretreatment process

Biodegradable fraction
- Biochemical conversion
  - Anaerobic digestion

Combustible fraction
- Thermo-chemical process
  - Gasification
  - Incineration
     - Fluffy
     - Pellet/briquettes

Biofertilizer

Output
- Biogas
  - Using engine or boiler as energy conversion process after pre-treatment of the gas
    - Use biogas for other purposes like bio-CNG etc

- Producer gas
  - Using engine or boiler as energy conversion process after pre-treatment of the gas
    - Power and heat - CHP

Residue for land fill after necessary treatment

Exhaust emissions - treatment

Boiler
- Steam
- Steam Turbine
- Power and steam - CHP
- Exhaust emissions - treatment
Achieved Performance
Observations

• Minutes of the second meeting clearly indicates there has been varied experience in the WTE projects
  – Experience in Chandigarh
  – Ahmedabad
  – BARC

• Concluding remarks by the Chairman clearly suggests
  – Existing database seems inadequate
  – Report should be objective and exhaustive
  – Uncertainties, complexities and concerns to be addressed
The fundamental question to be asked

• There are only few waste to energy projects
  – While the potential is for 2600 MW

• Reasons for this situation
  – Technology related?
  – Others
    • Financial?
    • Policy?
    • ........
Report preparation

• As a part this Task force group – a document is planned
  – It is important to arrive at criterion towards adapting/choosing the WTE projects for a given situation
    • At present it is – based on the promoter adapting the technology available
    • In majority of the projects, very little scientific based approach adapted
  – It is important to recognize that each of the conversion process has certain pros and cons
  – Instead of one there could be a situation with combination of technologies to meet the need
Analysis

• Important to capture initially the technical aspects of various processes for sustainable operations based on the typical composition of wastes
  – Mass and energy balance
  – Aspects related to disposal of residues
  – Value addition from the products
    • Electricity, heat, etc
  – Financial aspects
  – Any other ...

• Based on the above arrive at the siting criterion
In the document submitted by IISc and MNRE

• An attempt has been made towards establishing mass and energy balance and format for techno-economics for the WTE process

• The Ultimate objective is towards establishing best to practice technology (ies) in a given situation based on certain optimization techniques (modeling) considering factors like
  – Amount of wastes generated/collected, logistics related distance transported, cost for transportation, etc
  – Technology package outputs, value addition for products and disposal costs of residues
  – Environmental costs (benefits and treatment)
  – Any other factors
## Typical waste composition considered

<table>
<thead>
<tr>
<th>Moisture content</th>
<th>60</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>40</td>
<td>TPD</td>
</tr>
<tr>
<td>Fermantable in dry matter</td>
<td>28</td>
<td>TPD</td>
</tr>
<tr>
<td>Combustible in dry matter</td>
<td>36.7</td>
<td>TPD</td>
</tr>
</tbody>
</table>

### Distribution of Input feed stock for dry waste

<table>
<thead>
<tr>
<th>Components of Feed stock</th>
<th>%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fermentable</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Paper and cardboard</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Polythene and plastics</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Cloth rubber PVC leather</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Metals</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Dust and sweeping</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Non- combustible fractions</td>
<td>8.25</td>
<td></td>
</tr>
<tr>
<td>Environmental factors</td>
<td>Biological conversion</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td>Treating exhaust gases</td>
<td>INR/kWh</td>
<td></td>
</tr>
<tr>
<td>Total cost for exhaust treatment</td>
<td>Rs.</td>
<td></td>
</tr>
<tr>
<td>Residue disposal cost, Rs/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual treatment per hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sludge disposal, Rs./m³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total sludge disposal cost</td>
<td>Rs. Per hour</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental factors</th>
<th>Thermochemical conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treating exhaust gases</td>
<td>Rs./m³</td>
</tr>
<tr>
<td>Total cost for exhaust treatent</td>
<td>Rs.</td>
</tr>
<tr>
<td>Residue disposal cost, Rs/kg</td>
<td></td>
</tr>
<tr>
<td>Residual treatment per hour</td>
<td></td>
</tr>
</tbody>
</table>
**Biological conversion**

- **Fermentable material**: 28.8 TPD
- **Biogas yield**: 40% of dry matter, 11.52 TPD
- **Other wastes to handle**: 88.48 TPD
- **Liquid fraction**: 60 TPD
- **Volume**: 60 m³

**Energy balance**

- **Energy content in the gas**: 20 MJ/kg
- **Thermal Energy MW th**: 2.67 MW th, 242.4242
- **Possible electrical power**: 0.8 MW el
- **In house power consumption**: 25%, 230400
- **Net power available**: 0.6 MW el, 365.7143
## Waste treatment process - Biomethanation

<table>
<thead>
<tr>
<th>Input Parameter</th>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>System capacity Tons per day</td>
<td>28</td>
</tr>
<tr>
<td>Biomethanation capacity kg/hr</td>
<td>1166.67</td>
</tr>
<tr>
<td>Biogas generation per kg T per day (4 kg dry matter 1.5 kg gas)</td>
<td>11.2</td>
</tr>
<tr>
<td>Thermal rating, KW</td>
<td>2593</td>
</tr>
<tr>
<td>Engine capacity</td>
<td>648.15</td>
</tr>
<tr>
<td>Cost of Biogas system ( ex. Engine) (Rs.)</td>
<td>1960000</td>
</tr>
<tr>
<td>Cost of Engine (Rs.)</td>
<td>25925926</td>
</tr>
<tr>
<td>Life of engine (yr)</td>
<td>10</td>
</tr>
<tr>
<td>Useful Electrical Output (kW)</td>
<td>486</td>
</tr>
<tr>
<td>Annual Maintenance cost (Rs./kW)</td>
<td>1.00</td>
</tr>
<tr>
<td>Discount Rate (%)</td>
<td>0.12</td>
</tr>
<tr>
<td>Daily operational Hourse (hr)</td>
<td>24</td>
</tr>
<tr>
<td>Fuel Cost (Rs.)</td>
<td>0</td>
</tr>
<tr>
<td>Annual Fuel cost (Rs.)</td>
<td>0</td>
</tr>
<tr>
<td>Annual Maintenance Cost (Rs.)</td>
<td>10220000</td>
</tr>
</tbody>
</table>

### Annual Operation & Maintenance Cost

<table>
<thead>
<tr>
<th>Annualized Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Recovery Factor for Biomass Gasifier system</td>
</tr>
<tr>
<td>Annualized Capital cost of Biomass gasifier system (Rs.)</td>
</tr>
<tr>
<td>Cost Recovery Factor for Engine</td>
</tr>
<tr>
<td>Annualized Capital cost of Engine (Rs.)</td>
</tr>
<tr>
<td>Annual CO2 benefit (Rs)</td>
</tr>
<tr>
<td>Annual treatment cost</td>
</tr>
<tr>
<td>Annual Sludge oppurtunity cost</td>
</tr>
<tr>
<td>Annual non-biodegradable oppurtunity cost</td>
</tr>
</tbody>
</table>

**Total Annualized Cost (Rs.)**

25284812

**ALC (Rs./kWh)**

5.94
Total combustible, dry 3670 TPD  
Energy content 63.71528 MW thermal  
Other wastes to handle 3.3 TPD  
Volume to handle 3.3 m³  

Energy balance  
Possible electrical power 15.93 MW el  
In house power consumption 25 %  
Net power available 11.947 MW el
## Waste treatment process

### Input Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System capacity Tons per day</td>
<td>36.7</td>
</tr>
<tr>
<td>Gasifier system capacity kg/hr</td>
<td>1529.17</td>
</tr>
<tr>
<td>Biomass consumption per kW (kg/kWh)</td>
<td>1.5</td>
</tr>
<tr>
<td>Engine rating, KW</td>
<td>1019</td>
</tr>
<tr>
<td>Engine capacity</td>
<td></td>
</tr>
<tr>
<td>Cost of Biomass gasifier system (ex. Engine) (Rs.)</td>
<td>71361111</td>
</tr>
<tr>
<td>Cost of Engine (Rs.)</td>
<td>27185185</td>
</tr>
<tr>
<td>Total capital cost Rs. in Lakhs</td>
<td>985</td>
</tr>
<tr>
<td>Life of the gasifier systems (yr)</td>
<td>15</td>
</tr>
<tr>
<td>Life of engine (yr)</td>
<td>10</td>
</tr>
<tr>
<td>Useful Electrical Output (watt)</td>
<td>637</td>
</tr>
<tr>
<td>Maintenance cost (Rs./kWh)</td>
<td>1.52</td>
</tr>
<tr>
<td>Discount Rate (%)</td>
<td>0.12</td>
</tr>
<tr>
<td>Daily operational Hourse (hr)</td>
<td>24</td>
</tr>
<tr>
<td>Fuel Cost (Rs.)</td>
<td>0</td>
</tr>
</tbody>
</table>

### Environmental factors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treating exhaust gases INR/kWh</td>
<td>0.5</td>
</tr>
<tr>
<td>Total cost for exhaust treatent Rs.</td>
<td>510</td>
</tr>
<tr>
<td>Residue disposal cost, Rs/kg</td>
<td>0.5</td>
</tr>
<tr>
<td>In house consumption(%)</td>
<td>25</td>
</tr>
<tr>
<td>T&amp;D loss (%)</td>
<td>0</td>
</tr>
<tr>
<td>Useful Electricity from plant (kW)</td>
<td>637</td>
</tr>
<tr>
<td>Useful electricity at end use point (w)</td>
<td>637</td>
</tr>
<tr>
<td>CO2 emission (kg/kWh)</td>
<td>0.81</td>
</tr>
<tr>
<td>CO2 Trading @ Euro 10/ton (Rs to Euro)</td>
<td>65</td>
</tr>
<tr>
<td>CO2 benefit (Rs./ton)</td>
<td>650</td>
</tr>
<tr>
<td>CO2 benefit (Rs./kWh)</td>
<td>0.53</td>
</tr>
<tr>
<td>Annual Fuel cost (Rs.)</td>
<td>0</td>
</tr>
<tr>
<td>Annual Maintenance Cost (Rs.)</td>
<td>20361160</td>
</tr>
<tr>
<td>Total Annual Op &amp; Main. Cost (Rs.)</td>
<td>20361160</td>
</tr>
</tbody>
</table>

### Annual Operation & Maintenance Cost

<table>
<thead>
<tr>
<th>Cost</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annualized Capital Cost</td>
<td></td>
</tr>
<tr>
<td>Cost Recovery Factor for Biomass Gasifier system</td>
<td>0.1468</td>
</tr>
<tr>
<td>Annualized Capital cost of Biomass gasifier system</td>
<td>10477541</td>
</tr>
<tr>
<td>Cost Recovery Factor for Engine</td>
<td>0.1770</td>
</tr>
<tr>
<td>Annualized Capital cost of Engine (Rs.)</td>
<td>4811347</td>
</tr>
<tr>
<td>Annual CO2 benefit (Rs)</td>
<td>2939</td>
</tr>
<tr>
<td>Annual treatment cost</td>
<td>5067417</td>
</tr>
</tbody>
</table>

| Total Annualized Cost (Rs.) | 40714526     |
| ALC (Rs./kWh)               | 7.29         |
## Possible Technology Options

### Typical Properties
- **Composting**
  - Moisture Content (%): 60
  - Dry Matter (TPD): 40
  - Fermentable in Dry Matter (TPD): 28
  - Combustible in Dry Matter (TPD): 36.7

- **Biological Conversion**
  - Typical Fermentable: 23
  - Typical Yield of Gas: 40
  - Leachate as % of input: 40
  - Energy Content in the Gas: 11.2
  - Energy Content in the Gas MJ/kg: 20

- **Thermochemical Conversion**
  - Total Combustible: 36.7
  - Energy Content: 550,000
  - Thermal Power: 6371.53
  - Electrical Power: 1592.88

### Waste to handle
- **Composting**
  - Leachate: 40
  - Non-Composting Material: 30

- **Biological Conversion**
  - Non-Biodegradable: 28.8
  - Liquid along with Sludge: 60

- **Thermochemical Conversion**
  - Non Combustible: 3.3

### Total Volume to handle (m³)
- **Composting**: 58
- **Biological**: 88.8
- **Thermochemical**: 3.3

### Evaluate

![Graphs showing comparison between Composting, Biological, and Thermochemical options]
Thank you
Waste Management Scenario in SAIL Steel Plants

Steel Authority of India Limited

New Delhi

October 14, 2013
Roadmap of Presentation

- Waste Generation
- Solid Waste Utilisation
- Initiatives taken by SAIL
- Future Scope for Waste to Energy in SAIL
Overview of Steel process

- Billets/Blooms
- Slabs/Thin slabs
- HR Coils
- Section mill
- Wire-rod mill
- Heavy plate mill
- Hot strip mill
- Spirals pipe mill
- Electric resistance-welded pipe mill
- Butt-welded pipe mill

- Rails
- Sheet piles
- Shapes
- Bars
- Wire rods
- Heavy plates
- Hot-rolled sheets and coils
- CRM
- CR Sheets/Coils
- Spiral pipe and tubes
- Electric resistance-welded pipe and tubes
Waste Generated in Steel Plants

The Major waste generated in steel making process of integrated steel plants are:

- Blast furnace air cooled slag
- Blast furnace granulated slag
- LD/BOF slag
- Twin hearth furnace slag
- Blast furnace flue dust
- Blast furnace sludge
- LD/BOF sludge
- Mill scale
- Lime / dolo fines
- Refractory waste
# Solid waste generation and utilisation (2012-13)

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Generation, MT</th>
<th>Utilisation, MT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF air cooled &amp; granulated slag</td>
<td>5.775</td>
<td>5.178</td>
</tr>
<tr>
<td>LD/BOF slag</td>
<td>1.422</td>
<td>0.998</td>
</tr>
<tr>
<td>Twin hearth furnace slag</td>
<td>0.161</td>
<td>0.265 (from old stock)</td>
</tr>
<tr>
<td>BF flue dust</td>
<td>0.167</td>
<td>0.161</td>
</tr>
<tr>
<td>BF sludge</td>
<td>0.104</td>
<td>0.001</td>
</tr>
<tr>
<td>LD/BOF sludge</td>
<td>0.099</td>
<td>0.022</td>
</tr>
<tr>
<td>Mill scale</td>
<td>0.277</td>
<td>0.275</td>
</tr>
<tr>
<td>Lime / dolofines</td>
<td>0.213</td>
<td>0.216</td>
</tr>
<tr>
<td>Refractory waste</td>
<td>0.055</td>
<td>0.047</td>
</tr>
<tr>
<td>Total</td>
<td>7.914</td>
<td>7.164 (91.4%)</td>
</tr>
<tr>
<td>Solid waste (Apr-Aug,13)</td>
<td>3.414</td>
<td>2.809 (82%)</td>
</tr>
</tbody>
</table>
About 95% of the slag generated in the steel plants is being utilised.

Granulated BF slag is a raw material for Cement making as a replacement of cement clinker.

New Cast House Slag Granulation plants are coming along with all new/modernized Blast Furnaces for maximizing the utilization of Slag and selling it to cement industries.

Two JV Cement Plants have been installed, one each at BSP and BSL, for utilisation of the granulated slag.
Solid Waste Management

Basic Oxygen Furnace (BOF) Slag

- About 70% of the BOF slag generated in the steel plants is being utilised.
- BOF slag is used internally in the base mix of Sinter Plant as replacement of limestone.
- In Railway tracks as track ballast and in road making within the works premises.
- Exploring the possibilities with Railways for the use of weathered LD slag as Rail Track Ballast.
- Taken up a R&D project of “Dry Granulation of LD slag with Heat Recovery”
Initiatives taken at SAIL

- Beneficiation to use lean ore and to recover iron ore fines from slime
- Pelletisation of iron ore fines
- Gradual rebuilding of Coke Oven Batteries with state-of-the-art Pollution Control facilities
- Coke Dry Quenching (CDQ)
- Installation of Computerised Combustion Control System at Coke Oven Batteries
- Installation of multi-slit burners in Sinter Plant
- Injection of Direct reducing agents (CDI, CTI) in BFs
- Top Pressure Recovery Turbine system (TRT)
- Installation of Cast House de-dusting system at BFs
- Replacement of Scrubbers by ESPs/Bag Filters
- Replacement of open hearth furnaces by BOFs.
- Phasing out of the blooming/slabbing mill
Initiatives taken at SAIL.... contd

- Adoption of continuous casting
- Replacement of pusher type furnace by Walking beam furnaces
- Introduction of new technologies for waste utilisation and waste heat recovery system
- Gas based (using by-product gas) Power Plant
Waste to Energy
Production of Electricity from
MSW at SAIL
Waste to Energy: Production of Electricity from MSW at RSP

• Project for waste processing facility to produce electricity using municipal solid waste generated from RSP township.

• Preferably by the Pyrolysis technology which is used for MSW conversion to power using syngas generated during pyrolysis.

• The developer / power generation company shall ensure door to door collection of MSW from quarters, public premises and other places in RSP
Waste to Energy: Production of Electricity from MSW at RSP

• The developer / power generation company may receive around 130 TPD of MSW from Rourkela municipality.

• All the power generated in the facility shall be purchased by RSP.

• Rourkela Steel Plant has been authorized by State Pollution Control Board, Orissa for setting up & operation of waste processing/waste disposal facility under MSW (M&H) Rules, 2000.

• Capacity of the power project shall be 4 MW.
Waste to Energy: MSW processing at BSP, DSP & BSL

• Tendering for MSW processing facility thru’ BOO basis has also been floated at BSL.

• Asansol Durgapur Development Authority (ADDA), with a German Company M/s Hanjer Biotech Energies Limited and M/s Gujarat Enviro-protection and Development Corporation did set up a 300TPD MSW processing facility.

• Similar initiative is being taken at BSP
Research & Development
Pilot Plant
for
Production of Activated Carbon from Waste
RDPP for Production of Activated Carbon from Waste

• Steel Authority of India Limited (SAIL) has entered into an MOU with M/s Greenstar Global Energy Corporation (GGEC), USA

• Will jointly explore and establish technical and economic viability of installation and operation of R&D Pilot Plant (RDPP) for production of activated carbon based pollution abatement material primarily from municipal waste, at a Township of SAIL

• Exploration to be carried out in a proposed Joint Venture mode.
RDPP for Production of Activated Carbon from Waste

• M/s Green Star Global Energy Corporation, USA will provide technology
• The technology will have a potential to produce an effective pollution abatement product based on Activated Carbon from sewage waste and domestic waste
• The expected benefits from the technology are in the areas of
  - Waste management
  - Pollution abatement
  - Resource recovery
RDPP for Production of Activated Carbon from Waste

• The carbon based adsorbent product i.e. ‘Activated Carbon’ will be capable of removing pollutants from air and water streams, such as acid gases from air, and mercury from both air & water, in field and industrial processes.
• The carbon based adsorbents are effective filters for odour causing pollutants, such as Amines, Hydrogen Sulfide, etc; that are found in waste water treatment facilities and also effectively removes elemental mercury from that stream.
Issues

1. Mandate for use of Air cooled BF slag in Road making

2. Use of BOF slag as track ballast by the Railways

3. Use of BOF slag as Soil conditioner for Acidic Soil at Eastern India.
On-going

R&D Master Plan

(Achieve zero SOLID waste generation)
PROJECT- 1:
MICRO PELLETISATION OF SLUDGE & ITS USE IN SINTER PLANT

PROJECT- 2:
USE OF AIR COOLED BF SLAG IN ROAD MAKING

PROJECT- 3:
TECHNOLOGY DEVELOPMENT FOR DRY SLAG GRANULATION OF LD SLAG
**Project 1: MICRO PELLETISATION OF SLUDGE & USE IN SINTER PLANT**

**INTRODUCTION:**

- Micro pallet of sludge can be used in sinter plant
- This will facilitate use of fines in sintering process

**STATUS OF PROJECT**

- Laboratory study at RDCIS: **Completed**
  - *Study revealed that 20kg /ton of sludge can be used without affecting process parameters*
- Around 3 Ton sludge samples (BF,SPs & LD) collected and first set (batch type) of industrial trial was conducted in Eirech mixer unit of SP- 3 on 11th July 2013.

**FUTURE PLAN**

- Another set of industrial trial will be conducted
Project 1: MICRO PELLETISATION OF SLUDGE & USE IN SINTER PLANT (Contd...)

Result of trial use of micro pellets of sludge in Pot Sinter

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Micro-pellets kg/ts</th>
<th>Productivity t/m²/h</th>
<th>Yield (%)</th>
<th>Drum Tumbler Index (%)</th>
<th>Return sinter (&lt;5mm)</th>
<th>VSS (mm/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.534</td>
<td>75.1</td>
<td>68</td>
<td>24.9</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>1.53</td>
<td>75.2</td>
<td>70</td>
<td>24.8</td>
<td>24.5</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>1.52</td>
<td>77.0</td>
<td>73.3</td>
<td>23.0</td>
<td>23.5</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>1.63</td>
<td>77.4</td>
<td>70</td>
<td>22.1</td>
<td>25.5</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>1.64</td>
<td>77.6</td>
<td>71.7</td>
<td>22.4</td>
<td>25.5</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>1.53</td>
<td>79.9</td>
<td>73.3</td>
<td>20.1</td>
<td>23.1</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>1.49</td>
<td>79.7</td>
<td>72</td>
<td>20.3</td>
<td>22.6</td>
</tr>
</tbody>
</table>

Micro pellets of sludge vs. productivity

➤ **20kg /ton of sludge can be used without affecting process parameters**
INTRODUCTION:

• Huge Availability of air cooled BF Slag in our ISPs (Around 50 MT)

• **MOEF notification** G.S.R 46(E) dated 3\textsuperscript{rd} February 2006, point no.4 (solid waste management) under guidelines for pollution prevention in Blast furnace, it has been mandated that “Crushed and screened air cooled BF slag can be used in Road construction, if feasible,”

• If feasibility of BF Slag for roadmaking is comprehensively established, then, Suggestion can be made to MOEF for statutory inclusion of air cooled BF slag for road construction
PROJECT 2: USE OF AIR COOLED BF SLAG IN ROAD MAKING (Contd....)

STATUS OF PROJECT

• Central Road Research Institute (CRRI), New Delhi [ a CSIR lab under Govt of India ] was engaged for comprehensive technical feasibility study by comparing the possibility of using air cooled BF slag in bituminous construction vis-à-vis concrete construction

• Agreement signed on 26th July 2013 for Phase –I and Phase –II study.
  • PHASE – I: Laboratory characterization study to prepare suitable mix / aggregate
  • PHASE - II: Simulation Trials at CRRI using Accelerated Pavement Testing Facility (APTF)

Future plan

• Transportation of sample from BSP to CRRI
PROJECT 3: TECHNOLOGY DEVELOPMENT FOR DRY GRANULATION OF LD SLAG

INTRODUCTION:

• Identified by EMD and project initiated based on an Australian paper on laboratory work

• Site identified at RSP; based on schematic diagram, draft TS was prepared by CET for pilot study

• Technical feasibility of BOF slag should be established through laboratory study

• A team of professors from department of Mechanical Engineering, IIT Kharagpur was contacted by EMD, Kolkata
PROJECT 3: TECHNOLOGY DEVELOPMENT FOR DRY GRANULATION OF LD SLAG (Contd…) 

➢ STATUS OF PROJECT

• IIT, Kharagpur has submitted technical and budgetary offer for lab scale study. Budgetary offer – Rs.20 lakh; Time period - 24 months (10 lakh/each year);

• Communication were sent to NML Jamshedpur, IIMT Bhubaneswar, IIT Bombay, IIT Delhi, IIT Madras, IIT Kanpur and IISc Bangalore for project proposal

• NML Jamshedpur, IIT Bombay, IISc Bangalore and IIT Madras have responded till date; Based on available project proposals final scope of work shall be finalized

➢ Future plan: Signing of agreement for Lab study
PROJECT 4: TECHNOLOGY DEVELOPMENT FOR DRY GRANULATION OF LD SLAG (Contd...)

SCHEMATIC GA OF LD SLAG DRY GRANULATION SYSTEM (NOT TO SCALE) (conceactual)

FOR PR/TS PURPOSE ONLY

STEEL AUTHORITY OF INDIA LTD.
CENTRE FOR ENGINEERING & TECHNOLOGY, RANCHI

PLANT: ROURKELA STEEL PLANT
UNIT: (BoFST) STEEL MELTING SHOP-1
PROPOSED PILOT PLANT FOR DRY GRANULATION
OF BOF SLAG—SCHEMATIC GA

DESIGNED BY: M.T. MISHRA
CHECKED BY: P. K. SHARMA
APPROVED BY: D. V. SHARMA

DATE: 20/03/2013

DIMENSIONS: SCALE: 1:500

SHEET: 1 OF 1

STEEL SAIL
Solid Waste Management

Advantages of Dry Granulation Process over Wet Granulation Process

• Saving of water at the rate of 1000-1500 Ltr./ton of slag
• Eliminating unwanted gas (eg. SO$_2$) emission
• Recovery of waste heat to reduce energy consumption and consequent reduction in CO$_2$ footprint.

Uses of granulated LD slag

• Granulated BOF/LD slag can be used up to 15 % in the cement industry
• Increased use in base sinter mix and in road making
Feasibility study on utilisation of BOF slag at BSP

Objective:

➢ Improvement in utilization potential of BOF Slag and to establish the feasibility of adoptable technologies / processes
Feasibility study on utilisation/recyclability of select wastes at BSP (Contd…)

Hardened cement concrete samples using BOF slag
Feasibility study on utilisation/recyclability of select wastes at BSP (Contd…)

Cement Floor Tiles using BOF slag (250x250x25 mm)
Study on utilisation prospects of Blast Furnace flue dust (BFFD) & BOF sludge generated at BSL

Objective:

- Explore recycling and utilization prospects of BF flue dust & Characterization & utilization of BOF sludge

Potential constituents:

<table>
<thead>
<tr>
<th></th>
<th>Fe (T)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFFD</td>
<td>34.82 %</td>
<td>33.8 %</td>
</tr>
<tr>
<td>Fe (T)</td>
<td>CaO</td>
<td></td>
</tr>
<tr>
<td>BOF sludge</td>
<td>54.16 %</td>
<td>11.75 %</td>
</tr>
</tbody>
</table>
Study on utilisation prospects of Blast Furnace flue dust (BFFD) generated at BSL and characterisation & utilisation of BOF sludge (Contd...)

Sinter Productivity:

Effect of using BFFD on sinter productivity

Effect of using BOF sludge on sinter productivity

Results:

- Use of BFFD and BOF sludge up to 5 kg per Ton of sinter has no detrimental effect on quality and productivity of sinter
Use of BFFD in clay Bricks Making ->

- **Clay Bricks – Cold Compressive Strength (CCS) kg/cm²**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>0 % BFFD</th>
<th>2.5 % BFFD</th>
<th>5 % BFFD</th>
<th>10 % BFFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCS</td>
<td>28</td>
<td>46</td>
<td>15</td>
<td>22</td>
</tr>
</tbody>
</table>

- Cold Compressive Strength (CCS) of clay bricks made by replacing 2.5% with BFFD increased by almost 1.6 times compared to bricks made only with clay.
Use of BFFD in Briquettes Making ->

<table>
<thead>
<tr>
<th>Composition</th>
<th>Gross Calorific Value, kCal/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2% lime</td>
<td>2846</td>
</tr>
<tr>
<td>5% lime</td>
<td>2468</td>
</tr>
<tr>
<td>10% lime</td>
<td>2683</td>
</tr>
</tbody>
</table>

- Gross Calorific Value of briquettes with 2% lime fines is 2846 kCal/kg
- Can be used as an ordinary fuel to extract its fuel value.
Use of Waste Plastics in Steel Industry

• In the steel industry, some countries use waste plastics in blast furnaces, coke ovens, kilns etc.
• Pioneering work has been done in the area of blast furnace treatment in UK and Germany
• The key aspects of the technology are the preparation of the waste plastics pellets of a consistent quality and subsequent injection of the pellets into a blast furnace
• Contamination by chlorine-containing plastics and some other materials is prohibited in order to prevent any adverse effects to the steel quality
• Technology for preparation of solid fuel from waste plastic with a heating value of 8000 kcal/kg and a method for injecting it into a kiln has been developed and commercially utilized in Japan
Pre-treatment of Plastic waste
Use of Waste Plastics in Steel Industry.

- Coke oven treatment using waste plastics has been developed by a Japanese steel manufacturer.
- Agglomerated plastics are charged into coke ovens together with coal at around 1%, resulting in the formation of gaseous products and other chemicals under pyrolytic conditions.
- Under actual operation, the agglomerate charged into the coke ovens contains about 3% chlorine but, unlike in blast furnaces, the amines from the coal seem to neutralize the hydrogen chloride released from waste plastics without affecting the coke quality.
"THANK YOU"

Best replacement of steel is BETTER STEEL

There’s a little bit of SAIL in everybody’s life
Waste Heat Recovery in SAIL
Waste Heat Recovery

• Heat streams >260°C should be looked upon as a possible source of *economic* heat recovery

• Heat streams >150°C & < 260°C should be looked upon as a possible source of heat recovery
Coke Oven

92% Waste Heat

14% Useful Heat

26% Flue gas

45% COG

7% Equipment

Coke
Coke Oven - CDQ

Coke Dry Quenching

CDQ process

Benefits
CDQ Energy saving
CO2 cut
Water saving
OX, Dust decrease
Better coke quality

Commercialization: Mature
Coke Oven – Flue Gas Heat

• Reduction in coal moisture from 8-9% to 3-5% results in fuel saving of ~0.07 Gcal / t coke

• Other benefits
  – Coke quality improvement ~1.7%
  – Coke production increase ~10%
Sintering Plant – Hot Sinter Heat

Sintering plant

500 - 800°C

250°C

Cooler
## Sintering Plant – Hot Sinter Heat

### Heat recovery in SAIL

<table>
<thead>
<tr>
<th>Preheating of combustion &amp; post ignition air</th>
<th>SP-2 &amp; SP-3, RSP; SP-2, DSP; SP-3, BSP &amp; SP, ISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot air in pre-ignition</td>
<td>SP-3, BSP</td>
</tr>
<tr>
<td>Hot water for sinter mix</td>
<td>SP-2 &amp; SP-3, BSP Under implementation</td>
</tr>
</tbody>
</table>
Expected Benefits

- Recovery of heat to the tune of 1.5 & 2 Gcal/h at SP-2 and SP-3 respectively
- Improvement in productivity by 2 to 5%
- Reduction in specific coke breeze cons.
- Reduction in CO₂ emission by around 10,000 tons per year
Blast Furnace

- Reducing Heat: 62%
- Sensible Heat: 28%
- Stove flue: 10%
- Slag: 4%
- Cooling Water: 3%
- Top gas: 1%
Blast Furnace – Stove Flue Heat

- Stoves are normally 69 – 87% efficient
- Flue gas coming out of stoves at ~300°C contains ~0.10 Gcal / t hm heat
- Combustion air & / or BFG can be preheated up to 200°C via a circulating medium
- ~0.04 Gcal / t hm can be recovered
  - reduces the stove fuel intake
  - increases stove efficiency
Blast Furnace – Stove Flue Heat
Steel Melting Shop

• Energy is contained in the hot metal in its temperature and carbon & silicon content
• Conversion of chemical energy to heat energy takes place during reforming
• Additional energy not required
Steel Melting Shop – LDG Heat

Conversion boiler:
Second radiation section

Gas temperature 450-500 degrees C
Recover 65% of the sensible heat of the total exhaust gas
Steel Melting Shop – LDG Heat

- Partially combusted LDG coming out at 1600 - 1800°C contains ~0.06 Gcal / t cs heat
- 85% of this heat in LDG can be recovered through waste heat boilers generating steam
- More heat recovery is difficult because of increased capital cost in ESP
Steel Melting Shop – Slab Heat

- Slabs / billets / blooms on exit from a continuous casting machine or from a slabbing / blooming mill typically possess sensible heat of 140-160 Mcal / t steel
- The slabs are conveyed through a slab cooling boiler while giving off heat and cooling to 300 °C
- Steam at 40 bar and 450 °C generated, thereby recovering 40-70 Mcal / t steel through slab cooling boiler
Steel Melting Shop – Slab Heat
Steel Melting Shop – Flue Heat
Regenerative Burners in Reheating Furnace

Regenerative Burners

- Burner A
- Burner B
- Ceramic Regenerator A
- Ceramic Regenerator B
- Exhaust gas 200 °C
- Air
- Switch valve

Furnace temperature 1350 °C
Billets 1250 °C
### Waste Heat Recovery Possible

<table>
<thead>
<tr>
<th>Shop</th>
<th>Gcal / t product</th>
<th>Gcal / t cs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>0.44</td>
<td>0.23</td>
</tr>
<tr>
<td>SP</td>
<td>0.13</td>
<td>0.15</td>
</tr>
<tr>
<td>BF</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>SMS</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Mills</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.75</strong></td>
<td></td>
</tr>
</tbody>
</table>
SAIL Action Plan for BF Slag utilization

**BSP** : Out of total 7 furnaces, furnace # 4,5,6,7 have slag granulation facility; Furnace #1,2,3 may be phased out after commissioning of BF # 8

**BSL** : BF 4 & 5 have slag granulation facilities; slag granulation facilities being introduced in BF #1,2,3

**RSP** : Commissioning of BF #5 with Cast House Slag Granulation Plant. 1 & 4 have slag granulation facilities. Short Term Action Plan is to make efficient use of Common Slag Granulation Plant.

**ISP** : New BF#5 with Cast House Slag Granulation Plant

**DSP** : Out of total 3 furnaces, BF #3 & BF #4 have granulation facility

**VISL** : Total 1 BF with slag granulation plant, utilisation 100%
WtE in India: key issues

PLANNING COMMISSION
17TH FEBRUARY, 2014
Energy from municipal solid waste

- This presentation is limited to energy from MSW
- Historically, India had played a pioneering role in processing municipal waste and cattle manure
- A biogas plant was constructed in the leper ashram at Matunga in 1902
- Windrow composting was developed at Indore in 1934
- The number of small biogas plants (gobar gas plant) is second to only China
MSW processing

- Processing facilities / technologies used in India for MSW:
  - Composting
  - Vermicomposting
  - Biomethanation (biogas plant)
  - Preparation of RDF / pellets and
  - Mass burn

- Checkered history of success and failure
The past

- For cattle manure based biogas plants two designs have been very popular – the KVIC design (also called ‘Indian design’) and the fixed dome design with several variations (‘Janta’, ‘Deenbandhu’ etc.), sustained performance – an issue
- However, there are few plants based on MSW (heterogeneous unlike cattle manure)
- Biogas plants fed with canteen food waste have been commissioned in many industrial canteens and hostels
- Examples of city level or even market level biogas plants only a few
The present

- Vijaywada – 20 TPD (16 MSW + 4 slaughterhouse waste) – closed after 2-3 years, Koyambedu flower market – 30 TPD irregular operation, then closed
- Lucknow – 500 TPD controversy between the ULB and BOT operator, closed within a year
- Need to take the learnings from each of these examples.
- Choice of technology and design or bad construction or bad operation or lack of consistency – what were the real problem?
The present
... contd.

- RDF started with Bangalore (5 TPD - private) and Mumbai (80 TPD - DST) in mid nineties. Neither of these sustained.
- DST-TIFAC technology applied in Hyderabad for 150-200 TPD followed by power plant using 700 TPD – did not sustain
- Long period of operation essential for commercial viability, say 20-30 years for these high capital investments
- Some more plants have been tried but sustainability elusive
The mass burn plant in Delhi set up in 1986 could not run – became a famous example due to the wrong reasons.

Quarter of a century later another plant has come up in Delhi.

Lessons learnt?
Issues

- Long term commercial viability of a project is essential
- How do we achieve this? What are the pit-falls?
- Waste characteristics should match technology
- Otherwise pre-treatment (extra space, investment, O&M cost, extra manpower)
- Size of the project – 365 days’ concession, 300-330 days of operation
- Building redundancy – for down time, regular as well as major maintenance
Issues

.. Contd.

- Site constraints – environmental, habitat, statutory requirements, accessibility (safe passage for waste)
- Infrastructure and utilities
- Finances – sink fund for regular and major maintenance and any break down
- Only proven technologies should be considered for large projects (stakes high to very high)
- Safe bet would be minimum 5 years’ commercial operation continuously
Support structure

- For sustained performance, product based support is always advantageous.
- This also helps in checking BOT operators grabbing more projects than they can actually implement and sustain.
- In case there is a felt need for capital grant, the same should be fully covered by a strong instrument, say bank guarantee.
- The bid document is the most crucial document if the ULB wants to take a private partner. Serious deficiency – appropriate model document needed.
Thank You
PPP in MSWM in India: Experiences and Lessons

V. Srinivas Chary
Director, Urban Governance
Administrative Staff College of India (ASCI)
schary@asci.org.in
## Municipal Solid Waste Management - Benchmarks

<table>
<thead>
<tr>
<th>Proposed Indicator</th>
<th>Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household level coverage of Solid Waste Management services</td>
<td>100%</td>
</tr>
<tr>
<td>Efficiency of collection of municipal solid waste</td>
<td>100%</td>
</tr>
<tr>
<td>Extent of segregation of municipal solid waste</td>
<td>100%</td>
</tr>
<tr>
<td>Extent of municipal solid waste recovered/recycled</td>
<td>80%</td>
</tr>
<tr>
<td>Extent of scientific disposal of municipal solid waste</td>
<td>100%</td>
</tr>
<tr>
<td>Extent of cost recovery in solid waste management services</td>
<td>100%</td>
</tr>
<tr>
<td>Efficiency in redressal of customer complaints</td>
<td>80%</td>
</tr>
<tr>
<td>Efficiency in collection of user charges</td>
<td>90%</td>
</tr>
<tr>
<td>Extent of processing and treatment of MSW</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Solid Waste Management – Median Analysis (~1400 ULBS)

<table>
<thead>
<tr>
<th>S.no</th>
<th>Indicator</th>
<th>Unit</th>
<th>Benchmark</th>
<th>Median Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Household level coverage of Solid Waste Management services</td>
<td>%</td>
<td>100</td>
<td>47.5</td>
</tr>
<tr>
<td>2</td>
<td>Efficiency of collection of municipal solid waste</td>
<td>%</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>Extent of segregation of municipal solid waste</td>
<td>%</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Extent of municipal solid waste recovered/recycled</td>
<td>%</td>
<td>80</td>
<td>67.5</td>
</tr>
<tr>
<td>5</td>
<td>Extent of scientific disposal of municipal solid waste</td>
<td>%</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>Extent of cost recovery in solid waste management services</td>
<td>%</td>
<td>80</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Efficiency in redressal of customer complaints</td>
<td>%</td>
<td>80</td>
<td>65 -?</td>
</tr>
<tr>
<td>8</td>
<td>Efficiency in collection of user charges</td>
<td>%</td>
<td>90</td>
<td>30</td>
</tr>
</tbody>
</table>
How PPP will benefit municipal sector?

Current situation of municipal Sector

Financing Constraints
- help to meet financing needs

PPP Can
- provide required skills & technology
- shall improve service levels & accountability

Availability of skills
- Service Levels
• On a more practical note, while public-private partnerships may hold considerable potential, with the wrong partners or badly designed partnerships, they can also combine the worst features of the public and private sectors.

PPP initiatives in India

• More than 100 major contracts
• Tipping fee ranges from Rs 60 to Rs 1900 per tonne
• Scope of contracts vary
  – User charge based PPPs
  – CDM based PPPs
  – Zero tipping fee models
• Confusing signals to decisions makers
• More failures vis a vis success stories
# PPP Model- Solid Waste Management

<table>
<thead>
<tr>
<th>Type of service</th>
<th>Service contract</th>
<th>Management &amp; maintenance contract</th>
<th>BOT and related models</th>
<th>Concessions</th>
<th>Duration of the contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweeping and collection</td>
<td>xxx</td>
<td></td>
<td></td>
<td></td>
<td>1 yrs</td>
</tr>
<tr>
<td>Transportation</td>
<td>Xxx</td>
<td>Xxx</td>
<td></td>
<td></td>
<td>5 yrs</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td>Xxx</td>
<td>Xxx</td>
<td>20 plus</td>
<td></td>
</tr>
<tr>
<td>Disposal</td>
<td></td>
<td></td>
<td>Xxx</td>
<td></td>
<td>20 plus</td>
</tr>
</tbody>
</table>
PPPs in WTE

Select Cases
Timarpur (Old)

• Established at Timarpur, Delhi in 1987 with support from Government of Denmark
• 300 TPD waste and 3.75 MW power generation capacity
• Capital cost Rs 25 crores
• Trial run operated for few months and closed down in 1990
• Mismatch of quality of waste with plant design
Lucknow – Waste to Energy

• To address the critical issue of scientific disposal of MSW in the Lucknow city; Ministry of Non-conventional Energy Sources (MNES), GoI had given directives to the state govt. of UP
  – To Implement Municipal Solid Waste based power plant installation scheme under National Pilot Programme.

• The objective of the project was to process about **300 tonnes** per day Municipal Solid Waste of Lucknow city
  – to obtain 115 tonnes per day of dry volatile solids for production of biogas to be used to generate **5 MW** of **power** per day and
  – to obtain about **75 tonnes** per day **organic fertilizer** out of the slurry of biogas digesters.
Project Details

- Lucknow Nagar Nigam (LNN), partnered with Enkem India Ltd, a promoter, through a Special Purpose Vehicle called Asia Bio Energy (India) Ltd. (ABIL), to build a power generation-cum-bio-fertilizer plant on a Build-Own-Operate-Management (BOOM) basis.

- Project contract agreements viz.,

1. Supply of “Assured MSW” (with LNN, on 14.02.1997),
2. Power Purchase Agreement (with UPSEB, on 31.07.1998),
3. Land lease agreement (on 24.03.1999),
4. MNES in-principle sanction letter (on 27.07.1999) and
5. GoUP Guarantee agreement (on 10.02.2000)
Lucknow WTE

• M/s ABIL has signed a **30 year PPA** with UPSEB / UPPCL.

• The **tariff under PPA** (MNRE guidelines) - **Rs.2.48** per unit to be compounded at 5% p.a.

• The **total project cost** was estimated approximately **Rs. 760 million**.
Lucknow WTE

- The plant was based on BIMA (Biogas Induced Mixing Arrangement) technology, patented and commercialized by M/s Entec, Australia.
- The project construction has started in 2001 and has completed in 2003.
- Initial Feeding of 45 TPD MSW - commenced in August 2003.
- Waste processing quantity increased to 150 TPD by Oct 2003.
- The plant did not operate to its full capacity. M/s ABIL reported that it was due to non-availability of required quality of MSW.
Lucknow WTE

• **A meeting** of the High Level Monitoring Committee of **MNRE** was held in **January 2004**

• Certain **modifications** were carried by M/s ABIL in the **waste segregation system** of the plant.

• As a result, the plant started receiving **30 tonnes of** segregated organic waste, and power generation level of **1.5 MW** was achieved.

• Thereafter, the **output** of the plant **decreased**. The reason indicated by M/s ABIL was the **poor quality** of MSW supplied by LNN, and the **plant was closed** on **19th December 2004**.
Another Meeting of the High Level committee of MNRE held on 19th January 2005 decided on an Action Plan to restart the plant. Following were the key features of the Action Plan.

- LNN would start supplying 200 tonnes of MSW of assured quality per day within 4 months.
- Amount of waste would be increased gradually by LNN to 600 tonnes per day within 4 months.
- ABIL would open the plant on 10th February 2005 to receive the required quantity of waste.
- M/s ABIL would start operating the plant with effect from 20th February 2005.
Lucknow WTE

• **M/s ABIL** on 31st January 2005, filed an **Arbitration Petition** in the Lucknow Branch of the Hon’ble High Court for appointment of an Arbitrator for adjudicating the dispute

• The High Court has nominated Mr. Justice D.N. Jha, a retired Chief Justice of this High Court as an Arbitrator.

• M/s ABIL has informed that an **additional working capital** of Rs.3.00 crore by LNN/ State Government (GoUP) in the form of **equity participation** was needed for recommencement of the plant

• This **demand of M/s ABIL has not been accepted** by LNN and the State Government (GoUP). IDFC, had also expressed their inability to provide further financial assistance

• The Plant got closed
Subsequent to MNRE interventions, M/s ARCIL (Asset Reconstruction Company India Ltd.) was appointed by MNRE and IDFC for revival of the plant.

ARCIL has acquired the assets of ABIL. ARCIL has carried out a preliminary assessment and techno-economic study.

Meetings were being held by MNRE with various stakeholders, time to time, including Municipal Commissioner, Lucknow.

M/s ARCIL has identified a promoter and their final proposal is to be submitted to MNRE.
Lucknow WTE

1. **Lack of Technical Feasibility studies**, led to poor quality of MSW supplied by LNN to ABIL.

2. **Lack of Financial Viability assessment**, which resulted in cost over-runs.

3. **Project Structuring**: lack of motivation by the Govt. for greater involvement in the effective implementation of the project.

4. **Resolution of Issues**: There was no independent regulatory authority at state/central level to resolve the project implementation issues.

5. **Bid Documentation**: Lack of proper advisory support led to unanticipated problems
Kanpur

• Composting and RDF technologies
• Operational since 2010 by A2Z Infrastructure
• Integrated facility with 1500 TPD installed capacity at a cost of Rs 64.60 crores on 46 ha of land
• Facilities – tipping platform, pre-segregation unit, RDF unit, composting unit, brick manufacturing unit, plastic segregation unit and sanitary landfill
Kanpur

• PPP approach
• Tipping fee Rs 95 per TPD
• Compost sold at Rs 2000-2500 per ton, RDF at Rs 2500-3000 per ton, plastic Rs 5 per kg, and brick Rs 4 per brick
Rajkot

- 300 TPD capacity, operated by Hanjer
- No capital or tipping fee support from ULB
- ULB provided only land and support infrastructure
- Integrated facility producing compost, RDF, plastic ingots and sand
- Capital and O&M cost met from revenues
Green Technology for Green Products: 100% Segregation of Mixed waste

Mixed/Co-Mingled Residual waste

AUTOMATIC SEGREGATION (100%)

Composting by Bio-Methanation

Wet fraction

Dry fraction

Recyclables like plastics

Inert material

Gasification

Compost 14%

Methane Gas

Green RDF & RDF in Charcoal form 18.5%

Liquid RDF 1.2%

Plastic ingots 2%

Sand 5%

Fertilizer

Green energy

Furnace Oil

Remnant to landfills (below 5%)
Guwahati

- Integrated facility by Ramky, 20 years BOOT
- Compost, RDF and power
- Compost plant 50 TPD
- 500 TPD RDF Plant
- 180 TPD of RDF with a calorific value of 2500-2800 kcal/kg and 57 TPD of biomass to be used to produce 6 MW power
- Capital cost Rs 102 crores; JNNURM Rs 35 crores, operator, Rs 67 crores
- Tipping fee, revenues from sale of compost RDF and power to meet O&M costs
Vijayawada

• By Shriram Energy Systems in 2003
  – In partnership with VMC
  – With support from TIFAC and MNRE
  – Use of RDF, incineration and combustion technology

• Capital and O&M cost by private operator
  – Subsidies from TIFAC and MNRE

• VMC to provide
  – 225 MTD waste free of cost
  – land for setting up the facility at nominal cost
Vijayawada

• To produce 6 MW of power from waste
  – Up to 30% from bio material such as rice husk and wood chips??
• To sell the power to APTRANSCO at Rs 3.5 per unit
• Plant operated successfully until 2007 and closed due to poor calorific value of waste
Vijayawada

Bio-methanation

- Mailhem Engineers Limited set up the plant
  - Based on waste and slaughter house waste
- Plant capacity – 20 TPD
- VMC provided Rs. one cr as subsidy (?)
- O&M cost estimated at Rs. 1.5 crore while revenue from sale of power estimated at Rs. 1 crore
- Technology - anaerobic digestion of wet or organic waste to produce bio-gas
- Successfully operated for a couple of years
- Closed for several reasons including:
  - Non-availability of waste,
  - Weak ULB support
Hyderabad

- SELCO International established 6.6MW waste to energy power plant based
- In partnership with MCH
- Technology - RDF/pelletisation and incineration based technology
- The RDF plant commenced in 1999 and power plant in 2003
- Technology Development Board provided term loan
- Technology Information Forecasting Assessment Council (TIFAC) extended technology assistance
Hyderabad

- Plant generated 74 million units of power by processing 5 lakh tons of MSW
- Closed due to criticism and controversy
  - Opposition from environmentalists and others
  - Excessive use of bio material exceeding the permissible limits
  - High levels of air pollution due to poor technology
A.P. Cluster (Waste to) Energy Plants

• C&DMA grouped 122 ULBs into 19 Clusters
  – to develop waste to energy power projects
  – G.O.Rt.No.1464 MA dated October 24\textsuperscript{th} 2005
  – GHMC excluded

• Only five clusters covering 66 ULBs approved
# A.P. Cluster Based Power Plants

<table>
<thead>
<tr>
<th>Location</th>
<th>Karimnagar / Shalivahana</th>
<th>AP</th>
<th>Chirala / Green Energy</th>
<th>Chittoor / Bee Pee</th>
<th>Rajahmundry / Yuvraj</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rebladevipalli, Vibhulaparam, Chirala</strong></td>
<td>Rebladevipalli, Vibhulaparam, Chirala</td>
<td>Rebladevipalli, Vibhulaparam, Chirala</td>
<td>Rebladevipalli, Vibhulaparam, Chirala</td>
<td>Rebladevipalli, Vibhulaparam, Chirala</td>
<td>Rebladevipalli, Vibhulaparam, Chirala</td>
</tr>
<tr>
<td><strong>Cost (Rs.in cr.)</strong></td>
<td>102.13</td>
<td>98.24</td>
<td>10.00</td>
<td>165.12</td>
<td>136.01</td>
</tr>
<tr>
<td><strong>Date of Permission</strong></td>
<td>April 2006</td>
<td>April 2006</td>
<td>April 2006</td>
<td>Nov. 2006</td>
<td>Nov. 2006</td>
</tr>
<tr>
<td><strong>Capacity (MW)</strong></td>
<td>12</td>
<td>12.6</td>
<td>1</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td><strong>Statutory Permissions</strong></td>
<td>Obtained</td>
<td>Obtained</td>
<td>Not obtained</td>
<td>Obtained</td>
<td>Obtained</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Commissioned April 2011</td>
<td>80% of completed held up due to non-release of funds from financial institutions</td>
<td>Not responding and whereabouts not known</td>
<td>No construction work commenced except leveling of site</td>
<td>70% construction work completed and held up due to non-release of funds from financial institutions</td>
</tr>
</tbody>
</table>

30
Delhi

• Three plants
  – Okhla and Timarpur – 16 MW, 2050 TPD, power to 6 lakh houses, Rs 200 crores, operated by Jindal
  – Ghazipur – Integrated facility of compost and WtE, 12 MW, Belgian technology, will use 5 million tons of waste already dumped
  – Narela – Bawana Road- 36 MW
Pune

• 10MW Power Plant proposed under BOOT and 2.5 MW capacity is already operationalized
• Operated by Concord Blue Technology Pvt Ltd
• Patented and indigenously developed technology called Concord Blue Tower
• Meets EPA and European emission standards
• MoU for 25 years; 650 TPD capacity
• Capital cost Rs 15 crore per MW
• Tipping fee Rs 300 per ton
Hyderabad Integrated Waste Treatment Facility

- PPP in integrated ISWM in Hyderabad Proposed
- Collection and transportation component not operational
- Compost plant operational and landfill partly operational
- Waste to energy yet to commence
Lessons
Key Lessons

• **Weak policy framework at the State level**
  – Perceptions about tipping fee
  – MSW may require capital support / viability gap support and this is not appreciated by the Governments

• **Weak institutional capacity at the State level / City level to structure PPPs**
  – Project development capacity
  – Financial modeling
  – Lack of understanding of VGF, IIPDF and MNRE schemes

• **Diluted project development process**
  – Lack of credible information
  – Weak prequalification criteria
  – Contracts are often led by operators
  – Corrupt practices
Key lessons

• Limited fiscal support
  – WTE / MSWM is a waste treatment plant not a power generation plant
  – MSWM requires substantial capex and opex
  – Limited grants / fiscal incentives
  – ULBs have limited understanding of VGF
  – Municipal Acts do not permit user charges

• Lack of standardization of technology choice and PPP options

• NIMBY Syndrome

• No/weak regulatory mechanism

• Capacities of ULBs to manage the sector and absence of continuous advisory support to ULBs
Key Lessons

• Absence of source segregation
• Delays / ad hocism in land allocation
  – leading to cost escalation
• Weak initiative and commitment of ULB
  • Political will
Action Imperatives

• States should evolve policies as per the advisory / directives of GoI
• Standardization of technology options – establishment of TAGs at the state level to review and recommend technology and financial options
• State level institutional capacity
  – State SWM Board – a project development support unit
• Mission mode project for improving Sanitation - Fiscal incentives to support Capex
• Land should be provided by the Government
• Promote user charge on the lines of U.P/Bangalore etc
Action Imperatives

• Strengthening planning for MSWM in sync with master plans
• Favorable tariff regime for WTE sector
• JV models with equity from ULBs may be encouraged
• Capacity building of State and City level institutions – project development process and monitoring
  – Environmental engineering cadre in ULBs
• Strengthening regulatory role – SPCB
• Regional approaches for treatment and disposal to enhance project viability.
• Strengthening communication strategy and citizen participation
Recommendations

• **Putting in place a policy**
  – Financials, incentives, VGF, tipping fee, technology choice, PPP procurement, land, capacity and regulatory issues
  – Articulate user charge structure

• **Restructuring, strengthening SWM Board**
  – Overall advisory and technical support to ULBs under CDMA
  – Technical capacity, project development support, capacity building, PPP Management etc.

• **Create PPP Development Fund of Rs.100 cr.**
  – MSW Plan, PF studies, DPRs, BPM, capacity building, IEC etc.

• **Creation of state VGF to support PPPs in small / cluster ULBs**
Recommendations

• Technical Committee to standardize technology options, financing models
  – Composting, waste to energy and integrated technology options
  – Decisions on the tipping fee, tariffs for products (compost and PPA), marketing strategy

• Regional approaches for treatment and disposal to enhance project viability.

• Establish independent monitoring and evaluation

• Strengthening regulatory role – SPCB

• Capacity building across state and ULBs

• Strengthening communication strategy and citizen participation