Promotion of low carbon city by properly developing material recycling systems in Bengaluru City（Yokohama City- Bengaluru City Cooperation Project）

Final Report

March, 2016

City of Yokohama

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Institute of Global Environmental Strategies

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Contents

LIST OF ACRONYMS AND ABBREVIATIONS

3R	Reduce, Reuse, Recycle
BBMP	Bruhat Bengaluru Mahanagara Palike
BESCOM	Bangalore Electricity Supply Company
BWSSB	Bangalore Water Supply and Sewerage Board
CO_2	Carbon Dioxide
DWCC	Dry Waste Collection Centre
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
FIT	Feed in Tariff
FS	Feasibility Study
GDP	Gross Domestic Products
GHG	Green House Gas
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
IGES	Institute of Global Environmental Strategies
INDC	Intended Nationally Determined Contributions
INR	Indian Rupee
JPY	Japanese Yen
KCDC	Karnataka Composting Development Centre
KREDL	Karnataka Renewable Energy Development Limited
KSPCB	Karnataka State Pollution Control Board
KUIDFC	Karnataka Urban Infrastructure Development & Finance Corporation Ltd.
MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Waste
O&M	Operation and Maintenance
PPP	Public & Private Partnership
RDF	Refuse Derived Fuel
RPF	Refuse Paper and Plastic Fuel
SPC	Special Purpose Company
SWM	Solid Waste Management
UNFCCC	United Nations Framework of Conventions on Climage Change
WTE	Waste to Energy
Y-PORT	Yokohama Partnership of Resources and Technologies

1 Preface

1-1 Background

(1) Host Country's View on JCM

The Japanese government has been promoting the introduction of Joint Crediting Mechanism (JCM) as a new market-based mechanism that can appropriately evaluate the effort of GHG emission reduction overseas through the provision of Japanese low carbon technology, infrastructure and products. In the UNFCCC-centred international negotiations on climate change, discussions have been made for a new market-based mechanism and it has been decided to conduct a work programme for various approaches including JCM proposed by the Japanese government. The work programme is expected to review its framework, function, roles and method to prevent double counting in the international credit transfer.

In this background of discussion of an international system, there is an urgent need to demonstrate a methodology and procedure that can overcome challenges of existing market-based mechanism, support developing countries to reduce GHG emission and realise a low carbon society while concurrently achieving the mid-term goal of GHG emission reduction of the Japanese government. The Paris Agreement adopted in COP21 of UNFCCC in 2015 has also positioned the application of a new market-based mechanism as an important issue. The Japanese government has signed bilateral documents for JCM with 15 countries so far.

India's GHG emission was 1.9 billion and 54 million t-CO_2 in 2012 and this ranked third after China and the United States (fourth if EU is also counted). This accounts for 6.2% of the global GHG emissions. The government of India has issued National Action Plan for Climate Change in 2008 which identifies eight core national missions running through 2017 and directs ministries to submit detailed implementation plans. Further, India is dependent on the import of oil from overseas and hence has put a high priority on the development of renewable energy sources and has set incentives for renewable energy generation projects.

The Intended Nationally Determined Contribution (INDC) of India submitted to UNFCCC also mentioned the introduction of Waste to Energy (WTE) technology. Although Japan and India have not signed bilateral documents yet at this moment, it is hoped that actions for the agreement will be accelerated by a tangible project development through this study.

(2) Background of the study (City to City Cooperation)

This study is based on a city to city cooperation between City of Yokohama, Japan and Bengaluru City, India. City of Yokohama promotes international technical cooperation projects where both public and private sectors can actively participate in and work together for solving urban issues in the emerging countries through Y-PORT,(Yokohama Partnership of Resources and Technologies). Y-PORT is an initiative where Yokohama City government, research institute (IGES), government

affiliated organizations, CITYNET Yokohama Project Office and various private enterprises are actively working together for harnessing Yokohama's technology and know-how to contribute to emerging countries.

IGES, Mansei Recycling Systems and JFE Engineering are all members of Y-PORT and this study project was formulated as a part of this Y-PORT, a platform that promotes public-private partnership for the resolution of urban problems.

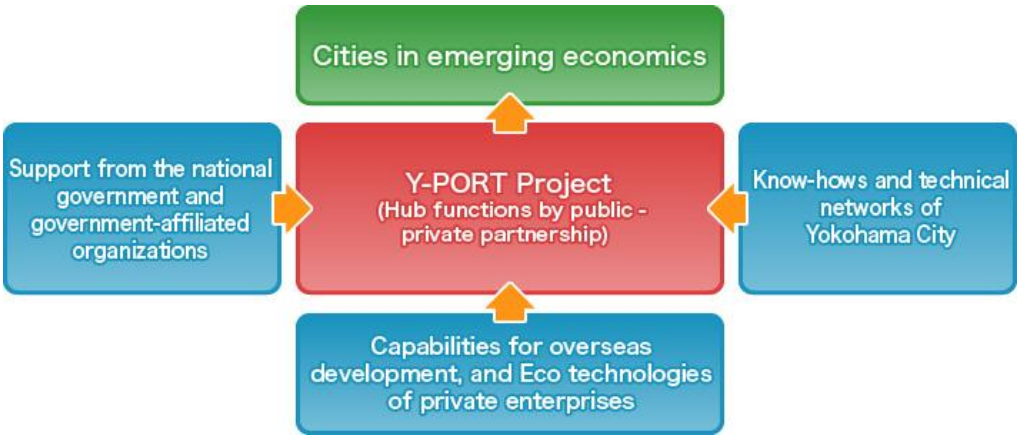

Figure 1-1: Functions of Y-PORT

Source: http://www.city.yokohama.lg.jp/kokusai/yport/en/

City of Yokohama and Bengaluru City have promoted technical cooperation in the field of solid waste management, water supply and sewage treatment and implement training sessions in this arena. In 2013, Bengaluru City requested Yokohama City for their cooperation in the field of solid waste segregation and discussions have been held on this matter since then.

It is essential to have a good partnership between the local government and citizens/private entities for the reduction of solid waste generation. City of Yokohama has many achievements in the area of reduction of solid waste generation obtained through awareness raising activities and close communication with its citizens and private enterprises. City of Yokohama intends to utilize its experience to conduct a study to explore business potential in solid waste management in Bengaluru and if feasible intends to promote JCM project with private companies to realize the solution.

Yokohama city has faced various urban problems such as natural disasters, war damages, population growth and environmental degradation and this fact has led to Yokohama developing technologies and know-how to resolve these problems. Yokohama city believes that these technologies and know-how can contribute to solve urban problems associated with rapid urbanization in the growing economies such as the Asian countries. Under this recognition, Yokohama city supports private companies to develop their business in the field of urban infrastructure overseas through Y-PORT by harnessing Yokohama's resources and technologies with the ultimate aim of revitalizing Yokohama's local economy.

1-2 Study Objective and Methodology

(1) Objective

This study aims to achieve the following by formulating a WTE (Waste-to-Energy) project and RDF (Refuse Derived Fuel) project based on a city-to-city cooperation between Ciy of Yokohama and Bengaluru city.

① Reduce GHG emission by preventing the emission of methane associated with municipal solid waste landfill

② Reduce GHG emission by introducing WTE technology that can utilize municipal solid waste and sewage sludge as fossil fuel substitute to generate energy

③ Achieve reduction, deodorization and detoxification of municipal solid waste and utilize landfill sites more effectively

④ Contribute to build a low carbon city system for Bengaluru and sustainable development in India ultimately

(2) Methodology

This study comprehensively covers the following items related to Waste to Energy (WTE) and Refuse Derived Fuel (RDF) facility introduction in Bengaluru.

1) WTE

1. Basic Information Collection

- Current status on and existing plans of MSW generation, flow, waste characterization, MSW treatment and disposal strategies, MSW management facilities and treatment fees
- Current status on treatment and disposal of sewage sludge
- Current status of MSW segregation and segregation method that fits in the future scenario where a WTE plant exists

2. WTE Facility Design

- Based on the results of (a), develop a conceptual design of a WTE facility taking into account the treatment capacity, waste quality to be accepted, incineration facility, waste heat recovery system (boiler, turbine, and adjunct facilities), approximate estimate of initial cost and operation and maintenance cost.
- Based on the results of (a) consider the possibility of co-combustion of sewage sludge.

3. Financial Analysis

- The project cost varies largely depending on the location and specification of the electric power substation that the WTE plant connects to. Hence, conduct interview survey of relevant

organizations in Bengaluru and Karnataka State.

- Review project feasibility based on the economic evaluation.

4. Survey for JCM Registration

- Set the default value that can assure Measurement Reporting and Verification (MRV) methodology, eligibility criterion and conservativeness. Particularly in determination of eligibility criterion, identify the facilities that are conventionally introduced, compare the local conventional technology and Japanese technology and confirm the superiority of Japanese technology.
- Study organizational structure for MRV implementation.

5. Business Plan

- Based on the above, a business plan will be developed. Specific contents include financial plan, project implementing body, business planning procedures.

2) RDF (RPF)

1. Basic Information Collection

- Waste characteristics (e.g. physical composition and lower calorific value)
- Locations of cement factories in and around Bengaluru

2. Business Development and Marketing

- Functions and roles of DWCC
- Estimation of annual plastic waste residue generation
- Needs survey of the potential customers (e.g. current fuel cost, possibility to use RDF, affordable cost)
- RDF preparation cost including collection, segregation, preparation, and transportation
- Marketing and identification of potential customers
- Interviews of potential partner companies
- Calculation of profitability
- Basic business plan development

3. Facility Design

- Confirmation of product quality required from customers
- Calculation of initial cost of pre-treatment facility based on the determined scale, manpower, and capacity
- Determination of scale, capacity, location and the number of plants
- Basic RDF facility design

- Survey of transportation plan

4. Other necessary survey

- Survey related to Special Purpose Company (SPC) establishment such as local potential partner companies
- Necessary permits and approvals
- Environmental integrity securement

5. Survey for JCM Registration

- JCM methodology development
- Organizational structure for MRV implementation

6. Business Plan Development

1-3 Implementing Structure

The roles and responsibilities of different organizations that participated in this study are shown in the table below.

Table 1-1: Roles and Responsibilities of the Organizations conducting the study

Roles	Organizations
General overview and Advisory	Yokohama City Government
WTE	EX Research Institute together with JFE Engineering
RDF	Mansei Recycle Systems
Policy Research	Institute for Global Environmental Strategies

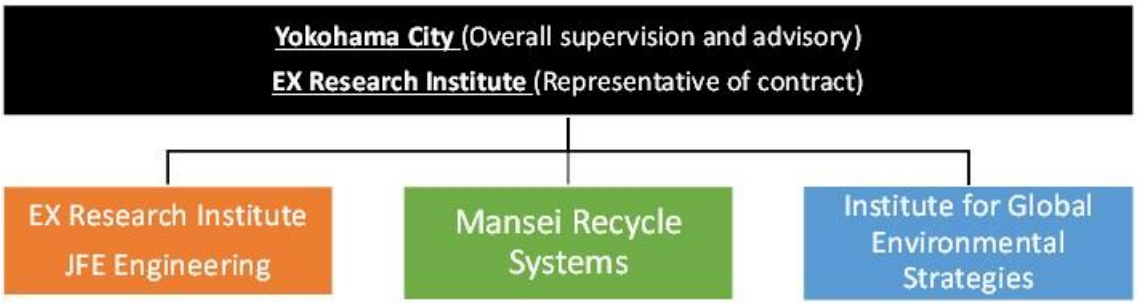

Figure 1-2: Implementation structure

1-4 Schedule

The study components shown above and other related activities were conducted according to the schedule shown below.

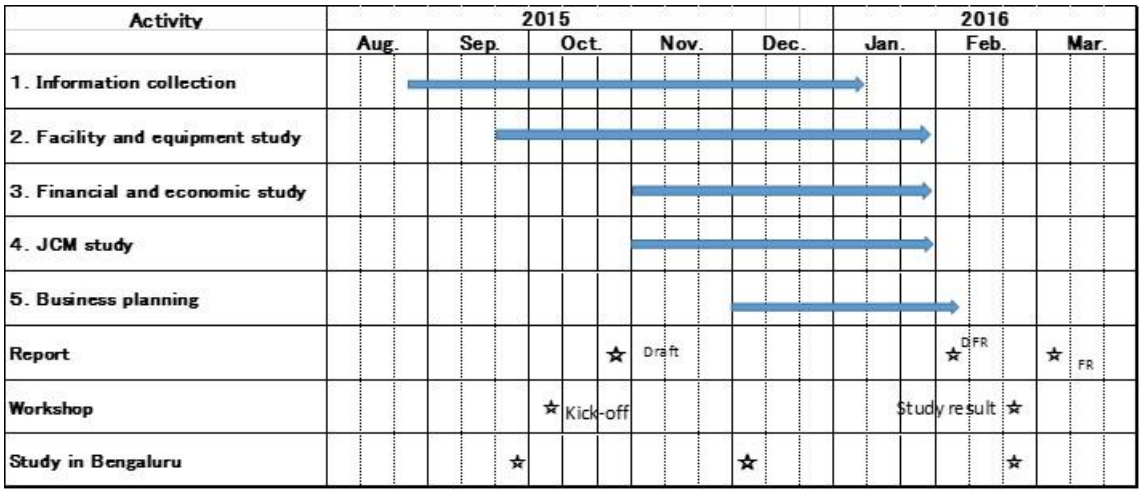

Figure 1-3: Study Schedule

2 Overview of India and Bengaluru

2-1 Environmental laws and regulations of India

(1) Laws and Regulations Related to Waste

1) Classification of Waste

Waste is classified in India as shown in the table below. Waste is broadly classified as Municipal Solid Waste (MSW), Hazardous Waste and Bio-Medical Waste and is governed by different regulations as shown below

Table 2-1: Classification of Waste in India

Classification	Relevant Regulations
Municipal Solid Waste	The MSW (Management and Handling) Rules, 2000
Commercial Waste (similar to Municipal Solid Waste)	
Horticulture / farm waste / Municipal Solid Waste）	
Horticulture Waste	
Hazardous Waste	The Hazardous Wastes (Management and Handling) Rules, 1989
Bio-medical Waste	The Bio-medical Waste (Management and Handling) Rules, 1998
E-Waste	E-Waste Management and Handling Rules, 2010

Municipal waste, the subject of this project is governed by the MSW (Management and Handling) Rules and its outline is summarized below.

2) MSW (Management and Handling) Rules

Municipal Solid Waste (Management and Handling) Rules, 2000: (MSW Rules 2000） is the governing regulation regarding municipal solid waste in India. This rule provides for the central pollution control board (CPCB) to monitor the implementation of the MSW rules 2000 and assigns the responsibility of the implementation of the rules to the various municipalities. The major points of the rule is listed below.

- Focus on segregation of waste
- Carry out activities regarding awareness raising for adequate management of waste
- Involve the public and the NGO in the waste management process
- Give priority to composting and methane fermentation for the treatment of organic component and minimize to the fullest extent the amount to be landfilled

In 2015, a proposal for the revision of the MSW rules 2000 has been proposed and its contents are

as follows

- Classification of waste : Waste is categorized into 4 categories ; Dry or non- biodegradable, Wet or biodegradable, Domestic Hazardous waste, Construction and Demolition waste
- Identification of the entities responsible for municipal solid waste : Clarification of the roles of the MoEFCC, MoUD(Ministry of Urban Development, Ministry of chemicals and fertilizers, Central pollution control board (CPCB), State pollution control boards(SPCB), municipalities, state government
- Recognition of the informal sector :Material Recovery Facility (MRF) specified as the temporary storage place for non-biodegradable waste and segregation and collection of valuables by the informal sector is recognized
- Introduction of User fee: Introduction of User-Fee for generators. Municipalities to determine the amount of user fee
- Promotion of decentralized waste treatment facilities
- Determination of waste management policy. Detail as follows:

Table 2-2: Policy on waste management as proposed in the 2015 MSW rules (draft amendment) (Summary only)

Parameter	Content
Storage of segregated solid waste at source	Prohibition of littering and open burning of solid waste, Urban local bodies to promote public awareness and promote segregation
Collection of solid wastes	▪ Door to door collection of waste by vehicles ▪ Bio-degradable wastes from fruits and vegetable markets, meat and fish markets, horticulture waste from parks and gardens, to be collected separately to make optimum use of such wastes and minimise the cost of collection and transportation of such waste ▪ Large institutional premises, residential complexes to be motivated and incentivized to process bio-degradable waste within their campus to the extent it is feasible to do so ▪ Construction and demolition wastes or debris to be separately collected and processed without mixing with other waste ▪ Appropriate user fees or charges shall be levied from the waste generator
Sweeping of street and cleaning of surface drains	▪ Urban local body shall arrange for cleaning of roads, streets, lanes,bye lanes, surface drains and public places at regular intervals
Secondary storage	▪ Segregated solid waste collected from the door step to be transported directly to respective waste processing facility having facility of sorting and recovery of recyclable waste and in absence of such arrangement, the waste collected from the doorstep to be taken to waste storage depots for secondary storage of waste; ▪ Not to bring in hazardous waste and E-waste

Parameter	Content
Material Recovery Facility（MRF）	▪ The urban local body shall designate temporary storage spaces and setup material recovery facility where non bio-degradable or recyclable solid waste collected from the doorstep shall be temporarily stored by the urban local body or operator of the facility before solid waste processing or disposal is taken up in order to facilitate segregation, sorting and recovery of various components of recyclable waste by informal sector of waste pickers or any other staff or agency engaged by the urban local body for the purpose and such sorting facilities shall be so designed that the solid waste stored is not exposed to open atmosphere and shall be user-friendly.
Processing of solid wastes	Urban local bodies shall adopt suitable technology or combination of appropriate technologies, with emphasis on decentralised processing to make use of all components of wastes that can be processed so as to minimise burden on landfill. Following criteria shall be adopted, namely.- ▪ (a) bio-degradable wastes shall be processed by bio-methanation, composting, vermi composting, anaerobic digestion or any other appropriate biological processing for stabilisation of wastes. ▪ (b) it shall be ensured that composting or any other end product shall comply with standards as specified in Schedule–II and also ensure that no damage is caused to the environment during this process; ▪ (c) to the extent feasible market waste may be processed or treated within the market area and horticulture waste within parks and gardens to make optimum use of such wastes and minimise the cost of collection and transportation of such waste; ▪ (d) dairy waste shall be used for bio-methanation or vermi-composting or aerobic composting, either separately or with other bio-degradable solid waste; ▪ (e) arrangement shall be made to provide segregated recyclable material to the recycling industry through waste pickers or any other agency engaged or authorised by the urban local body for the purpose; ▪ (f) residual combustible wastes shall be utilized for supplying as a feedstock for preparing refuse derived fuel (RDF) or for generating energy or power from the waste by adopting proven waste to energy technologies for which emission standards as well as standards for 18 dioxins and furans have been prescribed by the Central Pollution Control Board; ▪ (g) non-recyclable plastics and other high calorific content waste may be utilized for co-processing in cement kilns or for polymer or fuel production or manufacturing of products such as door panels and the like nature; ▪ (h) construction and demolition and other inert wastes shall be utilized for making bricks, pavement blocks, construction materials such as aggregates; and ▪ (i) urban local body or the operator of a facility planning to use other state-of-the- art technologies shall approach the Central

Parameter	Content
	Pollution Control Board to get the standards laid down before applying for grant of authorisation.
Disposal of waste	▪ land filling or dumping of mixed waste shall be stopped soon after the timeline as specified in Rule 10 for setting up and operationalisation of sanitary landfill is over; ▪ landfill shall only be permitted for non-usable, non-recyclable, nonbiodegradable, non-combustible and non-reactive inert waste and other wastes such as residues of waste processing facilities as well as preprocessing rejects from waste processing facilities and the landfill sites shall meet the specifications as given in Schedule–I, however every effort shall be made to recycle or reuse the rejects to achieve the desired objective of zero waste going to landfill; ▪ landfill site shall provide an appropriate facility for sorting, storing and transportation of recyclable material to the processing facility and ensure that such wastes do not get land filled; ▪ all old open dumpsites and existing operational dumpsites shall be carefully investigated and analyzed about their potential of bio-mining and bio-remediation and actions shall be taken accordingly in cases where such course of action is found feasible; and ▪ In absence of potential of bio-mining and bio-remediation of dumpsite, it shall be scientifically capped as per landfill capping norms to prevent further damage to the environment.

(2) Climate Change and Renewable Energy Policies

1) Climate Change Policy

As of 2012, India is the third largest emitter of CO2 in the world behind China and the US. On 30th of June, 2008, then prime minister of India, Mr. Manmohan Singh presented the National Plan for Climate Change (NAPCC). The plan identifies 8 missions until 2017 and requires the relevant ministries to present implementation plans to the Prime Minister's Council. The major points of the missions is summarized below[1].

1. National Solar Mission: The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes:
   - Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments;
   - A goal of increasing production of photovoltaics to 1000 MW/year; and
   - A goal of deploying at least 1000 MW of solar thermal power generation.

[1] Website of center for climate and energy solutions (http://www.c2es.org/international/key-country-policies/india/climate-plan-summary)

Other objectives include the establishment of a solar research center, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

2. National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012. Building on the Energy Conservation Act 2001, the plan recommends:
   - Mandating specific energy consumption decreases in large energy-consuming industries, with a system for companies to trade energy-savings certificates;
   - Energy incentives, including reduced taxes on energy-efficient appliances; and
   - Financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.
3. National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning, the plan calls for:
   - Extending the existing Energy Conservation Building Code;
   - A greater emphasis on urban waste management and recycling, including power production from waste;
   - Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles; and
   - Incentives for the use of public transportation.
4. National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures.
5. National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.
6. National Mission for a "Green India": Goals include the afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.
7. National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.
8. National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourage private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

On October 1, 2015, India has presented the INDC[2]（intended nationally determined contribution）to the UNFCCC. This specifies that India will have an objective to reduce the emission intensity of global warming gas by 33-35% by 2030 compared to 2005. However, emission intensity is the emission amount per GDP and hence even with a decrease in emission intensity, the total emission amount will increase.

Further, the INDC has an objective of generating 40% of total energy generation through renewable energy by 2030.

2) Renewable Energy

Ministry of New and Renewable Energy (MNRE) of the central government is the responsible ministry for renewable energy policies in India. In the 12th 5-year plan, it is planned to increase the share of renewable energy in the energy supply from 2.53% in 2011-12 to 3.66 in 2016-17.

In order to promote renewable energy, activities that are being undertaken include (1) Obligating the power companies to purchase renewable energy; (2) financial support (low interest loan, tax breaks, etc.) to renewable energy generators; (3)Support for Research and Development.

In the state of Karnataka, energy regulations fall under the jurisdiction of Karnataka Energy Regulatory Commission (KERC) and the purchase-price of renewable energy (e.g. Feed-in-tariff) is also decided by KERC. Karnataka Renewable Energy Development Agency (KREDL) has been setup to act as the front for renewable energy in Karnataka. In regards to renewable energy policy, Draft Karnataka Renewable Energy Policy 2014-2020 has been prepared which predicts the power generation through Biomass, Cogeneration and MSW to be 400MW. The purchase price for renewable energy obtained from waste to energy has not been specified and is expected to be decided on a case by case basis.

(3) Environmental Impact Assessment System

In India, Environmental Impact Assessment (EIA) is a process that is a part of the Environmental Clearance (EC) process which is required for projects that have possibility to have adverse impacts to the environment. The EC process is stipulated by the Environmental Impact Assessment Notification – 2006 (EIA notification, hereinafter) of September 2006[3]。

The EIA notification requires 39 types of projects to obtain EC[4]。However, according to project type, a detailed EIA is not required and the necessity of carrying out EIA is determined during the EC process.

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2 http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf

3 EIA notification 2006 (http://envfor.nic.in/legis/eia/eia-2006.htm)

4 When the project lies in a forest area, it is necessary to get forest clearance according to the Forest (Conservation) Act before carrying out EIA.

Projects subject to EC clearance process are classified into 「A」 or「B」 according to the degree of health and resource impact and the process differs for the respective classification.

The EIA notification requires the following projects to obtain Environmental Clearance.

a） New projects specified in the Schedule of the EIA notification (39 types)

b） Expansion work for existing projects classified under a) above. However, this only applies if the scale of the project after expansion exceeds the threshold limit specified in the Schedule.

c） Changes to content of the project that fall under a) above resulting in exceeding of limitations specified by the notification

All the Common Municipal Solid Waste Management Facilities are classified as「B」.

Projects classified as [A], under the recommendation of the Environmental Appraisal Committee (EAC)[5] setup by the central government, need to get the Environmental clearance from the central government (MoEFCC). However, projects classified as [B] need to get the Environmental Clearance from the State Environment Impact Assessment Authority (SEIAA) setup by the central government on the state level. The SEIAA provides Environmental Clearance based on the recommendation of the State level Expert Appraisal Committee (SEAC[6]). In states where SEIAA and SEAC do not exist, type [B] projects also have to undergo the same process as type [A] projects to obtain environmental clearance.

According to the amendment (2009) of the EIA notification, power plants using biomass (up to 15MW), Power plants using municipal waste without any hazardous components and power plants with heat recovery boilers (not using any auxiliary fuel) are exempted from the EC process[7].

(4) Water and Air

1) Water (Prevention and Control of Pollution) Act

The Water (prevention and control of pollution) Act, 1974 is an act aimed to prevent and manage water pollution and to improve water quality. It establishes the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCB) and defines their function and powers. Further, it also prohibits the discharge of effluent into public water bodies without the permission of the respective authority and establishes a system of punitive measures for those violating the act. Based on the Water Act, the Water (Prevention and control of pollution) Rules was formed which further clarifies the function of the CPCB along with determining the cost of carrying out water quality

[5] A body established by the central government to provide technical advice to the MoEFCC during the evaluation of projects classified as type A.

[6] A committee established to give technical advice to the SEIAA

[7] EIA notification 2009 amendment（http://www.moef.nic.in/downloads/rules-and-regulations/3067.pdf）

analysis at CPCB owned laboratories. The relation between various environmental bodies is shown below.

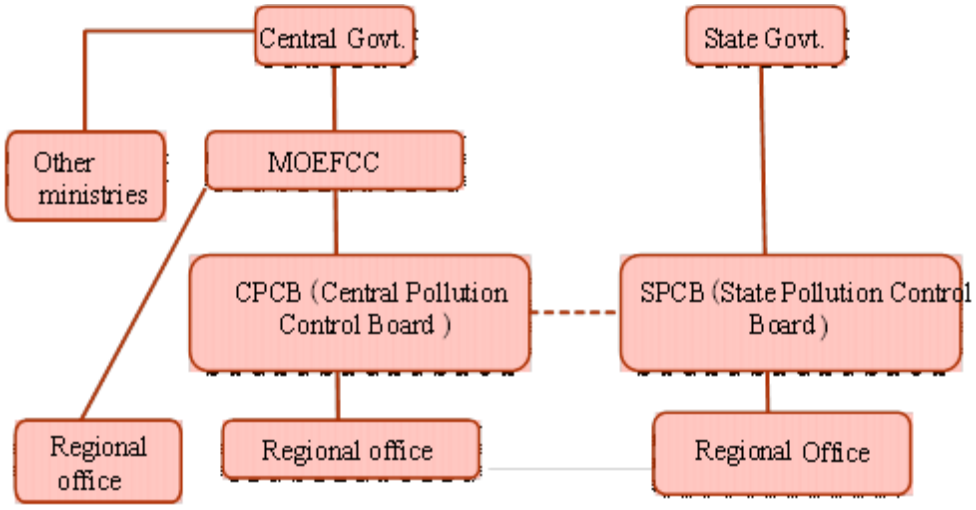


Figure 2-1: Outline of major environmental authorities in India

2) The Air (Prevention and Control of Pollution) Act

The Air (Prevention and control of pollution) Act, 1981 is an Act aimed to prevent, manage and mitigate the impact of air pollution. It gives power to the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB) to carry out necessary actions to achieve the objectives of the act. It also gives SPCB the power to designate Air Pollution Control Area and to regulate industrial activities in the area. SPCB has the power to designate stricter emission standards in the Air Pollution Control Areas after consultation with CPCB. Emission standards for solid waste thermal treatment facilities is shown below.

Table 2-3: Flue gas emission standard for municipal waste thermal treatment facility (draft)

Parameter	**Emission standard (O_2 =11%, dry)**
PM	50 mg/Nm^3
HCl	50 mg/Nm^3
SO_2	200 mg/Nm^3
CO	100 mg/Nm^3 (30 min average)
	200 mg/Nm^3 (1day average)
TOC	20 mg/Nm^3
HF	4 mg/Nm^3
NOx (NO and NO_2 expressed as NO_2)	400 mg/Nm^3
Total dioxins and furans	0.1 ng-TEQ/Nm^3
Cd+ Th + their compounds	0.05 mg/Nm^3
Mercury and its compounds	0.05 mg/Nm^3
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V and their compounds	0.5 mg/Nm^3

3) The Environment Protection Act (1986) and Environment Protection Rules

The Environment Protection Act is the basic law on environment in India. The law stipulates the responsibility of the central government in terms of prevention of environmental pollution, its management and reduction. The central government is given the power to formulate the necessary rules and regulations to achieve the objectives of the act. In the Environmental arena, Water Act and the Air Act both were formulated before the Environment Protection Act. The act defines environment to include "water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property". The Act gives the central government the necessary power to formulate necessary laws and regulations to regulate the environment. Article 15 of the act stipulates provisions for penalty for contravention of the Act, rules etc.

Environment Protection Rules, 1986 (latest amendment 2014) has been formulated under the Environment protection act. Article 3 of the rules stipulates the emission standard of effluents from factory etc. Schedule II of the rule stipulates the emission standard for effluent, flue gas, sound, chimney height etc. for 90 different industrial processes. The target substances differ among the industries and there are cases when special conditions are required for specific industries. An example is shown in the table below.

Table 2-4: Example of Emission Standard

Industry type	Parameter	Standard
Oil refinery industry	Oil and grease	10 mg/L
	Phenol	1 mg/L
	Sulphide	0.5 mg/L
	BOD(3 days at 27C)	15 mg/L
	Suspended Solids	20 mg/L
	pH	to 8.5

Article 5 of the Environment Protection rules stipulates the condition for setting up factories in specific areas. It gives the central government the authority to prohibit the setting up of factories in a specific area when the relevant conditions are not met.

Further, Schedule VI stipulates effluent standard, standard for effluent generation amount, air emission standard, noise limit for automobiles etc. for industries/processes designated in Schedule II. It also makes it mandatory for certain businesses to present annual Environmental statement to the State Pollution Control Board. Schedule III also sets the noise standard as follows:

Table 2-5: Noise standard(Daytime：6 AM －9 PM, Night time：9 PM － 6 AM）

Area code	**Area category**	**Standard dB (A)（Daytime）**	**Standard dB (A)（Night time）**
（A）	Industrial Area	75	70
（B）	Commercial Area	65	55
（C）	Residential Area	55	45
（D）	Silence Zone	50	40

Schedule VII sets the air quality standard (National Ambient Air Quality Standards - NAAQS) as follows.

Table 2-6: National Ambient Air Quality Standards (NAAQS)

	Parameter	**time**	**Industrial, Rural, Residential and others**	**Sensitive Area**
1	Sulphur Dioxide (SO_2) ($\mu g/m^3$)	Annual average 24 hour average	50 80	20 80
2	NO_2 ($\mu g/m^3$)	Annual average 24 hour average	40 80	30 80
3	PM10 ($\mu g/m^3$)	Annual average 24 hour average	60 100	60 100
4	PM2.5 ($\mu g/m^3$)	Annual average 24 hour average	40 60	40 60
5	Ozone ($\mu g/m^3$)	8 hour average 24 hour average	100 180	100 180
6	Pb ($\mu g/m^3$)	Annual average 24 hour average	0.50 1.0	0.50 1.0
7	CO (mg/m^3)	8 hour average 24 hour average	02 04	02 04

2-2 Overview of Bengaluru City

(1) Basic Information

Bengaluru City is the capital city of Karnataka State located in southern India. It is the third largest city in India with a total area of 741km^2 and at population of 8.42 million. Located on the Deccan plateau, at a height of over 900 m above sea level, Bengaluru is known for its pleasant climate throughout the year. Bengaluru is known for IT industry, research establishments, aerospace industry and as a commercial hub for southern India. It is commonly referred to as the "Indian Silicon Valley".

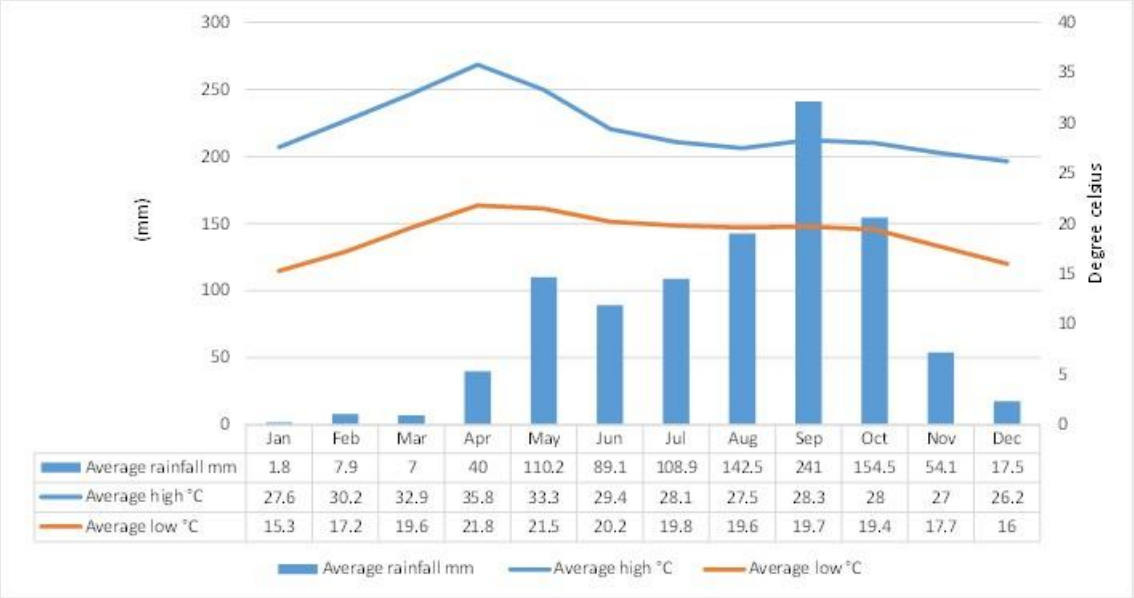
Figure 2-2: Location of Bengaluru

Source: d-maps.com http://www.d-maps.com/carte.php?num_car=4185&lang=en

(2) Climate

Bengaluru is located at an average altitude of 920m over the sea level and enjoys a relatively moderate climate throughout the year. It has a tropical savanna climate (Köppen climate classification Aw) with distinct wet and dry seasons. The wet season is from May to October and the dry season is from November to April. The coolest month is December with an average temperature of 15 degree Celsius and the hottest month is April with an average temperature of 36 degree Celsius.

2015 observed the warmest winter globally and this affected Bengaluru climate with continued unseasonal rain in December.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average rainfall mm	1.8	7.9	7	40	110.2	89.1	108.9	142.5	241	154.5	54.1	17.5
Average high °C	27.6	30.2	32.9	35.8	33.3	29.4	28.1	27.5	28.3	28	27	26.2
Average low °C	15.3	17.2	19.6	21.8	21.5	20.2	19.8	19.6	19.7	19.4	17.7	16

Figure 2-3: Average High and Low Temperature and Rainfall in Bengaluru

Source: Indian Meteorological Department,
https://web.archive.org/web/20131203023115/http://www.imd.gov.in/section/climate/bangaluru2.htm

(3) Population

The population of Bengaluru in 2014 was 10,178,146 making it the third largest city in India in terms of population. Population has been rapidly increasing due to the development of IT industry and is expected to increase in the future.

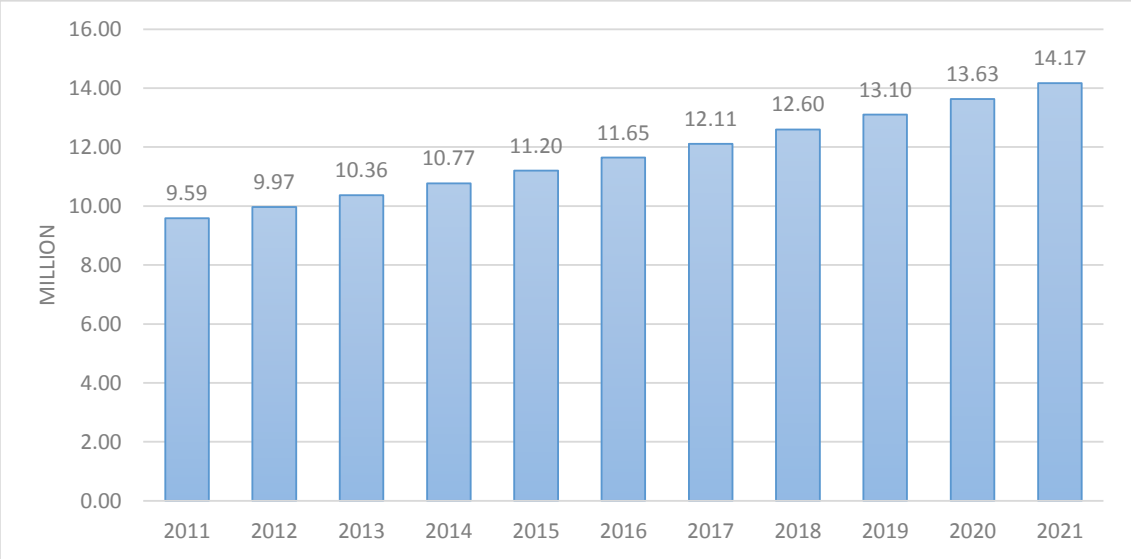


Figure 2-4: Estimation of Population Increase in Bengaluru by 2021

Source: Directorate of Economics and Statistics Bangalore, 2013. Projected Population of Karnataka, 2012-2021

The most populated area in Bengaluru is the city center which includes the East, the West, and the South zones. Dasarahalli Zone also has a relatively higher population density

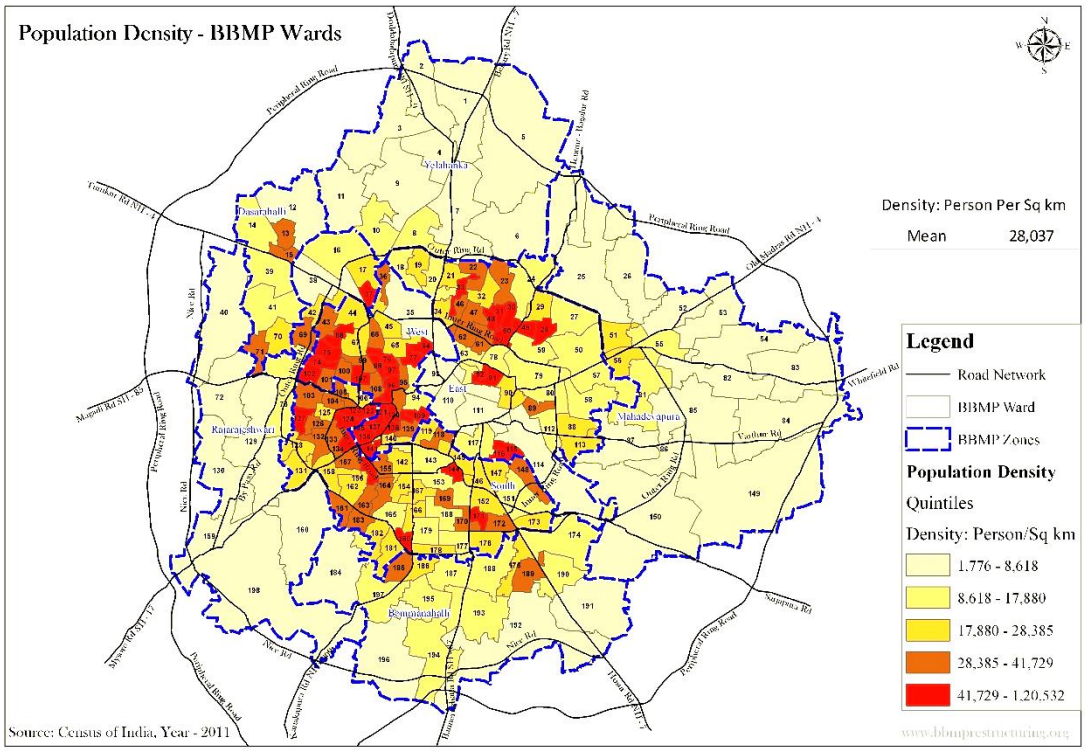


Figure 2-5: Ward-wise Population Density in Bengaluru

Source: BBMP Restructuring HP: http://www.bbmprestructuring.org/wp/ward-population-density/

(4) Administrative Boundary

In January 2007, former Bengaluru City Government BMP (Bengaluru Mahanagara Palike) was consolidated with CMCs (City Municipal Council), TMC (Town Municipal Council), and 111 villages in the vicinity and become BBMP (Brihat Bengaluru Mahanagara Palike). Due to this consolidation, the area governed was expanded from 226km^2 to 741km^2.

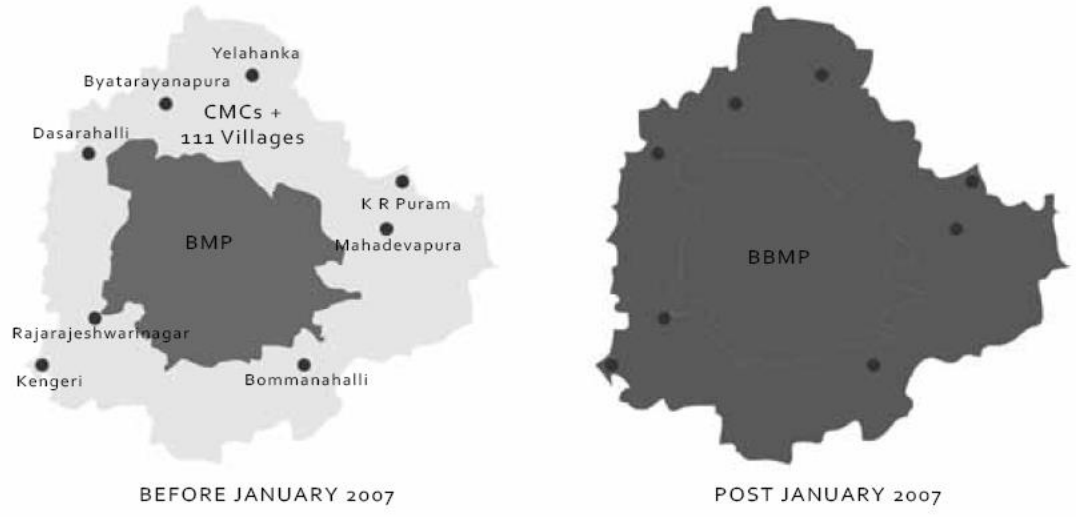


Figure 2-6: Consolidation of BMP and Other Municipalities

Sources: Social Venture Partners, Bengaluru, 2014. Extracting Value from Bengaluru's Dry Waste Chain

Bengaluru City is currently divided into 8 zones; central East, West, and South Zones and Byatarayanapura、Mahadevapura、Bommanahalli、RR Nagara、Dasarahalli Zones in the outskirts. In the outskirts a rapid urban sprawl has been occurring in recent years due to the rapid population growth.

Figure 2-7: Administrative Boundaries of and within Bengaluru City

3 Current Status of MSW Management in Bengaluru

3-1 SWM Events in the Past

BBMP has been promoting PPP and contracting out of MSW treatment and disposal facilities development to the private sector since 2007 when BBMP was created. Although BBMP has developed a Municipal Solid Waste Management Masterplan in 2008, it does not match with the current situation due to the rapid population growth. Therefore, BBMP is managing the daily MSW generation in the city as per the policies below without adhering to the masterplan.

- Actively promote segregation of MSW into wet and dry waste at source
- Undertake transport of waste, processing and disposal only for segregated waste
- Have decentralized MSW treatment and disposal facilities
- Have centralized common facilities for landfill.
- Have a combination of city owned facilities and private facilities for waste processing
- Remediate and bio-mine the old waste dumps to recover resources and land.

Bengaluru has experienced "waste crisis" situation many times in recent years due to the lack of MSW management masterplan, inappropriate management of landfill site and open dumping and rapid population growth. Further, many local protests are commonplace whenever any type of MSW treatment facilities such as composting facilities or landfill sites are constructed. These circumstances have forced BBMP to forfeit its plans to owning a landfill site and therefore excess waste is not collected and can be found scattered around the city. On 17th of December 2015, the high court of Karnataka has passed orders seeking all waste generators to undertake three-part segregation. Waste is to be segregated into wet waste, recyclable waste and others. The table below summarizes the major events relating to MSW management in Bengaluru in recent years.

Table 3-1: Chronological List of Events Related to SWM in Bengaluru

Year	Implementing Body	Events
2007	BBMP	Mavellipura landfill site started its operation
2008	BBMP	Municipal Solid Waste Masterplan for Bengaluru was developed
	Private company	Composting facility started its operation
	BBMP , Private company	Mandur landfill sites started its operation Private company started building composting facility and WTE facility in the southern area of the site.
2012	BBMP	KSPCB closed Mavellipura landfill site in July due to the groundwater pollution and environmental regulation violation.
	BBMP	Solid waste that had been transported to Mavellipura landfill site started to be transported to Mandur landfill site. The amount of solid waste accepted by Mandur landfill site

		increased to 1,500t/day.
	BBMP	Bingipura landfill site and Lakshmipura landfill site started its operations.
2013	BBMP , Mandur villagers	Route to Mandur landfill site was blocked by the local villagers and this stopped solid waste collection services for 10 days. This event was referred to as “waste crisis of Bengaluru”.
	Private company	Given a concession right for 600t/d facility at Subbarayanapalya
	Private company	Given a 600t/d concession at Mandur South
	Private company	Shortlisted for a 600t/d biogas plant project at Kannahalli
	Private company	Given a 1000t/d of WTE facility contract at Gorur
2014	Private company	Started operation of composting facility
	BBMP	Closed Mandur operations. Shifted focus to Lakshmipura and Bingipura
	Private company	Stopped construction of WTE and composting facility
	Private company	No progress so concession closed.
	BBMP	Brought out a plan for segregation of waste into 6 categories.
	BBMP, KUIDFC	Started construction of 6 compost plants across Bengaluru and upgradation of KCDC with funds available at KUIDFC.
2015	BBMP	Lakshmipura and Bingipura were closed due to public protests and environmental regulation violation
	BBMP	Started the 6 composting plants. A major segregation drive has been initiated and about 600 tons of organic segregated waste is being sent to the BBMP facilities.
	Dutch Consortium	Signed a consortium with the government of Karnataka to set up a 600t/d biogas facility.
	Polish company	Signed a consortium with the government of Karnataka to set up a 400t/d biogas facility.
	Private company , BBMP plant at Kannhalli & Sigehalli and KCDC	Facing significant local protests
	High court decision	MSW segregation at source into three categories

3-2 MSW Generation and Waste Characteristics

(1) MSW Generation

Data on the generation of MSW (excluding hazardous waste) in Bengaluru differs depending on the source of data; although it is estimated to be approximately 4,500t/d. Based on this number, MSW generation per capita in Bengaluru is calculated to be about 0.45kg/d. This is a relatively small number compared to other cities of India such as Delhi, Chennai, and Mumbai. This indicates the possibility that substantial amount of MSW is taken by the informal sector or uncollected. Considering this, it is more reasonable to think that the daily generation of MSW in Bengaluru is approximately 5,000 t/d.

According to interviews with BBMP engineers in charge of SWM, approximate estimation of solid

waste generation in each zone and waste processing facilities where solid waste is transported are as shown in the table below. However, it should be noted that as the amount of waste received by a particular facility differs greatly day by and and the fact that BBMP is currently building new composting facilities and DWCC (Dry Waste Collection Centers), the numbers in the following table shows a large fluctuation on a day by day basis.

Table 3-2: MSW Generation in Each Zone and Waste Processing Facilities

Zones	MSW Generation (t/d)	Waste Processing facilities		
		DWCCs	Composting Facilities	Capacity
South	916	168	Private company	250
			Private company	300
			Kannhalli / Sigehalli	200
East	894	140	Private company	600
West	638	120	Private company	400
Bommanahalli	485	80	KCDC	100
			Chikkanagamangala	100
R R nagar	561	80	Subbaranapalya (BBMP)	100
Dasarahalli	239	90	Dodda bidarakallu	100
Yelahanka	290	140	Private company	70
			Doddabidarakallu	100
Mahadevpura	468	80	Private company	200
Total	4491	898		2420

Source: Created based on the information provided by BBMP

As shown in the table above, difference between the total capacity of DWCCs and composting facilities and MSW generation is more than 1,000 t/d. Currently, there are no landfill sites available for MSW generated in Bengaluru and there are no plans to build a new landfill sites. As a result, a large amount of uncollected solid waste is found lying around in the city.

Figure 3-1: Uncollected Solid Waste in the City

(2) Waste Characterization Survey

To understand the physical composition and low calorific value of MSW generated in Bengaluru, waste characterization survey was conducted. Solid waste samples were collected from the private composting facility operated by Company Awhere unsegregated waste is transported.

The composting facility operated by Company A mainly receives MSW generated from South, East, and Yelahanka zones. As solid waste generated from both the central and outskirts area of Bengaluru are transported to this facility, the study team judged that this site would be suitable for collecting a representative sample. During sampling, MSW from three vehicles for each zone was collected, mixed, and sampled. South zone is an upper middle class residential area, East zone is downtown area where lower to middle class residences are found and Yelahanka zone is a middle class residential area.

Further, due to budgetary and time constaints, sampling was done within a period of two days. Therefore it should be noted that this survey does not accommodate the daily and seasonal fluctuation.

1) Sampling and Physical Composition

Solid waste sampling and physical composition survey was conducted from November 30 to December 1, 2015. Sampling procedure is as follows. One sample is collected from each zone and three samples in total were collected from South, East and Yelahnaka zones.

① Collected 66kg of representative solid waste from one vehicle and repeated this for three times to make 200kg sample from 3 vehicles per zone.
② Cut large matters in the waste sample to make it less than 15cm so that all can be mixed well
③ Mixed the solid waste sample by shovels and reduced the amount to 50kg by quartering method.
④ Categorized 50kg samples of three zones into the following categories.
- Food
- Paper
- Textiles
- Woods and grasses
- Plastics
- Rubber and leather
- Metals
- Glasses
- Soil and sand

⑤ Measured the weight of all the categories above and calculated the proportional rate.
⑥ Reduced the volume of MSW samples to 5kg according to the proportional rate of the 9 categorized types and put them in plastic bags.

Figure 3-2: Sampling and Cutting Large Matters of the Sampled Waste

Figure 3-3: Quartering and Categorization of waste Sample

Figure 3-4: Categorization of “Woods and Grasses” and “Soil and Sand” (right) and packaged samples for the further analysis (left)

(”Woods and Grasses” and “Soil and Sand” were sometimes difficult to distinguish and hence were categorized by the method shown in the picture. Small matters were categorized as “Soil and Sand”)

The result of physical composition and water contents are shown in the table below. Yelahanka zone and South zone have higher ratio of plastic waste compared to East zone whereas East zone has a

higher ratio of "woods and grasses" and "soil and sand". Sampling of Yelahanka zone and East zone was conducted on November 30, 2015 and South zone on December 1, 2015. The evening of November 30 observed heavy rain and hence this precipitation event is considered to be the reason why South zone's water content is higher despite the fact that plastic waste ratio is higher than other zones.

It is desirable to conduct waste characterization survey in each season with 3 to 4 days of sampling in order to fully comprehend the daily and seasonal differences of solid waste.

Table 3-3: Results of Physical Composition and Water Content Analysis of MSW in Bengaluru

Items	Yelahanka Zone		South Zone		East Zone	
	Composition by weight(Wet)	Moisture Content	Composition by weight(Wet)	MoistureContent	Composition by weight(Wet)	Moisture Content
1. Food	9.7%	48.7%	5.2%	78.0%	1.6%	60.2%
2. Paper	17.6%	48.1%	14.4%	57.0%	6.7%	52.1%
3. Textile	5.4%	22.6%	8.6%	37.5%	4.7%	29.1%
4. Woods and grasses	25.4%	51.4%	22.1%	68.6%	33.6%	57.9%
5. Plastic	18.3%	6.8%	21.7%	41.6%	11.7%	26.9%
6. Rubber and leather	0.6%	1.6%	0.9%	15.9%	1.4%	4.9%
7. Metals	0.3%	0.1%	0.5%	3.2%	0.0%	0.0%
8. Glasses	2.8%	26.3%	2.4%	10.7%	4.0%	11.3%
9. Soil and sand	19.9%	46.8%	24.3%	63.8%	36.2%	58.7%
Total	100.0%	38.8%	100.0%	55.6%	100.0%	50.2%

2) Three Components and Lower Calorific Value

Moisture, combustible, and ash contents were analyzed for three samples in a MOEFCC certified laboratory. The results are shown in the table below. The reason for the relatively high ash content is because it contains glasses. The reason for the calorific value of South zone to be lower than the other zones despite the fact that it contains the largest portion of plastic is because its moisture content is higher due to the rain on the day before the sampling day. The lower calorific values of the sample taken are in the range of 1,700 to 2,000kcal/kg which justies their treatment through incineration.

Three components	**Yelahanka Zone**	**South Zone**	**East Zone**
Water content (%)	38.8%	55.6%	50.2%
Combustible content (%)	9.1%	12.0%	15.3%
Ash content (%)	52.1%	32.4%	34.5%
Total (%)	100%	100%	100%
Specific gravity (kg/L)	0.41	0.45	0.72
Low calorific value (kcal/kg)	2,082	1,769	1,913
Average low calorific value (kcal/kg)	1,921		

The values in the table above have been plotted in the figure below. The three contents that can be incinerated without auxiliary fuel based on the World Bank Technical Guidance Report[8] is shown in the colored area (moisture content below 50%, combustibles more than 25%, and ash less than 60%). This is a standard that was created by the World Bank based on various cases and not based on the Indian conditions. The area in red-dotted line is the area where the three components of the waste can be incinerated without supplementary fuel by the use of Japanese technology.

As shown in the figure below, the average value is in the zone of incinerable without auxiliary fuel zone according to the World Bank Technical Guidance Report. The lower value of South zone is out of the zone of being incinerable. The calorific value of South zone is not considered to be representative value due to the rain observed during the sampling. Although it lies outside of zone for waste that is incinerable without auxiliary fuel, superior Japanese technology can be used for its incineration.

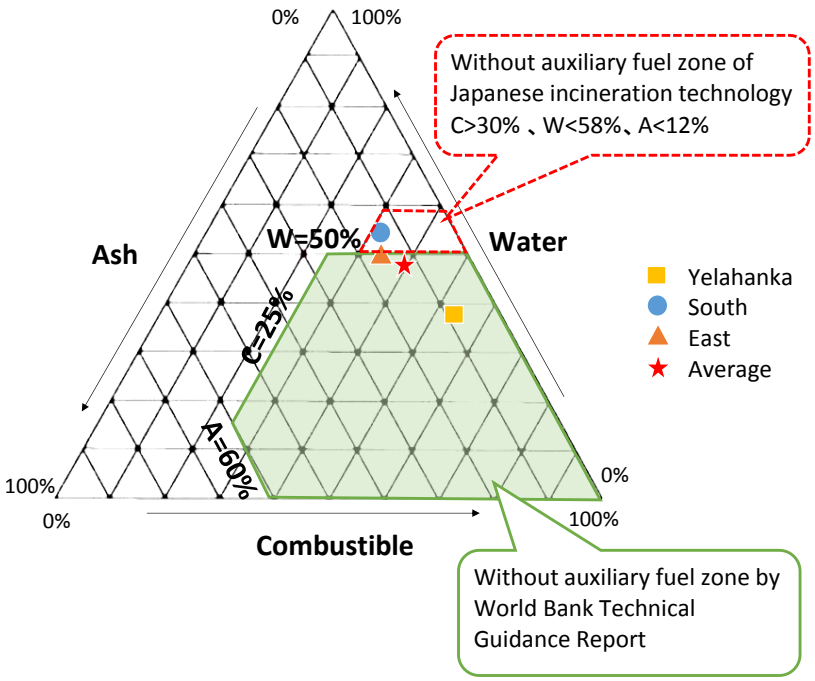


Figure 3-5: Three Components Value in Different Zones Plotted in Triangular Coordinates

The results of lower calorific value analysis and analysis on the triangular coordinates show that the wastes in Bengaluru can be fully incinerated without auxiliary fuel particularly by Japanese technology.

[8] WORLD BANK TECHNICAL GUIDANCE REPORT Municipal Solid Waste Incineration

3-3 Solid Waste Management Facilities

(1) Solid Waste Processing/Treatment Facilities in and around Bengaluru

The map below plots the major MSW processing/treatment/disposal facilities in and around Bengaluru including operational, closed/stopped and planned ones. All the facilities are located in the outskirts or villages far from the city center. The most-distant facilities such asCompany A and Company B composting sites are approximately 70km further from the city center and hence the transportation cost is considered to be quite high.

All the operational facilities among them are composting facilities or biogas facilities. With regards to the composting facilities,3 are operated by private companies, 6 are planned and now partially started being operated by BBMP and 1 has been operated since 1979 by Karnataka Composting Development Center (KCDC). As for the biogas facilities, 2 were planned but stopped and 2 are currently operational. As of January 2016, all the landfill sites were closed due to inappropriate management and associated environmental problems and there is no available final disposal site. Regarding the WTE combustion facilities, there were 2 proposals by two private companies. The construction of one of them is stopped due to the financial reasons whereas the other is currently facing a strong local protest. The map below shows the locations, types and current status of the MSW facilities existing in and around Bengaluru.

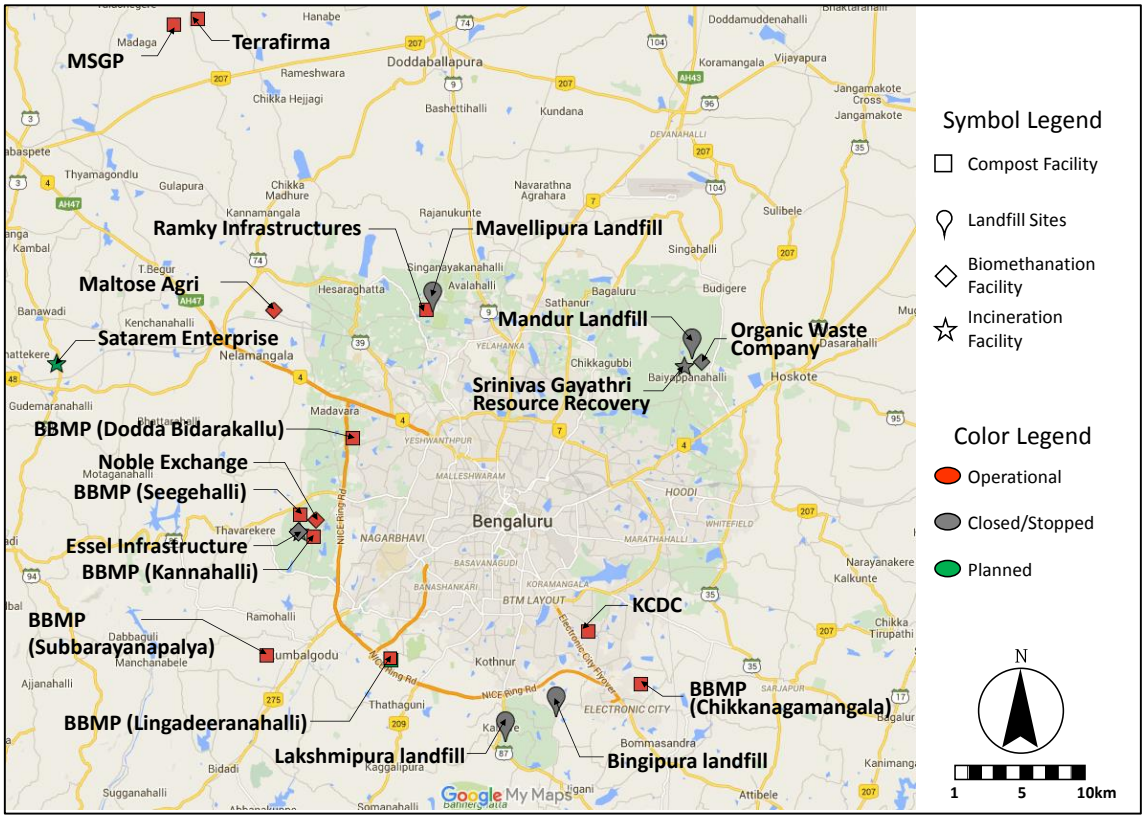


Figure 3-6: Locations of MSW Management Facilities in and around Bengaluru

1) Landfill Sites

Mavellipura landfill site started its operation in 2007 and was closed in 2012 due to the water pollution by the leachate in the nearby villages and environmental regulation violation. As a result of this, the city was covered with uncollected wastes and BBMP came under severe criticism.

Mandur landfill site started its operation in 2010 and was closed in 2014 due to the strong local protest and environmental hazards such as leachate pollution. Bingipura landfill site and Lakshmipura landfill site started being operational in 2012 but were also closed in 2015 for the same reasons.

Currently there is no available final disposal site and it is considered to be very difficult to secure a new landfill site because of the expected local protest.Therefore it can be said that the MSW management of BBMP is on the verge of crisis. Construction of sanitary landfill that can prevent odor and leachate leak and enhancement of sanitary landfill operational capacity as well as appropriate human resources is urgently needed. The table shows the overview of the existing landfill sites and their current status.

Table 3-4: Status of Major Landfill Sites that Existed in Bengaluru

Implementing Body	Start year	Planned capacity	Accepted amount	Status
BBMP Mavellipura landfill site	2007	ND	600	Received 600 t/d of MSW and faced local protest due to leachate pollution. Closed in 2012 by KSPCB for the environmental regulation violation.
BBMP Mandur landfill site	2010	ND	2500	Received 2,500t/d of MSW and faced local protest. Closed in November 2014.
BBMP Bingipura landfill site	2012	ND	1200	Started being operational in 2012 and fully operational from 2014. Received 800-1,200t/d of MSW and faced local protest. Closed in December 2015.
BBMP Lakshmipura landfill site	2012	ND	1000	Received 600-1,000 t/d of MSW and faced local protest. Closed in the beginning of 2015.

Figure 3-7: Closed Mandur Landfill Site (Left) and Leachate Found Outside of the Site (Right)

2) Composting Facilities, Dry Waste Collection Centers（DWCC）, Other Recycling

Facilities

In this situation, BBMP is actively promoting waste segregation at source into wet waste and dry waste as well as construction of Dry Waste Collection Centers (DWCCs) in all the 198 wards. As of January 2016, 6 composting facilities were constructed by KUIDFC and operated by BBMP and approximately 150 DWCCs are operational. Besides these, Karnataka Compost Development Center is also operational.

As for the composting facilities, some are operated by the private sector. The table below is the list of composting facilities.

Table 3-5: List of Composting Facilities in Bengaluru

Implementing Body	Start year	Planned capacity	Received amount	Operational Status
Karnataka Compost Development Corporation (KCDC)	1975	800	300	Currently operational. The planned capacity was 300t/d but expanded to 500t/d. Residential area is getting closer due to the urban sprawl and started facing the local protest.
Private company	1994	1000	600	Started operation in 1994 and changed the location several times and has been located 18km from Doddaballapura since 2008. A small biogas plant was installed but is not functional. It has a landfill site where dump excess of MSW is dumped openly and facing a strong local protest. The Chief Minister has mentioned the facility will be closed by March 2016.
Private company	2006	600	300	Started its operation in 2006 but there were many local protests leading to its closure in 2012. The plant was restarted and is operating at about 100 tons per day. Trying for permission to set up waste to energy facility but looks difficult.
Private company	2014	600	800	The concession was given in 2013 and being operational in 2014. The plant capacity is 600t/d but excessive amount is being received. Dumping excessive MSW in the site and no leachate treatment system. Facing local protest.
BBMP（Kannahalli）	2014	500	600	6 composting facilities were constructed by KUIDFC and operated by BBMP contractors. Receives only segregated wet wastes of 500t/d. Started its operation except Lingadeerahalli. Have
BBMP（Seegehalli）		100		
BBMP（Dodda Bidarakallu）		300		
BBMP		200		

（Subbarayanapalya）				pilers for RDF production.
BBMP （Chiknagamanagala）		500		
BBMP （Lingadeerahalli）		200		

Table 3-6: DWCCs and Other Recycling Companies

Implementing Body	Start year	Planned capacity	Received amount	Operational Status
150 Dry Waste Collection Centers	N/A	400	100	BBMP is planning to set up DWCCs for 198 wards in the Bengaluru City. Currently 150 DWCCs are operational. The Operational bodies are mainly non-profit organizations.
More than 100 Recycling Companies for Bulk Waste	N/A	N/A	1000-1500	There are more than 100 service providers signed by the BBMP for bulk waste management.

In the current situation where there is no available landfill site, one composting facility is receiving more MSW than their planned capacities. The excess transported waste is just openly dumped in the unused land in their sites. In some cases, the leachate generated in the composting facility is not properly treated and discharged directly into the environment. It is likely that this is polluting the ground water and leading to strong local protests.

Figure 3-8: Observed Open Dumping in a Composting Facility (Left) and Untreated Leachate Discahrged to the Environment (Right)

The representative composting process are: 1) segregate fresh MSW by trommel to over/ under 100mm; 2) Compost the segregated MSW under 100mm; and 3) Sieve compost by trommel of 35mm, 16mm, and 4mm then final compost is produced. Some composting facilities are producing the final compost of reasonably good quality but in other cases the quality leaves a lot to be desired. In a

composting facility operated by a private company, the temperature of the compost heap is being monitored and it ranges from 45 to 55 degree Celsius which does not reach the 60-80 degree Celsius range that is considered to be appropriate temperature for proper composting process. In another composting facility operated by a BBMP contractor, the temperature of the compost heap was around 30 degree Celsius. This could be a concern for existence of pathogen problems in the final compost product in this case.

Figure 3-9: Compost Heap (Left) and Final Compost Product (Right)
(Taken in a private composting facility)

Figure 3-10: Compost Heaps at a BBMP Composting Facility

Figure 3-11: Compost Heap Temperature (Left) and Final Compost Product (Right)
(Taken at a BBMP Facility. The temperature is not high enough and final compost is immature)

In the BBMP operated composting facilities, plastic wastes are being sold directly or mixed with coconut shell and pile to produce RDF. RDF is being sold to cement plants near Bengaluru

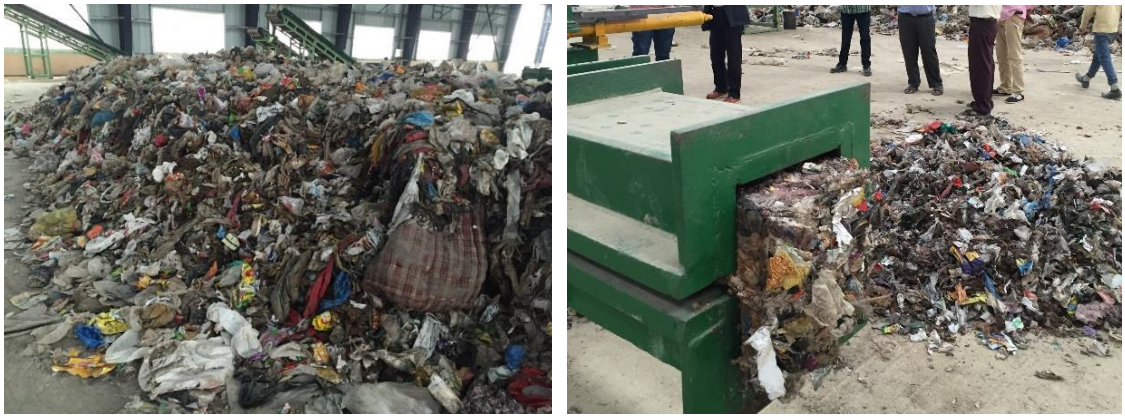


Figure 3-12: Segregated Plastic Residue (Left) and RDF Made of Plastic and Coconut Shell (Right)

3) Biogas Plants

Two private companies are operating small scale biogas plants by utilizing organic waste from hotels and agricultural wastes (Company A and B in the table below). Company C planned to set up a biogas facility in the south side of Mandur landfill site but the site was closed. So they are currently looking for a new site. Company D planned to construct biogas plant with 600t/d capacity in Kannahalli where other BBMP composting facilities are built, but the negotiation on tipping fee was stalled with BBMP so the plan was not realized. Besides these, 2 separate agreements on the cooperation for building 600t/d and 400t/d WTE plants were signed by the Dutch Government and a Polish company respectively in 2015 (described here as the technology is not shown).

Table 3-7: Status of Biogas Plants in Bengaluru

Implementing Body	Start year	Planned capacity	Received amount	Operational Status
Private company A	2014	250	20	Collects organic wastes from hotels and operate the biogas plant. BBMP provided the land and now operational at 20t/d
Private company B	ND	50	20	Started as a biogas plant only for cow dung. Recently has started receiving organic waste of MSW.
Dutch Consortium	N/A	600	N/A	Agreement to build WTE plant was signed between Dutch Ambassador and Karnataka State Government in the late 2015.
Polish Company	N/A	400	N/A	Karnataka State Government and a Polish company signed an agreement to set up 400t/d WTE plant.
Private company C	N/A	600	N/A	Was planning to build a biogas plant in the site of Mandur that was closed in 2014. Currently asking BBMP for providing the alternative site. Given a concession for the project by BBMP in 2011.
Private company D	N/A	600	N/A	Was planning to build a biogas plant in Kannahalli but talk on tipping fee was stalled and project was cancelled.

4) WTE Incineration Facilities

There have been two proposals on WTE Incineration facilities as shown in the table below. The facility proposed by company A was stopped during its construction due to the financial reasons and left out in the open in the Mandur site. The other proposal by company B is currently facing the local protest. The detail is described in the table below.

Table 3-8: Proposals on WTE Facilities and Current Status in Bengaluru

Implementing Body	Start year	Planned capacity	Received amount	Operational Status
Private company A	N/A	1000	N/A	Given a concession in 2008. Planned to build WTE incineration facility similar to the one in Hyderabad. After the initial investment of 600 million INR, no further investment was made and the construction was stopped. After that, the facility was left out in the open. BBMP cancelled the concession.
Private company B	N/A	1000	N/A	Given a concession by BBMP in 2012.

		(14MW)		BBMP provided sites at Gorur village of Solur on the Neelamangal -Kunigal Road. There have been many protests at the site. Recently the high court has directed the government to enable set up of the project at location.

Figure 3-13: SGRRL's WTE Facility Left out in the Open after cancellation of Construction

3-4 Segregation and Waste Flow

(1) Background

BMP carried out a waste related pilot project called "Swaccha Bangalore" in 2000 with cooperation of Bangalore Agenda Task Force (BATF). This program aimed to implement effective waste management through an analysis of waste management chain such as collection, transportation, intermediate treatment, final treatment etc. and identification of issues. The pilot project, which only covered 25% of the city area at the initial stage, was highly evaluated and expanded to 50 % of city. The project covered 100% of the city in 2003, after the three year from the start and ended in 2005. One of these activities was promotion of the aggregation at source.

After the merging of Bangaluru with the neighboring towns in 2007, BBMP conducted activities based on Public Private Partnership (PPP). However, waste segregation was not implemented enough and the mixed waste was treated at the Mandur and Mavalipura landfill. As a result, in 2012, Karnataka State Pollution Control Commission has instructed the closure of Mavalipura landfill and the residents opposed usage of the Mandur landfill. Bengaluru city fell into "Waste Crisis" with scattered 10,000 ton of waste in the city. Decision in the trial from these issues requeseted the waste separation. In response to this result, BBMP has promoted segregation at source and the decentralized waste treatment facilities toward sustainable waste management from the simple waste management based on collection, transportation and landfill.

In September 2012, BBMP issued a a guideline to promote segregation at source. This guideline has classified garbage into 6 categories of wet waste, dry waste, garden waste, rubbish, sanitary waste

and household hazardous wastes.

Figure 3-14: The Six categories of waste in Bengaluru

Source: http://www.deccanherald.com/content/279046/bbmp-issues-guidelines-garbage-segregation.html

Despite these efforts, segregation at source did not work properly and in December 2015, Karnataka state court gave an instruction to all the waste generators to promote segregation at source. In this instruction, three categories separation of wet waste, dry waste and other wastes is implemented with the primary purpose of processing in the compost or methane digestion gasification facility. However, the segregation rate is still low (less than 5%). Therefore, waste collectors need to separate the waste on the street.

(2) Segregation and Waste Flow of Dry Waste

For dry waste, BBMP has set up Dry Waste Collection Centers in the city and promoted segregation (below table).

Table 3-9：Common Types of Wet Waste and Dry Waste

BIO-DEGRADABLE / WET WASTE	NON BIO-DEGRADABLE / DRY WASTE
▪ Vegetables and fruits ▪ Food waste ▪ Flowers and leaves from gardens	▪ Paper: Newspapers, print-outs, diaries, text and note-books, tissue paper, carton boxes etc. ▪ Plastics: PET and other bottles, utensils, plastic covers and packaging, milk covers etc. ▪ Glass and ceramics: ketchup, beer, whisky bottles etc. ▪ Metals: soft-drink cans, aerosol cans, aluminium foils, etc. ▪ Old clothes

	▪ Tetra paks: juice, milk and whisky tetrapaks ▪ Laminates: Crackers (kurkure) and biscuit packets, flour packets.

Source: Bruhat Bengaluru Mahanagara Palike (BBMP)

There are currently 150 Dry Waste Collection Centers run by BBMP, NGO and private companies (table 3-10). BBMP aims to establish Dry Waste Collection Centers at all 198 wards in the city.

Table 3-10: Examples of Dry Waste Collection Centers

S. No	DWCC Ward No	Location	Contact	Operator	Category
1	Kasa Rasa 2	Kormangala	Nitesh	Saahas	NGO
2	170,171,177	JP Nagar – Jeyadeva Hospital Flyover			Entrepreneur
3	168	Near Nandi Theatre	Mansoor		Entrepreneur
4	112	Below Domlur Flyover	Ambedkar	Waste Wise Trust	NGO
5	65,64,45	Malleshwaram (behind Chowdiah Hall)	Ambika	BBMP	BBMP
6	22 & 33	Dollar's Colony 4th Cross	Raju	Venkatesh (Waste Contractor)	Contractor
7	23	Dollars Colony – 4th Cross	NA	Venkatesh Reddy	Contractor
8	6	Hegde Nagar 4th Cross	NA	Not Functioning	
9	61	Frazer Town, SK Nagar	Andrews	GRACE	Entrepreneur
10	94		Gayathri	Namana Foundation	NGO
11	95 & 109		Naveen	Namana Foundation	NGO
12	23	Hennur Main Road	Andrews	GRACE	Entrepreneur

Source: Bruhat Bengaluru Mahanagara Palike (BBMP)

Waste discharged from households or bulk generators (generating more than 10kg/day) is collected Door to Door (D2D) by Pourakarmikas or waste pickers and transferred to Dry Waste Collection Center. The Dry Waste Collection Centers purchase the waste. D2D collection is a key for segregating dry and wet waste at the source. The aggregated waste at Waste Collection Center is sold to buyers (Jolly Mohalla) according to the type of waste and subsequently recycled (Figure 3-15).

There are efforts to segregate recyclable waste at Dry Waste Collection Centers, but the residue and non-usable fraction will have to be ultimately landfilled. Some plastics are not suitable for material recycling and therefore some improvements (such as RDF utilization) are required. Figure 3-16 shows an example of separation of plastics and coconut shells at a Dry Waste Collection Center.

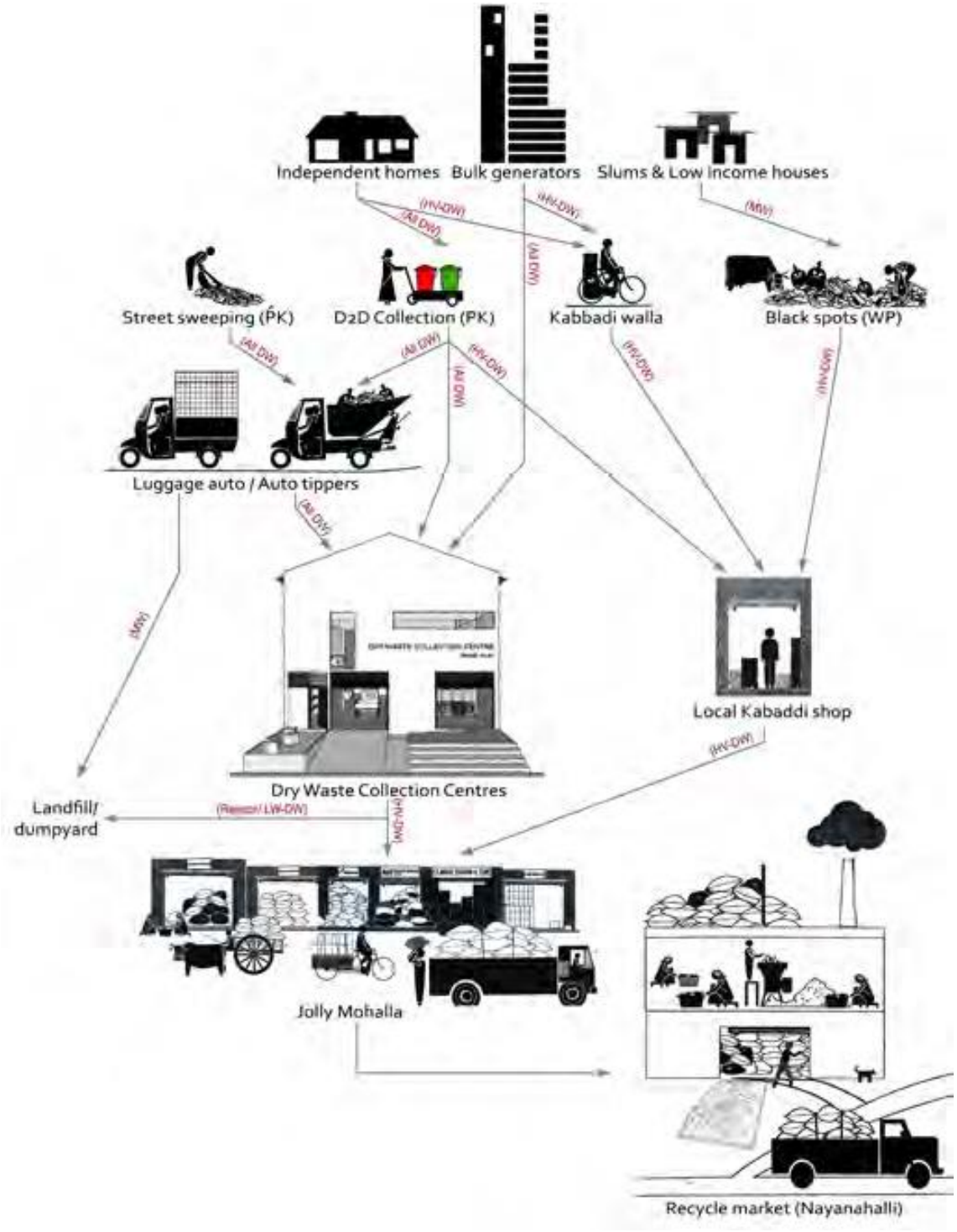


Figure 3-15: Flow of Dry Waste in Bengaluru

Source: Bruhat Bengaluru Mahanagara Palike (BBMP)

Figure 3-16: Separated and stored coconut shell (left) and plastic (right) at a DWCC

(3) Separation and Waste Flow of Wet Waste

A part of wet waste such as food, vegetable, fruits, flower, garden tree etc. discharged from households or bulk generators (generate more than 10kg/day) is collected and transported to the compost facilities for recycling.

Since Major landfill sites such as Mandur, Lakshmipura, Bigupura have been closed, BBMP is making efforts to reduce waste amount to landfill by establishing composting and biomethanation facilities in the suburbian areas. RDF facilities are also installed at some of the existing composting plants and are producing RDF by compressing plastics mixed in organic waste. Apart from compost, biomethanation facilities producing electricity from organic waste are under operation at Maltose, Nobel Exchange but the treatment capacity of these facility is 20 ton/day and relatively small. The figure below shows the flow of wet waste in the city.

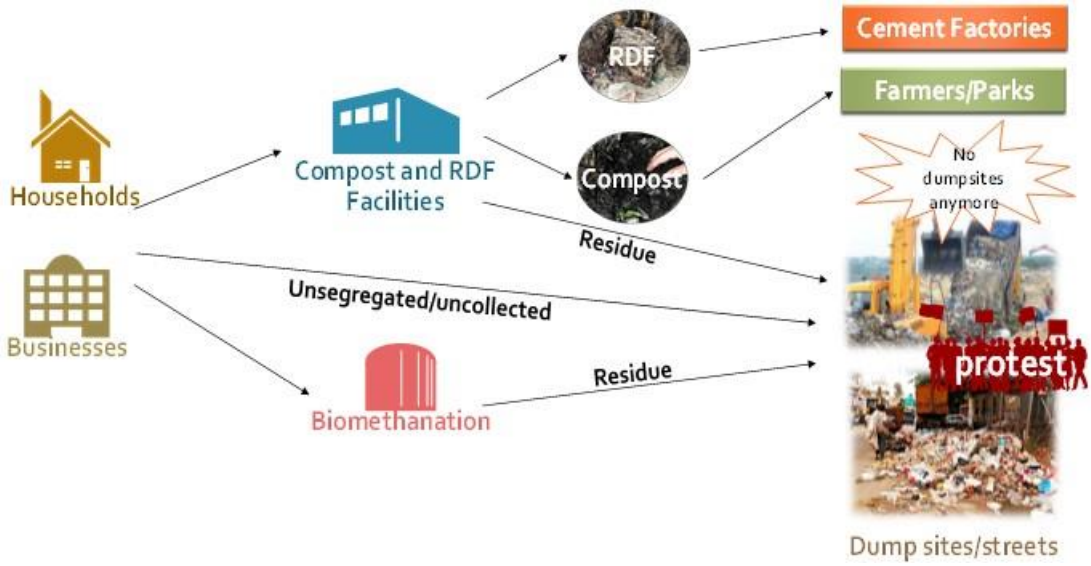


Figure 3-17: Flow of Wet Waste in Bengaluru

Due to D2D collection and collection from the bulk generator, the dry waste is extracted from wet waste for composing. However, low quality plastics such as plastic shopping bags are still mixed (Table3 18). Further efforts on segregation at source and mechanical treatment at composting facilities as intermediate treatment are needed.

Figure 3-18: Composting Organic Waste (left), bailing reside of plastic (right)

3-5 BBMP's Solid Waste Management Governance Structure

BBMP is managed by Urban Development Department of Government of Karnataka. BBMP has two wings; one is the political wing consisting of elected members and the other is the administrative wing. The political wing is led by Mayor elected every year and the administrative wing is led by Commissioner who is appointed by the Government of Karnataka. The political wing has a council consisting of elected members in the 198 wards, Karnataka State Government and Central Government and there is also a Health Committee in it. The Health Committee discusses and directs on SWM issues and advises the administrative wing on the policy directions.

Actual SWM services are provided by organization and personnel in the administrative wing led by the Commissioner. A person in charge of solid waste management is Special Commissioner of Solid Waste Management. Special Commissioner is supported by Joint Commissioner for the organizational operation. Technical support for Special Commissioner is provided by Chief Engineers but this position is currently vacant and this is conducted by Assistant Engineers to the Joint Commissioner. These personnel are the people handling the daily basis operation.

The roles and responsibilities on SWM service of BBMP is clearly divided between central office and zonal offices. The central office is mainly responsible for comprehensive planning of SWM, project planning and implementation such as compost facility operation, signing of concession agreements for new projects, etc.. On the other hand, the zonal offices of the BBMP are responsible for managing the collection, transport and the waste management facilities to which they send the

waste to. A Joint commissioner heads the zonal offices of the BBMP. An Engineering team (Superintending and Executive Engineers) for managing the solid waste activity supports the Joint Commissioner.The figure below summarizes the organizational structure of BBMP related to SWM.

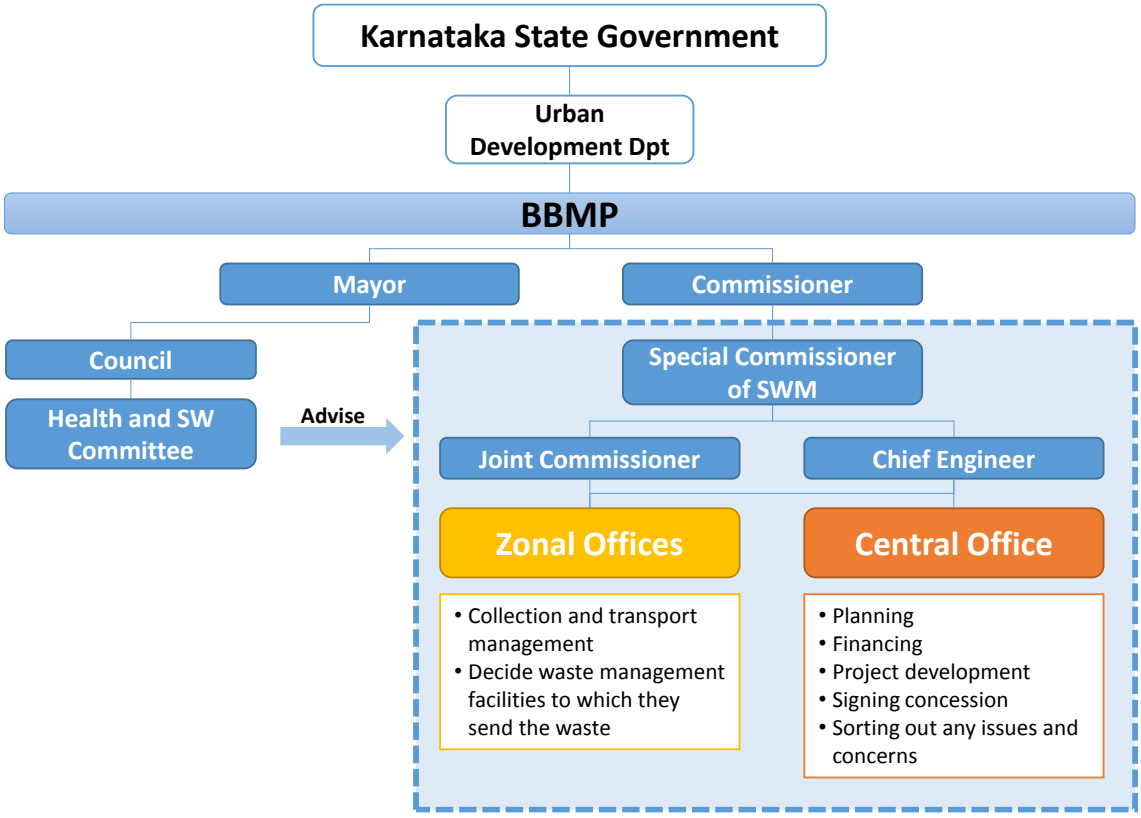


Figure 3-19: Organizational Structure of BBMP for SWM

3-6 Current Status of Sewer Sludge and Treatment Plan

(1) Current Status

In Bengaluru, the jurisdiction of water and sewer lies with BWSSB (Bangalore Water Supply and Sewerage Board). Water in Bengaluru is being supplied through the Cauvery River Water Supply Scheme at a rate of 1450 MLD from Cauvery River which is about 100km away. Development of water and sewer infrastructure to cater for the increase in population is becoming one of the challenges for Bengaluru.

The generation of sewer in Bengaluru has been estimated to be about 1125 MLD for 2011 and it is predicted that the amount[9] will increase to 1464MLD in 2021 and 1949 MLD in 2036. Currently,

[9] Presentation on Status of Water and Sanitation in Bangalore, V.C. Kumar, BWSSM
(http://icrier.org/pdf/bangalore_status.pdf)

there are 14 sewer treatment plants under the jurisdiction of BWSSB as shown below.

Table 3-11: Outline of sewer treatment plants in Bengaluru

No.	Name of the Plant	Treatment capacity (MLD)	Treatment process
1)	Vrishabhavathi Valley	180	Secondary – Trickling filters
2)	K & C Valley	248	Secondary:Activated sludge process
3)	Hebbal Valley	60	Secondary: Activated sludge process
4)	Madivala	4	Secondary+oxidation ponds + constructed wetlands
5)	Kempambudhi	1	Secondary: extended Aeration
6)	Yelahanka	10	Activated sludge process + filtration + chlorination (Tertiary)
7)	Mylasandra	75	Secondary – Extended aeration
8)	Nagasandra	20	Secondary -Extended aeration
9)	Jakkur	10	Secondary – UASB + Extended aeration
10)	K. R. Puram	20	Secondary – UASB+Extended aeration
11)	Kadabeesanahalli	50	Secondary - Extended aeration
12)	Rajacanal	40	Secondary - Extended aeration
13)	Cubbon Park	1.5	Membrane Bio Reactor
14)	Lalbagh	1.5	Extended Aeration + Plate Settlers + UV disinfection
合計		721	

※MLD：Million Liters per Day
Source: Presentation on Status of Water and Sanitation in Bangalore, V.C. Kumar, BWSSM (http://icrier.org/pdf/bangalore_status.pdf)

BWSSB does not measure volume of sludge produced aat the sewage treatment plant. Almost all of the sewage sludge from the 14 existing treatment plants are purchased by the farmers of the surrounding areas and used as fertilizers. The purchase price has been reported to be about Rs 450 for a truck (9 tons). In the K&C Valley plant, a part of the sewage sludge is used for electricity generation and a total of 1MW of electricity is generated from a 60MLD plant, which caters for about 50% of the electricity required by the plant.

(2) Characteristics of the Sewage Sludge

Sewage sludge from the K&C Valley plant was analyzed to determine its characteristics. The result is summarized below.

Table 3-12: Characteristics of Sewage Sludge from Sewer Treatment Plant*

	Method	Sample 1	Sample 2	Sample 3
Calorific value (Kcal/kg)	ASTM E711-87	2,549	2,688	2,544
Cl_2 (mg/kg)	ASTM E778-87	176	199	81
S (%)	ASTM E775-87	0.26	0.42	0.35

N (%)	ASTM E778-87	3.85	3.8	1.75
C (%)	ASTM E778-87	50.54	49.41	48.52
H (%)	ASTM E778-87	6.21	5.98	7.41
水分(%)	Gravimetri method	87	87.5	87.7
灰分(%)	Gravimetric method	5.6	5.2	5.3

*Sewage sludge were collected from 3 sludge drying pits located at K&C Valley plant on Dec 2, 2015 and analyzed at a MoEF accredited lab in India.

(3) Plans for Sewer Treatment Plants

A Master Plan (for up to year 2050) for the treatment of sewage sludge is being prepared by a consulting firm and it expected to be disclosed in 2016. According to information obtained from interview with a BWSSB personnel (Nov, 2015), approval for the construction of 6 STPSs equivalent to 520MLD in total has been granted by the government and it is expected that their construction will be completed by 2019. An outline of the proposed facility is shown below.

Table 3-13: Proposed STPs in Bengaluru

	Proposed construction site	**Capacity(MLD)**
1.	Vrishabhavathi Valley.	150
2.	Hebbal Valley	100
3.	K&C Valley	150
4.	Bangalore University Valley	60
5.	K.R. Puram	20
6.	Doddabele	40
Total		520

4 Future SWM in Bengaluru

4-1 SWM Scenario

(1) MSW Generation in the Future

The municipal solid waste generation is estimated for the target year 2025to examine a scenario in the future. Population forecast for Bengaluru until 2021 is made based on the census in 2011. Population is predicted to reach 14.17 million in 2021 from 9.59 million in 2011. Population is predicted to be 16.59 million in 2025 using the population growth rate of 2020-2021.

Further, solid waste generation per capita was 0.445 kg/day/person in Bengaluru in 2012. It is the smallest among the mega cities in India. Solid waste generation per capita is 0.708 kg/day/person in Chennai, which is highest in the same year. High growth of solid waste generation is expected reflecting India's high economic growth. Solid waste generation is estimated based on the fact that solid waste generation per capita will be the same as Chennai in 2025.

Solid waste generation in Bengaluru is estimated to be about 11,700 t/d in 2025.

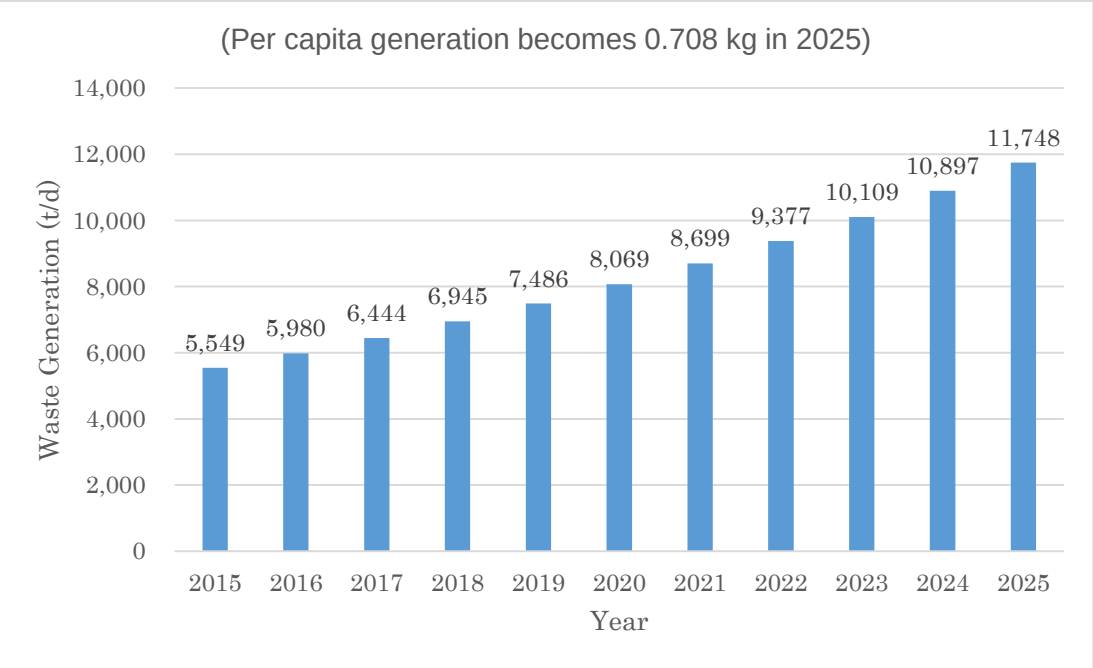


Figure 4-1: Estimated solid waste generation for 2015-2025

(2) Improvement of Waste Flow

1) Treatment Facilities

Following issues and challenges in regards to present and future waste flow exist. Reduction of waste to be landfilled and establishment of new landfill site is urgently needed.

- Quality of compost is low (such as including plastic). Some of the compost produced will

not be accepted by farmers as the volume of compost is too large and transportation cost will become higher for farmers.

- There is already a lot of objection from residents against running compost facilities and some facilities have stopped operation because of the objection from time to time. That means it will be difficult to operate all the compost facilities in a stable manner.
- A large volume of waste will be rejected and needs to be dumped at the compost facilities (some with RDF facilities).
- RDF users such as cement companies complain on the quality of RDF as RDF has high water content and its calorific value is low.
- Much volume of plastics is rejected at DWCCs.
- No new landfill site is planned now. Vacant space in the compost facilities is used currently in place of a landfill site. There will be no landfill space when vacant space in the compost facilities becomes full.
- BBMP does not well understand the situation on solid waste management by bulk waste generators.

The most important issue is the significant reduction of amount of waste that needs to be landfilled and pollution load from landfill site. Hence, introduction and expansion of waste treatment facilities is an urgent matter in order to reduce the amount of waste landfilled. Furtherutilization of waste for energy generation is an important option to respond to growing energy demand and diversification of energy source.

The study team proposes following approach to improve SWM in Bengaluru.

The proposed approach is to reduce the amount of waste landfilled significantly by a combination of measures such as waste segregation & recycling ,RDF(RDF) utilization and WTE as can be seen in City of Yokohama, Japan. Such appropriate management of solid waste contributes to forming a better living environment and the reduction of GHG emission

2) Target of introduction of treatment facilities[10]

Treatment facilities already planned and approved include a total of 4,550 t/d compost plants but many of the facilities accept much less waste than planned capacity. . Also many treatment facility plans were withdrawn. Further, if dry waste is well segregated and brought to DWCCs, DWCCs can work as expected. As a result, it is fragile to plan treatment facilities in a quantitative way for future waste generation.

However, treatment facilities to treat the increased amount of waste in the future, treat the rejected waste at composting and RDF facilities and DWCCs is required. In order for that,

[10] refer to 4) for GHG reduction

construction/improvement of the following is necessary.

(a) Improvement of Existing RDF facility:

At the existing RDF facilities, produced RDF is of low quality witha high moisture content and low calorific value. To respond to this issue, upgrading the process can decrease the moisture content. The method of upgrading is adding separation, dewatering and drying process as shown in chapter 6-3. Further, utilizing plastics left in the DWCCs can improve the quality of RDF and can lead to increased supply of RDF, reduction of waste to be landfilled and reduction of GHG through utilization of RDF as alternative fuel in cement plants.

(b) Installation of WTE facility:

Incineration, can reduc the amount to be landfilled significantly (about 95%). Heat generation from incineration can be utilized for electric power generation. By supplying electric power to electric grid, GHG emission in the grid side can be reduced. Residue generated from WTE facility is ash which does not cause sanitary issues at landfill sites.

3) Locations

In the megacity of Bengaluru,it is not realistic to introduce a very large scale waste treatment plant taking into account the transportation cost in the mega city area and changing waste volume and characteristics. Instead, a decentralized location would be suitable. In Tokyo, Tokyo metropolitan government has taken a similar stance to location. Considering these issues, the study team proposes the following:

(a) RDF facility will be situated at location/s where the collection of good quality of waste plastic is possible and access to user/s of RDF is good.
(b) WTE facility will be located at place/s where the discharge of relatively large and stable amount of waste is expected and stringent pollution control measures are required
(c) Existing operating small facilities are kept. Such small facilities are biogas plant in the Freedom Park and markets.

4) GHG Emission Reduction

(a) Improvement of RDF facility: Replacing fossil fuel with RDF and increase of power generation at the RDF user facilities
(b) Installation of WTE facility: Reduction of fossil fuel use in the power grid which power is supplied to from WTE facility. Also, organic waste will be reduced mentioned in (c).
(c) Methane generation will be decreased at landfill sites because of reduction of organic waste intake.

5) Model Facilities as the first step

As a short term response, improvement/installation of model plants treatment facilities with appropriate technologies should be commenced.

(a) Model RDF Plant: Upgrade of an existing RDF facility line with a minimum amount of cost as the Model RDF plant.

(b) Model waste to energy (WTE) plant: Due to the following reasons, it is better to start a WTE plant construction with a model plant scale.

- It is important to get better understanding on WTE including effect of WTE. It is important to understand individual effects such as reduction of waste amount, pollution control measures and power generation capacity. A model scale plant can form as a basis for expansion to a full scale WTE plant. Further, during the design stage, the plant can be customized to better reflect Bengaluru`s requirements.
- As there are no existing WTE facilities in Bengaluru, accumulation of know-how on the operation and training of operation staff is required.
- A WTE facility constructed in Delhi was not successful due to protests from the public and a low feed-in-tariff. A model plant is necessary to address these issues.

6) Improved waste flow

Above mentioned proposals can improve the MSW flow in Bengaluru as shown below.

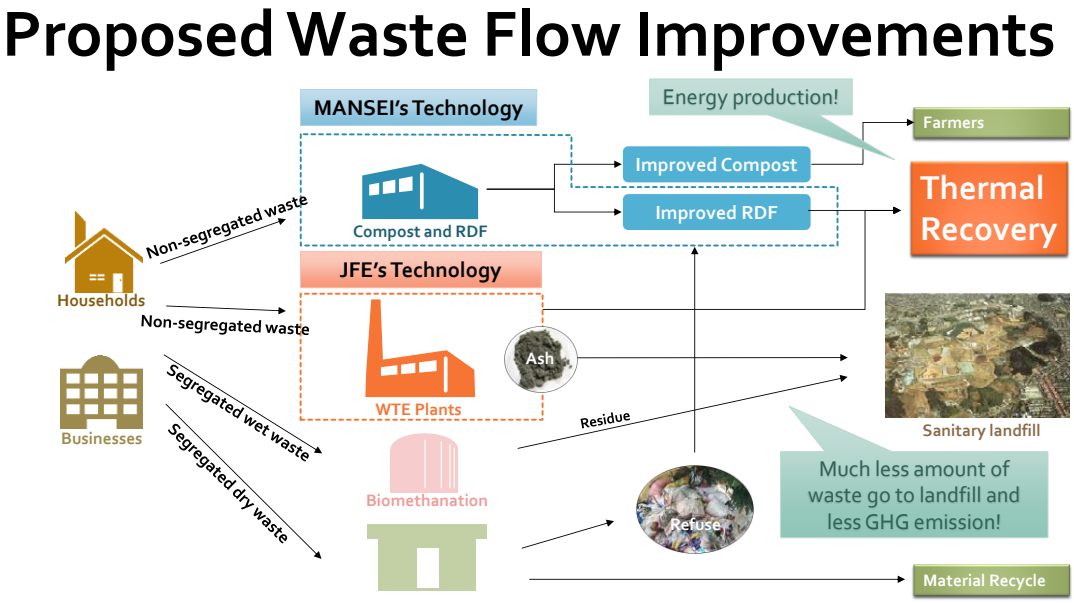


Figure 4-2: Improved MSW Flow

(3) Improvement Steps

As time and funding is required for improvement, the study team proposes a step by step improvement.

Step 1: Installation of model RDF plant

Step 2: Installation of model WTE plant

Step 3: a) Expansion of RDF plant and WTE plant, b) capacity building of BBMP and related institutions, c) strengthening segregation of waste

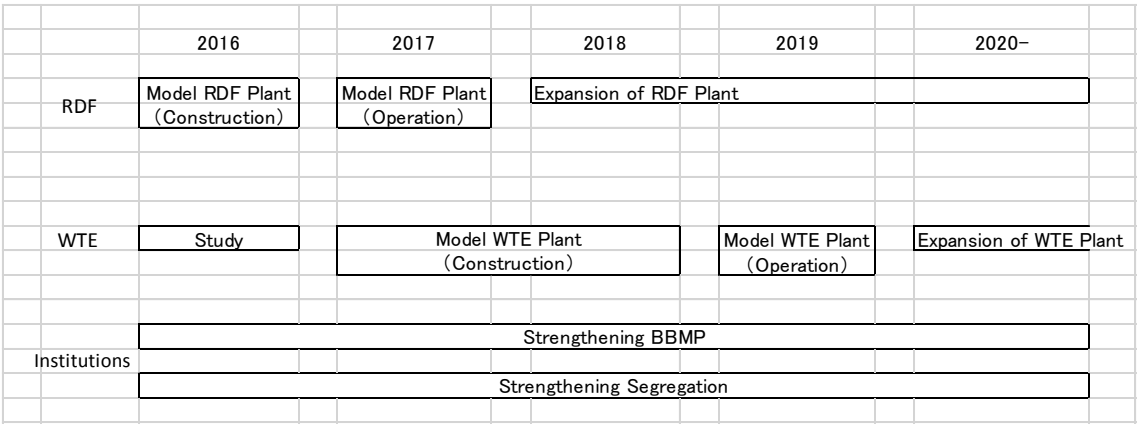


Figure 4-3: Improvement Steps

4-2 Improvement of Institution and System

In order to introduce RDF and Waste to Energy facilities in a step-by-step manner as described in 4-1 improvement of waste management system in Bengaluru is necessary. This section will explain the points to strengthen institutions and systems.

(1) Improvement of Separation and Collection at Source

In Bengaluru city, segregation at source for the dry and wet waste has been initiated. For the dry waste, Dry Waste Collection Centers have been established and purchase of recyclable wastes is being promoted. Door to Door collection has been introduced in 2001 and coverage area has been expanded. Current coverage is 40 % of the city and the city has some room to grow. In addition, it is necessary to encourage bulk generators to work with Dry Waste Collection Centers and promote segregation and appropriate treatment.

(2) Awareness Raising of Limitation of Composting and Potential of WTE Technology

BBMP expects to utilize wet waste as organic waste for composting or energy production through biomethanation. However, current waste production in Bengaluru is 4,500-5,000 ton/day of which 2,500-3,000 ton is considered to be organic waste. In order to response to the increasing demand in

the future, BBMP plans to construct more compositing facilities in the suburbs of the city. The capacity of the composting facility is expected to be between 100 to 500 tons/day. Currently, composting facilities under operation face opposition from the neighboring residents due to the bad smell from the process. It requires more spaces to make composting mature in order to correspond to the increasing treatment amount. Therefore, it is necessary for the residents to understand that there is a limitation of composting facility for waste management. At the same time, in order to conduct proper disposal in a sanitary manner, conserve spaces and extend the life of landfill sites, it is important to understand that introduction of WTE technology through a step-by-step process. Incineration is still not viewed positively by the residents. However, national government of India has considered WTE to be one of the solutions to reduce GHG emission at INDC submitted at COP21 and the awareness raising is needed.

(3) Shared Responsibility among Stakeholders

Since 2013, it has been decided that bulk waste generators with more than 10kg per day are required to have a contract with a waste treatment company for the collection and treatment. However, in some cases, wastes are treated by open burning or through illegal dumping. To prevent this and ensure the traceability and accountability for bulk waste generators, it is necessary to introduce a manifest system and data management. Waste amount reduction can be achieved by sharing the burden appropriate to the amount of waste by generators, and illegal or inappropriate waste companies can be eliminated by introducing manifest system and data management.

(4) Indroduction of Extended Producer Responsibility (EPR)

BBMP wants to introduce the Extended Producer Responsibility (EPR) concept thereby requiring product producers to take care of the responsibility from waste collection to disposal. BBMP wishes to develop recycling parks through fund from money collected from taxation to plastic and metal bottles.

While the EPR concept is considered as a new funding scheme for recycling and waste disposal, the introduction of EPR in Bengaluru will be challenging at the moment. Taking container packaging as an example, it is necessary to identify the manufacturers and users of packaging and and to establish a packaging association. It is also important to consider how to share the responsibility among producers, consumers, municipalities. Further, monitoring system to understand and track the data on amount of treated waste is necessary.

5 Waste to Energy Facility

5-1 Preliminary Design

This chapter demonstrates the preliminary design of the model waste to energy facility which is described as the second stage improvement in Chapter 4. In this design, site of the facility is not specified. The treatment flow of the model WTE facility is shown below.

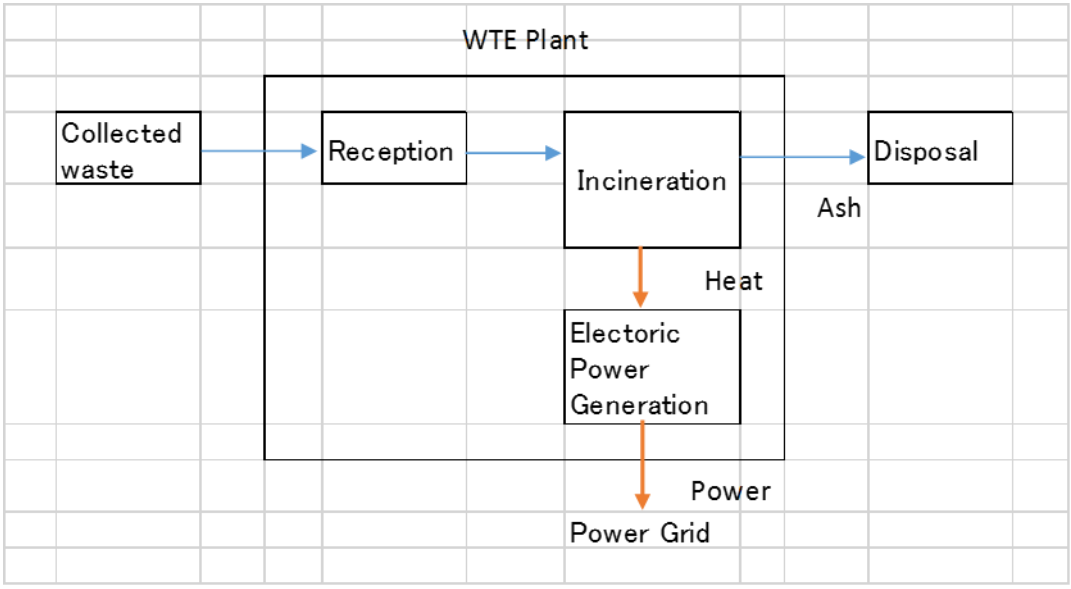


Figure 5-1: Treatment Flow of the Model WTE Facility

(1) Plant Capacity

In the megacity such as Bengaluru, it is not realistic to introduce a very large scale waste treatment plant considering transportation cost in a large area and changing waste volume and characteristics. Considering present waste collection route, treatment facility location and compost plant capacities, the plant capacity is set as 300 t/d.

(2) Design Summary

Stoker furnace is selected for incineration method. Design summary is shown in the table below.

- It can accommodate various types of wastes
- It can flexibly adapt to change in waste characteristics
- Large scale plants can be constructed
- Technology is mature and many plants have been constructed and are already operating

Table 5-1: Design Summary

Items	Basic Specifications
Treated Waste	Collected waste
Treatment Process	Incineration in stoker furnace with power generation
Plant Capacity	300 t/d (300 t/d×1 line)
Annual Working Days	310 days
Average lower calorific value of waste	8,037kJ/kg (1,921 kcal/kg)
Power Generation Capacity	6.2MW
Annual Power Sales	33,034MWh/year

(3) Outline of the Process

The plant mainly consists of the following facilities: waste receiving and charging system, incineration furnace system, flue gas cooling and heat recovery system (boiler), flue has cleaning system, heat utilization system (electric power generation) and ash (bottom & fly) discharging system. Incineration process flow is shown by the figure below and outline of each major system is described in the following sections.

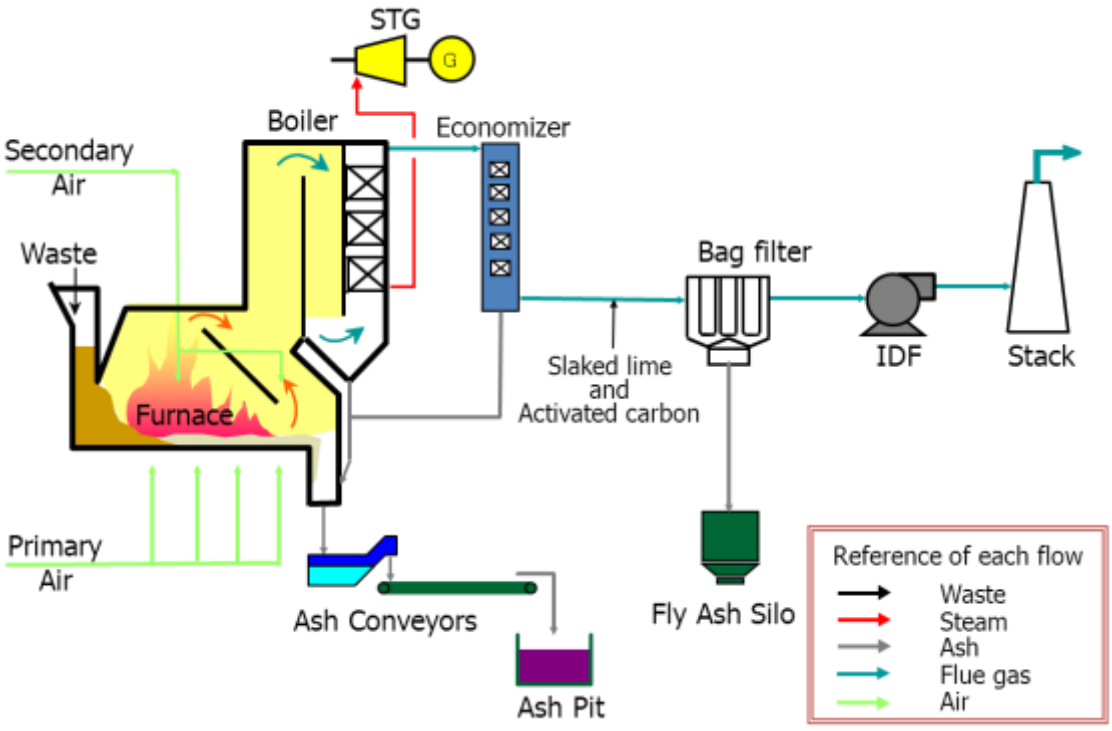


Figure 5-2: Process Flow of Incineration System

1) Waste Receiving and Charging System

Waste charging hopper has a wide opening to prevent occurance of bridges. With the combination of a waste chute having enough sealing height to prevent fire blow-off from furnace inside, it is able to bring waste into furnace smoothly.

2) Incineration Furnace System

① Waste Charging Hopper and Chute

Waste charging hopper has a wide opening to prevent occurance of bridges. With the combination of a waste chute having enough sealing height to prevent fire blow-off from furnace inside, it is able to bring waste into furnace smoothly.

② Waste Feeder

Charged waste is efficiently and smoothly fed to the furnace by a hydraulic driven pusher-type waste feeder. Waste amount fed by this feeder is controlled and/or set by automatic combustion controller or remote operation.

③ Combustion system (Combustion stoker)

Combustion system consists of movable grates and fixed grates. The type of grate is JFE-Hyper Grate, it has cooling fins inside grate piece, and therefore each grate piece can be cooled down efficiently through combustion air (primary air) blowing in.

Speed of movable grates driven by hydraulic devices are controlled and/or set by automatic combustion controller or remote operation.

In addition, there are separated blocks to supply air for drying and combustion under the grates, and the supply air flow is controlled and/or set by automatic combustion controller or remote operation.

④ Furnace

In this plant, JFE Two-Way Flue Gas Stoker Furnace which has intermediate ceiling is proposed. Since Two-Way Flue Gas Stoker Furnace can accommodate stable waste combustion against wider calorific value of waste, it is optimum for India;

Main combustion chamber consists of water cooling wall of boiler in order to maximize waste heat recovery. Inside furnace is lined with high heat resistant refractory. For those parts where clinker relatively easily adheres, a structure of air cooling wall or water cooling wall is designed.

The intermediate ceiling divides flue gas into 2 streams which flow through flue gas main path and sub-path and then turbulently mixes up in the secondary combustion chamber. Therefore, it is able to promote complete combustion by this raged confluence, while able to reduce generation of dioxins and NOx during combustion. Further, because this ceiling brings combusting waste effective thermal radiation, bottom ash quality is kept in a good condition and it is possible to greatly reduce environmental impact to final landfill.

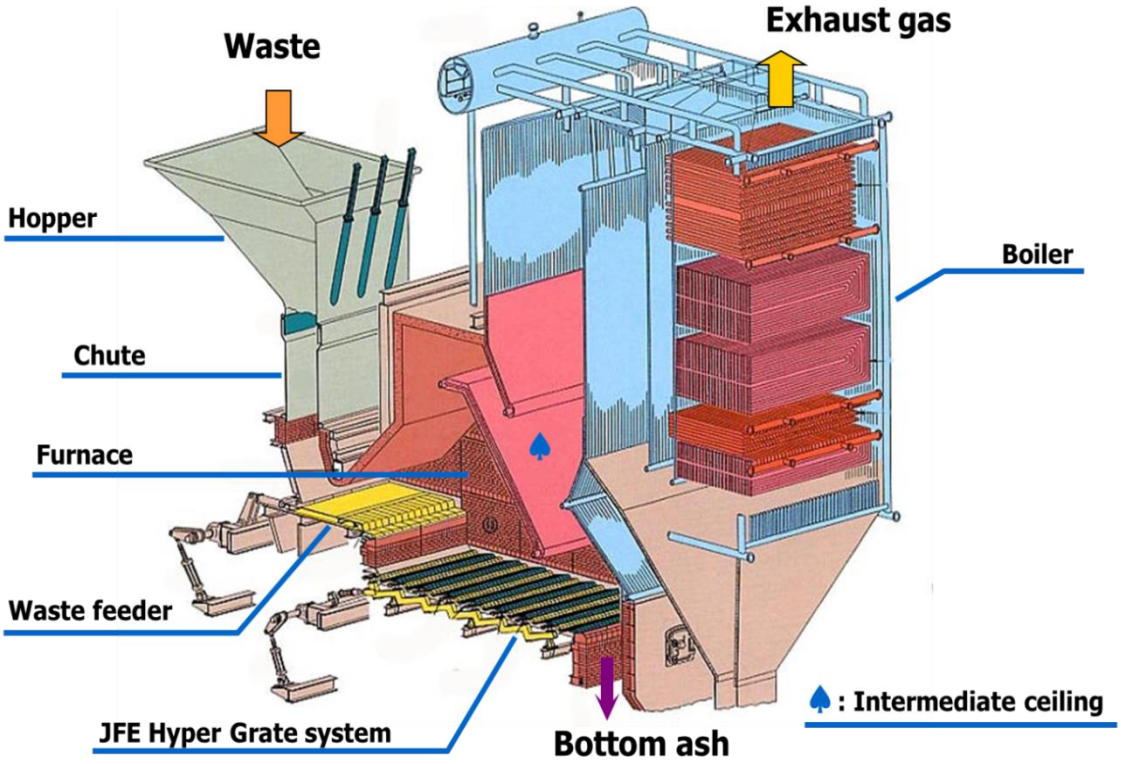


Figure 5-3: Structure of JFE Two Way Flute Gas Stoker Furnace

3) Automatic combustion control (ACC) System

Conventional automatic combustion control system has been used for maintaining stability of combustion condition by feedback control which adjusts each operation values based on control value from the waste incineration process.

Although feedback control is responsive to long-term change, it cannot respond to momentary change.

Hence, JFE has developed a Hybrid ACC system that is able to respond to momentary change by combining fuzzy control with conventional ACC system.

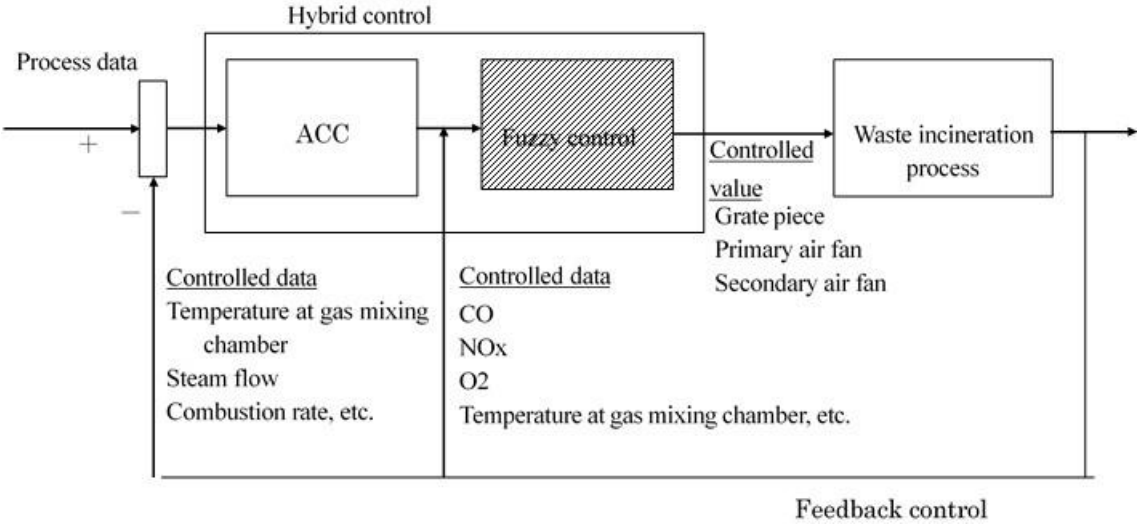


Figure 5-4: JFE Hybrid ACC Concept

4) Flue Gas Cooling and Waste Heat Recovery System

Boiler is installed for cooling flue gas and for recovering waste heat to produce steam efficiently. A natural circulation boiler with single drum is applied for this planning.

Boiler drum is fed high temperature water which is pre heated from heat generated from the de-aerated economizer. Boiler water flows down through distribution pipes by natural circulation and after being heated by heating pipe the heated water rises due to difference in specific gravity. Finally it returns to the boiler drum where the team and water are separated.

High pressure saturated steam from boiler outlet is heated in super heater and the superheated steam is transported to steam turbine for power generation.

This boiler is operated under three component control: feed water flow, water level in boiler drum and produced steam flow and hence is highly controllable. Due to this, this operation is especially optimum for a boiler adopted for a furnace which is selected for incinerating waste with variable calorific range. These controls run automatically by setting steam flow.

Dust adhering to the surface of heat transfer pipes is cleaned by steam blow (soot-blower). Surrounding equipment and ancillary equipment are also included in the heat recovery system, such as de-aerator, demineralizer, boiler chemical dosing unit, continuous blow-down unit, boiler water monitoring unit, etc.

5) Flue Gas Cleaning System

① Acid Gas (HCl: Hydrogen chloride, SOx: Sulfur oxide, HF: Hydrogen fluoride) Removal Equipment:

Dry type system, slaked lime powder is injected into an inlet duct of a bag filter by high pressure air from an injection blower. This system consists of slaked lime silo, slaked lime feeding device,

injection blower, etc. Calcium chloride [CaCl2] and calcium sulfide [CaSO4] which are produced from HCl, SOx removal systems are powdery and captured in bag filter.

② Dioxins Removal Equipment

Dry type system, activated carbon powder is injected into the flue gas duct with slaked lime powder. Activated carbon powder absorbs gaseous dioxins contained in flue gas. These powders and dioxins particles are captured by bag filter. AsJFE Two-Way Flue Gas Stoker Furnace makes it possible to restrain dioxins generation by adequate combustion control which greatly contributes to reducing activated carbon consumption.

③ Dust Removal Equipment

Bag filter is applied for this planning and it removes dust including all solid products present in the harmful gas removal process. Pulse jet method is adopted for removing the dust sticking on the surface of filter cloth, which is achieved by injecting compressed air through blow tubes on a fixed interval. Removed dust is discharged from bottom hoppers by bag filter conveyors and transferred to a fly ash silo by fly ash conveyors.

④ Nitrogen Oxides (NOx) Removal Equipment

Since the JFE Stoker Furnace for this planning is effective in promoting the reduction reaction of NOx by two-way flue gas flow, it makes it possible to comply with the present environmental regulation through appropriate operation of the furnace. Hence, there is no need to install a NOx removal equiplent.

6) Waste Heat Recovery System

① Steam Turbine

Heat generated by waste incineration is recovered as steam which in turn is used for power generation through steam turbine. Condensing extraction steam turbine is applied for this planning and extraction steam is used for process equipment such as de-aerator.

② Low Pressure Steam Condenser

This is the equipment to cool and condense all exhaust steam from the steam turbine. Air cooled type condenser, which does not require the use of a large amount of cooling water, is applied for this planning.

7) Ash Discharging System

① Bottom Ash

Completely combusted ash falls into the bottom ash conveyor (water bath type) from bottom ash chute. Extinguished and humidified ash is temporarily stored at the ash pit and is transported for final landfill by trucks at stated periods.

② Fly Ash

Fly ash discharged from bag filter is temporarily stored in fly ash silo. In this planning, fly ash is transported outside (other stabilization facility or hazardous waste treatment facility) by bulk transporter without solidification and/or stabilization.

8) Major Specifications of the Plant

Items	Units	Specifications
Incinerator		
Type	-	JFE Two Way Flow Gas Stoker Furnace
Quantity	Line	1
Capacity/line	t/d	300
Flue Gas Cooler		
Type	-	Single drum natural circulating boiler
Quantity	Set	1
Designated steam pressure (at superheater outlet)	MPa(G)	4.0
Designated steam temperature (at superheater outlet)	deg.C	400
Steam generation (at rated thermal load)	t/h	46
Flue Gas Treatment		
Acid gas removal	-	Dry method (Powdery slaked lime injection)
Dioxins removal	-	Dry method (Powdery activated carbon injection)
Dust removal	-	Bag filter
Nitrogen oxide removal	-	Combustion control
Heat utilization		
Type		Condensing steam turbine + Synchronous generator
Quantity	Line	1
Designated steam pressure (at inlet)	MPa(G)	3.8
Designated steam temperature (at inlet)	deg.C	395
Exhaust pressure	kPa(A)	25
Steam flow rate (at rated thermal load)	t/h	37
Generated power (at rated thermal load)	MW	6.2

9) Environmental and Social Considerations

The plant design needs to follow procedures of environmental impact assessment/clearance in India

and procedures of environmental and social considerations of the financing institutions (For example, JICA environmental and social considerations guidelines needs to be adhered to when JICA funding is utilized).

5-2 Financial Analysis

(1) Project Cost and Revenue

Project cost and revenue of the proposed WTE project is as follows.

Item	Settings
Total project cost	
Initial investment	Approximately 6.3 billion JPY
Operation and maintenance cost for 20 years	5.9 billion JPY (approximately 0.3 billion JPY/year)
Expected revenue	
Solid waste tippingfee Electric power sales revenue	Worked out in cash flow analysis

(2) Cash Flow Analysis

Cash flow analysis is conducted in the case of PPP. Refer to 5-4 for details of PPP. Table 5-2 shows the conditions and the result of the cash flow analysis.

Table 5-2: Conditions and Results of Cash Flow Analysis

Items	Conditions and Results
Implementing body	Special Purpose Company (SPC) established by the consortium between Japanese private consortium and Indian partner
Service to be provided	Treatment of solid waste and electric power generation
Project period	20 years（2019～2038）excluding construction and preparation period
Capital	1.5 billion JPY (25% of initial investment)
Financing method	JICA Private Sector Investment Finance: 3 billion JPY Joint Crediting Mechanism (JCM) Subsidy from Ministry of the Environment, Japan: 2.5 billion JPY
Financing condition	JICA Private Sector Investment Finance: Redemption period: 15 years（with 5 years deferment） Level payment Interest rate : 1.33% (JPY base) JCM subsidy from Ministry of the Environment, Japan: Grant （JCM Agreement between Japan and India hasnot been concluded yet. Intention to utilize the JCM scheme for project funding has already been communicated to BBMP by the study team.
Operation and maintenance for 20 years	5.9 billion JPY (approximately 0.3 billion JPY/year))
Depreciation of	Facilities will depreciate completely in 20 years under the straight-line method.

Items	Conditions and Results
facilities	
Corporate tax	The project will be completely exempt from corporate taxes for 10 years as it is a renewable energy project. Procurement from overseas would be exempt from customs duties.
Expected revenue source	①Electric power sales revenue (Unit price: 7.04 INR/kwh, Power amount: 33,034MWh/year) ③ Revenue from waste treatment (Tipping fee) Amount required to realize a project EIRR of 18% is 1,100 INR/t
Project IRR and Equity IRR	Project IRR: 17.7% Equity IRR: 18.2%
Financing method	JICA Private Sector Investment Finance: 3 billion JPY Joint Crediting Mechanism (JCM) Subsidy from Ministry of the Environment, Japan: 2.5 billion JPY

5-3 Survey for JCM Registration

(1) GHG Inventory of the Host Country and Karnataka State

The Ministry of Environment and Forest (MOEF) of India has published its latest national GHG inventory Report titled "India: Greenhouse Gas Inventory 2007" on May, 2010. The MOEF published it in order to update India`s GHG inventory after their last survey conducted in 1994, as various parties that need it for decision making requested MOEF to do so. The inventory report stated above confirms that India is the 5th largest GHG emitting country globally after USA, China, EU and Russia and also states that India has achieved a 30 percent of reduction of GHG emission per GDP during 1994 – 2007 period. Excerpt from the inventory report is shown below. It can be seen that India emitted 1,722.71 million t-CO_2 of GHG and the sector wise breakdown is as shown in the table.

Table 5-3: GHG Emission by Sector

Sector		GHG emission (10^6 t-CO_2)	Ratio
Energy	Sub Total	1,100.06	57.8%
	Power	719.31	
	Transportation	142.02	
	Others	238.71	
Industry	Sub Total	412.55	21.7%
	Cement	129.92	
	Steel & Metal	117.32	
	Others	165.31	
Agriculture		334.41	17.6%
Waste		57.73	3.0%
LULUCF		-177.03	-
Total (tCO_2 eq)		1,727.71	100%

Source: India Greenhouse Gas Inventory 2007

GHG emission by the type of Greenhouse Gases is as per the table below.

Table 5-4: GHG Emission by Greenhouse Gas Type

GHG Type	Emission 1 (10^6 tons)	Emission 2 (10^6 tCO_2eq)	%
CO_2	1,221.76	1,221.76	70.7
CH_4	20.56	431.76	25.0
N_2O	0.24	74.40	4.3

Amount of GHG emission reported in the 1st National Communication is 1,251.95 x 10^6 tCO_2 which implies that 652.78 x 10^6 tCO2 or 3.3% per annum in average of GHG emission increase was observed every year in the 13 year period (1994-2007). The table below shows the comparison of sector wise GHG emission between 1994 and 2007.

Table 5-5: GHG Emission by Sector in 1994 & 2007

Sector		GHG Emission (10^6 tCO2) (%)		Increase Ratio
		1994	2007	
Energy	Power	355.03(28.4%)	719.31(37.8%)	5.6%
	Transport	80.28(6.4%)	142.02(7.5%)	4.5%
	Domestic	78.89(6.3%)	137.84(7.2%)	4.4%
	Others	78.93(6.3%)	100.87(5.3%)	1.9%
Industry	Cement	60.87(4.9%)	129.92(6.8%)	6.0%
	Steel	90.53(7.2%)	117.32(6.2%)	2.0%
	Others	125.41(10.0%)	165.31(8.7%)	2.2%
Agriculture		344.48(27.6%)	334.41(17.6%)	-0.2%
Waste		23.23 (1.9%)	57.73 (3.0%)	7.3%
Total		1,251.91(100%)	1,904.73(100%)	3.3%

Source; India: Greenhouse Gas Inventory 2007

Karnataka state, where Bengaluru is located, has published its first action plan on climate change titled ”KARANATAKA ACTION PLAN FOR CLIMATE CHANGE(KAPCC)” on December, 2013. According to the action plan, 80 x 106 tCO2eq of Carbon Dioxide equivalent Greenhouse gas, which represents for 4.6 percent of total GHG emission in India, was emitted from the state. The following tables show the detail of GHG emission by GHG type and sector-wise emission amount in Karnataka.

Table 5-6 GHGInventory of Karnataka State

GHG Type	GHG Emission (10^6 tons)	Amount of GHG Type (10^6 tCO_2eq)	%
CO_2	56.0	56.0	73.0
CH_4	0.876	18.4	23.0
N_2O	0.009	2.6	3.3

Table 5-7: GHG Emission in Karnataka State by Sector

Sector		GHG Emission (10^6 tCO2)	Ratio (%)
Energy	Power	28.72	35.9
	Transport	8.32	10.4
	Others	5.84	7.3
Industry		18.08	22.6
Agriculture		16.16	20.2
Waste		2.88	3.6
Total		80.00	100.0

Source: Karnataka Action Plan for Climate Change (KAPCC)

The tables above clearly show that the power sector (energy sector) is the largest emission source with the highest share in percentage in GHG emission in not only India as a whole but also in the state of Karnataka. where the project development is being considered. Table 5-5shows that the amount of GHG emission in both the power and waste sectors are increasing with rates of above average during 1994 – 2007. This can be attributed to an increase in the waste generation amount due to the economic development and population increase in India. Hence, effort such as further promotion of utilization of renewable energy and avoidance of methane gas emission by proper management of municipal solid waste needs to be promoted..

According to the Annual Report issued by the Electricity Regulatory Committee, there is a potential capacity of 135MW of power generation from municipal waste in Karnataka of which 25.50 MW of allotment[11] has already been done. . No electricity generation from waste has been connected to the National grid at the moment.

(2) Consideration of JCM Registration

1) Technologies to be employed

The Project Participants consider to employ a complete set of technologies for Waste to Energy, consisting of waste heat recovery boiler, turbine, alternator, condenser and steam & water circulation pipes as boiler & power generation islands, control unit, incinerator, flue gas treatment facilities, water treatment facilities, ash handling unit and pre-treatment unit for MSW. Among the complete set of facilities, the incinerator is regarded as the core facility. Taking into account the expected seasonal variation of waste quality, use of the Two-way Flue Gas Stoker Furnace of JFE has been proposed. The stated furnace is effective in minimizing dioxin and NOx emissions through a superior combustion, minimizes clinker adherence inside furnace and achieves a complete combustion.

In addition to relatively lower environmental load operation stated above, the Two-way Flue Gas Stoker Furnace of JFE attains a more stable combustion by utilizing the hybrid Automatic Combustion

[11] State Administrative Office approves allotment for WtE based on application submitted by the responsible authority for MSW in the area

Control System.

2) Formation of International Consortium

Although discussion on business outline is on-going among potential project participants for the project, the parties have not yet reached an agreement on formation, including formation of international consortium for JCM registration. The project consists of two components; waste treatment and power generation. In regards to power generation, India allows for electric utility deregulation and if KERC specifies the purchase price, a contract with the power purchaser will be required. On the other hand, for waste management, as it lies in the jurisdication of BBMP, a partnership with BBMP or a party entrusted by BBMP will be required. Further discussion with the respective stakeholders to achieve a consensus is necessary.

3) Possible JCM Methodology Applicable to the Project

The project plans to generate power through the utilization of waste heat derived from the combustion of municipal solid waste which will be collected and transported by BBMP. According to the master plan for MSW management that was prepared and published by BBMP in 2008, they have considered the excavation of existing old waste from landfill and utilizing it as an alternative fuel. However, waste flow of the city shows that at least 4,000 tons per day of municipal solid waste is generated daily while capacity of intermediate facilities in total is only 2,600 tons per day indicating that rocessing capacity available for municipal solid waste is significantly insufficient in Bengaluru. Consequently, the project under planning will utilize only fresh MSW with a very low possibility to utilize existing old waste at landfills as fuel for power generation. Although the possibility of the project of utilizing existing & old waste at landfill as alternative fuel is very low, eligibility criteria for doing so has been summarized as shown below.

Table 5-8: Summary of the Eligibility Criteria

	Eligibility Criterion	Reasons
1	Project shall generate power by utilization of waste heat derived from incinerator that is designed, constructed and operated for combustion of MSW	Thermal energy derived from MSW incineration includes that from plastic waste. As emission factor for incineration of plastic waste is high, project might emit more GHG than reference scenario if incineration is included in the project
2	For the scenario where the project utilizes existing old waste buried at landfills as alternative fuel (including RDF & RPF), then 1) The project participants shall establish	RDF deprived from old waste is considered to be used as alternative fuel for power generation and this is not

	organization and system to conduct appropriate monitoring operation for RDF derived from old waste. 2) The Project participants shall not utilize RDF in excess of the upper limit set up by the PDD 3) The project shall adopt default values for GHG emission from combustion of plastic waste as follow (as per default value set up by IPCC2006) CF=0.85 FCF=1.00	categorized as waste heat (from MSW combustion)
3	The capacity of the incinerator shall be not less than 300tons/day and not less than 25% of total energy conversion efficiency in electricity form.	Efficiency of project management, adequacy of operation, stability of combustion are the core factors in the methodology.
4	For the scenario where MSW incinerator will be constructed under the project, power generation shall be added to the MSW incineration project. OR. It shall be verifiable that MSW to be combusted at the incinerator, in the absence of this project activity, would have been incinerated in a manner that does not involve waste heat usage or power generation.	Project is to achieve GHG emission reduction by utilization of waste heat. Thus the project shall prove that there is or will be waste heat available to use for power generation

Grid emission factor published by the Central Electricity Authority of India is 0.84tCO2/MWh for the Southern states[12], where Bengaluru is located and 0.90tCO2/MWh for the whole country[13]. In this project, a conservative approach is taken and the value of the southern state is adopted as the default value.

4) Quantification of GHG Emission Reduction

Methodology for Quantification

The sources and types of GHG for the project are as follows.

Table 5-9: Sources and Types of GHG for the Project

Category	Activity	GHG	Remarks
Reference Emission	Power Generation	CO_2	GHG that will be emitted from the Grid connected power stations in the absence of this project.
Project Emission	Fossil Fuel to be consumed on site	CO_2	GHG that will be emitted from the consumption of fossil fuel as auxiliary fuel on site

[12] National Grid in India can be devided into 5 zones, i.e. North, East, West & Northeast (NEWBE grid) and South (South Grid). South Grid covers six states including Karnataka.

[13] CO2Baseline Database Ver7.0 2012 / Central Electricity Authority

	Electricity to be consumed on site	CO_2	GHG that will be emitted from the consumption of electricity imported from the grid and consumed on site
	Fossil Fuel to be consumed on site	CO_2	GHG that will be emitted from the consumption of fossil fuel for pre-treatment
	Electricity to be consumed on site	CO_2	GHG that will be emitted from the consumption of electricity from the grid and consumed for pre-treatment
	RDF derived from old waste	CO_2	GHG that will be emitted from the combustion of RDF deprived from old waste

The following formula are used for the calculation of reference and project emissions.

$$RE = EG_p \times EF_{grid} \cdots\cdots 1$$

where

RE_p = Reference emission for period "p"(t CO_2)

EGp = Amount of electricity generated and exported to the national grid for period "p"(MWh)

EF_{grid} = Grid Emission Factor (t CO_2/MWh)

$$PE_p = PE_{elec,plant,p} + PE_{FF,plant,p} + PE_{elec,pre-t,p} + PE_{FF,pre-t,p} + PFalt, \cdots\cdots 2$$

where

PE_p = Project Emission for the period "p"(t CO_2)

$PE_{elec,plant,p}$ = GHG emission from electricity consumption on site for period"p" (t CO_2)

$PE_{FF,plant,p}$ = GHG emission from consumption of fossil fuel on site for period "p" (t CO_2)

$PE_{elec,pre-t,p}$ = GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PE_{FF,pre-t,p}$ = GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PEF_{alt,p}$ = GHG emission from fossil fuel consumption for pre-treatment for period "p" (tCO2)

$$PE_{elec,,plant,p} = EL_{plant,p} \times EF_{grid}$$

where

$EL_{plant,p}$ = Amount of electricity imported from the national grid and consumed by the project for period "p" (MWh)

EF_{grid} = Grid Emission Factor(tCO2/MWh)

$$PE_{FF,plant,p} = FF_{plant,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{plant,p}$ = Amount of Fossil Fuel consumed as auxiliary on site for period "p"(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type"i"(Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type "i"(tCO2/ton)

$$PE_{elec,,pre-t,p} = EL_{pre-t,p} \times EF_{grid}$$

where

$EL_{pre-t,p}$ = Amount of electricity imported from national grid and consumed for pre-treatment for period"p" (MWh)

EF_{grid} = Grid Emission Factor (tCO2/MWh)

$$PE_{FF,pre-t,p} = FF_{pre-t,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{pre-t,p}$ = Amount of Fossil Fuel consumed for pre-treatment for period "p"(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type "i" (Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type "i"(tCO2/ton)

$$PE_{Falt,p} = F_{alt,dry,p} \times TC_{pla} \times FCF_{pla} \times OF_{pla}$$

where

$F_{alt,dry,p,}$ = Amount of Electricity imported from the national grid and consumed on site for period "p"(MWh)

TC_{pla} = Fraction of carbon for plastic in dry matter (%)

FCF_{pla} = Fraction of fossil carbon in total (%)

OF_{pla} =

Amount of GHG emission reduction is quantified by the following equation, i.e. Reference Emission minus Project Emission.

$$ER_p = RE_p - PE_p \quad \cdots\cdots 3$$

where

ER_p = Emission Reduction for Period "p"(t CO_2)

The project under consideration will generate power by utilizing waste heat derived from MSW incineration and export power to the national grid as alternative to grid electricity, thus contributing to

GHG emission reduction. The actual amount of GHG emission reduction can be calculated with values for all parameters given and/or obtained through monitoring activities. For carrying out estimation, the following conditions are utilized based on various sources of data available.

- Capacity of Furnace：300t/day
  Net Calorific Value for MSW (after segregation): 10,000kj/kg
- Operational days: 310days /year
- Power Generation Efficiency of the Facility: 25%
- Amount of Electricity Consumed on Site: 2.0MWh

Reference Emission

Reference emission, i.e., the amount of GHG emission from power generation by power stations, which connected to grid, generate and export power to the grid, is quantified by equation (1) above and values to be applied are set up as per the table below.

Parameter	Unit	Value	Remarks
EG_{p}	MWh	By Monitoring	
EF_{grid}	tCO_2/MWh	Default Value	Default Value published by India (=0.84 (tCO2/MWh for Southern Grid)

Amount of electricity to be generated by the project is estimated to be 65,619MWh/year and the amount of electricity to be consumed on site is estimated to be 14,880MWh/year from the precondition stated above. As a result, the amount of electricity to be generated and exported to the grid will be 50,739MWh/year. Consequently, amount of GHG emission reduction is calculated as 42,620tCO_2/year.

Project Emission

As the project under consideration will establish power generation unit attached to a MSW incinerator, GHG emission from the MSW incineration is not regarded as project emission for the project. Therefore, project emission for the project is attributed to consumption of fossil fuel as auxiliary fuel on site, consumption of electricity on site, consumption of fossil fuel for pre-treatment and consumption of electricity for pre-treatment. Project emission is calculated by equation (2) shown above with values for each parameter shown in the table below.

Parameters	Units	Values	Remarks
$EC_{plant,p}$	MWh	Monitoring	
$EC_{pre-t,p}$	MWh	Monitoring	
EF_{grid}	tCO2/MWh	Default	Default Value published for India (=0.84 for southern grid)
$FF_{aux,i,p}$	L	Monitoring	

$FF_{pre-t,,i,p}$	L	Monitoring	
NCV_{FFi}	GJ/t	Default	i=diesel (43.3) IPPC Default Value
EF_{FFi}	tCO2/GJ	Default	i=diesel (0.0748) IPPC default value (max)
TC_{pla}	%	Default	IPCC Default Value (85)
FCF_{pla}	%	Default	IPCC Default Value (100)

In this project, electricity generated by the project is planned to be utilized for operation of the plant for waste treatment except for periods when the power plant isoff-operation.(During this time, grid electricity will be consumed). Fossil fuel might be consumed by the emergency generator during power outage in off-operation period, if any. Actual amount of both electricity and fossil fuel to be consumed will be monitored through the project operation, while it is estimated approximately to be 100MWh/year covering amount of electricity to be consumed for maintenance and at office buildings during off-operation period.

(3) Emission Reduction

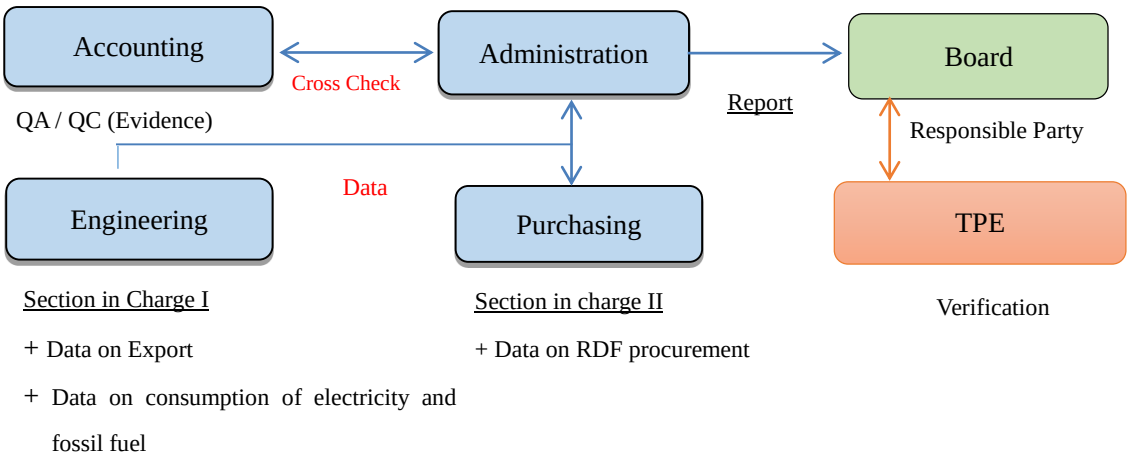
GHG emission reduction by the project is estimated to be 42,536tCO2/year from the reference emission and project emission estimated above.

(4) MRV

Monitoring is expected to be done by the project operator as a part of routine work of business operation and monitoring report prepared by the business operator is expected to undergo internal audit and subsequently submitted to a Third Party Entity for verification after final approval given by the board of directors.

1) Organizational Structure for MRV Implementation

Organizational structure planned to be formed in the project is as follows:



2) Monitoring Methodology

Assumed flow from monitoring activities to verification to be conducted by the third party entity is as follows.

- Appointed person in charge from The Engineering Section, which is responsible for operation of the plant, will monitor and record values of 1) amount of electricity exported to the grid, 2) amount of RDF, which is processed from old waste, consumed, 3)fossil fuel consumed as auxiliary and electricity imported from the grid & consumed both on site and for pre-treatment.
- The format shall be checked by the chief of the section and filed in pre-fixed files on daily basis, then sent to Administrative Section periodically.
- Administration Section shall cross check values in the report submitted by accounting section, purchasing section and engineering section, then convert into electric format for filing.
- Values for each parameter monitored and filed, will be transcribed to monitoring report including spread sheets of Project Design Document and submitted to the Board of Directors for approval
- Board of Director will submit monitoring report to Third Party Entity for verification, then submitted verified monitoring report to JCM joint committee for credit issuance.

A summary of roles of each section in terms of monitoring, filing and QA/QC in operation flow is as per description in the table below.

Table 5-10: Assumed QA/QC for each parameter to be monitored

Parameter	Measurement and Record	QA/QC
Amount of electricity to be exported to the national	**Engineering Section** will monitor the parameters and record actual	cross check with invoices issued to electricity buyer(s)

grid	values in the pre-fixed format **Administration Section** will convert data into electric form and file **Administration Section** will prepare monitoring report to be sent to board for approval, then send to TPE for verification	
Amount of RDF consumed		cross check with both with delivery notes and invoice to be issued by RDF supplier(s)
Amount of electricity imported from the national grid and consumed on site & pre-treatment		Cross check values in the report submitted by the engineering division with invoice issued by electricity buyer(s)
Amount of fossil fuel consumed on site & for pre-treatment		Cross check with values in the report submitted by the purchasing division and engineering division with invoice issued by supplier(s)

3) Measurement Instrument for Monitoring Activities

The project participants will install measurement instrument with error of less than 5% as prescribed by the JCM and the instrument will be calibrated periodically to reduce errors in the monitored values.

5-4 Business Plan

(1) Implementing Scheme and Organization

As BBMP does not have a budget for initial investment for the model WTE project (opinion of Karnataka State needs to be confirmed), there are 2 options for base business plan from financial point of view. Merit and demerit of the 2 options are shown as follows. JCM subsidy procedure is not discussed here as there is no bilateral agreement presently between Indian and Japanese Government.

- Option 1 (Public Project with State/Central Government Fund + JCM Subsidy by the Japanese Government:

  As the investment cost is high, state government will send proposal to the Central government to seek funds with detailed project report. Recent compost plants constructed by KUIDFC was funded by the State government.
- Option 2 (PPP Project with Fund from Japanese and Indian Consortium + JCM Subsidy by Japanese Government):

  For fund from Japanese and Indian consortium, the study team tentatively assumes that JICA Private Sector Investment Finance can be used because parties of the consortium is not clarified at this moment..

	Option 1	**Option 2**
Merits	・Finance is made by Central government	・If the study team member/s are part of the consortium, the study result can be reflected to the plant design.
Demerits	・The possibility of Central	・The cost for financial arrangements is

	government finance approval is not clear. ・As there will be an open tender process, it is not guaranteed that the consortium in this study will win the tender.	higher. ・It is not easy to select the entity to form the consortium. ・It is not clear how long the appraisal time for JICA Private Sector Investment Finance will take.

(2) Points to be Considered in the Case of Option 2

1) Joint venture agreement on establishment of SPC

When establishing the SPC that will be the implementing body for this project, the Japanese and Indian partners must sign a memorandum of understanding that should include information relevant to the issues below.

- Mission of the SPC and the roles and responsibilities of participating organizations
- Organization structure of the SPC
- Capital, financing, and distribution of revenue
- Standing rules of the company
- Operation of business (including rules regarding EPC by SPC, operation and maintenance contract)
- Arbitration
- Any other issues that need agreement among the participating entities

2) Contract between BBMP and SPC Regarding "Municipal Solid Waste Treatment Service"

The most important contract in relation to project revenue is the contract regarding municipal solid waste treatment service between BBMP and SPC. This contract should clarify the following issues so that project revenue can be secured.

- Basic information (e.g. contracting party, period of contract)
- Amount and quality of the waste to be received by SPC (e.g. guarantee of minimum waste amount, quality standards, method of evaluation, measures to be taken when standards are not met)
- Tipping fee (method of tipping fee calculation, agreement on tipping fee)
- Tipping fee payment method (currency of payment, mode of payment, time of payment)
- Standard of service to be provided by SPC (treatment method, treatment capacity, treatment standards, handling of treatment residues)
- Role and responsibilities of BBMP and SPC
- Measures to be taken when contract is breached or not fulfilled
- Accounting method (during or after the contract period)
- Conflict resolution

3) Contract between BESCOM and SPC on "Power Purchase Agreement (PPA)"

Another important contract for securing project revenue is the power purchase agreement (PPA) between SPC and BESCOM (Bangalore Electricity Supply Company). This contract must clarify the following issues so that the project revenue would be guaranteed.

- Basic information (e.g. contracting party, period of contract)
- Conditions regarding networking the power generating facility of SPC and the grid electricity (e.g. conditions on power supply, role, responsibilities and cost-sharing regarding constructing and operating grid electricity facilities)
- Selling price of electric power (Unit price and calculation method of payment amount)
- Payment method of electric power sales (currency of payment, payment method, time of payment)
- Role and responsibilities of BESCOM and SPC
- Measures to be taken when contract is breached or not fulfilled
- Accounting method (during or after the contract period)
- Conflict resolution

4) Contract with Ministry of the Environment, Japan Regarding JCM Subsidy

In order to be granted with the JCM subsidy, the SPC should sign a contract with the MOE Japan as required by the said Ministry. In order to be granted with this subsidy, the SPC must measure, report, and register with the approval of a third-party the amount of GHG reduction that would be realized by this project and handover the reduced GHG to the Japanese Government through MOE Japan. If the contents of this contract become clear and concrete, the profitability and sustainability of this project would be guaranteed and SPC would be able to start the official procedures to realize this project through JICA Private Sector Investment Finance scheme.

6 RDF Study

6-1 Basic Information Collection

(1) Waste Characterization Survey

1) Summary

RDF currently being shipped to the cement companies are not suitable for use as alternative to coals because of their high moisture content, high chlorine content and low calorific value. It was confirmed through site visits that the source of RDF at present are the compost sites and DWCCs. High moisture content of waste at the composting sites was confirmed by visual inspection. However, variation in moisture content according to the site was also observed indicating that detailed data is necessary to choose the site whose waste is most suitable for RDF. Although there is a potential for waste from DWCC to be used as RDF, factors such as high chlorine content need to be analyzed. Hence, waste analysis needs to be done to determine the best RDF waste source including analysis of mixture of waste from composting sites and DWCCs.

2) Methodology

① Sampling points

As per BBMP planning, 7 large scale composting sites are supposed to be constructed in Bengaluru. At present (December 2015), 5 sites are operating and samples were chosen from these plants.

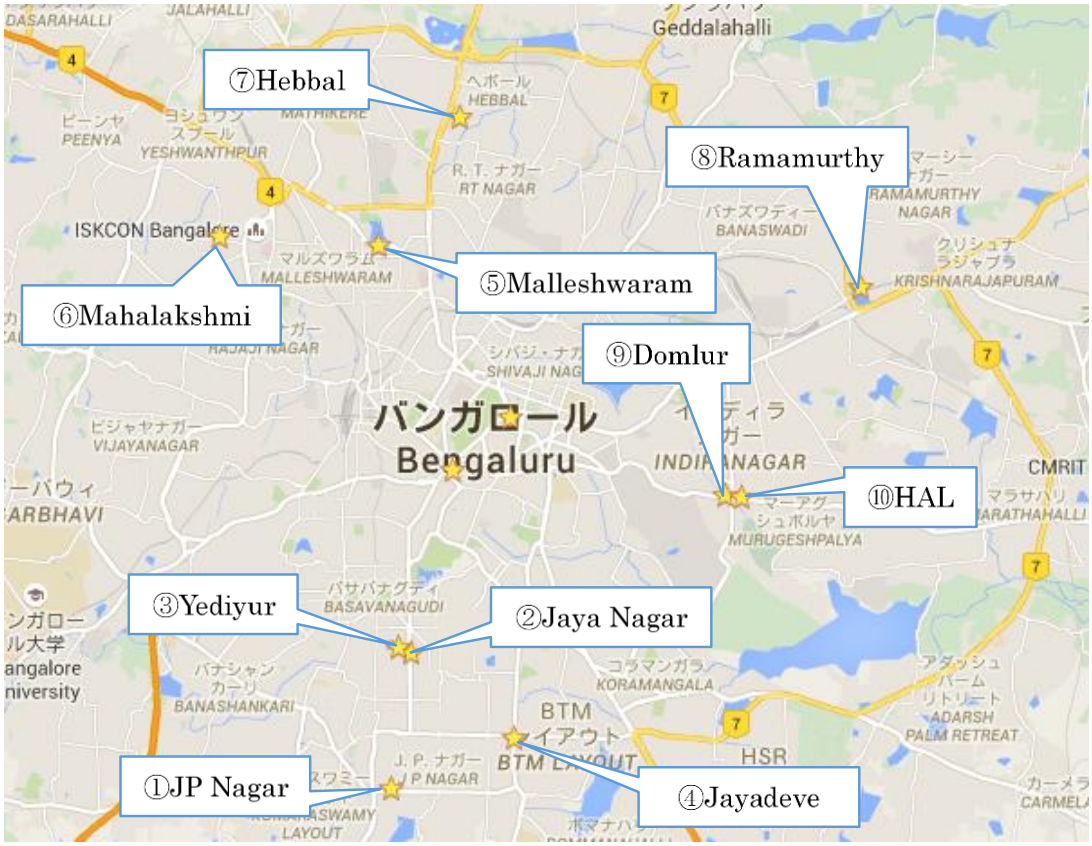
Table 6-1: Composting sites in and around Bengaluru where sampling was carried out

Sites	Operators	Amount	Notes
MSGP	Terra Firma	1000t→600t Mixed wastes	Located in the northern part of the city. Due to the local protests, processing quantities hasnot reached the planned amount. Segregation done manually.
Doddabidarakallu	UPL	200t→123t Segregated wastes	Located in the western part of the city. Only test operation being carried out and planned treatment amount has not been achieved yet.
Kannahalli	IL&FS	500t Segregated wastes	Located in the western part of the city. Operating again after closure due to portests relating to smell.
Seegehalli	IL&FS	200t～150t Segregated wastes	Located in the western part of the city. Shipping small quantities of RDF (30 tons/week) to a cement company
Kudlu	KCDC	800t→400t Mixed wastes	Located in the southern part of the city. Segregation being carried out by trommels

* Mixed waste = Waste that has not been segregated into waste/dry waste

10 DWCCs were also chosen as sampling points for survey because a lot of plastic that can potentially be used as RDF was found to be present in large amounts in these locations. These sampling

points and the features of the sampling points and areas are shown in the map below.



South Area 4 points（①～④） ＝ middle and upper class residential area

West Area 2 points(⑤ & ⑥） ＝ commercial area

North Area 1 point（⑦） ＝ upper class residential area（IT engineers）

North East Area 1 point (⑧） ＝ downtown area

East Area 2 points（⑨ & ⑩） ＝ Industrial park and middle class residential area

Figure 6-1:Location and features of DWCCs where sampling was carried out

② Sampling Method

A. Items sampled

At the composting sites, two categories of wastes sample were chosen: Fresh plastic waste and Final plastic wastes.

-Fresh Plastic Wastes:

Plastic waste separated from organic wastes by segregation using trommels or manual segragation

-Final Plastic Waste:

Waste that is removed from the composting process

In order to understand the effect of composting process to the RDF quality, 2 sampling points before and after the composting processes were chosen so that solutions to the improvement of the composting process can be provided. In regards to DWCC, plastics that is rejected from the material recycling process can be used as a raw material to improve the RDF quality.Hence, rejected plastics from DWCCs were also sampled and analyzed.

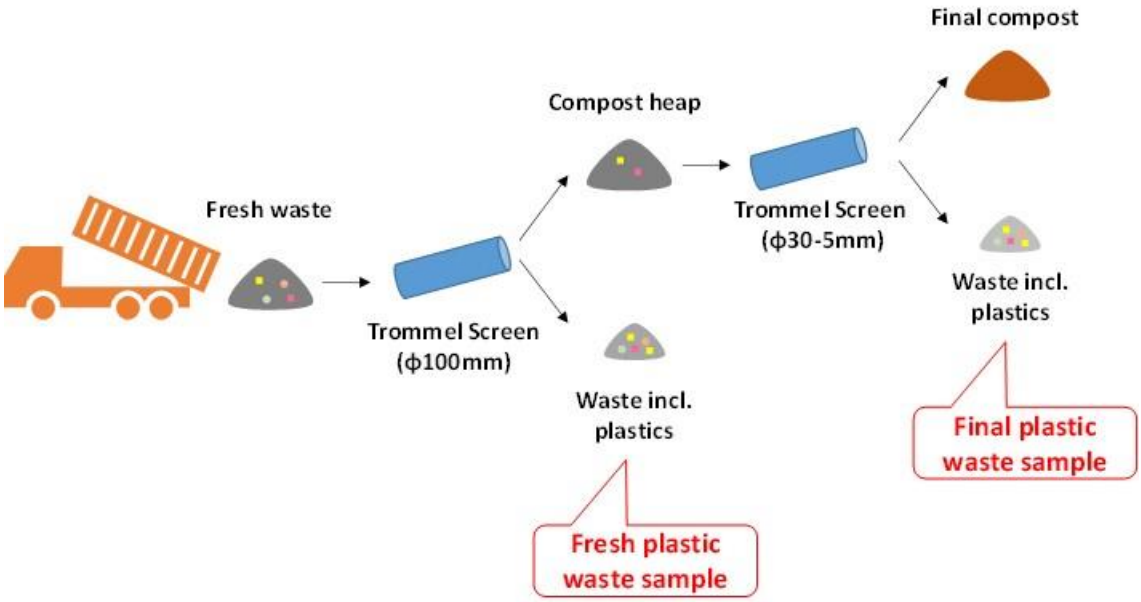


Figure 6-2: Sampling Points of Fresh Plastic Waste and Final Plastic Waste in the Composting Process

B. Sampling Method

The study team, with the help of a local laboratory, carried out sampling during November 30, 2015 to December 2, 2015 as follows:

I. Picked up as many types of waste components as possible from the waste heap (weight about10kg). The sampling was done from various points of the heap.

II. The waste was segregated into each type of waste, mainly the following 4 types:

・Plastics (including PVC etc.)

・Papers (including Carton, Aluminum foil etc.)

・Cloth (string, thread etc.)

・Others (reject from the treatment process)

III. The waste was cut with scissors to a size of less than 5 square centimeters and mixed well

IV. Picked up about 150 gram of the samples in random 10 times and put them into a plastic bag.

V. Repeated steps Ⅰto Ⅳ 3 times to obtain a sample of about 5kg

Figure 6-3　(left) Waste from which samples were taken from the composting process (right) Rejected material from DWCC

The samples were analyzed for the following parameters:

Table 6-2 Analysis items and method

Items of analysis	Analyzing method	unit
Calorific Value	ASTM E711-87(2004)	Kcal/kg
Chlorin as CL2	ASTM E778-87	mg/kg
Total Sulfur as S	ASTM E778-87	%
Nitrogen as N	ASTM E778-87	%
Carbon as C	ASTM E778-87	%
Hydrogen as H	ASTM E778-87	%
Moisture	Gravimetric method	%
Ash Content	Gravimetric method	%

③　Results

The Final plastic waste was found to have a high moisture content and although the calorific value was small and organic matter was mixed, a certain level of calory that could be used was confirmed. The sample of Final plastic waste from Doddabidarakallu composting site shows a high moisture content since a liquid type microbial material and non-dried coconut shells are added to the process.

It was also confirmed that the sample from Kannahalli compost site is the most suitable for RDF. Further, the result shows a varying degree of moisture content from samples taken from Kudlu and MSGP. The reason for this difference could be the fact that segregating is carried out by trommles in Kudlu but manually in MSGP.

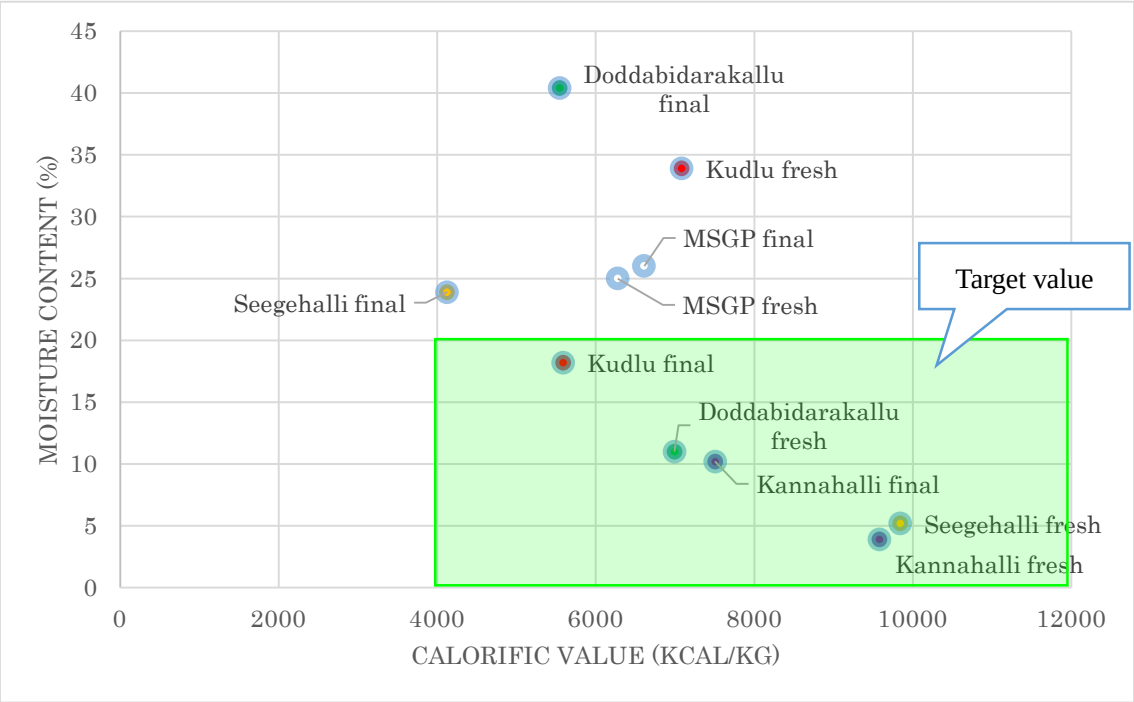


Figure 6-4: Moisture Content and Calorific Values of Samples Taken from Composting Sites

On the other hands, waste plastics from DWCCs shows a higher calorific value than that of the composting sites and the southern area shows the most significant performance in terms of calorific value trends

Samples from Hebbal have a high moisture content but also a higher calorific value. The reason for this could be that it was raining when the sampling was done. At DWCCs, quality of the reject plastics must be improved by putting them under a roof.

Waste plastics sampled from both the composting sites and DWCCs are usable looking at their level of moisture content, calorific value and calorific volume. If the moisture content can be minimized, the RDF can be improved to better quality.

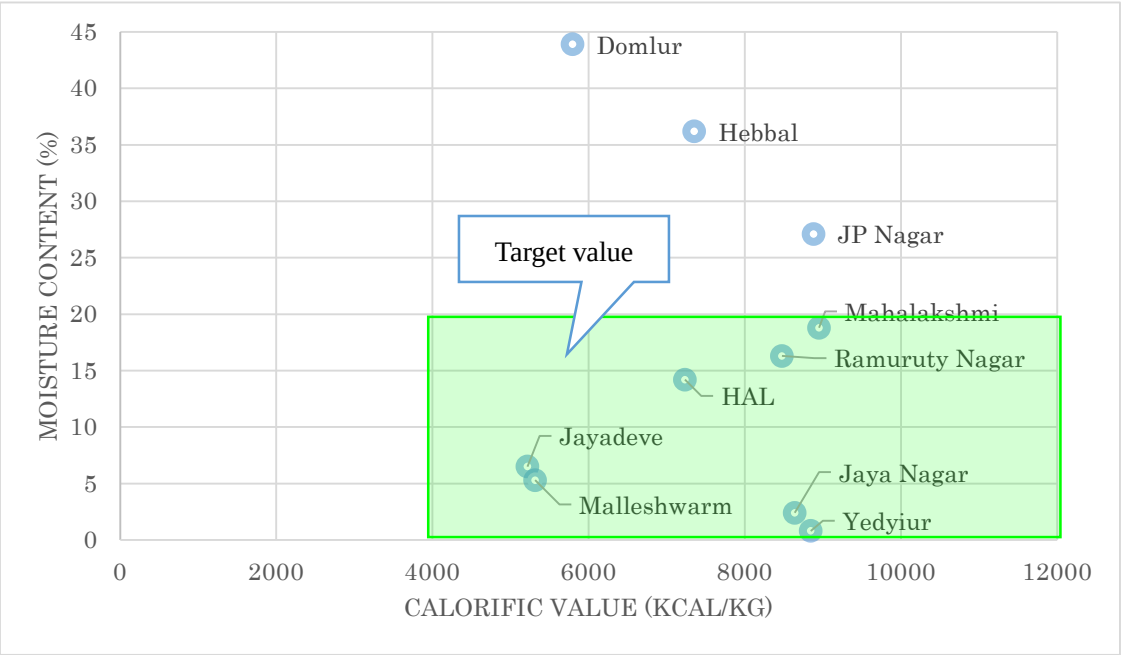


Figure 6-5 Moisture Contents and Calorific Values of Samples Taken at DWCCs

Result of chemical analysis are shown below.

Table 6-3 Result of chemical analysis of samples taken from the composting facility

	Cl_2 (mg/kg)	**S (%)**	**N (%)**	**C (%)**	**H (%)**	**Ash Content (%)**
Private composting facility (fresh)	233	BDL(DL:0.01)	0.29	74.69	12.56	11.3
Private composting facility (final)	311	BDL(DL:0.01)	0.18	70.11	12.12	16.9
Doddabidarakallu fresh	156	BDL(DL:0.01)	0.02	76.94	10.29	11.5
Doddabidarakallu final	348	BDL(DL:0.01)	0.11	78.71	13.62	6.3
Kannahalli fresh	118	BDL(DL:0.01)	0.14	81.65	11.41	5
Kannahalli final	159	BDL(DL:0.01)	0.13	71.21	10.25	16.6
Seegehalli fresh	241	BDL(DL:0.01)	0.23	76.82	12.44	9.9
Seegehalli final	233	BDL(DL:0.01)	0.22	66.96	10.81	21.2
Kudlu fresh	163	BDL(DL:0.01)	0.2	77.56	14.26	7.2
Kudlu final	1478	BDL(DL:0.01)	0.2	70.45	6.9	21.1

Table 6-4 Result of chemical analysis of samples taken from DWCCs

	Cl_2 (mg/kg)	**S (%)**	**N (%)**	**C (%)**	**H (%)**	**Ash Content (%)**
JP Nagar	508	BDL(DL:0.01)	0.16	79.81	13.62	5.8
Jaya Nagar	1361	BDL(DL:0.01)	0.1	80.42	13.71	5.2
Yedyiur	288	BDL(DL:0.01)	0.18	41.92	11.8	39
Jayadeve	BDL(DL:5.0)	BDL(DL:0.01)	0.18	75.96	9.85	13.7
Malleshwarm	321	BDL(DL:0.01)	0.14	81.14	11.32	6.9
Mahalakshmi	129	BDL(DL:0.01)	0.17	83.24	14.61	1.6
Hebbal	283	BDL(DL:0.01)	0.18	80.24	16.51	2.3
Ramuruty Nagar	204	BDL(DL:0.01)	0.18	80.21	12.6	6.3
Domlur	288	BDL(DL:0.01)	0.21	61.71	9.48	28.2
HAL	588	BDL(DL:0.01)	0.16	77.81	11.92	9.7

From this result, it can be concluded that the best way for producing high quality RDF is to collect plastic residue from the DWCC of the southern area and mix them with those from the Kannahalli composting site to produce RDF. However, the high chlorine value of samples from DWCC Jaya Nagar needs to be taken into consideration and hence PVC materials etc. need to be removed. In all the facilities (DWCC, Composting), measures to protect from the rain to reduce moisture content is necessary.

(2) Locations of Cement Plants near Bengaluru

Cement plants that use RDF are not located in Karnataka state but in other neighboring states. The ones actually using RDF include Wadi plant of ACC (Holcim group) and Yarraguntra plant of Zuari Cement (Heidelberg Cement Group). Locations of both the plants are shown in the map below. Wadi plant is located about 580 Kms and Yarraguntra plant is located about 270Kms from Bengaluru. Transportation cost can be said to be the most important factor when considering the feasibility of RDF usage in the cement plants.

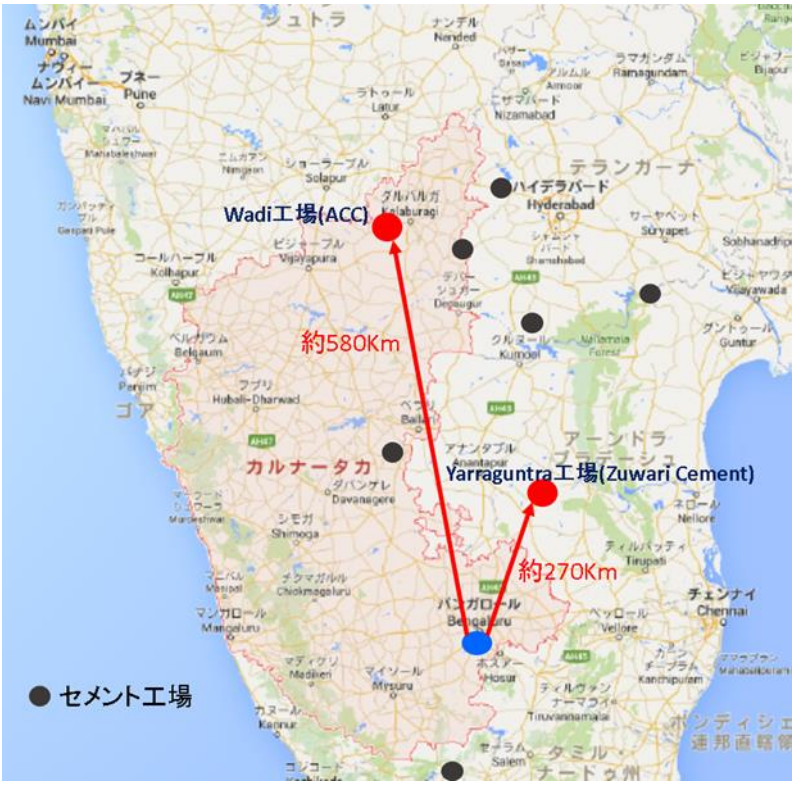


Figure 6-6: Location of the Cement Plants

6-2 Business Development and Marketing

(1) Functions and Roles of DWCCs

DWCCs (Dry Waste Collection Centers) are facilities that segregate valuable materials from dry wastes generated from households and offices for the purpose of recycling. BBMP has plans of constructing 1 DWCC per each ward (Bengaluru has 198 wards) and till now has completed building 150 DWCCs (see appendix sheet) almost all of which are operational.

The DWCC operators purchase metals, paper (cardboard, newspapers, etc.), plastics (PET bottles, soft/hard plastics, etc.), clothes, coconuts etc. from the residents and resell those to brokers. Operator`s business profit is derived from the gap between selling and buying price of each material.

Land for the DWCCs and construction of the buildings has been done by BBMP whereas the operation is entrusted to private companies. All the transactions of materials are recorded in a record book and can be inspected by BBMP officers when required.

BBMP operation flow for DWCCs is shown below.

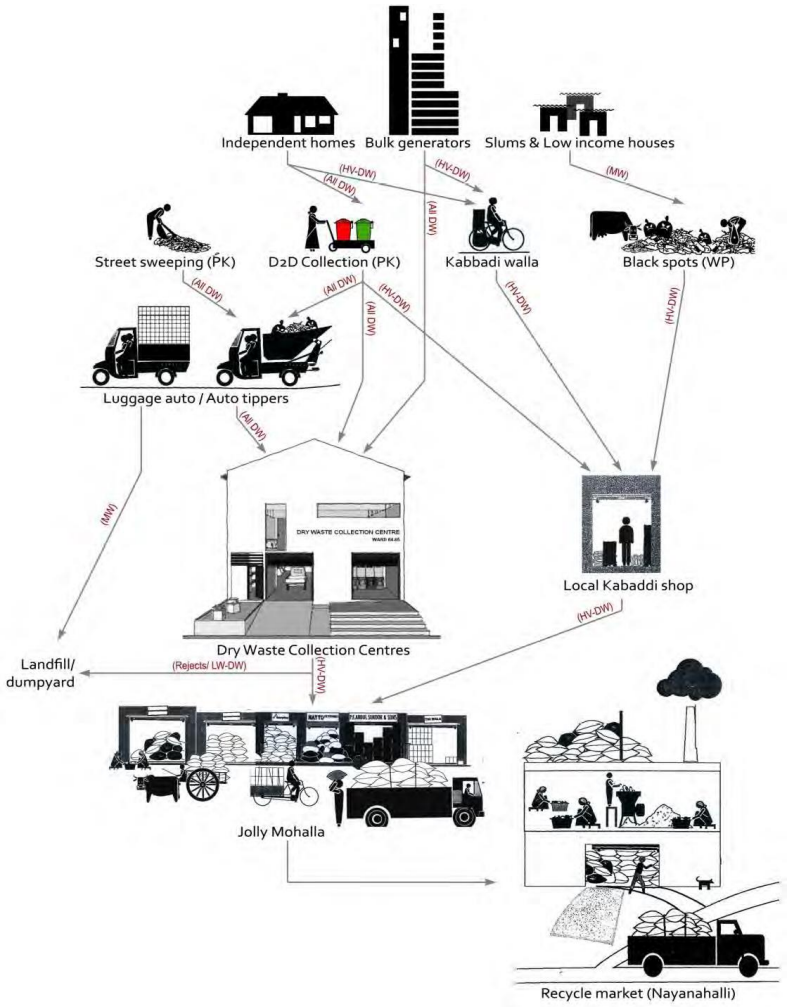


Figure 6-7: Function of DWCCs

Figure 6-8: Current situation of a DWCC

(2) Estimation of annual plastic residue generation

Waste plastic comprises about 17.2% of the total solid waste as per the result of waste analysis. The

current total waste generation amount in Bengalure is reported as 4,500tons/day which indicates that waste plastics generation amount is around 675 tons/day. With an increase in population, total wastes and waste plastics generation is also expeted to increase. The estimated waste plastics generation amount by 2025 is shown below.

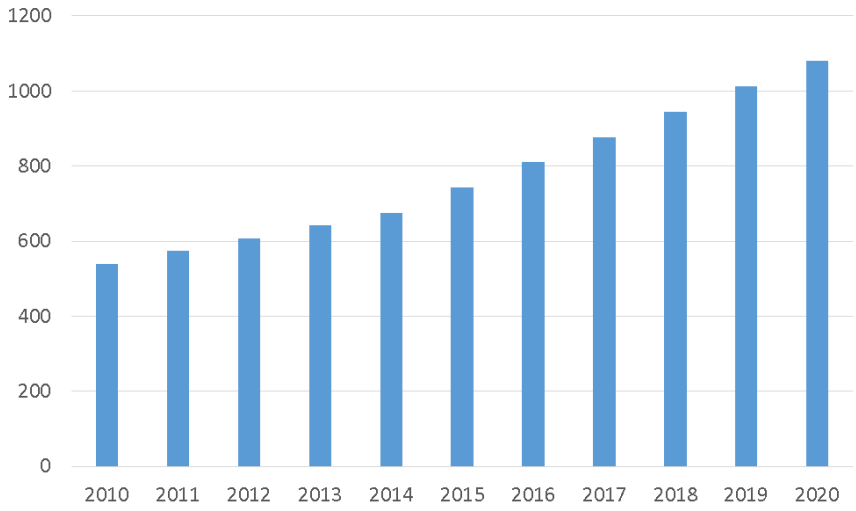


Figure 6-9: Prediction of future plastic generation in Bangaluru

(3) Interview with Potential RDF Users

Interviewes were conducted with representatives of ACC and Zuari Cement as prospective customers of RDF at their Bengaluru offices.

Both companies have studied the possibility of using RDF as an alternative fuel source to coal in their plants. The result of their study is positive in terms of RDF usage provided that a good quality RDF is available. Both ACC and Zuari opined that quality of RDF at present is not desirable due to their high moisture content. Hence, their calorific values are lower than coal and hence RDF cannot easily be used at their plants.

Efficiency of transportation can also be improved by decreasing the moisture content in the RDF. Hence, control of moisture content is the key factor for marketing of RDF to the cement companies.

Summary of the interview conducted is shown below.

1) ACC

As per interview with ACC, the following needs for RDF are identified.

- 580Km distance to Wadi, key issue is transportation cost
- ACC is already using RDF by installing a co-processing facility. Positive in utilizing good quality RDF.
- Wadi plant uses 2000 tons/day of coal. Total usage of RDF, sludge, paper etc is 300 tons/day.

Plan to increase RDF use.

- Studying the possibility of procurement of RDF from Seegehalli because of reliability of IL&FS who are the operators of Seegehalli
- Currently using RDF from Hyderabad but not satisfied with the quality because its calorific value is only 3000Kcal/Kg and the moisture content is 40%
- Procurement price from Hyderabad: transportation cost Rs. 1,300/ton, RDF price Rs. 150/ton
- Expected transportation cost from Bengaluru to Wadi to be about Rs. 2,500-3,000/ton. It is expensive but workable if the quality is good
- Chlorine content is a serious issue

2) Zuari Cement

As per interview with Zuari Cement, the following needs for RDF are identified.

- Distance from Bengaluru to Yarraguntra plant is about 280Kms.
- Procurement from DWCC in Bengaluru of 30 tons/week, calorific value 5200 – 5700kcal/kg
- Considering procurement of RDF from Seegehalli of 30 tons/week. However the quality of RDF is similar to that of Hyderabad (low quality)
- However, positive to procure RDF and already a contract between Zuari, IL&LF and BBMP has been signed
- Requirements of Zuari ; >3,800 kcal/Kg, <15% of moisture content, density2.0
- Transportation cost : Rs. 780/ton (when density is 0.8)
- Requesting lower transportation cost through measures such as compressing and baling (desired density 1.2-1.3)
- If supply amount can be increased by improving the quality of RDF, open to a joint venture project with Mansei
- Positive to purchase more RDF provided that the quality is improved

(4) Marketing and Identification of Customers

Through interviews and meeting conducted with the cement companies, it can be said that they are positive towards using RDF as alternative fuel source. However, they require an improvement in the quality, especially regarding moisture content and calorific value. Details of the best quality for the RDF should be determined after discussing with the cement companies (customer), BBMP (collection operator) and IL& FS (RDF producer).

Considering distance from Bengaluru and their positive attitude towards using RDF, ACC and Zuari cement are the most suitable customers for RDF. If transportation cost can be lowerd, than other

potential clients can also be considered. However, at present, improvement of RDF quality and ensuring a constant supply are priority issues. Generation of waste plastic is expected to increase to about 1,100ton/day after 2020 and in future, scaling up and finding additional customers can be considered.

(5) Profitability

Based on interviews with the cement companies mentioned above, a simulation of profitability of RDF business in Bengaluru under conditions specified below is carried out. The precoditions for simulation is summarized in the table below.

Table 6-5 Conditions for cost simulation

Items	Unit (per one site)	Unit Price
Input Quantity	500t/day	―
RDF Production	100t/day (Moisture Contents ; 10%, Calorific Value ; 4,000Kcal/Kg)	Rs1,700/t
Working Days	310 days/yesr	―
Labor Cost	21 persons/shift x 2 shifts	Rs158/head/day
Power Consumption	5,250kw/h/day	Rs6/km/h
Transportation Cost	10t track	Rs780/track
Initial Investment	JPY 500, 000,000	―
Land Use	5,000m2	―

Business performances and profit calculated based on the conditions metioned above is shown below.

Table 6-6 Result of simulation of business profit

Items		Per ton(Rs)	Annual (Thousand Rs)	Note
Income	RDF sales	1,700	52,700	By using formula of the Cement company
Expense	Production cost	844	26,156	According to condition set above
	Overhead	510	15,810	Sales amount x 30%
Sales Profit		346	10,734	
Profit rate		20%	20%	

As explained in the following section “(6) Formulation of a Business Plan (Draft)”, the study team was informed by BBMP that the RDF producing operators are not paid any “tipping fee” for processing.However, the operator does not need to pay any investment cost, depreciation, land and machines rental fee to BBMP. Hence, these factors are not considered in the calculation mentioned above. As a result, it can be seen that if a constant sale of RDF can be ensured, there is a high likelihood of having a profitable business.

(6) Formulation of a Business Plan (draft)

In order to formulate a RDF business in Bengaluru, the following operation policy of BBMP should be considered.

- Buildings of facility to be constructed by Karnataka State or BBMP
- All machineries and equipment in these facilities to be procured by Karnataka State or BBMP
- Operator to be chosen based on an international bid
- Operator to use the Equipment and machineries provided by BBMP by free of charge with no rent, machine rental fees or building usage fee
- BBMP not to pay a tipping fee to the operator
- Running cost of facility to be labor cost, electricity and water cost. Proceed from the sale of RDF to become the income of the operator

According to the condition specified above, the following business scheme is considered.

① Mansei Recycle Systems (MRS) to conduct business on its own
② Joint venture between existing composting facility operator and MRS
③ A 3 party company (tri-lateral) between companies involved in ② above and an additional cement company
④ A special purpose company comprising of entities specified in ③ above with addition of BBMP

Details of each of the options mentioned above is summarized below.

1) MRS on its own

For MRS to conduct business in India on its own is expected to be extremely difficult

Firstly, in order to sign a contract with BBMP, MRS will need to win the international bid as an operator in Bengaluru. This is expected to extremely difficult due to factors like country risk, geopoliticals risks and challenges to building a cooperative relationship with current operators and local companies.Even if business establishment is possible, MRS may have to face challenges like public opposition, labor disputes etc. after the operation starts.Hence, it is more favorable to establish a joint venture between MRS and an existing operator.

2) Joint venture between an existing operating company and MRS

IL&FS is the contracted operator for Seegehalli and Kannahalli compost sites. IL&FS is one of the larger conglomerates of India. They run business in industries relating to construction, agriculture and trading and are one of the trusted companies in India. They have been operating composting sites in Bengaluru while also producing RDF in Seegehalli and Kannahalli. Therefore, it can be logically assumed that they will be open to improvements of machinaries and improving operating efficiency for quality improvement. Further, improvement can be done without a drastic change in the business model which will make it possible to get result in a short time. A further merit would also be that existing sales contracts (Cement Company, IL&FS and BBMP) currently present can be used.

3) A 3 party joint venture between existing operator, Cement Company and MRS

This option includes the companies mentioned in 2) along with an additional cement company as RDF user. In this scheme, produced RDF can be sold to the cement company. However, it would be difficult to realize a high business performance by negotiable unit price for RDF supplier since the operator has to disclose all the production costs and profits.

4) A special purpose company comprising of an existing operator, Cement Company, BBMP and MRS

This option is the same as 3) above with BBMP added as a party to form a SPC. This will allow all the stakeholders from waste generation to RDF user to be involved making a stable operation of securing waste and sales possible. On the other hand, the disadvantage would be that in various situations, interest of the stakeholders may collide making the operation of the SPC difficult.

Judging from the situation explained above, the best possible options are 2) and 3).Option 2) provides a degree of freedom in terms of sailes and pricing but requires marketing to secure the purchaser. Option 3) ensures that purchaser and hence sales are secured, but the expected profit can be low and freedom on price setting can be restricted.

Based on the discussion mentioned above, the business plan for the project can be summarized as shown in the figure below.

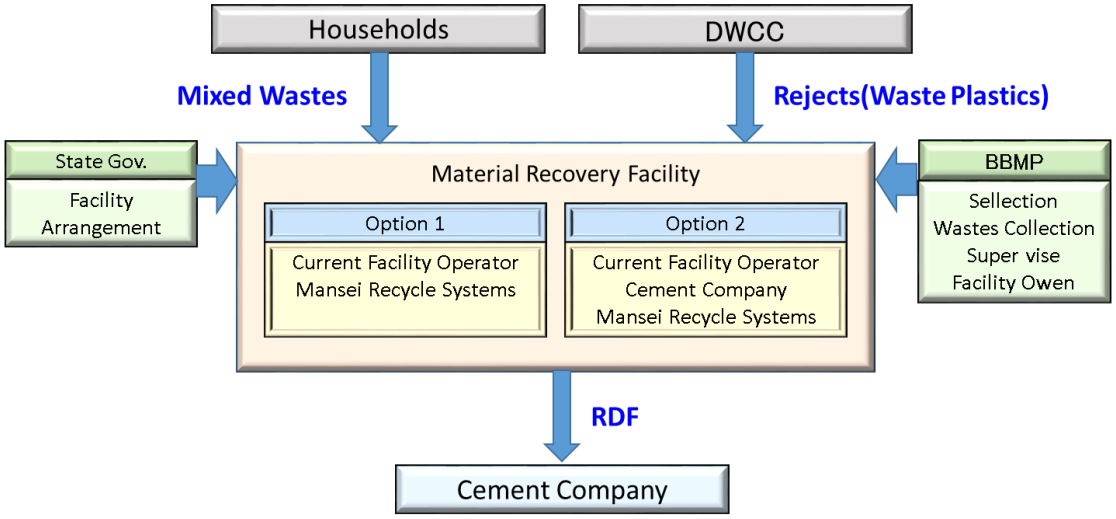


Figure 6-10: RDF business plan

In Bengaluru, the following companies are expected to be JV partners of the business. Through the pilot study, details will be discussed with these companies.

Table 6-7: Prospective partners

Specialty	Companies
Operator	IL & FS、UPL、KCDC、etc.
Cement Comapny	ACC, Zuari Cement,Bharathi Cement,India Cement,etc.

RDF Material:

Raw material for RDF will be waste generated from compost facilities containing plastic and rejects generated from DWCCs. From the waste survey, it can be concluded that it will be possible to effectively utilize the rejects from DWCCs. Further consideration of measures to improve the quality through means such as moisture content reduction is required.

Business Site:

RDF processing site should be located within an existing composting site by improving functions of machines and processes. Discussion with current operators to establish a joint venture is necessary.

In near the future, these sites could be located near to a waste to energy facility.

6-3 Facilities Design

(1) Customer Requirement

The requirement of the cement companies has been quite clear through interviews conducted with them. The key factors in terms of quality are moisture content and calorific value. These factors have a large impact on RDF pricing and hence need to be well controlled during manufacture to ensure quality.

Table 6-8 : Quality of RDF required by cement companies

Company Name	Requirements
ACC	>4,000Kcal/Kg, Moisture Content<40%
Zuari Cement	>3,800Kcal/Kg, Moisture Content <15%, Density 2.0

(2) RDF (RPF) Facility Basic Planning

To reduce the moisture content, it is proposed that a dewatering or drying process is added to the current RDF process. The processing flow is shown below.

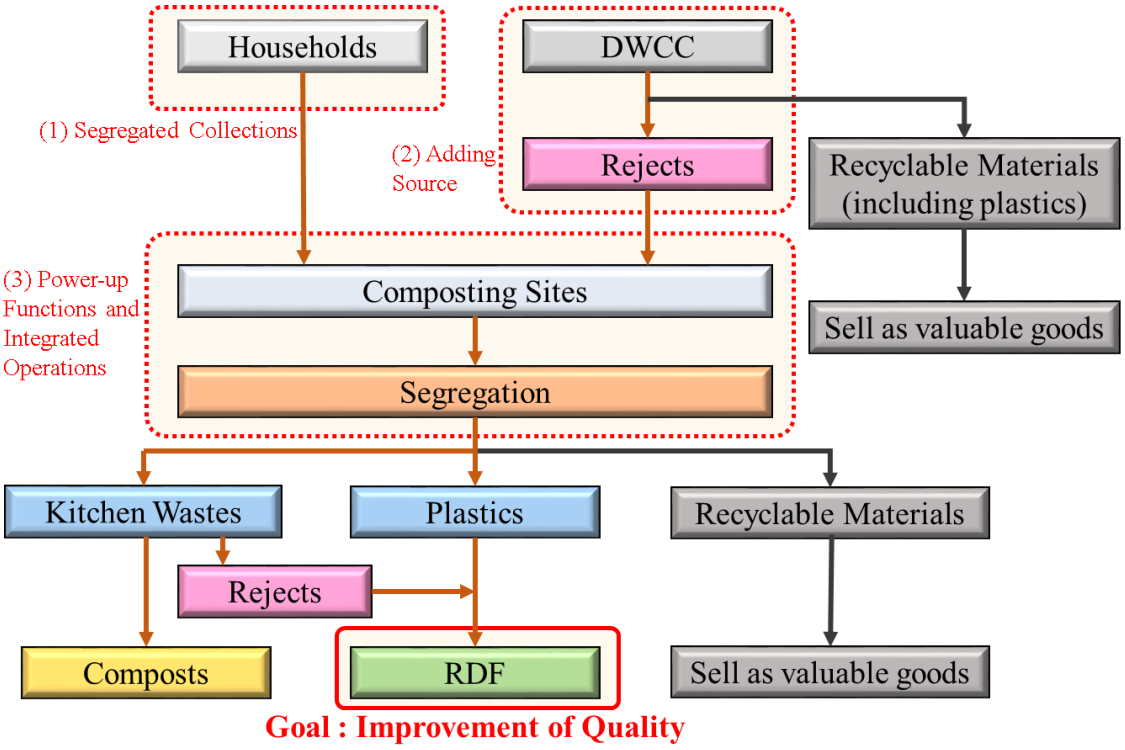


Figure 6-11: RDF(RPF） process flow

Process flow for the improvement of RDF quality is shown below. Here, additional equipment is installed to an existing composting facility. Improvement of RDF quality is expected to help improve the performance of the composting production line also. Although only slightly, the improvement is also expected to contribute to the reduction of CO2 and GHG gas like methane. By lowering the

moisture content, anaerobic fermentation can be changed to an aerobic process hence helping to reduce smell to an acceptable level.

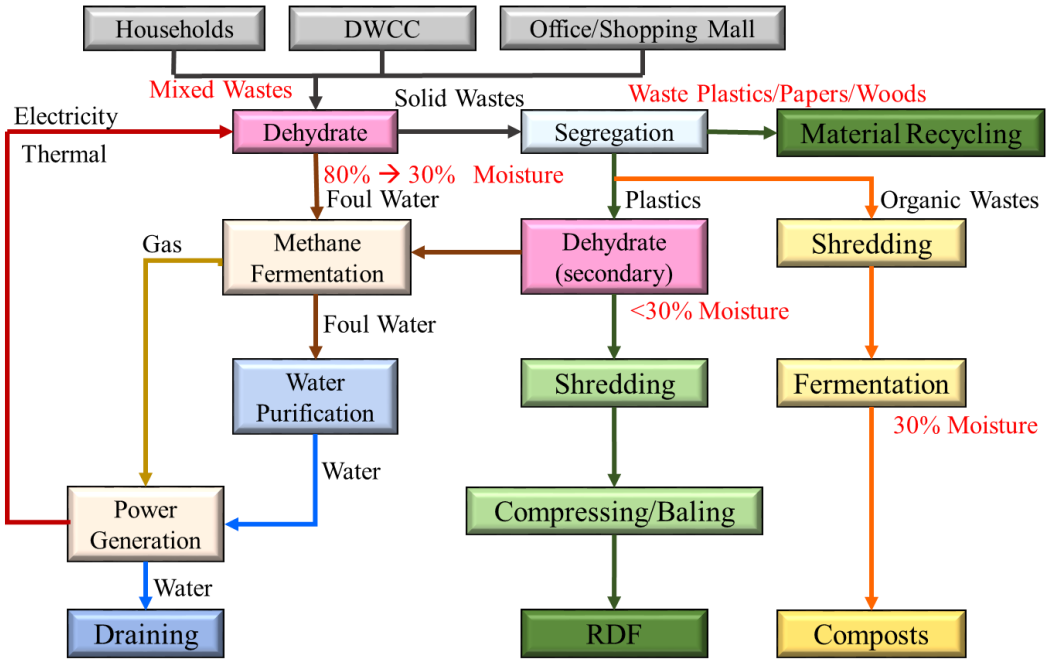


Figure 6-12: Flow for improvement of RDF quality

Futher, process flow that includes dewatering and drying processes are shown below.

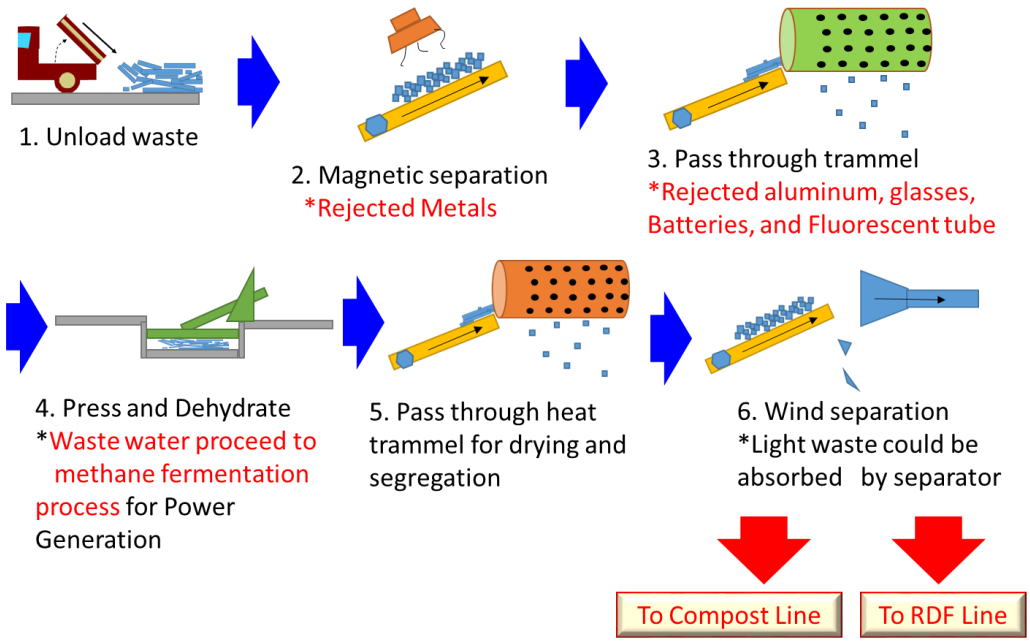


Figure 6-13: Image of the Process Flow with Dewatering and Drying Processes Added

RDF production line process is shown below. With this process, it will be possible to satisfy Zuari Cement's requirements and moisture content can be reduced to under 15 %.

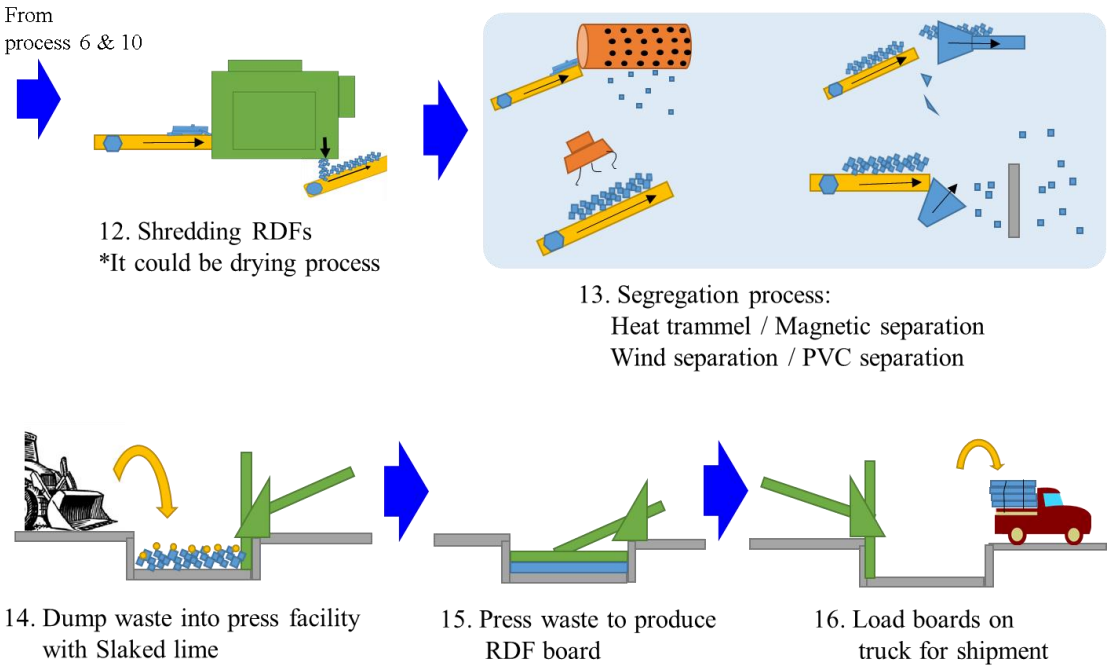
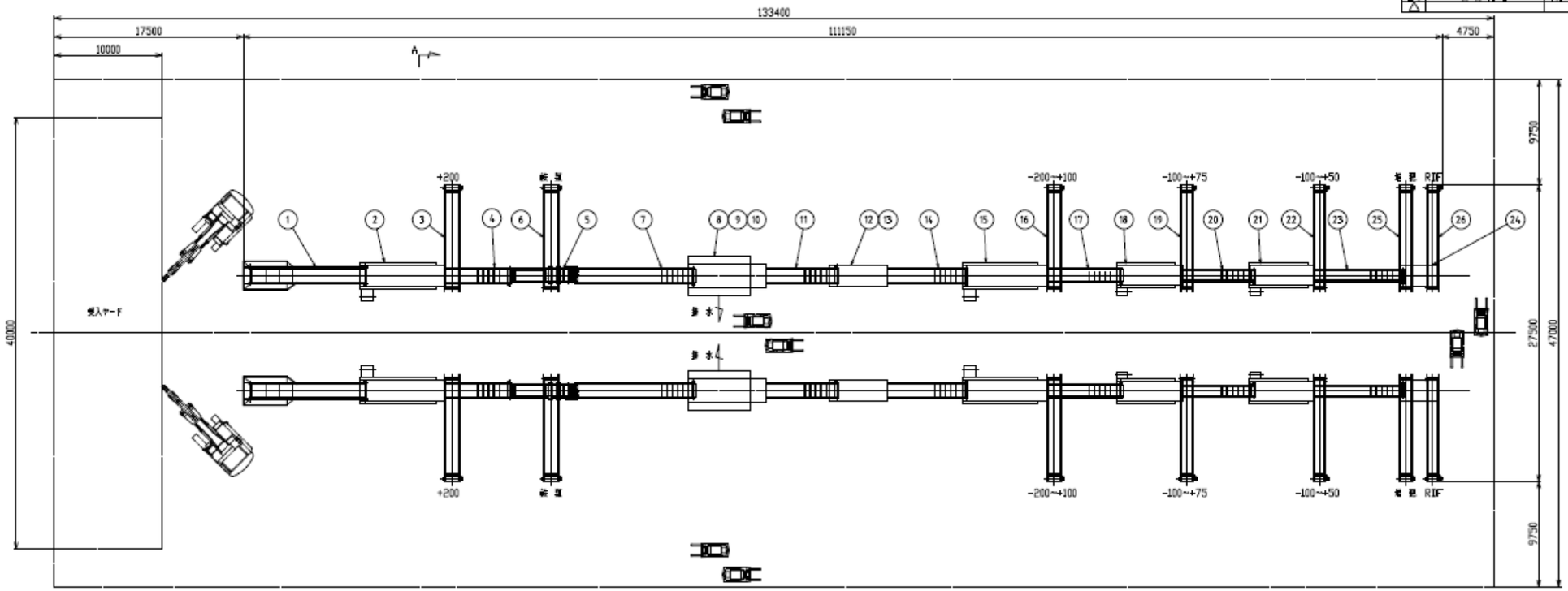


Figure 6-14 : Assumed RDF Production Process

(3) Planning for Facility Concept Design

Facility Design for quality improvement of RDF is shown below.



合計 xxxxx kw

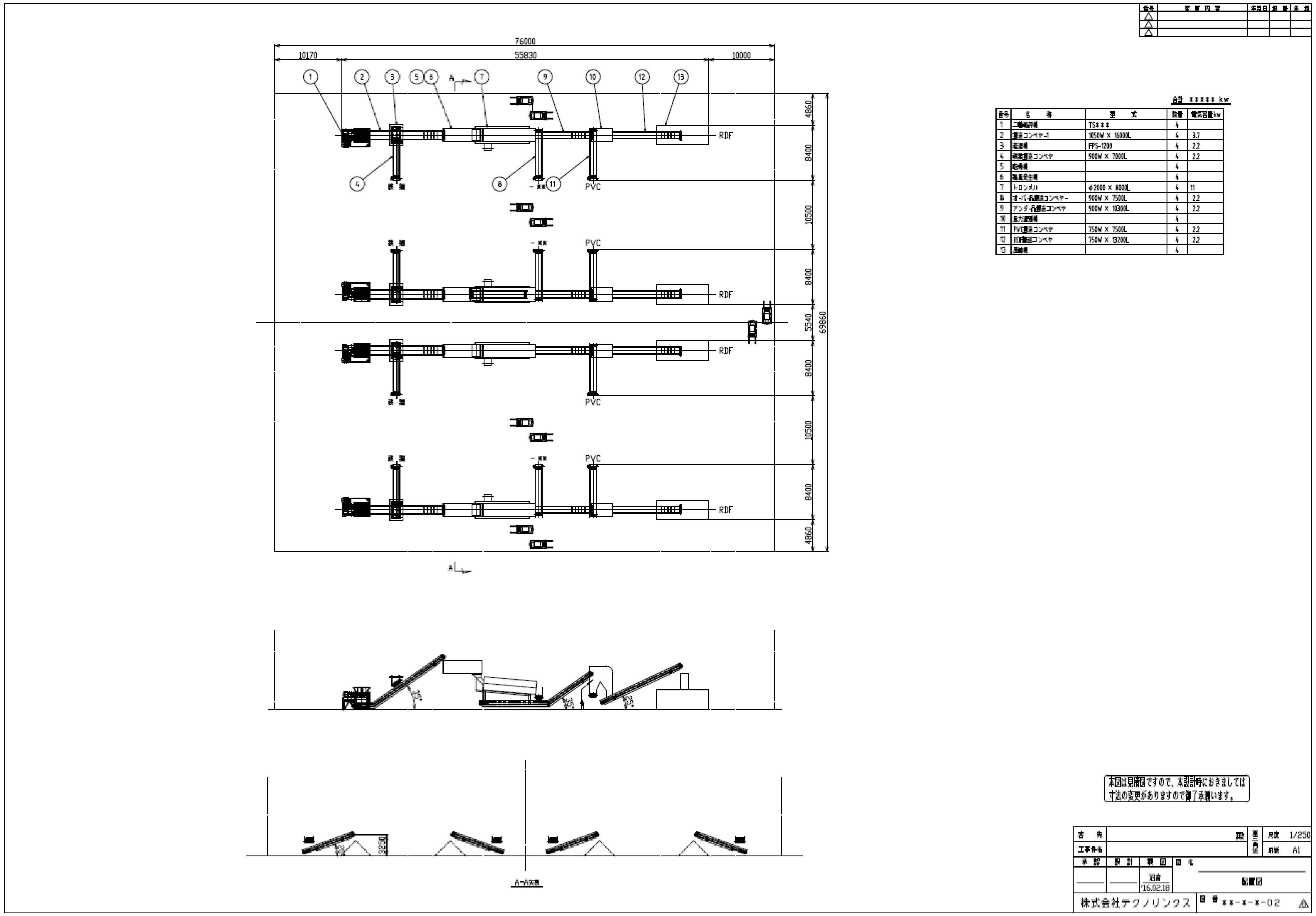
番号	名　称	型　式	台数	電動機容量kw
1	エプロンコンベヤ	1200W × 19800L	2	5.5
2	トロンメル-1	φ2000 × 8000L	2	11
3	オーバー品積込コンベヤ-1	1200W × 9600L	2	3.7
4	アンダー品積込コンベヤ-1	1200W × 15200L	2	3.7
5	多段階式金属検出器コンベヤ	1200W × 5000L	2	3.7
6	移載排出コンベヤ	1200W × 9600L	2	3.7
7	良品排出コンベヤ-A	1200W × 14500L	2	3.7
8	圧縮機		2	
9	粉砕機		2	
10	分別機		2	
11	良品排出コンベヤ-B	1200W × 9000L	2	3.7
12	乾燥機		2	
13	熱風発生機		2	
14	良品排出コンベヤ-C	1200W × 9000L	2	3.7
15	トロンメル-2	φ2000 × 8000L	2	11
16	オーバー品積込コンベヤ-2	1050W × 9600L	2	3.7
17	アンダー品積込コンベヤ-2	1050W × 15200L	2	3.7
18	トロンメル-3	φ1800 × 6000L	2	5.5
19	オーバー品積込コンベヤ-3	900W × 9600L	2	2.2
20	アンダー品積込コンベヤ-3	900W × 14200L	2	2.2
21	トロンメル-4	φ1800 × 6000L	2	5.5
22	オーバー品積込コンベヤ-4	900W × 9600L	2	2.2
23	アンダー品積込コンベヤ-4	900W × 14200L	2	2.2
24	風力選別機		2	3.4
25	軽量物排出コンベヤ	900W × 9600L	2	2.2
26	RDF排出コンベヤ	900W × 9600L	2	2.2

本図は見積図ですので、本設計時におきましては寸法の変更がありますので御了承願います。

客先		設計	第三角法	R度 1/200
工事件名				用紙 A1
承認	設計	製図	図名	
		岩倉 '16.02.18	配置図	
株式会社テクノリンクス			図番 xx-x-x-01	

(4) Plan for Equipment Concept Design

For improving the quality of RDF, dewatering equipment will be introduced. Process flow of the dewatering equipment is shown below.



(5) Transportation Plan

Reduction of transportation cost from Bengaluru to the plant is the most important issue for RDF users. RDF price will largely depend on the transportation cost. At present, the distance is 580km for Wadi of ACC and 270km for Yarraguntra of Zuari. Distance factor is a serious disadvantage for RDF pricing.

Reduction of transportation cost will be a key factor for increasing RDF sales. One of the measures could be to take measures to maximize loading efficiency of RDF freight. Maximizing loading efficiency will help to reduce GHG gas emission by reducing the number of trucks required.

1) Transportation by Truck

At present, transportation of RDF is carried out by trucks. Due to the high moisture content, RDF transportation is being carried out by garbage trucks instead of regular trucks.

However, by reducing moisture content to under 15%, the cement companies can transport RDF by regular trucks. Currently the cement companies use normal trucks for shipping their cement products from their plant to Bengaluru and these trucks are going back to their respective plants empty. If RDF becomes a dry cargo, these empty trucks could be used to transport RDF on their way back. This could be the most efficient and economical transportation method for the cement companies.

If the RDF density can be increased to near 1.0 from the current value of 0.3, the efficiency of RDF transportation could be three times that of the current value. Therefore, transportation cost could be reduced by one third.

2) Railway transportation

Transporting a distance of 600km by trucks is very expensive and hence usage of the existing railway infrastructure has been proposed. The image of transportation by railway is summarized in the following figure.

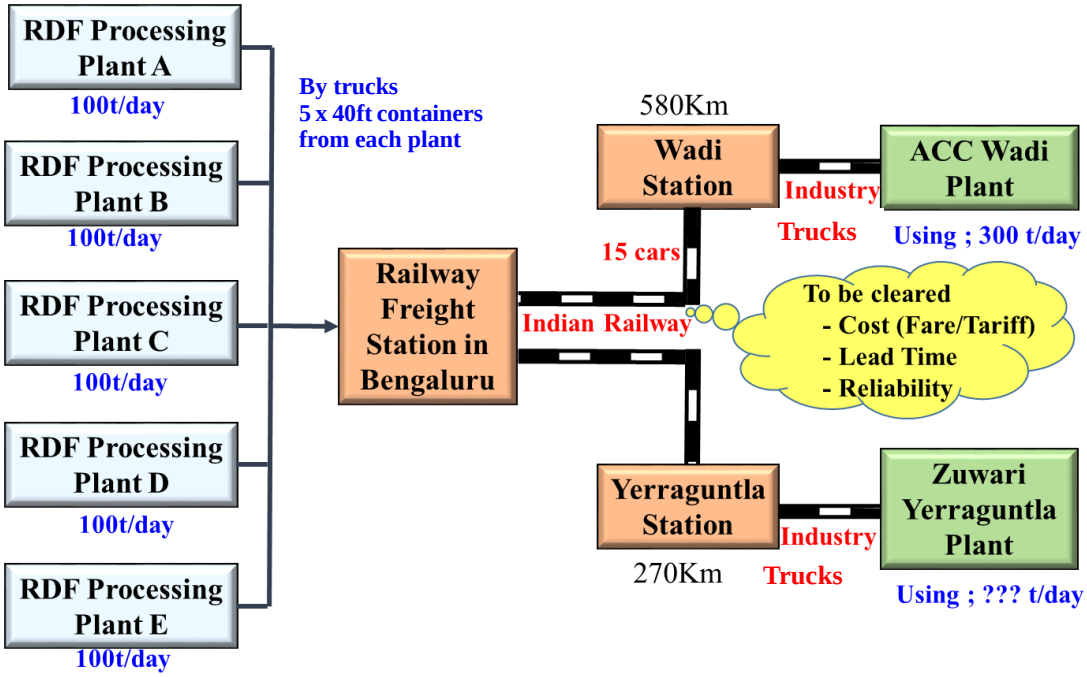


Figure 6-15 Image of railway usage

6-4 Other Survey on Possibility of Business

(1) Business Partner and Establishing Joint Venture

1) Overview

During business implementation stage of RDF in Bengalore, it will be necessary to establish a joint venture with a local company. In this study, it is envisaged that ① composting facility operator and ② Cement Company will be the business partners.

①will be one of the current operators of an existing composting facility whereas② will be the user and customer of RDF.

In regards to the composting sites, it is considered that there is not much difference between the sites beacause all the facilities have been installed by Karnataka state government. Therefore, they are not studied in detail.

Expected Partner	Content of Study
① Existing Facility Operator	Business outline, Business situation, Wastes acceptance conditions, Composting production, RDF production, Existence of technical issues, Marketing of RDF
②Cement Company	RDF usage volume, RDF use situation, Requirements for RDF, Transportation cost, Technical issues for RDF

2) Prospective Business Partners

①Existing Facility Operators

a. IL&FS (Operators of BBMP composting facilities in Seegehalli, Kannahalli)

- The business area of IL＆FS covers many businesses related to agriculture and they have a good reputation in India..
- They are supplying RDF produced in Seegehalli to Yerraguntla plant of Zuari Cement. The volume is 30 tons per week only. This comprises the only sale of RDF to cement companies from Bengaluru.
- RDF production capacity in both the Seegehalli and Kannahalli amount to 150 tons per day (6 tons per hour x 3 lines x 8 hours) .
- The most serious issue of current RDF is the high moisture content (50% currently). Therefore, reduction of moisture content for quality improvement and efficiency of transportation is necessary.

b. UPL (Doddabidarakallu)

- Composting manufacturer based in Hyderabad
- Their composting technology utilizes microorganism (“EM”) in the composting process. Due to that, the produced compost and RDF have a higher moisture content.
- They don’t have a lot of experience of producing RDF and don’t yet have any specific customer. However, they are constructing an analysis laboratory adjacent to the composting site and are preparing for commencement of RDF business.
- They have an interest in material recycling through the usage of the rejects from the composting process.
- Require an improvement of the composting and RDF processes focusing on reuction of moisture contents.

c. KCDC (Kudlu)

A public company funded by Karnataka State for the purpose of composting.

- Although the planned volume is 800 tons per day, they currently at 400 tons per day due to public opposition
- The amount of compost produced compared to waste accepted is small
- The process of composting is fully windrow methods.
- They don’t have any baling machines for RDF production. Hence, rejects from the composting process that could potentially be used for RDF production is piling up within the site.

Figure 6-16 View of the composting site (left-down), Production Lines (right-up), Microorganism "EM" (right-up), Piling Composts (right-down)

②Cement Company

a. ACC Cement（Wadi plant）

Interview date：Februaly 17th, 2016

- A part of the largest cement company in the world (Holcim-Lafarge)
- Cement production ; 13,000 tons per day (2nd in the world)
- Although they had accepted RDF from Hyderabad for 6 months in 2015, they have stopped accepting them because of the high moisture content (over 50%) and low calorific value (less than 3,000 kcal/kg).
- Intend to accept accept RDF from Bengaluru if their requirement is met. Their requirement is moisture content (20 to 25 %) and calorific value (over 3,000kcal/kg)
- Intended volume for purchase ; 200 ton per day
- If the quality of RDF is sufficiently high, they are not worried about the transportation cost

b. Zuari Cement（Yerraguntla plant）

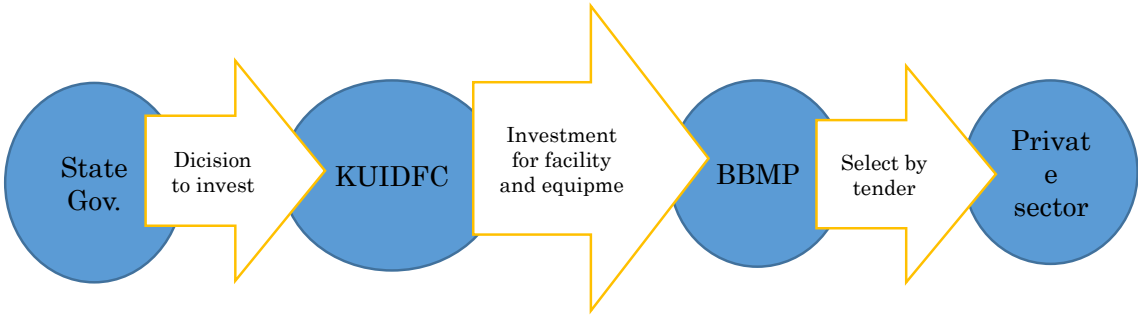
- A part of the 3rd largest cement company globally (Heidelberg Cement)
- Cement production capacity : 16,000 tons per day
- They are accepting 40 tons of RDF per day from Chennai and 30 tons per week from Bengaluru (Seegehalli site). They have stopped accepting RDF from Hyderabad due to low quality.
- Required target of quality is moisture content less than 10 % and 6,000kcal/kg of calorific value in the case of mixed use of coal and RDF.
- The final target of accepting RDF in terms of amount is 1000 ton per day.
- They are in the process of constructing a new RDF feeding system. The capacity of processing is 300 tons per day and operation will start next September.
- Transportation cost should be compared by comparison with coal price.

Figure 6-17 :View of Cement Company(left), stone quarry of Slaked lime and private line of railway (right)

(2) Study of Business Authorization

According to BBMP and KUIDFC, waste processing business in Bengaluru should be chosen by an international bid. The conditions of participating in the bid are as follows;

- Initial cost for land and equipment to be provided by state of Karnataka
- Operator selected by international bidding (contract terms : 5 years)
- Tipping fee not paid to the contractor
- Running cost to be the operator’s responsibility. Sale of all the compost and RDF to be the operator’s income



(3) Ensuring environmental preservation

Environmental preservation needs to be discussed in three separate phases: 1) production, 2) transportation, & 3) RDF use. For toxic matters and pollutants generated from each process, the focus should be on the reduction of waste, resue and recycling.

1) Manufacture

RDF production line will involve rearranging and improving equipment of the existing compost sites. For this phase, as describe previously in (2), Karnataka state will ensure environmental protection. During operation, foul smell and drainage will need to be addressed and they will be dealt with as follows:

Table 6-9 Pollution measures in the production line

	Cause	Countermeasures
Foul smell	Composting involves a higher moisture content due to wet organic waste and microorganism and waste is fermented anaerobically leading to methane generation and foul smell.	Moisture contents should be controlled. The moisture content to be controlled under 30% in addition to having a dewatering process.
Foul Water	Generated from kitchen waste and hyderation process.	Foul water should be used for power generation through methane fermentation. The foul water should be purified before using for power generation and drained.

2) Transportation

In RDF transportation, foul smell from RDF and Green House Gas (GHG) from trucks are the major environmental concerns.

Table 6-10 Pollition measures during transportation

	Cause	Countermeasures
Foul smell	RDF has a high moisture content and the kitchen waste that has adhered to the plastics causes foul smell.	Lowering the moisture content by adding slaked lime in the process of production and compression should result in alleviation of foul smell

GHG	As the transportation efficiency is not good due to low density of RDF,it results in higher GHG emission	Increase the RDF density through compression. Reduce GHG emission by increasing transportation efficiency.

3) RDF Use

Cement companies that have developed technology to utilize RDF in the optimum way possible are present in India. For example, Holcim-Lafage group including ACC has a "co-processing technology" installed in its plants in India. This allows for an efficient and environmentally sound RDF usage. Specifically, process that uses RDF is incorporated into the cement production process and the emission of gas, ash and other residue produced due to RDF usage is virtually zero. These technologies have already been standardized for cement campanies (CEMEX, the second largest global company, is also studying and developing a similar technology) and RDF can be used with due consideration to environmental protection.

6-5 Study for implementation under JCM Scheme

(1) Study for Development of JCM Methodology

1) Amount of GHG Emission in Bengaluru

Main sources of GHG related to RDF business whose emission can be reducted include Transportation of RDF and alternative fuel source to coal. The current emission amount is summarized as follows:

Table 6-11 GHG emission

	Prediction of GHG emission based on current situation	**Remarks**
Transportation	104.8t/day	Transport volume：200tpd RDF density：0.3 Number of 15t trucks with 200ℓ fuel tank：45 Coefficient of CO2 emission for diesel：2.62kgCO2/ℓ
Use	4704.6t/day	Amount of coal usage: 2000tpd Calorific Value of boiler usage: 46,724.210MJ
Total	4809.4t/day	

2) Applied technology

In the project, additional equipment as describe in 6-3 will be added to attain dewatering and drying, hence reducing the moisture content to 10-20% from the present value of 50%. Further, a new compressing process for dehydrating will improve density from 0.3 to approximate 1.0. This will result in the following benefits.

- Reduction of GHG emission by improvement of transportation efficiency
- Reduction of GHG emission by usage of high quality RDF instead of coal

3) Study for forming a consensus among stakeholders for JCM project implementation

In order to implement a RDF business under JCM scheme, the 3 preconditions need to be met.

① Stable supply of municipal wastes mainly comprising of plastics（BBMP）
② Stable manufacturing and sale of RDF with supplied waste from BBMP（Compost/RDF site operators）
③ Stable utilizing of RDF instead of coal（Cement companies）

Hence, similar to the contract between BBMP and facility operators, a trilateral contract between BBMP, Cement Company and facility operator (RDF manufacturer) will be necessary to ensure a stable supply and usage.

In this pre-feasible study, there is no contract between the 3 entities yet. However, the study team already has confirmed the following; ①Need for the proper treatment of waste, ②Need for improvement of RDF quality, ③Need for a stable supply of RDF. Hence, in order to proceed to the JCM scheme, these 3 needs should be interconnected and a proper treatment flow of waste needs to be formulated. Hence a pilot plant for manufacturing high quality RDF should be installed and the possibility of feasibility should be studied.

4) Study for Quantification of GHG emission reduction

① Basic concept of calculation of GHG emission reduction

The basic concept for calculation of GHG emission reduction related to RDF is as follows:

a. CO2 emission reduction by improvement of transportation efficiency related to density improvement of RDF

New RDF manufacturing line with compression process would improve the density from 0.3 to 0.9~1.0 which would make the transportation operation efficient and ultimately reduce the number of trucks. The amount of GHG reduction is based on the calculation method for fuel provided from MOEJ.

<Formula>

CO_2 reduction amount (Kg-CO_2)

= (number of trucks when density is 0.3－number of trucks with improved RDF line)

×amount of fuel usage×coefficient of CO_2 emission

＜Precondition＞

Capacity of fuel tank for 15t truck: 200 litter

Coefficient of CO2 emission for diesel: 2.62KgCO2/ℓ

b. CO2 emission reduction by use of RDF instead of coal

Comparing the amount of CO2 emission between coal and RDF, there is a 20% difference because the efficiency of calorie generation is different. Therefore, assuming that the heat generation amount (MJ) of the boilers is the same, the amount needed for generation of same amount of heat would be different for coal and RDF. Hence, when RDF is used instead of coal, reduction of CO2 emission can be achieved.

<Formula>

Amount of CO2 reduction (Kg-CO2)

= Amount of CO2 emission with coal － Amount of CO2 emission with RDF

＝ Amount of coal usage (t) × Amount of CO2 emission with coal － Amount of RDF usage (t) × Amount of CO2 emission with RDF

<Detailed formula>

ER = (ERc – ERf) ×365

CVf = 500 × D1

ERc = CVf ÷ D2　× D3

ERf = 500 × D4

<Precondition>＞

Calorific Value generated by boiler: 35,141 MJ (same value between coal and RDF)

Amount of coal usage for generating 35,141MJ: 1.547t

Amount of RDF usage for generating 35,141MJ: 0.989t

	Numeric value	unit	explanation
ER	variable	t-CO2/year	Total amount of CO2 emission reduction
ERc	variable	t-CO2	Amount of CO2 emission with coal
ERf	variable	t-CO2	Amount of CO2 emission with RDF
CVf	500 (1000)	MJ	Calorific Value when all of RDF was utilized
D1	36,542	MJ/t	Calorific Value of RDF
D2	23,361	MJ/t	Calorific Value of coal
D3	3.05	t-CO2/t	Coefficient of CO2 emission for coal
D4	2.35	t-CO2/t	Coefficient of CO2 emission for RDF
-	310	days	Annual operation days

② Calculation of reduction effect

The result of estimation based on the method describe in the previous section ① is as below

Table 6-12 Estimation result

Amount of RDF (tpd)	Reduction by transportation improvement (tpd)	Reduction by RDF usage instead of coal (tpd)	Total amount of reduction (tpd)	Annual reduction (t/year)
100t	7.86	62.32	70.18	21,755.8
200t	15.72	124.6	140.32	43,499.2
500t	39.3	311.58	350.88	108,772.8
1,000t	78.08	623.16	701.24	217,384.4
2,000t	155.1	1246.3	1401.4	434,434.0

＊Annual operation days of RDF line is 310 days

＊Currently cement companies are targeting 200tpd – 1000tpd for utilizing RDF. In the future it is assumed that these companies will increase the total amount of RDF usage replacing coal. Hence the estimation assumes that 2000tpd of coal is replaced by RDF.

(2) Survey and Investigation for Formation of MRV Implementation Structure

In regards to RDF business, MRV should be carried out by the cement companies through their daily operation which involves monitoring and reporting. The monitoring report should be audited by an auditor selected by BBMP and the result should be submitted to a 3rd party certifier.

1) Implementation Structure

MRV implementation structure for RDF should be as follows.

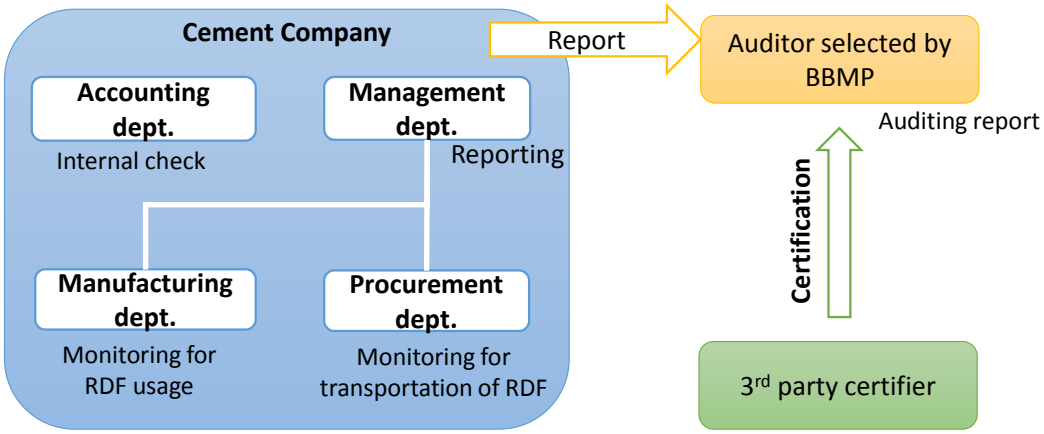


Figure 6-18 MRV implementation structure

2) Monitoring Method

The monitoring for MRV should follow the procedure shown below to ensure accuracy.;

① Procurement department of cement company monitors the number of trucks that transport RDF

and the amount of RDF

② Manufacturing department of the cement company monitors the amount of RDF that is utilized instead of coal.

③ Management department of the cement company collects the data of ① and ② to prepare a monitoring report.

④ Accounting department and Management department conduct internal check of the monitoring report.

⑤ The Cement company submits the monitoring report to the auditor selected by BBMP

⑥ BBMP Auditor checks the report.

⑦ The 3rd party certifier gives certification to the monitoring report.

6-6 Business Planning

Before the commencement of the RDF business, following items should be checked.

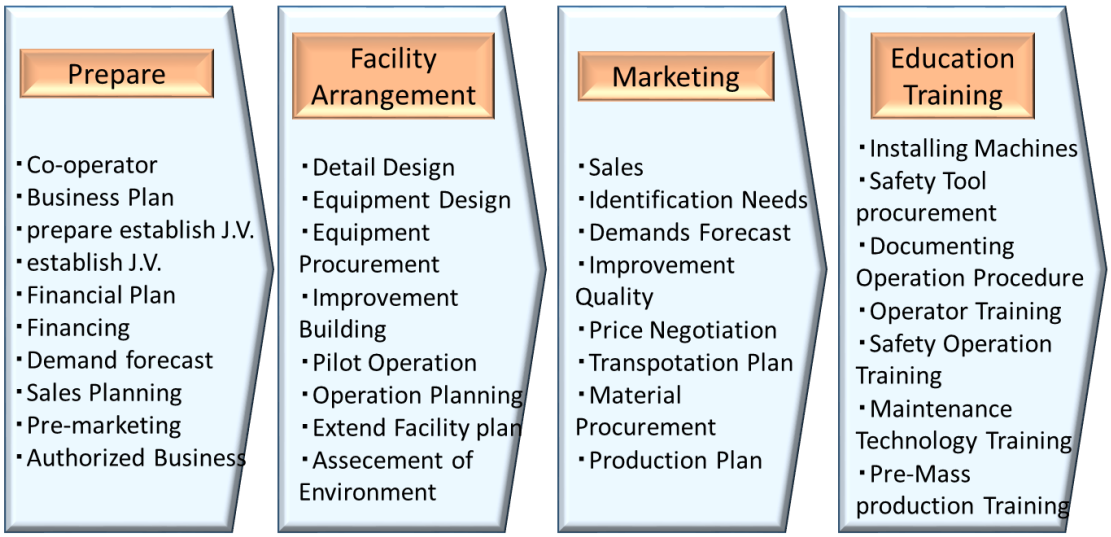


Figure 6-19 Steps to be taken before business commencement

In the preparation stage, a joint venture should be established and authorized by officials. In order to do that, the joint venture company needs to prepare a sales plan based on demand forecast and procure the operation capital based on a financing plan.

After that, buildings and facilities need to be installed based on the facility plan of this study. At the same time, the actual demands need to be confirmed through marketing to customers to prepare a sales and production plan.

After installation of the machinaries and equipment, it will be necessary to conduct operator training and safety education of the workers. After completion of these training, mass production can be started.

The schedule is shown below.

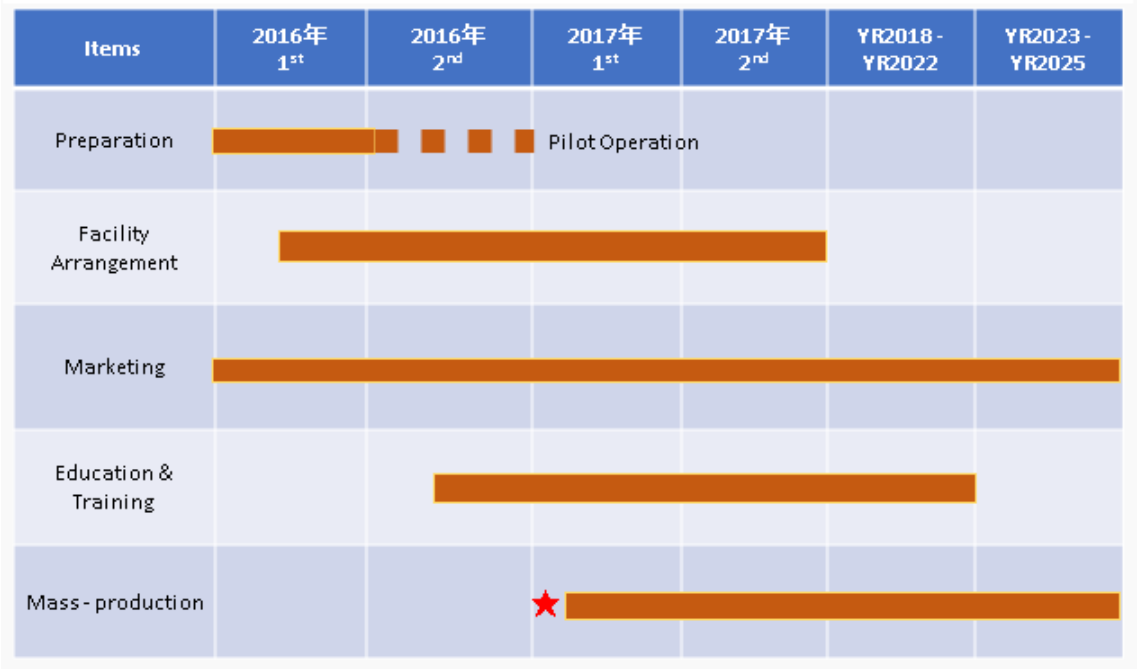


Figure 6-20 : Proposed business commencement schedule

If preparations can proceed as anticipated and mass production can commence from 2017, the expected sales quantity and sales amount is expected to be as shown in the figure below. The figures are based on the assumption that sale expands to other cement companies and the facility is also expanded to accommodate to customers demands.

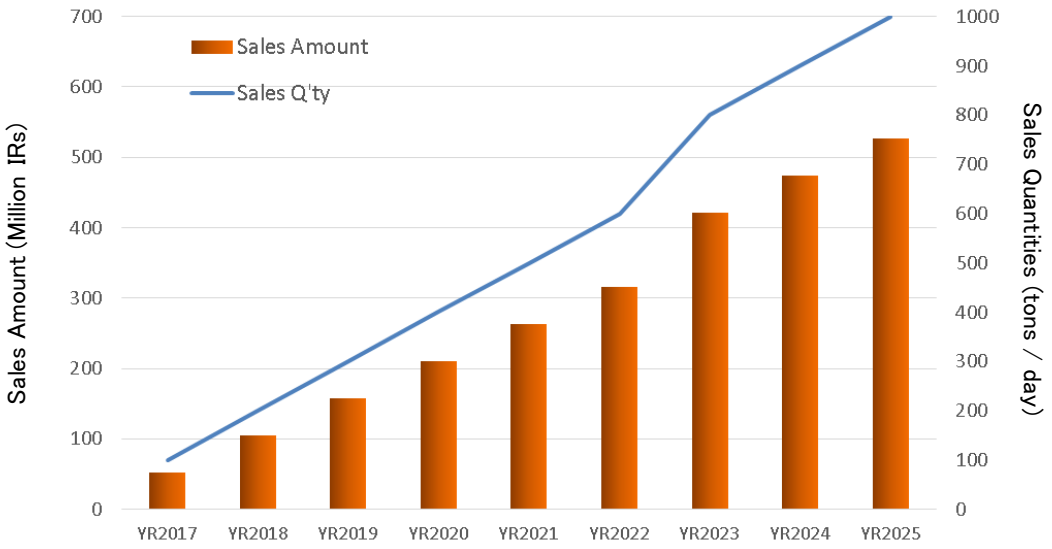


Figure 6-21 : Plan for sale amount and quantity

7 Way Forward

This study yields promising results towards the future MSW management improvement in Bengaluru, GHG reduction in the MSW sector and JCM project development. A bilateral agreement between Japan and India for JCM projects has not been signed yet and therefore it is hoped that this will be realized soon. This JCM project will be realized with the signing of the bilateral agreement and disclosure of the project development procedure based on the agreement.

Before the signing of the agreement, it is hoped that a model project will be prepared and implemented with funding from Indian side if possible.

Following is the recommendation for stakeholders.

- Karnataka State Government

Provide funding for solie waste treatment facilities and support arrangement among stakeholders

- BBMP

Operate and manage properly waste treatment and disposal facilities, Supervise contractors supportingly and strengthen its organization in charge of solid waste management

- Private sector

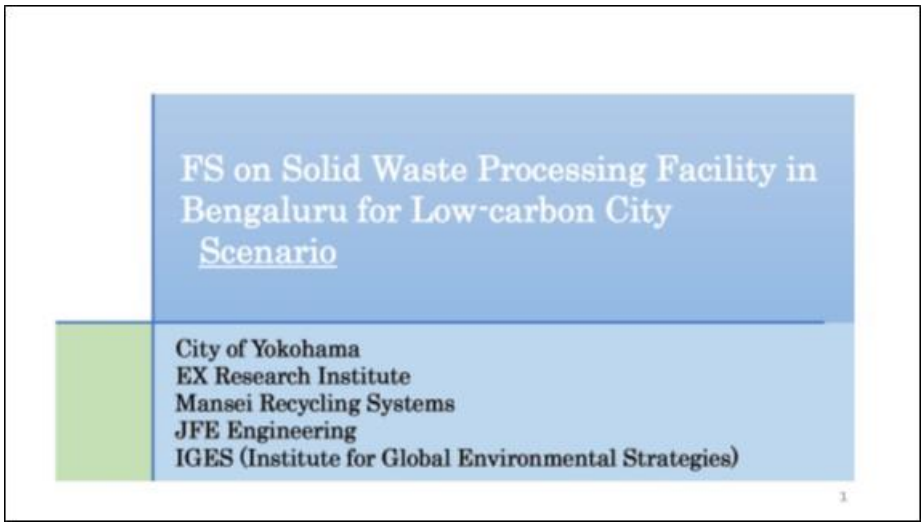
Provide their expertise

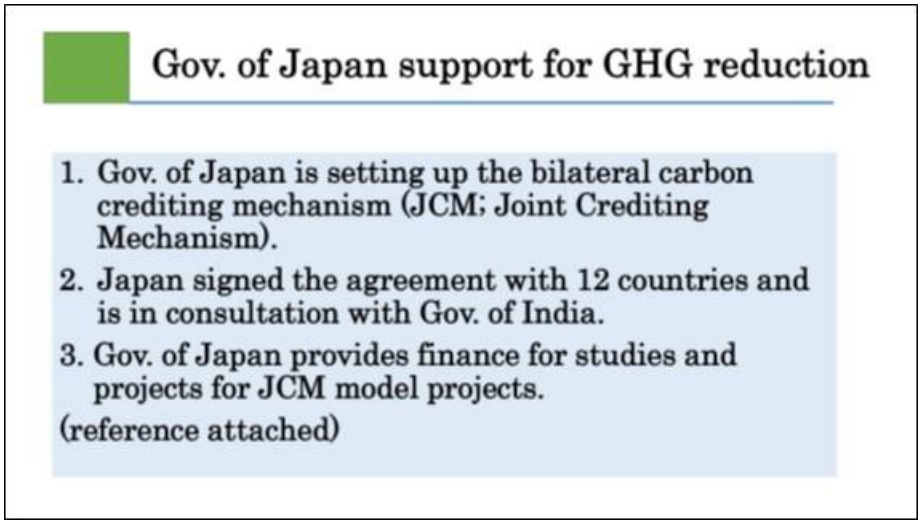
- Residents and NGO

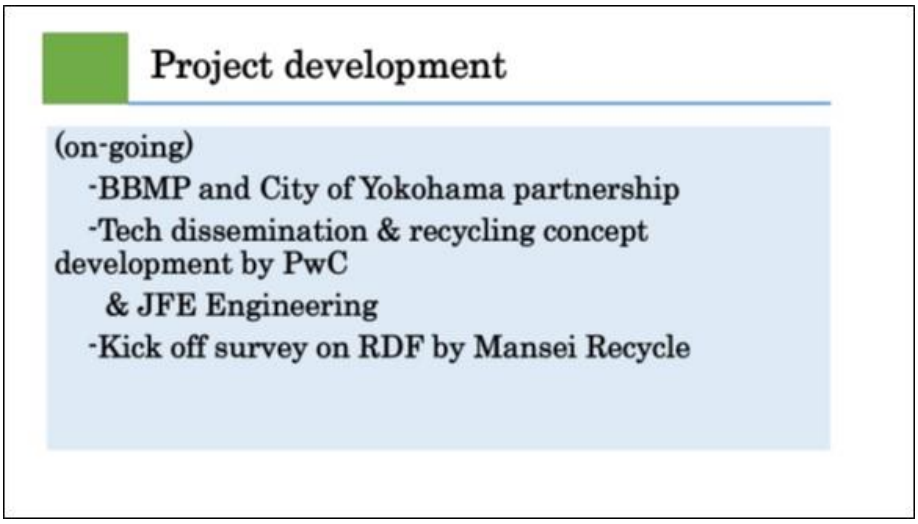
Cooperate segregation and watch solid waste management service

8 References

8-1 Presentation Material in the First Workshop







Project development

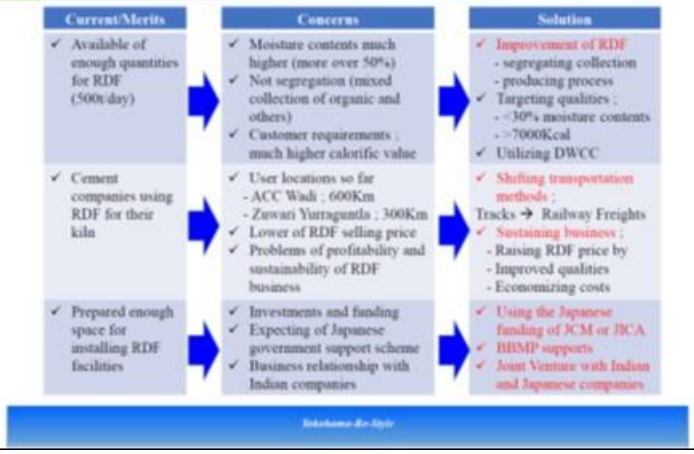
(This time)

Study the feasibility including GHG reduction of Waste to Energy and RDF facility in Bengaluru

(If JCM is agreed in India, next)

Business development for financing the project

Way to Solution (RDF case)



Knowledge Team can provide

- SWM institutional experience including segregation: Japanese and Asian experience
- Waste reduction strategy
- Technical knowledge such as WTE, RDF(RPF)

FS on Solid Waste Processing Facility in Bengaluru for Low-carbon City
Outline of the Study

City of Yokohama
EX Research Institute
Mansei Recycling Systems
JFE Engineering
IGES (Institute for Global Environmental Strategies)

7

Background

1. BBMP needs solid waste management (SWM) solution, especially reduction of solid waste amount to be landfilled. This needs waste processing facility to reduce the volume.
2. BBMP and City of Yokohama has been in partnerhip on SWM issues.
3. Ministry of Environment, Japan provides a study grant for the preparation of carbon credit mechanism projects.

Objective

Conduct pre-feasibility study on the following facility in Bengaluru to achieve the reduction of solid waste landfilled and greenhouse gas emission

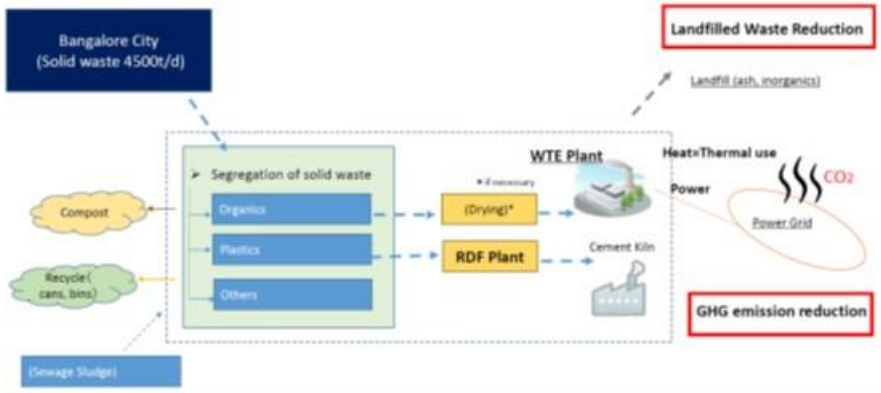
1. Waste to Energy (WTE) Plant

2. RDF (Refuse Drived Fuel) Plant

Study team

- City of Yokohama
- EX Research Institute (coordinator) (WTE)
- Mansei Recycling Systems (RDF)
- JFE Engineering (WTE)
- IGES (Institute for Global Environmental Strategies)

Concept of the Processing Plant



Scope of the Study (WTE)

1. SWM situation
- Amount, characterization, segregation
- Facility plan
- Institutional set-up

2. Concept design of the plant
- Facility design
- Cost

Scope of the Study (WTE)

3. Feasibility analysis (economic side)
- Conditions to connect to power grid
- Potential site

4. Carbon credit potential analysis
- Methodology
- Measurement, Reporting & Verification

5. Compilation of report

Scope of the Study (RDF)

1. Situation of waste plastics
- Analysis on characteristics and chemical contents
- Location of RDF customers

2. Feasibility analysis and marketing
- Collection and segregation
- Estimating volume and costs of RDF processing
- Marketing for expecting RDF users
- Estimating profitability

Scope of the Study (RDF) (2)

3. Concept design of plants and facilities
- Quality requirements of RDF customers
- Capacities, locations, sizes, and costs
- Designing on plants and facilities
- Planning on delivery transportation

4. Business planning
- Planning business scheme
- Researching laws and regulations for establishing business
- Planning environment assessment studies

Scope of the Study (RDF) (3)

5. Carbon credit potential analysis
- Methodology
- Measure, Reporting, and Verification

6. Compilation of report

Study Schedule

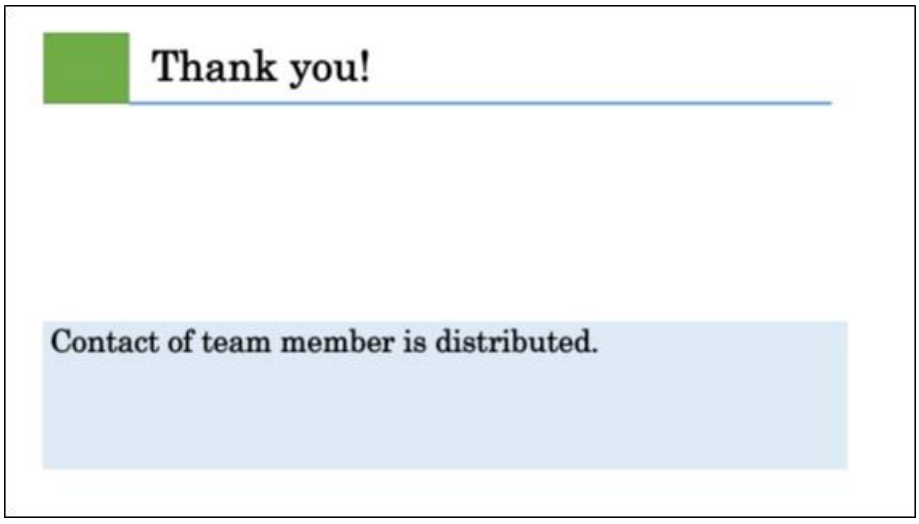
- 1st Joint discussion (kick off workshop): Late September, 2015
  October, 2015- JCM WS & Asia Smart City Conference in Yokohama
- 2nd Joint discussion (progress review): December, 2015
- 3rd Joint discussion (study result): January or early February, 2016
- Submission of draft report to MOEJ: early February, 2016
- Submission of final report to MOEJ & BBMP: early March, 2016

(The study is financed by Ministry of Environment, Japan)

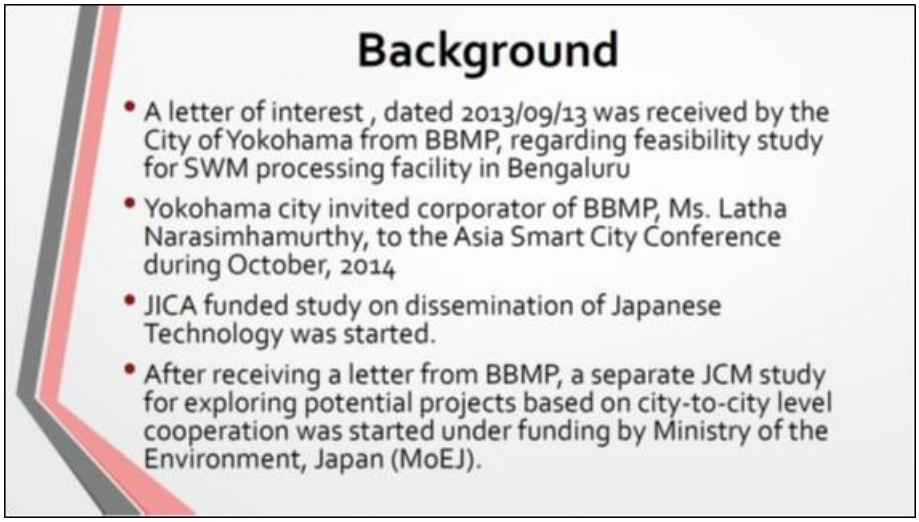
Request for BBMP cooperation

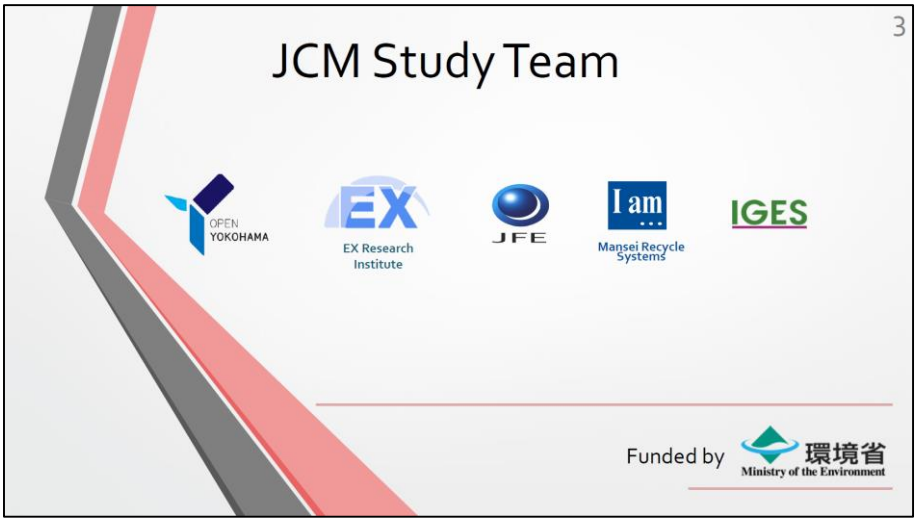
- Assign the contact person of BBMP
- Information on waste situation
  Method of waste amount estimation, waste flow
- Sampling of waste (by consultant)
- Information on Facility plan
- Information on BBMP function by organization
- Reviewing the draft report

(Detail will be contacted from the team or its consultant)
(Questionnaire is distributed this time)


Thank you!
Contact of team member is distributed.

8-2 Presentation Material in the Second Workshop





Purpose and Goal of Study

- To understand and analyze the current situation of waste treatment in Bengaluru
- To study the possibility for waste treatment solution (e.g. RDF plant, Waste to Energy) under JCM (Joint Crediting Mechanism) Scheme

Current actions

- JCM pre-F/S duration Aug 2015 – Mar 2016
  - Project commencement Sept 2015
  - Visits to Bengaluru by study team (Sept, 2015 , Nov-Dec,2015)
  - Meeting with BBMP (**today**)
  - Japan Technical Study Tour of BBMP/Stakeholders (End of Jan proposed)
  - Meeting with BBMP (Mid Feb proposed)
  - Final report to MoEJ (Mid March)
- As a part of the JCM project we are conducting the following :
  - Sampling and analysis for waste characterization
  - Consideration of JCM financing scheme
  - Preliminary design of waste treatment facilities (e.g. RDF utilization, WtE etc.)

6

Current Status of SWM Facilities

Key Facts

- Main landfill sites (Mandur, Lakshmipura and Bingipura) were/soon to be closed due to protest
- 10 compost plant is in operation or to be opened. Some of them have landfill
- Small scale biomethanation plant started its operation and upgraded
- WTE plant (thermal recovery) in Mandur is stopped
- WTE plant by Essel was halted
- WTE Plant by Satarem is approved
- 600 tpd biomethanation project is proposed by Dutch
- Many of the facilities are located outside of the city. Waste collection and transportation cost is higher.

Implication

- Securing new landfill sites is very difficult. Reduction of SW landfilled is an urgent issue.
- There has been no successful WTE (thermal recovery) project so far therefore needs a good model case.

7

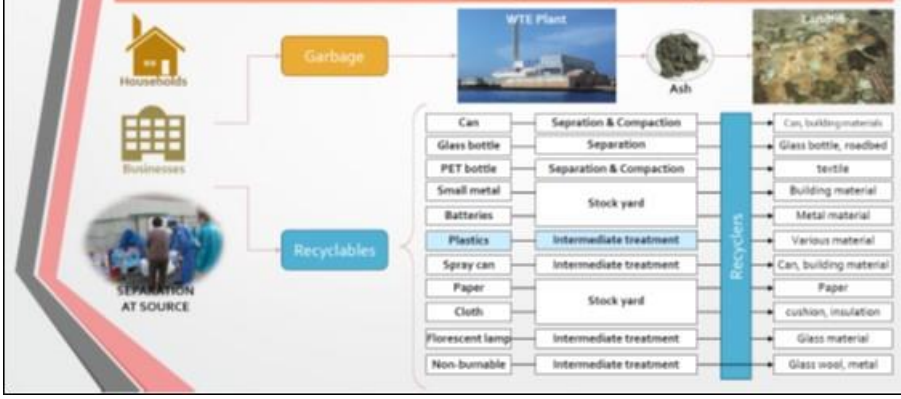
Yokohama's Decentralized SWM

- Population: 3.72 millions
- 437.4km²
- Yokohama's SW facilities:
  - 18 collection offices
  - 3 transport offices
  - 4 WTE plants
  - 1 landfill site
- WTE plants are built in the middle of urban area -> **reducing the collection and transportation cost**

8

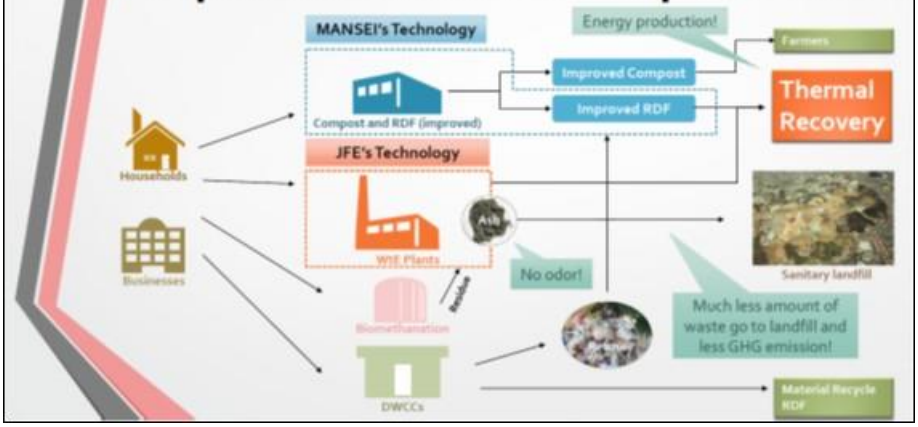
Yokohama's Waste Flow

The Best mix of material recycle and thermal recovery



9

Proposed Waste Flow Improvement



10

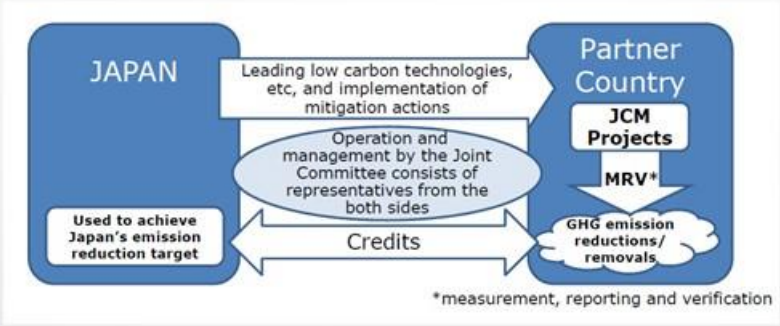
What is JCM?

JCM = Joint Credit Mechanism

NEW initiative by the Japanese Government to offset its emission reduction targets

A bilateral cooperation scheme addressing climate change through the dissemination of advanced Low-Carbon Technologies and Products to benefit the "Leapfrog" development of Developing Countries.

JCM scheme overview



12

Funding Scheme 1: JCM Model Projects

Budget for FY2015	JPY 2.4B (approx. USD 20MM) per year by FY2017 (total JPY 7.2B over 3 years)
Scope of Financing	Facilities, equipment, vehicles, etc. which reduce CO_2 from fossil fuel combustion as well as construction cost for those facilities, etc.
Eligible Projects	Starting installation after the adoption of the financing and finishing installation within 3 years.

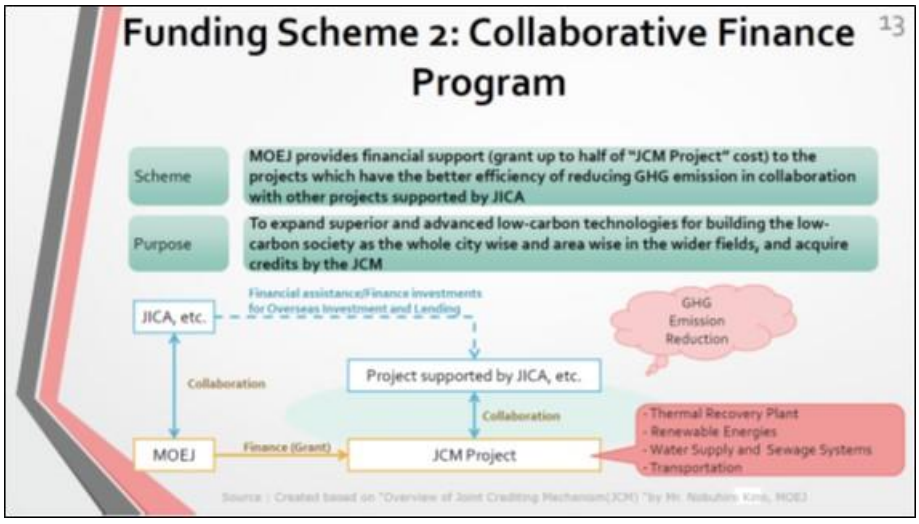
Government of Japan

Conduct MRV and expected to deliver at least half of JCM credits issued

Finance part of an investment cost (up to the half)

International Consortiums (which include Japanese entities)

Source : Created based on "Overview of Joint Crediting Mechanism(JCM) " by Mr. Nobuhiro Kino, MOEJ


Funding Scheme 2: Collaborative Finance Program
13
Scheme
MOEJ provides financial support (grant up to half of "JCM Project" cost) to the projects which have the better efficiency of reducing GHG emission in collaboration with other projects supported by JICA
Purpose
To expand superior and advanced low-carbon technologies for building the low-carbon society as the whole city wise and area wise in the wider fields, and acquire credits by the JCM
Financial assistance/Finance investments for Overseas Investment and Lending
JICA, etc.
GHG Emission Reduction
Collaboration
Project supported by JICA, etc.
Collaboration
MOEJ
Finance (Grant)
JCM Project
- Thermal Recovery Plant
- Renewable Energies
- Water Supply and Sewage Systems
- Transportation


Proposed Timeline
RDF Plant
Small Scale WTE
As JCM Model Project
Larger Scale WTE
Feasibility Study for JCM Application
Capacity Building, Regulation Setting, Training of WTE Operation, Finance Arranging, etc.
Install WTEs in another Areas


Outline of technical visit
Objective
•Provide an opportunity to key members of waste management in Bangalore to observe and understand how the waste management solutions are integrated and implemented in Yokohama
•Deepen the collaborative relationship between Bangalore, City of Yokohama and the key Japanese partners through discussions on how to adopt the solution for waste management in Bangalore
Timing(Planned)
•2016/Jan 25th-
Site tour facilities
Program facilitator and activity support
•Facilitator: City of Yokohama
•Supporter: JFE Engineering , PwC
Participants (Total 4- 5 members)
•To be selected by BBMP
Schedule
•5 day program in Yokohama (incl. 2day for travelling)

Tentative Schedule of technical visit

Date	Activity	Detail
25/Jan.	Arrive in Japan	15:45 Narita Airport →Hotel in Yokohama
26/Jan.	Study tour -AM: discussion on waste management technology -PM: tour on the Plant (Kanazawa factory area with)	
27/Jan.	Study tour -AM: tour on the collection/segregation points - PM: tour on other plant	
28/Jan.	Study tour -AM: tour on other plant - PM: workshop on wrap up	
29/Jan.	Departure from Japan	12:00 Narita Airport

Thank you

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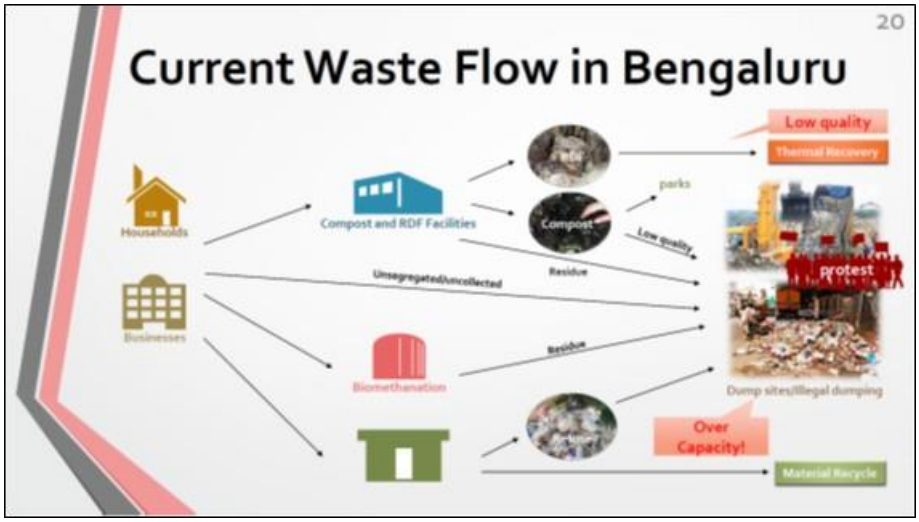
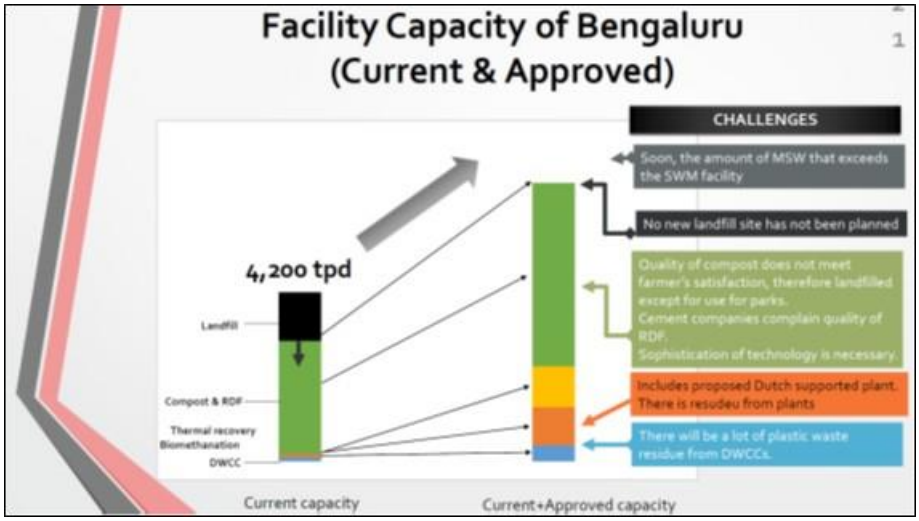
IGES

Funded by 環境省 Ministry of the Environment

Appendix

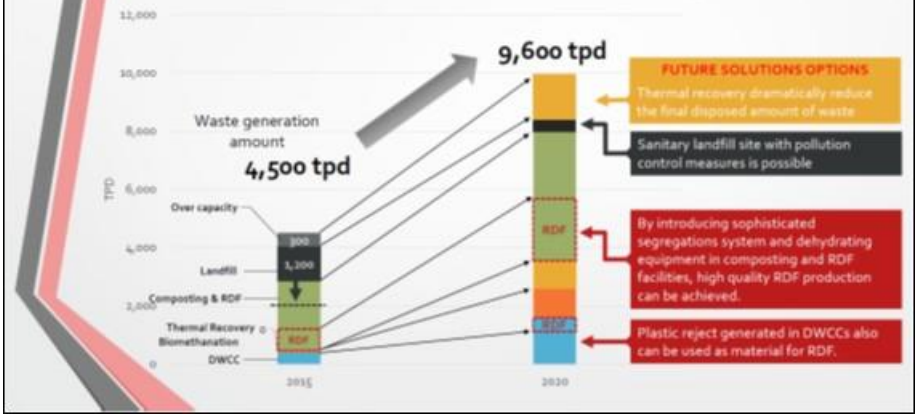

Future waste generation
9


20
Current Waste Flow in Bengaluru
Low quality
Thermal Recovery
Households
Compost and RDF Facilities
parks
Compost
Low quality
Residue
protest
Unsegregated/uncollected
Businesses
Residue
Biomethanation
Dump sites/Illegal dumping
Over Capacity!
Material Recycle


Facility Capacity of Bengaluru
(Current & Approved)
1
CHALLENGES
Soon, the amount of MSW that exceeds the SWM facility
No new landfill site has not been planned
Quality of compost does not meet farmer's satisfaction, therefore landfilled except for use for parks.
Cement companies complain quality of RDF.
Sophistication of technology is necessary.
Includes proposed Dutch supported plant. There is resudeu from plants
There will be a lot of plastic waste residue from DWCCs.
4,200 tpd
Landfill
Compost & RDF
Thermal recovery
Biomethanation
DWCC
Current capacity
Current+Approved capacity

22

Possible Scenario for Bengaluru



23

Waste Reduction Concept of Yokohama

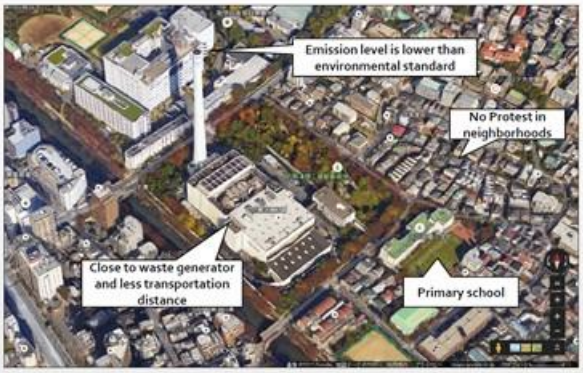
- G 30 plan (2003-)targets 30% of waste reduction by:
  - Segregation: 5 types -> 10 types
  - Public awareness raising for citizens
- Yokohama 3R Dream Plan (2011)

24

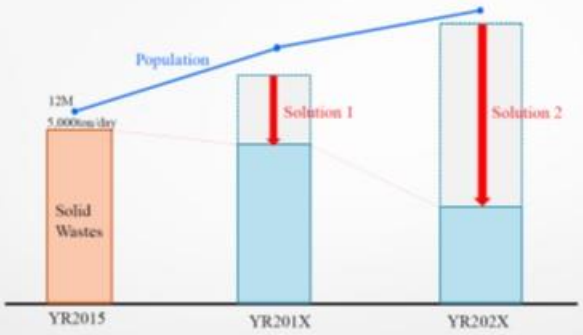
Waste Separation at Source (Yokohama)

		Burnables, spray cans, non-burnables, Used dry-cell batteries	Cans, glass bottles, PET bottles, small metallic items	Plastic Containers and Packaging	Recycle Paper & Used Cloth
Town Name (Collection Site) (Alphabet Order)		Two Times A Week	Once A Week	Once A Week	Two Times A Month
A	Aoki-cho	Mon, Fri	Tue	Thu	1,3 Tue of every month
A	Asahigaoka	Mon, Fri	Thu	Sat	2,4 Sat of every month
C	Chiwaka-cho	Mon, Fri	Tue	Thu	2,4 Tue of every month
D	Daimachi	Mon,Fri	Tue	Thu	1,3 Tue of every month

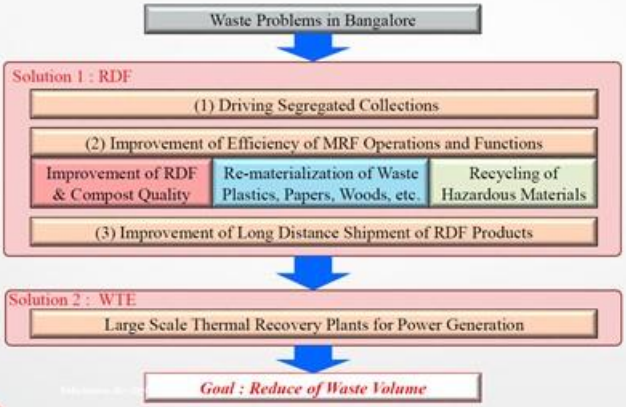
Thermal Recovery Plant in the middle of a City is Possible



Future Image of Waste Issues in Bangalore



Outline of Solutions



28

Benefits of RDF

- **Alternative fuel for coal at cement factories and power plants**
  - GHG emission reduction
  - No emission of pollutants such as PM2.5
- **Contribution to the reduction of finally disposed waste**
  - 20% of waste is plastic waste
  - Plastic waste generated in composting facilities can be used as material
  - Reduction rate is 100%
- **High calorific value**
  - Possible to have 7,000 cal/kg if proper segregation is done (e.g. Cebu City)
- **High demand**
  - Many cement factories show interest in RDF as an alternative to coal
  - The unit price of RDF is much cheaper compared to coal (RDF: XX USD/t, Coal: 100 USD/t)

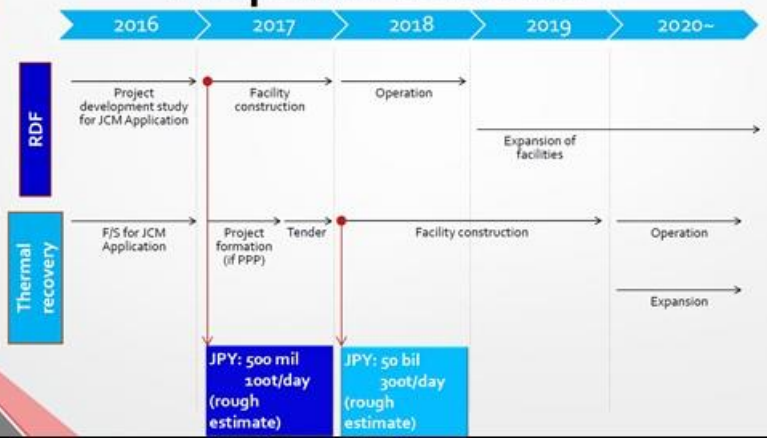
29

Benefits of Thermal Recovery

- Dramatic reduction of waste finally disposed at landfill
  - Volume reduction rate is 95%
  - It also reduces methane emission from landfill site
- Hygienic and Sanitary Treatment of Waste
  - Best solution for Public health problems (smell, disease, pests, etc.)
  - Residue(ash) to be landfilled is very safe and clean
- Efficient Energy Recovery
  - Power generation with using waste heat
  - Waste heat utilization for community (e.g. sports centers, swimming pools, and hot spas)

30

Proposed Timeline



31

MANSEI AND JFE TECHNOLOGY

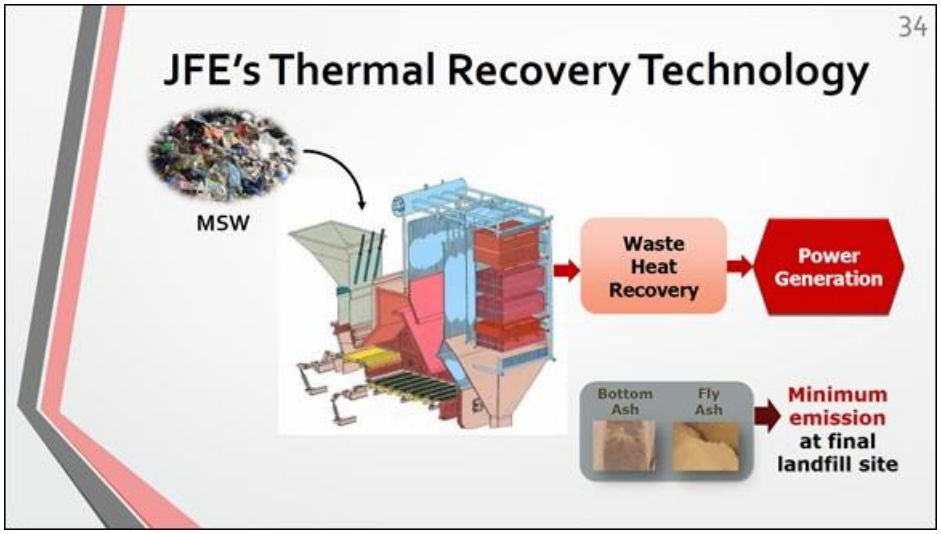
32

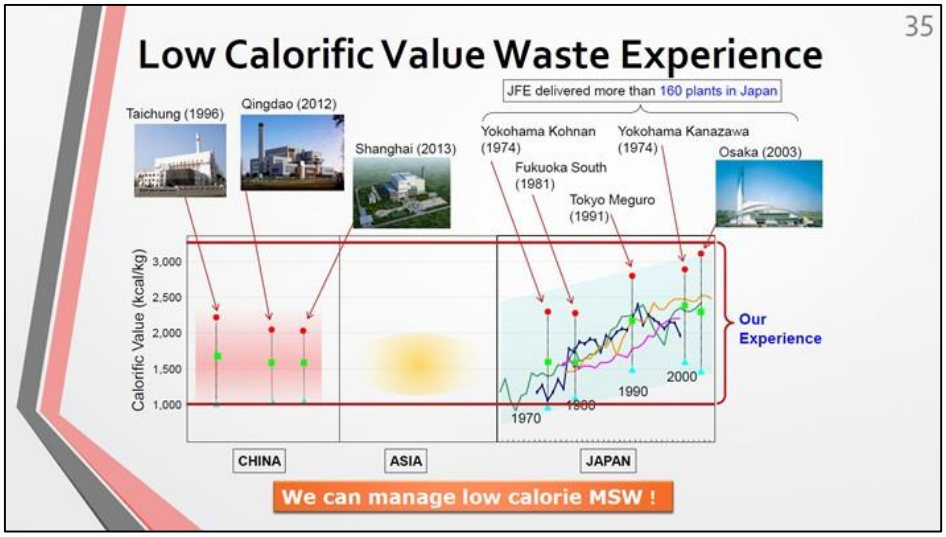
MANSEI's Solution

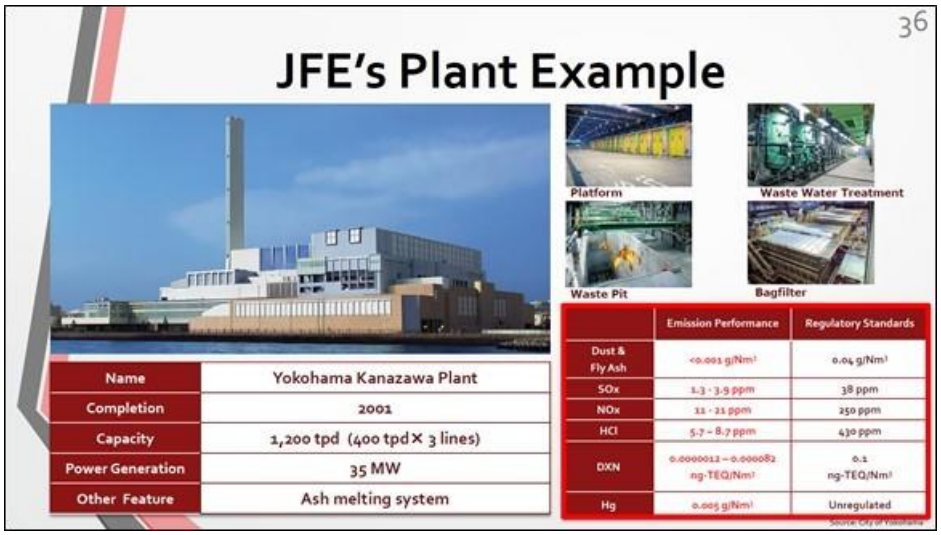
MANSEI's RDF Plant Example

- High quality waste from Industrial and commercial sector

- Shipment of RDF


34
JFE's Thermal Recovery Technology
MSW
Waste Heat Recovery
Power Generation
Bottom Ash
Fly Ash
Minimum emission at final landfill site


35
Low Calorific Value Waste Experience
JFE delivered more than 160 plants in Japan
Taichung (1996)
Qingdao (2012)
Shanghai (2013)
Yokohama Kohnan (1974)
Fukuoka South (1981)
Tokyo Meguro (1991)
Yokohama Kanazawa (1974)
Osaka (2003)
Calorific Value (kcal/kg)
3,000
2,500
2,000
1,500
1,000
1970
1980
1990
2000
Our Experience
CHINA
ASIA
JAPAN
We can manage low calorie MSW !


36
JFE's Plant Example
Platform
Waste Water Treatment
Waste Pit
Bagfilter
Name
Yokohama Kanazawa Plant
Completion
2001
Capacity
1,200 tpd (400 tpd × 3 lines)
Power Generation
35 MW
Other Feature
Ash melting system
Emission Performance
Regulatory Standards
Dust & Fly Ash
<0.001 g/Nm³
0.04 g/Nm³
SOx
1.3 - 3.9 ppm
38 ppm
NOx
11 - 21 ppm
250 ppm
HCl
5.7 - 8.7 ppm
430 ppm
DXN
0.0000012 – 0.000082 ng-TEQ/Nm³
0.1 ng-TEQ/Nm³
Hg
0.005 g/Nm³
Unregulated

Reference

Composting & RDF Facility

Dry Waste Collection Centers

8-3 Presentation Material in the Final Workshop

1

India-Japan Collaboration Workshop

Pre-FS for JCM Application on Solid Waste Processing Facility in Bengaluru for Low-carbon City

* JCM (Joint Crediting Mechanism): Facility set up by Japanese Gov.

EX Research Institute IGES OPEN YOKOHAMA JFE I am Mansei Recycle Systems

Study Team

環境省 Ministry of the Environment

February 2016

Funded by

2

In This Presentation

- Background & Purpose of the Study
- Review current SWM situation in Bengaluru
- Experience in Japan and Yokohama
- Future Improvement Scenario and Waste Treatment Solution
- Proposal on waste treatment (RDF and WTE)
- Funding scheme by Japanese Gov. "JCM"
- Proposals

3

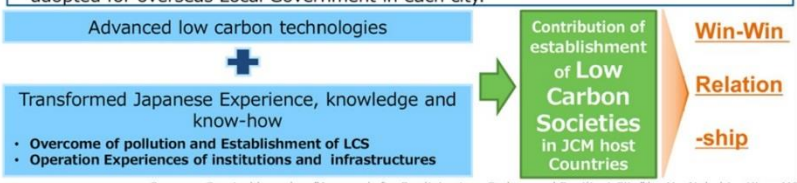
Background

- A letter of interest , dated 13/Sep./2013 was received by the City of Yokohama from BBMP, regarding feasibility study for SWM processing facility in Bengaluru
- After receiving a letter from BBMP, this JCM study for exploring potential projects based on **city-to-city level cooperation** was started under funding by Ministry of the Environment, Japan (MoEJ).
- JCM Study team visited Bengaluru in Sep. and Dec. 2015

4

Why "City to City Level Cooperation" ?

- It is NESSESARY to establish LOW CARBON SOCIETIES in Asia and other developing and emerging countries to reduce GHG emission.
- Under the process of JCM project formulation, it aims NOT ONLY diffusion of advanced low carbon technologies BUT ALSO transfer of knowledge and know-how between Japanese and overseas Local Government in the JCM(Joint Crediting Mechanism) led by Japanese Government.
- Japanese Government emphasizes and supports the City to City Collaboration to leverage the knowledge and know-how of Japanese Local Government transformed or adopted for overseas Local Government in each city.



Source : Created based on "Approach for Realizing Low Carbon and Resilient City" by Mr. Nobuhiro Kino, MOEJ

5

Purpose and Goal of Study

- To understand and analyze the current situation of solid waste management in Bengaluru
- To propose the possibility for waste treatment solution (e.g. RDF, Waste to Energy) with the JCM (Joint Crediting Mechanism) Scheme

6

JCM Study Team

The City of YOKOHAMA

JFE Engineering Corporation

EX Research Institute

MANSEI Recycle Systems Co.Ltd.

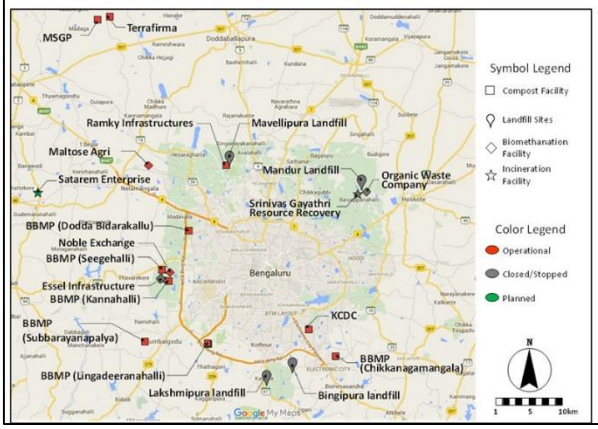
Institute for Global Environmental Strategies

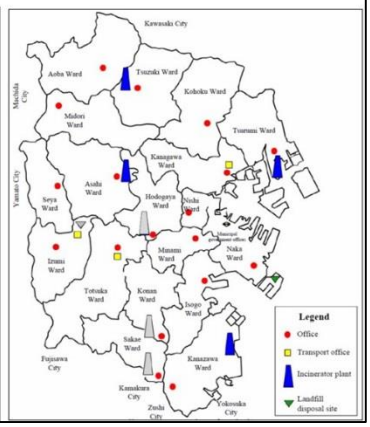
7

Review of the current situation
of solid waste management in Bengaluru

8

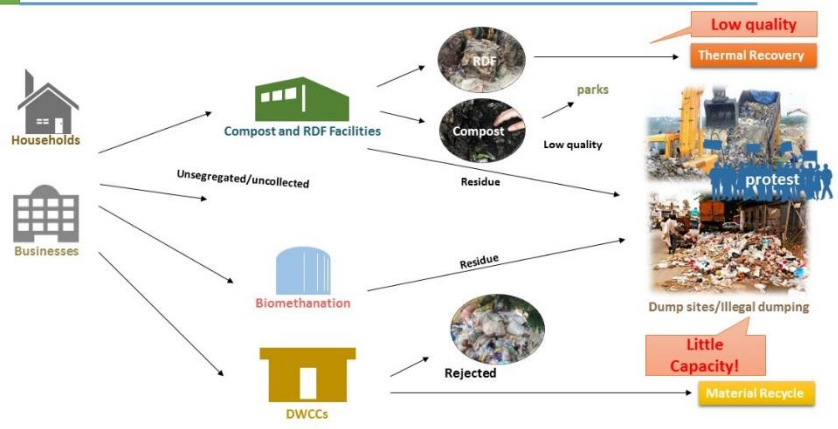
Current Status of SWM Facilities





9

Current Waste Flow in Bengaluru



10

Waste Collection Depot

Garbage not sorted? You face ₹1k penalty

CLEAN-UP ACT

- BBMP gets tough with citizens and establishments on garbage segregation
- Plans to double penalty to Rs 1,000
- Likely to book cases against repeat offenders

Times Of India
Nov. 29, 2015
Page : 1

11

Composting & RDF Facility

Compost
- Low fermentation Temp.
- High water content

RDF
- Sorted plastics
- Bailed RDF

12

Dry Waste Collection Centers

Huge quantity of plastic waste have rejected

13

Current Status of SWM Facilities

Key Facts

- 10 compost plant is in operation. Some of them have RDF facility and landfill
- According to the Cement factories, current quality of RDF needs improvement.
- Pilot activities for segregation have been implemented in several areas.
- Small scale biomethanation plant started its operation

- Main landfill sites (Mandur, Lakshmipura and Bingipura) were closed due to protest
- WTE plant (thermal recovery) in Mandur is stopped
- One WTE plant is halted
- One WTE Plant is approved

- 600 tpd biomethanation project is proposed by Dutch consortium
- Many of the facilities are located outskirts of the city.
  Waste collection and transportation cost is higher.

14

Current Status of SWM Situation

Implication

- Securing new landfill sites is very difficult.
  Reduction of SW landfilled is an urgent issue.
- There has been no successful RDF & WTE (thermal recovery) project so far therefore needs a good model case.

15

The experience in Japan and Yokohama

16

SWM Development in Japan

Post WW II to 1950s	Economic Recovery Manual collection & open trucks, Open dumping at landfill
1960s to 1970s	Rapid Economic Development – **Rapid increase of solid waste** (5 times from 1960 to 1980) Air & Water Pollution Issues nation wide Government subsidy for SWM facility started **Introduction of waste incineration in many cities** 1970 Waste Management & Public Cleansing Law 1970s **Tokyo Garbage War**
1980s to early 1990s	1980s Bubble economy Solid waste continued to increase, ex. PET bottle, bulky waste Stringent situation on landfill capacity
1990s	Economic slowdown Recycling laws enacted Illegal dumping issues
2000s to present	From 2000 solid waste decreasing Emphasis on 3R

17

Emission Regulation / Guideline

Emission Gas Regulation			Japan	JFE Plant in Osaka	Singapore
Particles		mg/Nm^3	40	10	100
Gases	SOx	mg/Nm^3	K-value regulation (Vary by region)	26	500
	NOx	mg/Nm^3	335	27	700
	HCl	mg/Nm^3	700	24	200
	CO	mg/Nm^3	125	38	625
	DXNs	ng-TEQ/Nm^3	0.1	0.1	0.1

Other than emission gas

DXNs in dust, ash	ng-TEQ/g	3	3	
DXNs in water	pg-TEQ/l	10	10	
Ignition Loss of Bottom ash	%	5%	3%	

18

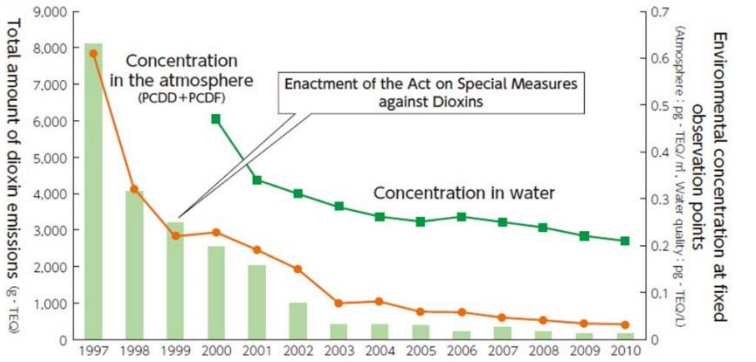
DIOXIN Regulation in Japan

- Special legislation on dioxin emission control (1999)
- Legislation stipulates control plan, environment standard, emission & effluent standards and monitoring
- Gov. set basic guidance to promote control measures (1999)

19

DIOXINs Emissions in Japan

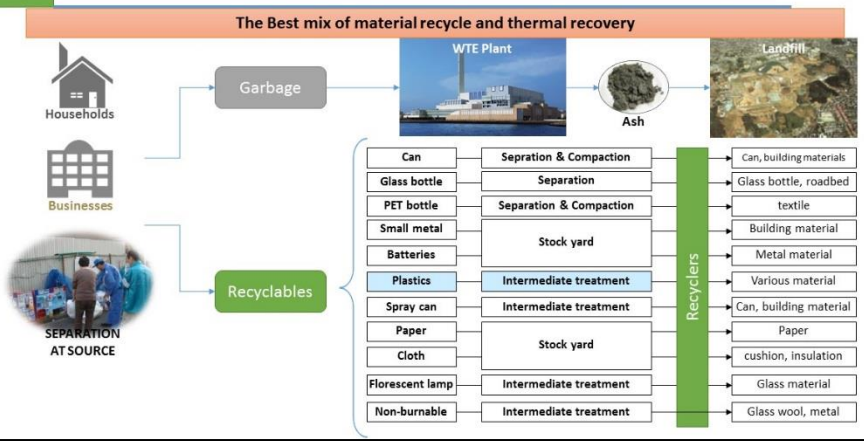
Changes in the total amount of dioxin emissions and dioxin concentrations in the atmosphere and water



Source : History and Current State of Waste Management in Japan, MOEJ

20

Yokohama's Waste Flow



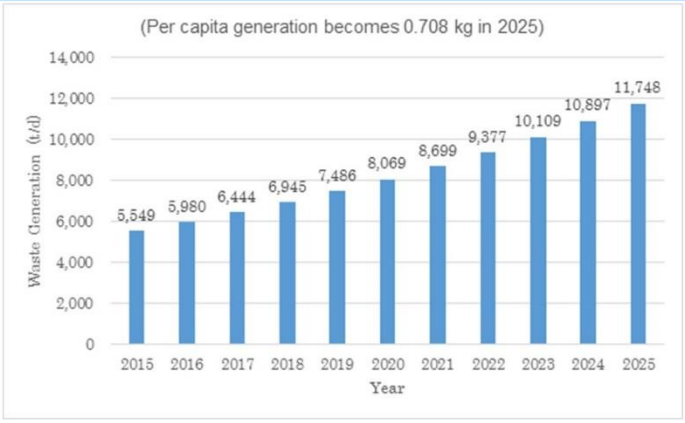
21

The future improvement scenario and waste treatment solution

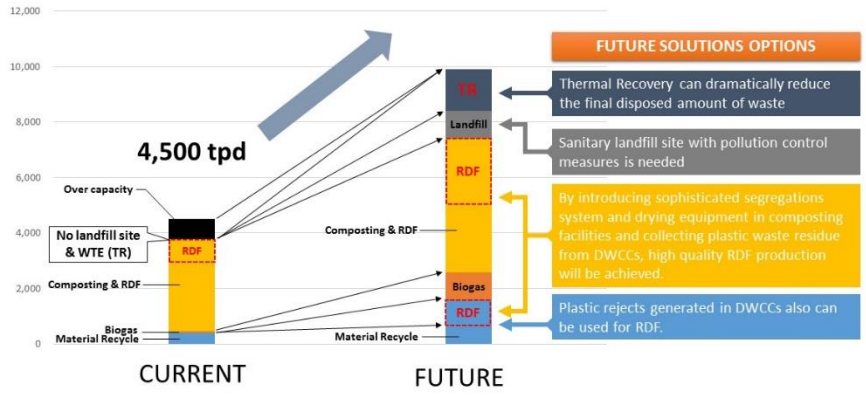
For Bengaluru

22

Future waste generation



Possible Scenario for Bengaluru (conceptual)



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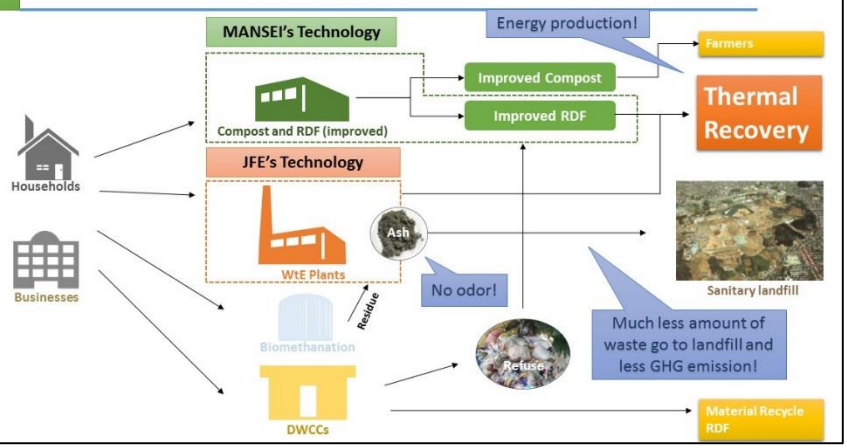
Proposed Waste Flow Improvement



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Outline of Solutions

Waste Problems in Bangalore

Solution 1 : RDF along with Composting

(1) Driving Segregated Collections

(2) Improvement of RDF and Composting Operations and Functions

Improvement of RDF & Compost Quality

Re-materialization of Waste Plastics, Papers, Woods, etc.

(3) Improvement of Long Distance Shipment of RDF Products

Solution 2 : WTE

Thermal Recovery Plants with Power Generation

Goal : Reduction of Waste Volume

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Proposed Timeflow

Model RDF Plant

Small Scale WTE
As JCM Model Project

Expand RDF
Larger Scale WTE

Present Study

Install WTEs
in another Areas

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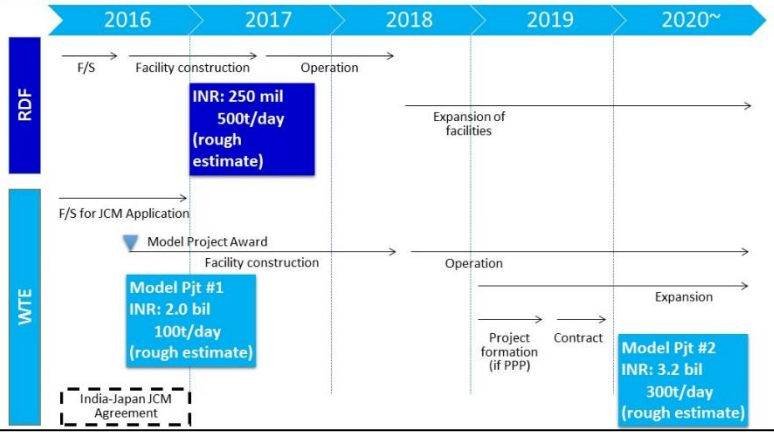
Proposed Timeline



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Proposal on waste treatment 1

Improvement of RDF Plant

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Benefits of RDF

- **Alternative fuel for coal at cement factories and power plants**
  - GHG emission reduction
  - No emission of pollutants such as PM2.5
- **Contribution to the reduction of finally disposed waste**
  - 20% of waste is plastic waste
  - Plastic waste generated in composting facilities can be used as material
  - Reduction rate is 100%
- **High calorific value**
  - Possible to have 3,000-4,000 kcal/kg.
    If proper segregation is done, higher calorific value will be possible, e.g. 6,000 kcal/kg.
- **High demand**
  - Many cement factories show interest in RDF as an alternative to coal
  - The unit price of RDF is much cheaper compared to coal (Coal: 100 USD/t)

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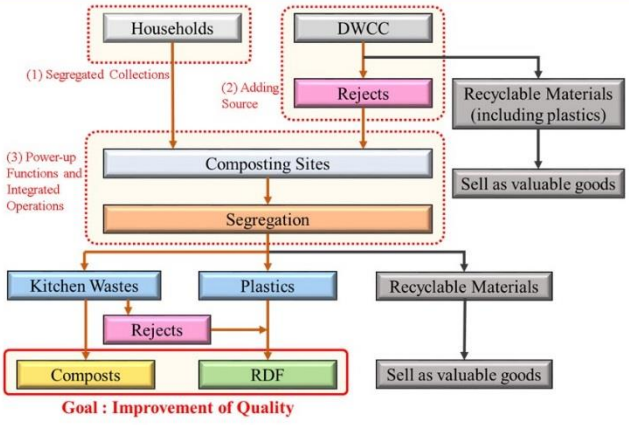
Concepts of RDF Improvement



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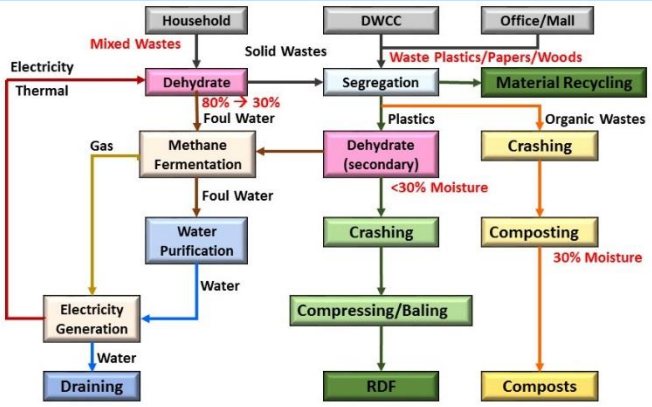
MANSEI's RDF Solution



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Rough Estimation of RDF Facilities

Items	Estimation
Processing Capacity	500 t/d/site of solid waste (100 t/d of RDF output)
Needs of Sites	1site as Pilot project
Location	One of the existing RDF facility
Handling Materials	Plastics (High Value, Low Value, Styrene Form), Woods, Paper
Processing	Plastics ; fluff fuels, pelletizing Woods / Papers ; chips for fuels, paper materials
Configuration	100 tons fluff machine x 1 1 tons/H wet type shredding/washing/dewatering machine x 1 500KG/H pelletizing machine x 2
Needed Area	5,000 m2 / site
Rough Image of Investment Cost	Total cost per site : INR 250 million/site (JPY500 million/site) - fluff machine ; INR 150 million/unit (JPY300 million/site) - laundry & pelletizing ; INR 100 million (JPY200 million) * Not including building construction costs, woods and paper processing machines, and technical fee for installing.

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MANSEI's RDF Plant Example (Cebu, Philippines)

- High quality waste from Industrial and commercial sector

- Shipment of RDF

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Proposal on waste treatment 2

Thermal Recovery (Waste to Energy) Plant

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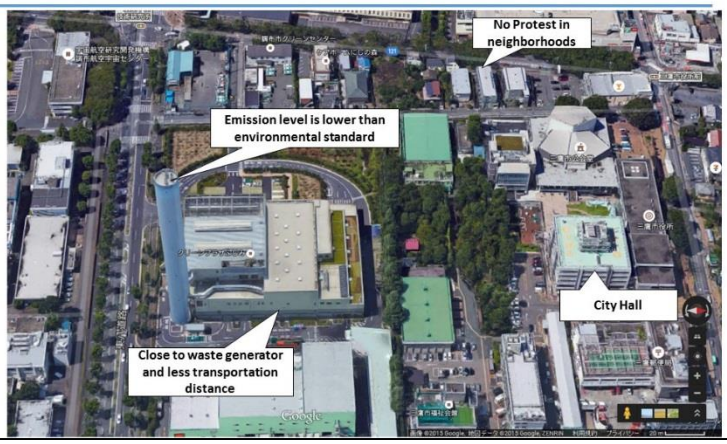
WTE Plant in the middle of a City is Possible



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Benefits of Thermal Recovery

- Dramatic reduction of waste finally disposed at landfill
  - Volume reduction rate is 95%
  - It also reduces methane emission from landfill site
- Hygienic and Sanitary Treatment of Waste
  - Best solution for public health problems (smell, disease, pests, etc.)
  - Residue(ash) to be landfilled is very safe and clean
- Efficient Energy Recovery
  - Power generation with using combustion heat

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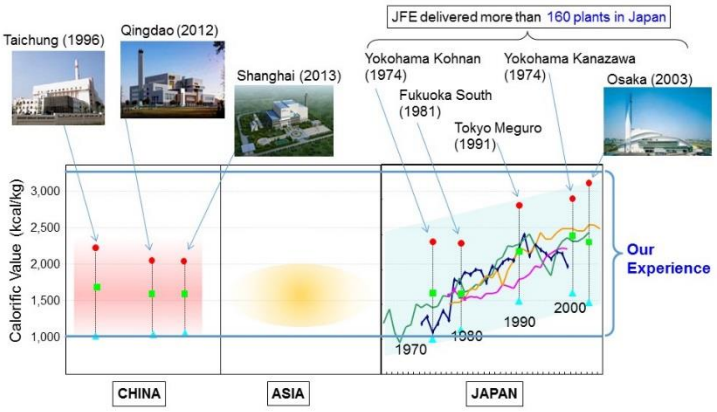
Low Calorific Value Waste Experience



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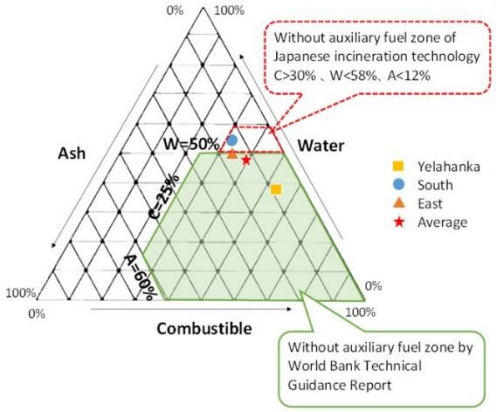
Waste Composition Analysis by JCM Team



Average lower calorific value: 1,900kcal/kg

The results of lower calorific value analysis and analysis on the triangular coordinates show that **the wastes in Bengaluru can be fully incinerated without auxiliary fuel particularly by Japanese technology by taking care of emission control norms.**

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RESULTS of Analysis in Bangalore

			JFE Track records		
ITEM	UNIT	BANGALORE (By JCM Team)	CHIBA A Plant	TOKYO C Plant	TOKYO D Plant
Moisture	%wet	48	43	49	41
Ash Content	%	40	15.8	8.0	13.8
Calorific Value (Wet)	kcal/kg	1,920	1,780	2,508	2,842

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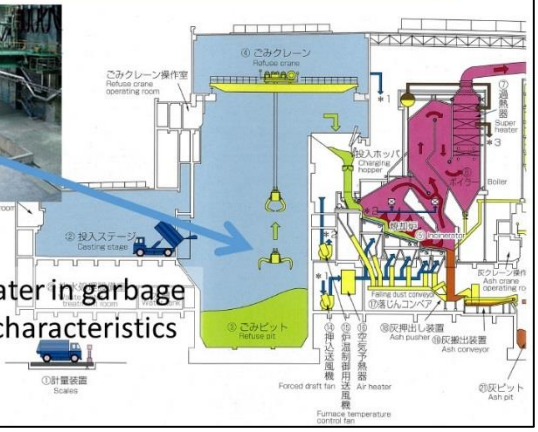
How to Manage Water in Garbage in WTE



- Gravitationally discharging water in garbage
- Mixing and Equalizing waste characteristics

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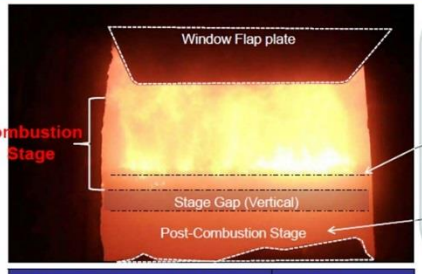
How to Manage Water in Garbage in WTE



GOOD STABLE COMBUSTION

Combustion completes before end of combustion stage

No outstanding flare In this stage

Waste Characteristics	Value
Moisture (%)	50～60
Ash (%)	18～23
Burnable (%)	22～27
Lower Heat Value (MJ/kg)	4.7～5.8

Data / Photo from Qingdao(China) plant

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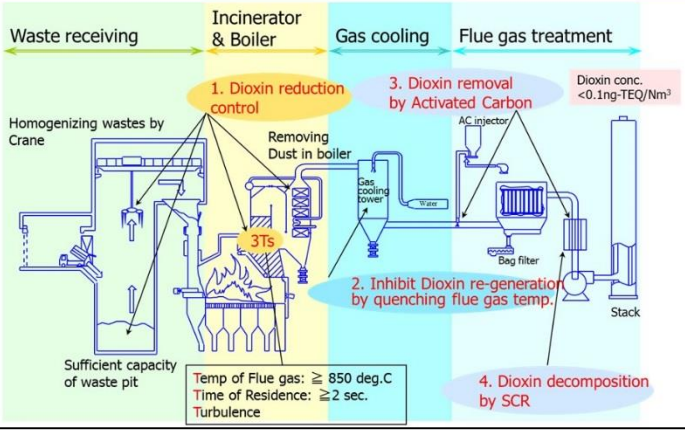
JFE's Anti-DIOXINs Technology



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Case Study : JCM Model Project, WTE in Yangon

Technology	Grate Furnace
Input	MSW
Capacity	60 ton/day
Power Generation	700 kW (Net 300 kW)
CAPEX	USD 16 Mil.
OPEX	USD 0.8 Mil./year
JCM Subsidy	Apprx. 50%

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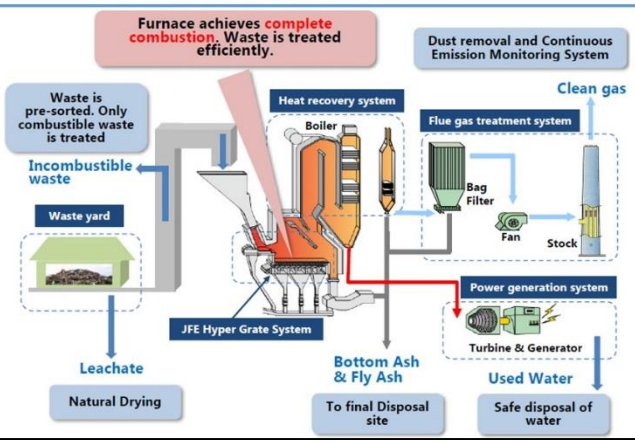
Case Study : JCM Model Project, WTE in Yangon



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JFE's WTE Plant Example


Platform


Waste Water Treatment


Waste Pit


Bagfilter

Name	Yokohama Kanazawa Plant
Completion	2001
Capacity	1,200 tpd (400 tpd× 3 lines)
Power Generation	35 MW
Other Feature	Ash melting system

	Emission Performance	Regulatory Standards
Dust & Fly Ash	<0.001 g/Nm³	0.04 g/Nm³
SOx	1.3 - 3.9 ppm	38 ppm
NOx	11 - 21 ppm	250 ppm
HCl	5.7 – 8.7 ppm	430 ppm
DXN	0.0000012 – 0.000082 ng-TEQ/Nm³	0.1 ng-TEQ/Nm³
Hg	0.005 g/Nm³	Unregulated

Source: City of Yokohama

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Funding Scheme by Japanese Gov.

- JCM (Joint Crediting Mechanism)

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What is JCM?

(Photo: Cabinet Public Relations Office)

"Many of the advanced low-carbon technologies do not generally promise investment return to developing countries.
Japan, will, while lowering burdens of those countries, promote diffusion of advanced low-carbon technologies, particularly through implementation of the **JCM**."

Speech by Prime Minister Abe at COP21

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What is JCM?

JCM = Joint Credit Mechanism

NEW initiative by the Japanese Government to offset its emission reduction targets

A bilateral cooperation scheme addressing climate change through the dissemination of advanced Low-Carbon Technologies and Products to benefit the "Leapfrog" development of Developing Countries.

* Bilateral agreement with India not yet

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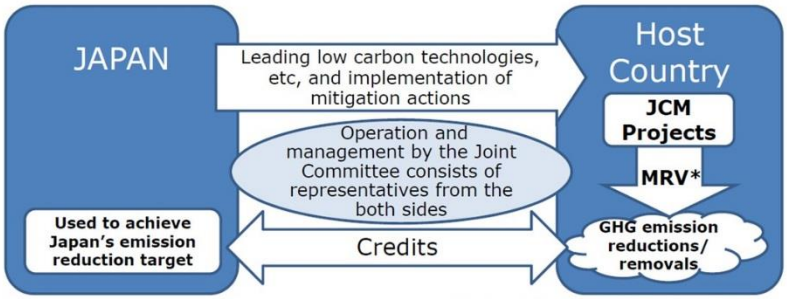
JCM scheme overview



*measurement, reporting and verification

50

Funding Scheme : JCM Model Projects

Budget for FY2016	**Total JPY 6.7 Bil (approx. USD 56MM) over 3 years (FY2016-FY2018) *includes collaboration with projects supported by JICA and other governmental-affiliated financial institute.**
Scope of Financing	**Facilities, equipment, vehicles, etc. which reduce CO2 from fossil fuel combustion as well as construction cost for those facilities, etc.**
Eligible Projects	**Starting installation after the adoption of the financing and finishing installation within 3 years.**

Finance part of an investment cost (less than half)

Government of Japan

Conduct MRV and expected to deliver at least half of JCM credits issued

International Consortiums (which include Japanese entities)

Source : Created based on "Approach for Realizing Low Carbon and Resilient City "by Mr. Nobuhiro Kino, MOEJ

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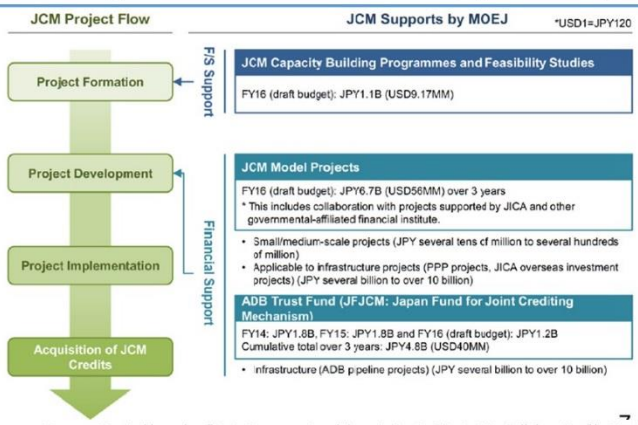
JCM Project Flow & JCM Supports by MOEJ



Source : Created based on "Paris Agreement and Expectation to City to City Collaboration" by Mr. Nobuhiro Kino, MOEJ

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Proposals

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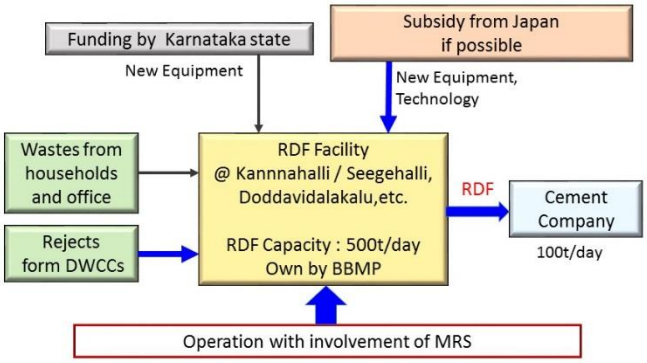
RDF Proposal : Option 1

Option 1 : Improvement of Current Composting Facility



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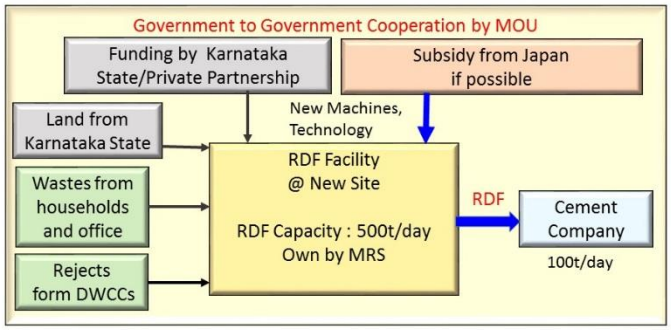
RDF Proposal : Option 2

Option 2 : New RDF Facility Under G2G Umbrella Karnataka State / BBMP and City of Yokohama, e.g. Operation by Joint Venture of Private and MRS



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Steps to be required during the Feasibility Study

- Time Period for the F/S – 4 months
- Identification of Land for the project
- Study for total cost, detail business plan for new RDF facility and funding arrangement for the project.
- Identification of private partnership or partnership with Government (e.g. public fund)
- Submission of the final proposal to the Karnataka State Gov./ BBMP/ KUIDFC
- Possibility of implementing of the "Karnataka Transparency in Public Procurement Act 1999, Section 3 & 4g" for this project

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Requirements from Government for RDF Facilities

- Letter from the Karnataka State Gov./ BBMP/ KUIDFC for further Feasibility Study for implementing of RDF project under the umbrella of City-to-City Cooperation
- Land Lease Arrangement and Waste Supply Agreement

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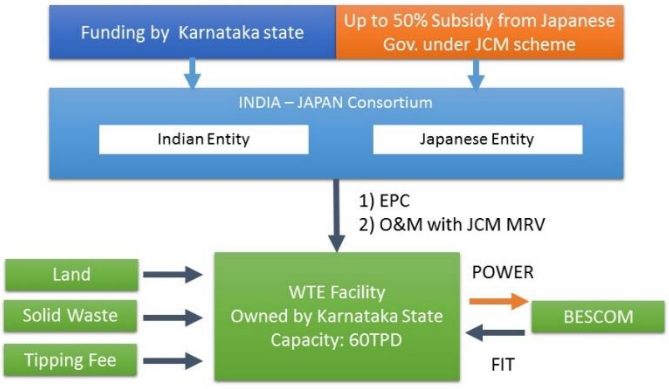
WTE Proposal : Option 1

Option 1 : Public finance case " JCM Model Project"



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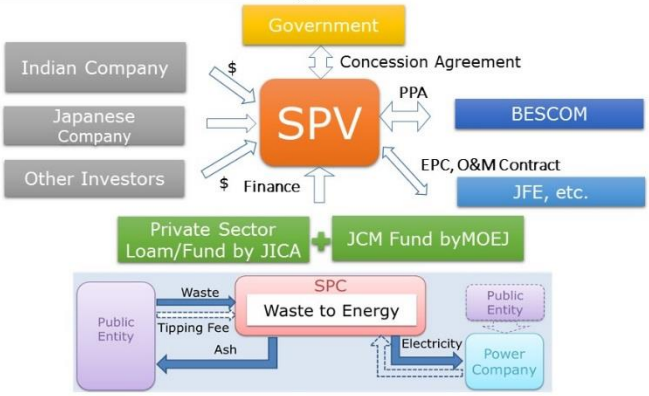
WTE Proposal : Option 2

Option 2 : PPP case " JICA Fund +JCM Subsidy"



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Steps to be required for the WTE Feasibility Study

- Letter from the Karnataka State Gov./ BBMP/ KUIDFC for further Feasibility Study for implementing of WTE project under the City-to-City Cooperation and the JCM Scheme
- G to G Discussion for JCM agreement of India and Japan
- Possibility of implementing of the "Karnataka Transparency in Public Procurement Act 1999, Section 3 & 4g" for this project

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Requirements from Government for WTE Facilities

- Appropriate land for WTE secured/offered by Government
- Publically Secured Volume, quality, character etc. of MSW
- Consideration of reasonable T/F (Tipping Fee) and FIT (Feed-in-Tariff) by Government
- Reliable PPP regulation for WTE

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" Report of the Task Force on Waste to Energy(2014)" by Planning Commission pointed out:

i. Absence of a comprehensive short and long term plan, to handle MSW in accordance with the MSW Rules, 2000, with municipal authorities.
ii. Lack of requisite preparedness, to set up waste processing and disposal facilities, with the majority of the municipal authorities.
iii. Waste management contract being looked at as a source of revenue by the municipal authorities.
iv. Non availability of suitable lands for processing and disposal of wastes in cities and towns.
v. Need to consider 'total' recycling and re-use of wastes and aim for negligible or 'Zero Waste' to be landfilled.

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Study Visit in Japan

Objective
•Provide an opportunity to key members of waste management in Bangalore to observe and understand how the waste management solutions are integrated and implemented in Yokohama
•Deepen the collaborative relationship between Bangalore, City of Yokohama and the key Japanese partners through discussions on how to adopt the solution for waste management in Bangalore

Program facilitator and activity support
•Facilitator: City of Yokohama
•Supporter: JFE Engineering , PwC
•Travel and Accommodation cost will be covered under Japan Government Funding scheme.

Participants (Total 4- 5 members)
•To be selected by Karnataka State

Schedule
•5 day program in Yokohama (incl. 2day for travelling)

Site tour facilities

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Thank you

EX Research Institute IGES OPEN YOKOHAMA JFE Mansei Recycle Systems

Study Team

環境省 Ministry of the Environment

Funded by

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Reference

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Risk Allocation of PPP scheme

Optimization of Risk Allocation between Public and Private for Minimization of Total Project Life-Cycle Cost

	City A Indonesia		City B Japan (Typical)		City C Japan (Biogas)	
Business Scheme	PPP (BOT)		Public Work (EPC)		PPP (BTO)	
-Finance	Failed		Local Gov. + state subsidy		Private	
-O&M	By Private		By Public with outsourcing		By Private	
Risk Allocation	**Public**	**Private**	**Public**	**Private**	**Public**	**Private**
-Waste Quantity		✓	✓		✓	
-Waste Quality		✓	✓		✓	
-PPA(Rate & Tenure)		✓	✓		✓	
-Survey & Soil Condition		✓	✓		✓	
-Ash Disposal		✓	✓		✓	
-Plant Performance		✓		✓		✓
-Durability & Availability		✓	✓			✓
-O&M Cost		✓	✓			✓
-Law & Regulation	✓		✓		✓	
-Escalation (CPI)	✓		✓		✓	
-Plant Shutdown		✓	✓		Landfill	✓

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Reasonable Tipping Fee and FIT ?

	GDP per Capita (USD)	Tipping Fee (JPY/t)	FIT (JPY/kWh)
Singapore	56,286	7,000	20
Malaysia	11,049	3,000	14
Thailand	5,896	3,200	20
Indonesia	3,524	2,800	14
Philippines	2,862	3,000	15
India	1,607	?	12
Vietnam	2,051	2,500	12
Myanmar	1,227	1,000	7

Source : JFE Engineering

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Feed in Tariff (FIT) in Japan

Categories			Price excl.tax
Biomass	Wood (unused)	2,000 kW or more	16
		Less than 2,000 kW	20
	Wood (general)		12
	Wood (waste materials of buildings)		7
	Municipal Solid Waste		**9**
	Methane fermentation		**20**

Unit: INR/kWh

Source : Created based on http://www.meti.go.jp/english/press/2015/0319_01.html

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Financial Sources for the WTE Construction

Name of WTE	Total Construction Cost	Central Government	Prefectural Government	City Bond	City Budget
	Mil. JPY (%)	Mil. JPY (%)	Mil. JPY (%)	Mil. JPY (%)	Mil. JPY (%)
TSUZUKI	28,683 (100.0)	8,044 (28.0)	0 (0.0)	16,428 (57.3)	4,211 (14.7)
TSURUMI	51,778 (100.0)	12,450 (24.0)	0 (0.0)	27,532 (53.2)	11,797 (22.8)
ASAHI	27,289 (100.0)	4,633 (17.0)	96 (0.4)	13,911 (51.0)	8,649 (31.6)
KANAZAWA	62,594 (100.0)	11,030 (17.6)	47 (0.1)	43,344 (69.2)	8,173 (13.1)

Source : Resources and Waste Recycling Bureau, City of Yokohama

8-4 Draft Solid Waste Management Rules, 2015

[To be published In the Gazette of India, Part-II, Section-3, Sub-section (ii)]
Ministry of Environment, Forest and Climate Change
NOTIFICATION

New Delhi, the 3rd June, 2015

Draft Rules

G.S.R. 452(E).- The following draft of the rules, which the Central Government proposes to issue in exercise of the powers conferred by sections 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986) and in supersession of the Municipal Solid Wastes (Management and Handling) Rules, 2000 except as respects things done or omitted to be done before such suppression, it is hereby published for the information of the public likely to be affected thereby; and the notice is hereby given that the said draft notification shall be taken in to consideration on or after the expiry of a period of sixty days from the date on which copies of this notification as published in the gazette of India are made available to public;

Objections or suggestions on the proposals contained in the draft notification, if any may be addressed, within the period so specified, to the Secretary, Ministry of Environment, Forest and Climate Change, Indira ParyavaranBhawan, Jorbagh Road, New Delhi- 110 003 or electronically at e-mail addressed : bnsinha@gov.in, shard.sapra@nic.in;

The objections and suggestion which may be received from any person with respect to the said draft rules before the expiry of the period so specified shall be considered by the Central Government.

Draft Rules

1. Short title and commencement.-(1) These rules may be called **Solid Waste Management Rules, 2015;**
(2) They shall come into force on the date of their final publication in the Official Gazette.

2.Application - These rules shall apply to every urban local body, all statutory towns, outgrowths in urban agglomerations as declared by the registrar general & census commissioner of India, **notified areas/notified industrial townships, notified area committees, area under indian railways, defense cantonments, special economic zones in the country and every waste generator.**

3.Definitions –(1) In these rules, unless the context otherwise requires.-

(i) **"aerobic composting"** means a controlled process involving microbial decomposition of organic matter in the presence of oxygen;

(ii) **"anaerobic digestion"** means a controlled process involving microbial decomposition of organic matter in absence of oxygen;

(iii) **"authorisation"** means the permission given by the State Pollution Control Board or Pollution Control Committee, as the case may be, to the "operator of a facility" or "urban local body", or any other agency responsible for processing and disposal of solid waste;

(iv) **"biodegradablewaste "** means any organic material that can be degraded by micro-organisms into simpler stable compounds;

(v) **"biomethanation"** means a process which entails enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas;

(vi) **"buffer zone"** means a zone of no development which shall be maintained around landfills, processing and disposal facilities of solid waste;

(vii) **"composting"** means a controlled process involving microbial decomposition of organic matter;

(viii) **"construction"** means the process of erecting of building or built facility or other structure, or building of infrastructure includingalteration in these entities.

(ix) **"construction and demolition waste"** means the waste comprising of building materials, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure;

(x) **"contractors"** means a person or firm that undertakes a contract to provide materials or labour to perform a service or do a job for service providing authority.

(xi) **"co-processing"** means use of solid waste as raw material or as a source of energy or both to replace or supplement the natural mineral resources and fossil fuels in industrial processes;

(xii) **"de-construction"** means a planned selective demolition in which salvage, re-use and recycling of the demolished structure is maximized.

(xiii) **"demolition"** means breaking down or tearing down buildings and other structures either manually or using mechanical force (by various equipment) or by implosion using explosives.

(xiv) **"disposal"** means the final and safe disposal of solid waste on land as specified in Schedule I to prevent contamination of ground water, surface water, ambient air and attraction of animals or birds;

(xv) **"domestic hazardous waste"** domestic hazardous wastes means waste contaminated with hazardous chemicals or infectious waste such as discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, used needles, gauge and syringes, etc. generated at

the household level;

(xvi) "**dry waste**" means waste other than food waste and inert and includes recyclable waste, non recyclable waste, combustible waste and sanitary waste;

(xvii) "**dump sites**" means a land utilised by urban local body for unscientific disposal of solid waste without following the principles of sanitary land filling;

(xviii) "**facility**" means any establishment wherein the solid waste management processes namely segregation, recovery, storage, collection, recycling, processing, treatment or safe disposal are carried out;

(xix) "**form**" means a form appended to these rules;

(xx) "**handling**" includes all activities relating to sorting, segregation, material recovery, collection, secondary storage, shredding, baling, crushing, loading, unloading, transportation, processing and disposal of solid wastes;

(xxi) "**inerts**" means wastes which are not bio-degradable, recyclable or combustible and includes non recyclable fraction of construction and demolition waste, street sweeping or dust and silt removed from the surface drains;

(xxii) "**incineration**" means an engineered process involving burning or combustion of solid waste to thermally degrade waste materials at high temperatures;

(xxiii) "**institutional generator**" means and includes occupier of the institutional buildings such as building occupied by central government departments, state government departments, public or private sector companies, hospitals, schools, colleges, universities or other places of education, organization, academy, hotels and restaurants;

(xxiv) "**leachate**" means the liquid that seeps through solid waste or other medium and has extracts of dissolved or suspended material from it;

(xxv) "**materials recovery facility (MRF)**" means a facility where non-compostable solid waste can be temporarily stored by the urban local body or any person authorised by the urban local body to facilitate segregation, sorting and recovery of various components of waste by informal sector of waste pickers or any other work force engaged for the purpose before the waste is delivered or taken up for its processing or disposal;

(xxvi) "**non-biodegradable waste**" means any waste that cannot be degraded by micro organisms into simpler stable compounds;

(xxvii) "**operator of a facility**" means a person or entity, who owns or operates a facility for handling solid waste which includes the urban local body and any other entity or agency appointed by the urban local body;

(xxviii) "**prescribed authority**" means the Authority declared as State Pollution Control Board or Pollution Control Committee for Union Territory under rule 4 and made responsible to perform the duties and undertake responsibilities as specified in rule 5;

(xxix) "**primarycollection**" means collecting, lifting and removal of segregated solid waste from source of its generation including households, shops, offices and any other non-residential premises or from any collection points or any other location specified by the urban local body;

(xxx) "**processing**" means the process by which solid waste is transformed into new or recycled products;

(xxxi) "**recycling**" means the process of transforming segregated solid waste into a new product or raw material for producing new products;

(xxxii) "**redevelopment**" means rebuilding of old residential or commercial buildings at the same site, where the existing buildings and other infrastructures have become dilapidated;

(xxxiii) "**refuse derived fuel**" means segregated combustible fraction of solid waste other than chlorinated plastics in the form of pellets or fluff produced by drying, shredding, dehydrating and compacting combustible components of solid wastethat can be used as fuel;

(xxxiv) "**residual waste**" means and includes the waste and rejects from the solid waste processing facilities which are not suitable for recycling or further processing ;

(xxxv) "**sanitaryland filling** " means the final and safe disposal of residual solid waste and inert wastes on land in a facility designed with protective measures against pollution of ground water, surface water and fugitive air dust, wind-blown litter, bad odour, fire hazard, animal menace, bird menace, pests or rodents, greenhouse gas emissions, persistent organic pollutants slope instability and erosion;

(xxxvi) "**sanitary waste**" means wastes comprising of used diapers, sanitary towels or napkins, tampons, condoms, incontinence sheets and any other similar waste;

(xxxvii) "**schedule**" means the Schedule appended to these rules;

(xxxviii) "**secondary collection**" means collection of solid waste deposited at secondary waste storage depots or bins for onward transportation of the waste to the processing or disposal facility;

(xxxix) "**secondary storage**" means the temporary containment of solid waste at a public place in a covered bin or container in a manner so as to prevent littering, vectors, stray animals and odour;

(xl) "**segregation**" means sorting and separate storage of various components of solid waste namely biodegradable wastes or wet waste, non biodegradable wastes or dry waste-including recyclable waste, combustible waste sanitary waste and non recyclable inert waste, domestic hazardous wastes, e-waste and construction and demolition wastes;

(xli) "**service provider**" means an authority providing public utility services like water, sewerage, electricity, telephone, roads, drainage etc.

(xlii) "**solid waste**" means and includes solid or semi-solid domestic waste including sanitary waste, commercial waste, institutional waste, catering and market waste and other non residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, construction and demolition waste and treated bio-medical waste excluding industrial hazardous waste, bio-medical waste and e-waste generated in an area under urban local body;

(xliii) "**stabilising**" means the biological decomposition of biodegradable wastes to a stable state where it generates no leachate or offensive odours and is fit for application to farm land ,soil erosion control and soil remediation;

(xliv) "**street vendor**" means a person engaged in vending of articles, goods, wares, food items or merchandise of everyday use or offering services to the general public, in a street, lane, side walk, footpath, pavement, public park or any other public place or private area, from a temporary built up structure or by moving from place to place and includes hawker, peddler, squatter and all other synonymous terms which may be local or region specific; and the words "street vending" with their grammatical variations and cognate expressions, shall be construed accordingly;

(xlv) "**tipping fee**"means a fee or support price determined by the urban local body or any state agency authorized by the state government to be paid to the concessionaire or operator for handling one or more components of solid waste

(xlvi) "**transportation**" means conveyance of solid waste, either treated, partly treated or untreated from a location to another location in an environmentally sound manner through specially designed and covered transport system so as to prevent the foul odour, littering and unsightly conditions;

(xlvii) "**treated bio-medical wastes**" means the wastes generated in hospitals and health care institutions which have been prescribed as treated *in accordance with Bio-medical Waste (Management and Handling) Rule1998, as amended from time to time;*

(xlviii) "**treatment**" means the method, technique or process designed to modify physical, chemical or biological characteristics or composition of any waste so as to reduce its volume and potential to cause harm;

(xlix) "**user fee**" means a fee imposed through a bye-law by the urban local body on the waste generator

(l) "**urban local body**" for the purpose of these rules means and includes themunicipal corporation, nagarnigam, municipal council, nagarpalika, nagarpalikaparishad, municipal board, nagarpanchyat, town panchayat, notified area committeeor any other local body constituted under the relevant statutes where management of solid waste is entrusted to such agency including the body in notified industrial township, notified area, villages declared outgrowth in urban agglomeration by the Registrar General and Census Commissioner of India from time to time;

(li) "**viability gap funding**" means financial support determined by the urban local body or authorisedState Government or Central Government agency to be paid to the concessionaire or operator of a solid waste processing facility based on the output quantity of compost, biogas produced or energy or power generated so as to cover or partly cover the difference between market price of the output and its production cost plus reasonable profit margin;

(lii) "**vermi composting**" means the process of conversion of bio-degradable waste into compost using earth worms;

(liii) "**waste generator**" means and includes every person or group of persons or residential and commercial establishments including Indian Railways and Defense cantonments which generate solid waste;

(liv) "**waste picker**" means a person or groups of persons engaged in collection of reusable and recyclable solid waste from the source of waste generation as well as picking up of wastes from the streets, bins, processing and waste disposal facilities for sale to recyclers directly or through intermediaries to earn their livelihood;

(2) Words and expressions used herein but not defined, but defined in the Environment (Protection) Act, 1986, the Water (Prevention and Control of Pollution) Act, 1974, Water (Prevention and Control of Pollution) Cess Act, 1977 and the Air (prevention and Control of Pollution) Act, 1981 shall have the same meaning as assigned to them in the respective Acts.

CHAPTER 1

Management of Solid Waste excluding Construction and Demolition waste

4. Duties of waste generators.-(1)Everywaste generator shall,-

(a) segregate and store the waste generated by them in three separate streams namely bio-degradable or wet waste, non bio-degradable or dry waste and domestic hazardous wastes in suitable bins and handover segregated wastes to waste collectors as per the direction by the urban local body from time to time;

(b) wrap securely the used sanitary waste as and when generated in a newspaper or suitable bio-degradable wrapping material and place the same in the domestic bin meant for non bio-degradable waste or dry waste;

(c) store separately construction and demolition waste in his own premises, as and when generated and shall dispose off as per these rules; and

(d) store separately horticulture waste and garden waste in his premises and dispose of the same as may be prescribed by urban local body from time to time.

(2) No waste generator shall throw the waste generated by him on the street, open spaces, drain or water bodies.

(3) All waste generators shall pay such user fee or charge or fines as may be specified in the bye-laws of the urban local bodies for solid waste management.

(4) No person shall organise an event or gathering likely to generate solid waste at unlicensed place without intimating the urban local body at least three working days in advance and such person or the organizer of such event shall arrange for segregation of waste at source and ensure handing over of segregated waste to the placed designated by urban local body or to waste collection agency authorised by the urban local body.

(5) Every institutional generators of solid waste shall segregate and store the waste generated by them in three separate streams namely bio-degradable or wet waste, non bio-degradable or dry waste and domestic hazardous wastes in suitable bins and handover segregated wastes to authorised waste processing or disposal facilities or deposition centers either at its own or through the authorised waste collection agency.

(6) Every waste generator shall pay the user fee as may be prescribed by the urban local body from time to time, to the waste collector or any person authorized by the urban local body and the charges shall be imposed for the sustainability of the solid waste management systems.

5. Prescribed Authorities.-The following shall be the Prescribed Authorities under these:-

(i) Secretary–in-charge, Urban Development Department, in States or Union Territory.
(ii) Commissioner or Director of Municipal Administration or Director of Local Bodies in States or Union Territories.
(iii) District Magistrate or District Collector or Deputy Commissioner of District in State or Union Territory.
(iv) Central Pollution Control Board.
(v) Urban Local Body.
(vi) State Pollution Control Board.

6. Duties of Ministry of Environment and Forest and Climate Change.-(1)The Ministry of Environment, Forest and Climate Change shall be responsible for enforcement of these rules in the country.

(2) The Ministry of Environment, Forest and Climate Change shall monitor the activities undertaken by central pollution control board, state pollution control boards and the pollution control committee committees for enforcement of the provisions of the rules.

(3) The Ministry of Environment, Forest and Climate Change shall constitute a central monitoring committee under the chairmanship of secretary (environment, forest and climate change) comprising of ministry of urban development, central pollution control board and at least three representatives each from state pollution control boards, urban development departments of state governments/ union territories, urban local bodies and subject experts to monitor and review the implementation of the rules and the committee constituted so shall meet at least once a year.

7.Duties of Ministry of Urban Development.-(1) The Ministry of Urban Development shall coordinate with State Governments and Union Territory Administrations to,-

(a) take periodic review of the measures taken by the states and urban local bodies for improving solid waste management practices and execution of solid waste management projects funded by the Ministry and external agencies at least once in a year and give advice on taking corrective measures;

(b) formulate National Policy and Strategy on Solid Waste Management in consultation with stakeholders;

(c) guide and facilitate States and Union Territories in formulation of state policy and strategy on solid management based on national solid waste management policy and national urban sanitation policy;

(d) promote research and development in solid waste management sector and disseminate information to States and urban local bodies;

(e) undertake training and capacity building of urban local bodies and other stakeholders;and

(f) provide technical guidelines and project finance to states, UTs and urban local bodies on solid waste managementto facilitate meeting timelines and standards.

8. Duties of Department of Fertilisers, Ministry of Chemicals and Fertilisers.-(1) the Department of Fertilisers through appropriate mechanisms may,-

(a) incentivize the sale of city compost; and

(b) ensure promotion of co-marketing of compost with chemical fertilizers in the ratio of 3 to 4 bags: 6 to 7 bags by the fertilizer companies or whatever quantity is made available to the companies.

9. Duties of the Secretary–in-charge, State Urban Development Department.-

(1) The Secretary, State Urban Development Department who is in-charge of Urban Local Bodies in the State or Union Territory shall,-

(a) prepare a state policy and solid waste management strategy for the state or the union territory in consultation with stakeholders including representative of waste pickers, which shall be consistent with these rules, national policy on solid waste management and national urban sanitation policy of the ministry of urban development within one year from the date of notification of these rules;

(b) shall lay emphasis on waste reduction, reuse, recycling, recovery and optimum utilization of various components of solid waste to ensure minimization of waste going to the landfill and minimise impact of solid waste on human health and environment in the state policy and solid waste management strategy;

(c)ensure implementation of provisions of these rules by all urban local bodies;

(d) delegate powers to Commissioner/ Director of Municipal Administration/ Director of Local Bodies to monitor the performance of local bodies under their control;

(e) ensure identification and allocation of suitable land to the urban local bodies within one year for setting up of processing and disposal facilities for solid wastes and incorporate them in the master plans (land use plan) of the state/cities through Metropolitan and district planning committees or town and country planning department;

(f) direct the town planning department of the state and urban local bodies to ensure that a separate space for segregation, storage and decentralised processing of Solid Waste is demarcated in the development plan for group housing or commercial, institutional or any other non-residential complex exceeding 200 dwelling or having a plot area more than 10,000 square meter;

(g) facilitate establishment of common regional sanitary land fill for a group of cities and towns falling within 50 km (or more) radius from the regional facility on a cost sharing basis and ensure professional management of such sanitary landfills;

(h) direct the town planning department of the state to ensure that master plan of every city in the State or Union Territory has provisions for setting up of solid waste processing and disposal facilities except for the cities who are members of common waste processing facility or regional sanitary landfill for a group of cities; and

(i) arrange for training and capacity building of urban local bodies in managing solid waste.

10. Duties of Commissioner or Director of Municipal Administration or Director of Local Bodies.-(1)Under the supervision and control of Secretary-in-charge of State Urban Development shall,-

(a) ensure implementation of these rules by all urban local bodies falling under his control;

(b) undertake training and capacity building of urban local bodies for management of solid waste; and

(c) facilitate establishment of common regional sanitary land fill for a group of cities and towns falling within a radial distance of fifty kilometer or more from the regional facility on a cost sharing basis and ensure professional management of such sanitary landfills.

11.Duties of District Magistrate or District Collector or Deputy Commissioner.-The District Magistrate or District Collector or Deputy Commissionershall, -

(a) facilitate identification and allocation of suitable land for setting up solid waste processing and disposal facilities to Urban Local Bodies in his district in close coordination with the Secretary-in-charge of State Urban Development Department within one year from the date of notification of these rules;

(b) extend support to Secretary-in-charge of State Urban Development in implementation of these rules by all urban local bodies; and

(c) review the performance of urban local bodies, at least once in a quarter and take corrective measures in consultation with Commissioner or Director of Municipal Administration or Director of local bodies and secretary-in-charge of the State Urban Development.

12. Duties of Central Pollution Control Board.-The Central Pollution Control Board shall, -

(a) co-ordinate with the State Pollution Control Boards and the Pollution Control Committees for implementation of these rules and adherence to the prescribed standards by urban local bodies;

(b) formulate the standards of ground water, ambient air, leachate in respect of all solid waste processing facilities including composting, incineration, land filling;

(c) review environmental standards and norms prescribed for solid waste processing facilities or treatment technologies and update them as and when required;

(d) review through state pollution control boards or pollution control committees, at least once in a year, the implementation of prescribedenvironmental standards for solid waste processing facilities or treatment technologiesand compile the data monitored by them;

(e) review the proposals of state pollution control boards or pollution control committees on use of any new technologies for processing, recycling and treatment of solid waste and prescribe performance standards, emission norms for the same;

(f) monitor through State Pollution Control Boards or Pollution Control Committees the implementation of these rules by urban local bodies;

(g) prepare an Annual Report on implementation of these rules on the basis of reports received from State Pollution Control Boards and Committees and submit to the Ministry of Environment, Forest and Climate Change and the report shall also be put in public domain;

(h) publish indicative guidelines for maintaining buffer zone restricting any residential, commercial or any other construction activity from the outer boundary of the waste processing and disposal facilities for different sizes of facilities handling more than 5 tons per day of solid waste;

(i) publishguidelines, from time to time, on environmental aspects of processing and disposal of solid waste to enable urban local bodies to comply with the provisions of the rules; and

(j) provide guidance to States or Union Territories on inter-state movement of waste.

13.Duties and Responsibilities of urban local bodies.-(1) The urban local bodies shall,-

(a) prepare a solid waste management plan as per State Policy And Strategy On Solid Waste Management within six months from the date of notification of state policy and strategy and get it approved from the State Government or Union Administration or agency authorised by the State Government or Union Administration;

(b) frame bye-laws, incorporating the provisions of these rules and ensure timely implementation;

(c) prescribe from time to time user fee as deemed appropriate and collect the fee from the waste generators for the sustainability of collection, transportation, processing and disposal of solid waste;

(d) direct waste generators not to litter, to segregate the waste at source as prescribed under these rules and hand over the segregated waste to the waste collector;

(e) give direction to waste generators, from time to time, to deposit domestic hazardous wastes at waste deposition centre established by urban local bodies for its safe disposal at hazardous waste disposal facility;

(f) develop infrastructure for segregation, collection, transportation, storage, processing and disposal of solid waste in their respective jurisdiction either at its own or through public private partnership mode;

(g) arrange for day to day Collection of segregated bio-degradable and non bio-degradable solid waste or wet waste or dry waste from the door step of all households including slums and informal settlements, commercial, institutional and other non residential premises;

(h) collect waste from markets in waste of vegetable, fruit, meat and fish market on day to day basis and promotion of setting up of decentralised compost plant or bio-methanation plant at suitable locations in the markets;

(i) separately collect waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week depending on the density of population, commercial activity and local situation. Such waste shall not be mixed with the wet, dry or any other form of solid waste;

(j) separately collect horticulture, parks and garden waste with focus on on-site processing in the parks and gardens;

(k) transport segregated bio-degradable (wet waste) to the processing facilities like compost plant, bio-methanation plant or any such facility;

(l) transport non-bio-degradable (dry waste) including wrapped sanitary waste to the respective processing facility or material recovery facilities (MRF) or secondary storage facility;

(m) transport inert waste (non recyclable, street sweepings and silt collected from the surface drains) directly to disposal facility;

(n) transport horticulture and garden waste to the appropriate processing facility;

(o) transport construction and demolition waste as per the provisions contained un chapter 2 of these rules;

(q) provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or from material recovery facilities;

(r) establish domestic hazardous waste deposition or delivery centres in city or town in a manner that one centreis set up for thearea of twentysquare kilometers or part thereof and notify the timings of receiving domestic hazardous waste at such centres;

(s) ensure safe storage, transportation of the domestic hazardous waste to the hazardous waste disposal facility or as may be directed by the state pollution control board/ committee;

(t) involve communities in municipal waste management and promotion of decentralised processing of waste;

(u) facilitate construction, operation and maintenance of solid waste processing facilities and associated infrastructure in house or with private sector participation or through any agency for optimum utilization of various components of solid waste adopting any of the following technologies and adhering to the guidelines issued by the ministry of urban development and central pollution control board from time to time and standards prescribed by central pollution control baord and preference shall be given to decentralise processing to minimise cost and environmental impacts:

(i) bio-methanation, microbial composting facility, vermi composting, anaerobic digestion or any other appropriate processing for bio-stabilisation of wet biodegradable wastes;

(ii) waste to energy processes for conversion of dry non recyclable combustible fraction of waste into energy or supply as feedstock to solid waste or refused derived fuel based power plants or cement kilns or like; and

(iii) construction and demolition waste processing facility for optimum utilization of construction and demolition waste making aggregates, bricks, paver blocks or any other useful product.

(v) undertake in house or through any other authorised agency, construction, operation and maintenance of Sanitary landfill and associated infrastructure as per Schedule 1 for disposal of residual wastes as permitted under the rules and the CPCB guidelines issued from time to time;

(w) make adequate provision of funds for capital investments as well as operation and maintenance of solid waste management services in the annual budget ensuring that funds for discretionary functions of the urban local body have been allocated only after meeting the requirement of necessary funds for solid waste management and other obligatory functions of the local body as per these rules;

(x) make an application in Form-I, for grant of authorisation for setting up waste processing, treatment, recycling or disposal facility including landfills from the State Pollution Control Board or the Pollution Control Committee, as the case may be;

(y) submit application for renewal of authorisation at least sixty days before the expiry of the validity of authorisation;

(z) close down, remediate wherever feasible and cap the existing dumpsites, which are not engineered landfill sites as per the provision of these Rules within the time frame prescribed under rule 8;

(za) prepare and submit annual report in Form IV on the status of compliance of these rules during the calendar year on or before the 30th April of the succeeding year to the Commissioner or Director Municipal Administration who in turn shall send the same to the Secretary-In-charge of State Urban Development Department and to the respective State Pollution Control Board or Pollution Control Committee by the 31st May of every year;

(zb) educate workers including contract workers and supervisors for door to door collection of segregated waste and transporting the unmixed waste during primary and secondary transportation to processing or disposal facility;

(zc) ensure that the operator of a facility provides personal protection equipment namely uniform, fluorescent jacket, hand gloves, appropriate foot wear and masks to all workers for handling solid waste and its use by the workforce shall be ensured;

(zd) prior to the approval of building plan of a group housing society or market complex, ensure that the plan has provisions for setting up of waste collection centers for segregated collection and storage of wastes;and

(ze) frame bye-laws and prescribed criteria for levy of spot fines to person who litters or fails to comply with the provisions of these rules and delegate powers to appropriate officers or urban local bodies to levy spot fines as per the bye laws framed; and

(zf) create public awareness through Information, Education and Communication (IEC) campaign and educate the waste generators on the following:

i. not to litter;
ii. minimise generation of waste;
iii. reuse the waste to the extent possible;
iv. practice segregation of wet bio–degradable waste, dry recyclable and combustible wastes and domestic hazardous wastes at source;
v. wrap securely used sanitary waste as and when generated in a newspaper or suitable bio-degradable wrapping material and place the same in the domestic bin meant for non bio-degradable waste;
vi. storage of segregated waste at source;
vii. handover segregated waste to waste pickers, recyclers or waste collection agencies;and
viii. pay monthly user fee or charge to waste collectors or urban local bodies or any other person authorized by the urban local body for sustainability of solid waste management.

14 Duties of State Pollution Control Board or Pollution Control Committee.- (1)TheState Pollution Control Board or Pollution Control Committee shall.-
enforce these rules in their State through urban local bodies in their respective jurisdiction and monitor implementation of these rules at least twice a year in close coordination with concerned Directorate of Municipal Administration or Secretary-in-charge of State urban Development Department;

(a) monitor, environmental standards and adherence to condition as specified under the Schedule I and Schedule II;

(b) examine the proposal and make such inquiries as deemed fit, after the receipt of the application for the same in Form I from the urban local body;

(c) take into consideration, while examining the proposal the requirement of consent under Water and Air Acts, views of other agencies like the State Urban Development Department, the Town and Country Planning Department, district planning committee or metropolitan area planning committee as may be applicable, Airport or Airbase Authority, the Ground Water Board and any other agencies as deemed appropriate who shall be given four weeks time to give their views, if any;

(d) issueauthorisation within a period of sixty days in Form II to the urban local body or an operator of a facility stipulating compliance criteria and standards as specified in Schedules I and II including other conditions, as may be necessary.

(e) theauthorisationissued under clause (e) shall initially be valid for a period of three years to enable the urban local body or operator of the facility to demonstrate the operation of the plant as per the conditions of grant of authorisation, environmental clearance, consents for establishment, and contract conditions with the urban local body.

(f) the authorisationissued under clause (e) shall be suspended or cancelled by the state pollution control board any time, if the urban local body or operator of the facility fails to operate the facility as per the conditions stipulated:-

(g) Provided that no such authorisation shall be suspended or cancelled without giving notice to the urban local body or operator, as the case may be.

(h) on receipt of application for renewal, renew the authorisation for next five years, after examining every application on merit and subject to the condition that the operator of the facility has fulfilled all the provisions of the rules, standards or conditions specified in the authorisation, consents or environment clearance;

(2) The State Pollution Control Board or Pollution Control Committee may, after giving reasonable opportunity of being heard to the applicant and for reasons thereof to be recorded in writing, refuse to grant or renew an authorisation.

(3) In case of new technologies, where no standards have been prescribed by the Central Pollution Control Board, State Pollution Control Board or Pollution Control Committee, as the case may be, shall approach Central Pollution Control Board for getting standards specified.

(4) The State Pollution Control Board or the Pollution Control Committee, as the case may be, shall monitor the compliance of the standards as prescribed or laid down and treatment technology as approvedand the conditions stipulated in the authorisation and the standards specified in Schedules I and II under these rules as and when deemed appropriate but not less than once in a year; and

(5) The State Pollution Control Board or the Pollution Control Committee shall give directions to urban local bodies for safe handling and disposal of domestic hazardous waste deposited by the waste generators at hazardous waste deposition facilities.

(6) The State Pollution Control Board or the Pollution Control Committeeshall regulate Inter-State movement of waste.

15. Management of solid waste.–The urban local body shall adhere to the following compliance criteria in the matter of solid waste segregation at source, primary collection, cleaning of streets and surface drains, secondary storage, transportation, processing and the disposal of solid waste at the facilities to be set up by the urban local body on their own or through an agency or an operator of a facility.

Sl. No.	Parameters	Compliance criteria
(1.)	**Storage of segregated solid waste at source**	(1) Littering and open burning of solid waste shall be prohibited by all Urban Local Bodies within the area covered under their jurisdiction within six months from the date of the notification of these rules. (2) To facilitate compliance, the following steps shall be taken by the urban local body, namely: - (a) create public awareness on- (i) reducing the generation of waste; (ii) reusing the waste material to the extent possible; (iii) processing food waste through home composting or community composting; (iv) separately store bio-degradable wastes or wet waste and non bio-degradable including recyclable and combustible wastes or dry waste; (v) encouragingwaste pickers to take away segregated

		recyclable material stored at source; (vi) wrapping securely sanitary napkins/pads, tampons, infant and adult diapers, condoms, and menstrual cups before putting in domestic bin meant for non bio-degradable waste; (vii) storing separately domestic hazardous wastes such as contaminated paint drums, pesticide cans, Compact florescent lamps, tube lights, used Ni.cd batteries, used needles and syringes and health care waste; and (viii)storing separately construction and demolition waste at the source of waste generation. (b) mandate citizens to store segregated wastes at source in separate domestic or trade bins and hand over these wastes separately to designated waste collectors for recycling, processing and disposal of solid waste.
(2)	**Collection of solid wastes**	(1) organise door to door collection of segregated bio-degradable or wet and non bio-degradable or dry solid wastes on a daily basis at pre informed timings from all residential and non residential premises including slums and informal settlements using motorised vehicles or containerized tricycles, handcarts or any other device which is suitable for collection of segregated waste without necessitating deposition of waste on the ground and multiple handling of waste; (2) bio-degradable wastes from fruits and vegetable markets, meat and fish markets, horticulture waste from parks and gardens, shall be collected separately and to the extent feasible market waste may be processed or treated within the market area and horticulture waste within parks and gardens to make optimum use of such wastes and minimise the cost of collection and transportation of such waste; (3) large institutional premises, residential complexes shall be motivated and incentivized to process bio-degradable waste within their campus to the extent it is feasible to do so; (4) construction and demolition wastes or debris shall be separately collected and processed by the urban local body or agency appointed by it for the purpose of its processing and disposal without mixing the same with bio-degradable, recyclable or non recyclable combustible wastes that shall be collected from the door step;

		(5) dairy waste shall be collected separately and regulated as may be prescribed in the municipal bye-laws; (6) appropriate user fees or charges shall be levied from the waste generator for sustainability of operations of solid waste management.
(3)	**Sweeping of street and cleaning of surface drains**	(1) urban local body shall arrange for cleaning of roads, streets, lanes, bye lanes, surface drains and public places at regular intervals and use containerized tricycles, containerized handcarts, and suitable motorized or non motorized devices for collection of such waste; (2) synchronise with the system of secondary storage and transportation of such waste without necessitating deposition of such waste on the ground; and (3) thewaste shall not be mixed at any stage with the solid waste collected from the door step.
(4)	**Secondary Storage**	(1) segregated solid waste collected from the door step as per 2 above shall, as far as practicable, be transported directly to respective waste processing facility having facility of sorting and recovery of recyclable waste and in absence of such arrangement, the waste collected from the doorstep shall be taken to waste storage depots for secondary storage of waste; (2) waste depots shall have covered containers for separate storage of bio-degradable or wet waste and non bio-degradable or dry waste collected from the doorstep; (3) the street sweepings and silt collected from the surface drains shall not be left or accumulated on roadsides and shall be transported directly to waste disposal facility or shall be temporarily stored in covered bins or containers kept separately for secondary storage of inert wastes at suitable locations for facilitating onward transportation of such waste to the disposal site; if the street sweepings contain bio-degradable or recyclable waste, such waste shall be segregated and sent to respective processing facility; (4) the secondary storage vehicles or containers shall synchronise with transportation system to avoid multiple handling of waste;

		(5) secondary storage of waste in open spaces on the roadsides or open plots or in cylindrical concrete bins or open masonry bins shall be dispensed with; (6) urban local bodies shall where necessary, establish and maintain covered secondary storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it and the following criteria shall be taken into account while establishing and maintaining storage facilities, namely:- (a) storage facilities shall be created and established by taking into account quantities of waste generation in a given area and distance required to be travelled by the waste collectors to deposit the waste at the storage facility; (b) storage facility shall be so placed that it is accessible to users; (c) storage facilities to be set up by urban local bodies or any other agency shall be so designed that waste stored is not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly and shall not be accessible to stray animals and birds; (d) storage facilities shall be a covered bins or containers of appropriate design including flaps and shall have 'easy to operate' design for handling, transfer and transportation of waste and handling during evacuation of waste should be user friendly and not cumbersome; (e) bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be painted blue and those for storage of street sweepings and silt shall be painted black; (f) the design shall be developed in accordance with local practices and material available to ensure minimal impact on health and environment;
		(g) manual handling of waste shall be minimised and waste handlers shall be given personal protection equipment to avoid direct contact with the waste; (7) Construction & Demolition waste shall be separately stored in enclosed areas or containers separately without mixing this waste with waste collected from door step or street sweepings; (8) bio-medical wastes, industrial wastes, e-waste and domestic hazardous wastes shall not be brought to the secondary waste storage depots or mixed with solid wastes and such wastes shall be handled as specified in specific rules framed for management of such wastes and domestic hazardous waste may be handled as directed by the state pollution control board or pollution control committee; and (9) secondary storage bins if placed shall be cleaned at regular intervals at least once in a month and shall be painted at least once in a year.
(5)	**Material recovery facilities**	The urban local body shall designate temporary storage spaces and setup material recovery facility where non bio-degradable or recyclable solid waste collected from the doorstep shall be temporarily stored by the urban local body or operator of the facility before solid waste processing or disposal is taken up in order to facilitate segregation, sorting and recovery of various components of recyclable waste by informal sector of waste pickers or any other staff or agency engaged by the urban local body for the purpose and such sorting facilities shall be so designed that the solid waste stored is not exposed to open atmosphere and shall be user-friendly.
(6)	**Transportation of solid wastes**	(1) waste collected from the door step in motorised vehicles shall be directly transported to the processing facility through material recovery facility to be set up at the waste processing site or to the transfer station or transfer point or waste storage depots for facilitating, sorting and bulk transfer of waste to the processing facility in large hauling vehicles or containers; (2) vehicles used for transportation of wastes shall be covered and shall have a facility to prevent waste spillage and leachate dropping from the vehicles on the ground en-route to the processing or disposal facility. (3) waste shall not be visible to public, nor exposed to open

		environment preventing their scattering; (4) waste stored at the secondary waste storage depots in covered bins or containers shall be attended daily and waste picked up before container start overflowing; (5) bio-degradable waste stored in green and recyclable and combustible and domestic inert waste stored in blue containers at the waste storage depots shall be transported to respective processing facilities in a segregated manner and the inerts street sweepings and silt collected from the drains shall be stored in black containers and shall not be allowed to be mixed with the waste collected from the door step or those stored in green or blue containers and such inert waste shall be directly taken to waste disposal facility or to the processing facility, if and when created for processing; (6) separate transportation of domestic hazardous waste shall be arranged as directed by the State Pollution Control Board or the pollution control committee, as the case may be; (7) construction and demolition waste shall be transported in covered vehicles separately to construction and demolition waste processing facility; and (8) transportation vehicles shall be covered and so designed that multiple handling of wastes, prior to final disposal, is avoided.
(7)	**Processing of solid wastes**	(1) urban local bodies shall adopt suitable technology or combination of appropriate technologies, with emphasis on decentralised processing to make use of all components of wastes that can be processed so as to minimise burden on landfill. Following criteria shall be adopted, namely.- (a) biodegradable wastes shall be processed by bio-methanation, composting, vermi composting, anaerobic digestion or any other appropriate biological processing for stabilisation of wastes. (b) it shall be ensured that composting or any other end product shall comply with standards as specified in Schedule–II and also ensure that no damage is caused to the environment during this process; (c) to the extent feasible market waste may be processed or treated within the market area and horticulture waste within parks and gardens to make optimum use of such wastes and minimise the cost of collection and transportation of such waste; (d) dairy waste shall be used for bio-methanation or vermi-composting or aerobic composting, either separately or with other bio-degradable solid waste; (e) arrangement shall be made to provide segregated recyclable material to the recycling industry through waste pickers or any other agency engaged or authorised by the urban local body for the purpose; (f) residual combustible wastes shall be utilized for supplying as a feedstock for preparing refuse derived fuel (RDF) or for generating energy or power from the waste by adopting proven waste to energy technologies for which emission standards as well as standards for dioxins and furans have been prescribed by the Central Pollution Control Board; (g) non-recyclable plastics and other high calorific content waste may be utilized for co-processing in cement kilns or for polymer or fuel production or manufacturing of products such as door panels and the like nature; (h) construction and demolition and other inert wastes shall be utilized for making bricks, pavement blocks, construction materials such as aggregates; and (i) urban local body or the operator of a facility planning 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.
(8.)	**Disposal of solid wastes**	(1) land filling or dumping of mixed waste shall be stopped soon after the timeline as specified in Rule 10 for setting up and operationalisation of sanitary landfill is over; (2) landfill shall only be permitted for non-usable, non-recyclable, non-biodegradable, non-combustible and non-reactive inert waste and other wastes such as residues of waste processing facilities as well as pre-processing rejects from waste processing facilities and the landfill sites shall meet the specifications as given in Schedule–I, however every effort shall be made to recycle or reuse the rejects

		to achieve the desired objective of zero waste going to landfill; (3) landfill site shall provide an appropriate facility for sorting, storing and transportation of recyclable material to the processing facility and ensure that such wastes do not get land filled; (5) all old open dumpsites and existing operational dumpsites shall be carefully investigated and analyzed about their potential of bio-mining and bio-remediation and actions shall be taken accordingly in cases where such course of action is found feasible; and (6) in absence of potential of bio-mining and bio-remediationof dumpsite, it shall be scientifically capped as per landfill capping norms to prevent further damage to the environment.

16. Criteria for setting-up solid waste processing and treatment facility.- **(1)** The urban local body or state agency authorised by urban development department of the State Government or Union Territory Administration shall identify land for setting up the solid waste processing and treatment facilities and notify such sites.

(2) The operator of the facility shall design and set up the facility as per the technical guidelines issued by the Central Pollution Control Board in this regard from time to time and the manual of Central Public Health and Environmental Engineering Organisation, New Delhi.

(3)The operator of the facility shall obtain the approval from the State Pollution Control Board or Pollution Control Committee.

(4)The State Pollution Control Board or Pollution Control Committee shall monitor the setting and operation of the solid waste processing and treatment Facility.

(5)The operator of the facility shall be responsible for the safe and environmentally sound operations of the solid waste processing and treatment facility and its closure and post closure phase as per the guidelines issued by Central Pollution Control Boardfrom time to time and the Manual of Central Public Health and Environmental Engineering Organisation, New Delhi.

(6)The operator of the solid waste processing and treatment facility shall submit annual report in Form III.

17. Criteria and actions to be taken for solid waste management in hilly areas.-In the hilly areas, the duties and responsibilities of the urban local bodies shall be the same as mentioned in rule 13 with additional clauses in rule 14(4) as under:

(a) urban local body shall frame and prohibit citizen from littering wastes on the streets and give strict direction to the tourists not to dispose any non bio-degradable waste such as paper, water bottles, liquor bottles, soft drink canes, tetra packs, any other plastic or paper waste and any other bio-degradable waste on the streets or down the hills and instead deposit such waste in the litter bins that may be placed by the urban local body at all tourist destinations.
(b) urban local body shall arrange to convey the provisions of solid waste management under the bye-laws to all tourists visiting the hilly areas at the entry point in the town as well as through the hotels, guest houses or like where they stay and by putting suitable hoardings at tourist destinations.

(c) urban local body may levy solid waste management charge from the tourist at the entry point to make the solid waste management services sustainable.

(d) urban local body shall arrange to pick up all such segregated waste deposited in the litterbins on a day to day basis or authorise waste pickers or civil societies or any private agency to do so.

(e) door to door collection of domestic, commercial and other non residentialsolid waste shall be carried out using small covered pick up vans from the areas which are accessible to such vehicles;

(f) waste shall be picked up and transported in a segregated manner and the vehicles shall have special type of horn, to alert the waste generators about its arrival for solid waste collection;

(g) segregated waste collection from narrow lanes and inaccessible hilly areas shall be done using backpacks having small containers upto 50 litre capacity or local traditional load-bearing methods like pack animals, shoulder-poles or head-bands, bag-wheelers;

(h) waste collectors shall be provided protective clothing and mask to avoid direct contact with Solid Waste and a whistle to announce their arrival for waste collection;

(i) waste collected from the doorstep shall be taken to the nearest point identified by the urban local body from the collection area for decentralised processing of bio-degradable waste;

(j) waste picker association, civil societies and private entrepreneurs shall be encouraged to take up the work of door to door collection of segregated waste and decentralised bio-methanation or composting as may be deemed appropriate;

(k) urban local body may provide viability gap funding to such entrepreneurs to ensure that bio-degradable waste get processed in a decentralised manner;

(l) urban local body shall identify and allot suitable space on the hills for setting up decentralised waste processing facilities and step garden system may be adopted for optimum utilization of hill space;

(m) recyclable material, if collected by urban local body may be given away to recyclers for recycling of such waste;

(n) construction of landfill on the hill shall be avoided. If a suitable land could be identified in the plain areas down the hill within 25 kilometers, a transfer station at a suitable enclosed location shall be setup to collect residual waste from the processing facility and inert waste. In case of non-availability of such land, efforts shall be made to adopt zero waste concept and minimise waste going to landfill, it shall be ensured that by properly segregating , recycling and reusing of waste including rejects and inert wastes by converting such wastes into useable products; and

(o) heavyfines may be imposed by the urban local body on those who litter the waste.

18. Criteria for waste to energy process.- (1) Any non recyclable waste having high calorific value of 1000 Kcal or more shall be utilised for generating energy and shall not be disposed of on landfills.

(2) High calorific value waste shall either be directly utilized for energy production or by preparing refuse derived fuel for energy production or give away as feed stock for preparing refuse derived fuel.

(3) High calorific wastes shall be used for co-processing in cement plants or for power generation in independently installed waste to energy power plants.

(4) The urban local body or an operator of facility or an agency designated by them or an independent operator shall submit a proposal on the setting up of 'Waste to Energy' plant to the State Pollution Control Board or Pollution Control Committee for consideration.

(5) The State Pollution Control Board or Pollution ControlCommittee, on receiving a proposal from urban local body or an operator on behalf of these authorities for setting up waste to energy facility other than small facility, treating less than 5 tonnes per day waste, shall examine the same and grant permission.

(6) If the proposal includes the technology other than the one for which standards have been prescribed by the central pollution control board, the State Pollution Control Board or Pollution Control Committee shall forward the proposal with its recommendations to Central Pollution Control Board for prescribing suitable standards.

19. Time frame for implementation.-Necessary infrastructure for implementation of these rules shall be created by the Urban Local Bodies and Prescribed Authorities, as the case may be, on their own directly or by engaging agencies within the time frame specified below:

Sl. No.	Activity	Time limit from the date of notification of rules
(1)	identification of suitable sites for setting up solid waste processing facilities	1 year
(2)	identification of suitable sites for setting up common regional sanitary landfill facilities for suitable clusters of urban local bodies under 0.5 million population and for setting up common regional sanitary landfill facilities or stand alonesanitary landfill facilities by all urban local bodies having a population of 0.5 million or more .	1 year
(3)	procurement of suitable sites for setting up solid waste processing facility and sanitary landfill facilities	2 years
(4)	enforcing waste generators to practice segregation of bio degradable, recyclable combustible, domestic hazardous and inert solid wastes at source ,	2 years
(5)	ensure door to door collection of segregated waste and its transportation in covered vehicles to processing or disposal facilities.	2 years
(6)	ensure separate storage, collection and transportation of construction and demolition wastes	2 years
(7)	setting up solid waste processing facilities by all urban local bodies having 100000 or more population	2 years
(8)	setting up solid waste processing facilities by urban local bodies below 100000 population.	3 years
(9)	setting up common or stand alone sanitary landfills by or for all urban local bodies having 0.5 million or more population for the disposal of only such residual wastes from the processing facilities as well as untreatable inert wastes as permitted under the rules	3 years
(10)	setting up common or regional sanitary landfills by all urban local bodies under 0.5 million population for the disposal of permitted waste under the rules	4 years
(11)	bio-remediation or capping of old and abandoned dump sites	11 years

20. State Level Advisory Body. –

(1) Every State Government and Union territory shall constitute a State Level Advisory Body within six month from the date of notification of these rules.

(2)The body shall be constituted by Urban Development Department of the concerned State Government or Union Territory.

(3)The constitution of the State Level Advisory Body shall be as follows:

Sl. No	Designation	
1.	Secretary, Department of Urban Development/ Local self government department of the state	Chairperson, ex-officio
2.	One representative of Panchayats or Rural development Department not below the rank of Joint Secretary to state government	Member, ex-officio
3.	One representative from Ministry of Environment, Forest& Climate Change Government of India	Member, ex-officio
4.	One representative from Ministry of Urban Development, Government of India	Member, ex-officio
5.	One representative from the Central Pollution Control Board	Member, ex-officio
6.	One representative from the State Pollution Control Board or Pollution Control Committee	Member, ex-officio
7.	One representative from Indian Institute of Technology or National Institute of Technology	Member,Ex-officio
8.	Chief town planner of the state	Member
9.	Three representatives from the Urban local bodies	Members
10.	One representative from reputed Non-Governmental Organisation or Civil Society working in the field of environment or waste management	Member
11.	One representative from a body representing Industries at the state or central level	Member
12.	Two subject experts	Members

(4) The State Level Advisory Body shall meet at least once in six months to review all the matters related to implementation of these rules, implementation of state policy and strategy on solid waste management and give advice to state government for taking measures that are necessary for expeditious and appropriate implementation of these rules.

(5) The copies of the review report shall be forwarded to all the 'Prescribed Authorities' under these rules for necessary action.

21. Annual report.-

(1)the urban local body shall furnish its annual report in Form-IV to state pollution control board or pollutioncommittee and the secretary-in-charge of the department of urban development of the concerned state or union territory in case of metropolitan city and to the director of municipal administration or commissioner of municipal administration or officer in charge of urban local bodies in the state in case of all other urban local bodies of state on or before the 30th day of June every year.

(2) The operator of facility shall submit the annual report to the urban local body in Form-III.

(3) Each state pollution control board or pollution control committee as the case may be, shall prepare and submit the consolidated annual report to the central pollution control board on the implementation of these rules and action taken against non complying urban local body by the 30th day of September of each year in Form-V.

(4) The central pollution control board shall prepare a consolidated annual review report on the status of implementation of these rules by urban local bodies in the country and forward the same to the ministry of urban development and ministry of environment, forest and climate change, along with its recommendations before the 30th day of December each year.

(5) The annual report will be reviewed by the ministry of environment, forest and climate change inviting concerned stakeholders including ministry of urban development, ministry of new and renewable energy, ministry of agriculture and ministry of health and give suitable instructions and guidance to the states as may be necessary for taking corrective measures.

22. Accident reporting- When an accident occurs at any solid waste processing or treatment or disposal facility or landfill site, the officer in charge of solid waste management in the urban local body or an operator of facility shall forthwith report of the accident in Form-VI to the Commissioner or Chief Executive Officer of the urban local body and the instructions issued by the said authority shall be followed.

CHAPTER 2

Construction and Demolition Waste

23. Roles and responsibilities.- The roles and responsibilities of different stake holders for management of construction and demolition waste as specified in Schedule III shall be as under:

(1) Responsibility of the waste generator for management of construction and demolition waste.-

(a) every waste generator shall prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed/notified by the concerned local body in consonance with these rules. The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and it is stored and disposed separately. Large generators shall segregate this waste into four streams– i) concrete, ii) soil, iii) steel, wood and plastics and iv) other construction and demolition waste such as bricks and mortar;

(b) every waste generator who requires permit for construction under local building by-laws shall give an undertaking for disposal of construction and demolition waste as per the bye laws or rules of the local body;

(c) The large waste generator shall submit waste management plan and get appropriate approvals from the urban local body before starting construction or demolition or remodeling work and keep the concerned authorities informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis;

(d) everywaste generator shall keep the construction and demolition waste within the premise or get the waste deposited at collection centre or handover it to the authorised processing facilities of construction and demolition waste; and

(e) every waste generator shall see that there is no littering or deposition of construction and demolition waste in a manner, which causes obstruction to the traffic or the public or drains.

(f) everywaste generator shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities.

(2) Responsibility of service provider and their contractors for management of construction and demolition waste.-

(a) services providing authorities who provide services like water, sewerage, electricity, telephone, roads, drainage etc. often generate construction and demolition waste during their activities, which includes excavation, demolition and civil work and these departments need to have comprehensive waste management plan covering segregation, storage, collection, reuse, recycling, transportation and disposal of construction and demolition waste generated during the works;

(b) such authorities shall remove all construction and demolition waste and clean the area every day if possible or depending upon the duration of the work, the quantity and type(s) of waste generated, appropriate storage and collection a reasonable timeframe shall be worked out in consultation with the concerned urban local body;and

(c) in case they do not have the logistics to carry out such work, they shall tie up with the authorised agencies and pay the relevant charges as notified by the urban local body and also submit proof for disposal.

(3) Duties of urban local body for management of construction and demolition waste.-

(a) urban local body shall issue detailed directions with regard to proper management of construction and demolition waste within its jurisdiction in consonance with these rules and the urban local body shall seek detailed plan or undertaking as applicable from construction and demolition waste generator;

(b) such plan shall chalk out stages, methodology and equipment use, material involved in the overall activity and final clean up after completion of the job and it should specifically mention;

(c) if any industrial hazardous or toxic material or nuclear contamination is involved or expected, urban local body shall seek assistance from concerned authorities in case of nuclear or toxic material;

(d) urban local body shall make arrangements for placement of appropriate containers or skips or other containers and their removal at regular intervals or when they are filled either through own resources or by appointing private operators;

(e) urban local body shall get the collected waste transported to appropriate sites for further processing and disposal either through own resources or by appointing private operators, who shall be the authorised agency and in case of private operators, the urban local body shall work out the cost of service in a transparent manner;

(f) urban local body shall give incentives to any generator who plans an appropriate salvage plan, processing, and recycling, de-construction and above all in-situ recycling;

(g) urban local body shall examine and sanction the waste management plan and the waste management plan shall be sanctioned within a period of one month or building plan approval, whichever is earlier from the date of submission;

(h) each urban local body shall keep track of the generation of construction and demolition waste within its jurisdiction and create a continuous data base for at least one year at a time and this exercise shall then be repeated once in every 3 years;

(i) in consultation with expertinstitutions, the urban local bodies shall plan for appropriate management of construction and demolition waste generated including processing facility and further plan to use the recycled products in the best possible manner;

(j) expert institutions may also suggest ways to introduce 'de-construction' activity from the construction planning stage and provide assistance in this matter;

(k) the town and country planning department or urban development department or urban local body shall identify suitable sites for setting up processing facilities for construction and

demolition waste according to the parameters necessary for such projects and identified land shall be incorporated in the approved land use plan so that there is no disturbance to the processing facility on a long term basis and 'No Development zone' shall be notified around the site to safeguard the facility.

(l) in cities where land is not available for processing and disposal, the urban local body and State pollution control board or pollution control committee shall constitute a committee of experts for suitable sites along with measures for pollution control for such facility;

(m) the urban local body shall ensure a sustained system of information, education and communication (IEC) for construction and demolition waste through collaboration with expert institutions and civil societies.

(n) urban local body shall arrange and plan for information dissemination through their own website and through public workshops and public awareness programs;

(o) urban local body shall make provision for giving incentives for use of recycled material in the construction activity;

(p) urban local body shall submit the annual report to the State Pollution Control Board in Form IX.

(4) Duties of State Pollution Control Board or Pollution Control Committee for management of construction and demolition waste.-

(a) the state pollution control board or pollution control committeeshall monitor the implementation of these rules by the concerned local bodies and the competent authorities at local level and the annual data shall be sent to the Central Pollution Control Board and the State Government or Union Territory or any other state level nodal agency identified by the State Government or Union Territory administration for generating state level comprehensive data;

(b) suchreports shall also contain the comments and suggestions of the state pollution control board or pollution control committee with respect to any comments or changes required;

(c) the state pollution control board or pollution control committee after examining the application received in Form VII shall give authorisation to construction and demolition waste processing facility in Form-VIII as specified under these rules; and

(d) thestate pollution control board or pollution control committeeshall prepare annual review report in Form X with special emphasis on the implementation status of compliance with these rules and forward report to central pollution control board before the 31st May for each financial year.

(5) Duties of State Government or Union territory administration for management of construction and demolition waste.-

(a) TheState Government or Union territory administration shall prepare their policy document with respect to management of construction and demolition waste in line with these rules within one year from date of final notification of these rules and

(b) the State Government or Union territory administration shall also facilitate identification of appropriate land for setting up processing and recycling facilities in different cities through land use plan and identification of waste land.

(6) Duties of the Central Pollution Control Board for management of construction and demolition waste.-

(a) The Central Pollution Control Board shall prepare operational guidelines related to environmental management of construction and demolition waste management;

(b) data received from the state pollution control boards or pollution control committeeshall be analyzed and collated by the Central Pollution Control Board so that these rules can be reviewed from time to time;

(c) central pollution control board shall coordinate with all the state pollution control board and pollution control committees for any matter related to development of environmental standards; and

(d) Central Pollution Control Board shall forward annual compliance report to Central Government before the 30th September for each financial year based on reports given by state pollution control boards of pollution control committees;

(7) Responsibility of Bureau of Indian Standards (BIS) and Indian Roads Congress (IRC).-The Bureau of Indian Standards and Indian Roads Congressshall beresponsible for preparation of code of practices and standards for use of recycled materials and products of construction and demolition waste in respect of construction activities. The role of Indian Road Congress shall be specific to the standards and practices pertaining to construction of roads.

(8) Responsibility of the Central Government for management of construction and demolition waste.-

(a)the Ministry Of Urban Development, and the Ministry of Rural Development,Ministry of Panchayat Raj, shall be responsible for facilitating urban local bodies in compliance of these rules; and

(b) theMinistry of Environment, Forest and Climate Change shall be responsible for reviewing implementation of these rules as and when required.

(9) Responsibility of expert organizations.- Expert organizations or institutions mandated by the Central Government or any State Government or Union territory administration shall analyse the data gathered at state and national levels and evolve ways through research anddevelopment) to use such material in the best possible manner depending on use of locally available construction material.

24. Criteria for storage and processing or recycling facilities for construction and demolition waste.-

(a) the selection of the site for storage and processing or recycling facilities for construction and demolition waste shall be as per the criteria given in Schedule V; and

(b) the operator of the facility shall apply in Form VII for authorisation from State Pollution Control Board.

25. Timeline for implementation of provisions of these rules for management of construction and demolition waste management.-The timeline for implementation of these rules shall be as given below:

(a) one year and six months from the date of its notification for million plus cities based on 2011 census of India;

(b) two years from the date of its notification for 0.5 to 1 million cities based on 2011 census of India;

(c) three years from the date of its notification for other cities (< 0.5 million populations) based on 2011 census of India; and

(d) timeframe for planning and implementation for these shall be as given Schedule IV.

26. Monitoring compliance of the provisions of these rule for construction and demolition waste management.-The respective urban local body, state pollution control board or pollution control committeeas the case may be shall monitor implementation of these rules.

27. Accident reporting by the construction and demolition waste processing facilities.-When an accident occurs at any construction and demolition waste processing/ treatment or disposal facility, the officer in charge the facility in the urban local body or the operator of the facility shall forthwith report of the accident in Form-XI to urban local body, as applicable and the instructions issued by the said authority shall be followed.

SCHEDULE I

See [Rule 3(1)(xv), 13 (1) (v), 14 (1) (b), 14 (1) (e), 14(4), 15(8) (2)[

Specifications for Landfill Sites

A. Criteria for site selection.-

1. In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.

2. Selection of landfill sites shall take into consideration the relevant environmental issues.

3. The landfill site shall be planned, and designed and developed with proper documentation of construction plan as well as a closure planin a phased manner. In case of creation of a new landfill facility is created adjoining an existing landfill site, the closure plan of existing landfill should form a part of the proposal of such new landfill.

4. The landfill sites shall be selected to make use of nearby wastes processing facilities. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.

5. Landfill sites shall be set up as per the guidance notes or guidelines formulated by the Ministry of Urban Development, Government of India.

6. The existing landfill sites which are in use for more than five years shall be improved in accordance of with the specifications given in this Schedule.

7. The landfill site shall be large enough to last for at least 20-25 years and shall develop 'landfill cells' in a phased manner to avoid water logging and misuse.

8. The landfill site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest and the distance to be maintained, as prescribed by the State Environment Impact Assessment Authority (SEIAA) or the state pollution control board or pollution control committee onthe case to case basis for management of solid waste management plan or 100 meter away from river, 200 meter from a pond, 500 meter from Highways, Habitations, Public Parks and water supply wells and 20 km away from Airports or Airbase. However in a special case, landfill site may be set up within a distance of 10 and 20 km away from the Airport/Airbase after obtaining no objection certificate from the civil aviation authority/ Air force as the case may be. The Landfill site shall not be permitted within the zone of coastal regulation, wetland, Critical habitat areas, sensitive eco-fragile areas and flood plains as recorded for the last 100 years.

9. A buffer zone of no development shall be maintained around landfill sites and sites for processing and disposal of solid waste. The sites for landfill, and processing and disposal of solid waste shall be incorporated in the Town Planning Department's land-use plans. The buffer zone shall be prescribed by the State Environment Impact Assessment Authority (SEIAA) or State Pollution Control Board or Pollution Control Committee, on the case to case basis. The site, as approved by the State Environment Impact Assessment Authority shall be notified by the concerned Local Government.

10. The biomedical waste shall be disposed of in accordance with the Bio-medical Waste (Management and Handling) Rules, 1998, as amended. The hazardous waste shall be managed in accordance with the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008, as amended, from time to time. The E-waste shall be managed in accordance with the e-Waste (Management and Handling) Rules, 2011.

11. Facilities to be created for 'temporary storage' of solid waste in each landfill sites for incoming wastes in case of shutting down of waste processing plants; which shall be taken again for further processing. The landfill site shall have provisions for using as temporary storage during emergency or natural calamities

B. Criteria for development of facilities at the site.-

1. Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.

2. The landfill site shall be well protected to prevent entry of unauthorised persons and stray animals.

3. Approach and other internal roads for free movement of vehicles and other machinery shall exist at the landfill site.The approach/internal roads shall be concreted or paved so as to avoid generation of dust particles due to vehicular movement.

4. The landfill site shall have waste inspection facility to monitor waste brought in for landfill, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipment. The operator of the facility shall maintain record of waste receiving, processing and disposal.

5. Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipment and other facilities as may be required shall be provided.

6. Utilities such as drinking water and sanitary facilities (preferably washing/bathing facilities for workers)and lighting arrangements for easy landfill operations when carried out in night hours shall be provided.

7. Safety provisions including health inspections of workers at landfill sites shall be periodically made.

8. Provisions to be made for parking and cleaning or washing transport vehicles after delivery of garbage at the site. The wastewater shall be treated to meet the prescribed standards.

C. Criteria for specifications for land filling operations and closure on completion of landfill.-

1. Waste subjected to land filling shall be compacted in thin layers using heavy compactors to achieve high density of the waste. In high rainfall areas where heavy compactors cannot be used alternative measures shall be adopted.

2. Waste shall be covered immediately or at the end of each working day with minimum 10 cm of soil, inert debris or construction material till such time waste processing facilities for composting or recycling or energy recovery are set up.

3. Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage shall be constructed to divert run-off away from the active cell of the landfill.

4. After completion of landfill, a final cover shall be designed to minimise infiltration and erosion. The final cover shall meet the following specifications, namely :--

(i) The final cover shall have a barrier soil layer comprising of 60 cm of clay or amended soil with permeability coefficient less than 1×10^{-7} cm/sec.
(ii) On top of the barrier soil layer, there shall be a drainage layer of 15 cm.
(iii) On top of the drainage layer, there shall be a vegetative layer of 45 cm to support natural plant growth and to minimise erosion.

D. Criteria for pollution prevention.-In order to prevent pollution problems from landfill operations, the following provisions shall be made, namely:-

1. The storm water drain shall be designed and constructed in such a way that the surface runoff water is diverted from the landfilling site and leachates fromsolid waste locations do not get mix with the surface runoff water. Provisions for diversion of storm water dischargesdrains shall be made to minimise leachate generation and prevent pollution of surface water and also for avoiding flooding and creation of marshy conditions.

2. Construction of a non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specifications shall be a composite barrier having 1.5 mm thick high density polyethylene (HDPE) geo-membrane or geo-synthetic liners, or equivalent, overlying 90 cm of soil (clay or amended soil) having permeability coefficient not greater than 1 x 10-7 cm/sec. The highest level of water table shall be at least two meter below the base of clay or amended soil barrier layer provided at the bottom of

landfills.

3. Provisions for management of leachates including its collection and treatment shall be made. The treated leachates shall meet the standards specified in Schedule- II. The treated leachate shall be recycled or utilized as permitted, otherwise shall be released into the sewerage line of municipality for further treatment in Sewage Treatment Plants. In no case, leachate shall be released into open environment.

4. Arrangement shall be made to prevent runoff water from landfill area entering any drain, stream, river, lake or pond. In case of mixing of runoff water with leachate or solid waste, the entire mixed water shall be treated by the concern authority.

E. Criteria for water quality monitoring.-

1. Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within 50 meter of the periphery of landfill site shall be periodically monitored covering different seasons in a year that is, summer, monsoon and post-monsoon period to ensure that the ground water is not contaminated beyond acceptable limit as decided by the Ground Water Board or the State Pollution Control Board or the Pollution Control Committee.

2. Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) shall be considered only after ensuring its quality. The following specifications for drinking water quality shall apply for monitoring purpose, namely :-

S. No.	Parameters	IS 10500:1991, Edition 2.2(2003-09) Desirable limit (mg/l except for pH)
(1)	Arsenic	0.01
(2)	Cadmium	0.01
(3)	Chromium(as Cr^{6+})	0.05
(4)	Copper	0.05
(5)	Cyanide	0.05
(6)	Lead	0.05
(7)	Mercury	0.001
(8)	Nickel	-
(9)	Nitrate as NO_3	45.0
(10)	pH	6.5-8.5
(11)	Iron	0.3
(12)	Total hardness (as $CaCO_3$)	300.0
(13)	Chlorides	250
(14)	Dissolved solids	500
(15)	Phenolic compounds (as C_6H_5OH)	0.001
(16)	Zinc	5.0
(17)	Sulphate (as SO_4)	200

F.Criteria for ambient air aualitymonitoring.-

1. Installation of landfill gas control system including gas collection system shall be made at landfill site to minimiseodour generation, prevent off-site migration of gases and to protect vegetation planted on the rehabilitated landfill surface.

2. The concentration of methane gas generated at landfill site shall not exceed 25 per cent of the lower explosive limit (LEL).

3. The landfill gas from the collection facility at a landfill site shall be utilized for either direct thermal applications or power generation, as per viability. Otherwise, landfill gas shall be burnt (flared) and shall not be allowed to escape directly to the atmosphere or for illegal tapping. Passive venting shall be allowed in case if its utilization or flaring is not possible.

4. Ambient air quality at the landfill site and at the vicinity shall be monitored.

G. Criteria for plantation at landfill Site.-

1. A vegetative cover shall be provided over the completed site in accordance with the and following specifications, namely:-

(a) Selection of locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures shall be allowed to grow;

(b) The plants grown should be of such variety that their roots do not penetrate more than 30 cms. This condition shall apply till the landfill is stabilized;

(c) Selected plants shall have ability to thrive on low-nutrient soil with minimum nutrient addition;

(d) Plantation to be made in sufficient density to minimise soil erosion.

(e) Green belts shall be developed all around the boundary of the landfill in consultation with State Pollution Control Boards or Pollution Control Committees .

H. Criteria for post-care of landfill site.-

1. The post-closure care of landfill site shall be conducted for at least fifteen years and long term monitoring or care plan shall consist of the following, namely :-'

(a) Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) Monitoring leachate collection system in accordance with the requirement;

(c) Monitoring of ground water in accordance with requirements and maintaining ground water quality;

(d) Maintaining and operating the landfill gas collection system to meet the standards.

2. Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous emission and leachate quality analysis complies with the specified standards and the soil stability is ensured.

I. Criteria for special provisions for hilly areas.-Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid waste by the municipal authority with the approval of the concerned State Board or the Committee. The municipal authority shall set up processing facilities for utilization of biodegradable organic waste. The non-biodegradable recyclable materials shall be stored and sent for recycling periodically. The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills. Because of constraints in finding adequate land in hilly areas, waste not suitable for road-laying or filling up shall be disposed of in specially designed landfills.

SCHEDULE II

See [Rule 14 (1)(b), 14 (1)(e), 14(4), 15(7)(b)

Standards of processing and treatment of solid waste

A. Standards for composting:

1. The waste processing facilities shall include composting as one of the technologies for processing of bio degradable waste.

2. In order to prevent pollution problems from compost plant .The following shall be complied with, namely :-

3. The incoming organic waste at site shall be maintained prior to further processing. To the extent possible, the waste storage area should be covered. If, such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility;

4. Necessary precautions shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard;

5. In case of breakdown or maintenance of plant, waste intake shall be stopped and arrangements be worked out for diversion of waste to the temporary processing site or temporary landfill sites which will be again reprocessed when plant is in order;

6. Pre-process and post-process rejects shall be removed from the processing facility on regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclable high calorific fractions to be segregated as a feedstock and sent for RDF production/ co-processing in cement plants or to power plants. Only rejects from all processes shall be sent for well-designed landfill site(s).

7. The windrow area shall be provided with impermeable base. Such a base shall be made of concrete or compacted clay, 50 cm thick, having permeability coefficient less than 10^{-7} cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off;

8. Ambient air quality monitoring shall be regularly carried out particularly for checking odor nuisance at down-wind direction on the boundary of processing plant.

9. Leachate shall be re-circulated in compost plant for moisture maintenance.

10. The end product compost shall meet the standards prescribed under Fertilizer Control Order 2009/2013.

11. In order to ensure safe application of compost, the following specifications for compost quality shall be met, namely:-

Parameters	Organic Compost (FCO 2009)	Phosphate Rich Organic Manure (FCO 2013)
Arsenic (mg/Kg)	10.00	10.00
Cadmium (mg/Kg)	5.00	5.00
Chromium (mg/Kg)	50.00	50.00
Copper (mg/Kg)	300.00	300.00
Lead (mg/Kg)	100.00	100.00
Mercury (mg/Kg)	0.15	0.15
Nickel (mg/Kg)	50.00	50.00
Zinc (mg/Kg)	1000.00	1000.00
C/N ratio	<20	Less than 20:1
pH	6.5-7.5	(1:5 solution) maximum 6.7

Moisture, percent by weight, maximum	15.0-25.0	25.0
Bulk density (g/cm^3)	<1.0	Less than 1.6
Total Organic Carbon, per cent by weight, minimum	12.0	7.9
Total Nitrogen (as N), per cent by weight, minimum	0.8	0.4
Total Phosphate (as P_2O_5) percent by weight, minimum	0.4	10.4
Total Potassium (as K_2O), percent by weight, minimum	0.4	-
Colour	Dark brown to black	-
Odour	Absence of foul Odor	-
Particle size	Minimum 90% material should pass through 4.0 mm IS sieve	Minimum 90% material should pass through 4.0 mm IS sieve
Conductivity (as dsm-1), not more than	4.0	8.2

* Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

B. Standards for treated leachates.-The disposal of treated leachates shall follow the following standards, namely:-

S. No	Parameter	Standards (Mode of Disposal)		
		Inland surface water	Public sewers	Land disposal
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/l, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27° C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-
12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-
15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

Note : While discharging treated leachates into inland surface waters, quantity of leachates being discharged and the quantity of dilution water available in the receiving water body shall be given due consideration.

C. Standards for incineration:

The incinerators shall meet the following standards, namely:-

Emission standards

The stack emission standards for Incinerator/Thermal technologies in Solid Waste treatment/disposal facility:-

Parameter	**Emission standard**	
Particulates	50 mg/Nm^3	Standard refers to half hourly average value
HCl	50 mg/Nm^3	Standard refers to half hourly average value

SO_2	200 mg/Nm^3	Standard refers to half hourly average value
CO	100 mg/Nm^3	Standard refers to half hourly average value
	50 mg/Nm^3	Standard refers to daily average value
Total Organic Carbon	20 mg/Nm^3	Standard refers to half hourly average value
HF	4 mg/Nm^3	Standard refers to half hourly average value
NOx (NO and NO_2 expressed as NO_2)	400 mg/Nm^3	Standard refers to half hourly average value
Total dioxins and furans	0.1 ng TEQ/Nm^3	Standard refers to 6-8 hours sampling. Please refer guidelines for 17 concerned congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd + Th + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.5 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Note:*All values corrected to 11% oxygen on a dry basis.*		

Note:

(i) Suitably designed pollution control devices shall be installed or retrofitted with the incinerator to achieve the above emission limits, if necessary.

(ii) Waste to be incinerated shall not be chemically treated with any chlorinated disinfectants.

(iii) Chlorinated plastics shall not be incinerated.

(iv) Toxic metals in incineration ash shall be limited within the regulatory quantities as specified in the Hazardous Waste (Management, Handling and Trans boundary Movement) Rules, 2008, as amended from time to time.

(v) Only low sulphur fuel like LDO or LSHS or Diesel shall be used as fuel in the incinerator.

(vi) The CO_2 concentration in tail gas shall not be less than 7%.

(vii) All the facilities in twin chamber incinerators shall be designed to achieve a minimum temperature of 950°C in secondary combustion chamber and with a gas residence time in secondary combustion chamber not less than 2 (two) seconds.

(viii) Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, as to achieve total Organic Carbon (TOC) content in the slag and bottom ashes less than 3%, or their loss on ignition is less than 5% of the dry weight.

Schedule III: Management of Construction and Demolition (C&D) Waste

See [Rule 23]

PART A

Sl. No.	Parameters	Compliance Criteria
1	**Plan approval by local body**	Prior to the construction or demolition work as per these rules. The generator shall obtain permission from local body and shall submit the waste management plan of C&D waste.
2.	**Storage, collection and transportation of C&D waste**	i. Littering of C&D waste shall be strictly prohibited. ii. C&D waste shall be stored separately and not allowed to get mixed with other waste (e.g., municipal / biomedical / e-waste / hazardous / nuclear etc.). iii. The storage bins/designated area shall be in accordance with the quantum and nature of the C&D waste. iv. Collection of the C&D waste shall be done at regular intervals, using appropriate mechanism. v. The collected material shall be transported to the identified location for further processing and / or disposal. vi. The generators of C&D waste shall have to pay for the services rendered for its storage, collection and transportation at a rate fixed by the concerned municipal body or any other authority designated by the State Government.
4	**Processing and disposal of C&D waste**	i. It is highly desirable that the hierarchy of using/ disposing of C& D waste should be maintained. The Hierarchy should be a) Reuse as much as possible

		b) Whatever cannot be reused, process & recycle, the residue after processing and recycling only be disposed in the place designated by the appropriate authority. ii. For reducing the space required for disposal of C&D waste and for saving of natural resources, C&D waste shall be processed (where feasible) and the products utilized to the extent possible. iii. The material rejected after due processing shall be deposited in designated areas or landfill (last resort). The low lying areas should not be natural drainage channels / water bodies. iv. Large generators shall explore the possibility of setting up in-situ facility for processing and reuse of the C&D waste generated. The Local Government / State Government would incentivize such endeavour. Large generators should deconstruct a facility/ building rather than demolishing the same. The deconstruction plan to be got approved by the appropriate authority. v. Large generators shall have to pay for the processing and disposal of C&D waste generated by them, apart from the payment for storage, collection and transportation. The rate shall be fixed by the concerned municipal body or any other authority designated by the State Government. Those generating 20 tons or more in one day or 300 tons per project in a month shall be defined as large generators. vi. For larger cities (say million plus), the processing should be done through appropriate technology, which minimises land-fillable process residues.
5	**Use of recycled products**	i. Use of recycled C&D waste products (such as in non-structural concrete, manufactured sand, paving blocks, lower layers of road pavements, colony and rural roads etc.) shall be incentivised in places where there is any operational facility for recycling C&D waste. Such applications shall be subject to quality requirements for the specific application. Other suitable products would also be encouraged (as given in schedule IV). ii. Procurement of such materials shall be made mandatory to a certain percentage (say 10-20%) in municipal and Govt. contracts subject to strict quality control.

PART B

Application of C&D products in operation of sanitary landfill

Sl. No.	Parameters	Compliance Criteria
1	(i) Drainage layer in leachate collection system at bottom of Sanitary Landfill and (ii) Gas Collection Layer above the waste at top of Sanitary Landfill and (iii) Drainage Layer in top Cover System above Gas Collection Layer of Sanitary Landfill For capping of sanitary landfill / dumpsite, drainage layer at the top	i. Only crushed and graded hard material (stone, concrete etc.) shall be used having coarse sand size graded material (2mm – 4.75mm standard sieve size). ii. Since the coarse sand particles will be angular in shape (and not rounded as for riverbed sand), protection layers of non-woven geo-textiles may be provided, wherever required, to prevent puncturing of adjacent layers / components.
2	Daily cover	i. Fines from C&D processed waste having size up to 2 mm shall be used for daily cover over the fresh waste. ii. Use of Construction and Demolition (C&D) fines as landfill cover shall be mandatory where such material is available. Fresh soil (sweet earth) shall not be used for such places and borrow-pits shall not be allowed. Exception – soil excavated during construction of the same landfill. iii. During hot windy days in summer months, some fugitive dust problems may

		arise. These can be minimised by mixing with local soil wherever available for limited period.
3	Civil construction in a sanitary landfill	iv. Non-structural applications, e.g., kerb stones, drain covers, paving blocks in pedestrian areas.

PART C

Standards and specifications

Construction and Demolition (C&D) waste as stored and collected at present, is mostly in mixed form. Therefore, the proposed standards should address mixed aggregates or recycled aggregates (RA), which is distinct from recycled concrete aggregates (RCA).

Proposed standards for recycled aggregates:

I. Recycled aggregate (RA) may be used in making concrete for non-structural purposes. The extent of use would be limited to non-load bearing structures only, provided the conditions mentioned below at point no. 2 is complied with. Examples of use – wall between two RCC load bearing members, filling walls between RCC frame, non-industrial flooring, etc.

II. The RA should be free from deleterious material, such as, organic content, vegetable matter, coal, clay lumps, external substances such as, soft fragments like pieces of plastics, paper etc. RA should also be free from chemicals, known to be detrimental for the strength or durability of concrete or steel reinforcement, such as, chlorides, etc. beyond the threshold value.

III. Percentage of replacement of natural aggregates by RA can be up to 20% for any type of plain concreting (PCC) work. The percentage can be increased up to 30% for road sub-base / base / other road related applications except wearing course. However, this should be backed up by laboratory test reports.

IV. RA of appropriate quality (as mentioned above) can be used for various purposes, such as, in making kerb stones, paving blocks, concrete blocks and bricks, road sub-base, pathways for pedestrian use, rural roads (used for walking and bicycles) etc. However, it has to be ensured that the existing norms for strength (such as, M20, M25 etc.) are complied with for desired application.

V. Recycled concrete aggregate (RCA) can be used in all grades of PCC (structural and non-structural).

VI. RCA have to be pre-wetted near to SSD (saturated surface dry) conditions before use to avoid rapid slump loss due to its high water absorption rate. Admixtures with better slump retention effect would be useful.

VII. Fine washed aggregates in the range of 4.75 mm to 0.075 mm (75 µ) separated from C&D waste using 'wet' process may be used as 'manufactured sand' for non-load bearing structures.

Schedule IV: Timeframe for Planning and Implementation
See [Rule 24(a) 25(d)]

Sl. No.	Compliance Criteria	Cities with population of 01 million and above	Cities with population of 0.5-01 million	Cities with population of less than 0.5 million
1	***Formulation of policy by State Govt.***	**12 months**	**12 months**	**12 months**
2	***Identification of sites for collection & processing facility***	**18 months**	**18 months**	**18 months**
3	***Commissioning & implementation of the facility***	**24 months**	**24 months**	**24 months**
4	***Monitoring by SPCBs***	3 times a year – once in 4 months	2 times a year – once in 6 months	2 times a year – once in 6 months

****The time Schedule shall be made effective from the date of notification.***

Schedule V: Criteria for Site Selection For Storage And Processing / Recycling Facilities For C&D Waste

A. ***Criteria for selection of storage and processing/recycling facilities for construction and demolition waste***

1. In areas falling under the jurisdiction of 'Development Authorities, it shall be the responsibility of such Development Authorities to identify the ***storage facility, processing/recycling facilities*** and hand over the sites to the concerned municipal authority for development, operation and maintenance, which shall ultimately be given to the operators by Competent Authority. ***Elsewhere, this responsibility shall lie with the concerned municipal authority.***
2. Selection of processing/recycling facility shall be based on examination of environmental issues. The Local body shall co-ordinate (in consultation with Department of Urban Development of the State or the Union territory) with the concerned organizations for giving necessary approvals and clearances to the operators.
3. C&D waste shall be utilized in sanitary landfill for municipal solid waste of the city / region as mentioned at Schedule III of this rule. Residues from C&D waste processing / recycling industries shall be land filled in the sanitary landfill for municipal solid waste.
4. The processing/recycling shall be large enough to last for 20-25 years (project based on-site recycling facilities).
5. The processing/recycling site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.
6. A buffer `Zone of no-development`* shall be maintained – 20m (for handling less than 500 TPD C&D waste) and 30m (500 TPD or more) – around processing / recycling site and shall be incorporated in the land use plans of the concerned authority. In the case of successful implementation of 'no-development zone' the buffer zone inside the facility boundary should be limited to 6m and 10m respectively for the above mentioned capacities. Thus land required to be leased for the facility would reduce.

   *Explanatory Note:
   In case the ULB / Development Authority is unable to procure a site where it is not feasible to provide any 'no-development zone', the ULB would constitute a committee comprising representation from the State Urban Dev. Department, State Pollution Control Board / Committee and at least one Expert Institution to deliberate on the long term impact and then give recommendation to the ULB. In case they recommend any specific technology or modification in design of the facility, the same should be incorporated in the bid. This way the project would be secure from objections from the neighborhood for siting of the plant / facility.

B. ***Facilities at the Processing/Recycling Sites for Construction and Demolition waste***

7. Processing / recycling site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.
8. Approach road and other internal roads for free movement of vehicles and other machinery shall exist at the storage and processing/recycling site.
9. Provisions like weigh bridge to measure quantity of construction and demolition waste brought at processing/recycling , fire protection equipment and other facilities as may be required shall be provided.
10. Utilities such as drinking water, toilets and bathing facilities for workers and lighting arrangements for safe processing/recycling operations shall be provided.
11. Safety provisions including health inspections of workers at storage, processing/recycling and landfill site shall be periodically made.

C. ***Pollution prevention***

In order to prevent pollution problems from processing / recycling operations, the following provisions shall be made, namely:

(a) Provision of storm water drains to prevent stagnation of surface water;
(b) Provision of paved / concreted surface in selected areas in the processing / recycling facility for minimizing dust and damage to the site.
(c) Prevention of noise pollution from processing and recycling plant: Noise is the main pollutant from a processing facility. In case of wet process, some quantity of effluent may be generated which shall be treated and discharged as per relevant norms – as per Environment (Protection) Rules, 1986.

a) Air Quality Monitoring

Work Zone air quality at the Processing/Recycling site and ambient air quality at the vicinity shall be monitored.

b) Noise monitoring

The measurement of ambient noise would be done at the interface of the facility with the surrounding area, i.e., at plant boundary.

Exemption: The following projects would be exempt from the norms for pollution from dust and noise as mentioned above:

1. For redevelopment of colonies and markets (please see definition), where in-situ recycling is carried out provided (a) the project is completed within 5 years (b) minimum 80% of the C&D waste generated at the site is recycled / reused within the same site and (c) sufficient buffer area is available to protect the surrounding habitation from any adverse impact.

2. In-situ recycling at large construction sites (minimum one hectare site area so that some buffer area is available) provided (a) the project is completed within 3 years and (b)

minimum 50% of the C&D waste generated at the site is reused / recycled within the same site.

D. Plantation at Processing / Recycling Sites

A vegetative boundary should be made around the Processing/Recycling plant/site to strengthen the buffer zone.

FORM – I
[Rule 13(1)(x), 14(1)(c)]

Application for obtaining authorisation under solid waste rules for processing/recycling/treatment and disposal of solid waste

To,

The Member Secretary
State Pollution Control Board/Pollution Control Committee
of.....

Sir,

I/We hereby apply for authorisation under the Solid Waste (Management and Handling) Rules, 2014 for processing, recycling, treatment and disposal of solid waste.

1.	Name of the urban local body/agency appointed by them/ operator of facility	
2.	Correspondence address Telephone No. Fax No. e-mail:	
3.	Nodal Officer & designation(Officer authorised by the urban local body or agency responsible for operation of processing/ treatment or disposal facility)	
4.	Authorisation required for setting up and operation of the facility (Please tick mark)	(i) waste processing (ii) recycling (iii)treatment (iv)disposal at landfill
5.	Attach copies of the Documents	(i) Site clearance (local authority) (ii) Proof of Environmental Clearance (iii)Consent for establishment (iv)Agreement between municipal authority and operating agency (v) Investment on the project and expected return
6.	**Processing/recycling/treatment of solid waste** (i) Total Quantity of waste to be processed per day a) Quantity of waste recycled per day b) Quantity of waste treated per day c) Quantity of waste disposed per day into landfill (ii)Utilization programme for waste processed (Product utilization) (iii)Methodology for disposal (attach details) a) Quantity of leachate b) Treatment technology for leachate (iv)Measures to be taken for prevention and control of environmental pollution (v)Measures to be taken for safety of workers working in the plant (vi)Details on solid waste processing/recycling/ treatment/disposal facility (to be attached)	

7.	**Disposal of solid waste** 1) Number of sites identified 2) Quantity of waste to be disposed per day 3) Nature and composition of waste 4) Details of methodology or criteria followed for site selection (attach) 5) Details of existing site under operation 6) Methodology and operational details of landfilling 7) Measures taken to check environmental pollution	
8	A detailed Action Plan for implementation may be attached	

Date: Signature:

Place: Designation

Form- II
See [Rule 14 (1) (e)]

Format for issue of authorisation

File No.: _____
Dated:_____
Authorisation No_____
To
Ref: Your application number _____dt. _____
The _____State Pollution Control Board/Pollution Control Committee after examining the proposal hereby authorises_____ having their administrative office at _____to set up and operate waste processing/recycling/ treatment/disposal facility at_____

The authorisation is hereby granted to operate the facility for processing, recycling, treatment and disposal of solid waste.

The authorisation is subject to the terms and conditions stated below and such conditions as may be otherwise specified in these rules and the standards laid down in Schedules I and II under these rules.

The _____State Pollution Control Board/Pollution Control Committees of the UT may, at any time, revoke any of the conditions applicable under the authorisation and shall communicate the same in writing.

Any violation of the provision of the Solid Waste (Management and Handling) Rules, 2014 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of 1986).

(Member Secretary)
State Pollution Control Board/Pollution Control Committee of the UT
(Signature and designation)

Date:
Place:

Form – III
See [Rule 16(6), 21(2)]

Format of annual report to be submitted by the operator of facility to the urban local body

1	Name of the City/Town and State	
2	Population	
3	Area in sq. kilometers	
4	Name & Address of the Urban local body Telephone No. Fax No. E-mail:	
5	Name and address of operator of the facility	
6	Name of officer in-charge of the facility Phone No: Fax No: E-mail:	
7	Number of households in the city/town , Number of non-residential premises in the city Number of election/ administrative wards in the city/town	
8	Quantity of Solid waste (SOLID WASTE)	

	Estimated Quantity of SOLID WASTE generated in the urban local body area per day in metric tonnes	/tpd
	Quantity of SOLID WASTE collected per day	/tpd
	Per capita waste collected per day	/gm/day
	Quantity of SOLID WASTE processed	/tpd
	Quantity of SOLID WASTE disposed at dumpsite/ landfill	/tpd
9	**Status of Solid Waste Management (SWM) service**	
	Segregation and storage of waste at source	Yes/No
	Whether SOLID WASTE is stored at source in domestic/commercial/ institutional bins If yes,	
	Percentage of households practice storage of waste at source in domestic bins	%
	Percentage of non-residential premises practice storage of waste at source in commercial /institutional bins	%
	Percentage of households dispose of throw SOLID WASTE on the streets	
	Percentage of non-residential premises dispose of throw SOLID WASTE on the streets	%
	Whether SOLID WASTE is stored at source in a segregated form	%
	If yes, Percentage of premises segregating the waste at source	Yes/No
		%
	Door to Door Collection of SOLID WASTE	
	Whether door to door collection (D2D) of SOLID WASTE is being done in the city/town	Yes/No
	if yes	
	Number of wards covered in D2D collection of waste	
	No. of households covered	

	No. of non-residential premises including commercial establishments ,hotels, restaurants educational institutions/ offices etc covered	
	Percentage of residential and non-residential premises covered in door to door collection through : Motorized vehicle Containerized tricycle/handcart Other device	 % % %
	If not, method of primary collection adopted	
	Sweeping of streets	
	Length of roads, streets, lanes, bye-lanes in the city that need to be cleaned	km
	Frequency of street sweepings and percentage of population covered	frequency: Daily / Alternate days / Twice a week / Occasionally % of population covered
	Tools used Manual sweeping Mechanical sweeping	 % %
	Whether long handle broom used by sanitation workers	Yes/No
	Whether each sanitation worker is given handcart/tricycle for collection of waste	Yes/No
	Whether handcart / tricycle is containerized	Yes/No
	Whether the collection tool synchronizes with collection/ waste storage containers utilized	Yes/No
	Secondary Waste Storage facilities	

	No. and type of waste storage depots in the city/town Open waste storage sites Masonry bins Cement concrete cylinder bins Dhalao/covered rooms/space Covered metal/plastic containers Upto 1.1 m^3 bins 2 to 5 m^3 bins Above 5m^3 containers Bin-less city	No. Capacity in m^3	
	Bin/ population ratio		
	Ward wise details of waste storage depots (attach) : Ward No: Area: Population: No. of bins placed Total volume of bins placed		
	Total storage capacity of waste storage facilities in cubic meters		
	Total waste actually stored at the waste storage depots daily		
	Give frequency of collection of waste from the depots **Number of bins cleared**	Frequency	No. of bins
		Daily Alternate day	
		Twice a week Once a week	
		Occasionally	
	Whether storage depots have facility for storage of segregated waste in green, blue and black bins	Yes/ No (if yes, add details) No. of green bins: No. of blue bins: No. of black bins:	

	Whether lifting of SOLID WASTE from storage depots is manual or mechanical. Give percentage	(%) of Manual Lifting of SOLID WASTE	%
		(%) of Mechanical lifting	%
	If mechanical – specify the method used	front-end loaders/ Top loaders	
	Whether SOLID WASTE is lifted from door to door and transported to treatment plant directly in a segregated form	Yes/ No (if yes, specify)	
	Waste Transportation per day	No. Trips made waste transported	
	Type and Number of vehicles used Animal cart Tractors Non tipping Truck Tipping Truck Dumper Placers Refuse collectors Compactors Others JCB/loader		
	Frequency of transportation of waste	Frequency (%) of waste transported Daily Alternate day Twice a week Once a week Occasionally	
	Quantity of waste transported each day	/tpd	
	Percentage of total waste transported daily	%	
	Waste Treatment Technologies used		
	Whether solid waste is processed	Yes/No	
	If yes, Quantity of waste processed daily	/tpd	

Land(s) available with the urban local body for waste processing (in Hectares)	
Land currently utilized for waste processing	
SOLID WASTE processing facilities in operation	
SOLID WASTE processing facilities under construction	
Distance of processing facilities from city/town boundary	
Details of technologies adopted	
Composting ,	Qty. raw material processed Qty. final product produced Qty. sold Qty. of residual waste landfilled
vermi composting	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
Bio-methanation	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
Refuse Derived Fuel	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
Waste to Energy technology such as incineration, gasification, pyrolysis or any other technology (give detail)	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
Co-processing	Qty. raw material processed
Combustible waste supplied to cement plant	
Combustible waste supplied to SOLID WASTE based power plants	
Others	Qty.
SOLID WASTE disposal facilities	
No. of dumpsites sites available with the urban local body	
No. of sanitary landfill sites available with the urban local body	
Area of each such sites available for waste disposal	
Area of land currently used for waste disposal	
Distance of dumpsite/landfill facility from city/town	kms
Distance from the nearest habitation	kms
Distance from water body	kms
Distance from state/national highway	kms
Distance from Airport	kms
Distance from important religious places or historical monument	kms
Whether it falls in flood prone area	kms
Whether it falls in earthquake fault line area	Yes/No
Quantity of waste landfilled each day	tpd
Whether landfill site is fenced	Yes / No
Whether Lighting facility is available on site	Yes / No
Whether Weigh bridge facility available	Yes / No
Vehicles and equipments used at landfill (specify)	Bulldozer, Compacters etc. available
Manpower deployed at landfill site	Yes/No (if yes, attach details)
Whether covering is done on daily basis	Yes/No

	If not,Frequency of covering the waste deposited at the landfill	
	Cover material used	
	Whether adequate covering material is available	Yes/No
	Provisions for gas venting provided	Yes/No, (if yes, attach technical data sheet)
	Provision for leachate collection	Yes/No, (if yes, attach technical data sheet)
10	Whether an Action Plan has been prepared for improving solid waste management practices in the city	Yes/No (if Yes attach Action Plan details)
11	What separate provisions are made for : Dairy related activities : Slaughter houses waste : C&D waste (construction debris) :	Attach details on Proposals, Steps taken, Yes/No Yes/No Yes/No
12	Details of Post Closure Plan	Attach Plan
13	How many slums are identified and whether these are provided with Solid Waste Management facilities :	Yes/ No (if Yes, attach details)
14	Give details of manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	
15	Mention briefly, the difficulties being experienced by the urban local body in complying with provisions of these rules	
16	Mention briefly, if any innovative idea is implemented to tackle a problem related to solid waste, which could be replicated by other urban local bodies.	

Signature of Operator

Dated :
Place:

Form – IV
Rule [13(za), 21(1)]

Format for annual report on solid waste management to be submitted by the urban local body

CALENDAR YEAR:	DATE OF SUBMISSION OF REPORT:

1	Name of the City/Town and State	
2	Population	
3	Area in sq. kilometers	
4	Name & Address of Urban local body Telephone No. Fax No. E-mail:	
5	Name of officer in-charge dealing with solid waste management (SOLID WASTEM)Phone No: Fax No: E-mail:	
6	Number of households in the city/town Number of non-residential premises in the city Number of election/ administrative wards in the city/town	
7	Quantity of Solid waste (SOLID WASTE)	
	Estimated Quantity of SOLID WASTE generated in the urban local body area per day in metric tonnes	/tpd
	Quantity of SOLID WASTE collected per day	/tpd
	Per capita waste collected per day	/gm/day
	Quantity of SOLID WASTE processed	/tpd
	Quantity of SOLID WASTE disposed at dumpsite/ landfill	/tpd
8	**Status of Solid Waste Management service**	

	Segregation and storage of waste at source	Yes/No
	Whether SOLID WASTE is stored at source in domestic/commercial/ institutional bins, If yes,	
	Percentage of households practice storage of waste at source in domestic bins	%
	Percentage of non-residential premises practice storage of waste at source in commercial /institutional bins	%
	Percentage of households dispose or throw SOLID WASTE on the streets	%
	Percentage of non-residential premises dispose of throw SOLID WASTE on the streets	%
	Whether SOLID WASTE is stored at source in a segregated form, If yes,	Yes/No
	Percentage of premises segregating the waste at source	%
	Door to Door Collection of SOLID WASTE	
	Whether door to door collection (D2D) of SOLID WASTE is being done in the city/town	Yes/No
	if yes	
	Number of wards covered in D2D collection of waste	
	No. of households covered	
	No. of non-residential premises including commercial establishments ,hotels, restaurants educational institutions/ offices etc covered	
	Percentage of residential and non-residential premises covered in door to door collection through :	
	Motorized vehicle	%
	Containerized tricycle/handcart	%
	Other device	%
	If not, method of primary collection adopted	
	Sweeping of streets	
	Length of roads, streets, lanes, bye-lanes in the city that need to be cleaned	km

	Frequency of street sweepings and percentage of population covered	frequency	Daily	Alternate days	Twice a week	Occasionally
		% of population covered				

	Tools used	
	Manual sweeping	%
	Mechanical sweeping	%
	Whether long handle broom used by sanitation workers	Yes/No
	Whether each sanitation worker is given handcart/tricycle for collection of waste	Yes/No
	Whether handcart / tricycle is containerized	Yes/No
	Whether the collection tool synchronizes with collection/ waste storage containers utilized	Yes/No
	Secondary Waste Storage facilities	
	No. and type of waste storage depots in the city/town	No. Capacity in m^3
	Open waste storage sites	
	Masonry bins	
	Cement concrete cylinder bins	
	Dhalao/covered rooms/space	
	Covered metal/plastic containers	
	Upto 1.1 m3 bins	
	2 to 5 m3 bins	
	Above 5m3 containers	
	Bin-less city	
	Bin/ population ratio	
	Ward wise details of waste storage depots (attach) :	
	Ward No:	
	Area:	
	Population:	
	No. of bins placed	
	Total volume of bins placed	
	Total storage capacity of waste storage facilities in cubic meters	
	Total waste actually stored at the waste storage depots daily	

	Give frequency of collection of waste from the depots **Number of bins cleared**	Frequency	No. of bins
		Daily	
		Alternate day	
		Twice a week	
		Once a week	
		Occasionally	
	Whether storage depots have facility for storage of segregated waste in green, blue and black bins	Yes/ No (if yes, add details) No. of green bins: No. of blue bins: No. of black bins:	
	Whether lifting of SOLID WASTE from storage depots is manual or mechanical. Give percentage (%) of Manual Lifting of SOLID WASTE (%) of Mechanical lifting		% %
	If mechanical – specify the method used	front-end loaders/ Top loaders	
	Whether SOLID WASTE is lifted from door to door and transported to treatment plant directly in a segregated form	Yes/ No (if yes, specify)	
	Waste transportation per day Type and Number of vehicles used	No. Trips made waste transported	
		Animal cart Tractors Non tipping Truck Tipping Truck Dumper Placers Refuse collectors Compactors Others JCB/loader	
	Frequency of transportation of waste	Frequency Daily Alternate day Twice a week Once a week Occasionally	(%) of waste transported
	Quantity of waste transported each day	/tpd	
	Percentage of total waste transported daily	%	
	Waste Treatment Technologies used		
	Whether solid waste is processed	Yes/No	
	If yes, Quantity of waste processed daily	/tpd	
	Whether treatment is done by urban local body or through an agency		
	Land(s) available with the urban local body for waste processing (in Hectares)		
	Land currently utilized for waste processing		

	SOLID WASTE processing facilities in operation	
	SOLID WASTE processing facilities under construction	
	Distance of processing facilities from city/town boundary	
	Details of technologies adopted	
	Composting ,	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	vermi composting	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Bio-methanation	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Refuse Derived Fuel	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Waste to Energy technology such as incineration, gasification, pyrolysis or any other technology (give detail)	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Co-processing	Qty. raw material processed
	Combustible waste supplied to cement plant	
	Combustible waste supplied to SOLID WASTE based power plants	
	Others	Qty.
	SOLID WASTE disposal facilities	
	No. of dumpsites sites available with the urban local body	
	No. of sanitary landfill sites available with the urban local body	
	Area of each such sites available for waste disposal	
	Area of land currently used for waste disposal	
	Distance of dumpsite/landfill facility from city/town	kms
	Distance from the nearest habitation	kms
	Distance from water body	kms
	Distance from state/national highway	kms
	Distance from Airport	kms
	Distance from important religious places or historical monument	kms
	Whether it falls in flood prone area	Yes/No
	Whether it falls in earthquake fault line area	Yes/No
	Quantity of waste landfilled each day	tpd
	Whether landfill site is fenced	Yes / No
	Whether Lighting facility is available on site	Yes / No
	Whether Weigh bridge facility available	Yes / No
	Vehicles and equipments used at landfill (specify)	Bulldozer, Compacters etc. available
	Manpower deployed at landfill site	Yes/No (if yes, attach details)
	Whether covering is done on daily basis	Yes/No
	If not, Frequency of covering the waste deposited at the landfill	
	Cover material used	
	Whether adequate covering material is available	Yes/No

	Provisions for gas venting provided	Yes/No (if yes, attach technical data sheet)
	Provision for leachate collection	Yes/No (if yes, attach technical data sheet)
9	Whether an Action Plan has been prepared for improving solid waste management practices in the city	Yes/No (if Yes attach Action Plan details)
10	What separate provisions are made for : Dairy related activities : Slaughter houses waste : C&D waste (construction debris) :	Attach details on Proposals,Steps taken, Yes/No Yes/No Yes/No
11	Details of Post Closure Plan	Attach Plan
12	How many slums are identified and whether these are provided with Solid Waste Management facilities :	Yes/ No (if Yes, attach details)
13	Give details of: Urban local body's own manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	
14	Give details of: Contractor/ concessionaire's manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	
15	Mention briefly, the difficulties being experienced by the urban local body in complying with provisions of these rules	
16	Mention briefly, if any innovative idea is implemented to tackle a problem related to solid waste, which could be replicated by other urban local bodies	

Signature of CEO/Municipal Commissioner/
Executive Officer/Chief Officer

Date:
Place:

Form – V
See [Rule 21(3)]

Format of annual report to be submitted by the state pollution control board or pollution control committee committees to the central pollution control board

PART A

To,

The Chairman
Central Pollution Control Board
PariveshBhawan
East Arjun Nagar
DELHI- 110 0032

1.	Name of the State/Union territory	:	
2.	Name & address of the State Pollution Control	:	
3.	Number of urban local bodies responsible for management of solid waste in the State/Union territory under these rules	:	
4.	No. of authorisation application Received	:	
5.	A Summary Statement on progress made by urban local body in respect of solid waste management	:	Please attach as Annexure-I
6.	A Summary Statement on progress made by urban local bodies in respect of waste collection, segregation, transportation and disposal	:	Please attach as Annexure-II

7.	A summary statement on progress made by: urban local bodies in respect of implementation of Schedule II		Please attach as Annexure-III
Date: ..... Place:			Chairman or the Member Secretary State Pollution Control Board/ Pollution Control Committee

PART B

1. Towns/cities

(i) Total number of towns/cities
(ii) Total number of ULBs
(iii) Number of class I & class II cities/towns

2. Authorisation status (names/number)

(i) Number of applications received
(ii) Number of authorisations granted
(iii) Authorisations under scrutiny

3. SOLID WASTE Generation status

(i) SOLID WASTE generation in the state (TPD)
(ii) SOLID WASTE collected (TPD)
(iii) SOLID WASTE treated (TPD)
(iv) SOLID WASTE landfilled (TPD)

4. Compliance to Schedule I of SW Rules (Number/names of towns/capacity)

(i) Good practices in cities/towns
(ii) House-to-house collection
(iii) Segregation
(iv) Storage
(v) Covered transportation

5. Processing of SW (Number/names of towns/capacity)

(i) SOLID WASTE processing facilities setup:

Sl. No.	Composting	Vermin-composting	Biogas	RDF/Pelletization
i.	ii.	iii.	iv.	v.

(ii) Processing facility operational:

Sl.	Composting	Vermin-	Biogas	vi. RDF/Pelletization
No.		composting		
i.	ii.	iii.	iv.	v.

(iii) Processing facility under installation/planned:

Sl. No.	Composting	Vermin-composting	Biogas	RDF/Pelletisation
i.	ii.	iii.	iv.	v.

6. Waste-to-Energy Plants: (Number/names of towns/capacity)

Sl. No.	Plant Location	Status of operation	Power generation (MW)	Remarks
i.	ii.	iii.	iv.	v.

7. Disposal of SOLID WASTE (number/names of towns/capacity):

(i) Landfill sites identified
(ii) Landfill constructed
(iii) Landfill under construction
(iv) Landfill in operation
(v) Landfill exhausted
(vi) Landfilled capped

8. SOLID WASTE Dumpsites (number/names of towns/capacity):

(i) Total number of existing dumpsites
(ii) Dumpsites reclaimed/capped
(iii) Dumpsites converted to sanitary landfill

9. Monitoring at Waste processing/Landfills sites

Sl. No.	Name of facilities	Ambient air	Groundwater	Leachate quality	Compost quality	VOCs
1.						
2.						
3.						

10. Status of Action Plan prepared by Municipalities

Total number of municipalities:
Number of Action Plan submitted:

Form – VI
See [Rule 22]
Accident Reporting

1.	Date and time of accident	:	
2.	Sequence of events leading to accident	:	
3.	The waste involved in accident	:	
4.	Assessment of the effects of the accidents on human health and the environment	:	
5.	Emergency measures taken	:	
6.	Steps taken to alleviate the effects of accidents	:	
7.	Steps taken to prevent the recurrence of such an accident	:	
Date:		Signature:.....	
Place:		Designation:	

FORM – VII
See [Rule 23 (4)(c), 24 (b)]
Application for obtaining authorisation

To,
The Member Secretary

1. Name of the municipal authority/Name of the agency appointed by the municipal authority :

2. Correspondence address :
   Telephone No. :
   Fax No. :

3. Nodal Officer & designation (Officer authorised by the competent authority or agency responsible for operation of processing / recycling or disposal facility) :

4. Authorisation applied for (Please tick mark) : Setting up of processing / recycling facility of Construction & Demolition waste

5. Detailed proposal of Construction & Demolition waste processing / recycling facility to include the following:

   (i) Location of site approved and allotted by the Competent Authority.
   (ii) Average quantity (in tons per day) and composition of C&D waste to be handled at the specific site.
   (iii) Details of C&D waste processing / recycling technology to be used.
   (iv) Quantity of Construction & Demolition waste to be processed per day.
   (v) Site clearance from Prescribed Authority.
   (vi) Salient points of agreement between competent authority / local body and operating agency (attach relevant document).
   (vii) Plan for utilization of recycled product.
   (viii) Expected amount of process rejects and plan for its disposal (e.g., SLF for SOLID WASTE).
   (ix) Measures to be taken for prevention and control of environmental pollution.
   (x) Investment on project and expected returns.
   (xi) Measures to be taken for safety of workers working in the processing / recycling plant.
   (xii) Any preventive plan for accident during the collection, transportation and treatment including processing and recycling should be informed to the Competent Authority (Local Body) / Prescribed Authority.
   (xiii)

Date: **Signature of Nodal Officer**

Form –VIII
See [Rule 23 (4) (c)]
Format for Issue of Authorisation to the Operator

File No.: _____
Date : _____

To,

_____
_____
_____

Ref : Your application number _____Dt. .....

The _____ State Pollution Control Board / Pollution Control Committee after examining the proposal hereby authorizes _____ having their administrative office at _____ to set up and operate Construction & Demolition waste processing facility at_____ on the terms and conditions (including the standards to comply) attached to this authorisation letter.

1. The validity of this authorisation is till _____. After expiry of the validity period, renewal of authorisation is to be sought.

2. The _____ State Pollution Control Board / Pollution Control Committee may, at any time, for justifiable reason, revoke any of the conditions applicable under the authorisation and shall communicate the same in writing.

3. Any violation of the provision of the Construction & Demolition Waste (Management and Handling) Rules, 2014 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of 1986).

Date:
Place:

(Member Secretary)
State Pollution Control Board/
Pollution Control Committee

Form –IX
See [Rule 23 (3) (p,q)]

Format of Annual Report to be submitted by Urban Local Body to the State Pollution Control Board

(i) Name of the City / Town.....(ii) Population.....
(iii) Name and address of local body / competent authority .....
.....
.....
Telephone No : .....
Fax : .....
Email ID: .....
Website: .....

(iv) Name of In-charge / Nodal Officer dealing with C&D wastes management with designation .....

1. Quantity and composition of C&D waste including any deconstruction waste

(i) Total quantity of Construction & Demolition waste generated during the whole year in metric ton

---

Any figures for lean period and peak period generation per day .....
Average generation of C&D waste per day (TPD) .....

(ii) Total quantity of Construction & Demolition waste collected per day

---

(iii) Any Processing / Recycling Facility set up in the city .....
Status of the facility

(iv) Total quantity of Construction & Demolition waste processed / recycled (in metric ton)

(a) Non-structural concrete aggregate :
.....
(b) Manufactured sand :
.....
(c) Ready-mix concrete (RMC) :
.....

(d) Paving blocks :

.....

(e) GSB :

.....

(f) Others, if any, please specify :

.....

(v) Total quantity of Construction & Demolition waste disposed by land filling without processing (last option) or filling low lying areas

(a) No of landfill sites used :

(b) Area used :

(c) Whether weigh-bridge facility used for quantity estimation? : Yes No

(d) Whether construction and demolition waste used in SLF (for SOLID WASTE) as per Schedule III : Yes No

2. Storage facilities

(i) Area/location/plot/societies covered for collection of Construction & Demolition waste :----------

(ii) No. of large Projects (including roadways project) covered :----------

(iii) Whether Area/location/plot/societies collection is Practiced (if yes, whether done by Competent Authority/Local Body or through Private Agency or Non-Governmental Organization) :----------

(iv) Storage Bins :

	Specifications (Shape & Size)	Existing Number	Proposed for future
(a) Containers/receptacle (Capacity) :			
(b) Others, please specify :			

(v) Whether all storage bins/collection spots are attended for daily lifting : Yes No

(vi) Whether lifting of Construction & Demolition Waste from Storage bins is manual or mechanical (please tick mark) please specify mode and equipment used : Manual Mechanical Others, (specify equipment)

3. Transportation

		Existing	Actually Required/Proposed number
(i)	Truck :		
(ii)	Truck-Hydraulic :		
(iii)	Tractor-Trailer :		
(iv)	Dumper-placers :		
(v)	Tricycle :		
(vi)	Refuse-collector :		
(vii)	Others (Please specify) :		

4. Whether any proposal has been made to improve Construction & Demolitionwaste management practices

5. Have any efforts been made to involve PPP for processing of Construction & Demolition waste : If yes, what is (are) the technologies being used, such as:

	Processing / recycling Technology	(Quantity to be processed)	Steps taken
(i)	Dry Process :		
(ii)	Wet Process :		
(iii)	Others, if any, Please specify :		

6. What provisions are available to check unauthorised operations of:

(i) Encroachment on river bank/wet bodies :
(ii) Unauthorised filling of low line areas :
(iii) Mixing with SOLID WASTE :
(iv) Encroachment in Parks, Footpaths etc. :

7. How many slums are provided with C&D waste receptacles facilities:

8. Are municipal magistrates appointed for taking penal action for non-compliance with these rules: Yes No

[If yes, how many cases registered & settled during last three years (give year wise details)]

Dated: **Signature of Municipal Commissioner**

Form –X
See [Rule 23 (4)(d)]

Format of Annual Report to be submitted by the State Pollution Control Board / Committees to the Central Pollution Control Board

To,

The Chairman,
Central Pollution Control Board,
(Ministry of Environment & Forests),
Government of India,
PariveshBhawan, East Arjun Nagar,
Delhi-110032

1. Name of the State/Union territory :

2. Name & address of the State Pollution Control Board/Pollution Control Committee :

3. Number of municipal authorities responsible for management of municipal solid wastes in the State/Union territory under these rules :

4. A Summary Statement on progress made by municipal authorities in respect of implementation of **Schedule III]** : Please attach as Annexure-I

5. A Summary Statement on progress made by municipal authorities in respect of implementation of **Schedule IV** : Please attach as Annexure-II

Date:
Secretary

Place:

Chairman or the Member

State Pollution Control Board/
Pollution Control Committee

Form –XI
See [Rule 27]

Accident reporting

1. Date and time of accident :

2. Sequence of events leading to accident :

3. The type of C&D waste involved in accident :

4. Assessment of the effects of the accidents on traffic, drainage system and the environment :

5. Emergency measures taken :

6. Steps taken to alleviate the effects of accidents :

7. Steps taken to prevent the recurrence of such an accident :

8. Regular monthly health checkup of workers at Processing / recycling site shall be made

9. Any accident during the collection, transportation and treatment including processing and recycling should be informed to the Competent Authority (Local Body)/ Prescribed Authority

Date :

Place:

Authorised Signatory

Designation

[18-3/2004-HSMD]
Bishwanath Sinha, Joint Secretary

8-5 Draft Karnataka Renewable Energy Policy

Government of Karnataka
Energy Department
Karnataka Renewable Energy Development Limited, Bangalore

Draft Karnataka Renewable Energy Policy 2014-2020.
(Wind, Small Hydro, Biomass, Cogeneration and MSW)

Preamble

Karnataka is blessed with ample renewable energy resources of all forms including wind, solar, small hydro, biomass and cogeneration. The State has an installed renewable energy capacity of 4386 MW at the end of FY 2013-14. Considering all the above mentioned sources it is anticipated that the State has the potential to generate an estimated capacity of 30,000 MW. Technological advances and increasing efficiencies brought in wind and solar sectors, the potential for development is significantly higher than the projected capacity.

The energy demand in the State grew at a higher Compound Annual Growth Rate (CAGR) than the supply resulting in a deficit of energy during 2006 - 14. Similarly the peak load of the State during 2013-14 was higher than that was met resulting in peak demand & supply mismatch. At present, there has been an increased dependence on high cost short term power by the ESCOM's to meet the energy requirement.

In this context, Government of Karnataka recognizing the need for long term energy security and considering the scenario of volatile fossil fuel costs, global warming & climate change has been promoting renewable power generation in the State through its nodal agency KREDL. Government of Karnataka issued "The Karnataka Renewable Energy Policy 2009-14" to promote and to harness the renewable potential in the State. **The policy initiatives have enabled capacity addition of 2104 MW during the 5 years of the policy period.**

Considering the huge renewable energy potential yet to be tapped, the State can accomplish more substantial achievement to make it the leading renewable energy State in the Country. The State wishes to put due emphasis on accelerating the growth of renewable energy sector in future. As an initiative the State has issued "Solar policy 2014-2021" which sets aggressive solar capacity addition targets in the State during the coming years. GoK has now decided to pronounce a new Renewable Energy Policy for the other renewable sources to accelerate capacity addition and to achieve energy security and sustainability in the State.

RESOLUTION:

1. Title:

This policy shall be known as the "Karnataka Renewable Energy Policy 2014-20" (Wind, Small Hydro, Biomass, Cogeneration and Municipal Solid Waste).

2. Nodal Agency:

KREDL shall be the nodal agency for implementation of the new Renewable Energy Policy.

3. Operative Period:

This policy will come into force with effect from the date of issue of Government Order and shall remain in operation for a period of Six years, which will be the operative period of the policy.

However in order to bring in course corrections and also evaluate the impact of policy, Government of Karnataka will undertake an evaluation of the policy in the year 2017. The evaluation will assess the impact of the policy on the sector and the achievements against the growth targets and in case of a requirement, issue amendments to the policy with the required changes.

4. Objectives

- Achieve a minimum capacity addition 3600 MW by 2020 in a phased manner.
- Provision of "single window" for clearances, approvals and technical consultation
- To translate Karnataka in to an investor friendly State.
- Encourage decentralized generation & distribution of energy where grid is inaccessible.
- Promote R&D and innovations, skill development in the sector.
- Take up pilots and demonstration projects to establish cost effectiveness, viability and reliability of various technologies like Waste-to-Energy, Hybrid technology projects etc.,

5. Capacity addition targets

The State of Karnataka will remain a pioneer in the area of renewable energy development in the country. As a part of its endeavor to be on par with the renewable energy obligations set by the National Action Plan for Climate Change and maximize the potential from the renewable energy sources, Government of Karnataka intends to realize a minimum capacity addition of 3600 MW during the policy period in a phased manner from various technologies. The proposed year-wise targets are as given below:

RE Source	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Total
Wind Power	350	400	425	450	475	500	2600
Mini, Micro & Small Hydro	50	100	100	100	125	125	600
Biomass, Cogeneration and MSW	35	65	75	75	75	75	400
Total	**435**	**565**	**600**	**625**	**675**	**700**	**3600**

The Government of Karnataka, in order to meet the target capacity additions during the operative Period would encourage setting up of projects under any of the following categories

- Feed-in-Tariff based or Competitive Bidding based projects
- Projects under Captive/Group Captive and Independent Power Producer mechanism
- Projects under REC mechanism

6. Eligibility

All Wind, Small Hydro, Biomass, Cogeneration and Municipal Solid Waste Management projects established in the State of Karnataka during the Operative period shall be eligible for benefits under this policy.

7. Regulatory Frame Work.

The Electricity Act 2003 mandates Karnataka Electricity Regulatory Commission to determine tariffs for renewable energy, to issue regulations regarding percentage of renewable purchase obligation to ESCOMs and determine charges with respect to wheeling, banking and cross subsidy charges. Conditions for getting accreditation to avail Renewable Energy Certificates shall be governed by CERC and KERC regulations.

Orders / regulations or any other dispensation issued by the State Commission from time to time shall be applicable to the provisions of this policy including the Acts passed by GoI. In case of any discrepancy between the provisions of this policy, orders/ regulations issued by KERC will prevail.

8. Governance & Institutional Structure for implementation of RE projects

A High Level Committee for Renewable Energy (HLC-RE) with Chief Secretary, GoK as Chairman. will be constituted by the GoK under this policy in order to fast track implementation of renewable energy projects and thus capacity addition in the State.

8.1 HIGH LEVEL COMMITTEE FOR RENEWABLE ENERGY (HLC-RE)

The HLC-RE in the state will comprise of the following members.

- Chief Secretary, GoK- Chairman
- Additional Chief Secretary/Principle Secretary, Energy Department- Member
- Principal Secretary, Finance Department-Member
- Principal Secretary, Revenue Department-Member
- Principal Secretary, Irrigation Department-Member
- Principal Secretary, Industries Department-Member
- Principal Secretary, Forest Department-Member
- Managing Director, KPTCL-Member
- Managing Director, concerned ESCOM-Member
- Managing Director, KREDL- Convenor & Member

The committee will review the issues relating to the statutory clearances of various departments. **The clearances / approvals which are not accorded within the specified time period will be dealt by the HLC-RE**. Inter departmental co-ordination will be strengthened to achieve faster clearances.

The HLPAC-RE shall meet once in every three months during the financial year. The implementation of the RE projects will be monitored by the Energy Department to ensure timely commissioning of the projects.

In addition to above, depending upon the need KREDL could invite RE technology (Wind, Small Hydro, Biomass, Co-gen, MSW) specific representation through RE associations/developers and academic experts to discuss specific issues.

The Allotment Committee for RE projects shall meet once in every three months. KREDL will examine and submit proposals with relevant details to Allotment Committee along with its recommendations. The developer will approach different departments for clearance/approvals after the issue of allotment Government Order. The developer may also forward the applications to the relevant departments through KREDL. The concerned department will convey the approval/clearance/observation or comments if any within a stipulated time period of 45 days.

KREDL shall submit a report to the HLC-RE seven days in advance to the meeting for its review and deliberations. The said report shall cover Note on project clearance issues to be resolved during inter-departmental meeting.

KREDL as a State Nodal Agency shall carry out the following functions:

a) Preparation of guidelines for allocation and implementation of RE Projects.
b) Act upon the guidelines of Allotment Committee and in accordance with this policy provisions.
c) Verification and Recommendation of proposal to Allotment Committee.
d) Act as a facilitator to obtain all statutory clearances.

e) Resolution of policy level issues for accelerating deployment of various RE technologies.
f) Monitoring the progress of project implementation.
g) Recommendation to GoK for cancellation of RE projects upon non-implementation within the stipulated period.
h) Recommendation for Re-allocation of cancelled projects.
i) KREDL shall act as a single window agency for implementation of RE Projects.
j) KREDL shall be strengthened suitably with necessary manpower and resources for successful implementation within 6 months from notification of this policy.

9. Procedure for Application and Allotment:

Common for all RE Projects

a) The applicant shall furnish the details as per the prescribed application form along with required documents by paying application fee as prescribed by the GoK from time to time.

b) The net worth of the company shall be at least 30% of the total project cost and the format should be as per **Government order No: EN 240 NCE 2011 dated 30-05-2011** or as amended by the GoK from time to time.

c) The capital cost per MW considered by KERC and revised from time to time in the respective tariff orders for Wind, Small Hydro, Biomass and Cogeneration projects can be used as reference for estimating the net worth requirements. However, in case of Cogeneration Projects Sugar factory cost to be excluded and only Cogeneration Power Project cost to be considered.

d) The developer has to identify the site area. The details of the land required for the proposed project, such as break up of Private/Revenue/Forest land along with tentative Survey Nos, RTC's and extent of land shall be marked in a Topo sheet and furnished.

Wind

a) Proposal containing the preliminary details required for the implementation of the project shall be furnished.

b) If the Allotment Committee approves the proposal, a facilitation letter valid for a period of 2 years will be issued by the Government to the developer to study the wind potential, preparation & submission of the Detailed Project Report.

c) Government order for Allotment will be issued only after submission of Detailed Project Report and payment of prescribed processing fee as notified by GoK from time to time. If the developer fails to submit Detailed Project Report by the end of 2 years, the allotment is deemed to be rejected.

d) The allottee will execute an Implementation Agreement within 45 days from the date of Government Order with KREDL.

e) One time Capacity enhancement is allowed on the first proposal.

Small Hydro

a) A Pre-Feasibility Report/Detailed Project Report as applicable containing the preliminary details required for the implementation of the project shall be furnished along with the Application.

b) The Developer shall take the following into consideration before applying:

- Water Discharge, levels, Head, location of Weir, Power House details shall be provided in the PFR/DPR.
- The PFR/DPR shall be prepared considering the fact that the release of water shall be strictly as per irrigation/domestic demands and the generation will have to be synchronized with these releases.
- Irrigation Department reserves the right to decide the water release schedule and modify it from time to time as per the requirements. Irrigation Department shall make efforts to release maximum volume of water in such a manner that it can be used for generation of electricity at desired time. However, the decision of Irrigation/Small Irrigation Department in this regard shall be final and binding.
- The developer is required to submit a No Objection Certificate from KPCL and Forest Department.

c) In case of submission of PFR, if the Allotment Committee approves the proposal, a facilitation letter valid for one year will be issued to the developer to prepare the DPR. After submission of the Detailed Project Report along with the prescribed DPR processing fees to KREDL, Allotment GO will be issued.

d) The allottee has to execute an Agreement within 45 days from the date of Government Order with KREDL.

Biomass, Cogen and MSW

a) The developer shall submit Detailed Project Report along with prescribed application and processing fee (Processing fee is not applicable for Cogen Power Projects as per the prevailing GO).

b) In case of Biomass, Cogeneration or MSW power projects, the Developer shall take the following into consideration before applying.

- In case of Biomass or Cogeneration projects the technology proposed, the fuel availability and catchment area for fuel shall be provided. The raw materials available in the radius of 40kms surroundings will be taken in to consideration for allotment of the Biomass Power Projects to avoid the overlapping of the other projects.
- Applications in respect of Cogeneration will be considered only after Sugar Cane allotment from the Department of Industries and Commerce, GoK.

- Applications in respect of MSW Projects will be considered only after allotment of Municipal Solid Waste from the concerned local bodies, details of waste storage shall be furnished along with the initial consent from Pollution Control Board.

c) After verifying the proposal, KREDL will recommend to GoK for issuing NOC.

d) Apart from this, the details of the availability of Municipal Solid Waste in each Taluk will be published / uploaded in KREDL web site after the detailed study and with authenticated input from the local governing bodies/authorities including the Municipal Authorities to ensure decentralized energy generation in each Taluk place. This will also help in minimizing MSW transportation and the eradication of the Epidemics.

e) The availability of Biomass in each village in each season with its type, quantity and calorific values will also be published / uploaded in KREDL website after the detailed study with authenticated input from the local governing bodies / authorities including the Agriculture Department to ensure decentralized energy generation and to increase the economic activities / GDP of Rural Karnataka while creating lot of rural job opportunities.

10. Timelines for Implementation:

Wind Power Projects

Total time period required for implementation of the project is 5 years 6 months from the date of issue of Allotment GO.

Stage 1: Two years for data collection and submission of DPR with enhancement if any.
Stage 2: One year three months for obtaining all statutory clearances.
Stage 3: Three months for technical clearance.
Stage 4: Two years for completion and commissioning of the project.

Small Hydro Power Projects:

Total time period required for implementation of the project is 5 years from the date of issue of Allotment GO.

Stage 1: One year forpreparation and submission of DPR with enhancement if any.
Stage 2: One year for obtaining all statutory clearances.
Stage 3: Three months for technical clearance.
Stage 4: Two years nine months for completion and commissioning of the project.

Biomass, Cogeneration and MSW Projects:

After issuance of NOC total time period for implementation of the project is 24 months.

Security Deposit or Performance Guarantee:

The Developer shall provide Security Deposit in the form of Bank Guarantee @ Rs 1 Lakh per MW or as per the prevailing Government order payable to KREDL based on allotted capacity within 45 days of Allotment GO or before the signing of agreement, whichever is earlier.

The project must be commissioned within the timelines mentioned in this policy.

In order to encourage Biomass and MSW projects, the performance guarantee clause is waived off as in Co-gen Power Projects.

11. Time Extension

Time extension may be recommended by the Nodal Agency to the Government if and only if the delays are due to reasons beyond the Developer's control. The Developer must approach the agency atleast 6 months before the scheduled commissioning date with the application for seeking extension with valid justification.

In case of delay in achieving CoD, the Nodal Agency may recommend to GoK to allow one-time extension along with payment of prescribed fee, provided the Developer is able to show adequate proof for the delay being beyond the control of the Developer.

In case the Developer fails to Commission the Project or approach the Nodal Agency seeking time extension within the stipulated period, KREDL will recommend the proposal to GoK for cancellation duly forfeiting the Performance Guarantee.

Progress Reports:

The Developer shall submit quarterly progress reports of the project related to approvals from other concerned departments, Power Purchase Agreement, financial closure and construction from the date of issue of Government Order.

12. a) Power Purchase Agreement

The Government will assign the PPA to the jurisdictional ESCOM at the time of allotment. The sale of electricity by independent power producer will be governed by the power purchase agreements executed between the sellers and purchasers and approved by the KERC.

12. b) Wheeling & Banking Agreement

The wheeling of electricity generated from the renewable sources mentioned in this policy, to the desired location(s) within the State and banking of such energy, shall be allowed on such terms and on payment of relevant charges as determined by KERC from time to time.

13. Land

a) The land required for setting up of projects shall be acquired by the Developer.

b) If the required land is private land, Developer has to acquire the same directly from land owners by any mode of transfer. If it is on lease, the minimum period of lease shall be 30 years.

c) If the required land belongs to Government, the Developer shall approach concerned Department, i.e., Revenue/Forest or irrigation Department, as the case may be for obtaining the land on lease basis in favour of the company, as per the circular No: **RD 78 LPG 2009 dated 4.1.2011** and subsequent orders of Revenue Department. Revenue Department will directly lease the land to the company for a period of 30 years. At the end of 30 years the lease shall be extended for 5 years at a time, subject to condition stipulated by Government.

d) In case, the land belongs to Forest Department, Forest Department should issue facilitation letter as per the standard draft approved by MOEF, GOI, New Delhi vide letter No: **F. No: 11-113/2008 FC dated 30.12.2008** and subsequent orders.

e) No projects will be entertained in the regions categorized as ecologically sensitive by the State.

f) Shifting/Change of locations for allotted Wind/Small Hydro/ Biomass/Co-gen/MSW Projects is not permitted. The developer has to apply afresh for seeking allotment in the new location.

g) The concerned Government departments shall make land available including waste land for developing Renewable Energy projects. KREDL shall explore feasibility of those sites for any probable RE development, which forms the land bank for respective RE technology.

h) The Municipal Bodies will identify and reserve the land for waste to energy projects. On feasibility check by KREDL or any third party authorized agency, the identified land will be acquired through the Karnataka Industrial Area Development Board (KIADB), under the provisions of the Karnataka Industrial Policy and the same is made available to KREDL.

14. Metering of Electricity:

The metering will be done as per Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 and amendments issued from time to time.

The Project developers will have to install Remote Transmitting Unit (RTU) for transferring real time data to SLDC for its monitoring purpose. The electricity generated from the projects, shall be metered and readings taken jointly by Power Project Developer with transmission company/ESCOMs at the metering point, on a monthly basis.

15. Reactive Power Charges:

The drawl of reactive power shall be charged as per the KERC order, as amended from time to time.

16. Government of India incentives:

MNRE, Govt. of India provides a package of fiscal and financial incentives which include concessions such as Central Financial Assistance, concessional custom duty on specified items, excise duty exemption, sales tax exemption, tax holidays etc. The same shall be extended to the project developers.

17. Additional focus areas for the Government include:

Encouraging repowering of wind projects:

- In order to maximize the tapping of energy from the existing projects, Government encourages repowering of wind projects.
- Projects commissioned with lower capacity Wind Turbines are eligible for repowering under this policy. The excess capacity can be considered to get the benefits at the prevailing tariff.

Biomass, Bagasse based cogeneration Projects:

- The State government shall address the issues of non availability of biomass fuel for power generation.
- GoK considers setting up "Biomass Parks" in rural areas of the State, dedicated for supply of biomass fuel to designated biomass power projects.
- The State government shall encourage plantation of biomass fuel in the dedicated zones identified by the Gram Panchayats of villages (or cluster of villages) where such potential exists.

Potential Assessment

- GoK intends to study the potential for zone based tariff and to carry out this study private players are encouraged & to set up met masts in different regions in the State and collect the necessary data. KREDL will seek support from CSTEP and undertake wind and solar mapping using Geospatial mapping.
- A separate dedicated cell with staff drawn from KREDL, KPCL, Revenue department and Irrigation department will take steps to identify the potential sites watershed basin wise including canal based projects and offer the identified sites for

development of Small hydro projects on Public Private Partnership/Build Operate Own Transfer mode.

- GoK intends to study the potential for MSW power projects with in BBMP/local body limits. Also GoK will work in consultation with Stakeholders/ESCOMs to seek viable tariff for such projects from KERC.
- GoK is contemplating through KREDL to study the availability of any raw material in the region and assess the potential and allot capacities on that basis.

18. Policy initiatives under consideration of GoK to promote renewable power projects.

Akshaya Shakthi Nidhi (Green Energy Fund)

- In order to facilitate Renewable Energy project financing and Energy Conservation and Efficiency measures Green Energy Fund "Akshaya Shakthi Nidhi" was announced in the last policy which will be taken up in this policy period.
- "Green Energy Cess" of Rs 0.05 (five paise) per unit would be levied on the electricity supplied to commercial and industrial consumers. 10 % of this fund will be set apart as contribution to Energy Conservation Fund for Energy Conservation activities. The balance will be set apart for Renewable Energy project financing.
- The Akshaya Shakthi Nidhi will be administered by KREDL for promotion of Renewable Energy particularly in Public Private Participation (PPP) mode, decentralized generation and distribution Renewable Energy projects for the benefit of rural sector.
- The funds may also be utilized for land acquisition and land development activity for Renewable Energy projects including compensatory afforestation, soil moisture conservation etc. for forest land clearance. A detailed framework for its implementation will be announced separately.

Land

- GoK contemplates to facilitate deemed conversion of land for projects by amending section 95 of Land Revenue ACT 1964.
- GoK contemplates time bound permissions and for vesting Deputy Commissioners with full powers to approve purchase of agriculture lands U/s 109 of Land Reforms Act for development of RE projects.
- Necessary amendments to section 79(a), 79(b) and 80 of the Karnataka Land Reforms Act are to be made to enable the Renewable Energy project developers to purchase suitable private land directly from the owners of the land.

- A separate dedicated cell with staff drawn from revenue department shall be created to ensure creation of Government land banks for development of renewable energy projects on lease basis including formulation of modalities, fees, etc.
- The Government shall develop barren land in Karnataka as per Clause 5.1.1 of the Karnataka Industrial Policy. The barren Government land, reserved, as per the industrial planning for industrial use, at declared Renewable Energy sites, 10% of such land will be earmarked for KREDL for developing the land to set up the Renewable Energy power projects.
- The barren land upon feasibility study shall be developed by KREDL to facilitate setting up of various RE projects. The Green Energy Fund will be utilized to develop the land including the payment towards Compensatory Afforestation in case of Forest Land. This will enable the State to offer ready to use developed land to set up Renewable Energy projects.
- Developers will be allowed to start project execution without waiting for formal approval on filing application for conversion of agricultural land for setting up of wind power projects on payment of specified fees.

Allotments and Clearances

- Time bound clearance for evacuation approval from KPTCL. Reduction of supervision charges by KPTCL /ESCOMs to 5%.
- Allotment of cancelled sites: For among the sites for which allotment has been cancelled, KREDL will shortlist sites which can be re-alloted.
- Cancellation of allotments beyond 6 years: Any allotments which failed to show any progress or intent in developing the projects within 6 years from the date of announcement of the policy shall deemed to be cancelled. Government reserves the right to extend time period for projects awaiting forest clearances.
- **All projects allotted 10 years before the announcement of this policy and have failed to show any satisfactory progress, their allotments shall be deemed as cancelled.**

Hybrid and Distributed Generation projects

- The GoK encourages large scale grid connected projects that can benefit from existing project infrastructure. In this regard "wind with solar hybrid projects" or "biomass with solar hybrid projects" shall be promoted through this policy.
- GoK also intends to promote small scale hybrids particularly in remote villages in the State where the grid is inaccessible.
- GoK recognizes supporting setting up of upto 2 MW biomass or MSW power project, as smaller plant capacities face no difficulties in sourcing (including transportation, storage and fuel security) and would be ideal for decentralized power production. The target under the category is 25 MW during the Operative Period of the policy. Such

plants are encouraged to be connected to the 11 kV distribution line and improve, stabilize the power supply at the local level. In this context;

- ESCOM's shall facilitate grid connectivity for such small power producers at 11 kV and work for grid availability, especially in rural areas.
- ESCOM's shall evaluate options to reduce power supply to rural areas and irrigation users through use of Biomass and MSW power projects.

Biomass resource specific

- GoK contemplates licensing/registration of biomass material trading/trader to bring in consolidation of biomass trading as well as help organize the process effectively.
- GoK will draw plans for investment to set up, manage and use of biomass resources available in the State for power generation projects. Appropriate rates and payment mechanism for the fuel sold to the biomass power producers shall be worked out.
- GoK is contemplating to project capacity that can be allocated in the region based on raw material available.
- GoK is contemplating to promote Biomass – Solar Hybrid power projects in the State based on viability.
- The State government would also ensure viability of biomass prices and would register all the biomass planters and traders.
- Besides, pilot schemes on Biomass-Wind hybrid projects in the State shall be established to demonstrate the mutual benefits offered by the technology and thereby promotion of Biomass projects.

Waste to Energy projects

- GoK intends to undertake through KREDL a pilot project on MSW to energy. The pilot will be undertaken on a small scale to establish viability.
- GoK will study the viability of the project, undertake stakeholder discussions in consultation with KERC to ensure successful implementation of the project.
- BBMP / Local Body responsible along with KREDL will identify land and design the framework for executing the project.

Support for R&D institutes and Technology Development centers

- GoK shall facilitate indigenous R&D for new and emerging renewable technologies and improvement of available technologies. GoK, in consultation with RE technology experts and experts from academic / R&D institutions, shall identify the priority areas for R&D. Time bound specific tasks for identified R&D activities shall be assigned to recognized / identified institutions and industry with clear understanding on the achievement of results.
- **Biomass, Waste to Energy and Storage**: The Centre for Sustainable Technologies (CST), Indian Institute of Science (IISc) has been working in the area of

R&D for biomass, waste to energy and storage of energy. GoK shall strengthen the capacity of CST, IISc to facilitate research in this field.

- **Other RE Sources**: Advances in basic science will be the foundation for progress on RE technologies. Creating linkages between basic research and applied technology development will be crucial to ensuring the needed technology breakthroughs. Therefore, GoK shall facilitate creation of a R&D center for renewable energy at a suitable Institution.
- Private Sector Participation in R&D Activities: Initiatives from the private sector in research and development activities for advancement of renewable energy shall be encouraged by GoK.

19. Fiscal Incentives from GoK to promote Renewable projects.

- Projects implemented under this policy shall receive the status of industry and shall be eligible for all the incentives provided under "Karnataka Industrial Policy 2014" of State government as amended from time to time. If there is any contradiction between the provisions of this policy and the Industrial Policy then the provision of this policy shall be applicable.
- Tax concessions in respect of entry tax, stamp duty and registration charges shall be as per Karnataka Industrial Policy as amended by GoK from time to time.
- The Industrial Consumers opting to procure power from Project set up under this policy, through Captive/Group captive route or Independent Power Producer route shall be allowed corresponding pro-rata reduction in Contract Demand on a permanent basis but subject to the decision of KERC in this regard.
- No green energy cess is applicable on the power procured from renewable energy power projects in the State.

20. General Conditions:

a) If the developers fail to commission at least 50% of the allotted capacity within the stipulated time period, no further allotment shall be entertained. Developers' history in implementation of projects will also be given a consideration to decide on further allotments.

b) One year time extension shall be permitted after furnishing the valid reasons on payment of time extension fee and the Performance Bank Guarantee in force at that time.

c) The enhancement of the already allotted capacity shall be considered only within the stipulated time period of the original allotment. The enhancement of capacity shall be limited to 3 times the original capacity.

d) The capacity allotted to developer shall be permitted to transfer the capacity to the investors only after achieving sufficient physical and financial progress duly paying

necessary transfer fees in force at that time for Wind Projects. For other RE Projects transfer of capacity can be considered only after commissioning of the project.

e) Any capacity surrendered or cancelled shall be re-allotted on a first cum first serve basis.

f) Land owners shall be given priority for installation of wind mills in the area allotted to a third party. In which case the original allottee shall be given due notice with regard to the re-allotment. Additionally the new applicant or land owner shall have to ensure that wind turbine generator being installed at the project site should comply to the technical requirements of inter-turbine spacing as per MNRE guidelines and from the other nearest previously identified/installed wind turbine generators of the original allottee.

g) Notwithstanding anything contained in this resolution, the provisions of the Electricity Act-2003 and KERC order as issued from time to time, shall prevail, for the purpose of the implementation of this policy.

21. Power to amend & interpret the policy.

Government of Karnataka will have power to amend/ Review/ Relax/ interpret any of the provisions under this policy as and when required.

Note-

Documents to be submitted for Facilitation Letter:

1. Application in the prescribed format
2. Detailed Proposal/DPR/PFR
3. Area/Location marked in the topo sheet 1:50,000 scale
4. Net worth certificate duly signed by registered Chartered Accountant in the Government approved format.
5. ROC certificate/MOA/AOA
6. Land details like Survey Nos., RTC with extent of land etc.

8-6 Public Information on Dry Waste

BRUHAT BENGALURU MAHANAGARA PALIKE

PUBLIC INFORMATION

Dear citizens **Date: 09-02-2015**

Please participate in BBMP programme of segregating solid waste at Source to keep our city clean

Reap benefits from Source Segregation of Municipal Solid Waste

You can make profit by selling dry waste at attractive rates to Dry Waste Collection Centers established by BBMP

BBMP has established Dry Waste Collection Centres (DWCC) in most of the wards. The address & contact numbers of DWCCs can be obtained from the BBMP website : www.bbmp.gov.in

You can sell different categories of dry waste at the rates defined by the DWCC operators. The approximate rates for different categories of dry waste is indicated as below (The rates are indicative, subject to changes as per market)

As per the section 256 & 260 of KMC act 1976, **the commissioner of BBMP has notified regarding segregation of Municipal Solid Waste at source. This is mandatory w.e.f. 01/10/2012** and it has also been upheld by the Hon'ble High Court of Karnataka. **Therefore public should segregate the Municipal Solid Waste generated from the houses, Commercial establishment into two categories i.e. Wet Waste and Dry Waste** and deliver to BBMP Collectors.

Dear Residents, Start from your home today! Use this information for correct methods of waste segregation & disposal. Explain this to every member of your family and also to your house maids.
Join Hands with BBMP and help us to keep our city clean & tidy.

"CLEAN CITY IS OUR RESPONSIBILITY"

Sri. Narayan H.
Chairman, Public Health Committee

Sri. K. Ranganna
Deputy Mayor

Smt. N. Shanthakumari
Worshipful Mayor

Dr. K.C. Yatishkumar K.C.S.
Joint Commissioner (Health & SWM

Sri. Darpan Jain, I.A.S.
Special Commissioner (SWM)

Sri. M. Laxminarayan I.A.S.
Commissioner