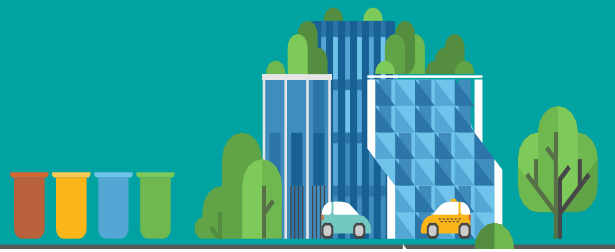
Integrated Waste Management with Decentralized Approach
Case Study – Indore , India



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Integrated Solid Waste Management

Scientific Waste Processing

IEC / BC Activity

Manual Sweeping in Wards

Door to Door Waste Collection

ODF++ City

ICT Based Intervention

Mechanized Road Sweeping

Scientific Landfill Site

Solid Waste Management

Material Recovery Center

Citizen Grievance Redressal

Disposal Free Markets

Bioremediation of Legacy Waste

Transfer of Waste

Source Segregation

Plastic Waste Management

Door to Door Collection with Segregation

Wet Waste

Dry Waste

Sanitary & Domestic Hazardous Waste

Ultra Modern Mechanized Transfer Stations

10

Ultra Modern Mechanized Transfer Stations

AT SANGAM NAGAR

IT PARK INDORE

STAR SQUARE MR-10

LALBAG INDORE

Distribution of Personal Protection Gears to all SWM workers






- IMC distributed Raincoats, Hand gloves, fluorescent jackets and Masks
- Ensuring that every employee uses personal protective safety gears while working in the field.

ISO CERTIFICATE - Disposal site Devguradiya

- IMC has obtained ISO 9001:2015, ISO 14001: 2015, OHSAS 18000:2007 for Segregation, Collection, Transportation & Disposal of Solid Waste.

Central Wet Waste Processing Unit

Decentralized Processing

Decentralized Organic Waste Processing

238 units
Hotels, Hospitals, Marriage Gardens, Schools and Colleges etc.

76 units
Residential Welfare Associations (RWA's)

386 units
City Gardens covering all 586 developed gardens

5 TPD
Capacity mobile decentralized composting unit

Hon'ble Mayor and IMC Commissioner at RWA Talk show

RWAs Bulk Garbage generators practicing Onsite processing

Mobile Composter

Decentralized Processing

Decentralized Organic Waste Processing

20 TPD
Biomethanation Plant at Choithram Mandi

Bio-CNG plant at Choithram Mandi

15 TPD
Bio-methanation Plant at Kabitkhedi

Bio-CNG plant at Kabitkhedi

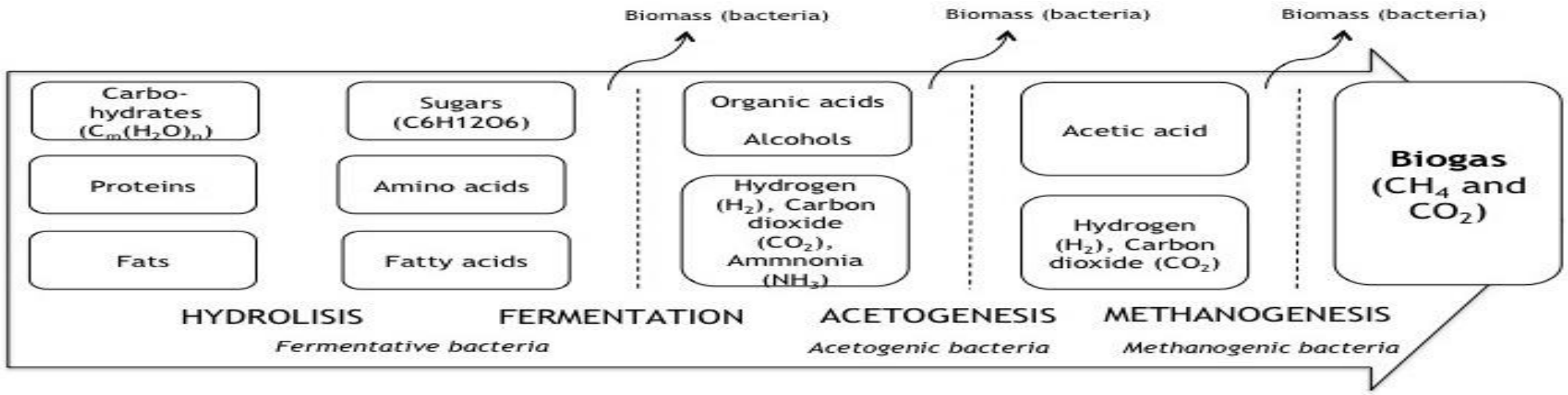
Biomethanation

Anaerobic digestion (AD) is a promising technology, which could effectively address the problem of food/organic waste disposal thereby yielding valuable outputs like biogas and fertilizers

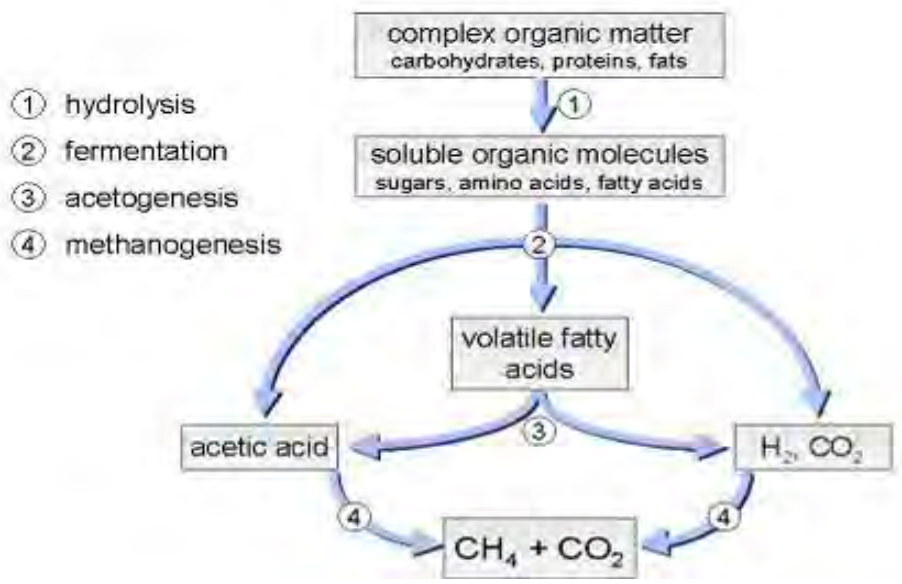
In this process, organic fraction of the wastes is segregated and fed to a closed container (Biogas digester) where, in the presence of methanogenic bacteria and under anaerobic conditions, it undergoes bio-degradation producing methane-rich biogas and compost.

The biogas can be utilized either for cooking / heating applications, or for generating motive power or electricity through dual-fuel, gas engines, low pressure gas turbines or steam turbines.

The sludge from anaerobic digestion, after stabilization, can be used as a soil conditioner, or as manure depending upon its composition, which is determined mainly by the composition of the input waste.



What is Biogas



Methane (CH_4)	50 to 75 %
Carbon Dioxide (CO_2)	25 to 50 %
Hydrogen (H)	5 to 10 %
Nitrogen (N_2)	1 to 2 %
Hydrogen sulphide (H_2S)	2 to 5 %

Biogas is a mixture of methane and carbon dioxide. The properties of biogas are similar to the ones of natural gas.

Typically biogas is composed of:
Biogas mainly consists of methane (about 50-75%), carbon dioxide (about 25-40%) besides small quantities of NH3 and H2S and has a Calorific Value of about 5000 kcal /m3.

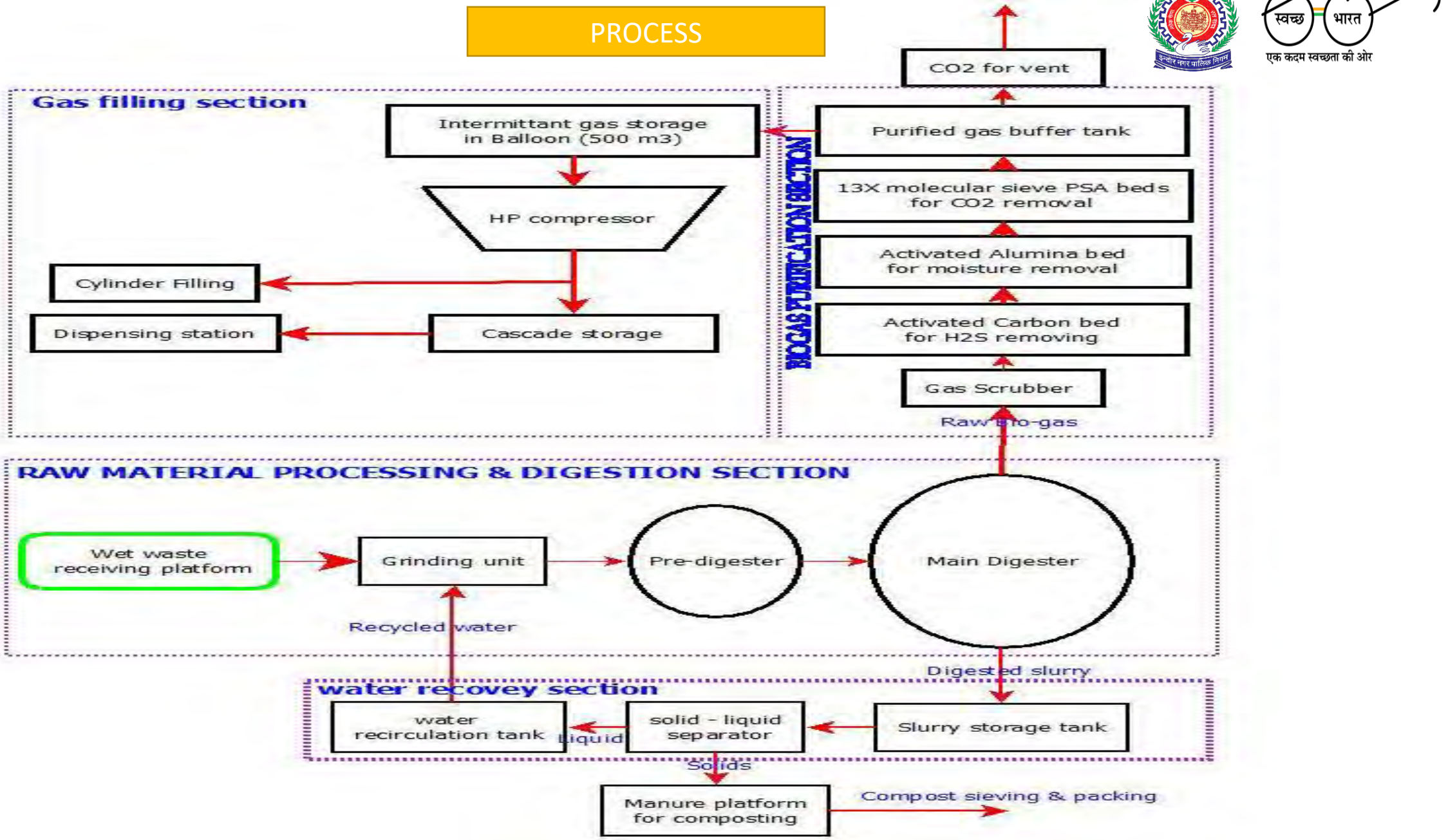
This composite gas can be separated and Methane and Carbon Dioxide of 92 to 95% purity can be recovered which can be used for various ancillary purposes as suitable.

Depending upon the waste composition, the biogas production ranges from 50-150m3/tonne of wastes.

Advantages of Anaerobic Digestion / Biomethanation

- **Biogas is Eco-Friendly** - Biogas is a renewable, as well as a clean, source of energy. Gas generated through bio digestion is non-polluting; it actually reduces greenhouse emissions (i.e. reduces the greenhouse effect). No combustion takes place in the process, meaning there is zero emission of greenhouse gasses to the atmosphere; therefore, using gas from waste as a form of energy is actually a great way to combat global warming.
- **Biogas Generation Reduces Soil and Water Pollution - In** biogas generation there is no spillage of water or effluent. It is a closed process which in turn, leads to improvements in the environment, sanitation, and hygiene.
- **Reduction of land requirement** for MSW disposal.
- By Biomethanation of organic waste no landfilling is required hence we can **avoid emissions** from landfills and potentially reduce the need for additional landfills.
- Production of stabilized sludge can be used as **soil conditioner** in the agriculture field.
- Energy generation which will **reduce operational cost**.
- Supplement SDGs to achieve real, long term, measurable and cost effective **GHG's reduction**

PROCESS


Gas filling section
Intermittant gas storage in Balloon (500 m3)
HP compressor
Cylinder Filling
Dispensing station
Cascade storage
BIOGAS PURIFICATION SECTION
CO2 for vent
Purified gas buffer tank
13X molecular sieve PSA beds for CO2 removal
Activated Alumina bed for moisture removal
Activated Carbon bed for H2S removing
Gas Scrubber
Raw bio-gas
RAW MATERIAL PROCESSING & DIGESTION SECTION
Wet waste receiving platform
Grinding unit
Pre-digester
Main Digester
Recycled water
Digested slurry
water recovey section
water recirculation tank
solid - liquid separator
Slurry storage tank
Liquid
Solids
Manure platform for composting
Compost sieving & packing

Bio-CNG Plant at Indore

Capacity : 20 TPD organic green waste

Digesters: The digestion capacity of the installed biogas plant is 20 tons/day. Gas production capacity: Around 1600 cum of raw biogas daily.

Cleaning of gas : Enriched to meet the gas quality equivalent to the standards specified by BIS (IS:16087 2016).

Final output: Bio-CNG 700 kgs/ day.

Organic Manure: 6 tons/day

Feeding Mechanism

The wet waste which is generated from the vegetable wholesale market(mandis), hotels and schools and from the bulk generators is brought to the bio-methanation plant and is kept on the feeding area.

Small portions of waste is feeded in the feeder and a grinder is connected with the feeder which grinds the waste to make the processing easy.

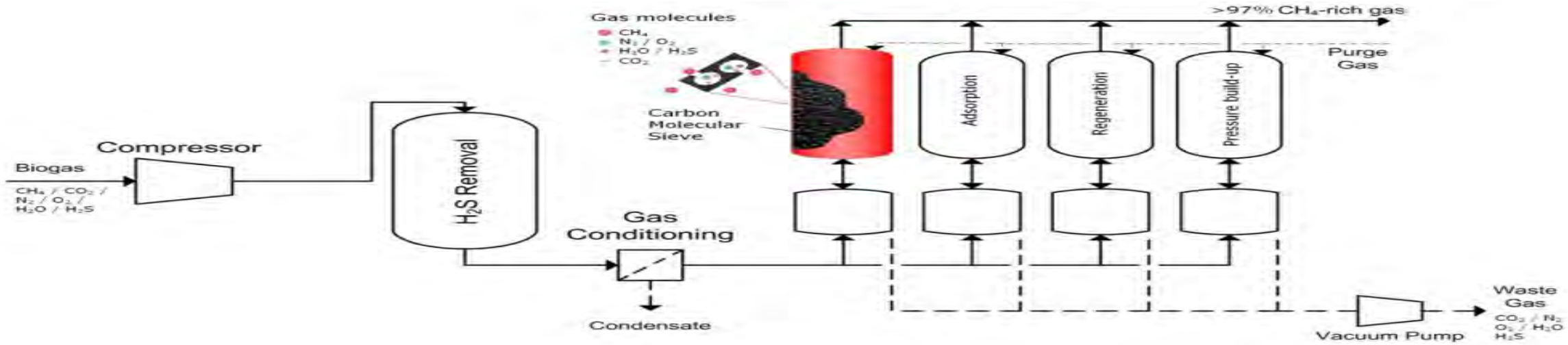
During the Feeding Process water is added up with the waste in the ratio of 1:1(in 1 kg of waste 1 liter water is added up.

Digester

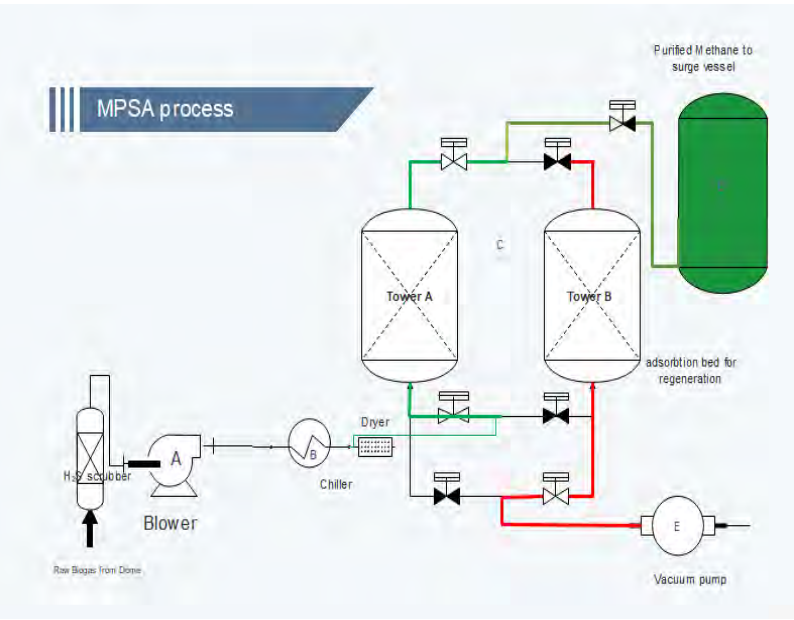
- Under anaerobic conditions, temperature around 35°C and a continuous mixing, biogas is being produced by the conversion of the dissolved organic matters.
- Daily feeding capacity of 20 Tons. Stirring is done using mechanical, hydraulic or pneumatic equipment. Up to 90% of biogas plants use mechanical stirring equipment.
- Stirring prevents formation of swimming layers and of sediments, brings the micro-organisms in contact with the new feedstock particles, facilitates the up-flow of gas bubbles and homogenises distribution of heat and nutrients through the whole mass of substrate.

Biogas Enrichment

- The raw biogas is processed and purified from the unwanted gases like CO2, H2S and moisture up to a certain required level.
- If biogas is to be used as renewable source of methane for power generation and vehicular fuel, it should meet with specifications(IS:16087 2016) (India).
- Biogas up-gradation would mainly involve integration of suitable CO2−CH4 separation facilities.
- The vacuum-pressure swing adsorption (VPSA) or medium pressure swing adsorption (MPSA) process, which is a subset of PSA, has high potential because here the adsorption step is carried out at near atmospheric pressure, at which the biogas is available, thus negating the high compression cost of PSA,
- The purification cost is substantially lower than the other technologies with this scale.



Medium Pressure Swing Adsorption process (MPSA)



BIOGAS-BLOWER *: Responsible for entire gas flow in the units.*
GAS-COOLER : *Cooling of adoption performance gas below 30 deg c'.*
ADSORPTION-SYSTEM : *Two towers alternately adsorb and produce methane gas of more than 94% consistently.*
BIO CNG SURGE-TANK *: Bio-CNG is continuously supplied to a Surge tank with large volume for stable Bio-CNG output.*
VACUUM-PUMP: *Ensures complete regeneration of the media to enable tower to be ready for the next cycle.*
CONTROL-SYSTEM : *System process is achieved by PLC (Programmable Logic Controller) control system. In order to ensure safe Bio-CNG supply, functions of inter link, protection, alarm, etc can be provided. System operating parameters can be adjusted to save energy.*

Purified Gas Storage Balloon

- Bio-CNG Storage Balloon are made with corrosion free double membrane balloon/ holders.
- The internal membrane is stretched by the pressure of the produced biogas.
- Air is pumped between the cover dome and internal membrane so that it provides pressure to the upper side of the membrane and gives a spherical shape to the cover dome.
- A Bio-CNG Storage Balloon, which is collapsible and intermediate storage tank for bio-CNG prior to the application or before compressor.

210 Bar MPA Compressor Gas Compressor and Cascade Gas storage and Filling

The installed compressor is an ATX proof robust compressor by considering the durability and safety. The installed compressor is ELGI Sauer Make of model No: WP4341, which is four stage air cooler type compressor with a rated capacity of 70 Nm3/hr capacity.

The standard Industrial grade cylinders certified by PESO were installed for gas storage. At present there are three cascade are installed at the site Everest Kanto Cylinders Ltd -1 cascade & Euro India Cylinders Ltd -2 No of cascade of total 3 were installed. Each cascade is 40 cylinders bank of 75 ltr each.

Bio-CNG Dispensing Unit

The present installed dispenser is Parker make dispenser designed for Hazardous area under class I, DIV I, Group IIA & IIB. The dispensers “Measure” the mass of CNG and “Monitor: the delivery pressure to control the filling operations,
It meets statutory regulations on safety of vehicle being filled.

Cost Benefit Analysis

Bio-methanation plant capacity in TPD	Area required in sqm	Capital Cost of plant and equipment in USD in Million	Average Biogas generated in Ton Per Day	Bio-CNG generated per year in Ton	Revenue per year @ USD 715 per Ton	Payback period in year
25	12000	2.0	115	350	250250.00	7.9
50	25000	3.40	120	700	500500.00	6.8
100	40000	5.7	120	1400	1001000.00	5.7

Government of India incentives and support

- Government has chosen Bio-methanation technology as recommended technology for cities generating 100 TPD segregated wet waste.
- Central Government provides 25% grant on capital cost under Swachh Bharat mission.
- Government has instructed all gas and fuel marketing companies to purchase and promote Bio-CNG gas generated form processing of Organic Garbage under “Satat” scheme

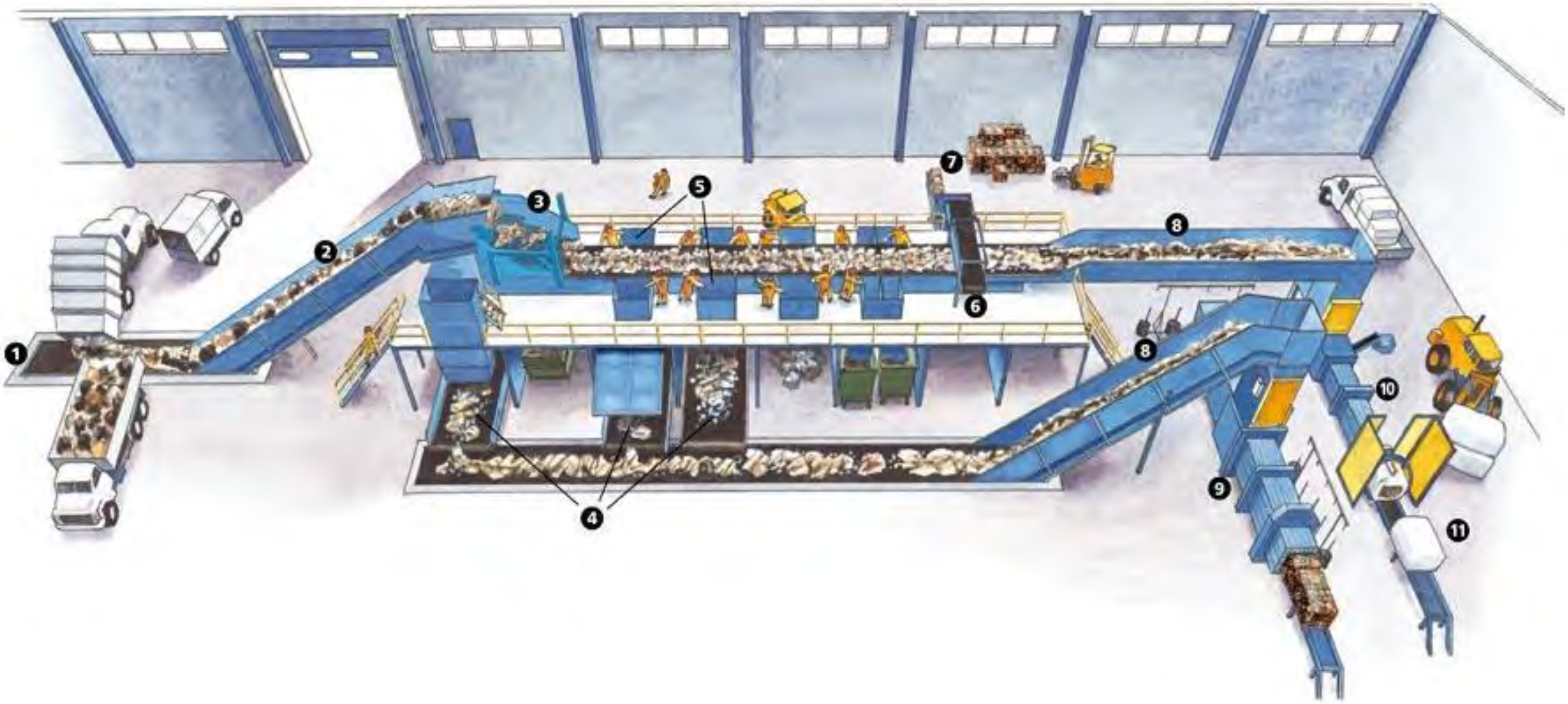
Material Recovery Facility (MRF)

Two Material Recovery Facility of 300 TPD and 200 TPD capacity respectively established by IMC

700 Rag pickers will be provided livelihood through IMC, Material Recovery Facility

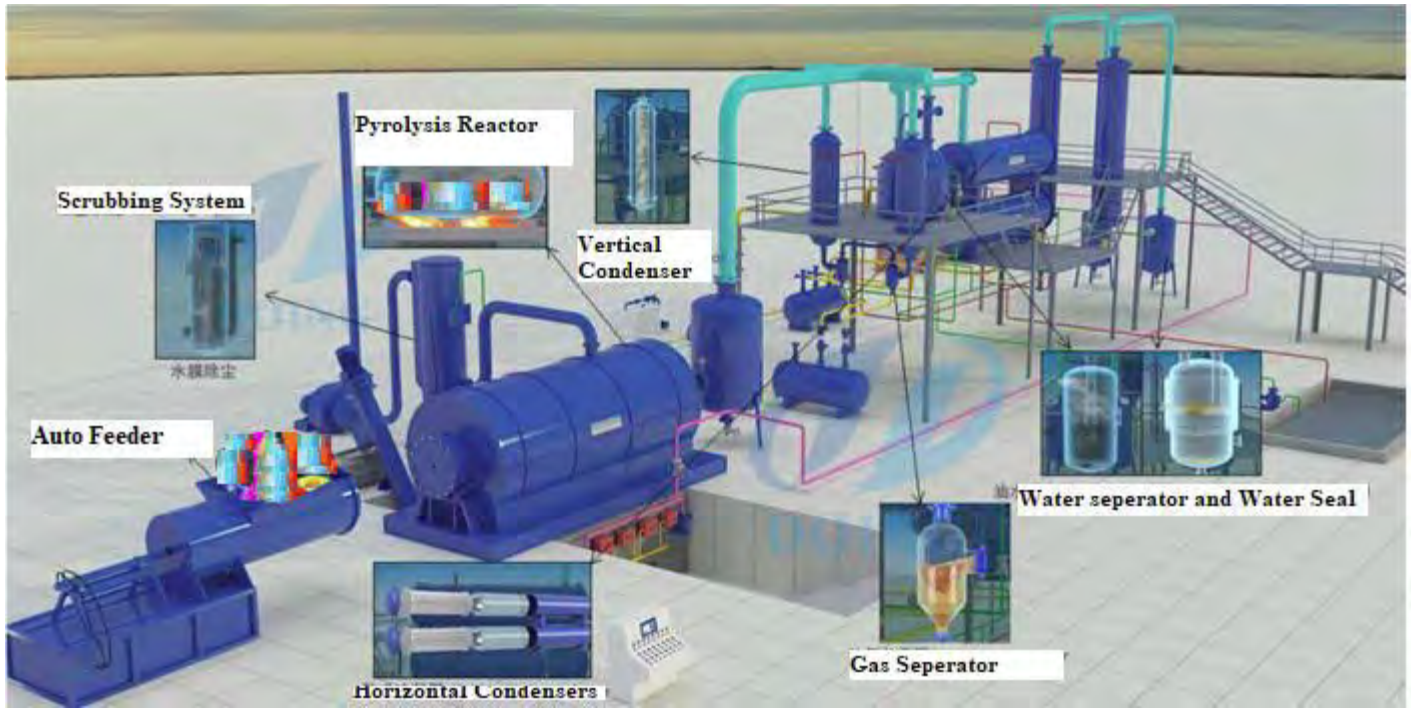
At MRF, sorting of all type of dry waste such as Paper, plastic, iron, glass, e-waste, polythene, rugs, leather, shoes, pet bottles, rubber etc.

Fully Automatic Material Recovery Facility (MRF) – (under construction)



Plastic to Diesel Plant

- Plastic to diesel Plant of 8 TPD Capacity wherein IMC process raw plastic that generates 3000lt crude oil from which 2600lt diesel, 180lt petrol, 200-300 kg carbon black is being obtained on



Bioremediation - Transformational Change

BEFORE

BEFORE

PRESENT

- 100 % legacy waste remediated
- 100 acres land worth Rs. 300 cr. Reclaimed
- Proposed Plan to develop Golf Course/ City Forest

Bioremediation - Transformational Change

- The work was taken up on war footing and complete the bio-remediation of legacy waste of approximately 15,00,000 cum was completed on 5th December 2018. This has also complied with the requirements of Star Ranking of Garbage Free Cities protocol issued by Ministry of Housing and Urban Affairs, Government of India.
- The recyclables recovered from the biomining process was sent for recycling, recyclable polythene was sent to cement plants and also for road making. The soil recovered was used for refilling the ground on the same site where granary is being developed. The recovered construction and demolition waste was recovered and sent to C&D processing facility to produce building materials. The left over of the waste was sent to secured landfill. Valuable land has been recovered by bio-remediation process of legacy waste.

IEC Activities

Awareness on Swachhta among Youngsters

Awareness on Swachhta among Citizens

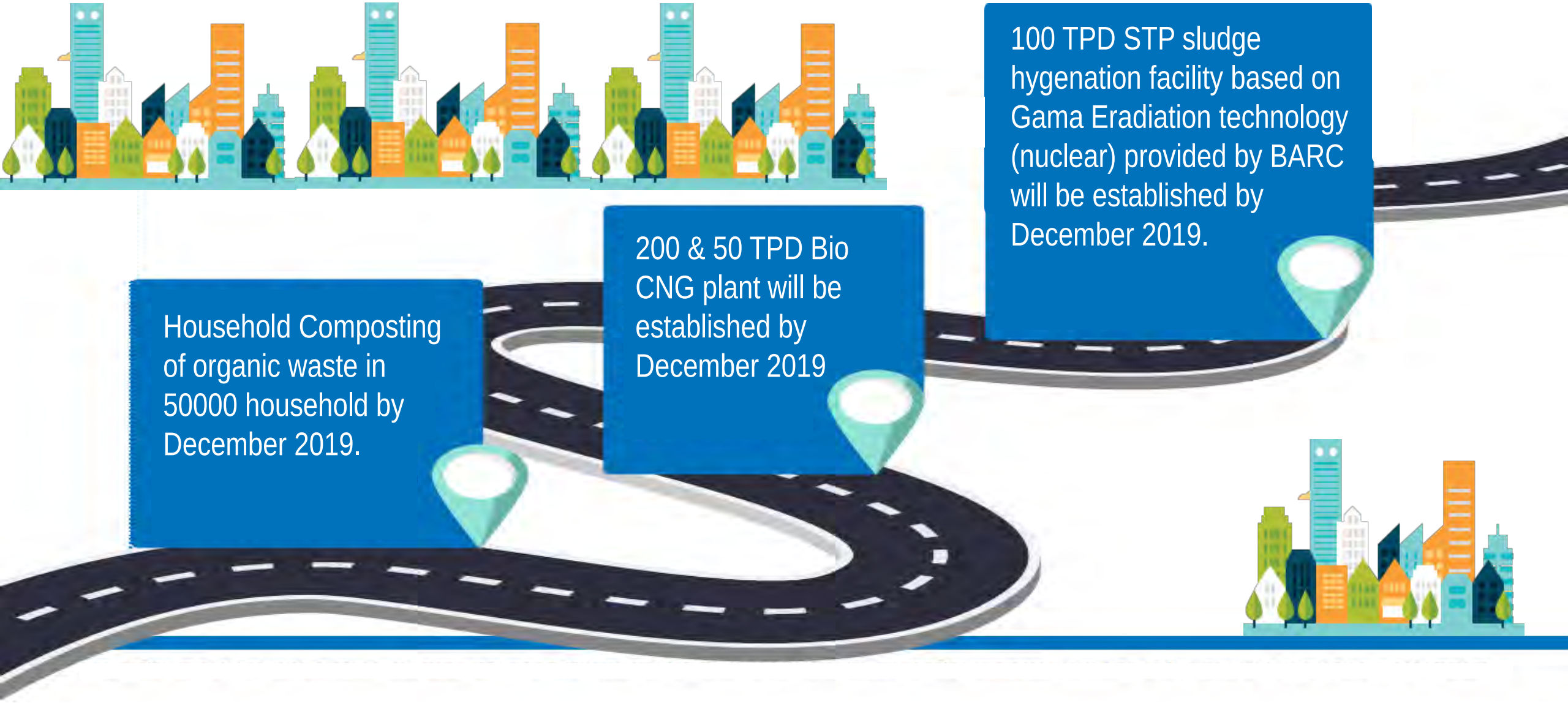
Awareness on Swachhta among Citizens

Awareness on Home Composting

Awareness on Indore Swachhta Abhiyan

Awareness on 311 App

Way Forward


Household Composting of organic waste in 50000 household by December 2019.
200 & 50 TPD Bio CNG plant will be established by December 2019
100 TPD STP sludge hygenation facility based on Gama Eradiation technology (nuclear) provided by BARC will be established by December 2019.

Thank You

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