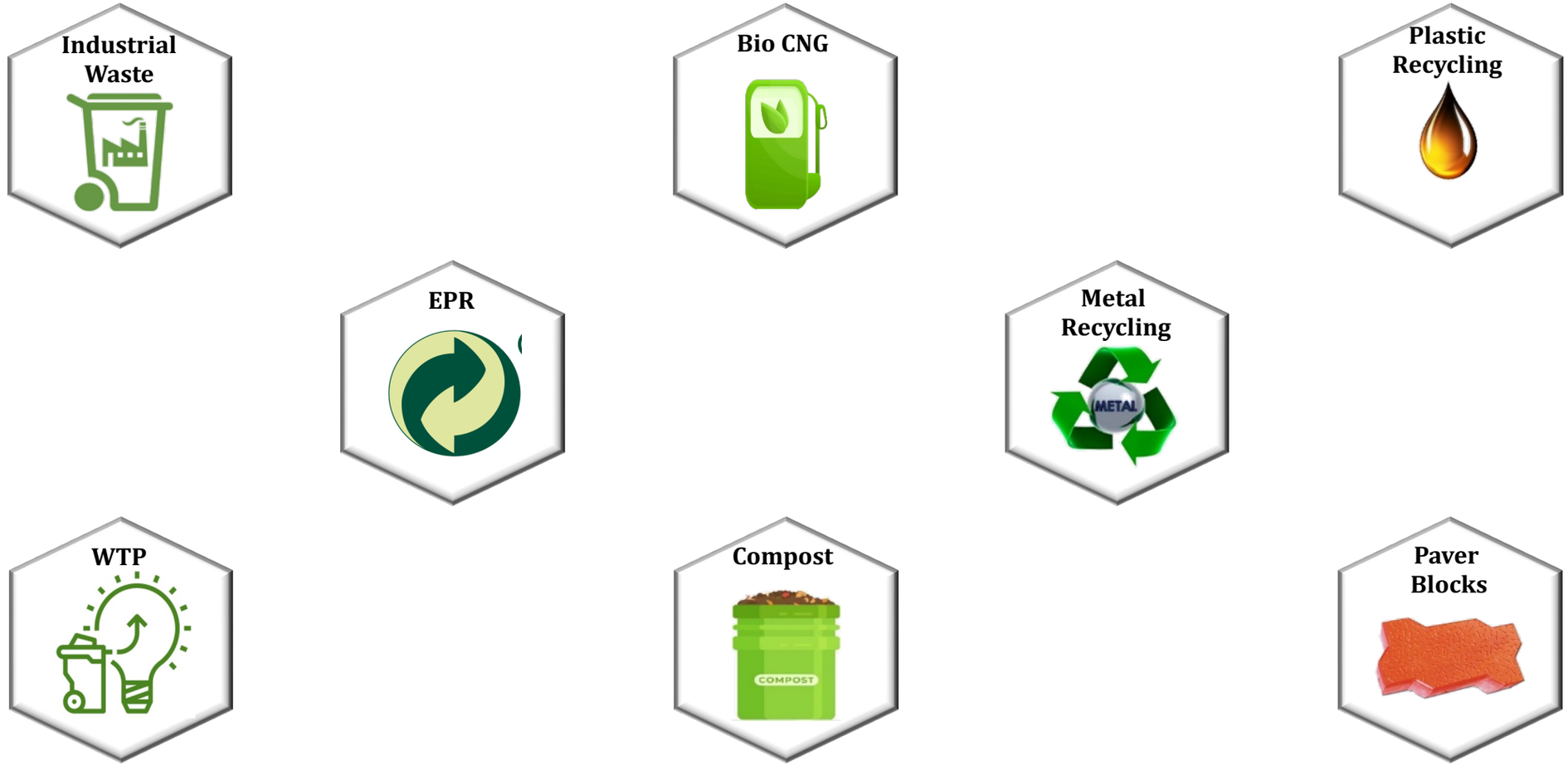
Abellon CleanEnergy

A Promise to Clean India

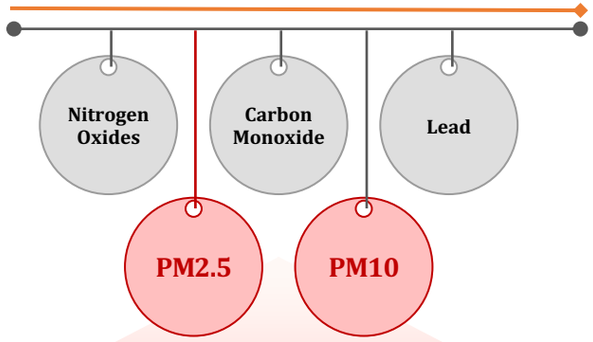


Swachh Bharat Mission 2.0

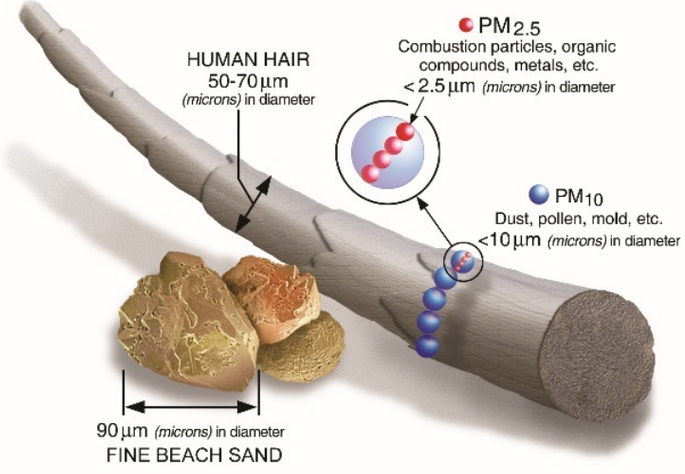
Making Cities Garbage Free

Waste is a Unique and Very Local Pollutant

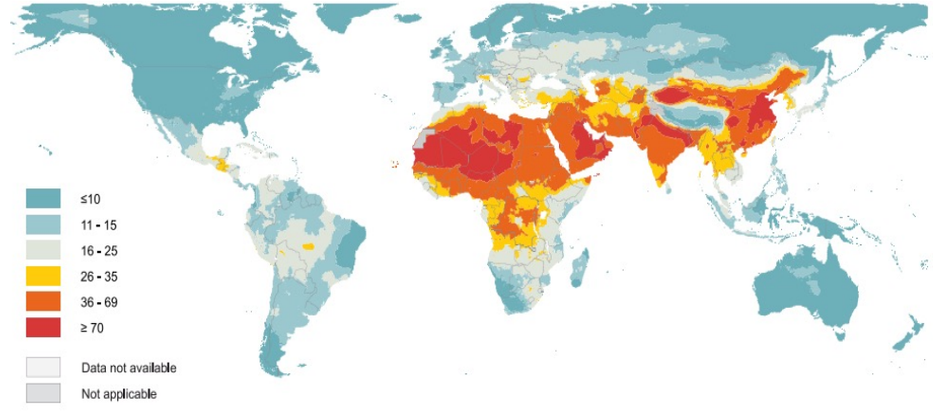
Other Pollutants in the Air

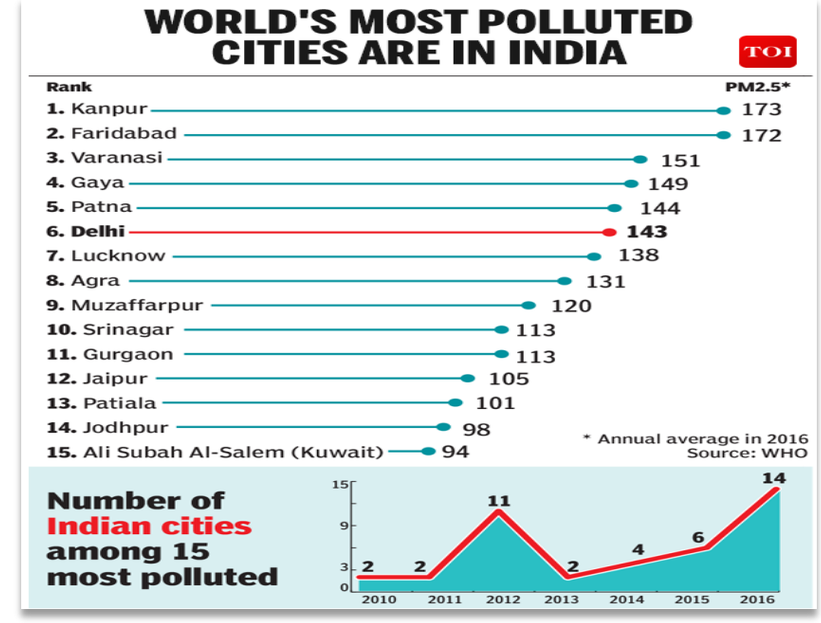


Relative Size of Particulate Matter



India has the Highest PM2.5 levels Globally





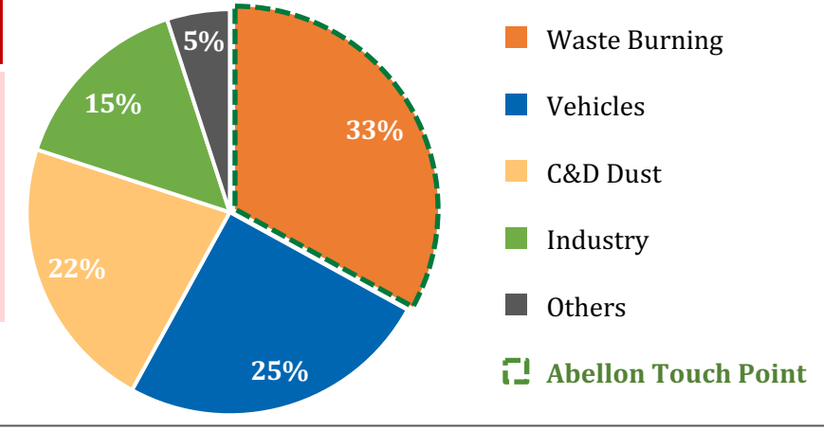
AQI – PM2.5 Levels

PM2.5 are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated

PM2.5 Most Dangerous due to Easy Inhalation of Smaller Particles and lead to:

- PM2.5 can enter directly into blood stream
- Leading cause of Lung Cancer, Stroke, Diabetes, Cardiovascular mortality, Birth defects etc.
- Body's immunity is lowered & affects the children the most

Causes for PM2.5 in India & Area that Abellon Touches



Waste in India

Waste Generation in India is expected to grow Exponentially

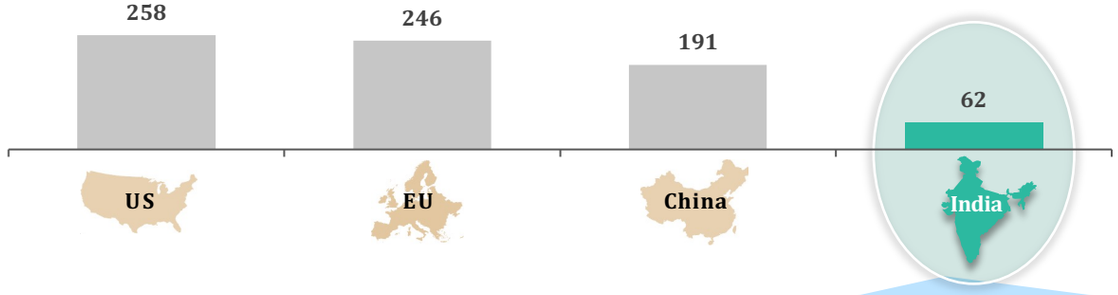
Annual MSW Generated and Collected – India (MMT)

Annual Agriwaste Generated (MMT)

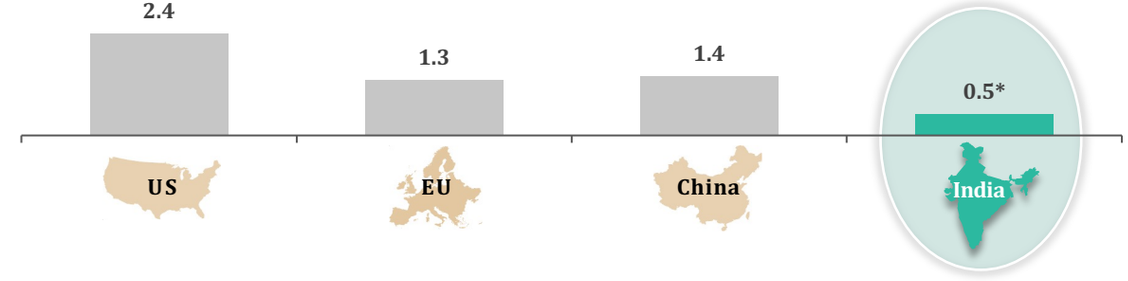
Annual Industrial Waste Generated (MMT)

Global Waste Generation Trend – India MSW Generation expected to increase significantly with economic development

Total Waste Generation (MMT)



Per Capita Waste Generation (Kgs/day)

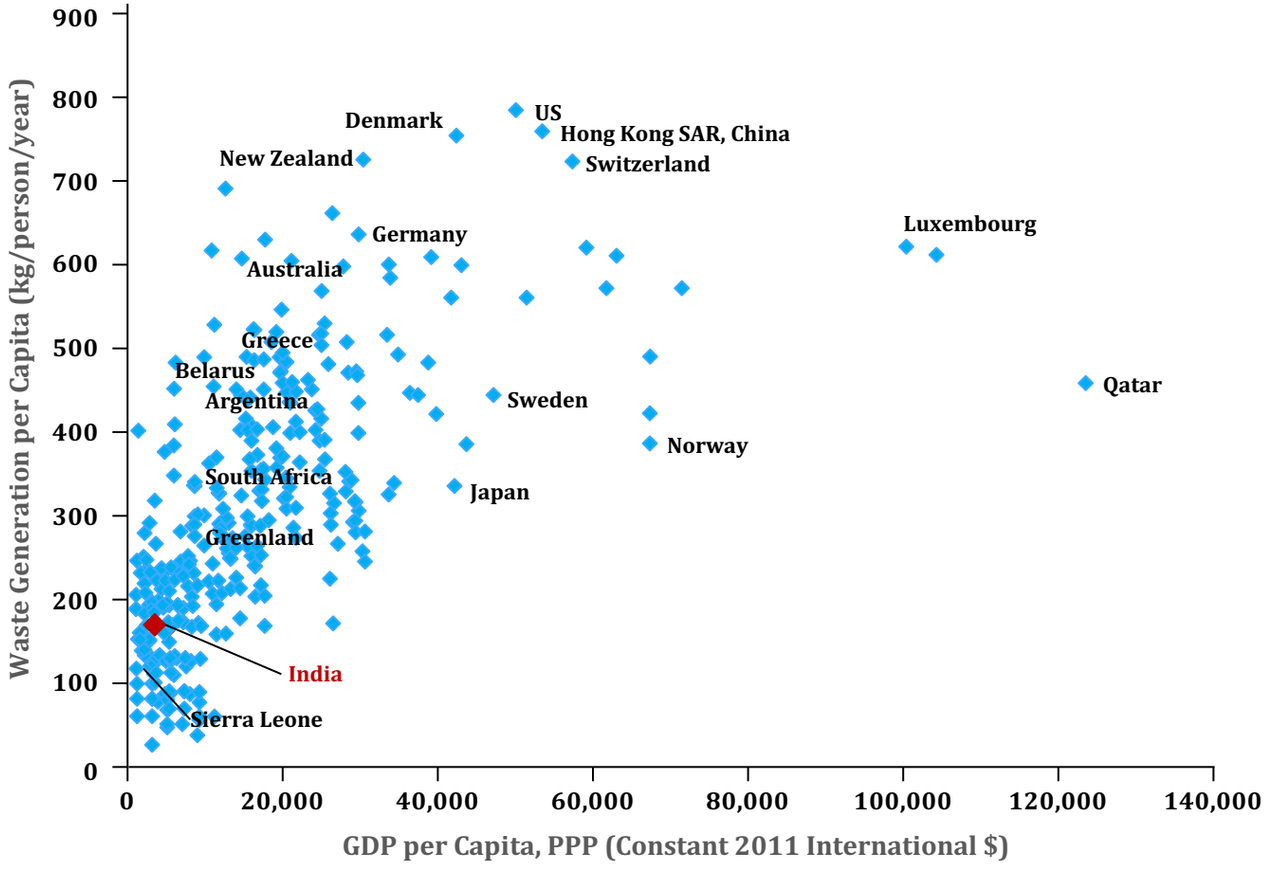


Category	No. of Cities	MSW (TPD)	MSW/Capita (in Kgs)
Tier 1	**8**	4k to 11k	**0.6**
Tier 2	**14**	1k to 4k	**0.5**
Tier 3	**19**	500	**0.5**
Tier 4	**1000+**	< 500	**0.1**

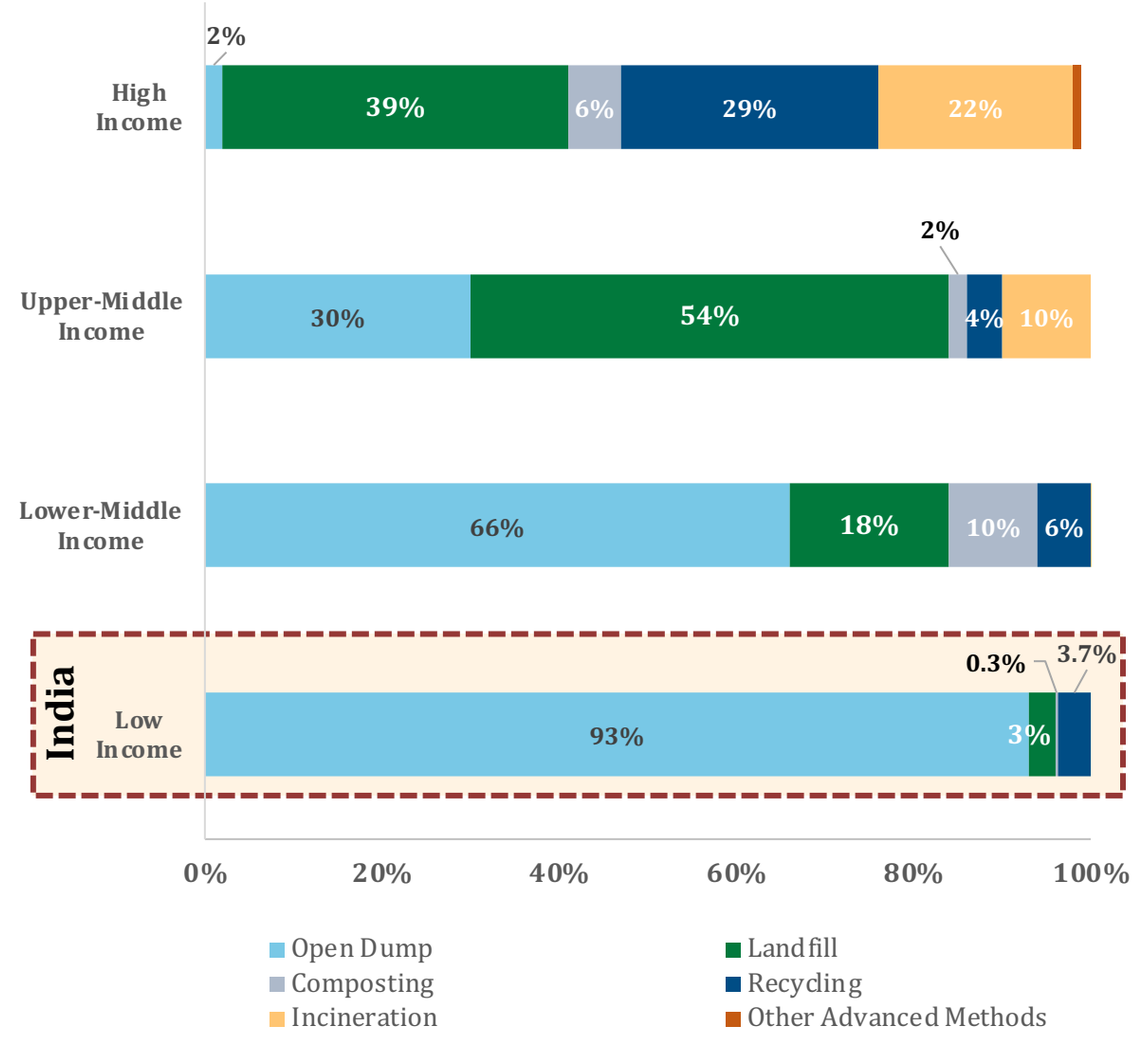
***Source**: PowerToday.in / Census of India, Ministry of Environment & Forests. Industry report by Grant Thornton. **Note**: Statistics as reported in 2016. MSW: Municipal Solid Waste. TPD: Tons per Day. MMT: Million Metric Tons. | **Note: ***: % of urban population*

India Has a Large and Growing Waste Problem

Waste Generation and Gross Domestic Product



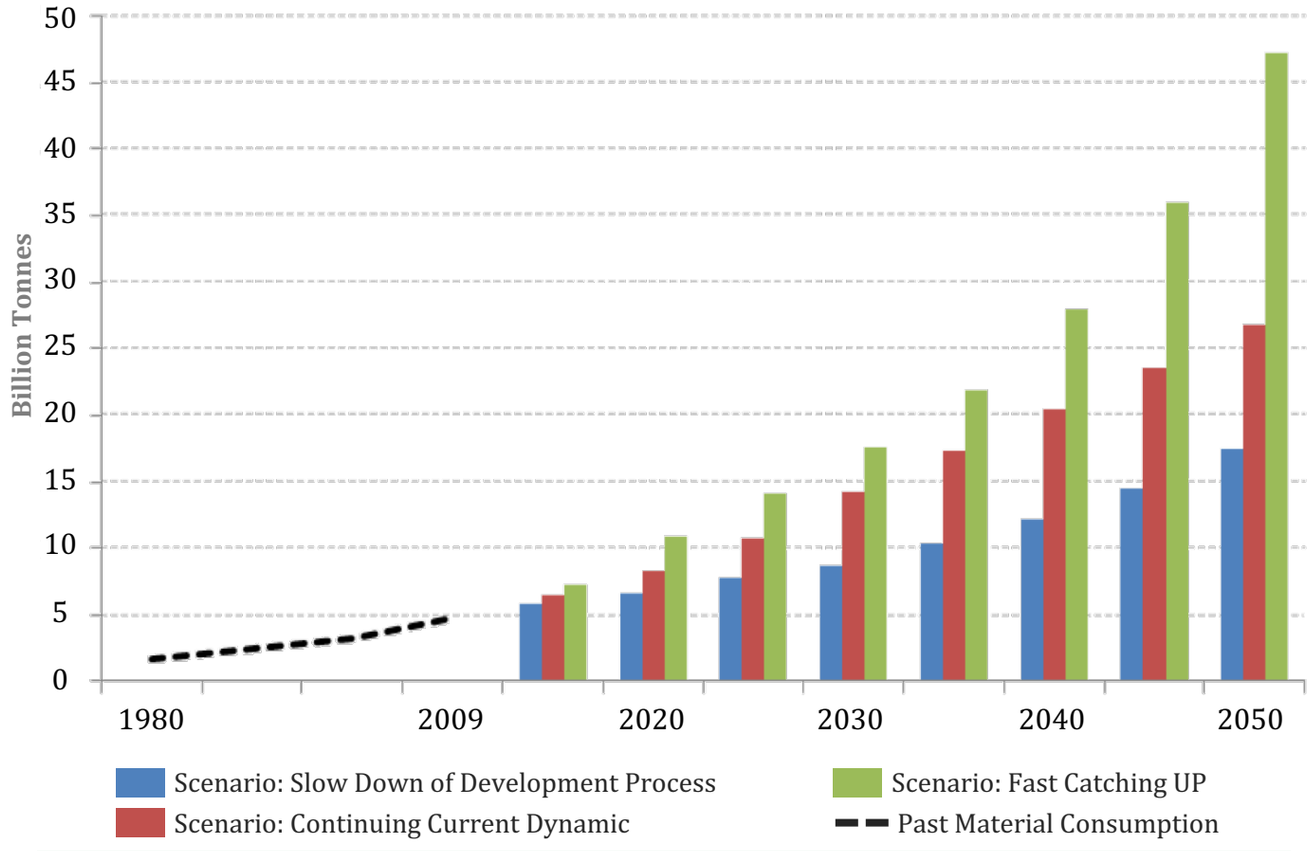
Disposal Methods by Income Level



***Source**: A background report prepared for the 2021 G20 Presidency of Italy – Towards a more resource-efficient and circular economy - Role of the G20 (Page No. 15)*

Waste is a Material Left after Using up Its Value

India's Past Material Demand and Future Projections



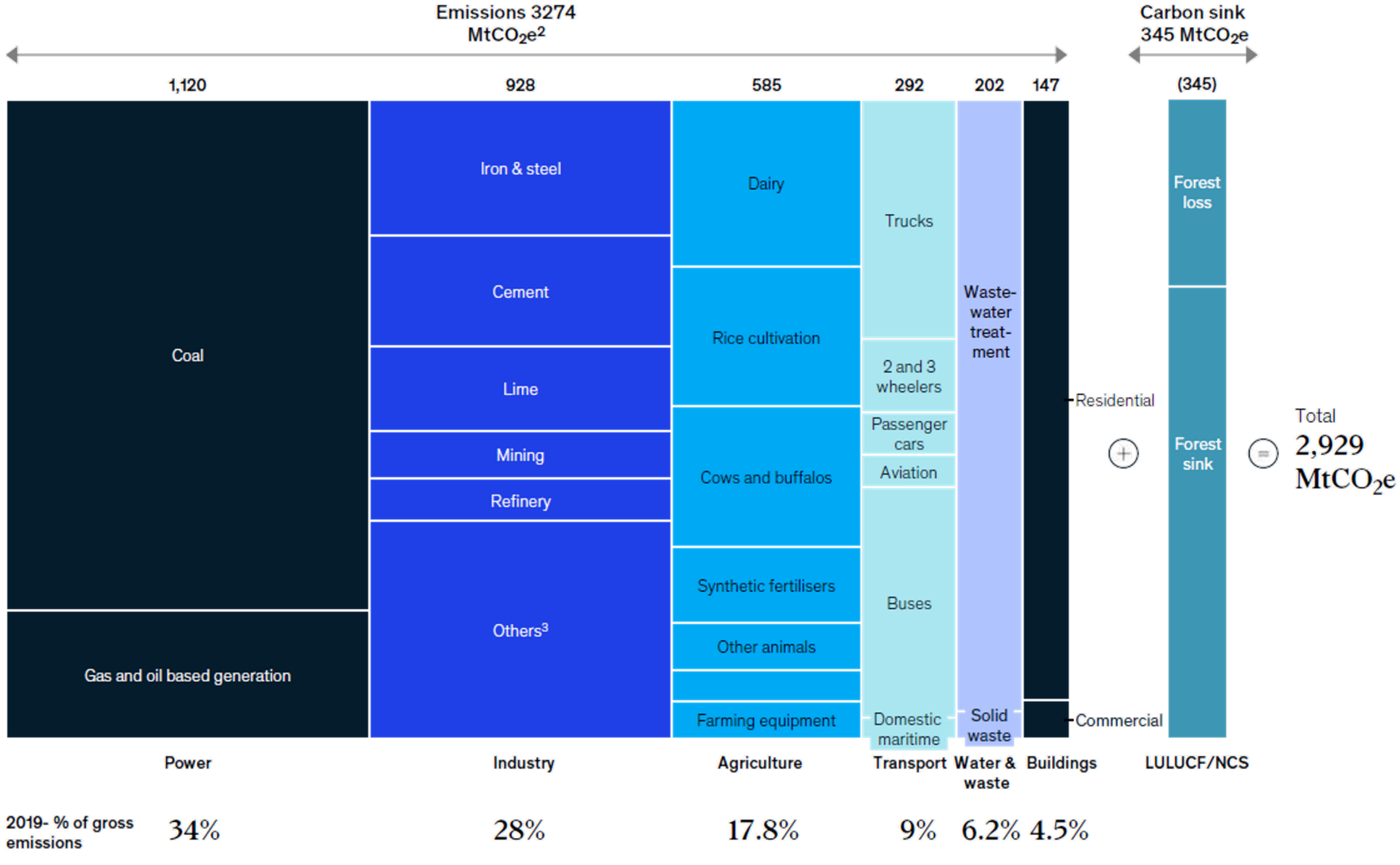
10 Billion Tonnes of Materials being used, will become 30 billion Tonnes in 20 years !

Improvement in Composition of Waste

Year	1996	2005	2020	Improves Circularity
Biodegradables	42.2	47.4	45.0	✔
Paper	3.6	8.1	7.3	✔
Plastic	0.6	9.2	16.1	✔
Rubber			1.0	✔
Metal	0.5	0.5	2.1	✔
Glass	0.6	1.0		✔
Rags	-	4.5	5.3	✔
Others (Human Hair, Coconut, Tetra pack, Footwear)	-	4.02	3.2	✔
Inert	45.1	25.2	20.0	✔

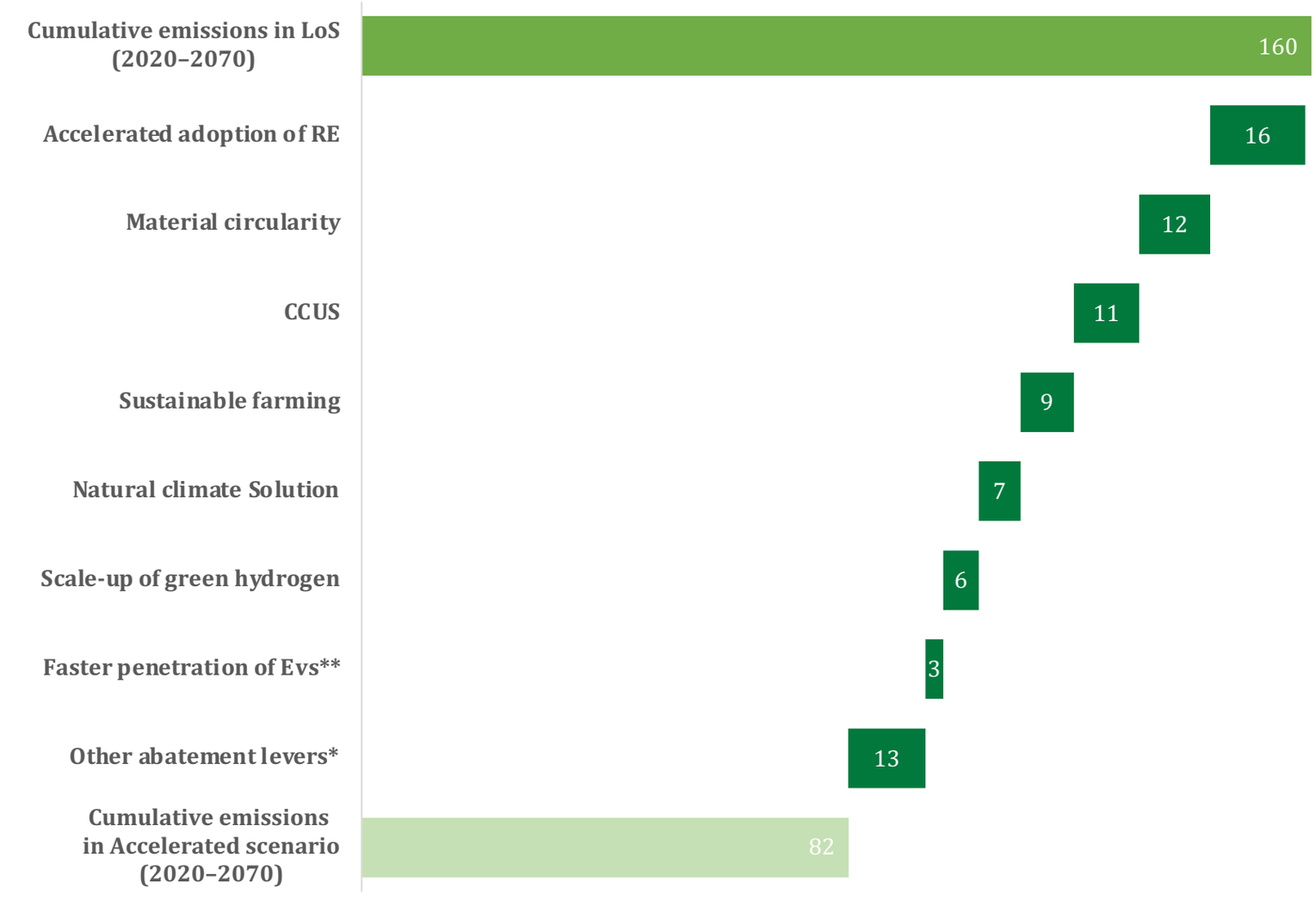
***Source**: Niti Aayog - Strategy Paper on Resource Efficiency, June, 2017. (Page No. 12)| IGEP – 2013 | Integration of Informal Sector in Solid Waste Management – Strategies and Approaches (Center for Science and Environment) (Page No. 16)*
MoHUA - Circular Economy in Municipal Solid and Liquid Waste (Page 20)

India's Current Carbon Emission Mix



Note: 1. Converting GHGs into CO2e assuming GWP-100 and AR5 methodology with India's BUR-3 reported emissions for 2016 as baseline. | 2. Gross and net emissions for 2019 based on Climate Action Tracker overall emissions for India. | 3. Others include: other industry oil & coal use, ammonia, aluminum, F-gases and ethylene.

Strategies to Reduce Carbon Emissions



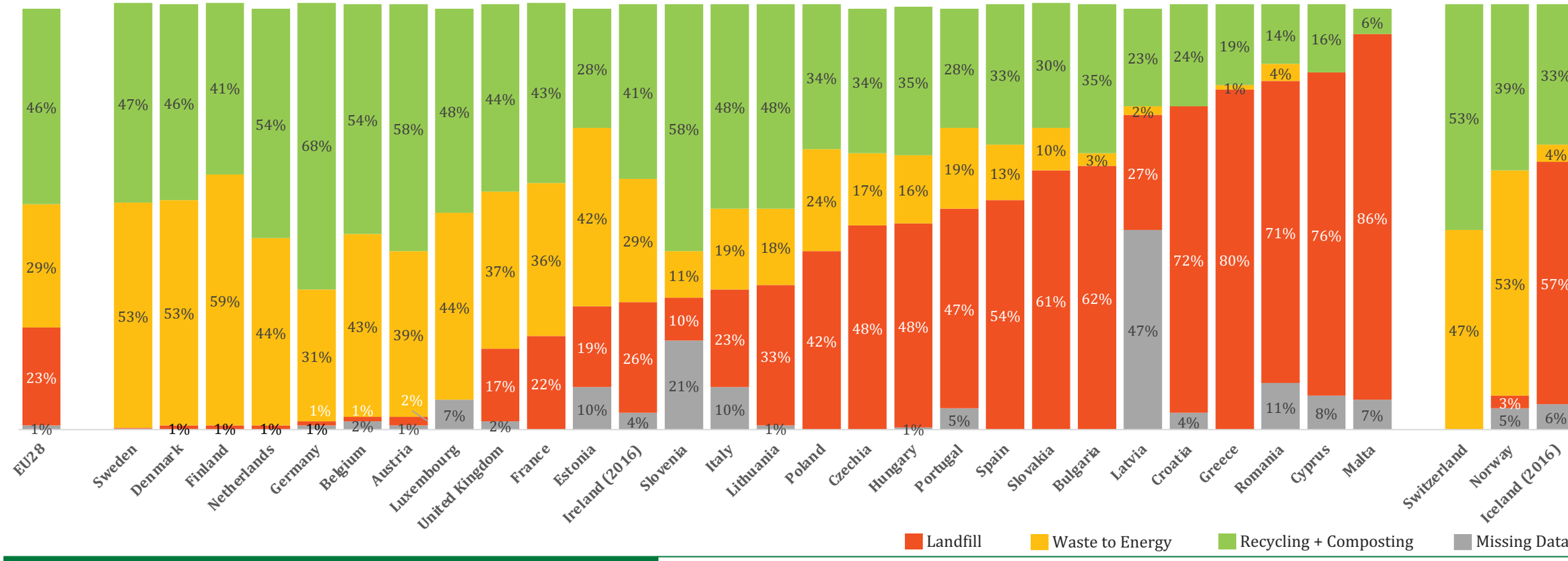
Source: *Decarbonizing India Charting a pathway for sustainable growth – McKinsey Sustainability*
Note: ** In the LoSscenario, EV penetration reaches 100% only by 2070 | ** Includes other miscellaneous abatement levers such as 100% electrification of cooking, complete treatment of wastewater, improved energy efficiency in industry, and so on.*

Both Strategies are Good Compliments to Each Other

As the graph below portrays WTE does not eat into circularity but reduces the Landfills. WTE is an Environmentally Friendly solution to Landfills or Dumpsites

Municipal Waste Treatment in 2017 (EU28 + Iceland, Norway and Switzerland)

Percentage are calculated based on the municipal waste reported as generated in the country.



"WTE can be Complementary and Compatible with Recycling"

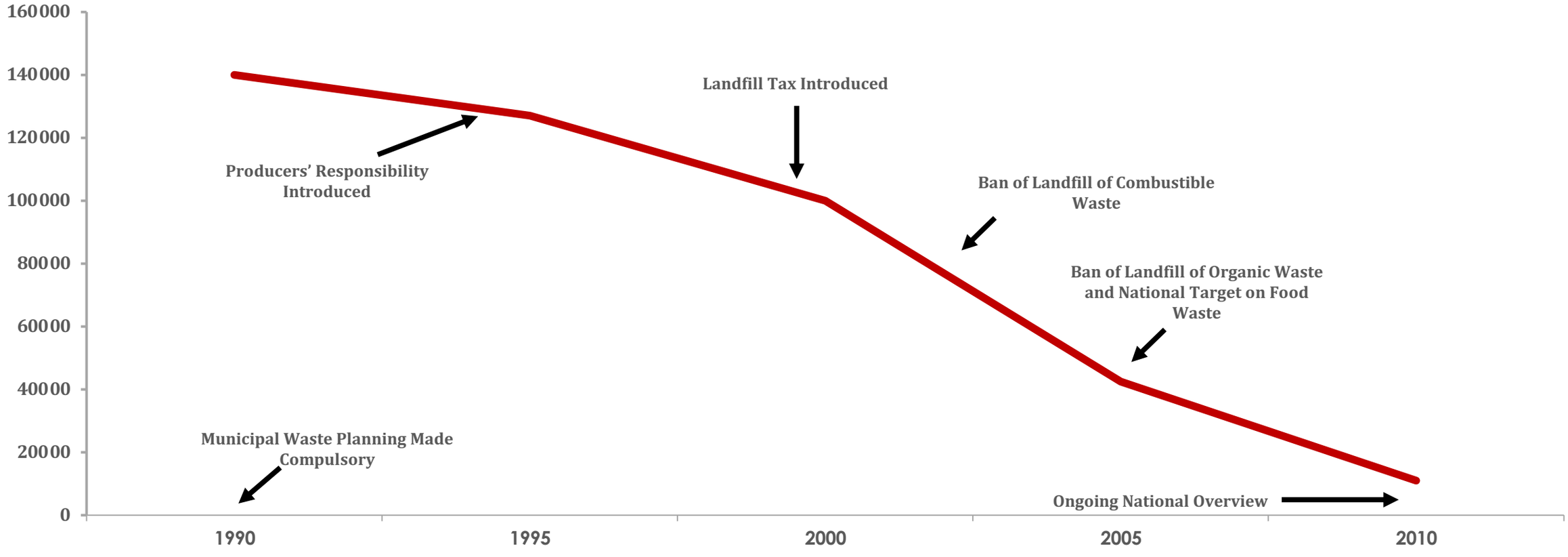
Reference:

'SCIENTIFIC TRUTH ABOUT WASTE-TO-ENERGY' -2021: Report by City University of New York and findings are supported by 'The Materials & Energy Recovery (MER) Division of ASME'.

***Source**: Energy from Waste and the Circular Economy – Net-Zero And Resource Efficient By 2050 – The Birmingham Policy Commission (Page No. 20) | Graph by CEWEP, Source: EUROSTAT (Last Update – April 2019)*

Pathway to Resource Recovery – Case Study of Sweden

A Slew of Measures Helped Sweden Bring Down Mountains of Waste



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Swatch Bharat Mission Launched in India in 2016

What Sweden achieved in 30 years, India is targeting to achieve the same by 2030-2035

***Source**: Personal Communication with Ylva Reinhard, Swedish Environmental Protection Agency on 9 March 2016*

Major Reforms & Policy Initiatives to Augment Waste Management Potential

Center Driven Policy & Regulatory Approach	**Niti Aayog**	**PM Office**	**National Green Tribunal**	**Supreme Court and High Courts**		
Central Ministries/ Departments	**Ministry of Housing & Urban Affairs (Swachh Bharat Mission)**	**Ministry of Power**	**Ministry of Environment, Forest and Climate Change**			
	Ministry of Petroleum and Natural Gas	**Ministry of Agriculture & Farmer Welfare**				
	Ministry of New & Renewable Energy	**Ministry of Chemical & Fertilizer**	**Ministry of Finance**			
Nodals/Regulators	**Urban Local Bodies (ULBs)**	**Distribution Companies (DISCOMs)**	**SERC/CERC**	**State Energy Development Agency**	**Oil Marketing Companies / NTPC**	**SPCB/CPCB**
Current Policy Initiatives	***Solid Waste Management Rules 2016***	***Plastic Waste Management Framework, 2016***	***SATAT Initiative***	***National Clean Air Programme, 2019***		
	Implementation of policy on promotion of city compost, 2017	***Swachh Bharat Mission Guidelines, 2014***	***Swachh Bharat Mission 2.0***	***National Electricity Policy, 2005***		
	National Bio-Fuel Policy,2018	***National Green Hydrogen Policy***	***National Biomass Mission***	***Hazardous Waste Management Rule, 2016***		

Waste to Power

- **Must Buy** for all DISCOMs not part of RPO
- **PIBO** obligation for **EPR** equivalent to Plastic Generation
- **Tariff** of **Rs. 7+ for 20 years**
- **Waste** Concession for **25 years FOC** at Door Step

Bio-CNG

- **SATAT** initiative – **OMCs** to buy Bio CNG at **Rs. 46/kg**
- **10 year** off-take **contracts**
- **5% escalation** every **3 years**
- Targeting **5k Bio CNG plants** in private sector
- Targeting **15MT per annum** by 2023

Material Recovery Facility

- **ULBs mandated to setup MRF**
- **EPR for Plastic waste processing**
- NGT direction for Uniform EPR framework
- States to be held accountable
- Hon'ble Courts taking strict action for non compliance

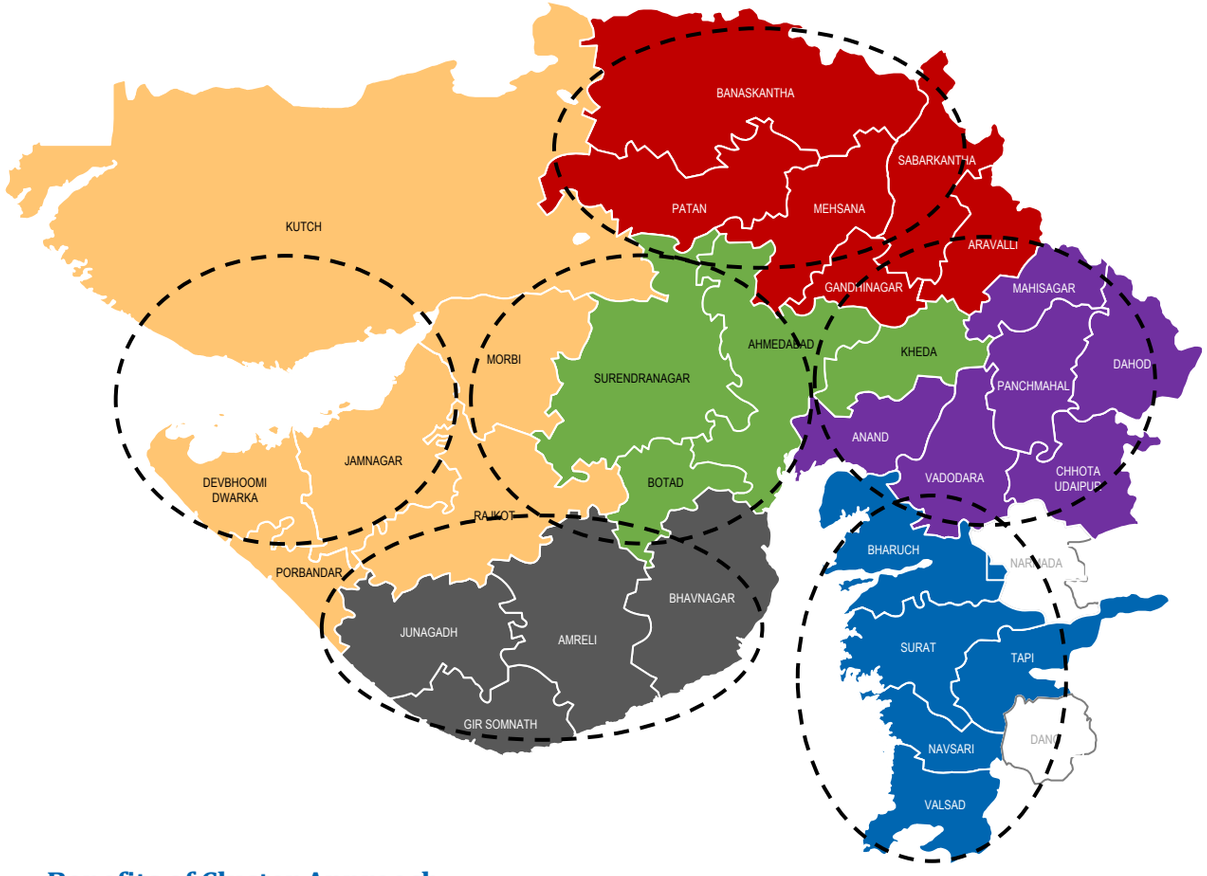
Bio-Pellets

- Policy for **Biomass** utilisation through **co-firing in all thermal power plants** from 2017
- 5-10% bend of bio-pellets advised
- **NTPC** tenders for **19kMT per day** of bio-pellets
- **Current capacity** in India is **only 300kMT**

Bio-Fuels

- **Bio-Fuels** are globally accepted alternatives to fossil fuels
- Policy Encourages setting up of **Supply Chain**
- **2G** fuels drop-in fuel from Plastic Waste found in MSW get higher purchase price

Clusters Based Approach



Regulatory Support – Cluster Based Approach

SBM Urban 2.0 Recommends Cluster Based Approach

Clause 6.2.2.2: "Cluster of ULBs can also be considered for creation of common infrastructure, keeping in mind the techno-commercial viability."

CPCB National Action Plan for Solid Waste Management

Clause 14.0.V: "The cluster based project to cover all villages and towns should be practiced. This will eliminate the process of setting up of individual waste processing and disposal facilities which subsequently will be difficult to monitor and also may raise public objections."

The National Green Tribunal (NGT)

The National Green Tribunal (NGT) has upheld cluster based approaches to Solid Waste Management in **Capt. Mall Singh & Ors. v. Punjab Pollution Control Board & Ors. (Appeal No. 70/2012) and Almitra H. Patel & Ors. v. Union of India & Ors. (OA No. 199/2014).**

Benefits of Cluster Approach

- Reduce Financial & Technical Burden on Individual ULBs
- Clusters will bring in Economies of Scale and reduce Costs
- The Legacy Waste Can Be Disposed in Scientific Manner
- More Efficient Use of Land and Other Scarce Natural Resources in the Region.
- Technologically & Commercially Viable Option to address the Solid Waste Issues
- Encourages Pooling of Resources to Achieve Common Goal of SWM

Abellon - Waste to Energy Business Transitioning to Circularity

LARGEST IN GUJARAT

Current Capacity ▶ 7.5 MW (1 Plant)

Pipeline Capacity ▶ 59.6 MW (4 Plants)

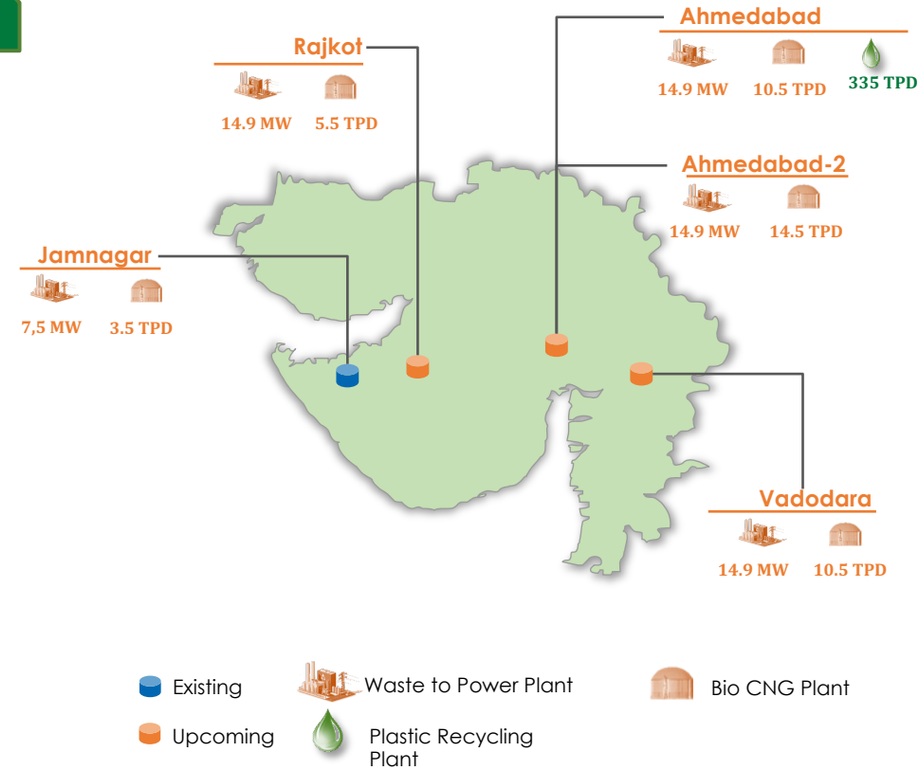
Estimates for FY 2027

Long term Waste Contracts: **2,750** TPD

Waste Processing: **1.8** Mn TPA

Plastic Cleaned: **210**K TPA

Waste to Power Plants: **04**



Estimates for FY 2029

Waste Contracts: **3,750** TPD

Waste Processing: **2.34** Mn TPA

Plastic Cleaned: **280**K TPA

Waste to Power Plants: **05**

Bio CNG Plants: **05** (37 TPD)

Plastic Recycling Plants: **01** (335 TPD)

45% of the **waste** is recovered for **circularity** instead of winding up in the Landfill.

180 MW Potential capacity for **Waste to** Power Projects in Gujarat.

85% of the **waste** will be recovered for **circularity** instead of winding up in the Landfill.

Jamnagar | Gujarat's First Waste to Power Plant

Plant Commissioned
May '22

Capacity
7.5 MW

650TPD
Achieved for Pre-Processing

85%
PLF

IGBC **Platinum Certification for** GoodWatts WTE Jamnagar

850°C
Temperature achieved

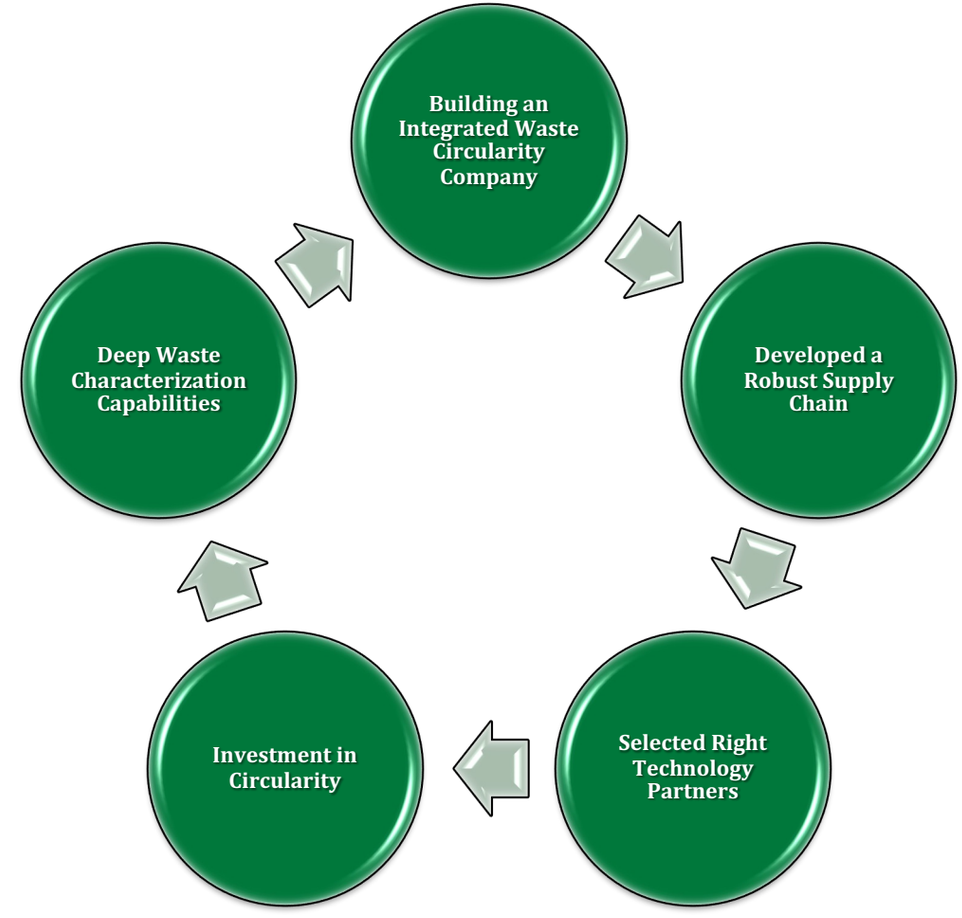
54.17 MN
Units of Power Generated From Nov'21 to Dec'23

55.84 MN
Units - Annual Power Generation Capacity

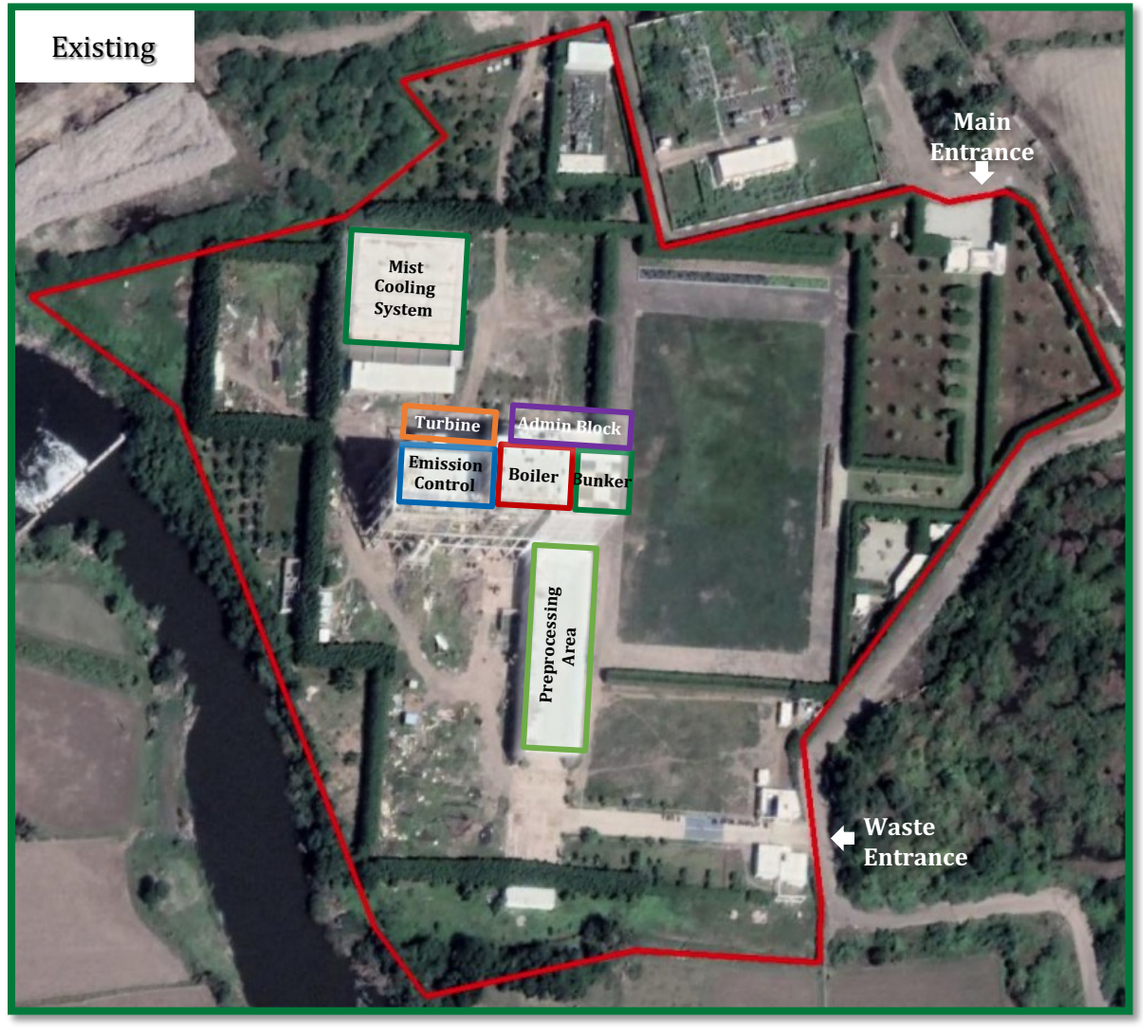
CV Increased by
300kcal
to
1930kcal

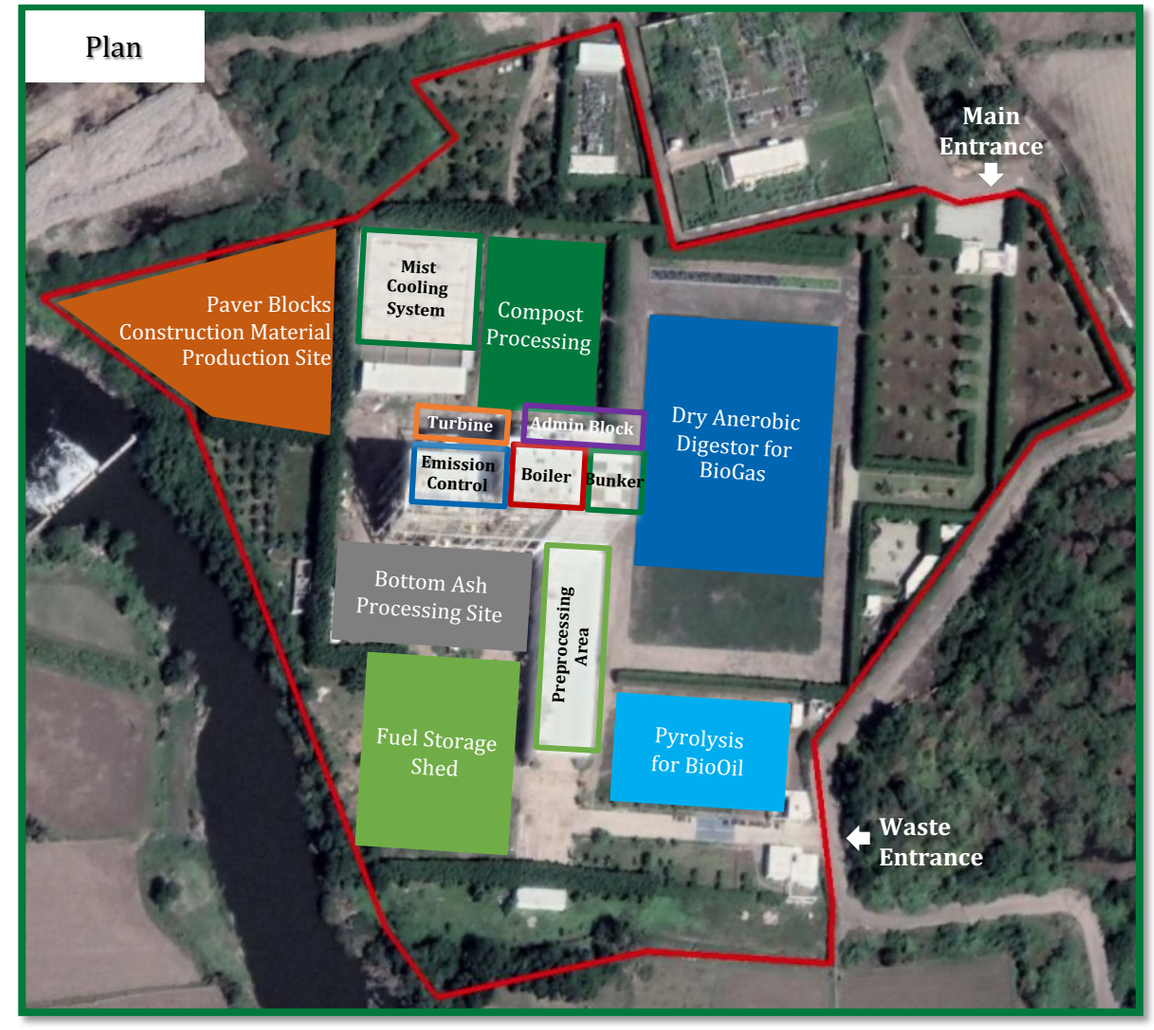
Emission Control Tests
OK

Pioneers in Waste Management and Vision of Circularity



Jamnagar – Value Add Facilities for Circularity



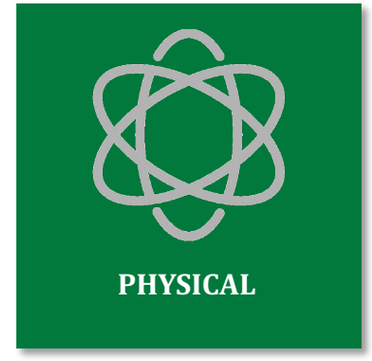


https://goo.gl/maps/f5mjpBxeaFqiPKBv7

Why Technology Matters Most

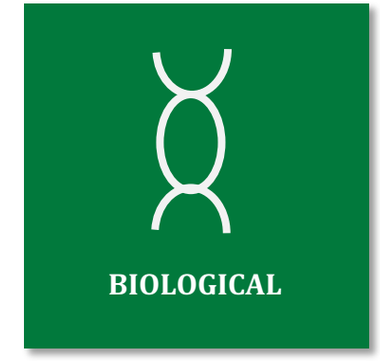
DIGITAL

Machine Vision	Machine Learning	Big Data
Blockchain	Cloud	Digital Twin
M2M Communication	Sensors & Actuators	Mobile Devices



PHYSICAL

3D Printing	Robotics	Energy Storage
UV/ IR / NIR / NMR Spectroscopy	Advanced Green Chemistry	Modular Design Technology
	New Materials	

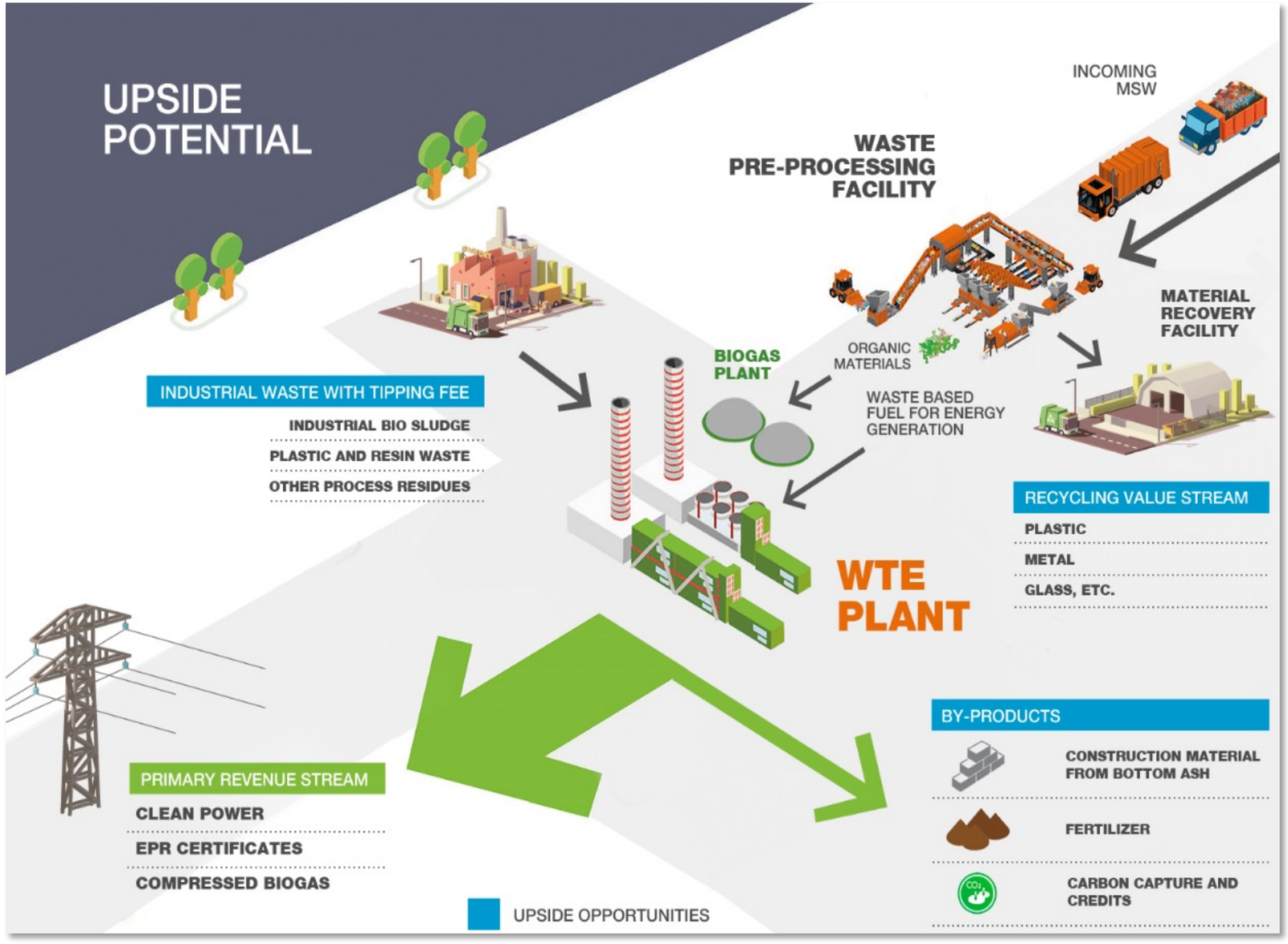


BIOLOGICAL

Bio-Energy	Bio-based Materials	Genetic Engineering
Bio-remediation	Biocatalysis	Hydroponics and Aeroponics
	Cellular and Tissue Engineering	

***Source**: Accelerating India's Circular Economy Shift – A Half-Trillion USD Opportunity – FICCI Circular Economy Symposium 2018*

Where are We Headed



Extended Producer's Responsibility (EPR)

- EPR is the responsibility of a producer for the environmentally sound management of the product until the end of its life
- Companies that use plastic in their processes have a responsibility to ensure that any resulting plastic waste is disposed off

Material Recovery

- Potential for higher material recovery from current waste by deploying additional pre-processing equipment

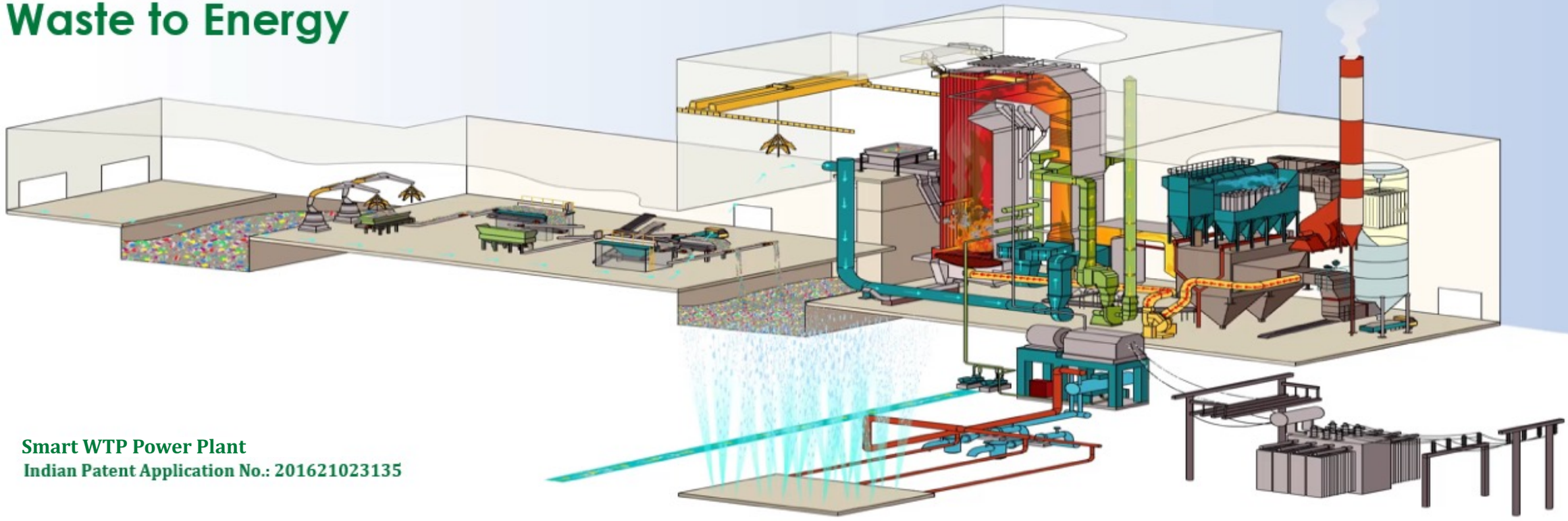
Industrial Waste

- Industrial waste which is currently being dumped into landfills can be utilized for power generation, offering an additional source of revenue

Byproducts

- By-products can be recovered from processes such as fertilizer along with a potential to recover ash from construction material and CO^2 from flue gas, driven further by policy support

Waste to Energy



Smart WTP Power Plant
Indian Patent Application No.: 201621023135

Pre-Processing

- Proprietary Pre-Processing Technology
- Segregating waste in Dry, Wet and Plastic
- Closed Door without Human Interface

Combustion in Boiler

- Fuel fed from a Height to a Travelling Grate
- Temperature of 850°C+ & resident time 2 seconds
- Prevents formation of Dioxins and Furans

Emission Control

- Stringent Air Quality Controls
- Continues Air Monitoring System
- State of the Art Technology

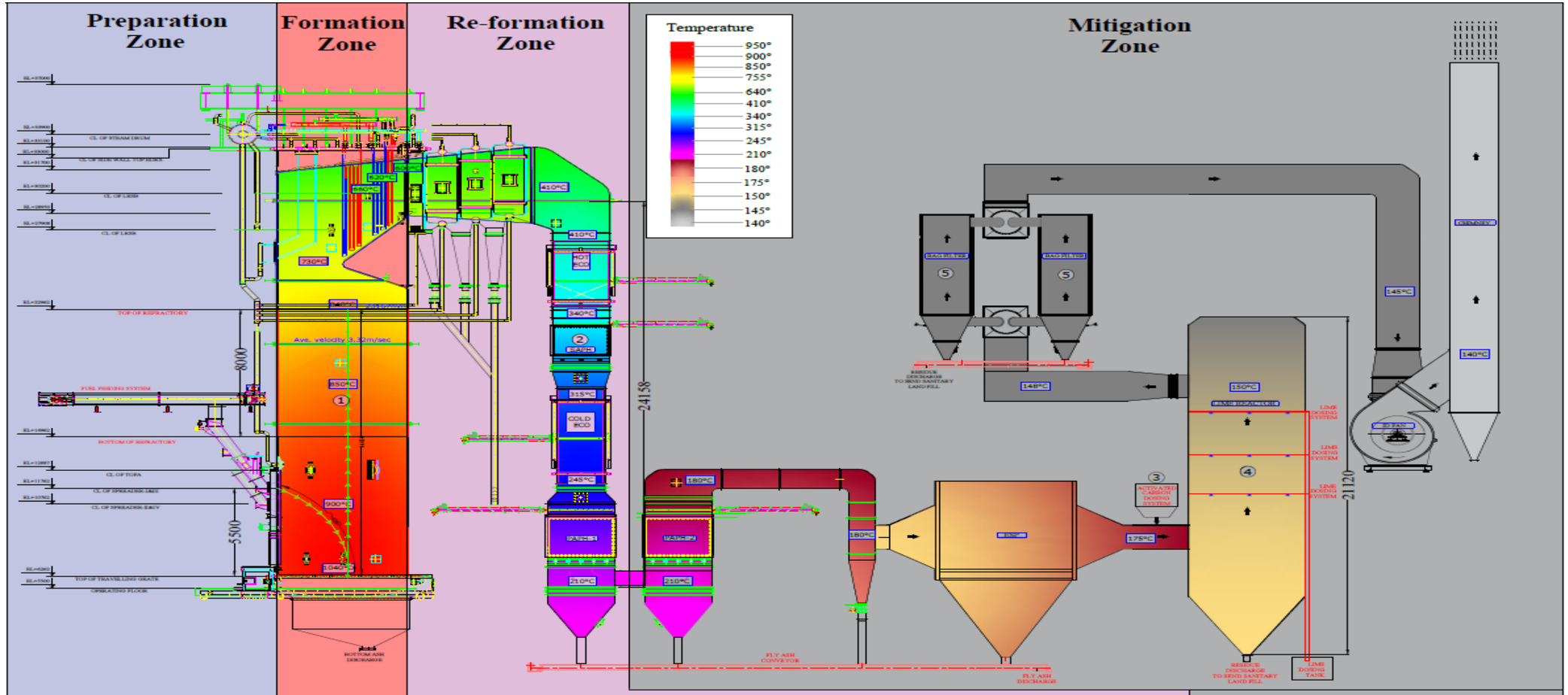
Sourcing Contract Terms with ULB

- 25-year concession agreement with Urban Local Body (ULB) awarded through a transparent online process
- Assured waste quantity of fresh MSW delivered at plant site free of cost

Revenue Contract Terms with DISCOM

- 20 year fixed price PPA with State DISCOM with 'Must Buy' mandate
- Tariff in the range of INR 7.03 / kWh – INR 7.07 / kWh
- PPA is on Take or Pay contract

Abellon's Approach to Develop Risk Mitigation Strategy for Emissions



- Better flowability of fuel feed.
- Restricting presence of fine material <10 mm in fuel feed.
- Control feeding mechanism link to plant Distributed Control System (DCS).

Control Measures:-

- High thermal stress to fuel at inlet of combustion zone.
- No drying and gradual combustion of fuel feed.
- Temperature in combustion zone including empty pass maintained at +850°C.
- Minimum resident time in empty pass with temperature achieved at 850°C for at least 2 seconds.
- 50% combustion in suspension & 50% combustion on traveling grate.
- Complete combustion of organic matter achieved in combustion zone.
- Injection of secondary air into combustion zone at 280°C to enhance speed of combustion.
- Provision for recirculation of flue gas up to 30% of total generated.
- Taller construction of combustion zone and empty pass to minimize carry over of fly ash.
- Preventing formation of precursors of Dioxins and Furans.

Factors promoting formation of Dioxins & Furans are :-

- Presence of chlorine in vapor phase.
- Presence of oxygen.
- Resident time of flue gas between 400°C to 200°C.
- Presence of precursors for Dioxins & Furans.
- Presence of larger surface area of fly ash.
- Presence of metallic catalysts like Copper (Cu).
- Lack of online cleaning mechanism for minimizing fouling on heat transfer area.

- Cyclonic arrangement in Air Pre-Heater (APH) zone to separate fly ash.
- Installation of Electro-Static Precipitator (ESP) to curb fly ash sized >100 microns.
- Injection of Activated Carbon for adsorption of harmful emissions including Dioxins, Furans & Heavy Metal Oxides, if any.
- Provision for Lime milk injection to curb acid gas presence in flue gas.
- Installation of high efficiency Bag-filters for better Suspended Particulate Matter (SPM) emissions.

स्वच्छ भारत

एक कदम स्वच्छता की ओर

You must be the **CHANGE**

You Want to See in the World

(M K Gandhi)

Thank You *Join us in making India a Clean & Healthy Nation*