



# AVANT-GARDE



## WASTE TO ENERGY - Incineration Technology

Presented By

**J. Gladstone Evans**  
(HOD - Thermal Department)

Mobile: 9840046888,

Email: [jgladstoneevans@avant-garde.co.in](mailto:jgladstoneevans@avant-garde.co.in)



**AVANT-GARDE**

# AGENDA



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**WTE – Operating Plants & Conclusion**

# Group Companies

**1** **AVANT-GARDE**  
Engineers and Consultants  
(P) Limited - Chennai



**2** **AVANT-GARDE**  
Systems and Controls (P)  
Limited - Chennai



**3** **AVANT-GARDE**  
Engineers and Consultants  
FZC - Shariah



Consultancy and Detailed  
Engineering Services &  
Supply of Power Plant  
Equipment, Site Services,  
O&M, Plant Revamping, etc

Consultancy and Detailed  
Engineering Services for  
Overseas Projects



# COMPANY INTRODUCTION

- ❖ Founded by a group of Technocrats in 1990
- ❖ Innovative solutions to the industry
- ❖ Committed to work for Engineering Excellence
- ❖ 30+ years of experience in Power Industry
- ❖ Executed projects in 40+ Countries
- ❖ 2000+ Projects and 500+ Clients
- ❖ 8000MW+ of Power projects
- ❖ Multi-disciplinary organization
- ❖ 200+ professionals



*“established with an innovative outlook, to do business with a mission and to provide Engineering with Excellence “*

# Present Area of Business

## Power Plants

Co-Gen, IPP, CPP, Biomass, MSW, WHRSG, DG, GTG

## Distillery / Ethanol Plants

Multi-feed & Multi-Product Distillery, Zero Liquid Discharge, Slop Incineration Projects

## Supply & Services

Supply of Boiler critical components, Energy and Technical audits, Quality audits, Boiler revamping, Capacity up-gradation, RLA study, Third party Inspection services, etc

## Sugar Plants

Raw Sugar, Plantation White, Refined Sugar

## Bio-CNG Plants

Press mud to Bio -CNG

## Boiler Design & Detailing

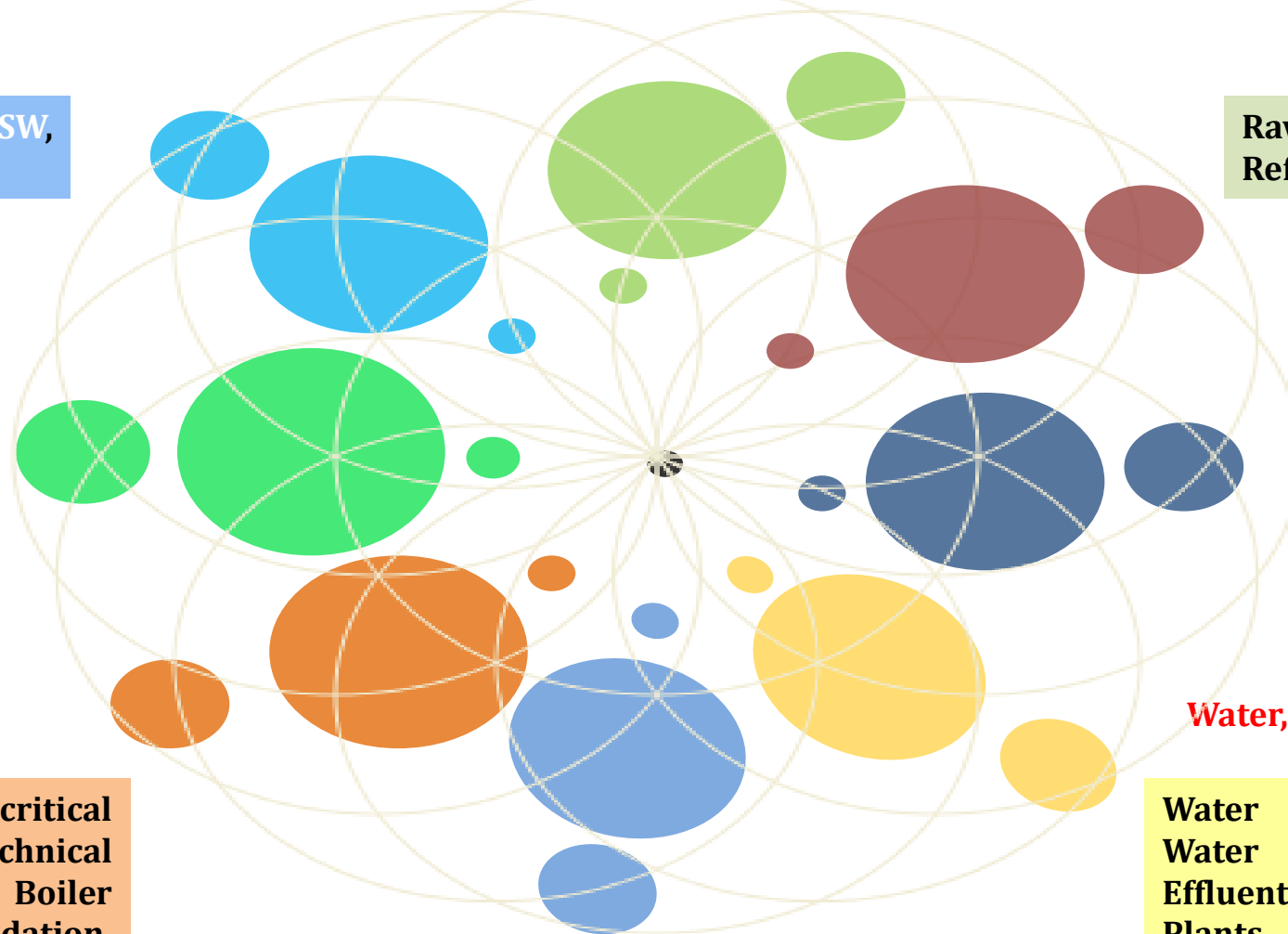
Grate Boiler, AFBC, WHRSG, Vinasse Fired

## Water, Wastewater Treatment and ZLD Plants

Water Treatment plants, Sea Water Desalination Plants, Effluent Treatment & Recycling Plants, Condensate Polishing Units, Sewage Treatment Plants

## Solar Plants

Design & Detailed Engineering



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# Overall Power Projects

S. No	Description	Commissioned		Under various stages		Total Capacity	Total No. of Plants
		Nos.	Capacity	Nos.	Capacity		
1	Cogeneration Plants	105	2298MW	41	1078MW	3376MW	146
2	Captive Power Plants	86	2662 MW	45	1282MW	3944MW	131
<b>3</b>	<b>Biomass Power Plants</b>	<b>53</b>	<b>493MW</b>	<b>7</b>	<b>95MW</b>	<b>588MW</b>	<b>60</b>
<b>4</b>	<b>MSW Plants</b>	<b>3</b>	<b>57MW</b>	<b>6</b>	<b>83MW</b>	<b>140MW</b>	<b>9</b>
5	Solar Power Plants	107	1990MW	14	905 MW	2895MW	121
6	Slop incineration Projects	24	2468 KLPD	25	3153KLPD	5522KLPD	49
7	Distillery Plant with ETP	14	1639 KLPD	27	4526KLPD	6165KLPD	41
8	Sugar Plants	10	62500TCD	9	53000TCD	115000TCD	19
9	Flue Gas Desulphurisation	4	180+MW	3	550+MW	730+MW	7

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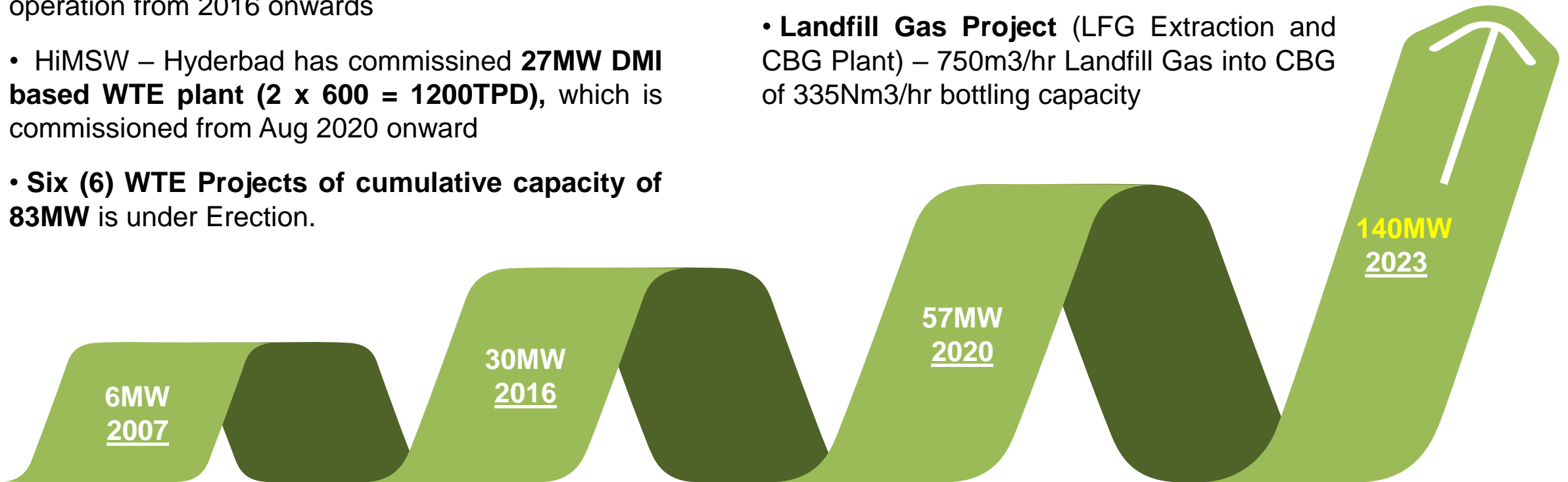
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# **Our Experience in WTE Projects**

# MSW Projects Commissioned & Projection for 2023

- The first **6.0MW RDF based power plant** was commissioned in Vijayawada – AP.
- DMSWSL has commissioned **24MW DMI based WTE plant (2 x 600 = 1200TPD)**, which is in operation from 2016 onwards
- HiMSW – Hyderabad has commissioned **27MW DMI based WTE plant (2 x 600 = 1200TPD)**, which is commissioned from Aug 2020 onward
- **Six (6) WTE Projects of cumulative capacity of 83MW** is under Erection.

- Detailed Project Report (DPR) has been completed for around **Eighteen (18) projects**.
- **Co-firing of MSW / Pellets** in CPP / IPP's
- **Landfill Gas Project** (LFG Extraction and CBG Plant) – 750m<sup>3</sup>/hr Landfill Gas into CBG of 335Nm<sup>3</sup>/hr bottling capacity





# Land Fill Based Bio-CNG Plant



Biogas plant inaugurated in Hyd, Ramky Enviro calls it largest in India

A biogas plant was inaugurated at the Hyderabad Integrated Municipal Solid Waste site in Jawaharnagar on Wednesday. Ramky Enviro Engineers Limited claimed that this is one of the world's first and India's largest such plant. The project focuses on the conversion of landfill gas into compressed biogas as an automotive fuel.

short by Deepika Bhatt / 28 Oct, 2021

# MSW Incineration Based WTE Plants in India

S.N	PLANT	RDF / MSW QTY (TPD)	POWER OUTPUT (MW)	Commissioned
1	Shriram Energy	1 x 350	6.0	2007
2	Timarpur Okhla Waste Management Private Ltd.	3 X 450	21.0	2015
3	East Delhi Waste Processing Company (P) Ltd.	1 x 550	12.0	2017
4	Delhi MSW Solutions (P) Ltd.	2 x 600	24.0	2017
5	Essel Infra	1 x 600	11.5	2017
6	Hyderabad MSW Energy Solution Pvt. Ltd.	2 x 600	27.0	2020
7	Jai Bharat Maruti	1 x 550	10.0	2022
8	Abellon	1 x 400	07.5	2022
9	Jindal Urban Waste Management	2 x 600	22.0	2022
10	Tekhhand Waste to Electricity Project Ltd.	2 x 600	25.0	2022
		8600	166	

# Waste Generation – Indian scenario

- **Total Municipal Solid Waste Generation**

- ~62 Million Tones / annum (*100 Million TPA Prediction for 2022 as per MoHUA & MoEFCC*)
- 1.7 Lakhs TPD
- 90% of the waste is collected (56 MTPA) and the remaining 10% of the waste is not collected (6 MTPA).
- From the collected waste, 20% of the waste is used for processing (11 MTPA) and the remaining 80% is dumped in an open dump yard (45 MTPA)

- **Power Generation Potential**

- ~56 Million Tones / annum (1.4 Lakhs TPD – 5800 TPH )
- Average power output is in the order of 2000 MW (1700 MW to 2600 MW)
- The present power generation in India is around <200 MW

- **Other Waste**

- ~E-waste (2.0 MTPA as of 2016 and will be around 5.0 MTPA in 2020)
- Biomedical waste (0.2 MTPA)
- Hazardous waste (8.0 MTPA)



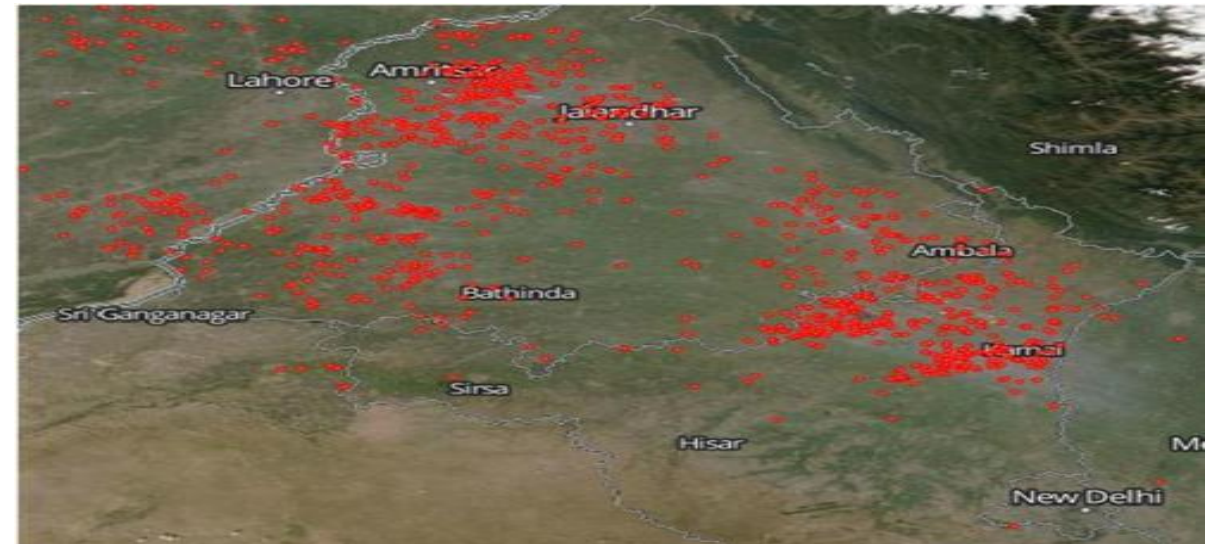
Source: Internet



# Biomass Waste (Agricultural Residue) – Indian scenario

- Punjab produces around 19 to 20 million tons of paddy straw and around 20 million tons of wheat straw every year. 85 to 90% of the straw is burnt in the field.
- The Central Electricity Regulatory Commission (CERC), under the Ministry of Power, has already notified favorable tariffs to biomass-based power plants.
- In Punjab, this tariff has been determined at Rs 8.17 per unit, and is even higher than competing sources of renewable energy, such as solar energy or wind-based power projects.
- There is a huge potential of power generation to an extent of 5000 to 6000MW of power.

Source: From Internet.....



# Specific Experience on 100% Agricultural Residue Projects

- Kalpa Taru -1 - 7.5MW Mustard Stalk fired Power Plant
- Kalpa Taru -2 - 6.0MW Mustard Stalk Fired Power plant
- Shree Jyothi Bio - 7.5MW Mustard Stalk Fired Power plant
- Viaton Energy - 10MW Cotton Stalk Fired Power Plant
- Green Infra - 8.0MW Mustard stalk fired Power Plant
- Star wire - 10MW Mustard Stalk Fired Power plant
- Indeen Bio - 9.0MW Mustard Stalk Fired Power Plant
- Radico Kaithan - 6.3MW Co-generation plant (cotton Stalk / Mustard Stalk)



# Biomass (Agricultural Residue) Co-firing in Boilers

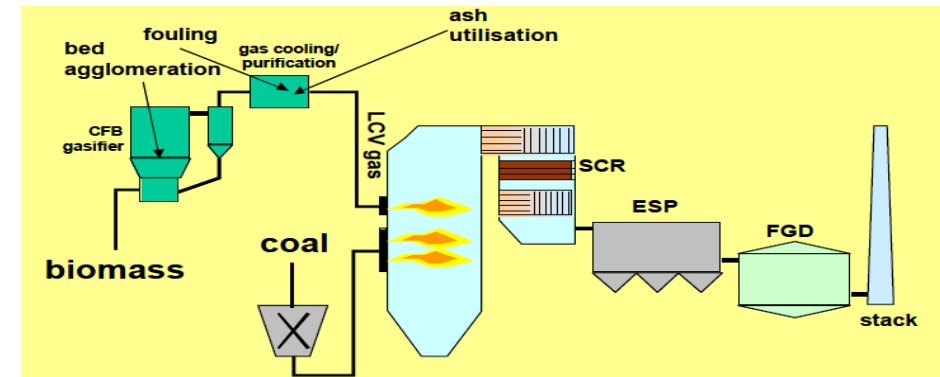
- **Direct Method**

- Blending the biomass and coal in the fuel handling system and feeding blend to the boiler
- Separate fuel handling system for the biomass, and thus no impact to the conventional coal delivery system



- **Indirect Method**

- Firing with derived Fuels (Briquettes / Pellets)
- Bio-gas through gasification Process



# Some Bio-mass fuels used ...

- Sugarcane Bagasse
- Cane Trash
- Briquette
- Rice Husk
- Rice Straw
- De Oiled Bran
- Juliflora (wood)
- Mustard stalk
- Cotton stalk
- Bengal gram stalk
- Chilli stalk
- Tapioca Skin / Sticks
- Palm Oil Mill Effluent
- Empty Fruit Bunches
- Palm shell
- Coconut shell
- Coconut coir pith
- Woodchips
- Saw dust
- Ground nut shell
- Casuarina woodchip
- Subabul wood
- Poultry litter
- Municipal Solid Waste
- Refuse Derived Fuel
- Cow & Camel Dung
- Corn Cobs
- Sun flower husk
- Bajra Stalk
- Casurina Root
- Eucalyptus Bark
- Tamma Wood
- Gliricidia Wood
- Cashew Waste
- Rubber Wood
- Coconut Fronts
- Palm Fibre
- Spent Wash
- Bagasse pith
- Furniture Shavings

Have rich experience in handling most of the Bio-mass fuels available

**3**

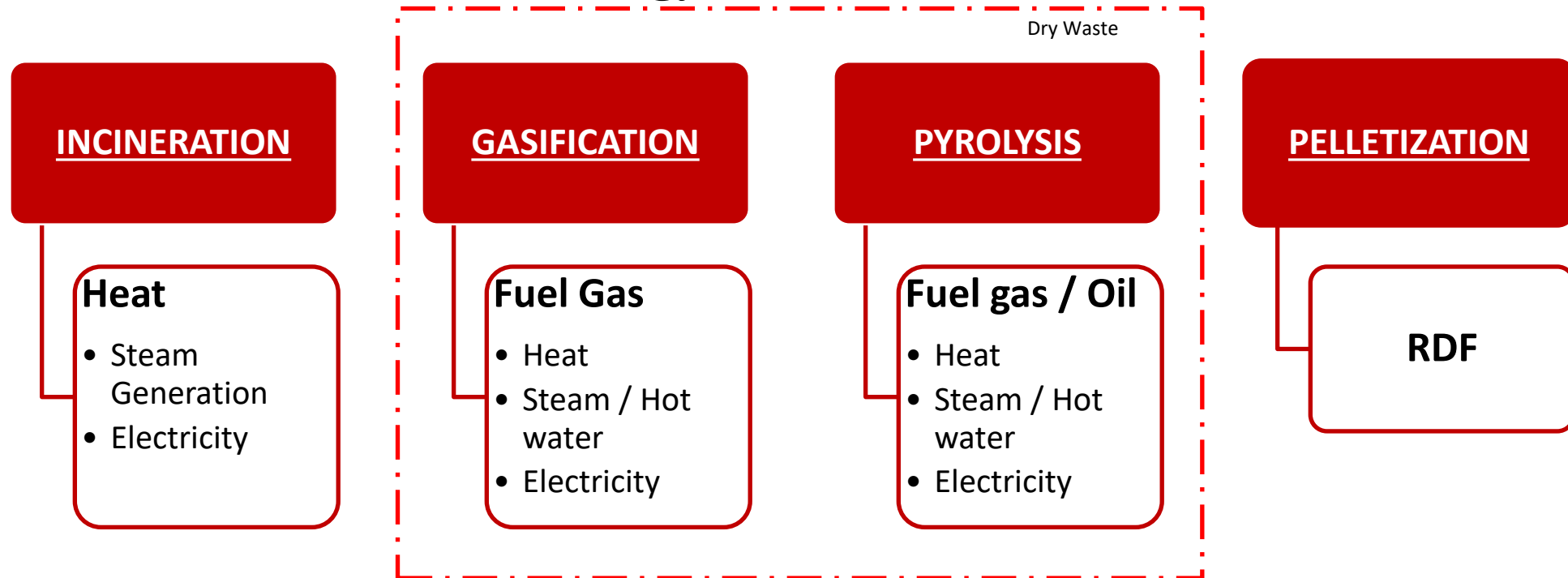
# **WTE Technologies**

# WTE – Conversion Technologies

There are various Process / Technology available in MSW based WTE

– Biological Processing Technology (Composting, Bio-Methanization, etc)

– **Thermal Conversion Technology**



# Technology - Selection Basis

→ Flexibility in the system due to wide change in the MSW quality

→ Proven Technology & In house availability

→ Expertise in Operation & Maintenance

→ Meeting the Environmental Pollution Norms

→ Meeting Contractual Targets

→ Energy Recovery & Over all Economics

**RISK'S TO BE  
ANALYSED**

**IN**

**TECHNOLOGY  
SELECTION**



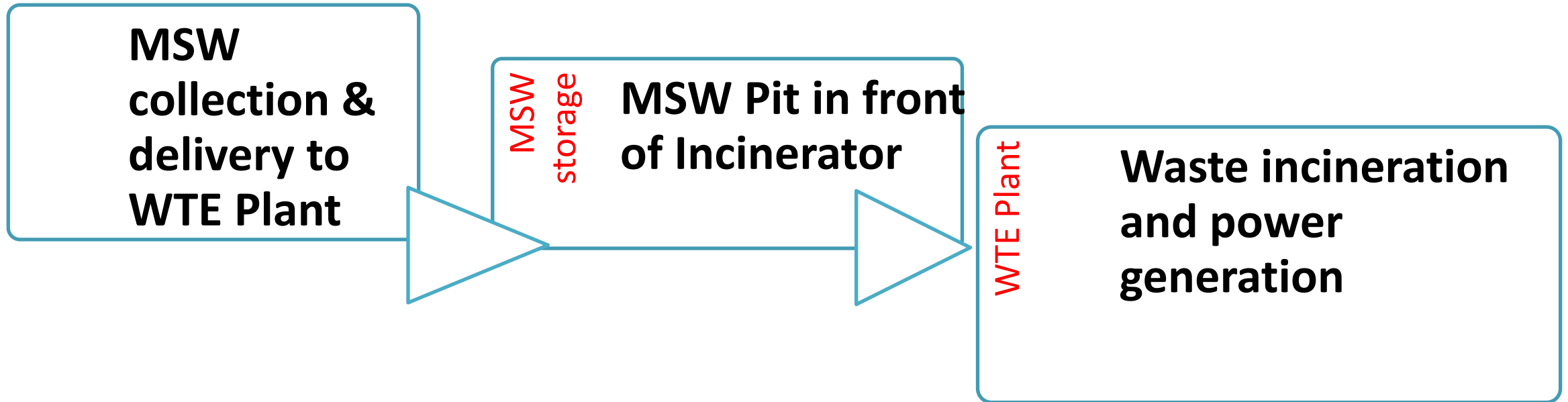
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# **Incineration Technology**

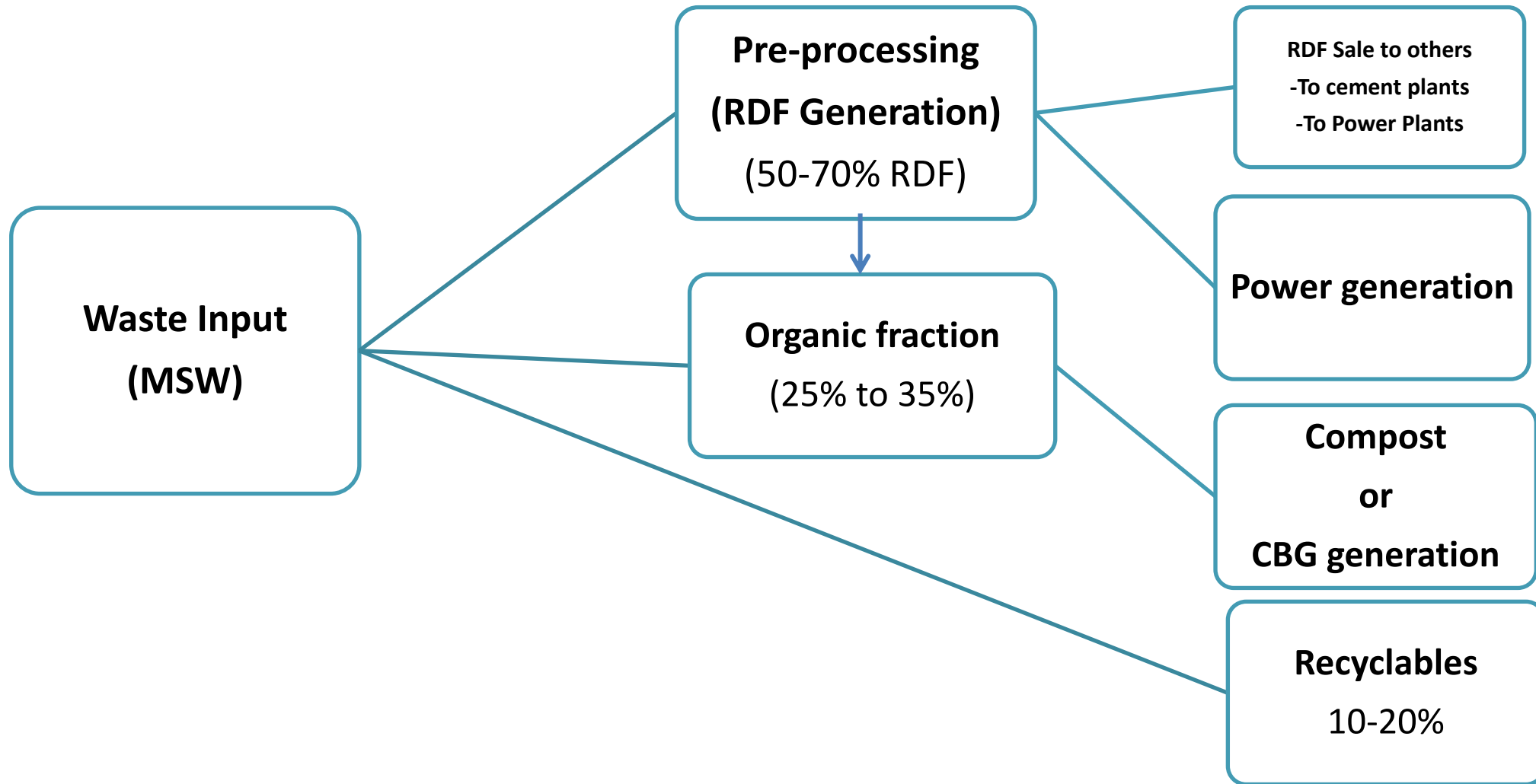
# Incineration

- **Incineration Technology** is a well developed technology followed in many countries from past few decades. In India also recently, few plant are in continuous operation with this technology.
- Incineration is the Engineered process of controlled burning / combustion of waste at a high temperature, in the presence of oxygen.
- Incineration of MSW is divided in to two broad categories
  - Burning “as received” waste.
  - Burning “pretreated” waste (Converting in to [RDF](#) – Refuse Derived Fuel)
- Burning of the “as received” waste requires little or no pretreatment. This is termed as **Direct Mass Incineration (DMI)**. Burning of pretreated waste, requires considerable amount of treatment process.

# Direct Mass Incineration



# MSW to RDF and Energy Generation



# Advantages of Incineration Plants

08  
Investment cost can be offset by heat recovery / sale of energy

07  
Ash residue is usually do not protrude, they are sterile & inert

06  
Gas discharges can be well controlled to the permissible norms

05  
Incineration is carried out at generation site



01

It address three sets of environmental issues in one stroke – Pollution issues due to open dumping, Effective Land use & Environmental impacts of fossil power plants

02

Volume reduction (approx. 85 to 90% in volume) and hence Small disposal area required

03

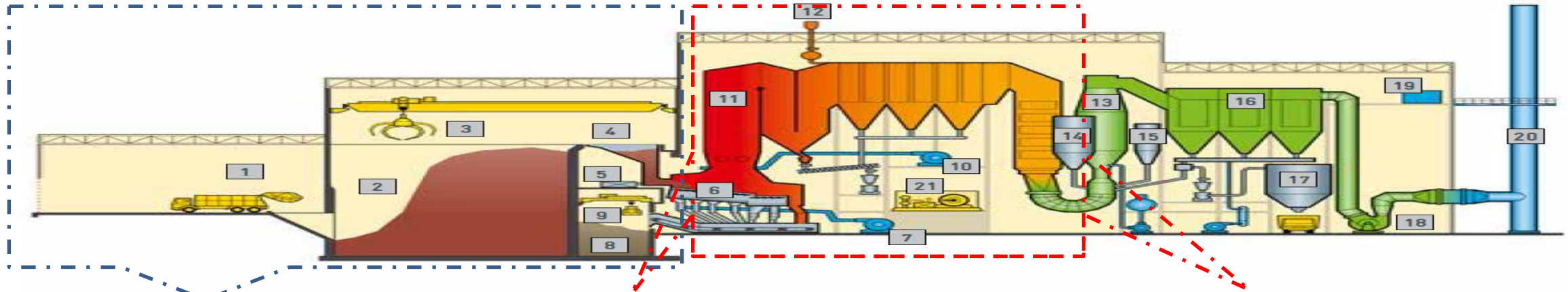
Waste Reduction & Destruction is immediate, no long term wait is required

04

No foul smell and infections to the public



# WTE Plant - Systems



## WASTE DELIVERY

- 1 Tipping hall
- 2 Waste bunker
- 3 Waste crane
- 4 Waste feeding chute

## INCINERATION

- 5 Ram feeder
- 6 Incineration grate
- 7 Primary air fan
- 8 Bottom ash bunker
- 9 Bottom ash crane
- 10 Secondary air fan
- 11 Steam boiler
- 12 Boiler safety valve

## FLUE GAS CLEANING

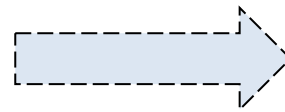
- 13 Flue gas reactor
- 14 Hydrated lime
- 15 Activated carbon
- 16 Bag filter
- 17 Residue silo (fly ash)
- 18 ID fan
- 19 Emissions Monitoring System (CEMS)
- 20 Stack

## ENERGY RECOVERY

- 21 Steam turbine / generator

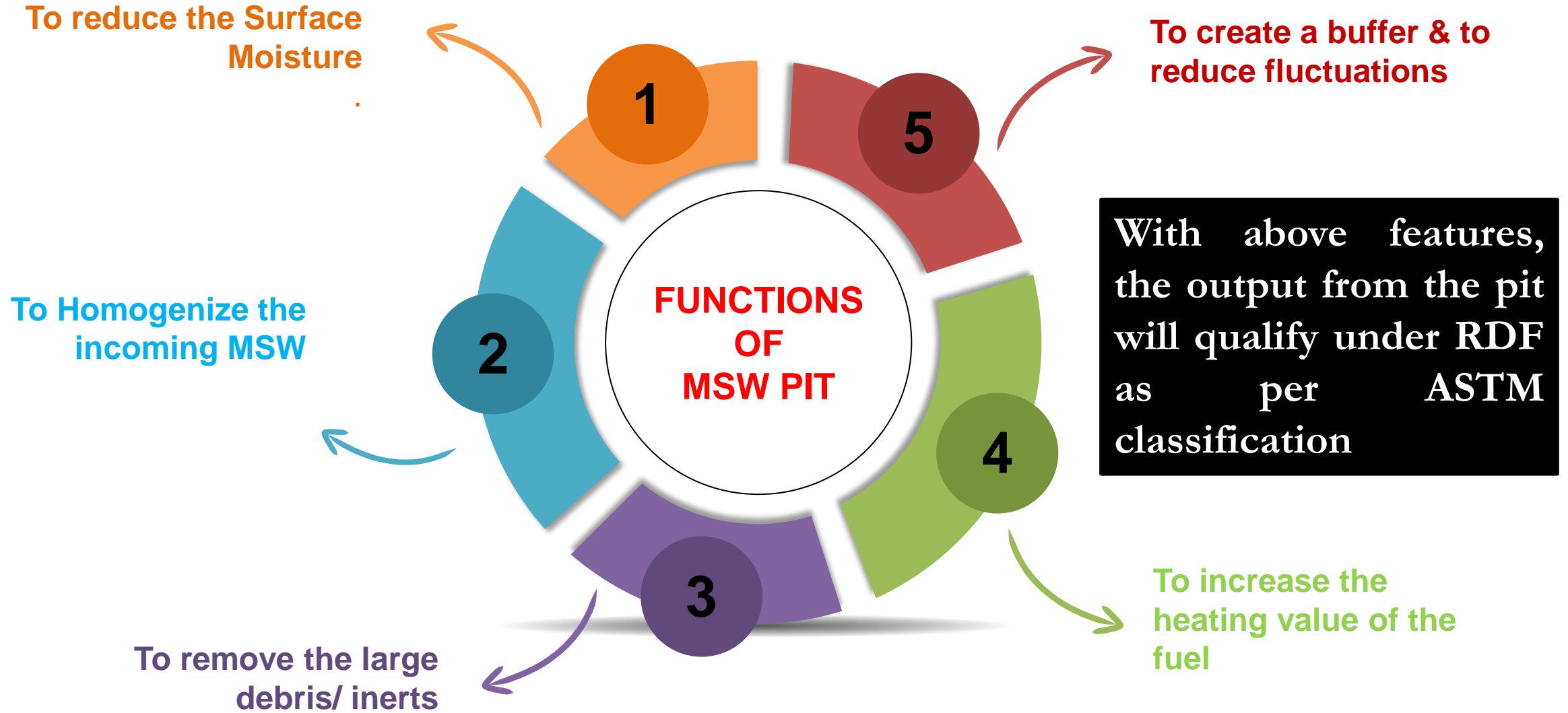
- MSW handling, Pre-processing and feeding system.
- Incineration System (MSW Firing & combustion system)
- Heat Recovery System from the flue gas & Power Generation System.
- Flue Gas Cleaning & Disposal system
- Ash Collection, Handling, Storage & Disposal system
- Leachate Collection and disposal system

# MSW Handling & Feeding System





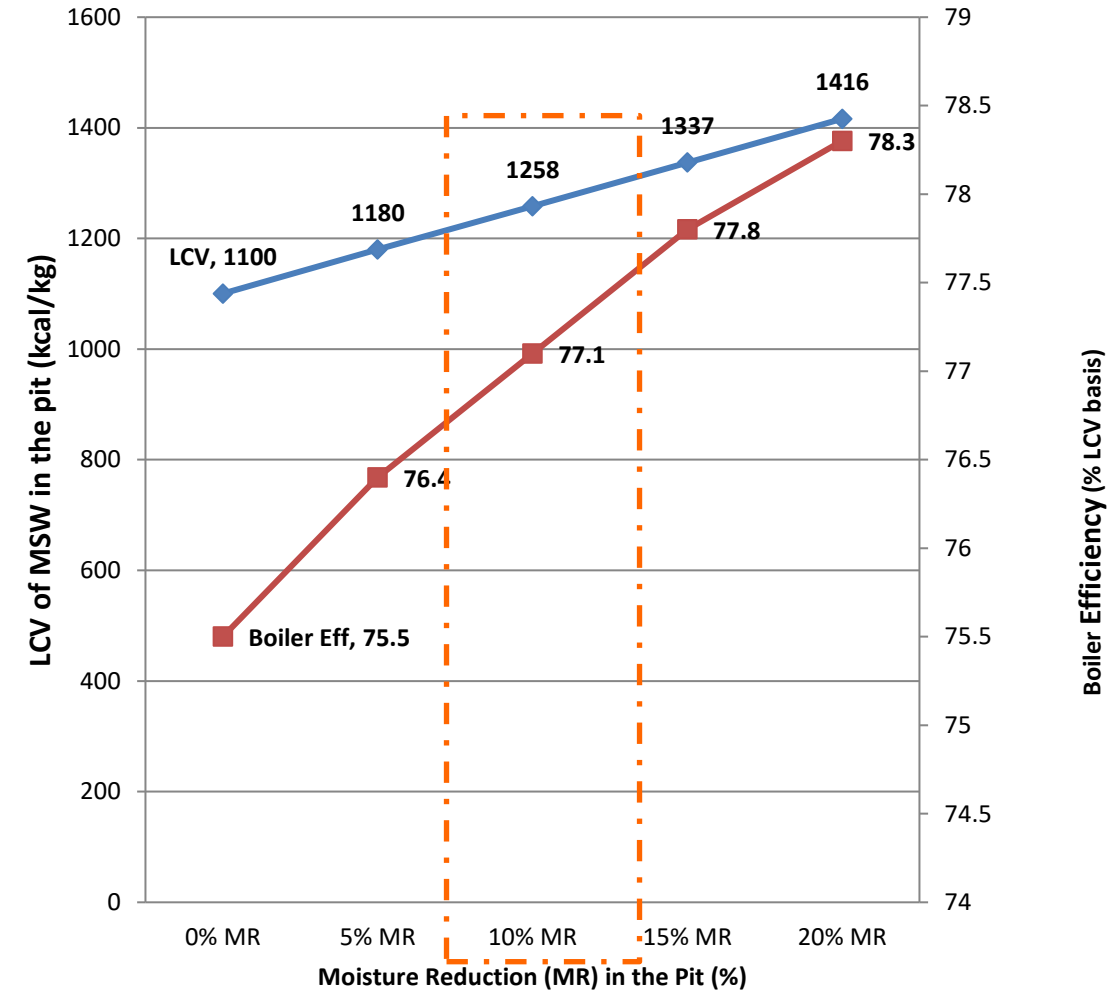
# MSW Pit in the WTE Plant



# MSW storage in pit - Calorific Value Improvement

Composition	In coming MSW	MSW with 5% MR in Pit	MSW with 10% MR in pit	MSW with 15% MR in pit
Carbon (%)	14.65	15.34	16.02	16.71
Hydrogen (%)	2.16	2.26	2.36	2.46
Oxygen (%)	10.12	10.57	11.07	11.54
Moisture (%)	48.35	45.93	43.52	41.10
Sulphur (%)	0.12	0.13	0.13	0.14
Ash (%)	23.60	24.70	25.81	26.91
Nitrogen (%)	1.00	1.07	1.09	1.14
<b>Total (%)</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>LCV (kcal/kg)</b>	<b>1100</b>	<b>1180</b>	<b>1258</b>	<b>1337</b>
<b>GCV (kcal/kg)</b>	<b>1495</b>	<b>1565</b>	<b>1635</b>	<b>1705</b>

Leachate collection quantity, Greatly depends on –The No. of storage days, Storage height, Surface moisture, Compaction, drainage etc.



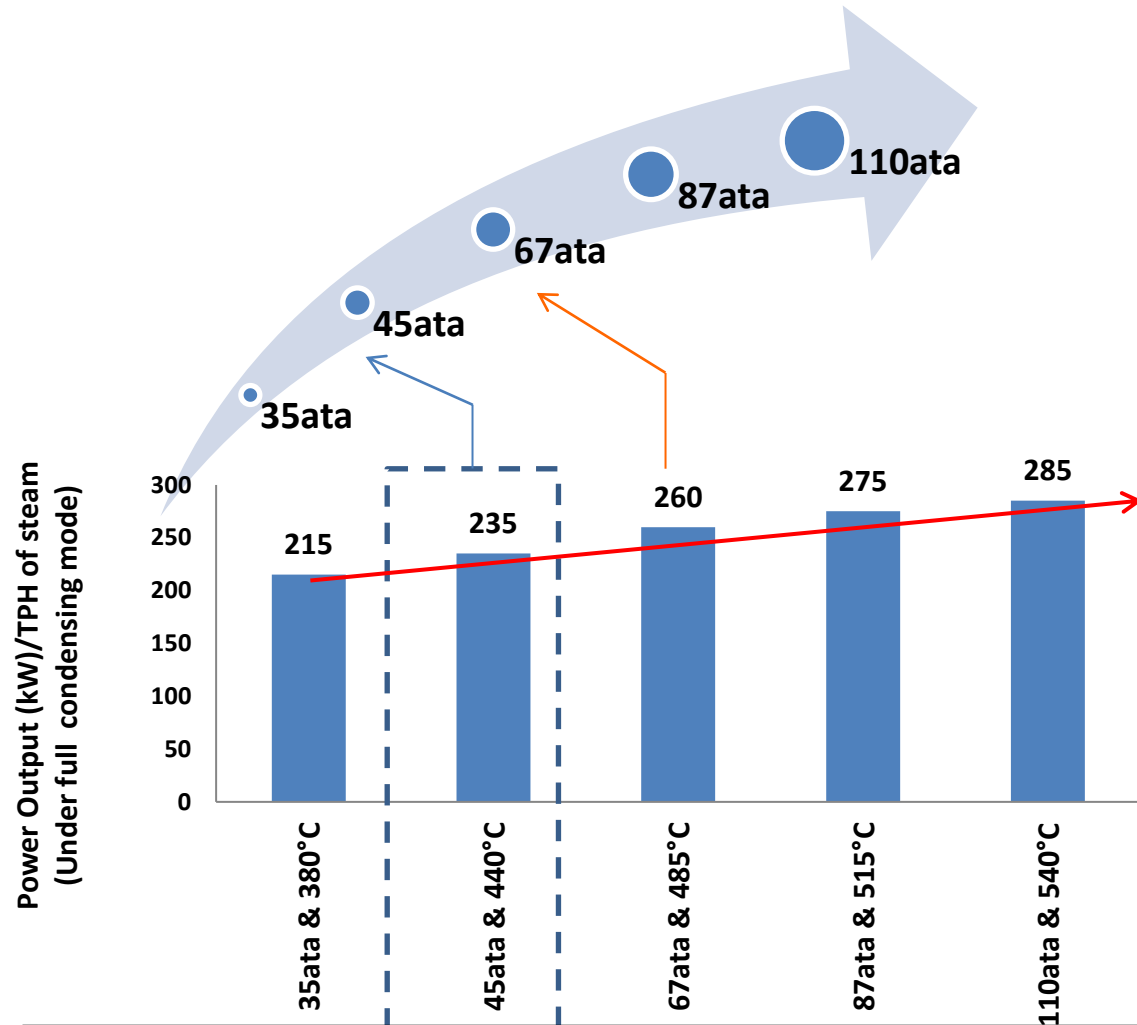
# MSW / RDF Classification as per ASTM

Type	Description
RDF 1: MSW	Municipal solid wastes used as fuel in as-discarded form
RDF 2: Coarse RDF	Municipal solid wastes processed to a coarse particle size
RDF 3: Fluff RDF	Municipal solid wastes processed to a particle size such that 95% by weight passes through a 2-inch.
RDF 4: Dust RDF	Municipal solid waste processed into a powdered form
RDF 5: Densified RDF	Municipal solid waste that has been processed and densified (compressed) into the form of pellets, slugs, cubettes, or briquettes
RDF 6: RDF Slurry	Municipal solid waste that has been processed into a liquid fuel
RDF 7: RDF Syngas	Municipal solid waste that has been processed into a gaseous fuel

**5**

# **Heat Recovery from Incineration Plant**

# History of Steam Cycle pressure



- There is a gradual increase in the power cycle parameters across the globe
- Today there are many small capacity power plants operating at 87ata and 110ata.
- However, WTE power plants normally operate a power cycle levels of 45ata & 400°C.

The data furnished above is preliminary in nature. Contact AVANT-GARDE for precise / more detail

# Selection of Boiler Steam Parameter





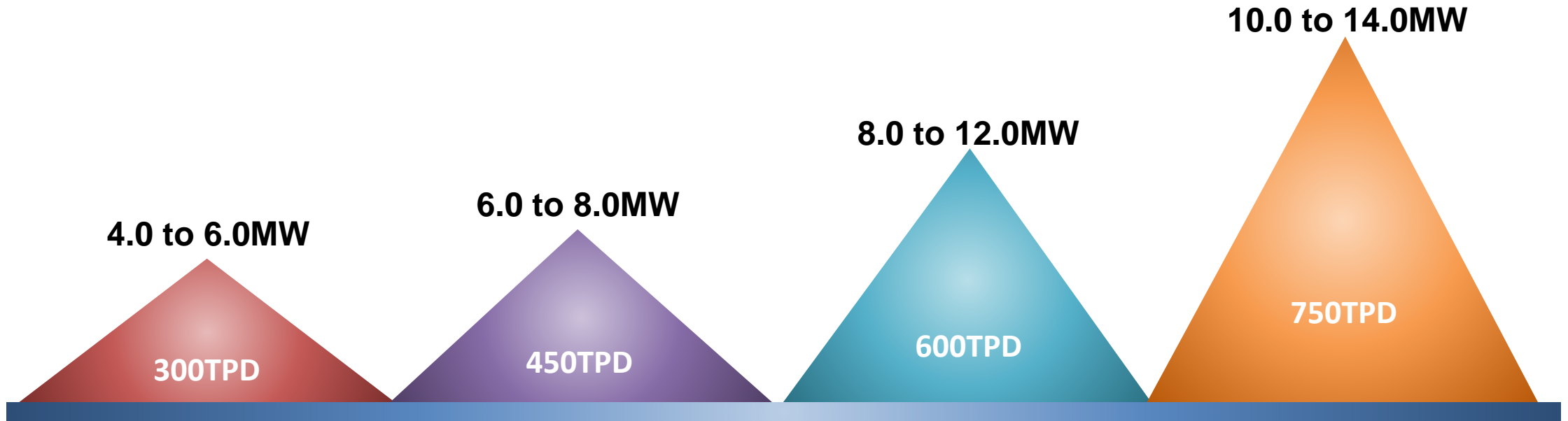
# Characteristics of MSW

	Indian Coal	Bagasse	Rice Husk	MSW
SiO <sub>2</sub>	55-65	40-55	80 -92	45-60
Fe <sub>2</sub> O <sub>3</sub>	03-06	03-08	01 - 03	03-12
Al <sub>2</sub> O <sub>3</sub>	08-20	05 - 10	00-05	06-12
CaO	01-03	05 - 08	02-04	07-16
MgO	01-02	01 - 04	Traces	01-02
Na <sub>2</sub> O	00-01	00-02	00-01	02-15
K <sub>2</sub> O	00-01	00-08	00-03	05-25
SO <sub>3</sub>	00-03	Traces	Traces	00-05
P <sub>2</sub> O <sub>5</sub>	00-02	01 - 04	Traces	10 -25
Cl	0	< 0.1	<0.1	00-02
IDT	1400	1100	1400	700 - 800

Parameter Variations in MSW (%)	
Moisture	15 to 80
Ash	20 to 60
Sulphur	0 to 4
Chlorine	0 to 2
LCV (kcal/kg)	800 to 1800

High Percentage of Fe<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O, K<sub>2</sub>O & Cl makes the fuel, a very high fouling, slagging and corrosive nature and hence a lower pressure and temperature is considered for the WTE Plant

# Power Generation from WTE Plant



1

Power variation depends on the calorific value of the MSW

2

Capacity of the plant is fixed based on the MSW availability

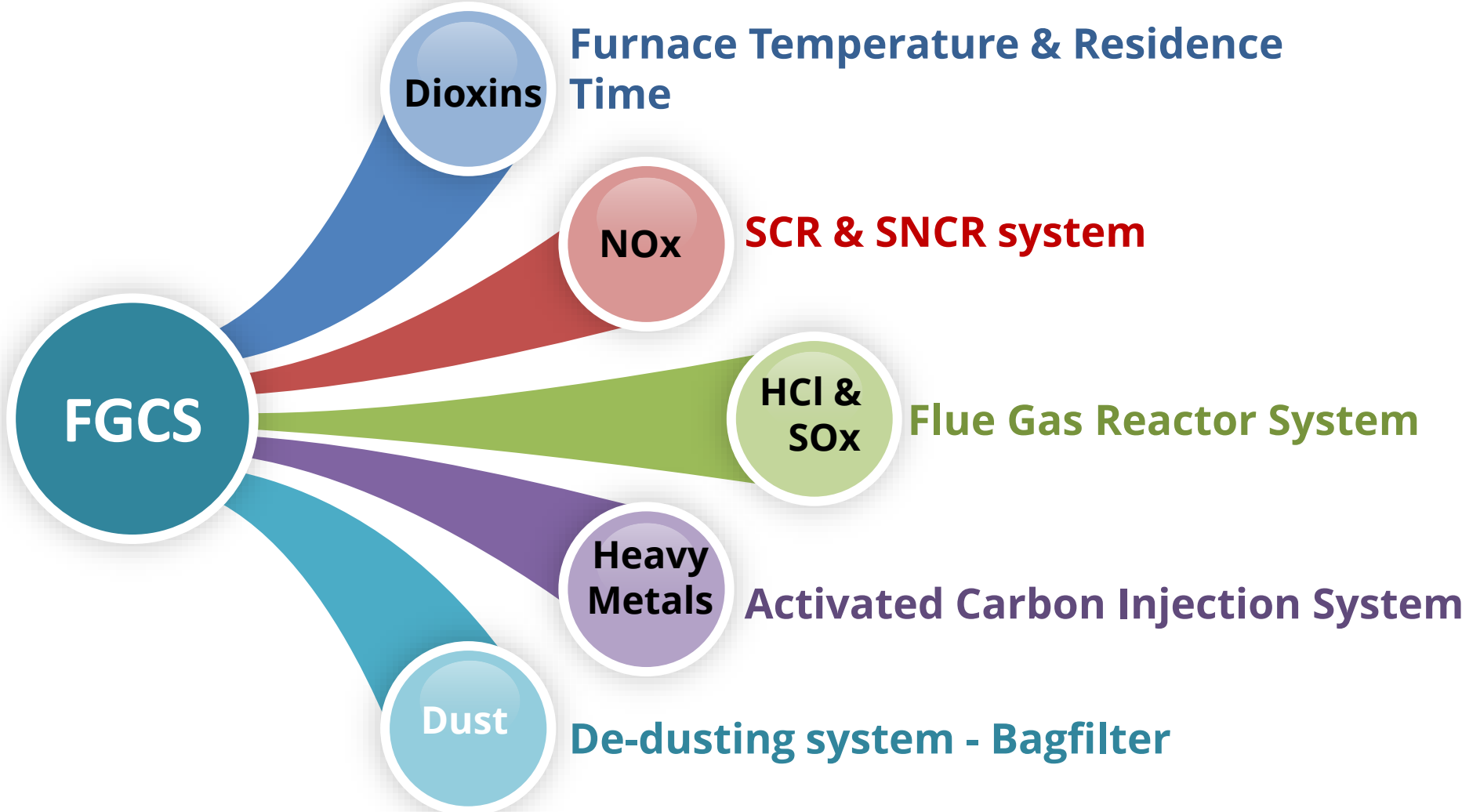
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Configuration of the plant depends on the plant capacity & Economics

6

# Pollution Control Systems

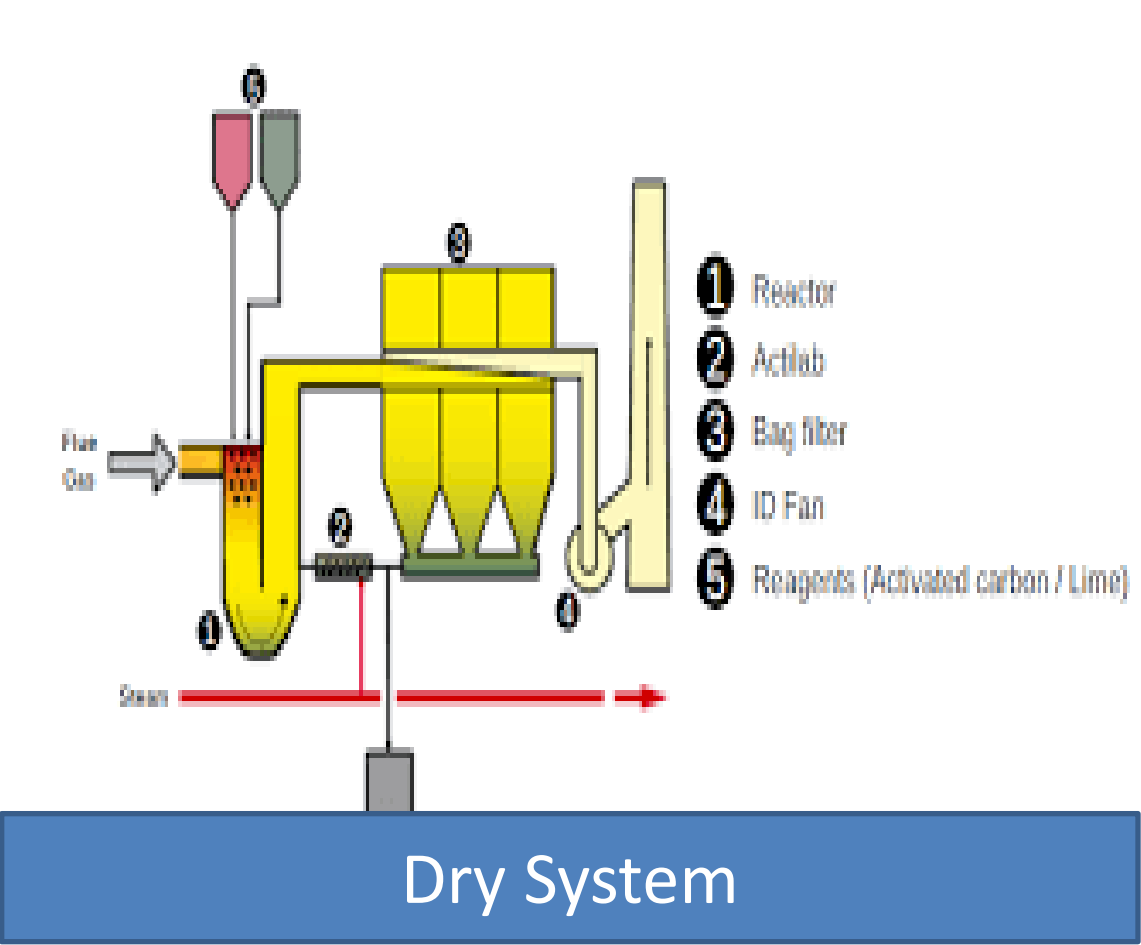
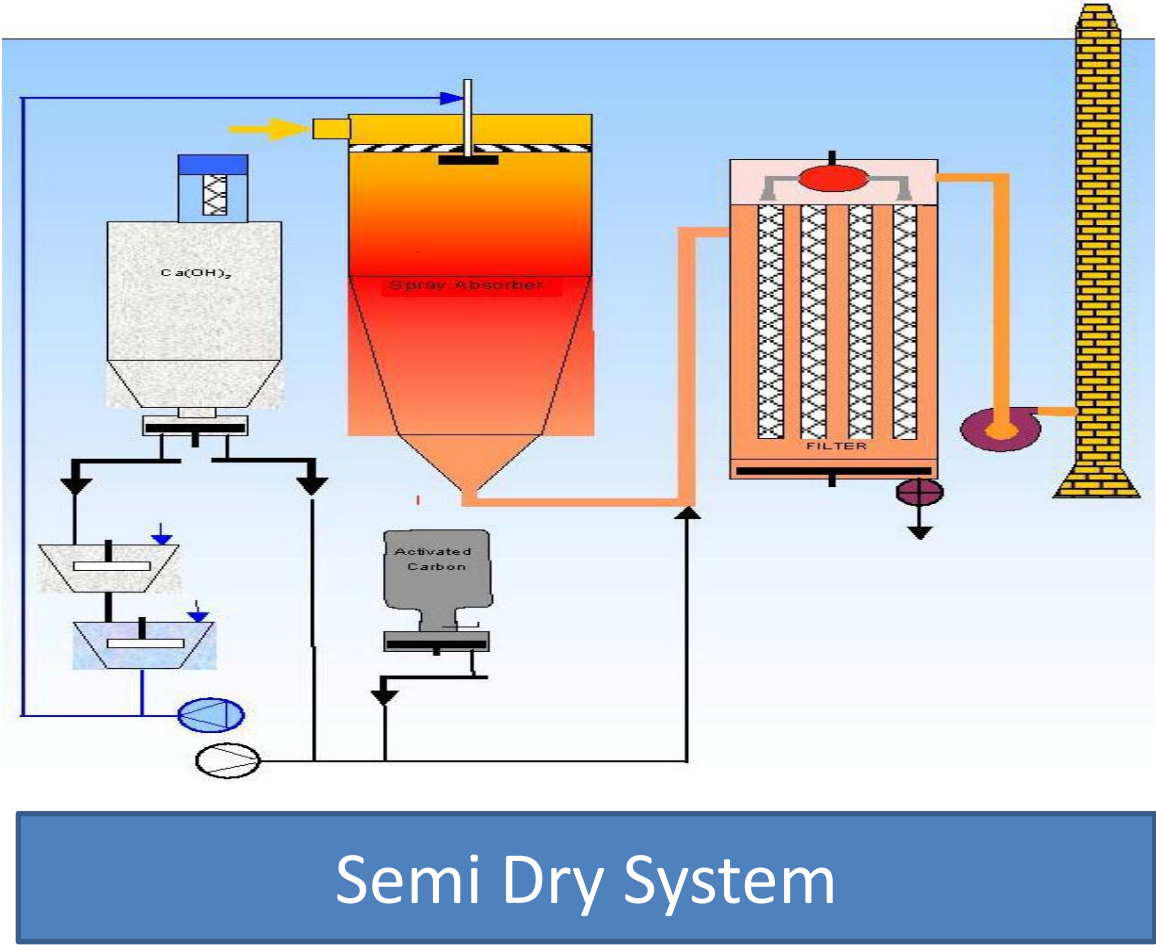
# Gas Cleaning & Disposal System



## Emission Standard – SWM 2016 Rules

Parameter	Unit	Limits as per SWM Rules, 2016	International Standards
Particulate Matter	mg/Nm <sup>3</sup>	50	10
Nox	mg/Nm <sup>3</sup>	400	200
SO <sub>2</sub>	mg/Nm <sup>3</sup>	200	50
HCl	mg/Nm <sup>3</sup>	50	10
HF	mg/Nm <sup>3</sup>	4	-
Dioxins & Furans	ngTEQ/Nm <sup>3</sup>	0.1	0.1
CO	mg/Nm <sup>3</sup>	100	50
TOC	mg/Nm <sup>3</sup>	20	-
Cd + Th + their Compounds	mg/Nm <sup>3</sup>	0.05	-
Hg and its compounds	mg/Nm <sup>3</sup>	0.05	-
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V+their compounds	mg/Nm <sup>3</sup>	0.5	0.5
(TEQ: Toxic equivalents)			

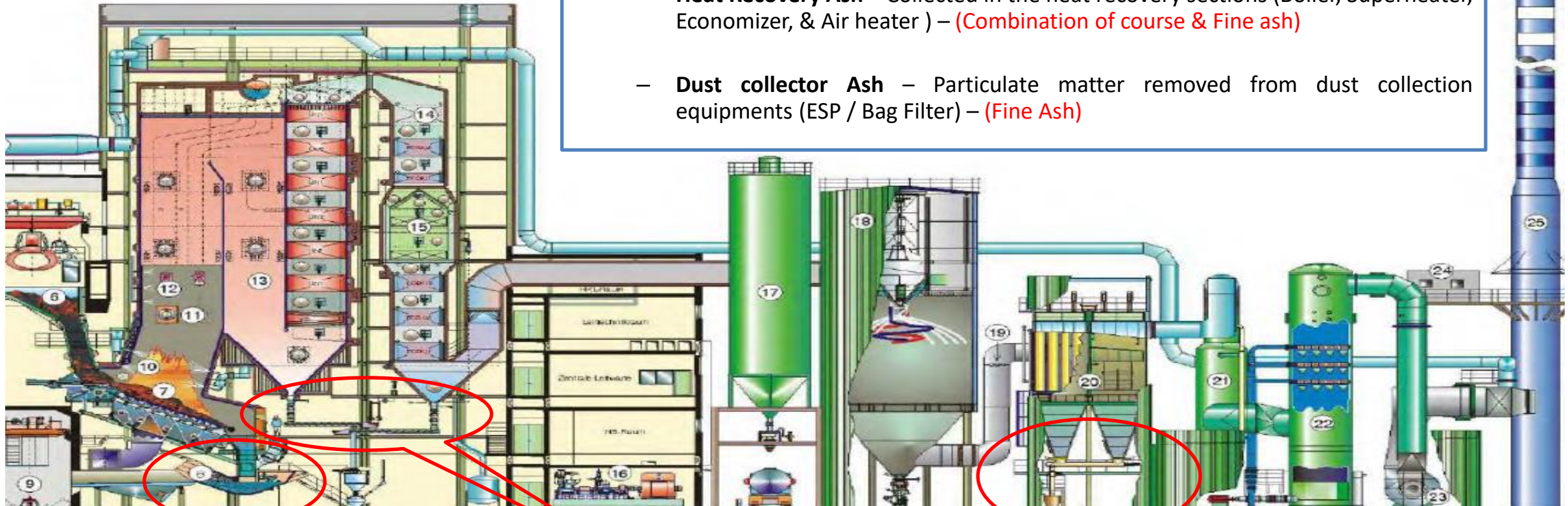
# Flue Gas Cleaning System





# Ash Collection and Disposal System

- **Bottom Ash (Slag)** – From combustion chamber / Grate outlet (**Course Ash**)
- **Fly Ash**
  - **Heat Recovery Ash** – Collected in the heat recovery sections (Boiler, Superheater, Economizer, & Air heater) – (**Combination of course & Fine ash**)
  - **Dust collector Ash** – Particulate matter removed from dust collection equipments (ESP / Bag Filter) – (**Fine Ash**)



Grate Ash - Slag

Fly Ash - Heat Recovery Ash

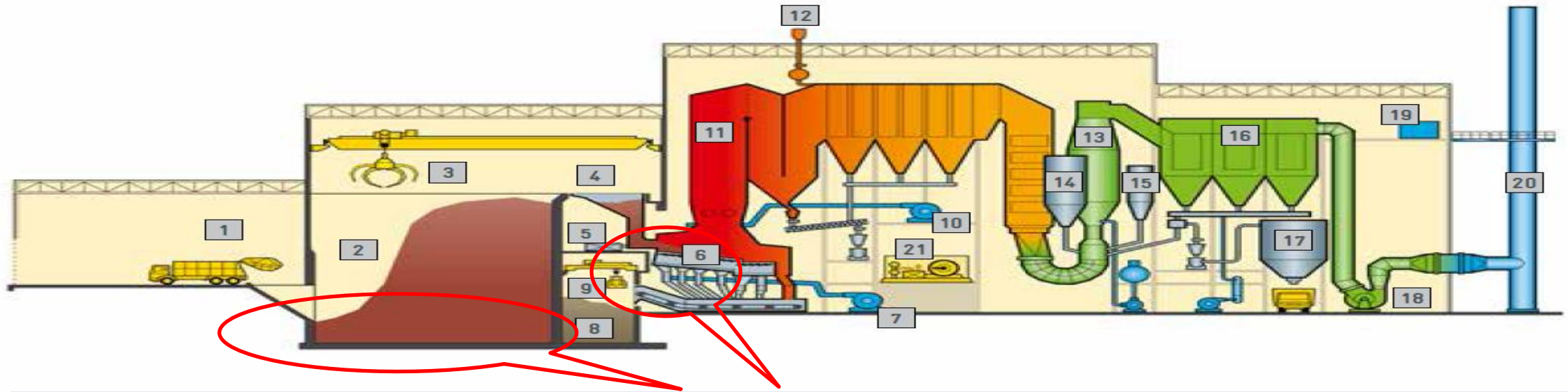
Fly Ash – From Dust Collector  
Ash

# Ash Reuse Options





# Leachate System



- Leachate drainage system.
- Leachate storage and discharge system.
- Leachate treatment system.
  - Leachate Concentration Plant (The by product can be mixed with the incoming MSW and fired in the boiler and the clear water can be used in the FGD Plant)
  - Biological treatment followed by RO system. (Further Energy recovery from the Leachate to an extent of 10 to 15kW/m<sup>3</sup>/hr is possible)

# WTE Plant

- **Water consumption - 225 to 250kl/day in case of ACC & 1300 to 1400kl/day in case of WCC (Typical values for a 750TPD WTE Plant)**
- **In house power consumption will be around 15 to 18%**
- **Plant Availability - 70% for 1<sup>st</sup> Year, 75 – 85<sup>+</sup>% from 2<sup>nd</sup> Year Onwards**
- **Load factor - 80 – 90%**

- **Manpower - Approx 60 - 100**
- **Project Schedule - 20 to 24Months from Boiler & TG ordering.**
- **Cost of the WTE plant will be around 15 to 18Cr / MW**
- **Land Requirement – 10 to 20Acres**
- **Chimney height around 60mts**

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# **WTE – Operating Plants**

# Few MSW based WTE Plants in India

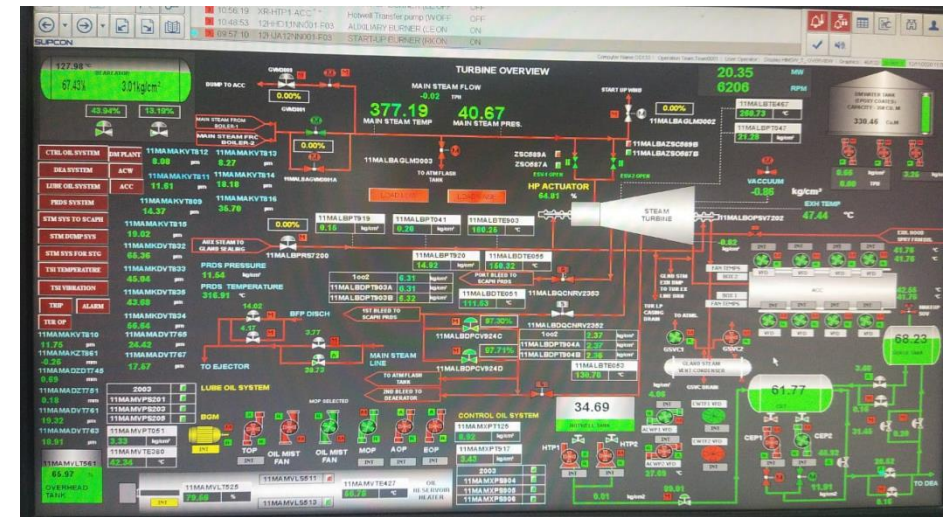


Jindal - Okhla Waste Management Company Private Limited  
MAW Handling - 3000 TPD

**AVANT-GARDE**



# Few MSW based WTE Plants in India



AVANT-GARDE



# Largest WTE Plant in the world



**5000TPD WTE Plant (168MW) in Shenzhen – China (Under Implementation)**



**5500TPD WTE Plant (185MW) in Dubai (Under Implementation)**

Source: Taken from Internet



# Few WTE Plant in the world

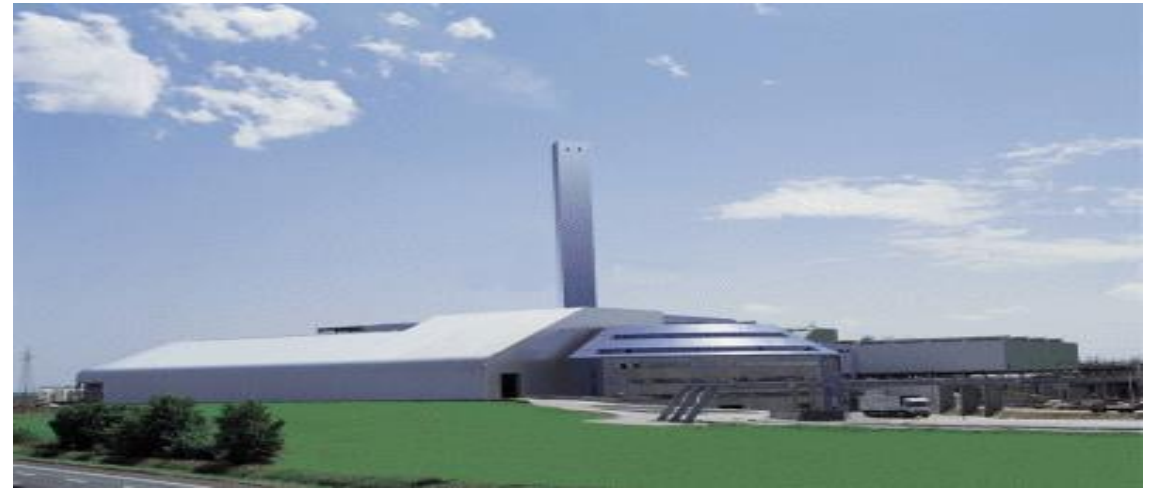


Source: Taken from Internet

**AVANT-GARDE**



# Few WTE Plant in the world



Source: Taken from Internet

# SUMMARY

## (MSW - A new beginning for an old source)

- DMI with Energy Recovery is one of the best WTE technology suitable for wide varying fuel like MSW, for effective disposal of waste. There are more than 1000 WTE plant with DMI technology in operation world wide. In India, around Ten (10) plants are in successful operation and few plant are under construction stage.
- In the incineration technology, there is a volume reduction to an extent of 90% and the gasses are let out from the chimney, satisfying the pollution norms. Most of the ash from the WTE plant can be used.
- There is a power generation potential from the MSW in the order of 270 to 445kW / TPH of MSW depending on the LCV.
- **With Tipping Fees, Capital Subsidy from the Government & Export power cost above 7.0Rs / unit, the DMI based WTE project becomes viable with a pay back less than 5.0years.**

# Why AVANT-GARDE ?

- Highly experienced team (SME's) in all disciplines
- Analyze various technologies and select optimum solution for a specific project.
- Tailor made solutions for each project.
- Optimized Layout Preparation with out compromising on the safety aspects
- Providing Innovative solutions in the WTE systems





# Contacts of Our Personnel



- Mr. S. Sivakumar – Chief Operating Officer
  - [ssk@avant-garde.co.in](mailto:ssk@avant-garde.co.in)
  - +91 9840040600
- Mr. S. Balaguru – Chief Technology Officer
  - [sbalaguru@avant-garde.co.in](mailto:sbalaguru@avant-garde.co.in)
  - +91 9840044300
- Mr. J. Gladstone Evans – HOD Thermal
  - [jgladstoneevans@avant-garde.co.in](mailto:jgladstoneevans@avant-garde.co.in)
  - +91 9840046888
- Mr. S. Ilango
  - [silango@avant-garde.co.in](mailto:silango@avant-garde.co.in)
  - +91 9940066663



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**Thank you**