POWERING SUSTAINABILITY

"THE FUTURE OF ALTERNATIVE FUELS IN CEMENT INDUSTRY"

HOLTEC CONSULTING PRIVATE LIMTED

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WHY ALTERNATIVE FUELS ?

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WHY ALTERNATIVE FUELS?

- Depletion of Fossil Fuels like Coal, HFO & NG
- Energy Security against imported fossil fuels
- Green house gas emissions reduction
- Converting Waste to Energy
- Solution to Better Waste Management
- Reduced requirement of land required for land fill
- Reduction in Energy Costs

AGENDA

- **Indian Cement Industries' AF journey**
- **Available Alternative Fuels & Types In India**
- **HOLTEC Role for enhancing AF Usage**
- **Technological Advancements**
  - Preprocessing & Co-processing systems for AFR usage
- **Impact Assessment on**
  - Pyro Process
  - Quality of Clinker
  - Bypass requirement
- **Environmental Benefits**
- **Holtec Global Experiences - Alternative fuels in Pyro process**
  - Case Studies

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INDIAN CEMENT INDUSTRIES' AFR JOURNEY

INDIAN CEMENT INDUSTRIES' AF JOURNEY

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Installed Cement Capacity – 553 MTA
Operating Cement Capacity – 298 MTA
(As on April 2024)

2010

0.6% TSR
~ 0.4 MTPA

- CPCB guidelines on Co-processing
- Only Industrial wastes utilized

2012

1.1% TSR
~ 0.7 MTPA

- Limited cement plant with waste co processing

2016

3% TSR
~ 1.9 MTPA

- Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016

2020

4% TSR
~ 2.6 MTPA

- Shift Towards Biomass , MSW & other wastes

2023

6% TSR
~ 4 MTPA

- Focused Sourcing
- High investment on Preprocessing , Feeding & Technological upgradation

2025

7% TSR
~ 4.7 MTPA

- Emission from AF exempted in CCTS

2030

25% TSR
~ 21 MTPA

TARGET

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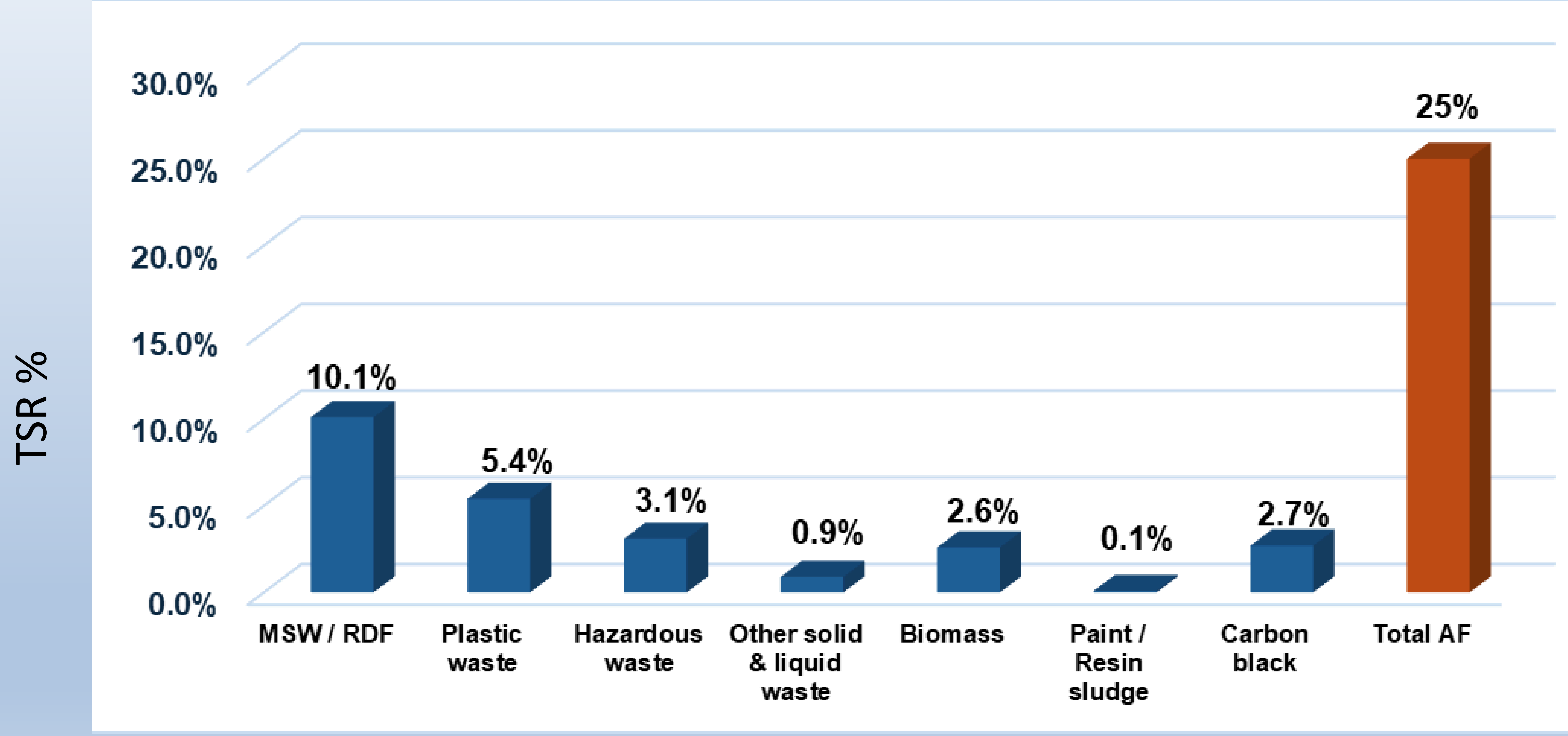
TSR TARGETS – LARGE CEMENT PLAYERS

TSR%	Ambuja Cement	ACC Cement	Dalmia Cement	JK Cement	Shree Cement	Ultratech Cement	JSW Cement	J K Lakshmi	Sagar Cement
2022-23	6.4	9.2	17	14.0	3.5	5.2	7.0	5.0	3.3
2023-24	7.8	9.2	22.	16.3	2.4	5.1	10.0	7.0	3.8
Target - 2030	25.0	28.0 (by 2027-28)	100 (by 2035)	35.0	25.0	30.0	30.0	20.0	25.0

Major Indian cement producers aim to achieve TSR levels between 25-35% by 2030, with net-zero goal for 2050.

WASTE STREAM AT 25% TSR (2030)



MSW/ RDF is Foreseen as Major AF @ 25% TSR Level

MSW/ SOLID WASTE GENERATION STATUS IN INDIA

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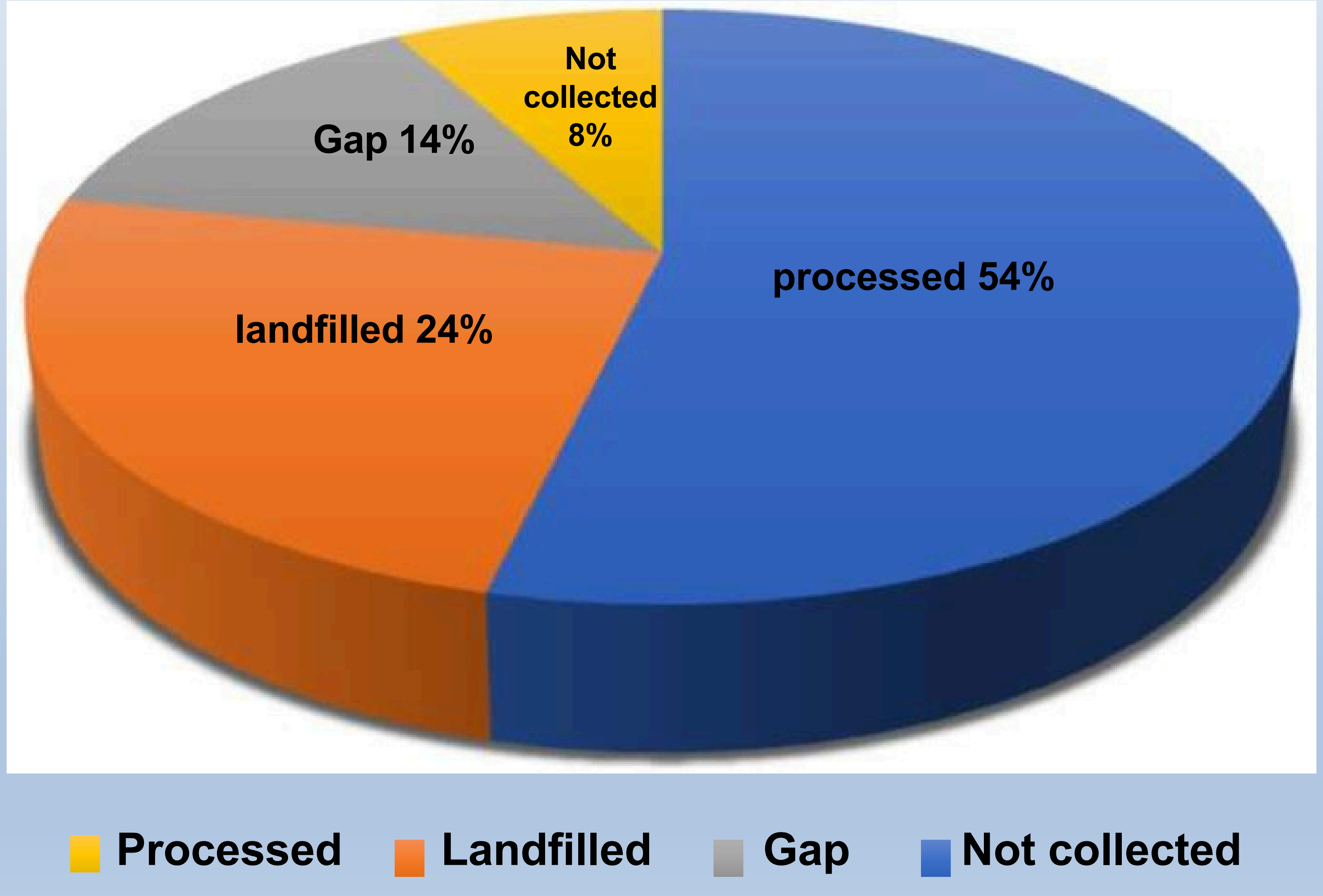
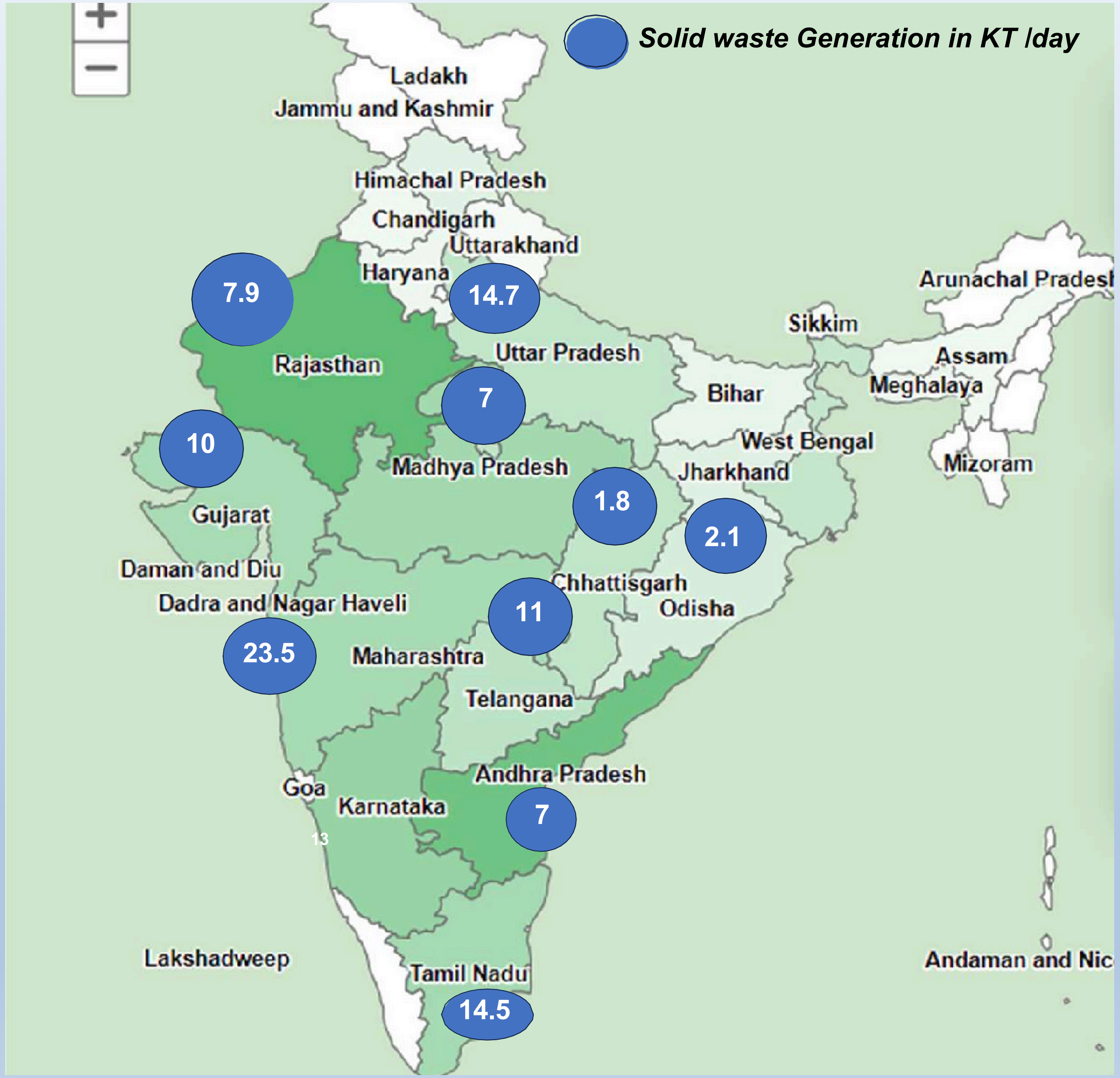
Generated Solid waste : 1,70,339 TPD



*https://www.marketresearchfuture.com/reports/india-waste-management-market-



Solid waste Generation in Cement Cluster Vicinity states : 32 MTPA

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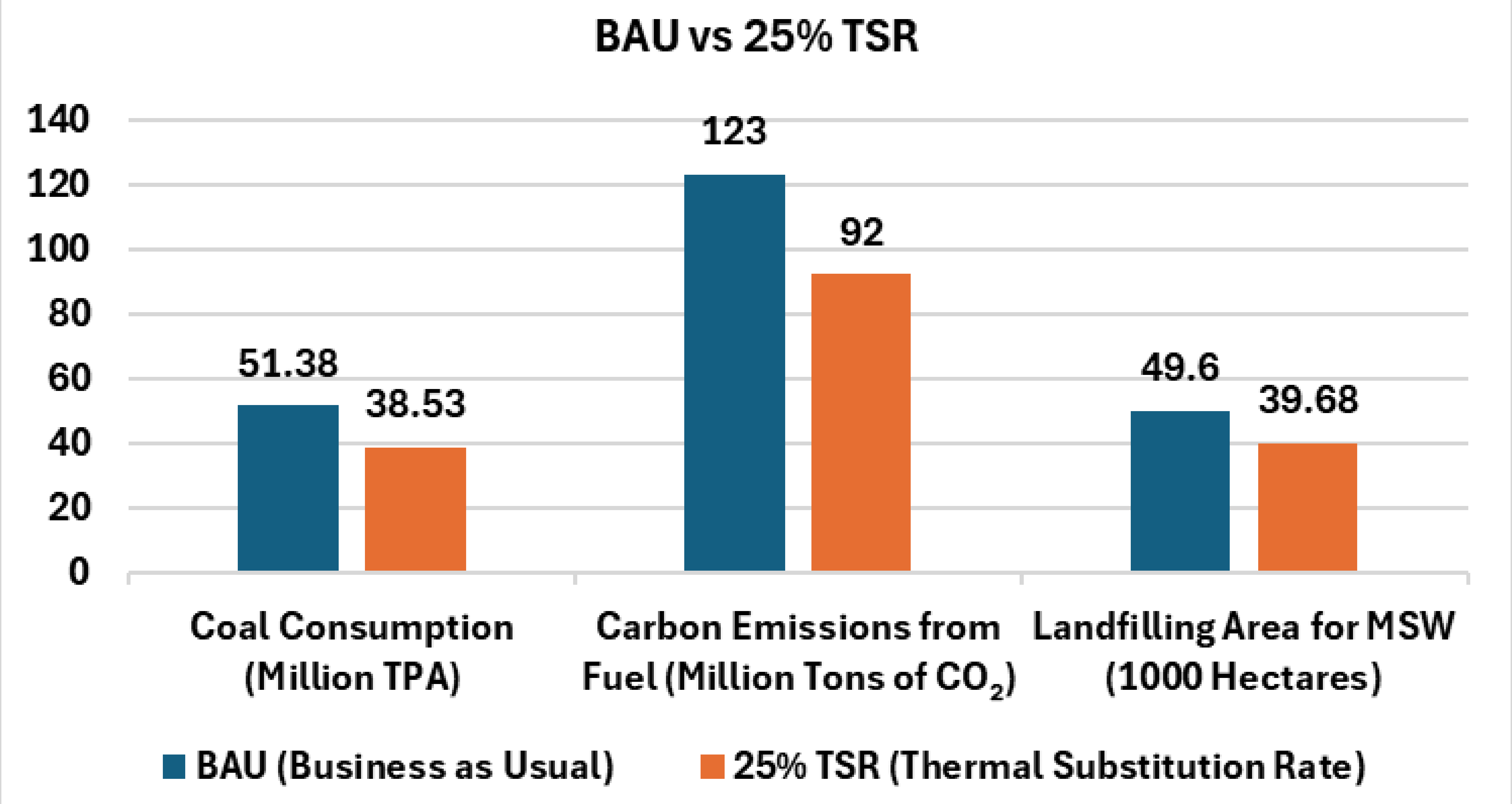
WHAT 25% TSR MEANS ?

Saving in Overall Cost of Production = INR 175-200/ t of Clinker



GLOBAL TSR SCENARIO

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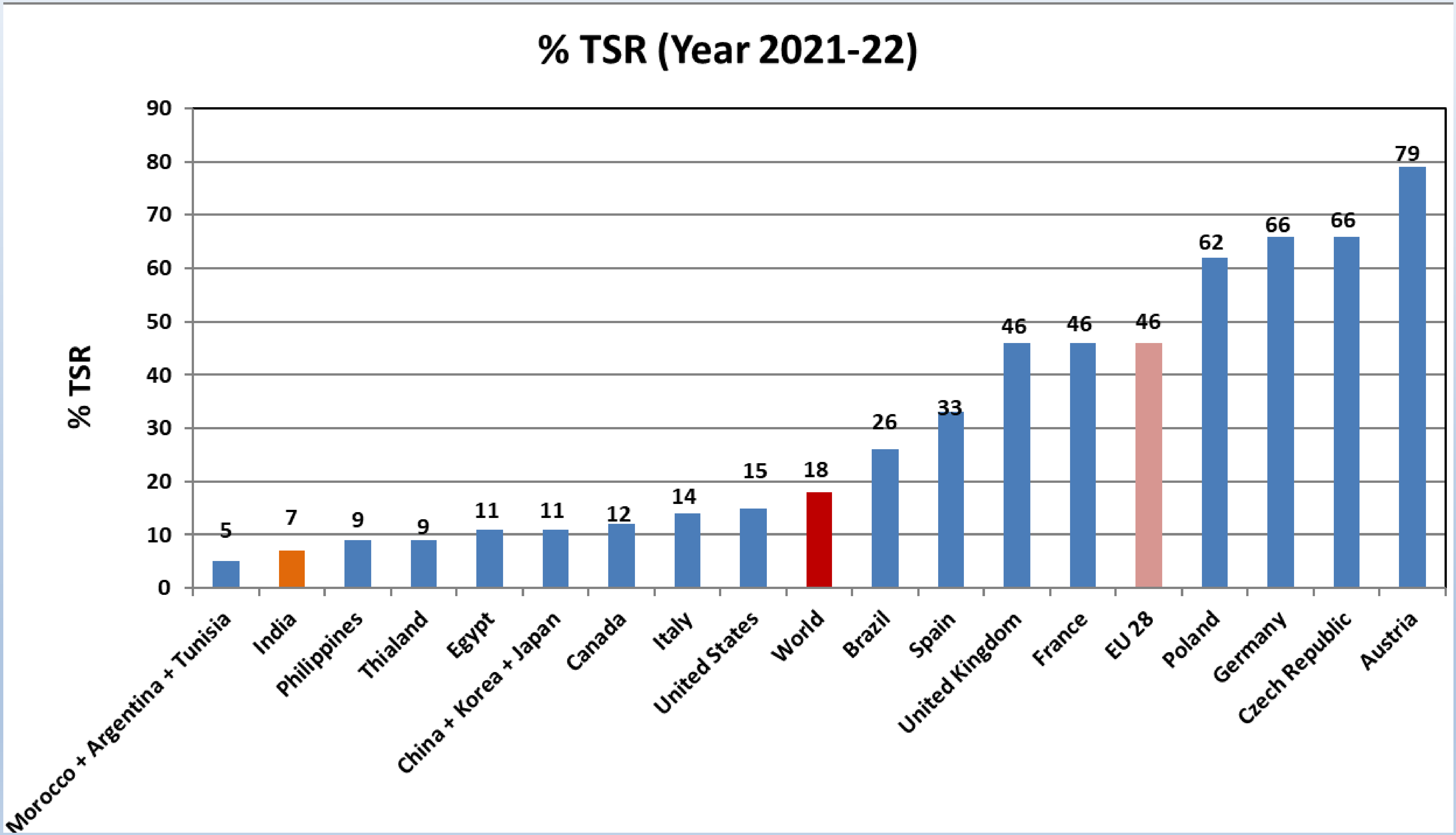

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WHY INDIA IS FAR BEHIND?

WESTERN COUNTRIES	INDIA
Regulatory and Policy Frameworks	
Stringent environmental regulations & compliance	Policies Introduced but Regulatory frameworks & enforcement mechanisms are still evolving & compliance is weaker/ less stringent
Economic Considerations	
• Cost of traditional fuels rising due to environmental taxes • Financially incentivized to adopt AF to reduce costs and offset the initial investment	• Traditional fuels (coal) is relatively cheaper • Financial incentives for using AFs are relatively limited • Initial investment and the fluctuating availability of AF are deterrent.
Waste Management and Supply Chain	
• Well-established waste management systems that separate & process waste materials for use as AF	• Waste management infrastructure is still underdeveloped • Collection, sorting & processing of waste into viable fuels inefficient leading to inconsistent supply of AF
Technological Infrastructure	
• Better equipped to handle AFs, which require specialized systems for storage, preprocessing and combustion • Invest heavily in R&D to improve AF technologies.	• Lack of infrastructure to handle the specific requirements of AFs such as moisture, particle size & contamination • Upgrading existing infrastructure requires high capital investment, often not feasible for smaller players.

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TECHNOLOGY INFRASTRUCTURE GAPS FOR 25% TSR

TECHNOLOGY INFRASTRUCTURE GAPS for 25% TSR

- Pre-processing plants to condition RDF and other fuels to kiln requirements
- Alternative fuel storage systems and advanced fuel feeding systems to handle diverse fuel types
- Bypass systems
- Multi-fuel burners
- Pyro System Capacity (Pre-Calciner, PH fan Capacity, Kiln Inlet , Bag House)
- Emission control systems (De-Nox/ De-Sox) to manage pollutants and comply with environmental regulations.
- Automation systems for optimized operations and consistency in fuel blending & dosing.

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TYPES OF ALTERNATIVE FUELS

ALTERNATIVE FUELS & CHARACTERISTICS

Agricultural Biomass

Fuel Type	Lower Heat Value (kcal/kg)	Moisture Content (%)	Ash Content (%)	Carbon Content (%)	Associated Emissions
Rice Husk	3150 - 3870	10	20.6	38.8	Cl
Wheat Straw	3775 - 4350	7.3 - 14.2	4.5 - 8.9	44.9 - 48.8	Cl
Corn Stover	3680	9.4	3.2 - 7.4	42.5	N/A
Sugarcane (Bagasse)	3440 - 4635	10 - 15	4.2	44.1	N/A

ALTERNATIVE FUELS & CHARACTERISTCS

Non-Agricultural Biomass & Others

Fuel Type	Lower Heat Value (kcal/kg)	Moisture Content (%)	Ash Content (%)	Carbon Content (%)	Associated Emissions
Dewatered Sewage Sludge	2500 - 4000	**75**	21.8	30 - 53.9	Heavy Metals
Paper Sludge	2030	**70**	26	N/A	Cl
Saw Dust	3940	**20.6**	46.9	N/A	Cl (if treated wood)

ALTERNATIVE FUELS & CHARACTERISTICS

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Chemical & Hazardous Waste, Petroleum-Based Waste

Fuel Type	Lower Heat Value (kcal/kg)	Moisture Content (%)	Ash Content (%)	Carbon Content (%)	Associated Emissions
Spent Solvent	5020 - 5970	10.3-16.5	-	47.7	Dioxins
Paint Residues	3894 - 5500	9	34	41-51	Dioxins, Heavy Metals
Hazardous Waste	33.5	-	-	50	Dioxins, Heavy Metals
Tires	6640 - 8870	0.3	-	-	Nox, SO2, CO

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ALTERNATIVE FUELS & CHARACTERISTICS

Other Wastes

Fuel Type	Lower Heat Value (kcal/kg)	Moisture Content (%)	Ash Content (%)	Carbon Content (%)	Associated Emissions
MSW	2,388 – 3,800	10-40	-	40	Cl, Heavy metals, NOx
Waste Oils	5,159	5	46	44	Zn, Cd, Cu, Pb
Textiles	3,892	5.8	1.2	44.6	Sb, Cr, Zn
Automotive Shredder Residues	3,940	2.2	36.2	46.2	Cl, Heavy metals

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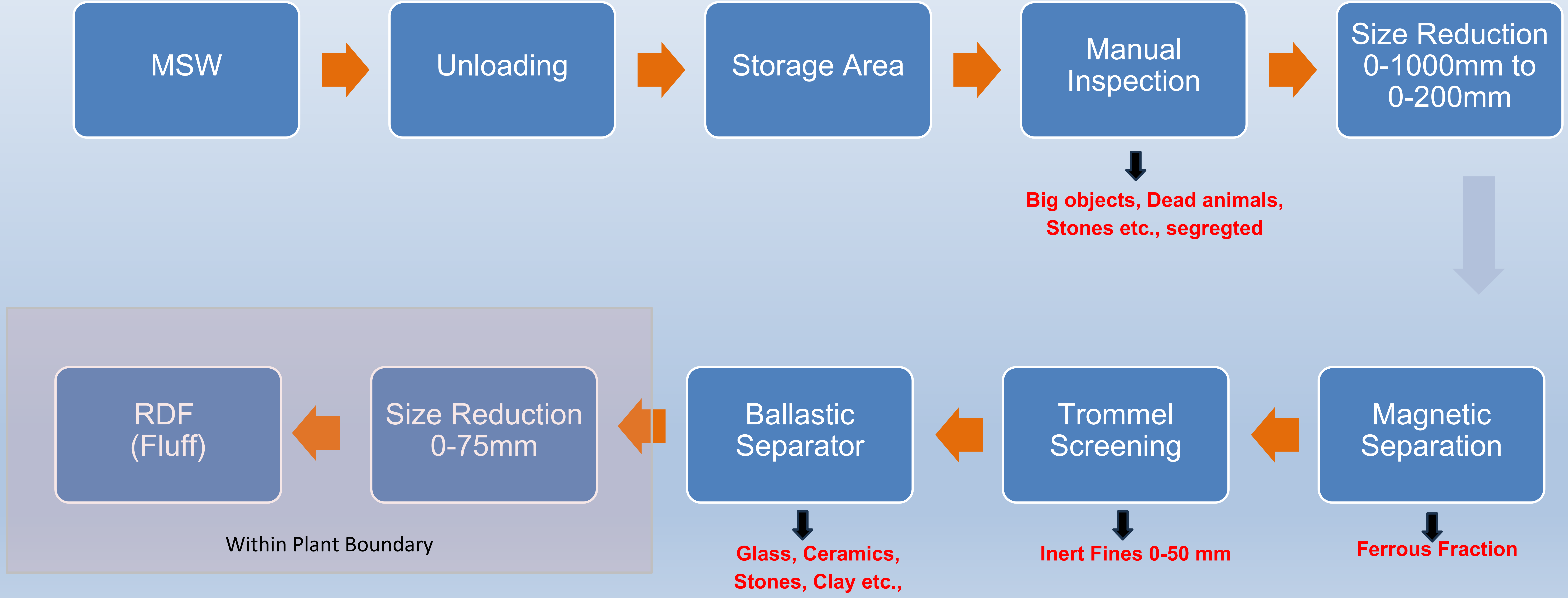
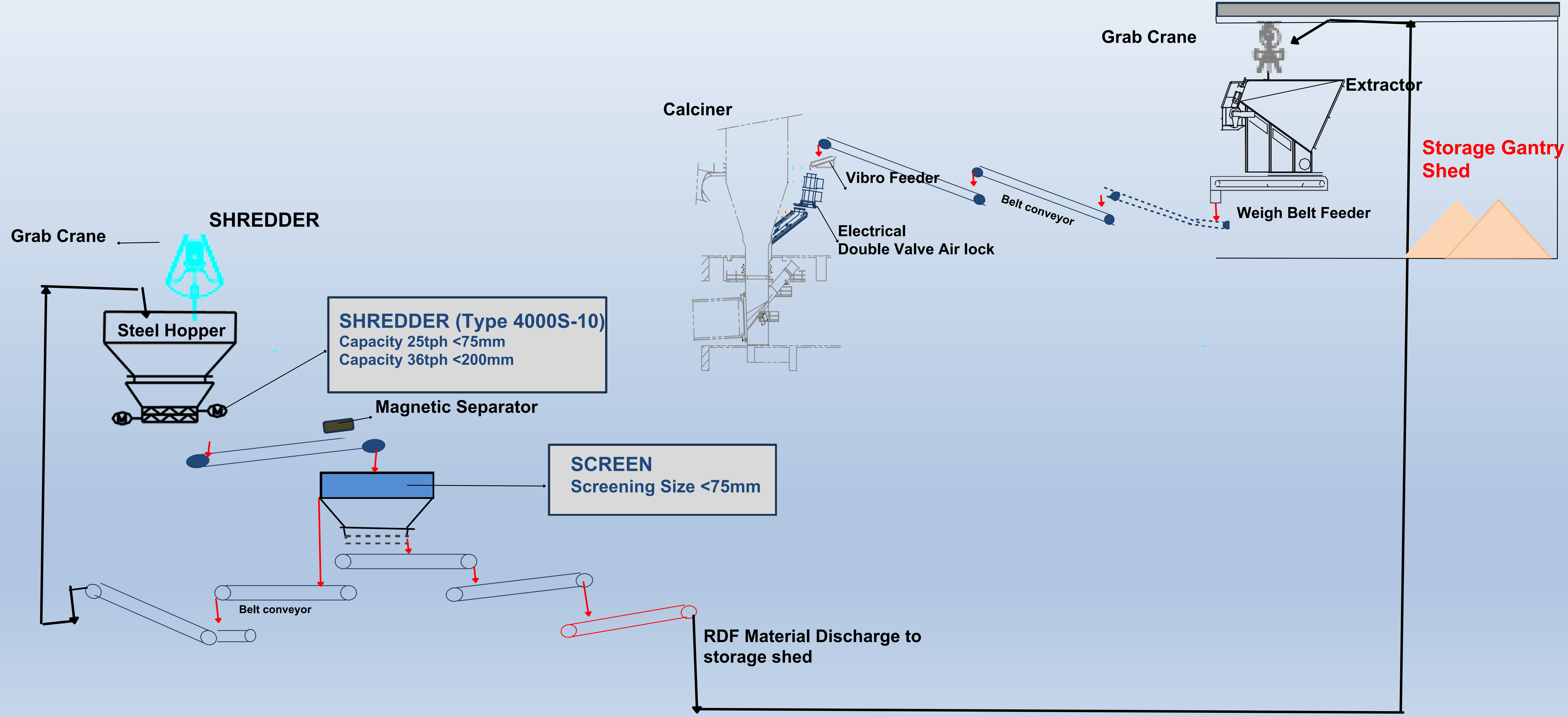
TECHNOLOGICAL ADVANCEMENTS

TYPICAL PROCESSING TECHNOLOGY



MSW PRE & CO-PROCESSING -TYPICAL FLOW SHEET

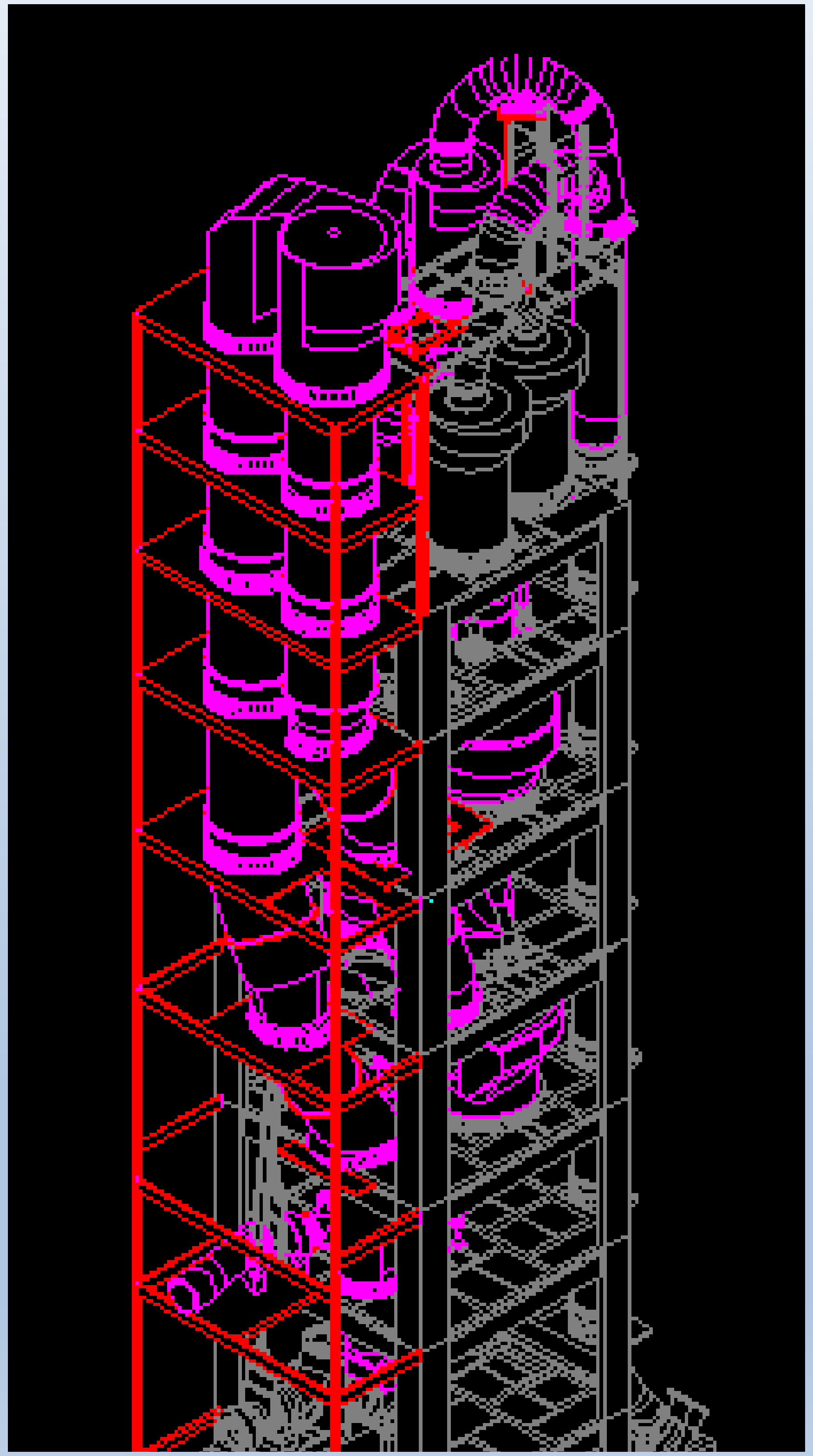


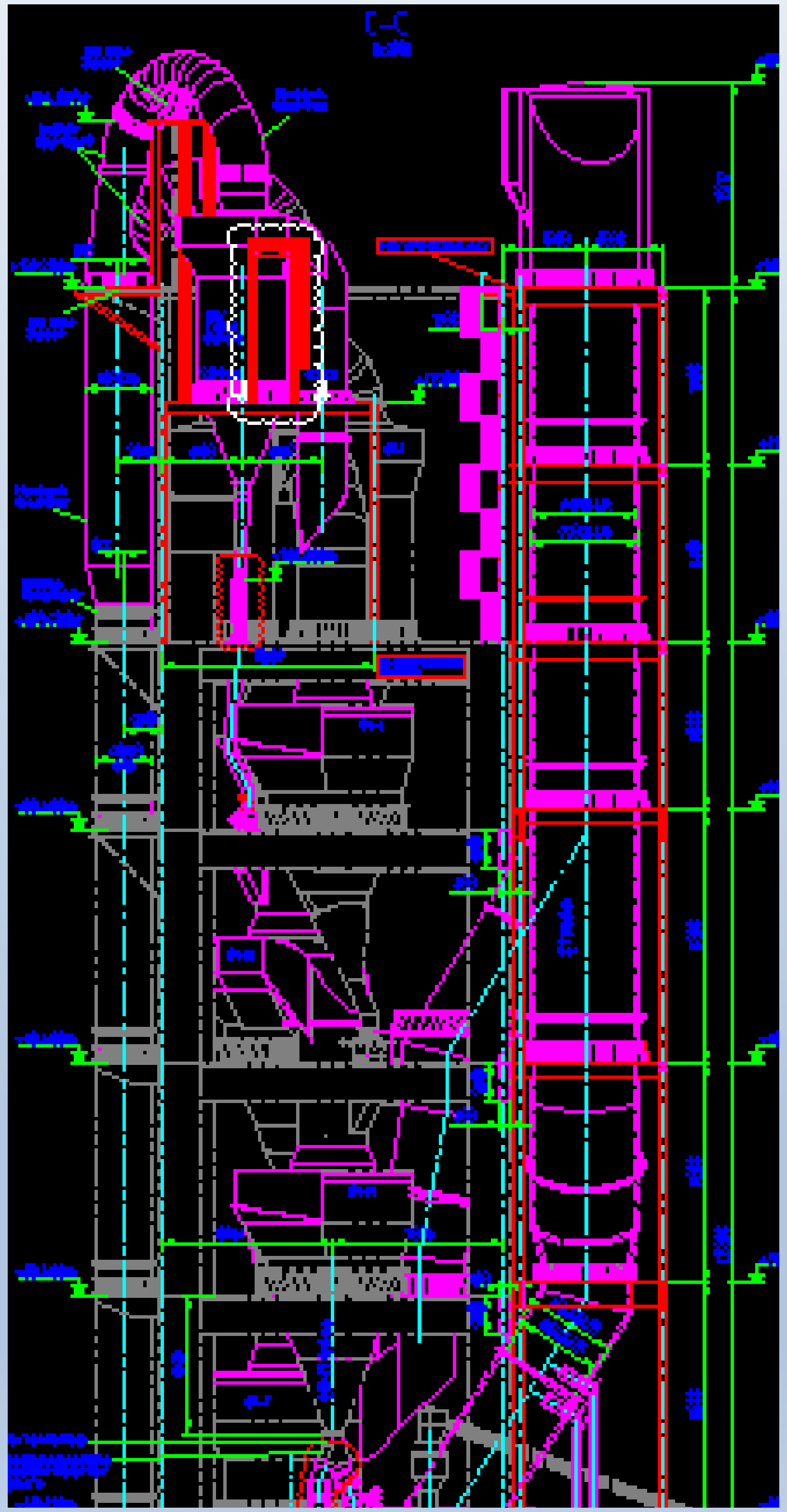
PREPROCESSING TECHNOLOGIES

Feeding System

Shredder

REFERENCE - CALCINER MODIFICATION IMPLEMENTED





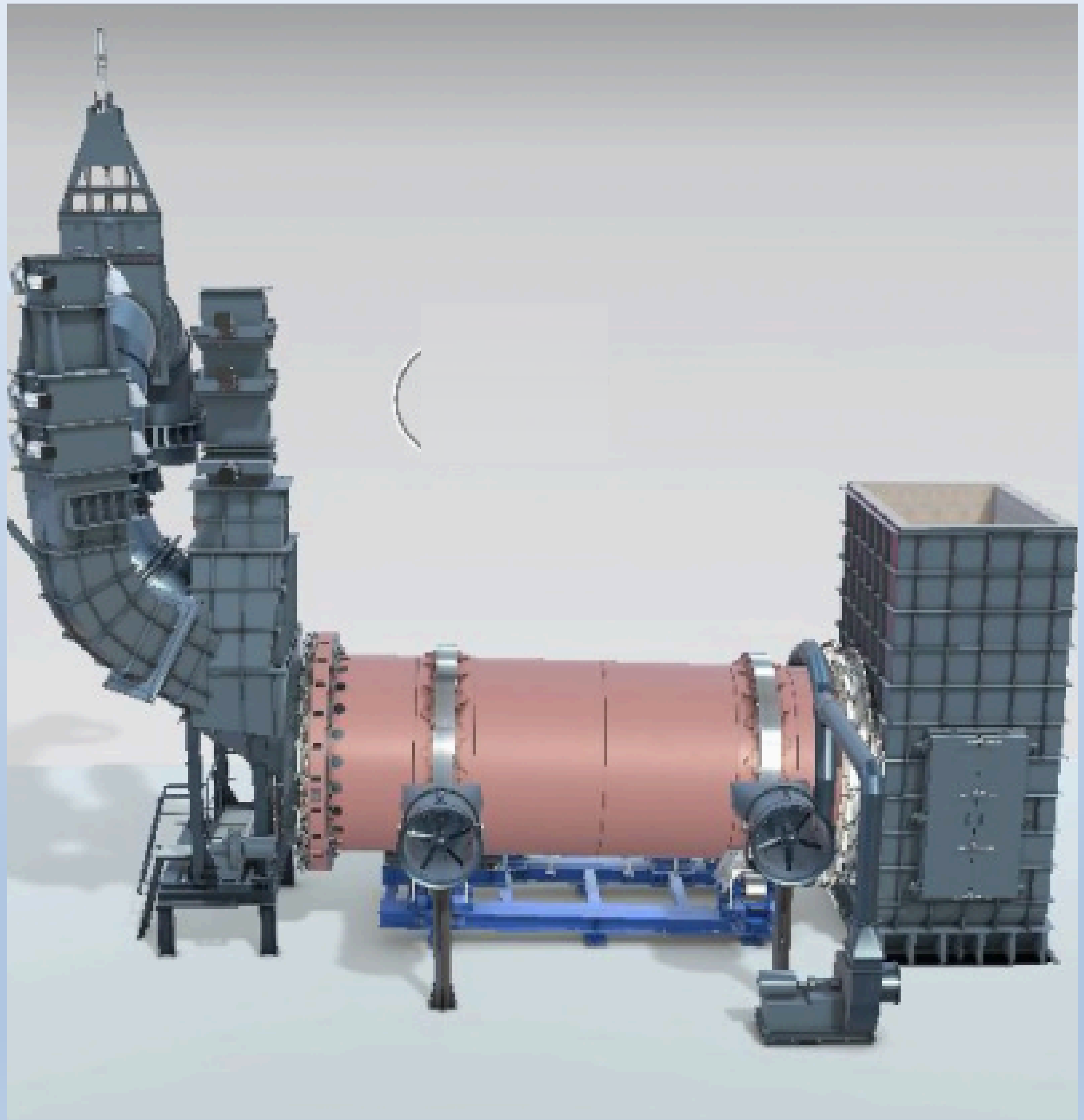
Reference Plant – Calciner modification implemented for Higher AF

INCINERATOR FOR ALTERNATIVE FUELS

Pyrorotor:

Constantly revolves AF and offers long retention time for complete burn-out of:

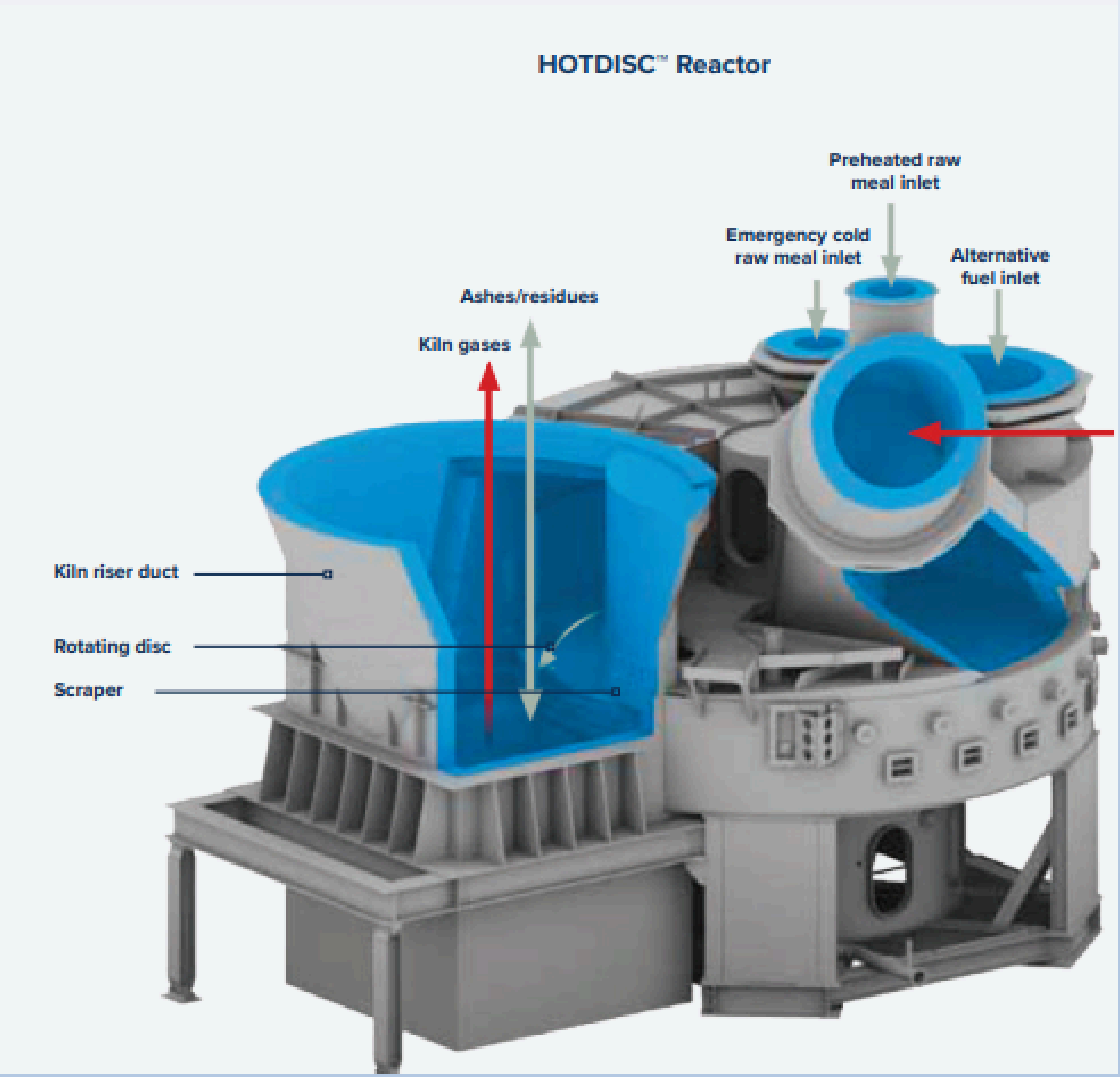
- Whole tires and tire chips
- RDF & fluff
- Coarsest, almost unprocessed waste
- Waste with extremely poor burning properties



INCINERATOR FOR ALTERNATIVE FUELS

Hot Disc:

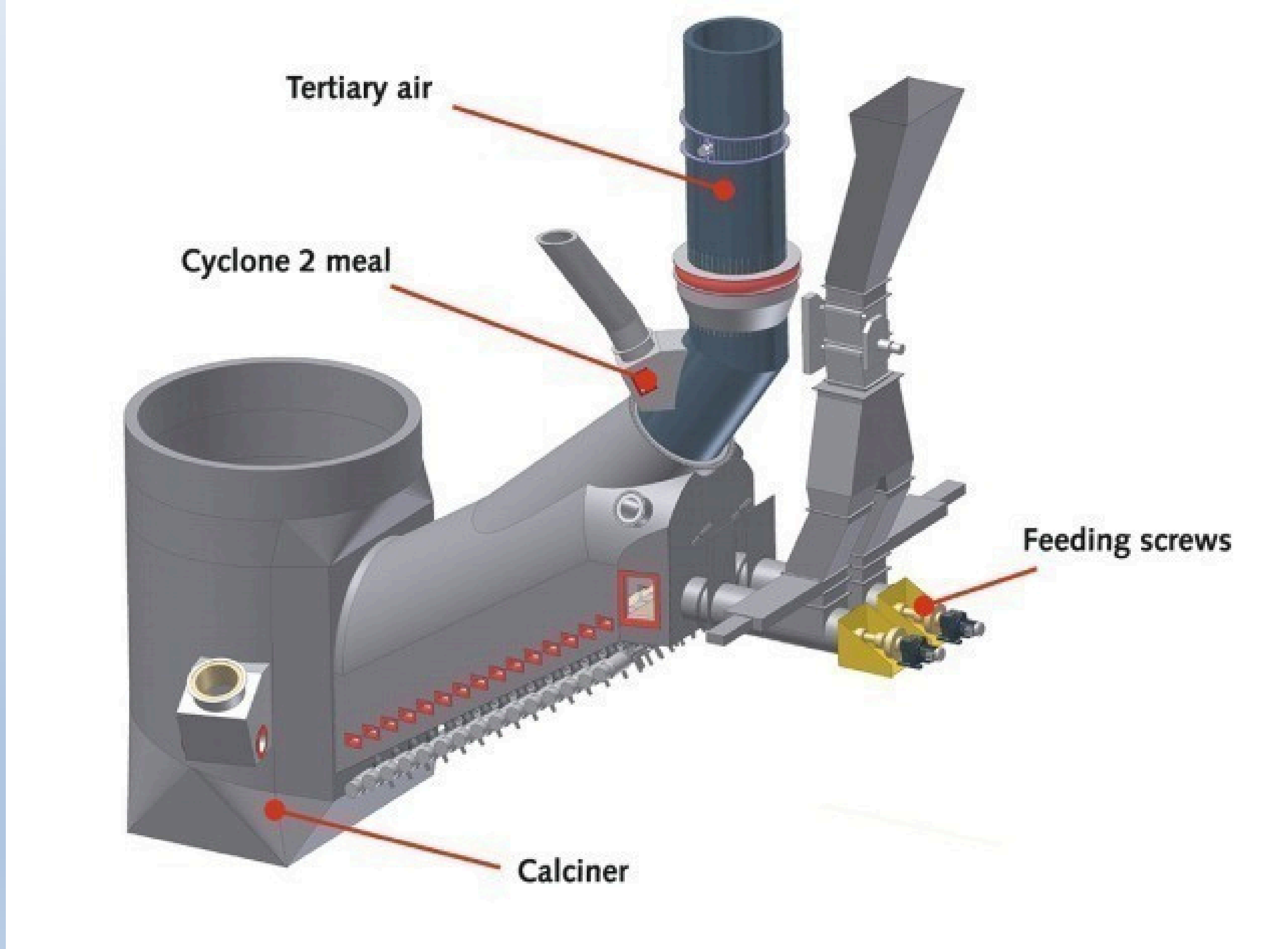
- Effective combustion device to maximize the TSR
- Variable retention time based on the type of Alternative Fuel is possible to ensure complete combustion
- Can accept lumpy materials – Whole tires, apart from the small size materials.
- Calciner TSR of up to 60 % can be achieved.



INCINERATOR FOR ALTERNATIVE FUELS

Step Combustor:

- Optimum solution for any AF type (up to 25% TSR)
- Require calciner residence time of ~ 5 sec.



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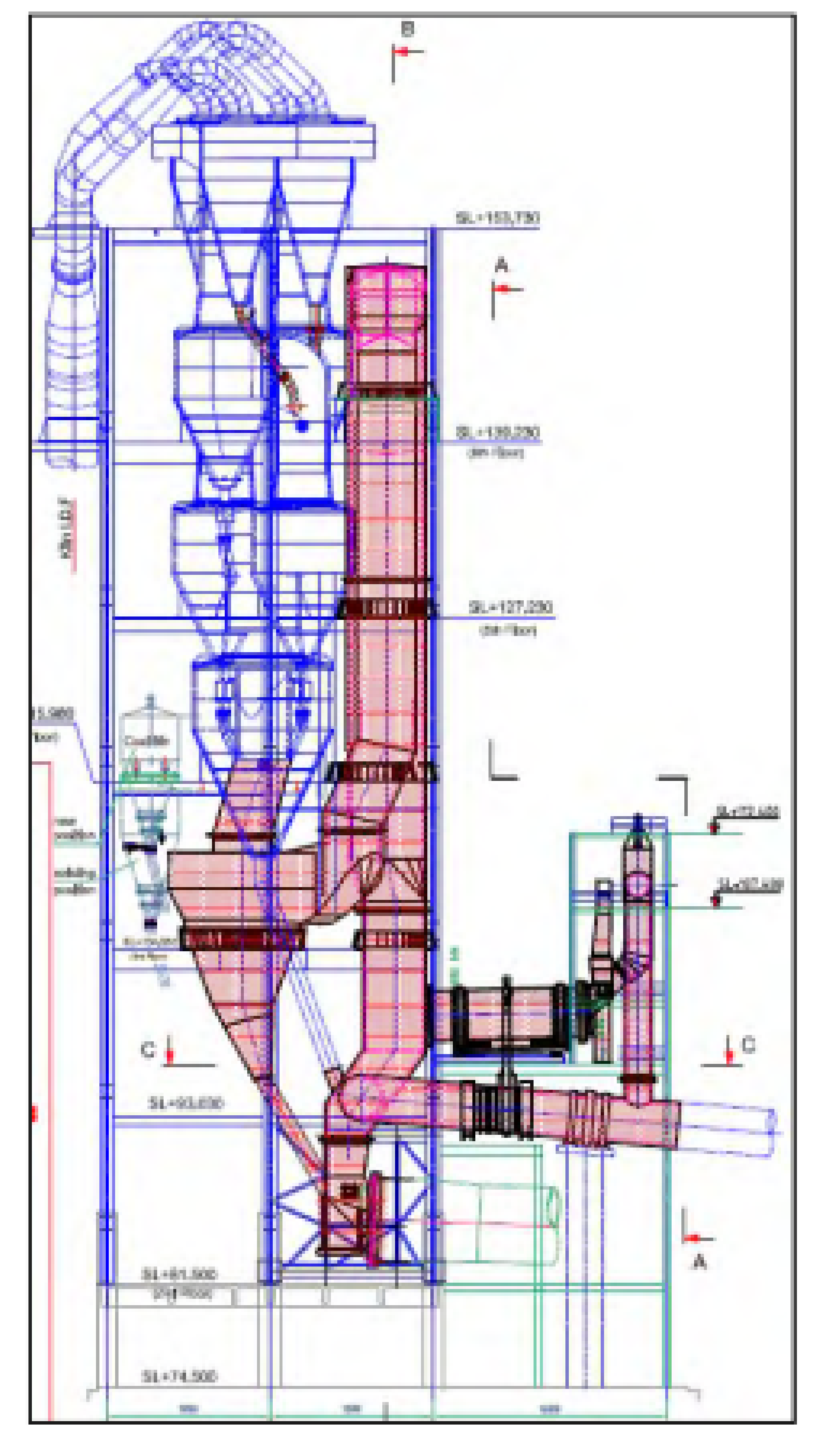

Reference Plant – Calciner modifications with Pyro Rotor- Under consideration/ proposed

IMPACT OF AF USAGE

IMPACTS OF AF USAGE

Type of alternative fuels and their annual availability have been the guiding factor for estimating the various impacts.

- Chlorine Bypass Requirement
- Impact on Specific Heat Consumption
- Impact on Production due to Limitation of PH fan Capacity & Calciner Volume
- Impact on Clinker Quality & Environmental Emission
- Impact of Ash & volatiles: Raw Mix optimization
- Impact of Heavy metals: The components As, Cr, Cu, Mn, Ni and V are primarily incorporated into the clinker and only above 0.1 % of the input results in gaseous emissions.
- Impact on existing WHR Power Generation with AF Usage.

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ENVIRONMENTAL BENEFITS

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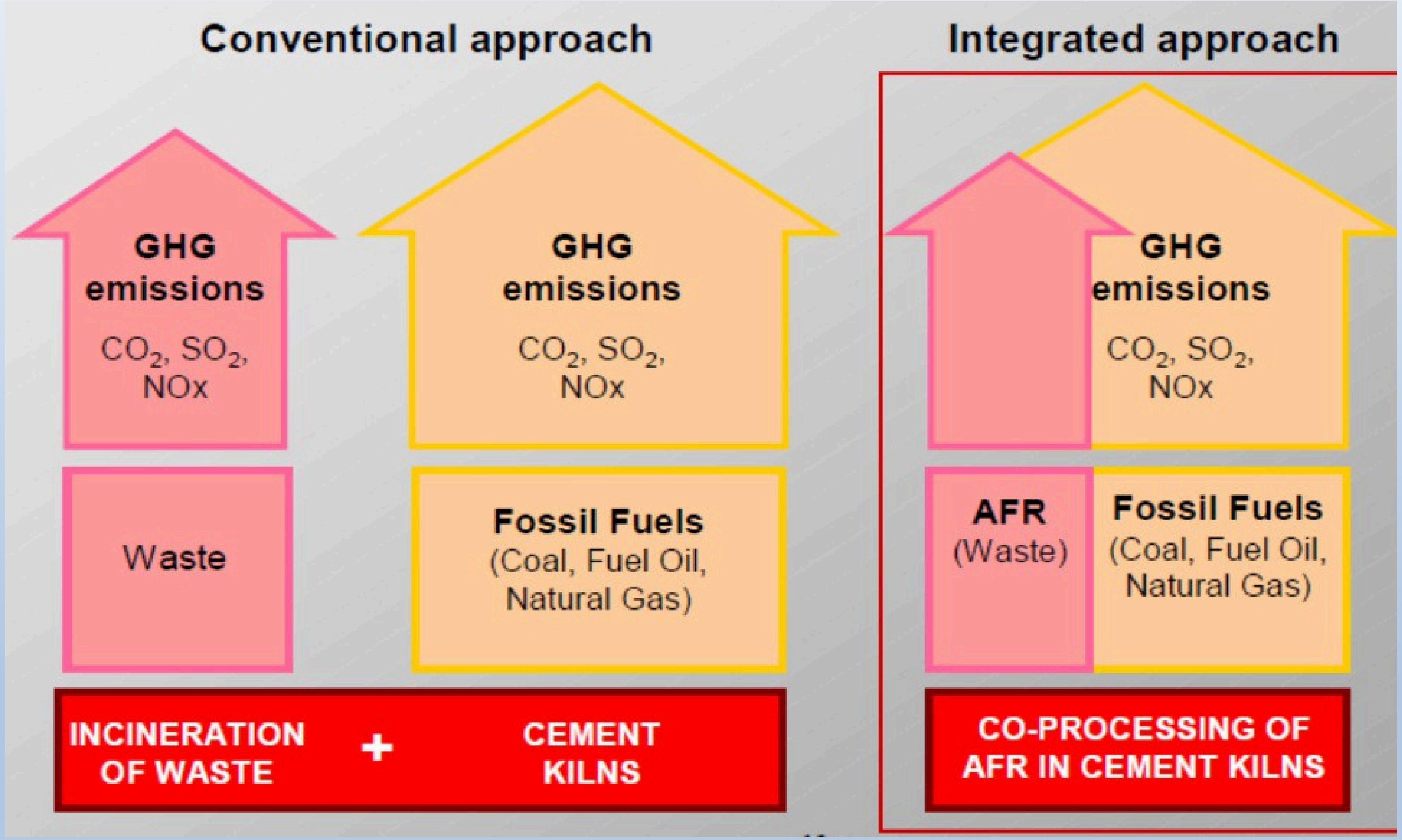

Reduction on GHG emissions & Saving of Natural fossil fuels

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ENVIRONMENTAL BENEFITS

- Reduction on GHG emissions.
- Potential to reduce coal usage in cement kiln by 25%, which will also reduce the coal imports and conservation of fossil fuels.
- Co-processing of AF is preferred over landfilling or incineration.
- Utilization of 8.6 million TPA hazardous waste in cement kiln will ensuring safe disposal of hazardous waste in the country.
- Pre- processing the waste will generate additional economic activity.
- Co-processing will support the country in moving towards "Zero waste to Environment"
- 20 % reduction in landfilling area requirement and reduce the pollution caused by the disposal of waste.

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HOLTEC's ROLE IN ENJANCING AF USAGE

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Conceptualization:

- Feasibility study Involving AF Evaluation & Impact Assessment
  - Evaluation of Identified AFs
  - Assessment of compatibility with existing system
  - Raw Mix Optimization with AF
  - Propose System Debottlenecking / Modifications requirement
  - Broad Capex estimate and simple payback

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HOLTEC's ROLE IN ENHANCING AF USAGE

Conceptualization:

- Impact Assessment of AF usage on:
  - Clinker production
  - Product quality
  - Emission
  - Pyro Equipment performance
  - Plant stability at different level of TSR

HOLTEC's ROLE IN ENHANCING AF USAGE

Execution:

- Basic Engineering
- Procurement Services
- Detailed Project Engineering
- Equipment Inspection
- Site Supervision Services

Alternative Fuel Projects ~ 50 Completed

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HOLTEC GLOBAL EXPERIENCES - CASE STUDIES

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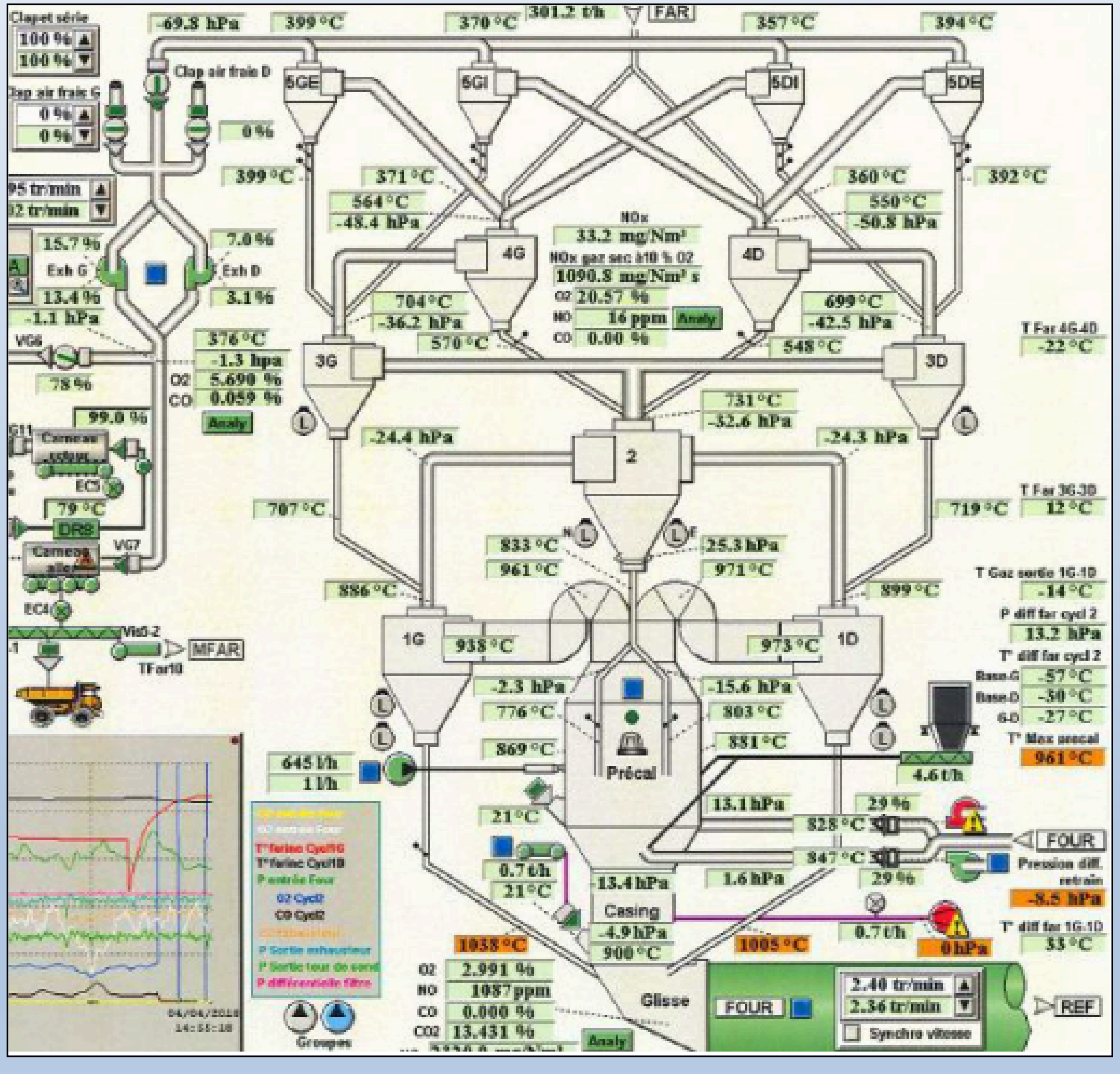
CASE STUDY 1

Cement Plant, Europe

- Existing double string, 5 stage Preheater kiln.
- Operating capacity ~ 4,500 tpd clinker.
- TSR of around ~ 38 % (32% Main burner + 6% Calciner).
- Calciner having less residence time of ~2.5 sec.
- Old generation grate cooler for clinker.



CASE STUDY 1

Type of Fuels/ AFs:

Traditional fuel:

- Coal

Alternate fuels:

- Animal Meal
- Seeds
- SRF (Solid Recoverable Fuel) Fluff
- SRF Pellets
- Saw dust

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CASE STUDY 1

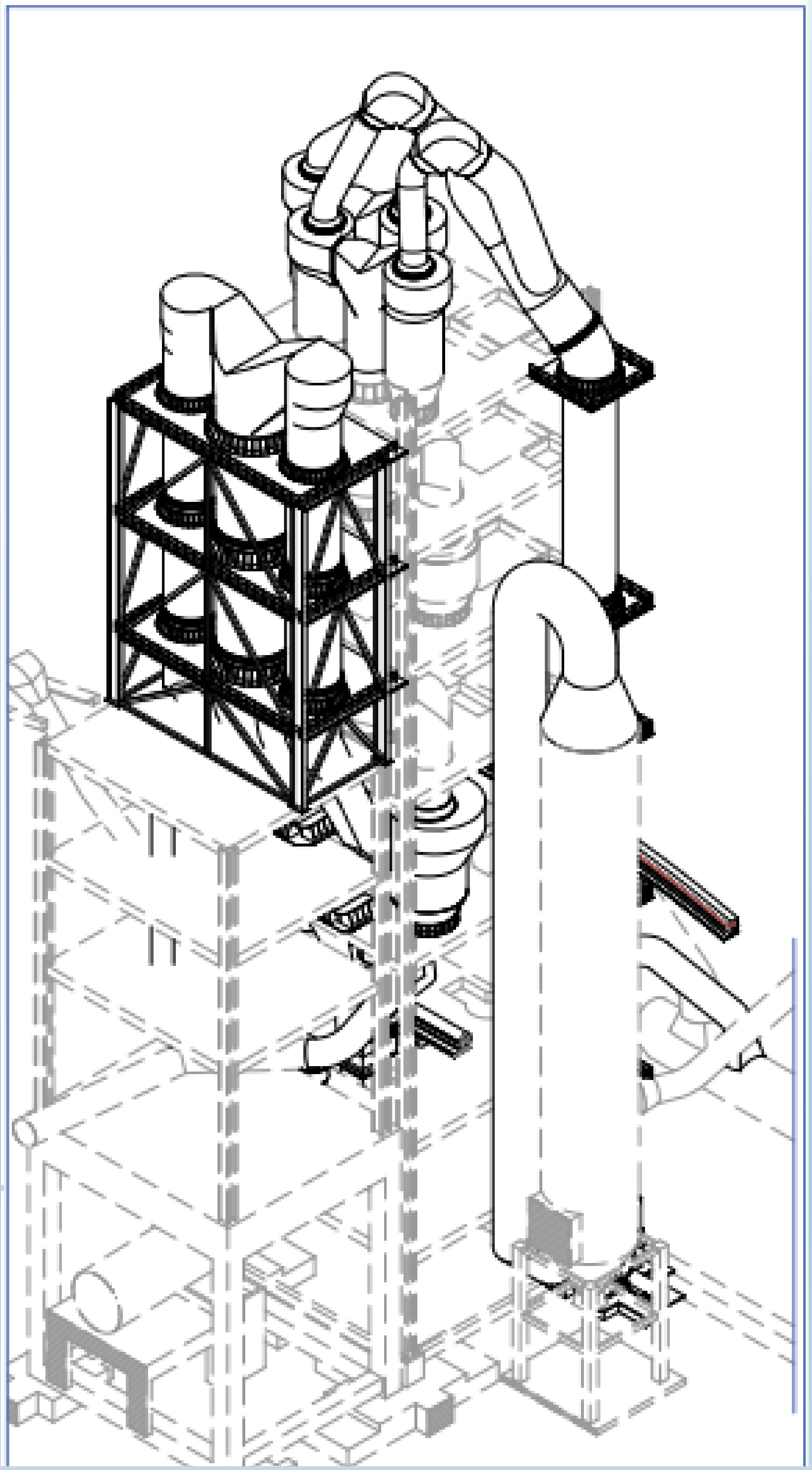
Management Target:

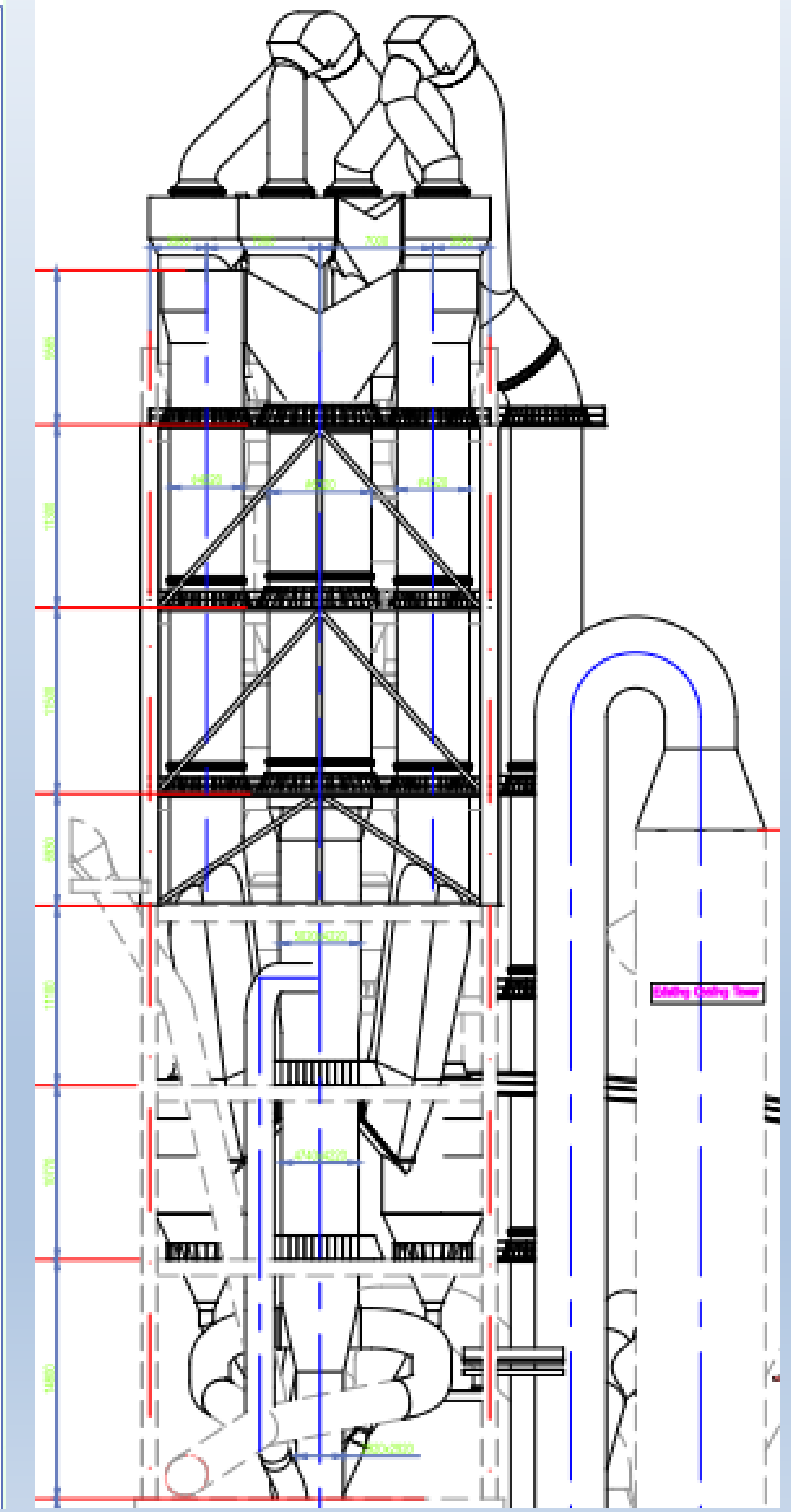
- Enhanced capacity up to 4,850 tpd clinker.
- Enhanced Alternate fuel usage (overall TSR of 80 %) with 97 % replacement of fuel in Calciner with AF.
- Improved operational efficiency and reliability.

CASE STUDY 1

Modifications Executed:

1. Modifications in Preheater-Top and bottom cyclones replaced
2. A New in-line calciner with enhanced retention time (≥ 8 sec)
3. Kiln inlet and tertiary air duct modified.
4. A new ID fan for handling enhanced gas volumes.





CASE STUDY 1

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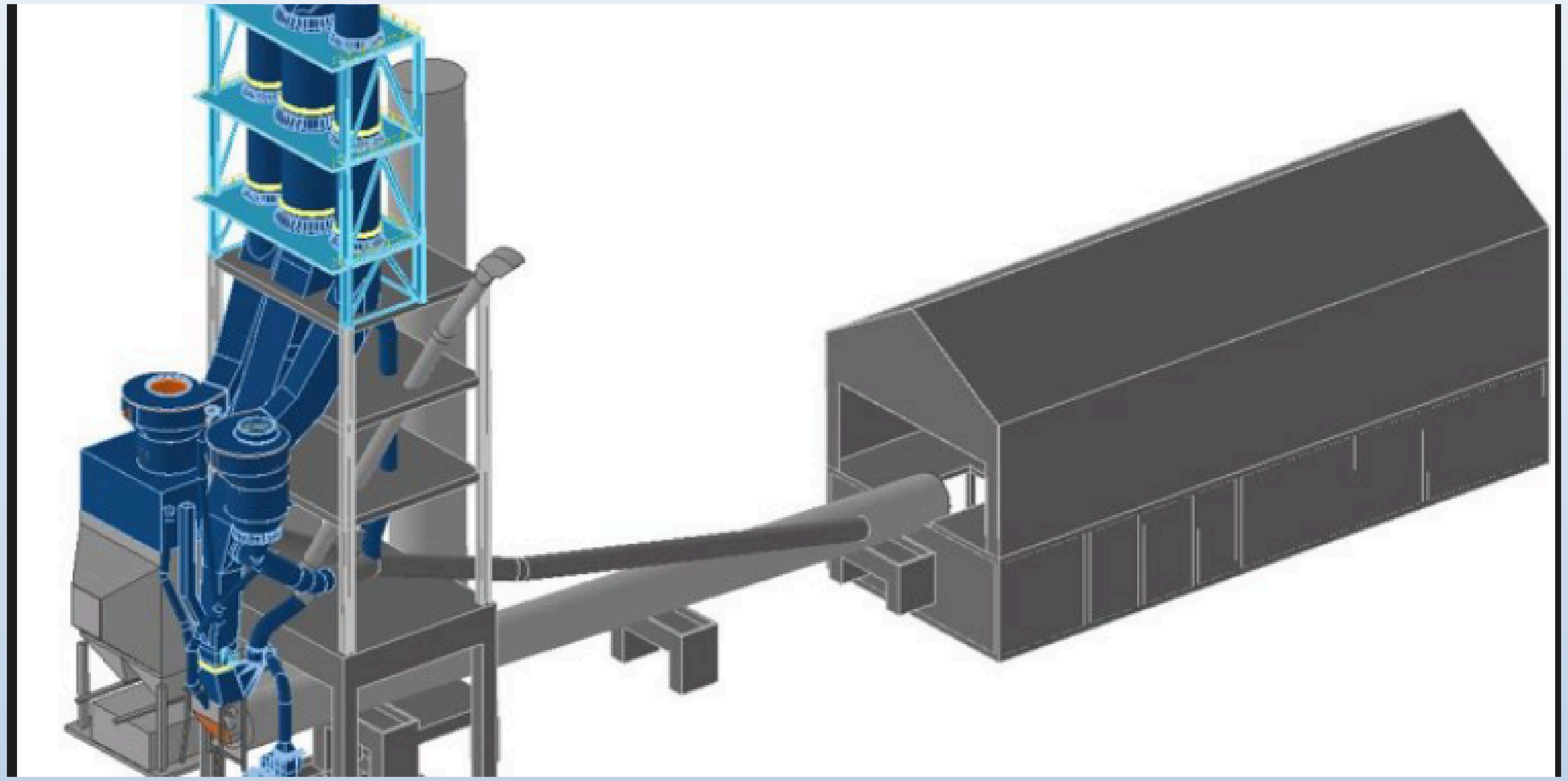
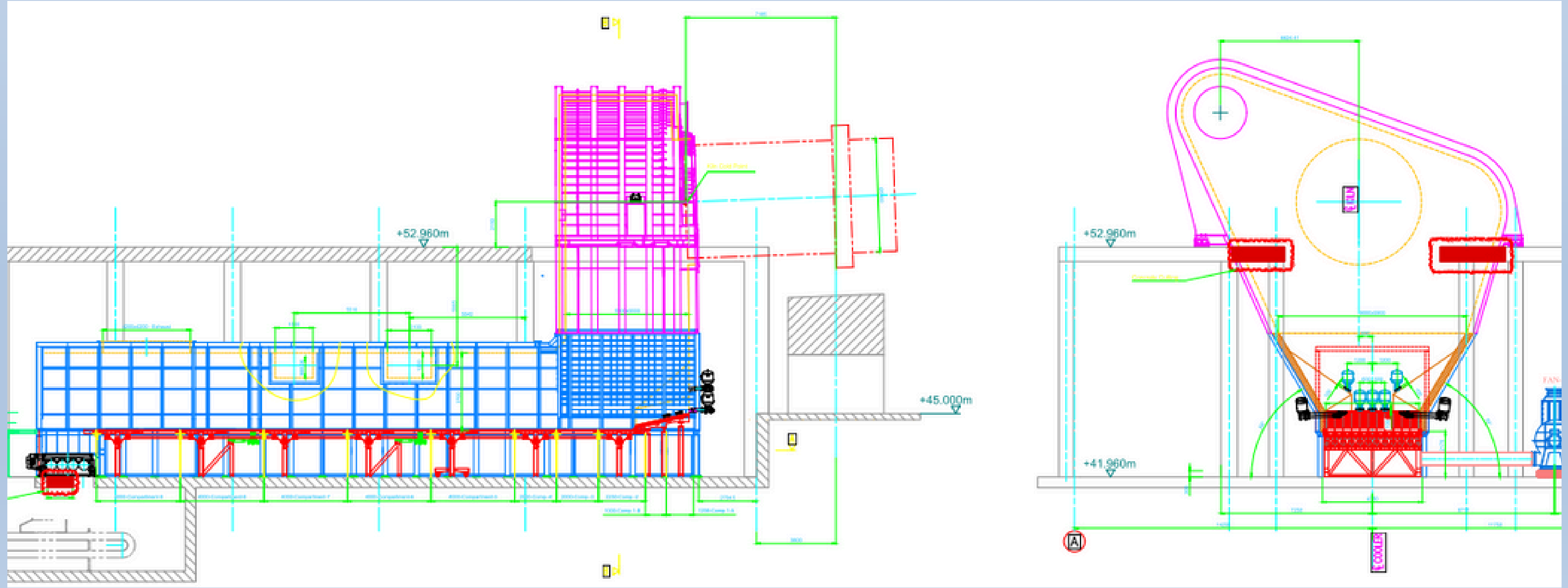




Modifications Executed:

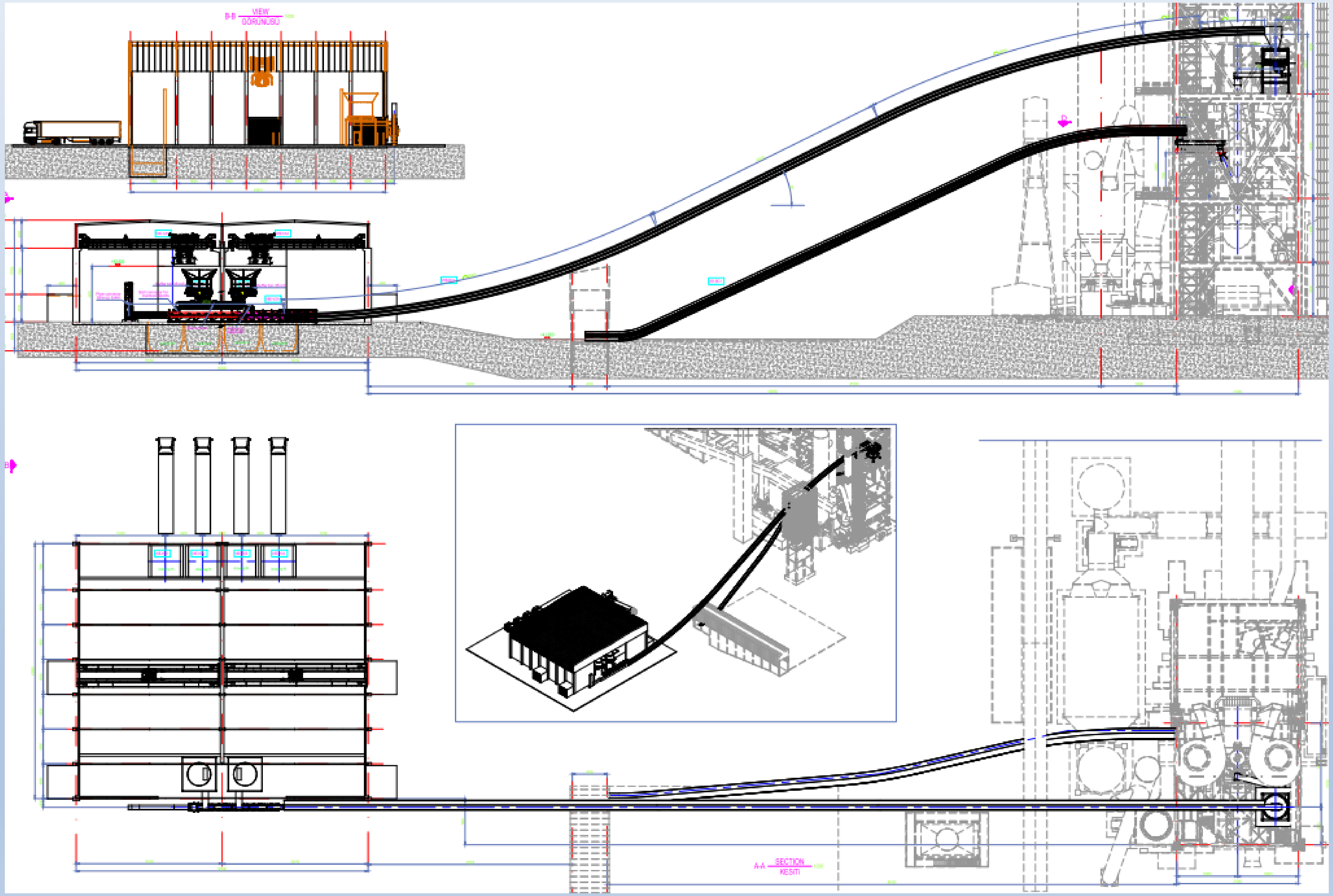
5. Enhanced the capacity of the kiln/ mill process filter by extending bag length and increasing the filtering area

6. Existing clinker cooler replaced with New generation cooler along with a new kiln hood.

CASE STUDY 1

Modifications Executed:

- A new AF storage, handling, dosing, and feeding system for Calciner firing (to increase TSR from 32% to 80%)
- Upgradation of existing chloride Bypass system.



CASE STUDY 1

Key aspects considered:

- AF preprocessing:
  - **Size reduction of AF – 1 -2 mm**
  - **Homogeneity of prepared AF** - Minimum quality fluctuations during firing.
- Chloride By-pass system:
  - **Diversion of by-pass gases to Cooling air fans** (**cooler recuperation zone after static grate**). Meeting EU emission norms.
  - **Usage of By-pass dust in Cement** (to the extent possible).
- AF storage sheds' vent gas handling:
  - **Diversion of AF vent gases to Cooling air fan (Quench fan)** – Minimizing the issue of foul smell.

CASE STUDY 1

Key aspects considered:

- NOx & SOx Emission Reduction:
  - A new SNCR system with ammonia injection.
  - A lime hydrate injection system to reduce SOx emissions.

Results:

- **Clinker production target achieved: > 5,000 tpd clinker.**
- **Heat consumption is reduced by 30 Kcal/ kg clinker with Capacity Upgradation**
- **Overall % TSR achieved: 81 %**
- **Calciner % TSR achieved: ~ 99 %.**
- **Improved cooler heat recuperation efficiency (>75%).**

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CASE STUDY 2

Cement plant , India

Objectives

Carry out Technical Feasibility Study to achieve the target TSR of 35%

Identified Alternative Fuels (AFs) & Target TSR

Fuel Type	Wet Qty (TPD)	Moisture (%)	NCV (Kcal/kg)	% TSR
RDF	1546.7	40	2450	29.8
Pre-process	100.0	40	3500	2.7
Organic Barrels	16.7	40	3900	0.5
Biomass	55.6	10	3036	2.0
Total	-	-	-	35.0

CASE STUDY 2

Operating Conditions:

- Clinker Production: **8,372 TPD**
- TSR: **20%**
- Specific Heat Consumption: 741 kcal/kg clinker
- Chloride content in Hot Meal: 0.44% (well below the norm of 1.5%).
- No Bypass system is required for the current operating level.
- Existing Calciner **Residence Time ~ 14 Sec**

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CASE STUDY 2

Impact Assessment (35% TSR @ 10,000 TPD Clinker)

Heat Consumption:

- Estimated Increase in Heat Consumption - 23 kcal/kg clinker (with 35% TSR (with RDF of 40% Moisture).

Production Impact:

- Wet RDF (40% Moisture): Estimated Reduction in clinker production by 1,015 TPD (without modifications).

Bypass Requirement:

- 4% Chlorine bypass required due to high chlorine input of ~620 grams per ton of clinker.
- A kiln bypass of 12% (design) proposed to accommodate higher AF usage in the future.

CASE STUDY 2

Modifications proposed to sustain 10,000 tpd clinker

1. **New PH Fan**
2. **Top Stage Cyclone Replacement:**
   - Expected saving in pressure drop: ~160 mmWC
   - Reduction in return dust: 4–6%
   - Saving in specific fuel consumption: 6–8 kcal/kg clinker.
3. **TAD Modification:**
   - Enlargement of TAD diameter from 2.9 m to 3.5 m.
   - Alternatively, installation of a parallel second TAD.

Results:

Target of 35% TSR achieved @ 10,000 tpd clinker, after implementation of Modifications.

THANK YOU

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