Alternative fuel & Raw material Co-processing in cement plants

Mapping & Sourcing of AFR and TSR levels of Indian cement plants

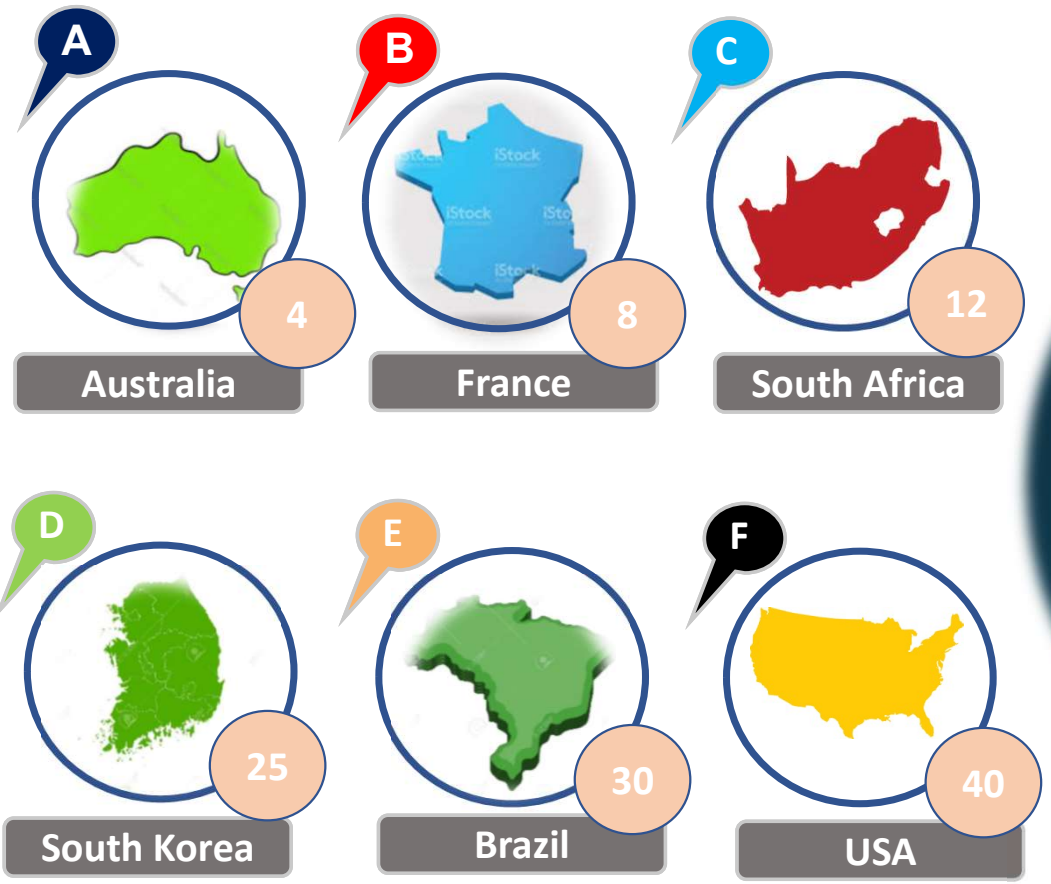
Confederation of Indian Industry

Confederation of Indian Industry
CII - Sohrabji Godrej Green Business Centre
Hyderabad, India

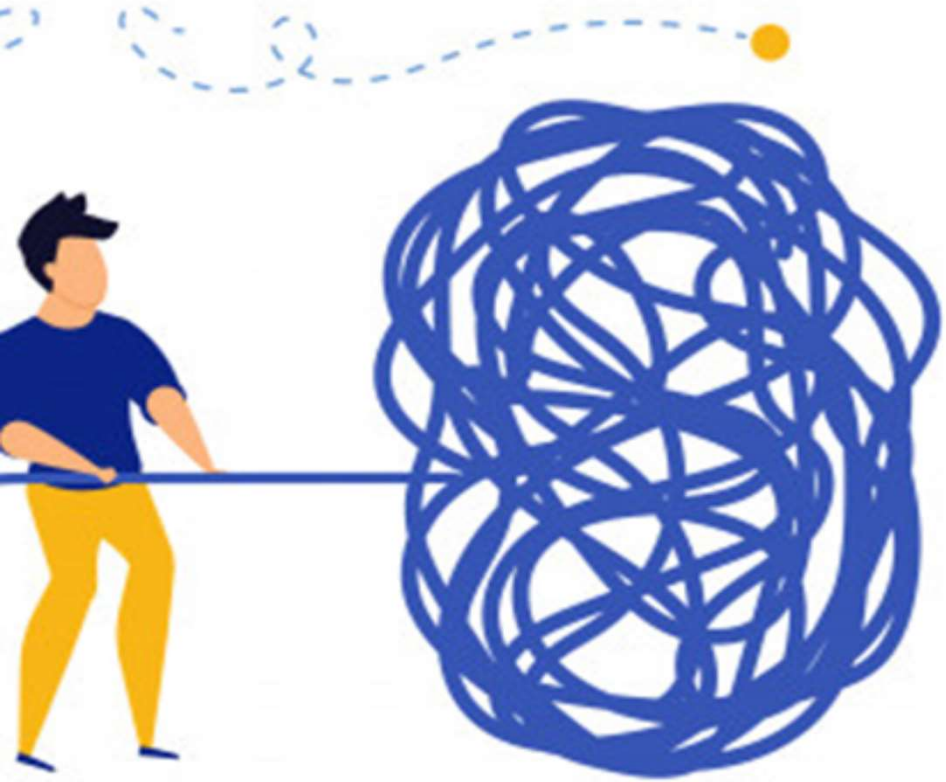
Usage of Alternative Fuel & Raw Material in Indian cement industry

- Average TSR 6 to 7%
- Highest Substitution on continuous basis: ~30% TSR
- 25+ cement plants setup standard infrastructure for AFR utilization

India’s equivalent TSR with 100% TSR of other Countries

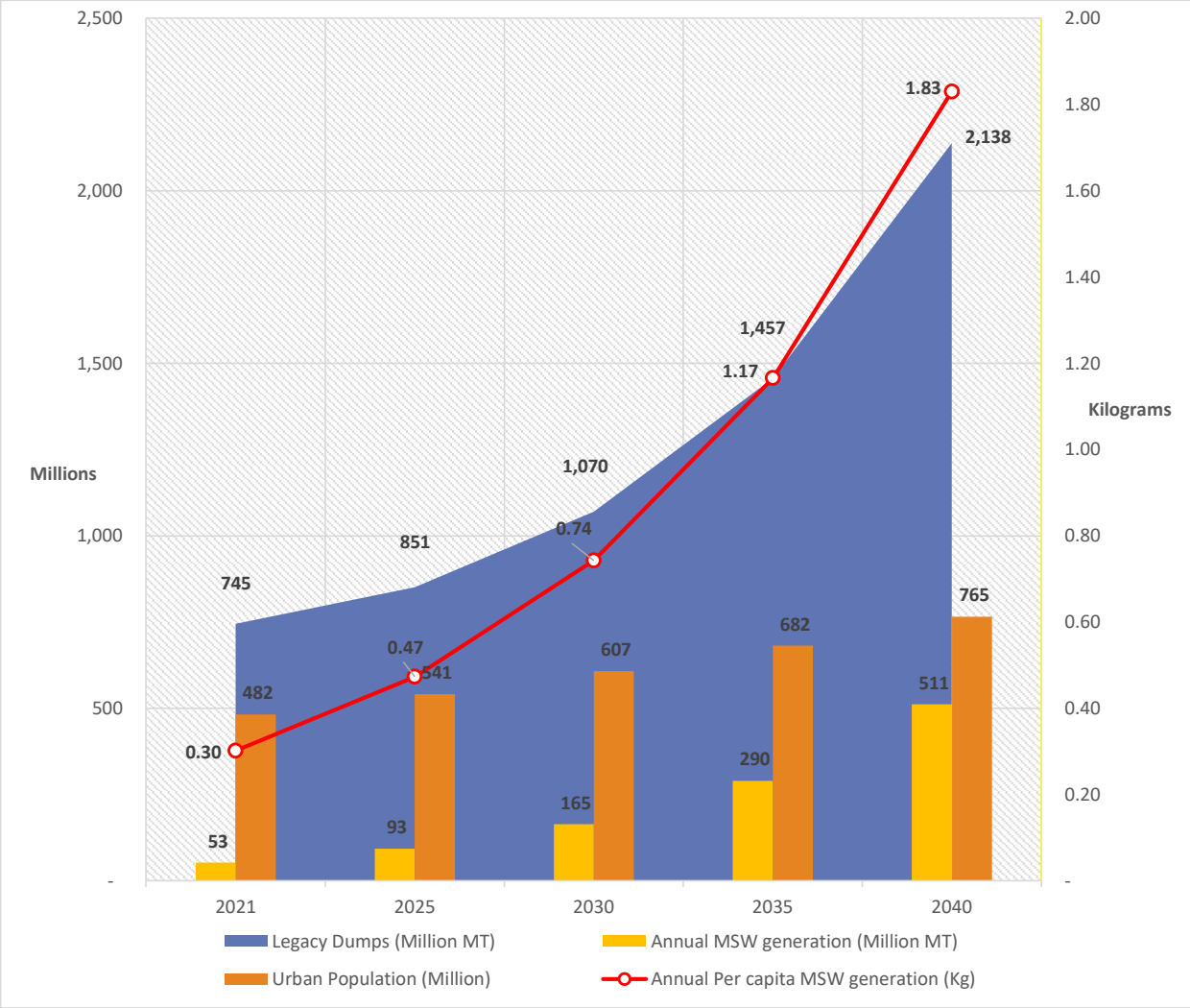


Challenges in accelerating AFR in Indian cement industry



- **Data** on waste generation & generator
- Material **mapping & availability**
- Viable **business models**
- **Technology upgradation** – Processing platforms & by-pass systems
- **Business models & Finance**
- **Bottlenecks in various areas of manufacturing**
  - Process, quality, emissions, SEC
- AFR professionals & Capacity building
- Policy implementation & collaboration among stakeholders

Sustaining Urbanization-MSW Scenario

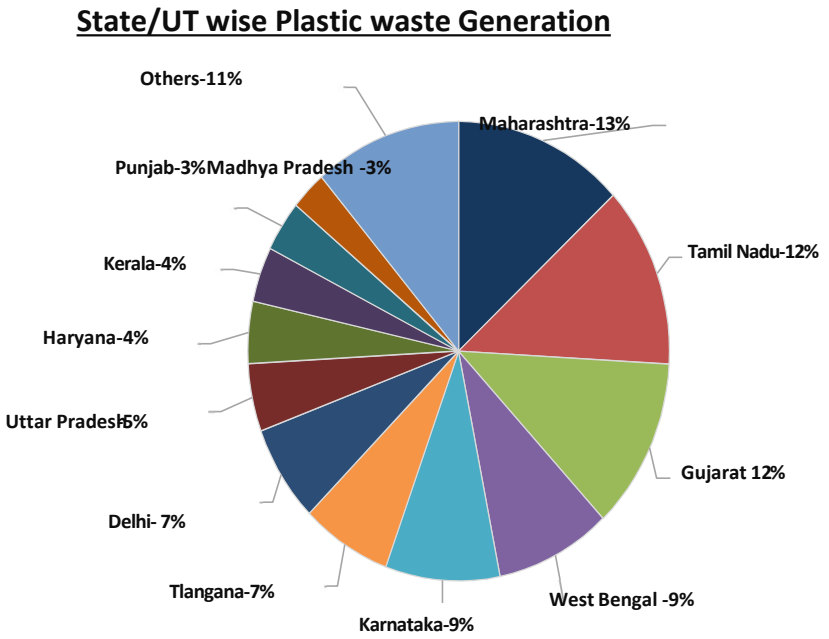


Sr. No	Particulars	Unit	2021	2040	Annual Growth
1	Urban Population	Millions	482	765	2.34%
2	Per capita MSW per day	Kgs	0.30	1.83	10.00%
3	Annual MSW Generation	Million Tonnes	53	511	12.00%
4	Legacy Dump	Million Tonnes	745	2138	5.7%

CURRENT PROJECTION LOOKS REALLY SCARY !!!!

INDIA Scenario on Plastic Waste

India generates around 56 lakh MT of plastic waste annually.

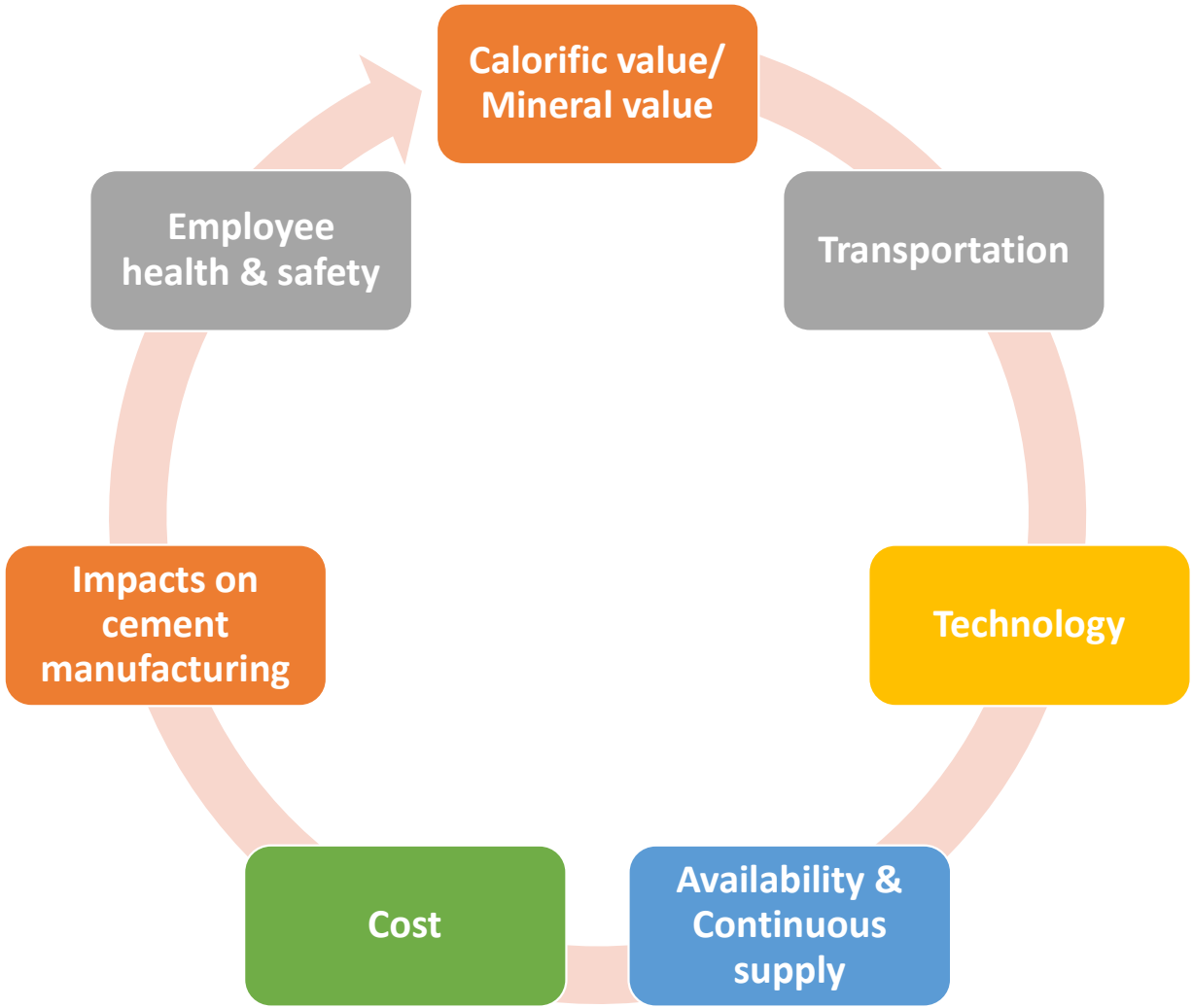


India generates approximately 25,950 MT of plastic waste daily.

40% of this plastic waste is discarded without proper disposal.

- Sustainable approaches are no longer optional
  - Reflect organization desire towards sustainability commitments
    - Country
    - Sector
- Manufacturing cost
  - Coal
  - AFR
- Green product – image, investors, customers

Typical considerations for Sourcing AFR



Sourcing strategies for AFR

Business models

- Win-win for all stakeholders

Develop supplier/ generator partnerships

- Co-innovate services, products & business models
  - Sourcing events / workshops
- Arrangements to incentivize better performance
- Acknowledgements for responsible waste management
  - Certificates, awards etc

Sourcing strategies for AFR

Performance review

- New opportunities/models
- Reassess price
- Demand-supply gap
- Plant performance
- Specific opportunities & challenges

Mapping waste generators in India

Conventional way

Waste management companies

GIS mapping : New way of mapping generators and sources

Conventional way - mapping waste generators
Direct contact of individuals

Urban local bodies	Near to cement plants
Industry clusters/ associations	Pharma – Hyderabad Chemical – Gujarat
Data from Pollution control boards	Annual returns by SPCBs

Connecting with waste management companies

- Producer Responsibility Organisation (PROs)
  - EPR requirements - Group level engagements
- Waste management companies
  - Industrial
  - Domestic

Geographical Information System (GIS)

- GIS : Harness information technology for representing geographic information, primarily with an emphasis on supporting decision making.
- Focused on collection, modeling, management, display, and interpretation of geographic data.

Geographical Information System (GIS)

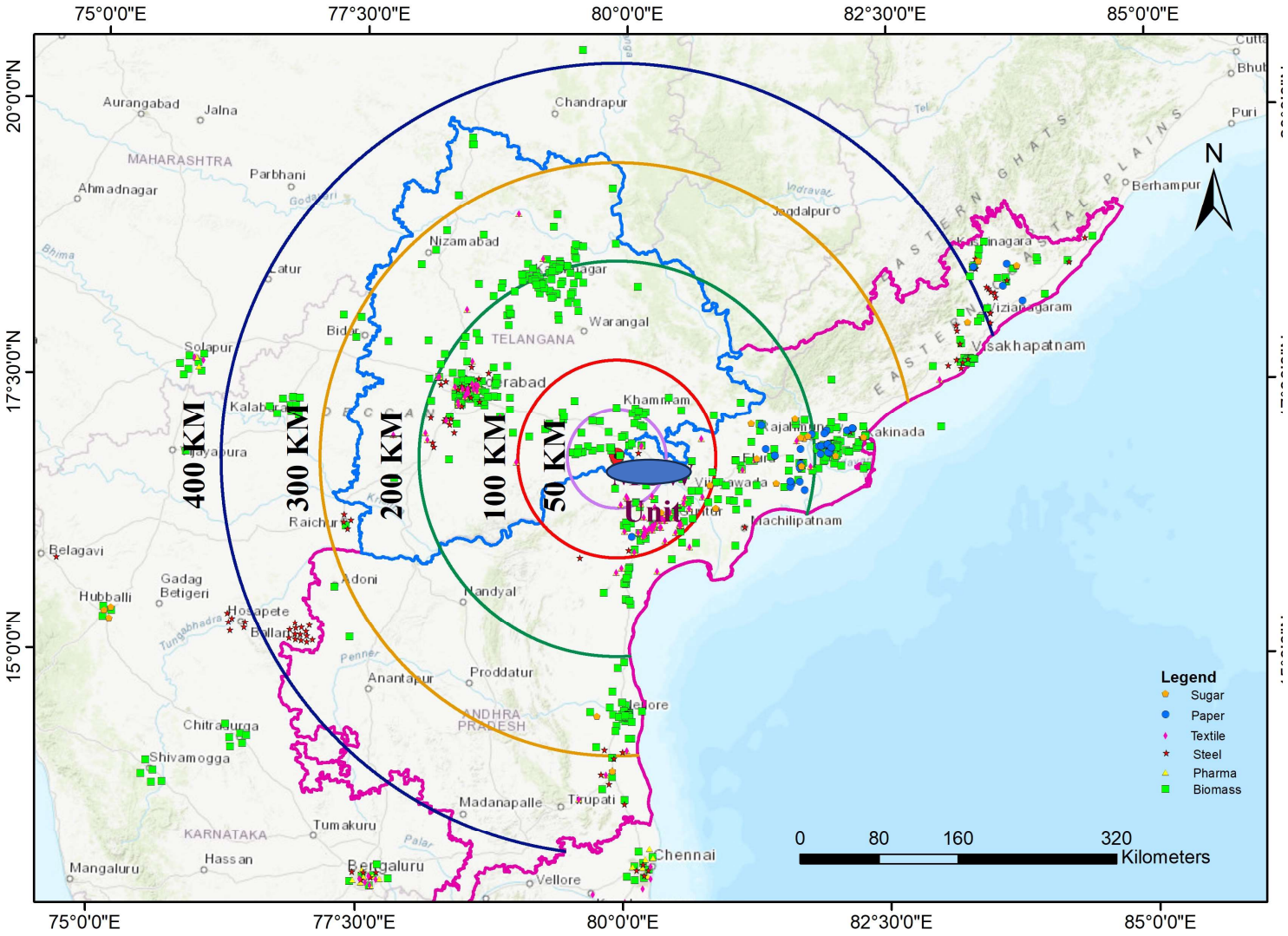
Advantages:

- GIS support to view, understand, and visualize data in many ways that reveal relationships, patterns, and trends.
- quickly understood and easily shared : maps, globes, reports, and charts.
- GIS can help to achieve the SDGs through:
  - Data Management
  - Enhanced Collaboration
  - Sustainable Design and Planning
  - Informed Decision-making

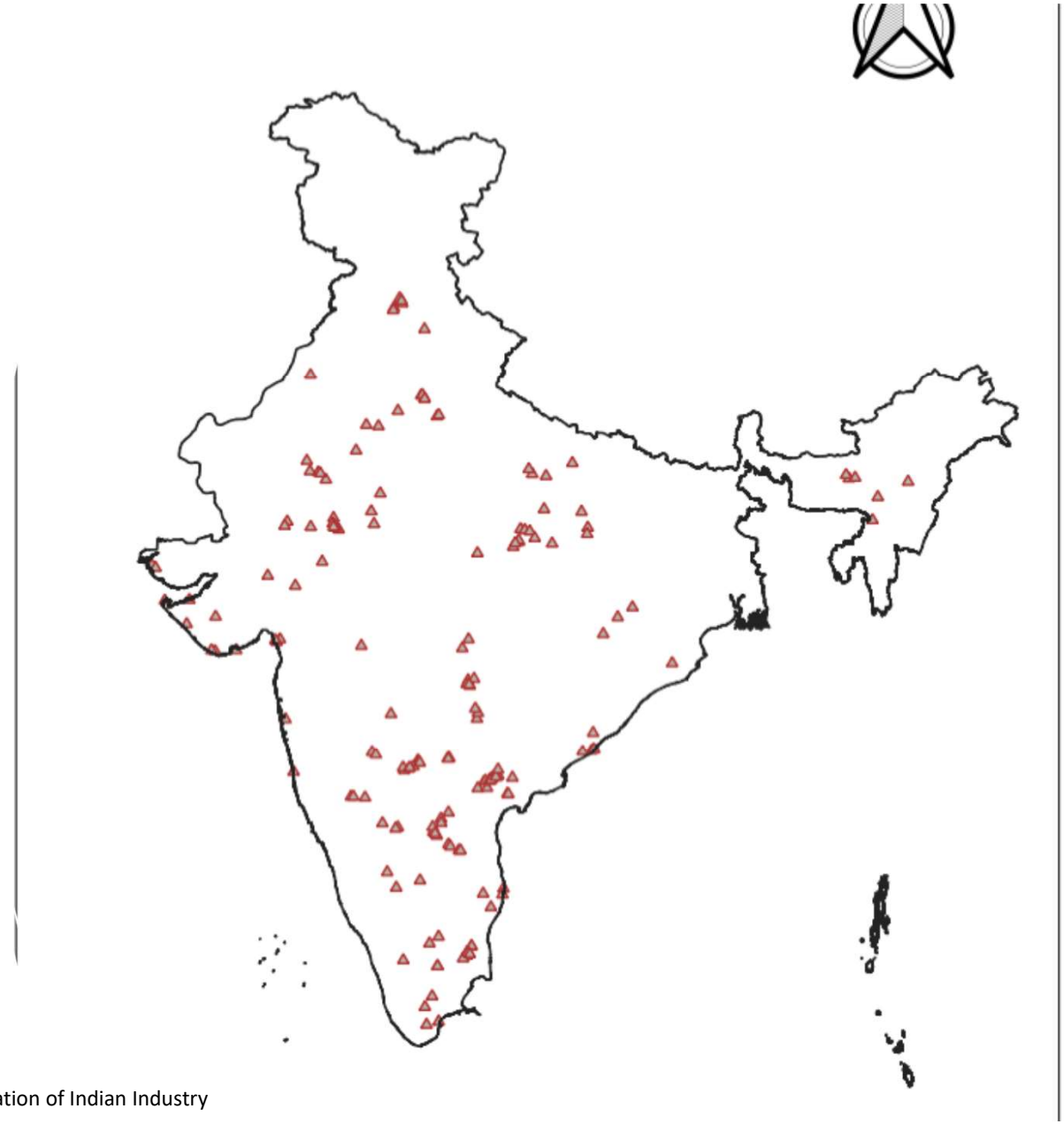
CII Engagement in Waste mapping

- CII engaged in waste mapping services for cement industry
  - Working with cement plants for AFR mapping services
- Utilising QGIS (Quantum GIS) Geographic Information System (GIS) application.
- Partnered with various organizations (GIS tools)

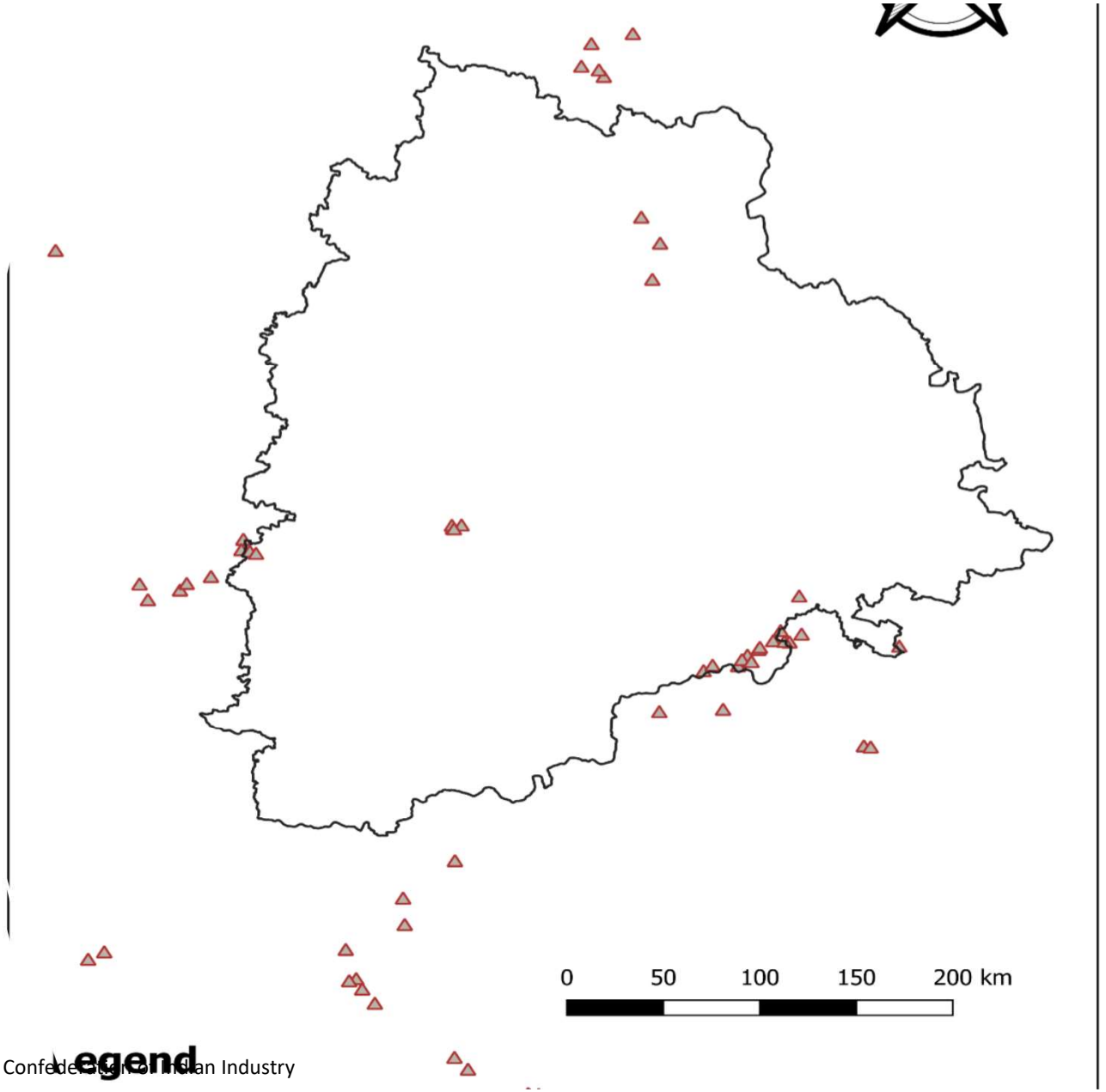
Mapping – various buffer zones



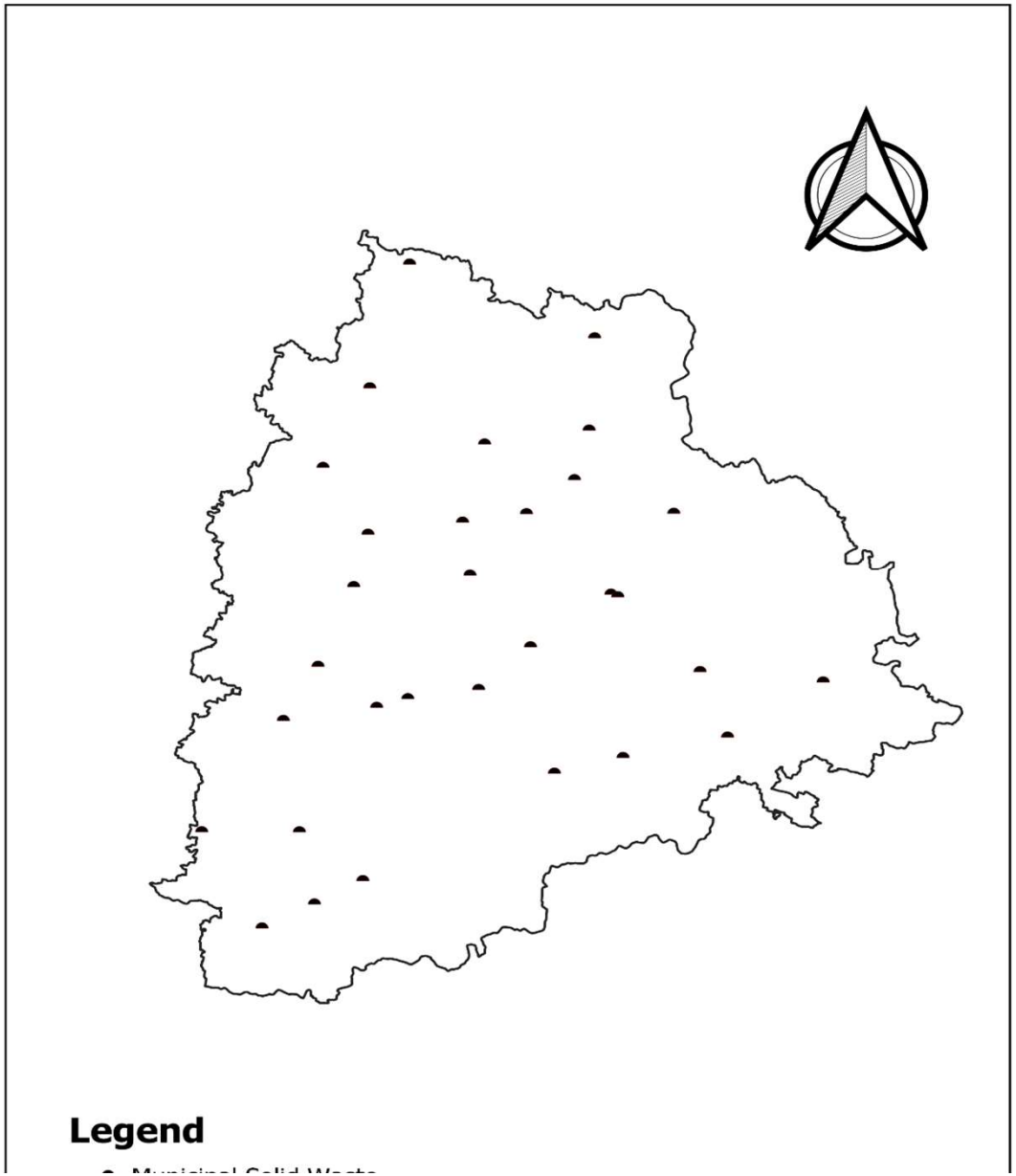
Cement plants in India



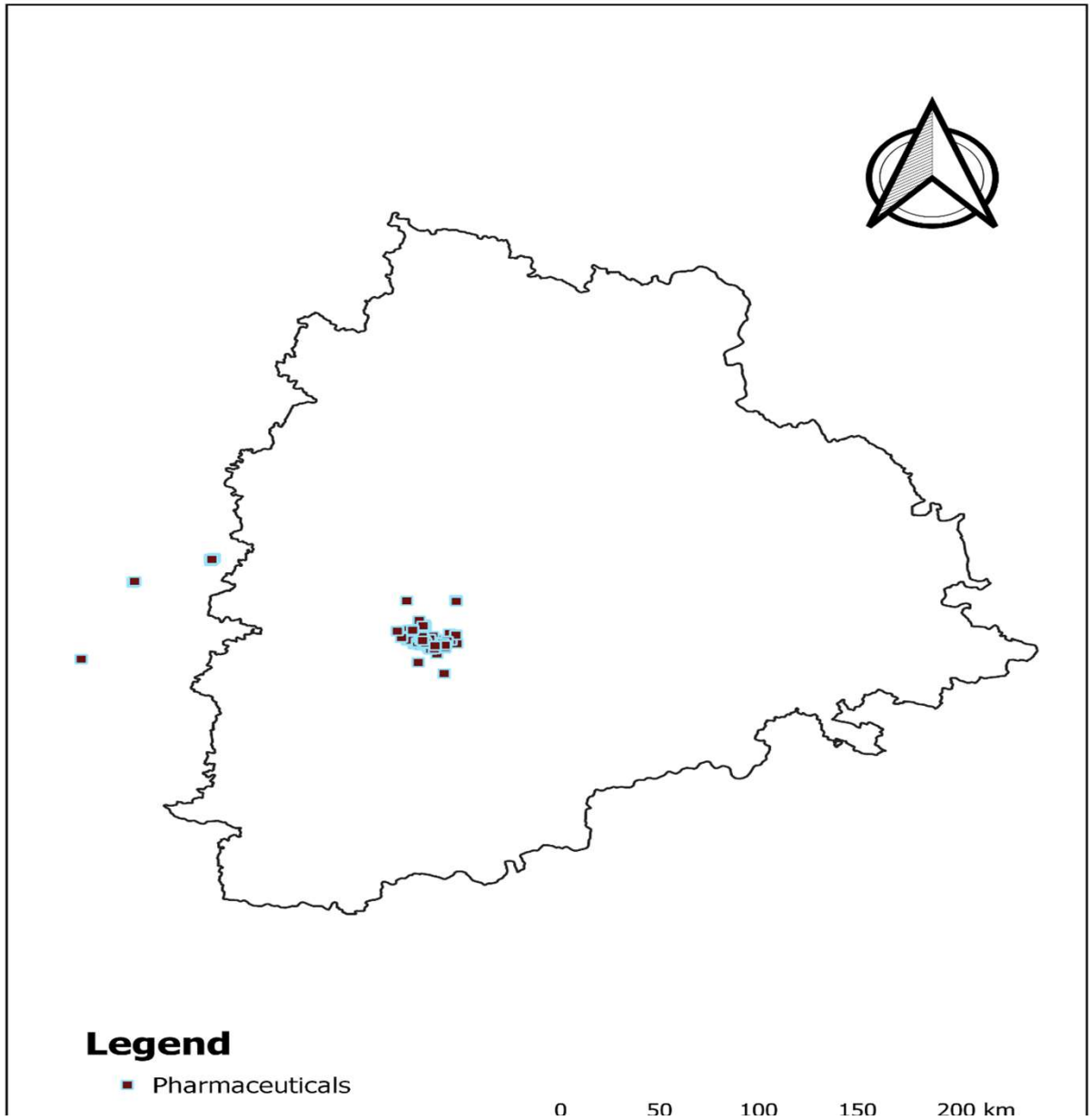
Cement plants in State of Telangana



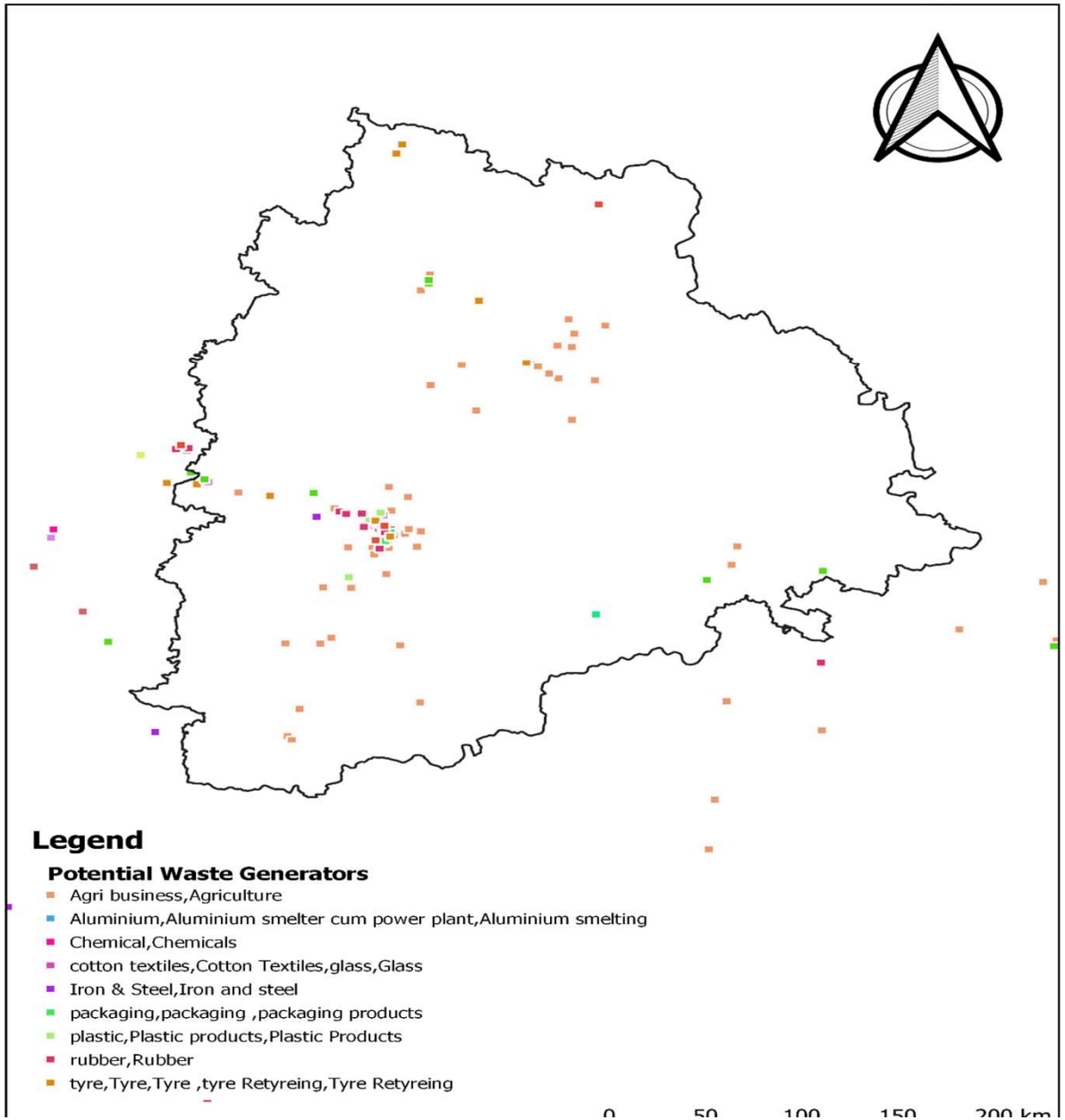
ULBs in the State of Telangana



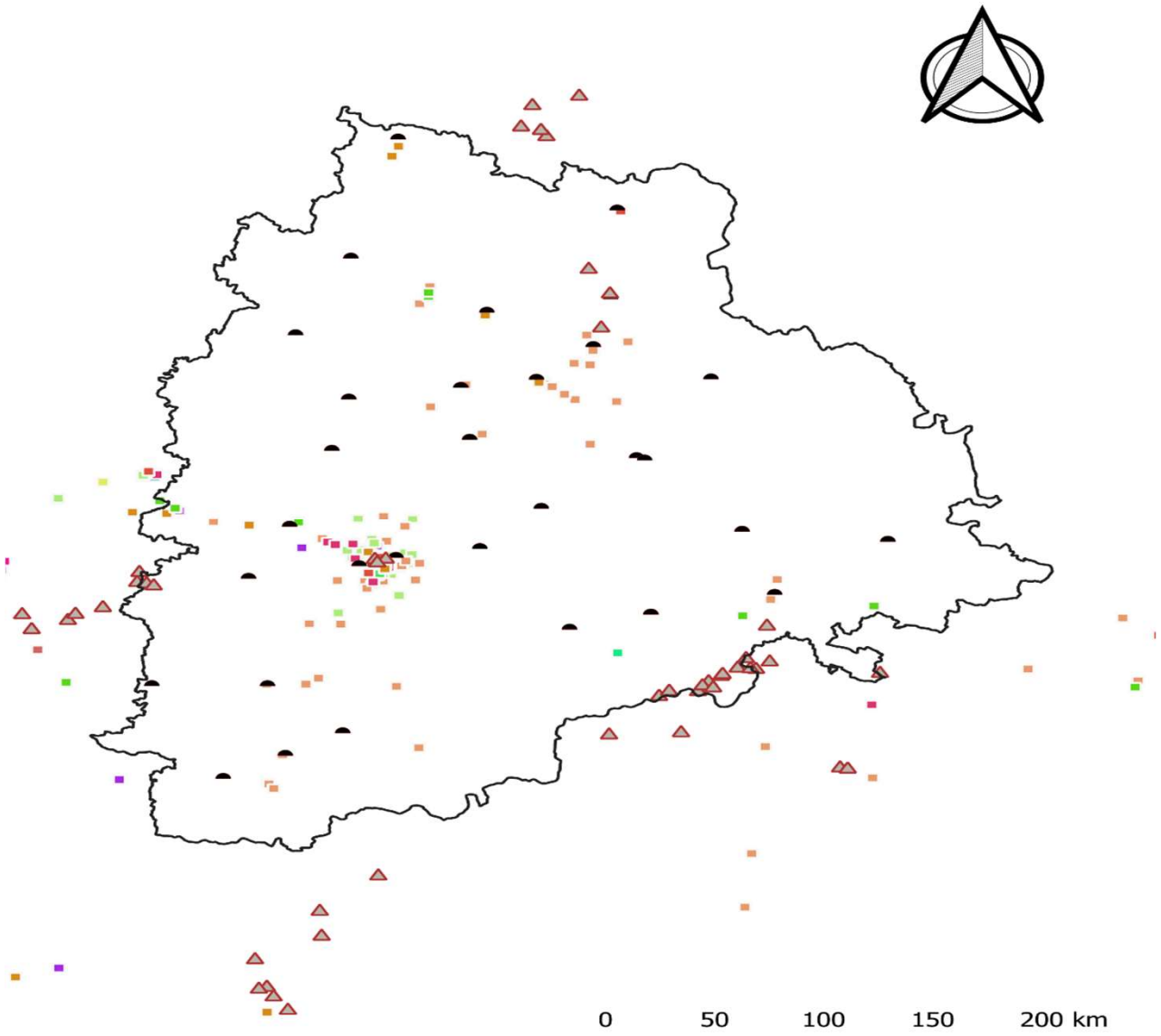
Pharma industry/ cluster in the State of Telangana



Other major waste generators in the State of Telangana



Cement plants & potential waste generators in the State of Telangana



- Cement Industries [178]
- Municipal Solid Waste

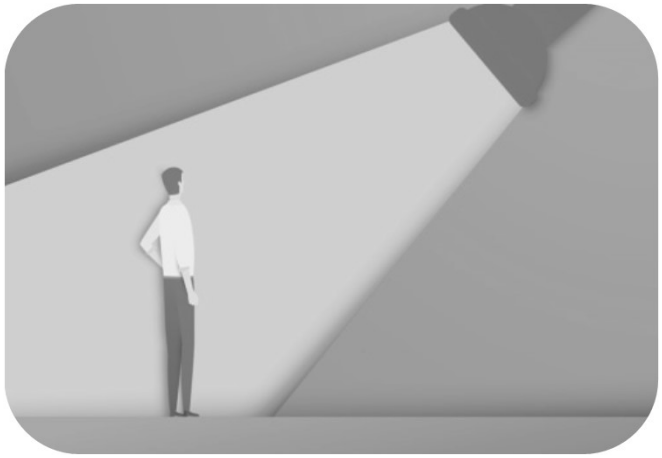
Potential Waste Generators [454]

- Agri business,Agriculture [84]
- Aluminium,Aluminium smelter cum power plant,Aluminium smelting [4]
- Bio-mass [1]
- Chemical,Chemicals [3]
- cotton textiles,Cotton Textiles,glass,Glass [6]
- FMCG,Food and Beverages,Food processing [17]
- hospital [2]
- Iron & Steel,Iron and steel [23]
- Minerals [3]
- Others (wood borad),Wood [2]
- packaging,packaging ,packaging products [7]
- Paper products,paper,Paper [23]
- Pharmaceuticals [131]
- plastic,Plastic products,Plastic Products [10]
- polymers [1]
- Power plant [2]
- Railway workshop [1]
- Rice [1]
- rubber,Rubber [15]
- solar [2]
- Sugar,sugar ,Sugar [42]
- Textile [1]
- Trading Unit [4]
- tyre,Tyre,Tyre ,tyre Retyreing,Tyre Retyreing [65]
- Waste management [3]

- Working with cement plants & stakeholders in various States
  - Odisha
  - Gujarat
  - Tamil Nadu
  - Telangana
  - Andhra Pradesh
- CII in past facilitated material exchange
  - Industrial waste in Gujarat & Tamil Nadu
  - Urban & agriculture waste in Odisha, TN
  - Railway waste in TN

Objective : Identify & Map potential waste generators & waste streams to be utilized in a cement plant

Identification & mapping potential waste generators within specific radius



Assessment and shortlisting potential waste streams for co-processing

Facilitating partnerships among stakeholders (Co-processor, waste generators/ processors/ aggregators)

Methodology

- Baseline assessment and goal setting
- Identification & Mapping of AFR material and generator
- Assessment (Technical & Economical) and shortlisting
- Facilitating long term engagements

Baseline assessment & Goal setting

Team formation

- Cross functional team
- Led by top management

Business needs

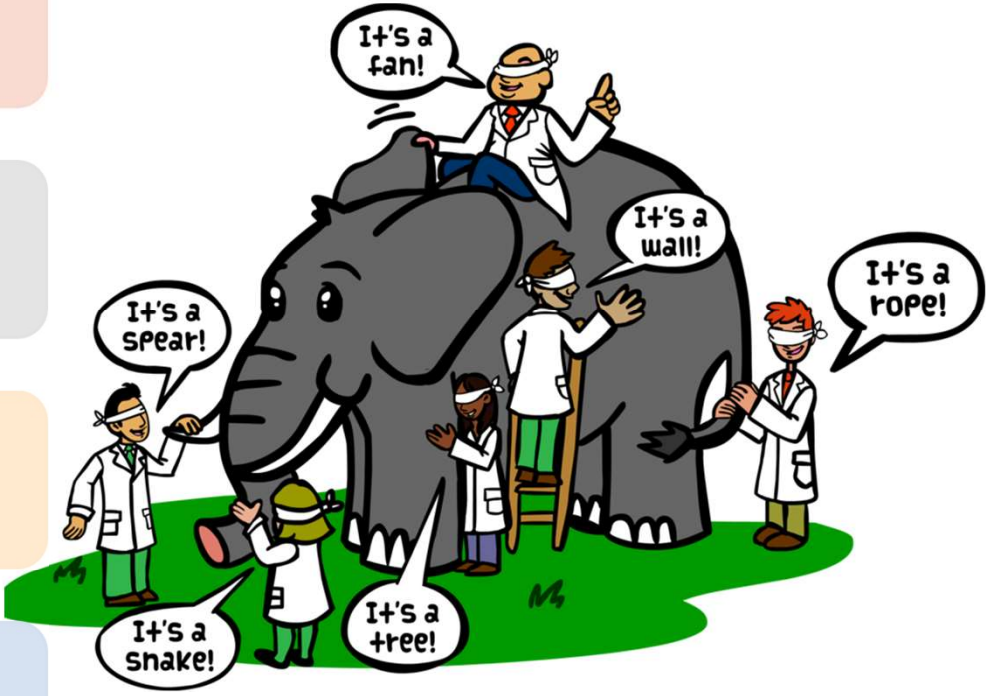
- Low carbon cement - Decarbonisation
- Manufacturing cost
- ESG - Image, investors, customers

Baseline assessment

- Current performance
- Technology & infrastructure gap analysis
- Location

Target fixation

- TSR%
- Typical AFR materials
- Business models & Timelines



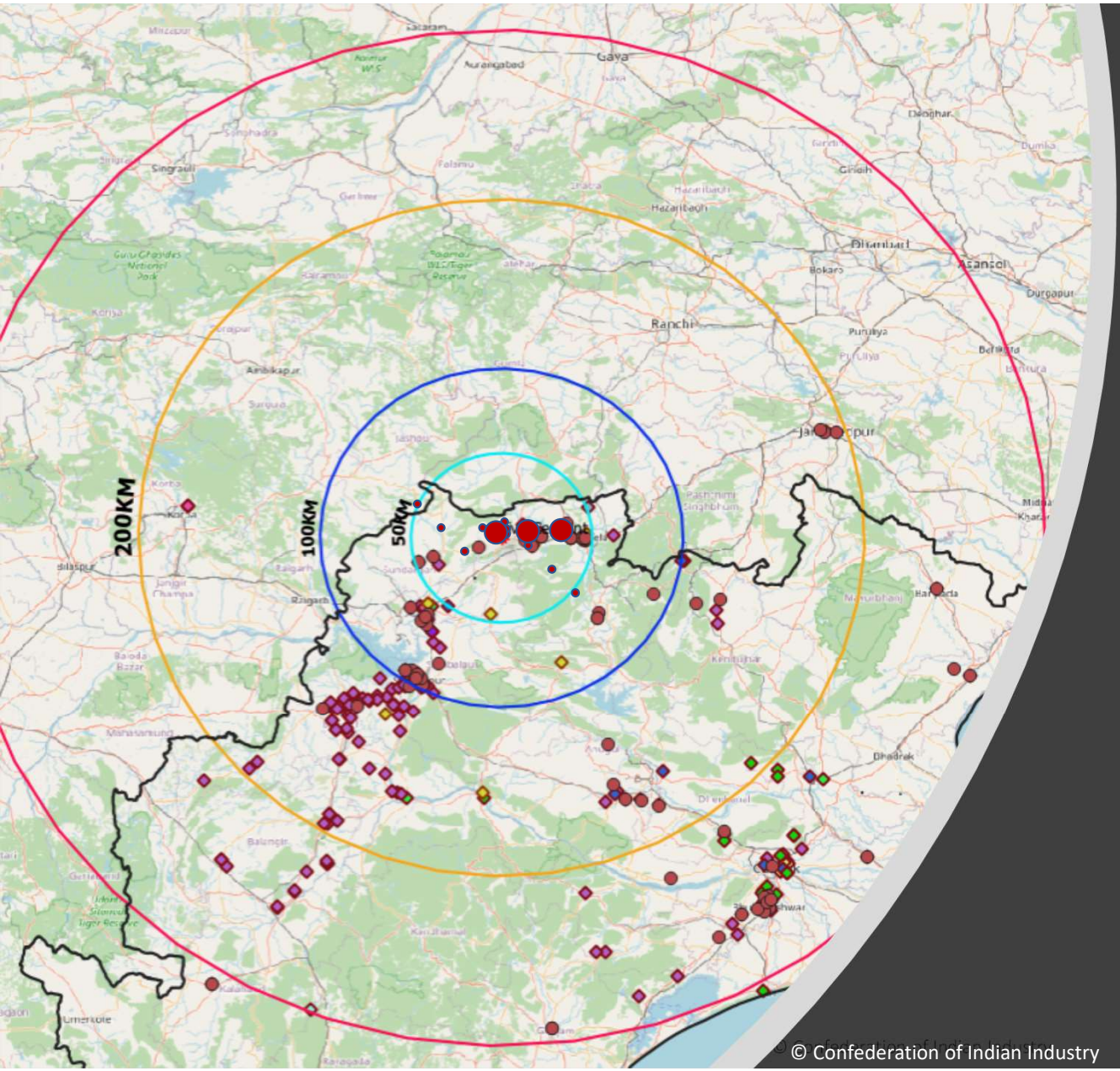
Estimate of alternative fuel requirement

Parameters	Unit	Values	Remarks
Clinker production	Million tons/ annum	2.1	
Specific heat consumption	Kcal/ kg clinker	690	
Energy required	Million Kcals/ annum	14,49,000	
Fuel requirement	Tons of coal / annum	2,41,500	@6000 Kcals/ kg
Fuel (Coal) rquirement	Tons of coal / Day	732	@330 days operation/ annum

TSR %	Dry quantity Tons/ annum	Dry quantity Tons/ day	Wet quantity (Tons/ day)	Remarks
5	28,980	88	110	Calorific value 2500 Kcals/ kg 25% moisture @330 days/ annum operation
10	57,960	176	220	
15	86,940	263	329	
20	1,15,920	351	439	
25	1,44,900	439	549	
30	1,73,880	527	659	

Estimate of alternative raw material requirement

Parameters	Unit	Values
Clinker production	Million tons/ annum	2.1
Raw material requirement	Million tons / annum	1.65
Laterite requirement	%	5
Laterite potentially substituted with other material	Tons/ annum	1,73,250
	Tons/ day	525



GIS mapping of the Cement plant & potential waste generators

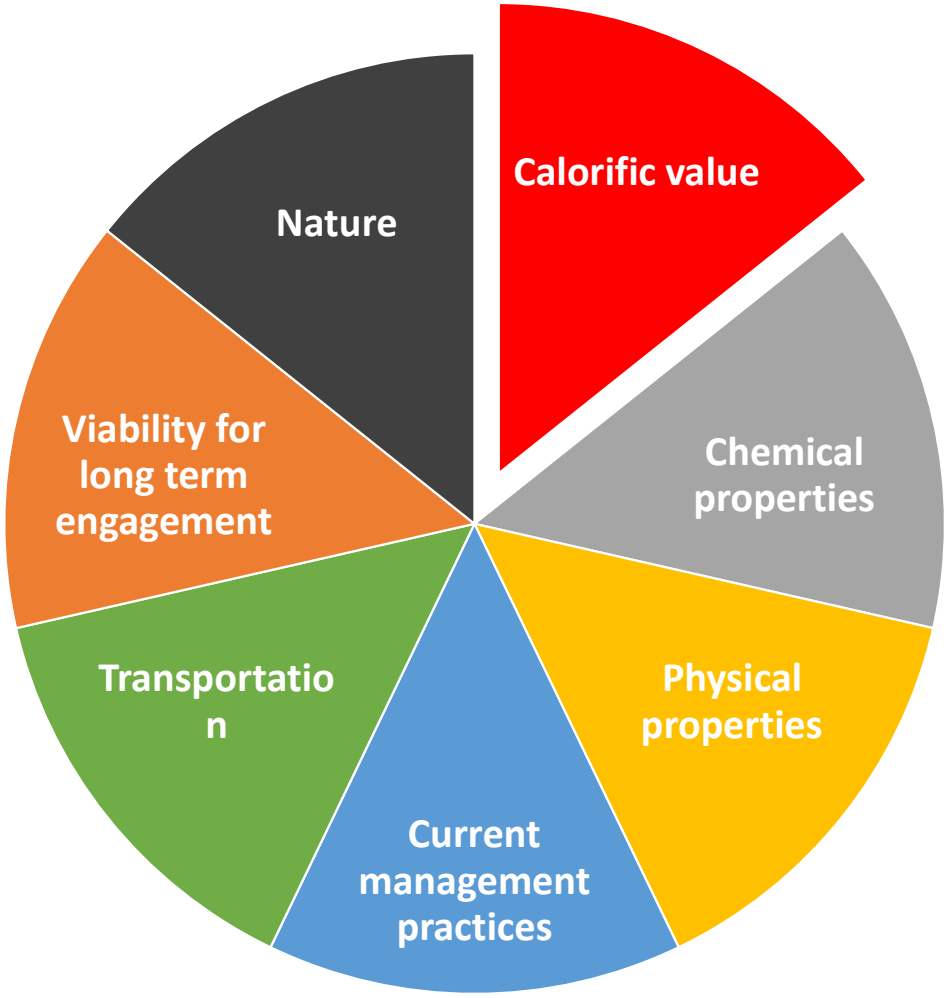
Waste mapping at a multi layered manner (50kms, 100kms, 200kms & 300 kms)

Mapping alternative materials & generators

- CII network
- GreenCo companies (800+)
  - Industries, 50+ railway units
  - 100+ SMEs
- Waste exchange platform (100+ members)
- Group level engagements
- FMCG - EPR requirements
- Waste management companies
- Producer Responsibility Organisation (PROs)

Assessment and shortlisting potential sources

- Generation & current management practices
- Distance & transportation
- Quality of AFR
- Business continuity options for range of scenarios
  - Multi sourcing opportunities for critical AF
- Viability for Long term engagement
  - Type of organization
  - Future growth potential etc



Potential AFRs based on mapping study

Total of 90+ waste generators mapped, 8 major types of Alternative materials

- Industrial waste – Carbon black, Spent pot liner, Waste from tyres, Pharma, Dolachar
- MSW & Bio mining waste
- Refuse Derived fuel
- Paper & plastic waste
- Segregated SCF
- Agricultural waste

Alternate fuel

- Red mud
- Fly ash

Alternate raw material

Facilitation of discussion between stakeholders

- Introduction & POC
- To understand specific opportunities and challenges for all stakeholders
- Site visits
- Material testing
- Financial negotiations
- Other potential long term engagements

Facilitation of partnerships

- **25+ organisations shortlisted**
  - **Waste generators**
  - **Waste processing companies**
  - **EPR organizations**
  - **Companies tied up with ULBs**
  - **Logistics arrangements**

Material facilitated through mapping study - 20% TSR

Nature	Potential generators	Type of waste	Potential quantity (TPA)
Domestic	X, Y Z	Refuse derived fuel, Plastic waste, Agro Waste, MSW	70,000
Industrial	X, Y Z	Pharma waste, Carbon black, Dolachar	55,000
		Total quantity (Tons/ annum)	1,25,000
	Quantity (Tons/ Day) @ 330 days of annual operation		378
	Alternative material		2 million TPA

Roadmap for enhanced AFR usage

Phase 1 3 -4 months	Phase 2 5-6 months	Phase 3 1 month
• Baseline assessment & goal setting • Mapping, assessment & shortlisting • Contracts & facilitating long-term engagements	• Technology upgradations • Implementation of infrastructure for AFR co-processing	• Expert engagement • Assessment of Impacts on increased used of AFR • Production, energy, quality, emissions & manufacturing cost

Sludge waste from Vapi Industrial Area

- Vapi has more than 30 dyes and dyes intermediate industries
- Generating 600 to 700 tonnes/day of spent sulphuric acid
- Sludge Generation
  - 1 tonne of spent acid generates 0.5 tonne of sludge
  - Total generation of sludge is estimated as 300-350 tons/day

Sludge waste from Vapi Industrial Area

- 15% of wastes received at the landfill is the sludge from dyes
- Landfill has a capacity of 1.4 million tonnes of hazardous waste
- More than 90% of landfill capacity is already filled
- At the present rate, Landfill will get exhausted in less than a year

CII GBC facilitation for Co-processing of Sludge

Organised the Stakeholders discussion

Sample of the waste analysed

Laboratory test revealed positive

Procedure of the trial discussed

Lab Analysis Report

	Unit	Marine gypsum* (Conventional)	Sludge from neutralisation of spent sulphuric acid
SO_3 content	%	34.88	38.52
Purity ($CaSO_4.2H_2O$)	%	75	82.8
Moisture content	%	0.1	21.76
Chloride content	%	<2	<0.1

**Marine gypsum is recovered from salt pans during production of common salt in coastal region, particularly in Gujarat and Tamil Nadu.*

Process of trial

Sludge sent from Vapi to Cement plant

20 tonnes of sludge

Mixed with 100 tons of marine gypsum

Charged into cement mill

Process parameters monitored during trial

	Unit	Before Trial	During Trial
Feed rate			
Pregrinder inlet	tonnes/hr	170	172
Gypsum	tonnes/hr (% of cement)	11.39 (6.7%)	11.18 (6.5%)
Pond fly ash	tonnes/hr (% of cement)	15.3 (9%)	15.48 (9%)
Dry fly ash	tonnes/hr (% of cement)	40.8 (24%)	41.28 (24%)
Clinker feed	tonnes/hr (% of cement)	102.51 (60.3%)	103.2 (60%)
Cement mill inlet	tonnes/hr	230	230

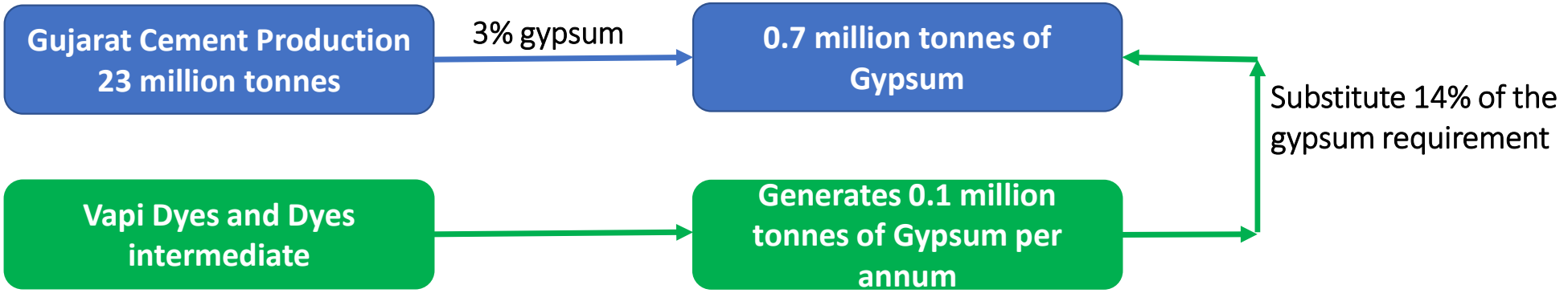
- **Utilization of Gypsum % and feed rate before trail and during trail was almost same**

Process parameters monitored during trial

	Unit	Before Trial	During Trial
Pregrinder			
Pre-grinder load	kW	980	989
Pre-grinder discharge elevator load	kW	64	69
Pregrinder bag house fan speed	rpm	280	290
Baghouse differential pressure	mmwc	70	70
Pregrinder working pressure	MPa	6.5	6.5
Cement mill			
Separator speed	rpm	630	625
Bag house fan speed	rpm	650	655
Cement mill load	kW	2820	2850

The success

>15% of the gypsum can be substituted by sludge generated from dyes industries



India is generating around 9 Million Tons per annum of Red mud

Al/Fe rich clay is added to adjust the composition mix as per the desired value

Potential to substitute this material with Red mud

Potential to balance the excess SOx that enters the system from High Sulphur fuel (Petcoke)

Raw mix alkali should be within limits

Typical characteristics of Redmud

Constituents	Red Mud generated from East Coast Bauxite (Weight %)	Red Mud generated from Central Indian Bauxite (Weight %)
Al_2O_3	18 - 20	18-20
Fe_2O_3	50-55	35-37
TiO_2	4-5	18-20
SiO_2	5-6	7-9
Na_2O	4.5-6	5-6
CaO	0.1-0.6	1-2
LOI	11-12	11-12
Particle size : typically 90% of the volume less than 150 µm		
* Source : Draft Strategy on Aluminium Resource Efficiency, NITI Aayog		

Potential Business Models : Utilization of Red mud in Cement plant

Models	Material Cost (Red Mud)	Transportation Cost
Model 1	100% Cement Plant	100% Cement Plant
Model 2	Nil	100% Cement Plant
Model 3	Nil	50% Cement Plant + 50% Alumina plant
Model 4	Nil	100 % Alumina plant

Business Models : Utilization of Red mud in Cement clusters of India

Sl No	Cluster	Model 1	Model 2	Model 3	Model 4
1	Ariyalur (TN)				*
2	Beawar (RJ)				*
3	Bilaspur (CG)	*	*	*	*
4	Chandrapur (MH)				*
5	Gulbarga (KN)			*	*
6	Himachal (HP)				*
7	Kodinar (GJ)				*

Business Models : Utilization of Red mud in Cement clusters of India

Sl No	Cluster	Model 1	Model 2	Model 3	Model 4
8	Meghalaya				*
9	Nalgonda (TS)				*
10	Odisha	*	*	*	*
11	Satna (MP)		*	*	*
12	Tadipatri (AP)			*	*
13	Udaipur (RJ)				*

Cultivation of Beema Bamboo as Energy Plantation in Cement Industry

- Superior clone : Higher Biomass yielding Bamboo species
- Tissue cultured **Beema Bamboo** is identical, homogeneous, and free from pest and disease, vigorous and superior clone.
- **Fast growth rate**
- constantly yield **high and predictable harvest.**

Action Taken at UTCL, Sidhi

STEP -1

Site Selection

COMPLETED

16.0 Acre Area Identified for First Phase

STEP -2

Ordering of Sapling

COMPLETED

16000 Sapling ordered and Sapling received at Sidhi Plant

STEP -3

Site Preparation

COMPLETED

Site Preparation was completed in 16.0 Acre area

STEP -4

Plantation of Bamboo

PENDING

Plantation will be done after Lockdown Clearance

Saving by using Bamboo as Energy

Cost of Cultivation in Rs./ Acre

Cost	1st Year	2nd Year and onwards
Sapling and Consultancy Cost	50,000	Zero
Cultivation	35,000	25,000
Labour	15,000	10,000
Drip irrigation	25,000	Zero
Total	**125,000**	**35,000**

Fuel Characteristics of Beema Bamboo

Particulars	Value
Total Moisture	12 to 15 %
Ash	1 %
Volatile Matter	80 to 83 %
Fixed Carbon	5 to 6 %
Total Sulphur	0.05 to 0.06 %
Carbon	48 to 52 %
Calorific Value	4000 Kcal/kg
Bulk Density	0.5 ton/m^3

Suggested weightages for shortlisting alternate fuels*

SN	Attribute	Weightage (Score)	Remarks
I	Energy Content (Calorific Value)	25	Highest Calorific Value gets maximum score due to attractiveness for co-processing
II	Availability	25	Includes existing and Potential availability in India. Highest availability gets maximum score
III	Addressing Environmental Concerns	20	Greatest contribution to addressing local pollution problems gets maximum score.
IV	Ease of Processing	20	Includes preprocessing needs, handling & firing equipments, transport logistics & Co-processing requirements. AFs which are easier and cheaper to process gets maximum score
V	CO2 Mitigation Potential	10	Highest mitigation potential gets maximum score.

*Action plan for enhancing the use of alternate fuels and raw materials in the Indian cement industry

Suggested weightages for shortlisting alternate raw materials*

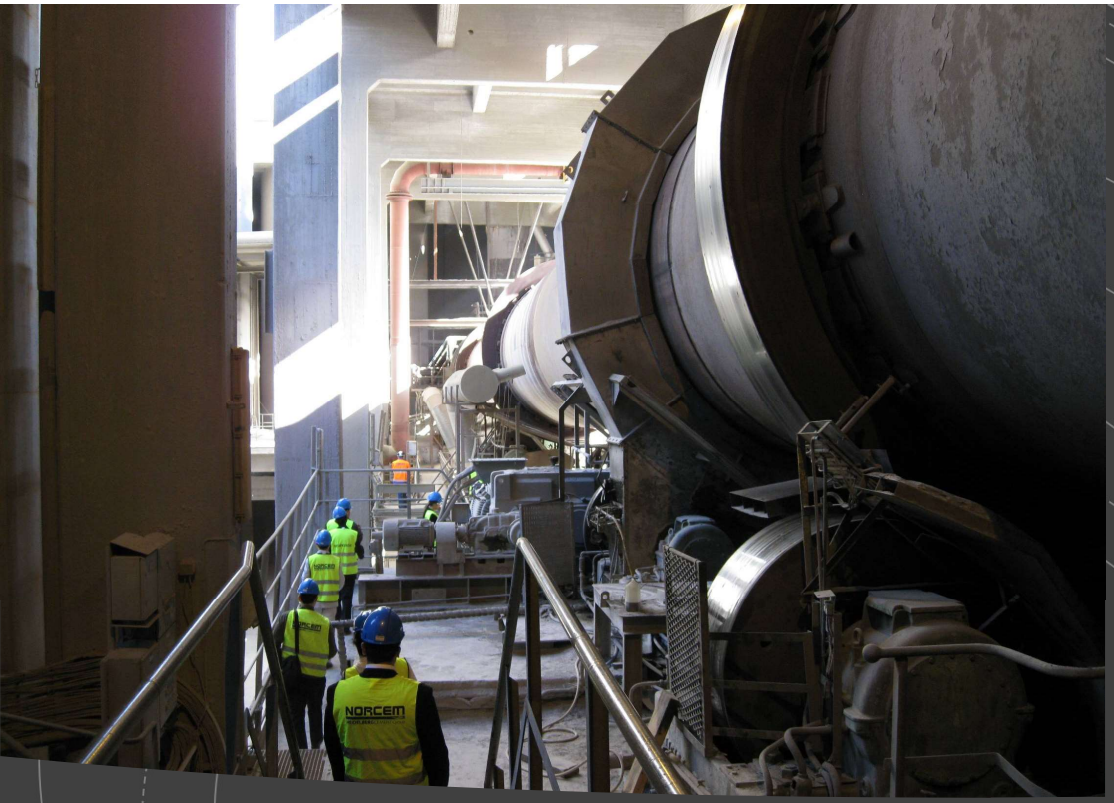
SN	Attribute	Weightage, (Score)	Remarks
I	Availability	30	Includes existing and Potential availability in India. Highest availability gets maximum score
II	Addressing Environmental Concerns	30	Greatest Potential to provide solutions to local pollution problem gets maximum score
III	CO2 mitigation potential	20	Highest mitigation potential gets maximum score.
IV	Ease of Processing	20	Ease of Processing includes preprocessing involved, handling, transport logistics & usage of raw materials. AF's which are easier to process gets maximum score

*Action plan for enhancing the use of alternate fuels and raw materials in the Indian cement industry

TSR levels in Indian cement plants

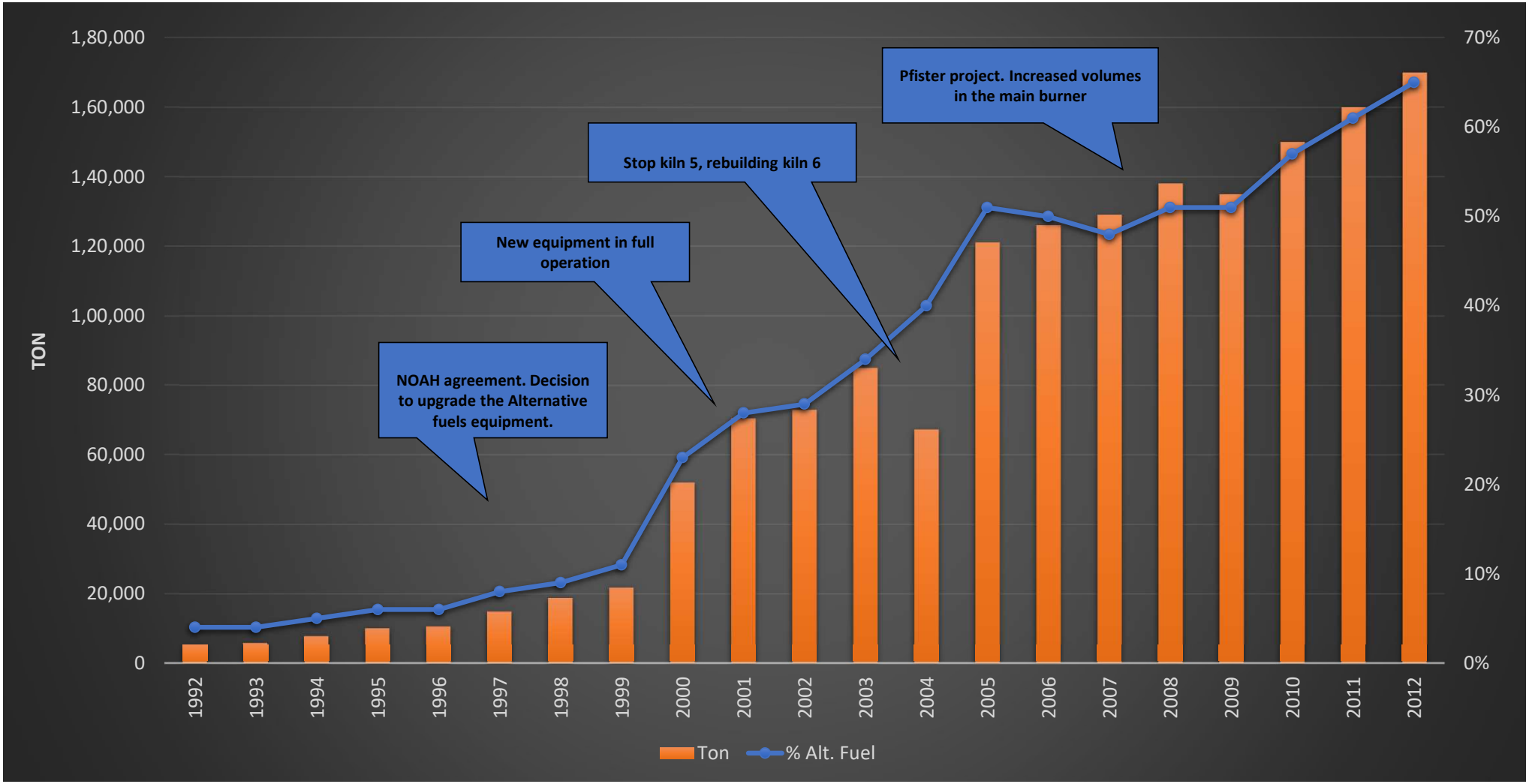
No dedicated incinerators for organic hazardous waste in Norway*

***SINTEF Norway also conducted test burns in several countries in partnership with cement plants**



- NORCEM Breivik Plant, South of Oslo
- ~ 70% of the coal is substituted with various wastes…

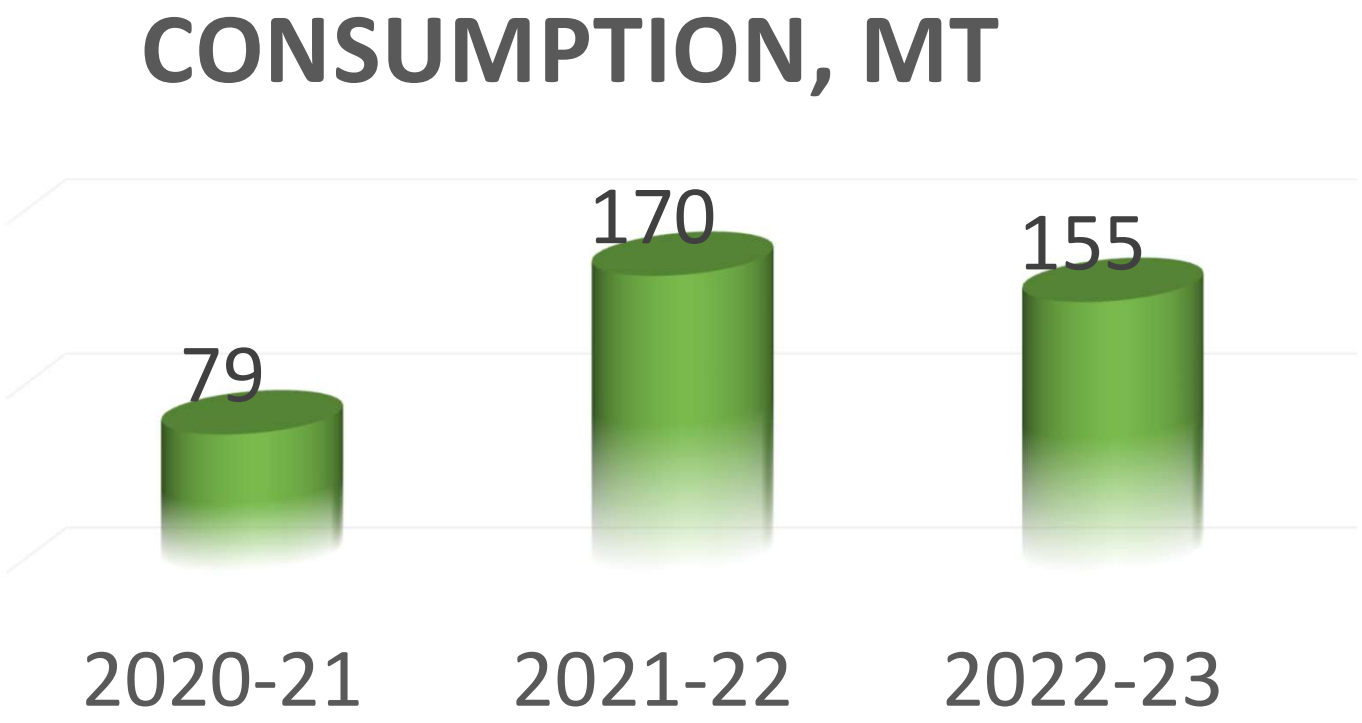
Alternative Fuels Development in Norcem Brevik



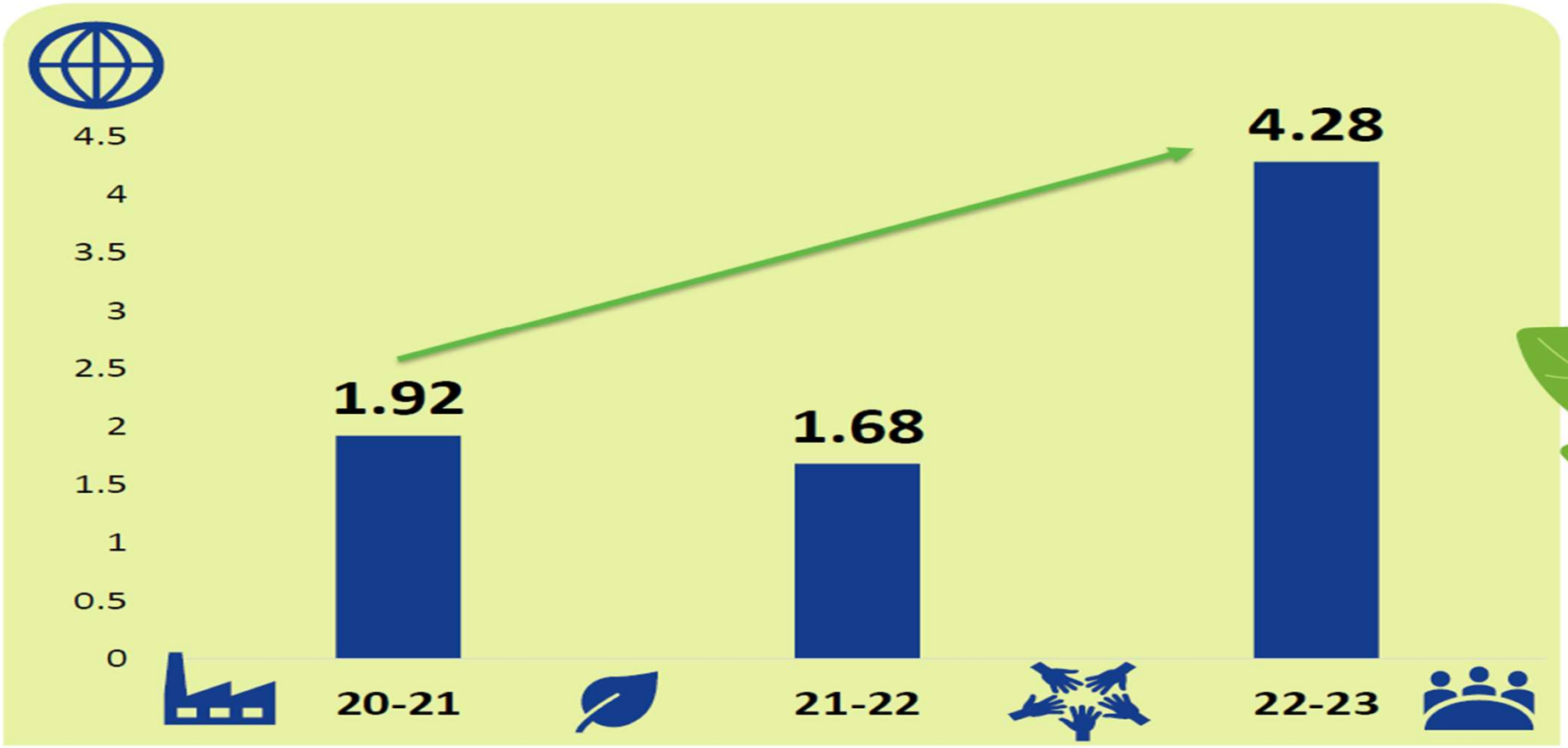
Sl.No	Water as fuel	Quantity in KMT				GCV, Kcal/kg			TSR %		
		FY 19-20	FY 20-21	FY 21-22	**Total**	FY 19-20	FY 20-21	FY 21-22	FY 19-20	FY 20-21	FY 21-22
1	Saw Dust	1.81	3.75	2.76	**8.32**	2829	2126	2101	0.65	1.12	0.75
2	Fire Wood	0.94	0.08		**1.02**	3261	3392		0.39	0.04	-
3	Sugercane Bugasse			0.60	**0.60**			3262	-	-	0.25
4	Plastic Waste	0.37	1.02	0.43	**1.81**	4494	4458	4430	0.21	0.64	0.24
5	RDF			0.16	**0.16**			1919	-	-	0.04
6	Bamboo Dust	0.46	0.45		**0.91**	3247	3228		0.19	0.21	-
7	HDPE Mtrl		0.03	0.02	**0.05**		5748	5040	-	0.02	0.02
8	Bamboo	0.73	0.01		**0.74**	3323	3392		0.31	0.01	-
9	Herbal Waste	0.11			**0.11**	2926			0.04	-	-
10	Fly Ash Bags	0.43			**0.43**	1670			0.09	-	-
11	Pharma Waste		0.29	0.78	**1.06**		3085	2751	-	0.12	0.27
12	Carbon Black	0.02	0.56	0.37	**0.95**	6694	6622	6594	0.02	0.52	0.31
13	Rice husk		0.13	0.00	**0.13**		2407	2797	-	0.04	0.00
14	Dry Coke 2		0.01		**0.01**		4582		-	0.01	-
15	Dry Coke 1		0.01		**0.01**		4440		-	0.01	-
16	Ink Waste/Nitrocellulose		0.03	0.01	**0.03**		6556	6541	-	0.02	0.01
17	Edible Product		0.04	0.09	**0.13**		3037	2898	-	0.02	0.03
18	Sludge		0.05	0.21	**0.27**		752	587	-	0.01	0.02
19	BBD Liquid			0.01	**0.01**			5369	-	-	0.00
20	Spent Charcoal		0.01		**0.01**		2071		-	0.00	-
21	Prcsorgresl			0.00	**0.00**			5751	-	-	0.00
22	Oilsoak Cotton Waste			0.01	**0.01**			3095	-	-	0.00
23	Spent Addditives		0.01	0.01	**0.02**		2141	4017	-	0.00	0.00
	Overall	**4.87**	**6.48**	**5.43**	**16.77**	**3071**	**3060**	**2784**	**1.89**	**2.79**	**1.95**

AFR Consumed MT	2019-20		2020-21		2021-22	
	Consumed, MT	Annual TSR %	Consumed, MT	Annual TSR %	Consumed, MT	Annual TSR %
Tire Chips	12.3	4.2	15.61	2.6	**	4.5
Carbon Black	17350		11995		30920.4	
RDF	**		**		**	
Stalk (Agri Waste)	**		**		45.75	
Plastic Waste	17438		6835		12655.05	
Total	34800.3		18846		34077.3	

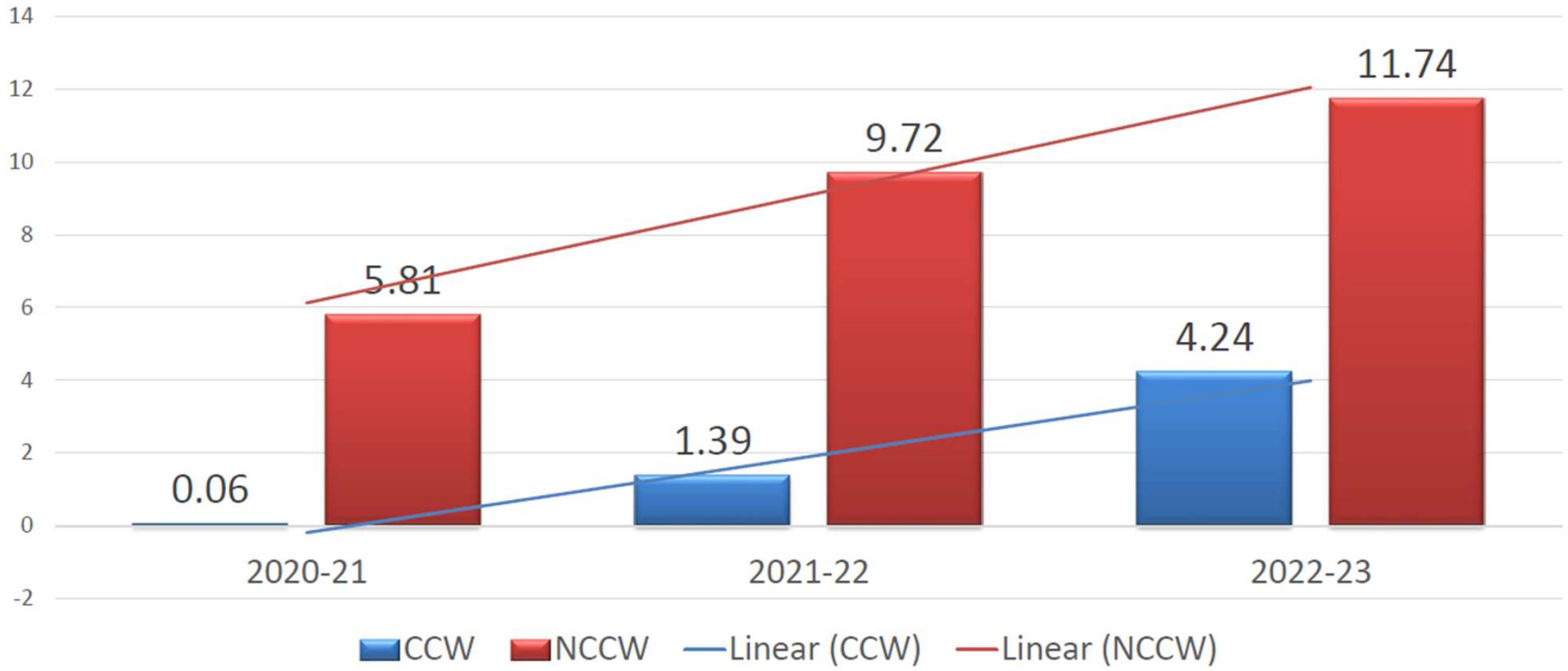
- WOODEN CHIPS
- CARBON BLACK
- PHARMA LIQUID
- PLASTIC WASTE



Thermal Substitution Rate (TSR%)

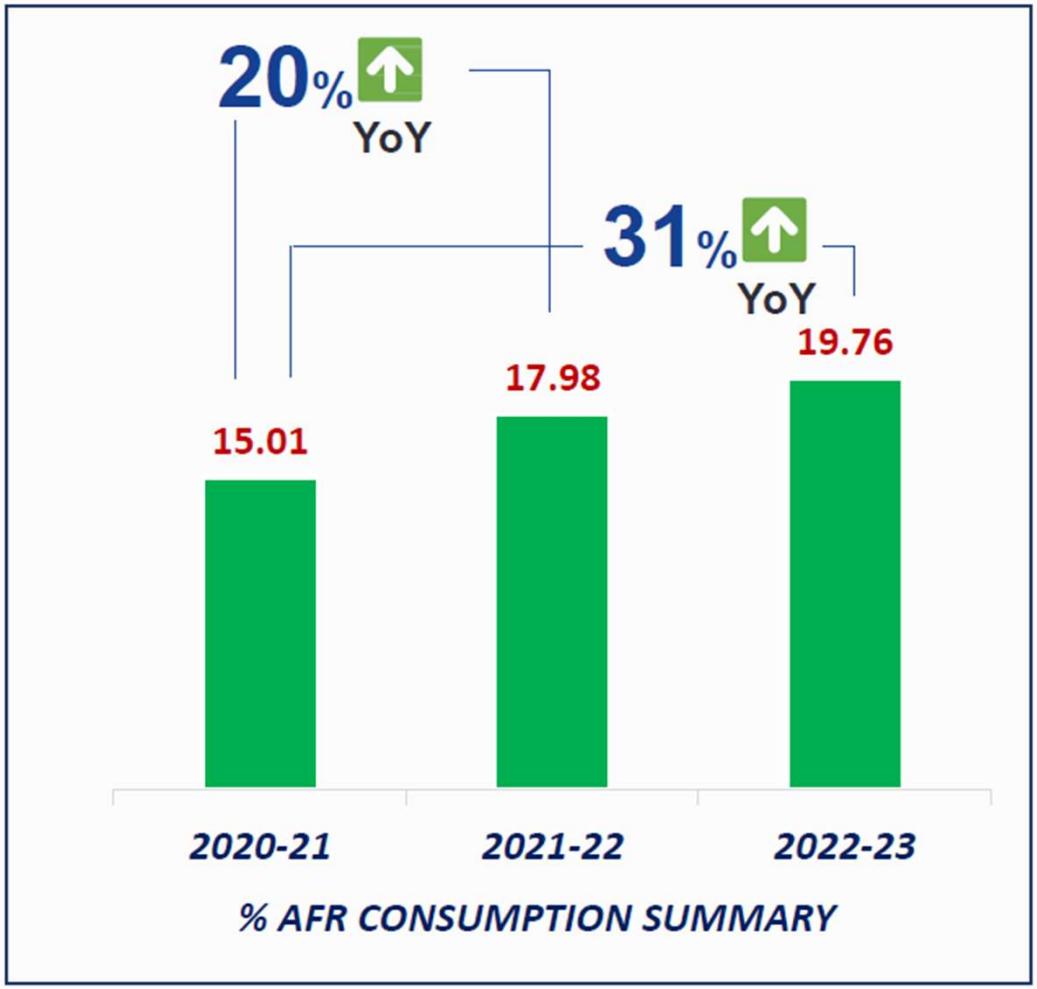


TSR %



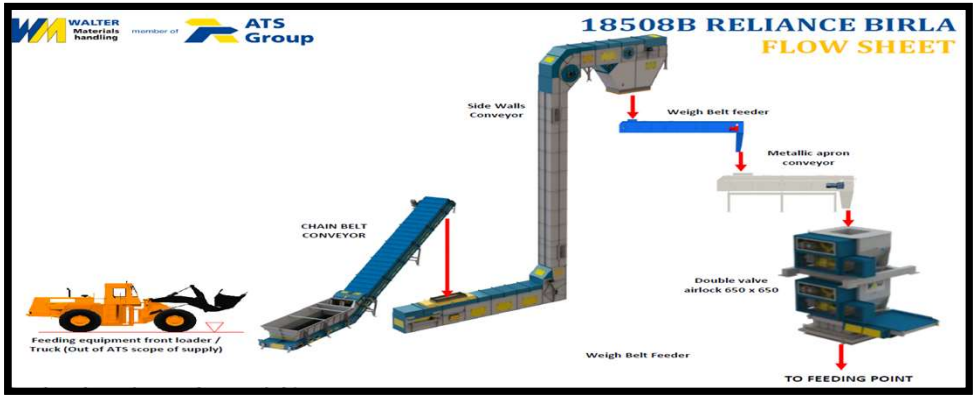
Increase in TSR % 4.18 in CCW 1 & 5.93 in CCW 2 From FY 20-21

Parameters	UOM	Apr’19-Mar'20	Apr’20-Mar'21	Apr’21-Mar’22	Apr’22-Mar’23
AFR Usage	MT	65580	88424	191633	291151
Thermal Substitution	%	4.5	3.2	9.5	17

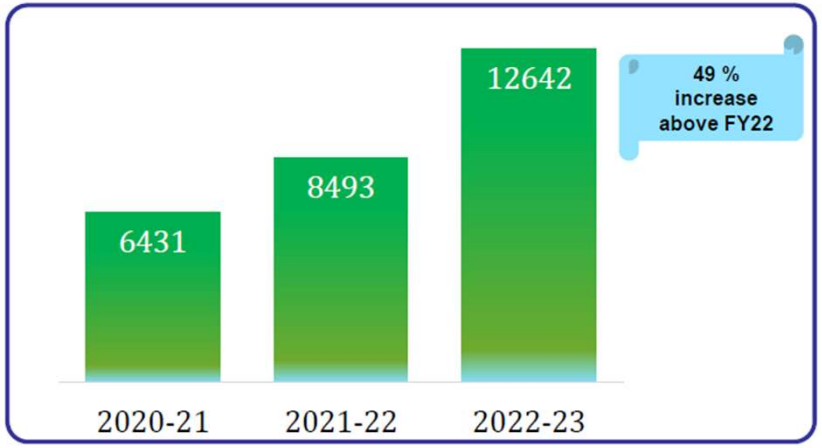

20% YoY
31% YoY
15.01
17.98
19.76
2020-21
2021-22
2022-23
% AFR CONSUMPTION SUMMARY

UTILIZATION OF WASTE AS FUEL IN LAST THREE YEARS

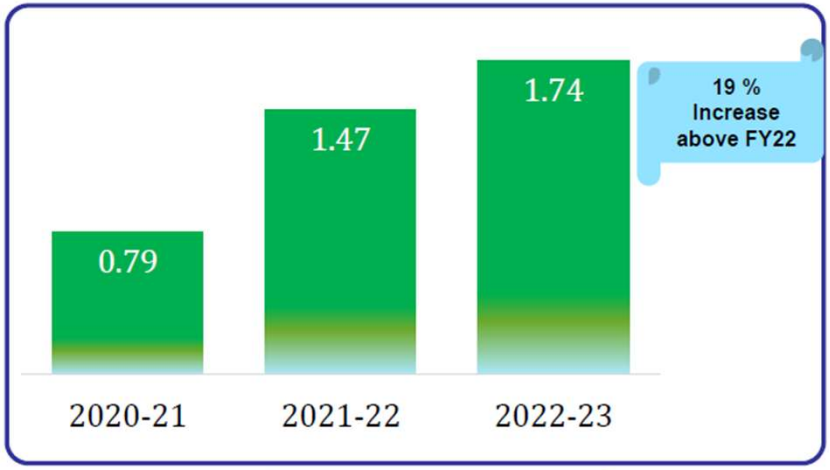
Description	2020-21			2021-22			2022-23		
Name of Fuel	Liquid Waste	Solid Waste	Bio Mass	Liquid Waste	Solid Waste	Bio Mass	Liquid Waste	Solid Waste	Bio Mass
Year	2020-2021	2020-2021	2020-2021	2021-2022	2021-2022	2021-2022	2022-2023	2022-2023	2022-2023
Qty in MT	7544.82	46130.77	2108.12	16336.39	61795.95	14790.95	13014.61	68169.22	14589.45
GCV	292.59	1961.421	3570.148	434.15	1561.434	3414.416	481.338	1501.615	3716.205
Heat Value in Million Kcal	2207.55	90481.87	7526.3	7092.5	96490.28	50502.46	6264.44	102363.91	54217.38



New AFR System is under commissioning which will increase TSR rate to 7 %



AFR CONSUMPTION (MT)



%TSR RATE

Sl No	FY (2021-23)	Waste as fuel	Quantity	GCV	Waste as percentage of total fuel	TSR %
1	FY 2020-21	Biomass (MT/year)	33240	3290	6.90 %	12.01
2		Solid waste (MT/year)	12314	6191	5.11 %	
3	FY 2021-22	Biomass (MT/year)	44703	3312	7.72 %	13.48
4		Solid waste (MT/year)	16654	5777	5.37 %	
5		Liquid Waste (MT/year)	2642	2820	0.39 %	
6	FY 2022-23	Biomass (MT/year)	22196	3310	4.34 %	11.67
7		Solid waste (MT/year)	19019	5718	6.13 %	
8		Liquid Waste (MT/year)	5494	3646	1.19 %	

Sl No	Details	Quantity (MT/year)	percentage of total fuel
1	Agro waste	6765	1.27
2	Carbon black	1461	0.70
3	Pharma waste	4522	0.84
4	Liquid AFR	2974	0.55
5	Plastic Waste	1495	0.42
6	RDF & M Waste	8640	1,51
7	Dolachar	15.5	0.003
Total			5.6

Name of the Fuel	2020-21		2021-22		2022-23	
	Quantity (MT)	Waste fuel as % of Energy used	Quantity (MT)	Waste fuel as % of Energy used	Quantity (MT)	Waste fuel as % of Energy used
TPP Coal Ash	11990		10966		9499	
Shredded Tyre Rubber	-		216.6		15.1	
Shredded Coir & Rubber mix	-	1.2	227.7	4.3	2311	
Plastic Waste mix	-		265.4		104.4	
Carbon Black	-		1037		-	3.84
Solid waste Mix					690.3	
Mica Shreds					1385	

WASTE UTILISED AS FUEL				
S. No	Waste as fuel	Quantity (Tons)	GCV (Kcal/kg)	Waste as percentage of total fuel
1	ALTERNATE FUEL - LIQUID MIX	2479.55	1800	0.20
2	ALTERNATE FUEL - HARD PLASTIC & RUBBER COMPOSITE GRANULES, SIZE: <= 5 MM	2588.129	4400	0.50
3	ALTERNATE FUEL SOILID WASTE	13126.183	1500	0.86
4	ALTERNATE FUEL- PAINT PIGMENTS	247.48	1500	0.02
5	ALTERNATE FUEL - PRODUCTION ASH WASTE	32.78	2000	0.00
6	ALTERNATE FUEL LIQUID MIX - SPENT WASH	37.25	400	0.00
7	ALTERNATE FUEL - SHREDDED FOAM AND RUBBER	1457.506	5050	0.32
8	ALTERNATE FUEL - SHREDDED RDF 40-60 MM	13290.041	2000	1.17
9	ALTERNATE FUEL - SHREDDED TYRE .	464.741	6500	0.13
10	Raw Mill/ Kiln	196	4600	0.04
11	ALTERNATE FUEL WOODCHIPS .	4006.81	3000	0.53
12	COAL ASH – POWER PLANT	26167.138	2500	2.87
13	ALTERNATE FUEL WASTE PLASTIC RUBBER .	2205.93	2000	0.19
14	ALTERNATIVE FUEL - MLP WASTE	2,489.14	2000	0.22
15	ALTERNATE FUEL - DIP PLASTIC WASTE	697.537	2000	0.06
16	ALTERNATE FUEL CARBON BLACK	107.789	5800	0.03
17	ALTERNATE FUEL - MANGO SEED	9070	4000	1.59
18	ALTERNATE FUEL RICE HUSK .	2892.013	3200	0.41
19	ALTERNATE FUEL - RESIDUES OF STARCH	142.675	3600	0.02
20	ALTERNATE FUEL - SHREDDED COIR WASTE	75	4749	0.02

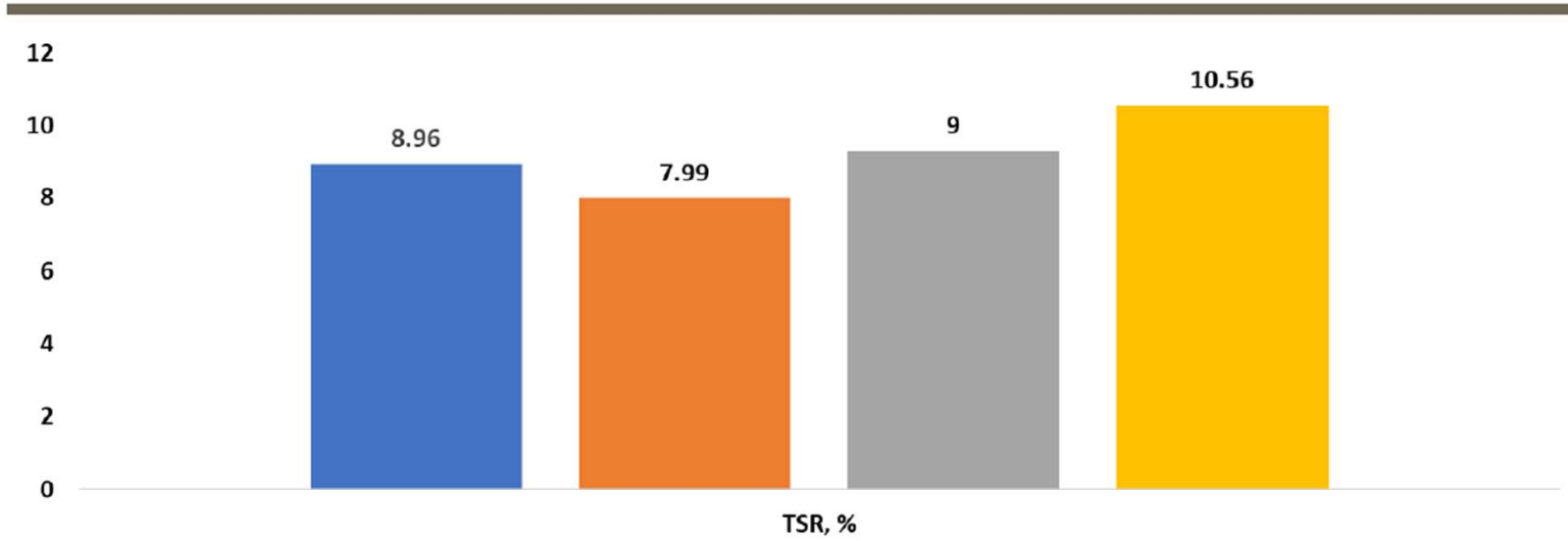
81773 Tons of AFR used and achieved 9.1% TSR in FY 22-23

S.No.	Year	Waste as a Fuel	Quantity (MT)	GCV	Waste as % of Total fuel
1	FY 2020-21	Carbon Black, Municipal waste, Biomass, Liquid waste, Plastic waste	33036	4463	13.3
2	FY 2021-22	Carbon Black, Municipal waste, Biomass, Liquid waste, Plastic waste	55264	4051	17.9
3	FY 2022-23	Carbon Black, Municipal waste, Biomass, Liquid waste, Plastic waste	79450	3938	23.8

Sl. No	Year	Waste as fuel	Quantity	GCV	Waste as percentage of total fuel (%)
1	2022-2023	AF-Non Haz-DOLACHAR	27423	2029	8.643
2	2022-2023	AF-Non Haz-COAL FINES	3513	3433	1.105
3	2022-2023	AF-Liq Haz-WASTE	704	1601	0.221
4	2022-2023	FLUE DUST;BLAST FURNANCE	290	1310	0.091
5	2022-2023	AF-Haz-ACID TAR SLUDGE	155	3217	0.049
6	2022-2023	AFR;PYROLYTIC OIL	79	9816	0.025
1	2021-2022	AF-Non Haz-COAL;WASHERY REJECT	6560	2820	2.0626
2	2021-2022	AF-Non Haz-DOLACHAR	1771	2098	0.5567
3	2021-2022	AF-Liq Haz-WASTE	898	4063	0.2823
4	2021-2022	AF-Haz-ACID TAR SLUDGE	262	3268	0.0822
5	2021-2022	AFR;PYROLYTIC OIL	141	9861	0.0442
6	2021-2022	AF-Non Haz-PLASTIC WASTE	84	3738	0.0265

Waste Utilization- Last 3 Years

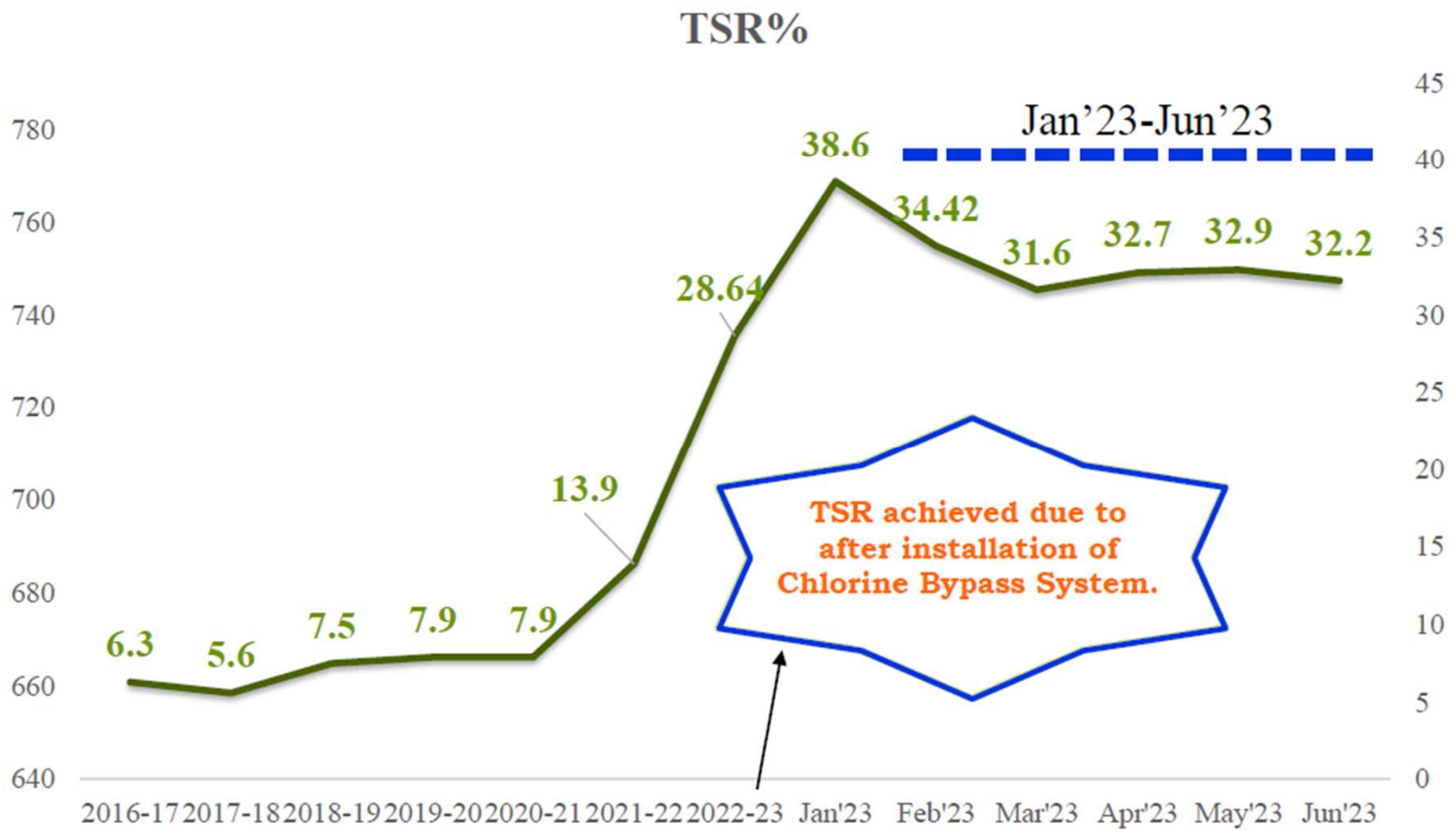
Year FY	Waste of fuel	Qty(Mt)	NCV (Kcal/Kg)	Waste as Percentage of Total fuel
2020-21	AF	49711	2072	**8**
2021-22	AF	80172	2206	**12**
2022-23	AF	85902	1921	**15**

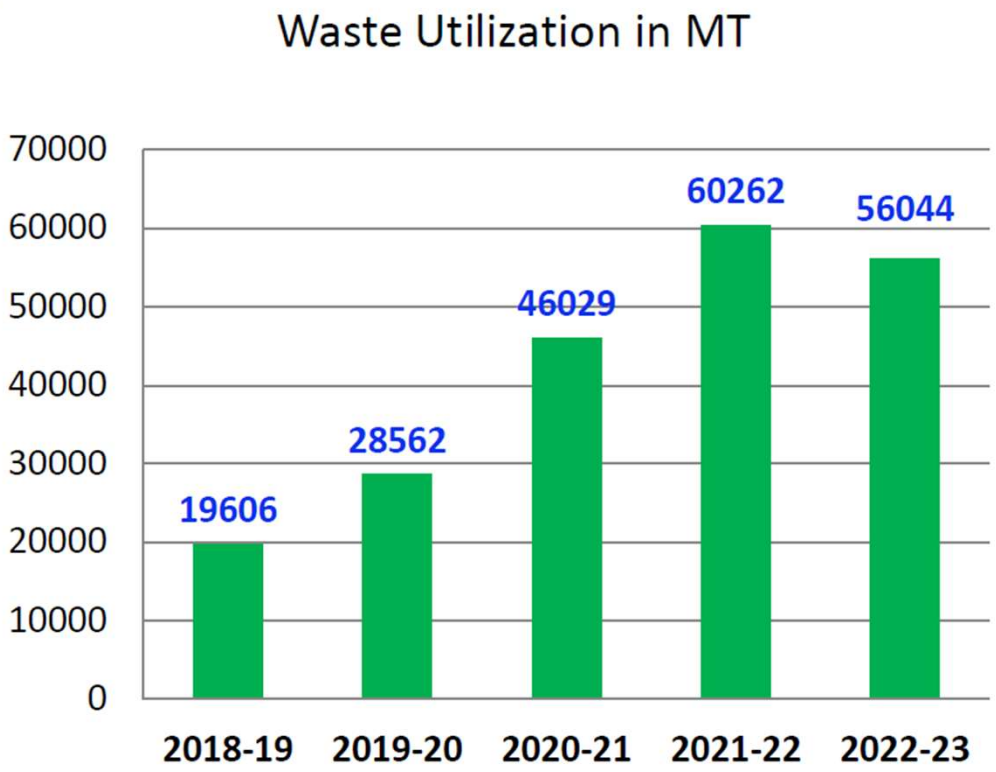


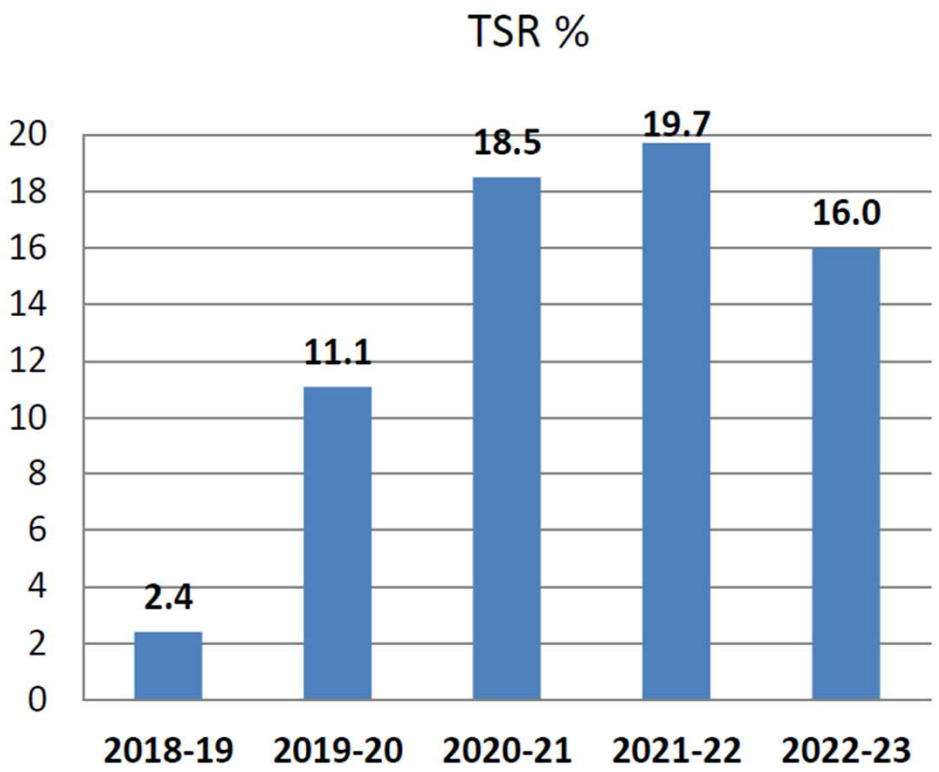
Name of Waste	Year 2019	Year 2020	Year 2021	Year 2022
NHZ	18,645	19,945	26,057	25,767
Biomass	16,162	14,082		
RDF	23,234	13,161	40,394	54,543
Trade Rejects	3,694	3,923	1,262	1,360
Pyrolitic Oil	45	20	0	36
AF Total	61,780	51,131	67,713	81,706
TSR, %	8.96	7.99	9	10.56

FY	2020-21		2021-22		2022-23	
MATERIAL	Qty, (MT)	% TSR	Qty, (MT)	% TSR	Qty, (MT)	% TSR
RDF	14753	5.1%	33495	7.9%	39239	8.90%
Plastic waste	7415	3.8%	14502	5.9%	16846	6.50%
Carbon black	0	0.0%	3192	1.6%	3537	1.90%
Cotton Waste	723	0.3%	1064	0.3%	1064	0.30%
SCF	264	0.1%	703	0.3%	687	0.30%
Paint Sludge	639	0.3%	655	0.2%	455	0.20%
Resin Waste	863	0.4%	526	0.2%	766	0.20%
Tyre Chips	236	0.1%	294	0.1%	133	0.10%
Solid Waste Mix	924	0.3%	129	0.0%	233	0.00%
Other AFR's	596	0.2%	437	0.1%	566	0.10%
Total	26412	10.4%	54996	16.6%	63526	18.50%

Green Raw Material	2020-21	2021-22	2022-23
Tannery Sludge - MT (Wet)	33	0	0
Lime Sludge - MT (Wet)	17489	4735	9111.2
Total Quantity-MT	17522	4735	9111.2


TSR%
Jan'23-Jun'23
38.6
34.42
31.6
32.7
32.9
32.2
28.64
13.9
7.9
7.9
7.5
6.3
5.6
TSR achieved due to after installation of Chlorine Bypass System.
780
760
740
720
700
680
660
640
45
40
35
30
25
20
15
10
5
0
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
Jan'23
Feb'23
Mar'23
Apr'23
May'23
Jun'23


Waste Utilization in MT
70000
60000
50000
40000
30000
20000
10000
0
19606
28562
46029
60262
56044
2018-19
2019-20
2020-21
2021-22
2022-23


TSR %
20
18
16
14
12
10
8
6
4
2
0
2.4
11.1
18.5
19.7
16.0
2018-19
2019-20
2020-21
2021-22
2022-23

AFR usage in Cement CPPS

- Ambuja and ACC Cement plant utilizing biomass for its captive power plant.
- The use of biomass has brought respite for villagers around, who find it difficult to manage agriculture waste
- The plant is presently using 24 types of biomass, like rice husk, mustard stalk, wood bark chips, cow dung cakes, sunflower stems, sugar mills waste, etc

AF USAGE % IN TPP 4&5

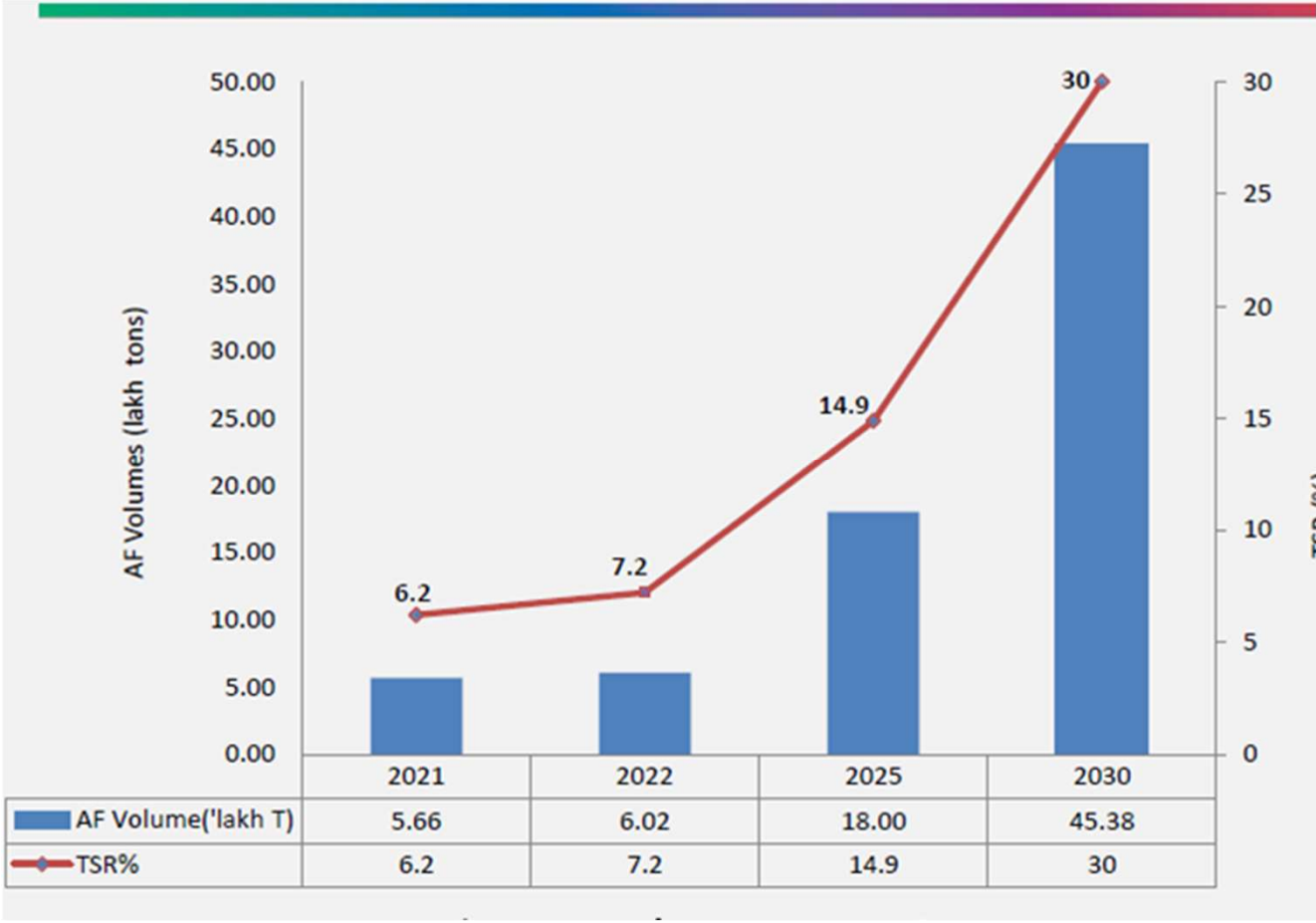
❖ AF Consumption Quantity in MT= 49829

❖ AF Consumption Quantity in MT= 45893

REDUCED CARBON FOOTPRINT – 64608 MT of CO_2 emission reduced

GeoClean

- 6 pre-processing & 14 Co-processing facilities
- Average TSR 7% and large plants 20%
- Partnered with 20+ municipalities
- Remediated 10 dumpsites
- collection, transportation, storage, treatment and disposal of MLP and Post Consumer Plastics – 15 PIBOs



Usage of Alternative Fuel & Raw Material in Indian cement industry

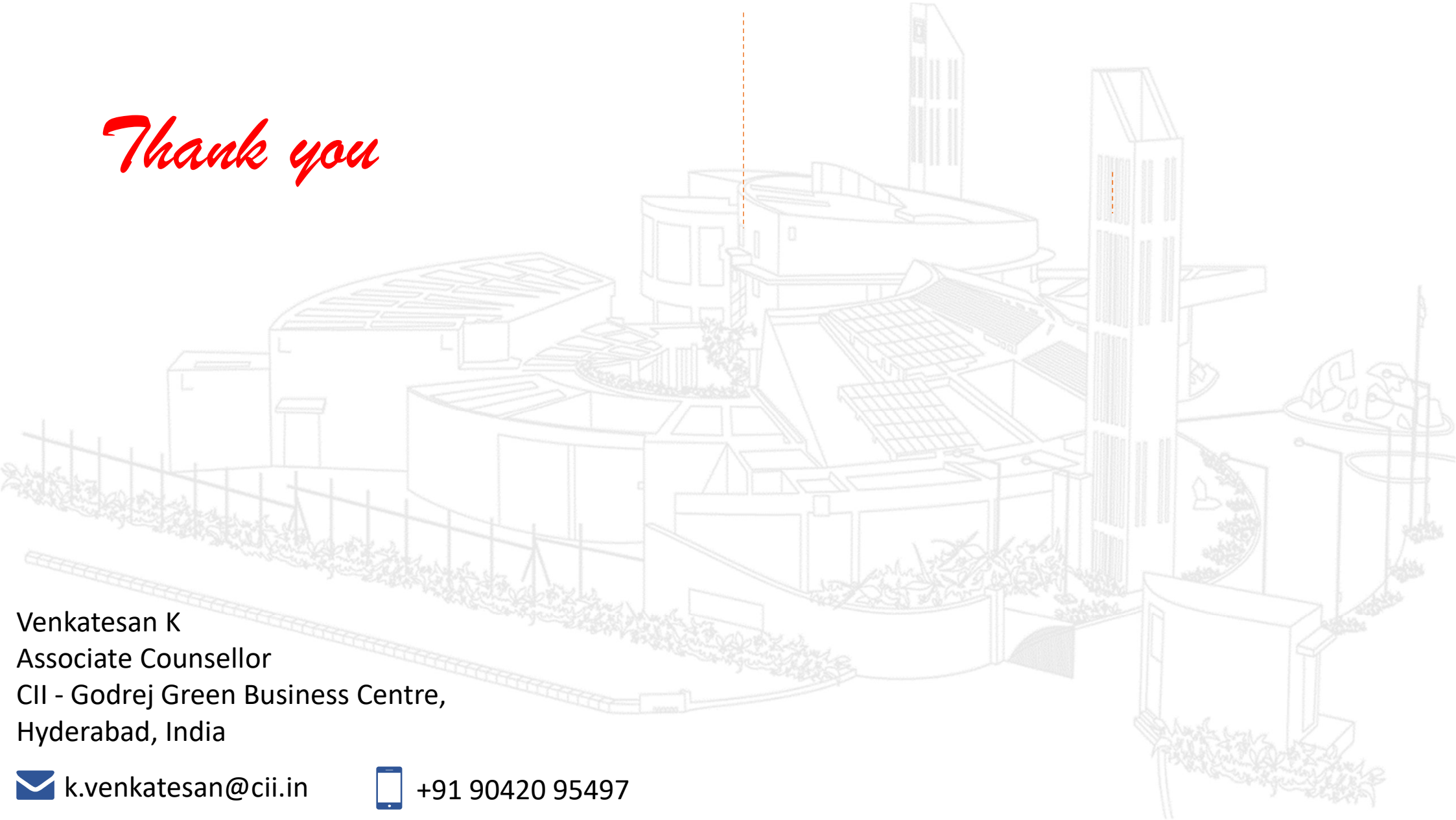
- Average TSR 6%
- Highest Substitution on continuous basis: ~30% TSR
- 25+ cement plants setup standard infrastructure for AFR utilization

Way Forward

Indian cement industry

- Significant potential to increase AFR co-processing
- Solution for waste management & Scope 1 emission reduction
- Internationally proven for managing various waste streams
  - Technical & Economical
  - Developed & developing countries
- CII will work closely with industry in accelerating TSR levels further

Thank you



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