Confederation of Indian Industry

Advanced Training Programme on Pre & Co-Processing of Alternative Fuel in Cement Plants

CII Initiatives for Cement Industry

Confederation of Indian industry

CII - Sohrabji Godrej Green Business Centre, Hyderabad

Objective

Facilitating Industries to achieve World Class Standards in Energy Efficiency

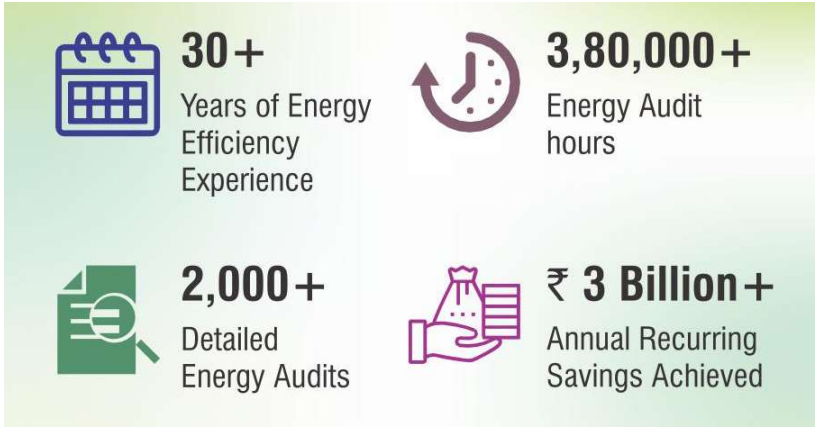
- Energy efficiency studies
- Climate Change Initiatives
- Decarbonization Studies
- Capacity building

CII Enhancing energy efficiency of Cement Industries since 1990s'

Energy Audits

- 500+ studies in Indian cement plants
  - Over 75% of cement plants in India
  - **50+ Energy professionals**
  - **20% Cement & CPP experts**

- International: Japan, South Korea, Togo, Lebanon, Australia, Nepal, Ghana, UAE Indonesia, Malaysia



Electrification of trucks for cement sector in India

To generate demand for e-trucks by facilitating the cement sector to reduce the use of ICE trucks through a shift to e-trucks, thereby also reducing carbon emissions from the sector

- **White paper – Potential, opportunities**
- **Awareness, Connect all stakeholders**
- **Feasibility studies in 4 Plants in 2 Clusters**
- **Pilot trial, PoC, M & V for the interested cement plants**
- **Recommendations and Replication**

AF Utilization & Mapping Study

- Estimation of plant AFR requirement – studies carried out for 4 cement plants
- Mapping of waste generator/waste supplier using GIS tool.
- Create different layers of waste generator under 50KM to 500KM radius.
- Assessment, shortlisting of waste generators and materials.
- Facilitating viable business model. Interaction and engagement with AF generating and handling companies

Training program on Enhancing AF usage

National Awards for Excellence in Energy Management – Cement sector

- Participation by all leading Cement plants
- Excellent Platform – “Facilitating Knowledge through Sharing Approach”
- Raise Performance Standard by instilling a “sense of comparison” and replication of best practices
- **“2024 – Silver Jubilee Year”**

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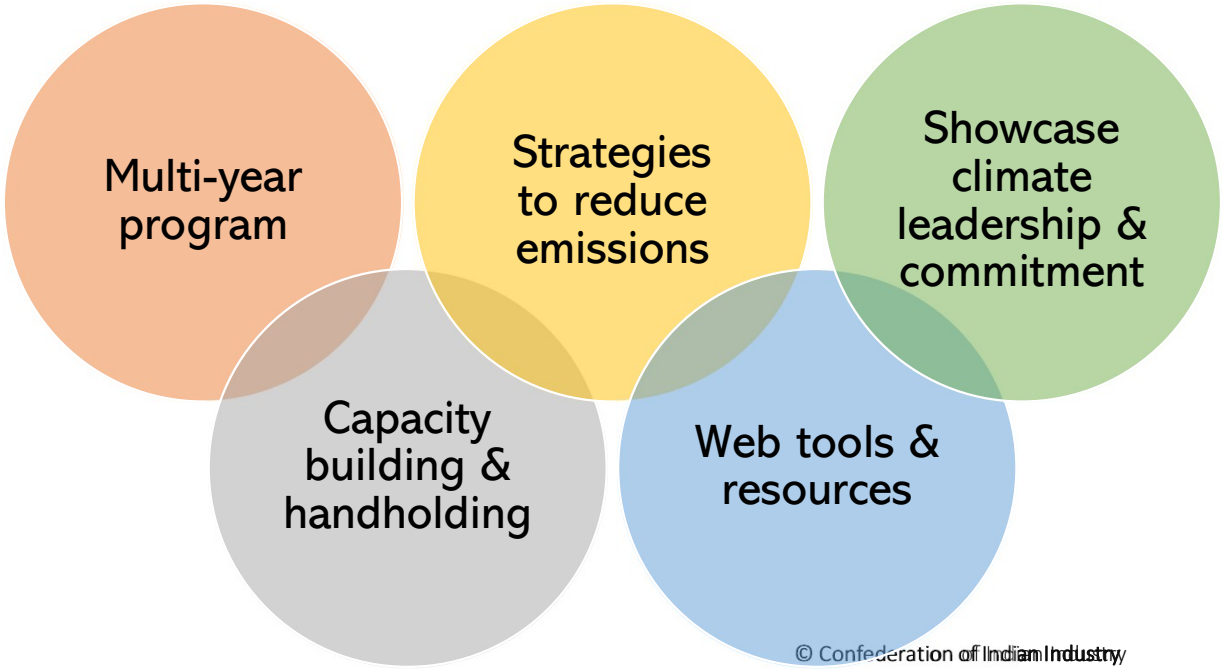
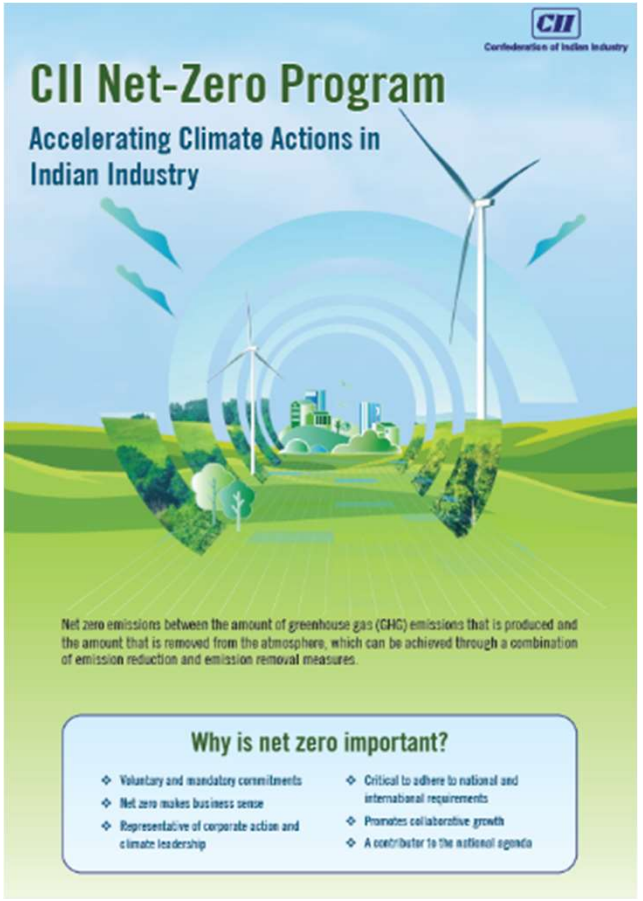
"Steer decarbonization pathways by enabling corporates & organizations to commit and accelerate actions towards Net - zero emissions"





Scope 1 & 2 – Transition towards net zero emissions

Scope 3 – Pathways for supply chain GHG emissions management

SAGAR CEMENT

Galaxy
Global Supplier to Global Brands

CUMI CARBORUNDUM UNIVERSAL LIMITED

NUVOCO
Shaping a new world

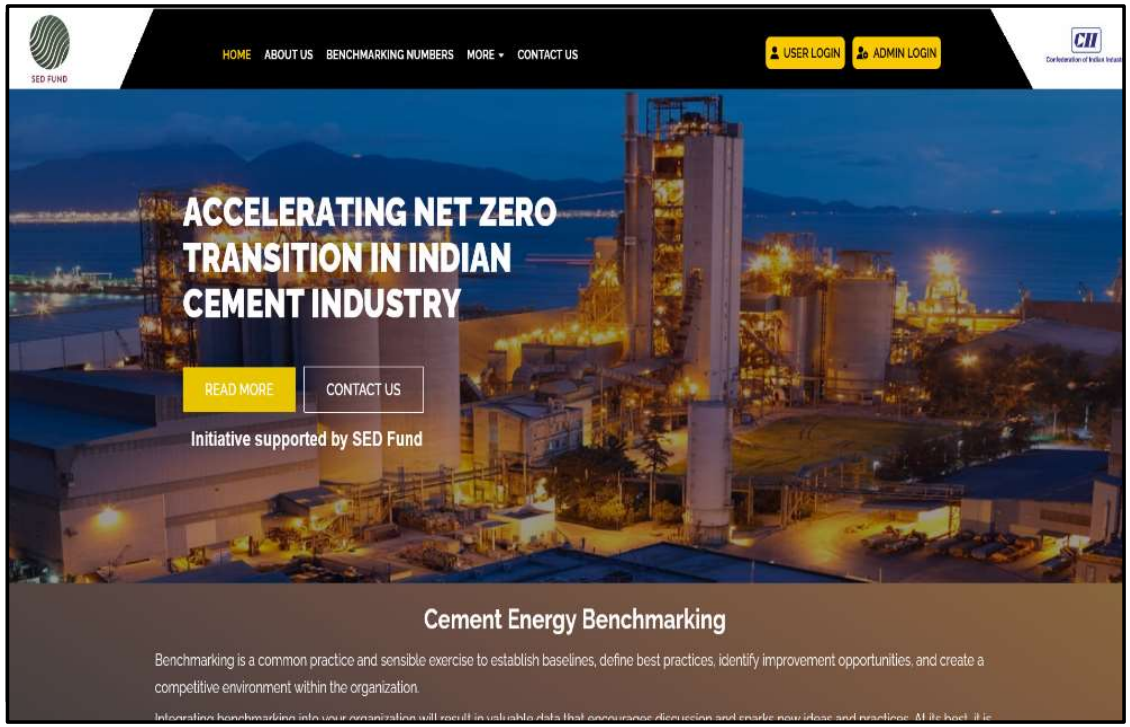
Facilitating the ecosystem for use of Application Specific Cement in India

- **Developing framework for use of application specific cement**
- **Development of a White paper - selected application specific cement like Portland limestone cement, LC3 cement, cement with C&D waste content etc. and their potential usage in India**
- **Development of training materials/modules and dissemination among stakeholders**
- **Submission of proposal to decision makers**
- **Commitment from cement manufacturers for initial trail**

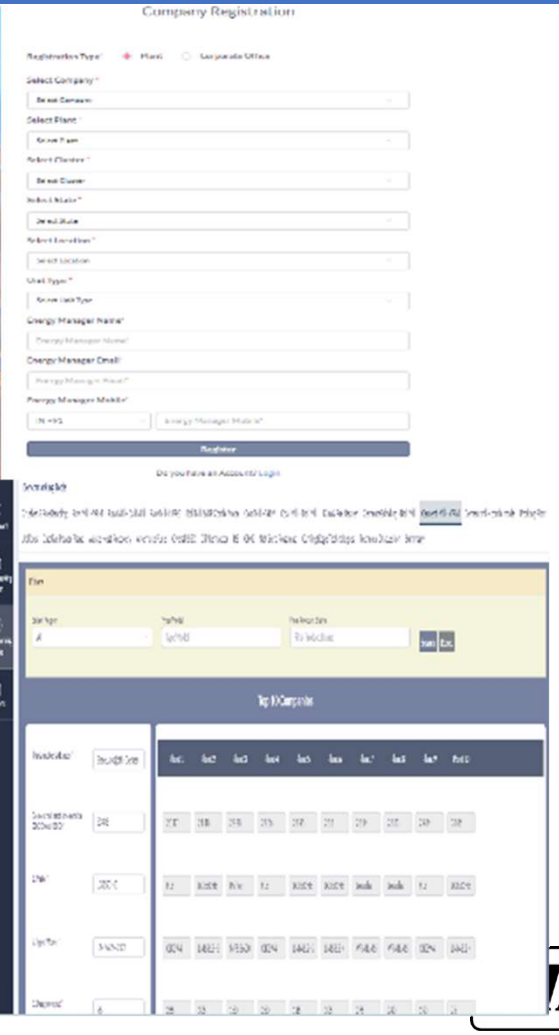
CII Energy Benchmarking for Cement Industry

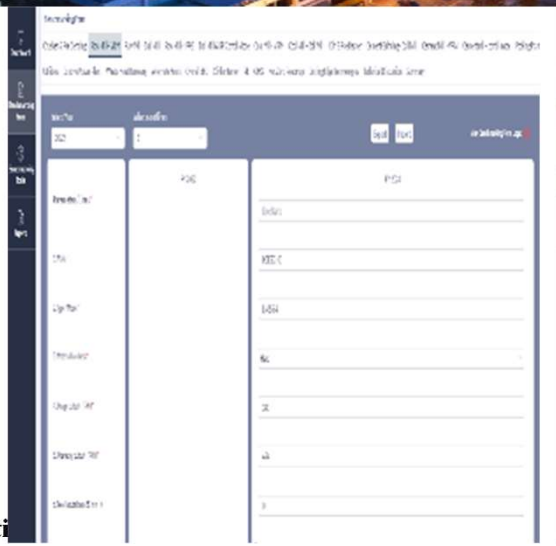
- Offline – Publication:
  - Data collected from 60+ Best Operating Cement Plants of India
  - 50+ Energy Indicators , 300 + best practices
  - 100+ Monitoring Parameters & Case studies

- Online Platform for real-time analysis
  - First of its kind in the world
  - www.ciicementbenchmarking.org
  - Compare plants at various levels:
    - Country Top-10
    - Cluster Top-10
    - Technology Top-10



Cement Benchmarking Webtool - **“First of its kind in the world”**





http://ciicementbenchmarking.org

- Webtool was launched during Green Cementech 2023
- Developed on 5 levers of LCTR
- Information on the latest specific energy consumption (SEC) numbers, latest technologies & best practices

Step 1 : Compare with Peers, considering technology, age, capacity

Table 5: The performance of top 10 plants in Specific heat consumption

Sr. No.	Section	Unit	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Plant 10
1	Thermal SEC	kCal/kg Clinker	675	676	682	682	683	683	685	686	688	689
2	No of Stages	No	6	6	6	6	6	5	6	6	6	6

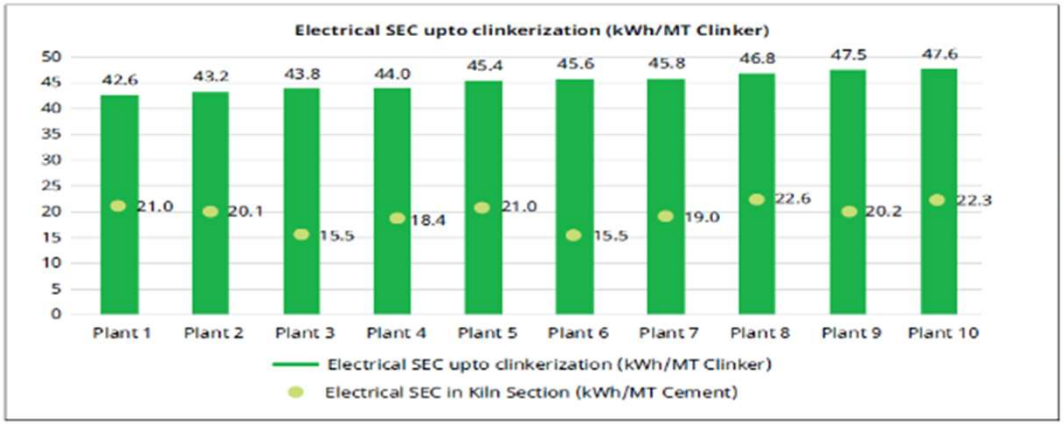
Table 6: The performance of top 10 plants in Specific Electricity consumption up to Clinkerisation

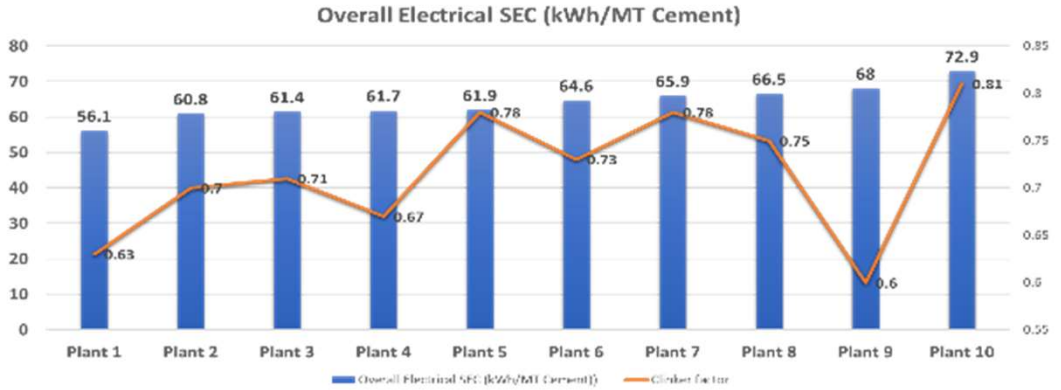
Sr. No.	Section	Unit	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Plant 10
1	Total SEC up to Clinkersiation	kWh/MT Clinker	42.59	43.18	43.81	43.96	45.40	45.60	45.78	46.81	47.51	47.60

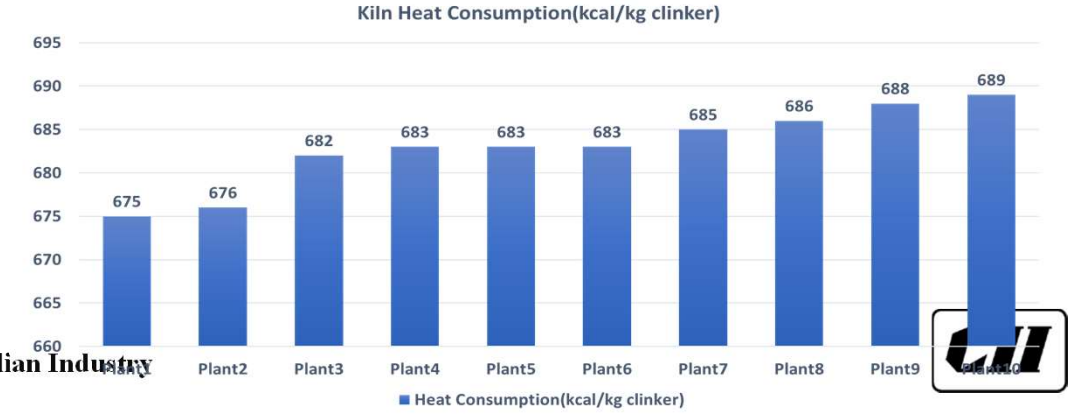
Step-2 : Macro Level Analysis

Overall Improvement Journey of Indian Cement Industry in last 9 years

S.No	Plant Section	Unit	2014	2023	Improvement (%)
1	Crusher	kWh/MT Limestone	0.7	0.57	19.0
2	Raw Mill VRM	kWh/MT Raw meal	13.3	10.64	20.0
3	Thermal SEC-5 Stage	kcal/kg Clinker	707	683	4.0
4	Thermal SEC-6 Stage	kcal/kg Clinker	686	675	1.6
5	Overall SEC up to clinkerization-6 Stage	kWh/MT Clinker	46	42.6	7.4
6	Pressure drop across 6 stage preheater	mmWc	450	350	22.3
7	Cement mill VRM (PPC)	kWh/MT Cement	21	18.6	11.5
8	TSR improvement – best achieved values	%	21	30	42.9
9	Total WHRS installation in India	MW	240	840	250







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Step 3 : Performance analysis into further steps – component / area / major drive

4.2.1 SPECIFIC HEAT CONSUMPTION BREAKUP FOR PLANT 1 (675 kCal/kg Clinker)

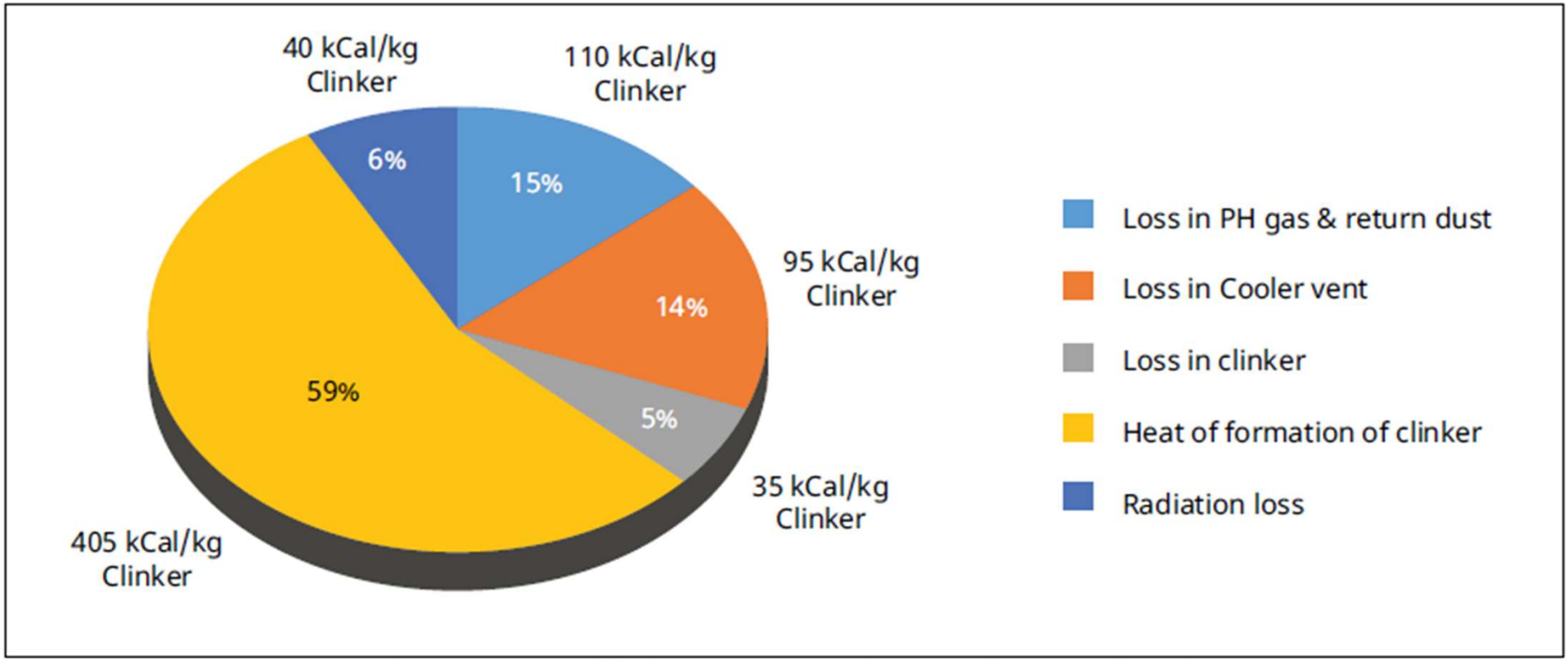

Figure 12: Specific heat consumption Breakup for plant 1

Table 21: Benchmarking of Pyrosection-Without WHRS Circuit

Sr. No.	Parameter	Unit	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8
1	Kiln section SEC	kWh/MT Clinker	15.5	18.5	20.1	20.2	20.8	22.6	23.1	24.0
2	Thermal SHC	kCal/kg Clinker	675	710	722	682	690	713	790	760
3	Electrical SEC upto Clinkersiation	kWh/MT Clinker	43.8	51.0	48.9	43.2	48.8	46.8	49.5	50.8
4	Kiln output rated	TPD	6,600	10,000	4,500	5,500	4,200	5,500	3,800	4,400
5	Kiln output operating	TPD	6,792	9,000	6,000	7,200	4,622	6,700	4,500	4,300
	PREHEATER SECTION									
1	PH type (ILC/SLC)		ILC	ILC	ILC	ILC	ILC	ILC	ILC	ILC
2	No of PH strings	Nos.	2	4	1	2	1	2	1	1
3	No of stages	Nos.	6	6	5	6	6	6	5	5
4	PH / Calciner exit O_2 & CO	%	1.6	2.0	Calciner-1% PH Exit -2.5%	Calciner exit O_2-1% PH exit O_2 3.3%	2.2-2.8	3.5	1.5	3.8
5	PH exit/top cyclone outlet temp	°C	260	257	300	275	272	270/275	315	368
6	PH exit/top cyclone outlet pressure	mmwc	-360	-468	-630	-565	-545	-580/-650	-610	-565
7	PH top cyclone efficiency	%	96	95	94	95	95	93	92	90
8	PH fan inlet flow	Nm^3/kg Clinker	1.5	1.4	1.6	1.4	1.4	0.74/0.75	1.7	1.4
9	PH fan speed control type	GRR/ SPRS/VFD	VFD	VFD	VFD	SPRS	VFD	GRR/SPRS	VFD	SPRS
10	PH fan inlet damper open position	%	100	-	-	100	100	100	-	100
11	PH fan operating efficiency	%	82	75	77	85	85	68/74	79	61
12	PH Fan inlet pressure	mmwc	-375	-480	-667	-596	-545	-650/-700	-685	-985
13	False air across PH	%	8	9	5	-	7	8	6	8
	KILN SECTION									
14	Kiln inlet pressure	mmwc	-21	-30	-45	-	-35	-50	-45	-25

Step 4 : Parameter wise

Table 21: Benchmarking of Pyrosection-Without WHRS Circuit

Sr. No.	Parameter	Unit	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8
15	Kiln Bag house flow	Nm^3/kg Clinker	1.7	1.8	2.6	1.8	1.6	1.5	2.4	1.8
16	Kiln Bag house speed control type	GRR/ SPRS/VFD	VFD	VFD	VFD	SPRS	VFD	GRR	VFD	VFD
17	Kiln Bag house damper open position	%	100	-	-	100	100	100	-	100
18	Kiln Bag house fan operating efficiency	%	77	75	66	67	67	50/56	62	65
19	Kiln Bag house Fan inlet pressure	mmwc	-170	-154	-160	-195	-	ESP Fan: -50	-160	-178
20	Kiln Bag house Pressure drop	mmwc	110	110	120	105	100	125	90	90
21	Kiln size	Dia(m) × length(m)	5 × 78	5.80 × 85	4.35 × 67	4.75 × 74	4.15 × 64	4.75 × 74	3.95 × 63	4.57 × 67.07
22	Kiln Volumetric loading	TPD/ m^3	5.6	4.5	7.3	6.5	6.8	6.2	7.5	4.8
23	Kiln Thermal loading	MkCal / hr /m^2	4.6	4.7	5.9	4.8	5.1	4.8	3.4	3.3
24	Kiln percentage filling	%	12	14	15	15	15	-	16	13

COOLER SECTION										
1	Cooling air flow	Nm^3/kg Clinker	1.7	1.8	1.6	1.5	1.6	1.75	2.0	1.7
2	Cooler vent flow	Nm^3/kg Clinker	0.9	1.1	1.1	0.7	0.7	-	1.2	0.9
3	Pressure Drop Across Cooler ESP	mmwc	50	40	40	50	15	-	40	10
4	Cooler ESP Fan efficiency	%	69	40	55	70-75	52	-	50	72
5	Clinker temp at cooler exit	°C	200	-	168	150	185	180	80	175
6	Cooler Grate Loading	TPD/m^2	47	-	51	50	46	-	38	41
7	TAD temperature	°C	920	945	931	950	1,025	900	990	871
8	Temperature Drop Across TAD	°C	30	75	80	25	20	-	60	80
9	Cooler water spray	m^3/hr	10	-	7	20	8.5	19.5	-	4.8
10	Coal Phase density – PC firing	kg Coal / kg Air	3.0	3.0	3.0	4.5	1.6	-	2.8	3.9

Table 21: Benchmarking of Pyrosection-Without WHRS Circuit

Sr. No.	Parameter	Unit	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8
11	Coal Phase density – Kiln firing	kg Coal / kg Air	2.7	1.6	2.0	4.8	2.7	-	1.7	3.2
12	Kiln Thermal SEC	kCal/kg Clinker	675	705	722	682	690	713	790	760
13	Loss in PH gas	kCal/kg Clinker	140	121	161	142	132	140	178	172
14	Loss in Cooler vent	kCal/kg Clinker	95	94	96	87	78	62	132	93
15	Loss in clinker	kCal/kg Clinker	25	33	31	33	38	22	18	37
16	Loss in cooler water spray	kCal/kg Clinker	0	29	20	20	21	33	0	19
17	Heat of formation	kCal/kg Clinker	405	410	412	412	399	416	412	406
18	Radiation loss	kCal/kg Clinker	40	54	48	38	50	40	50	52
19	Type of burner		Duoflex	Pyrojet	Pyro-Jet BURNER	KHD Pyrojet low NO_x burner	Duoflex	-	-	PyroJet -BS-1
20	Burner Capacity	MW	119	-	89	98	73	-	58	61

- **Step 4 : Parameter wise**
- **Step 5 : Identify opportunity areas, potential, possible solutions**
- **Step 6 : Evaluate savings, economics, time frame**
- **Step 7 : Facilitate Implementation**

Table 12: Alternative Fuel Utilization of Top 10 cement plants

Sr. No.	Type of alternative fuels (AF)	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Plant 10
	Overall thermal substitution%	30.0	21.0	19.6	19.0	16.6	15.4	15.3	15.1	15.1	14.0
1	MSW (RDF)	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
2	Paint sludge	-	-	-	-	✓	-	-	-	✓	-
3	Rice husk	✓	-	-	-	-	✓	-	-	✓	-
4	Carbon black	✓	✓	✓	✓	✓	-	✓	-	✓	-
5	Plastic	-	✓	✓	✓	✓	✓	-	-	-	✓
6	Solid waste	✓	-	✓	✓	✓	-	-	✓	-	-
7	Dolachar	✓	-	-	-	-	-	-	✓	-	-
8	Liquid Waste	-	-	✓	✓	-	✓	✓	✓	-	✓
9	Others (Biomass, waste, & Organic)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Suggestions to make best use of this trg prog

- Introduce your self – Network and stay connected
- Participate in discussion, specific doubts / inputs
- Share your Best practices, provide ways to contribute
- It is a beginning; we need to keep learning continuously
- CII family will be happy facilitate, support and learn together

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