

ENERGY EFFICIENCY BENCHMARKING FOR CEMENT INDUSTRY- IMPROVEMENT OPPORTUNITIES

7th & 8th July'16, at My Home Industries Pvt.
Ltd., Mellacheruvu



Confederation of Indian Industry



**Knowledge Exchange
Platform**

Transmitting Knowledge through Best Practices

ENERGY IS LIFE



SEC reduction – CII Experiences

	Electrical SEC reduction range	Thermal SEC reduction range
Reduction in 2014-15 (%):	0.00 – 6.581 Average – 2-3%	0.00-4.40 Average – 1-1.5%
Average reduction % (last 3 yrs):	0.00-8.712	0.00-2.55
Average yearly reduction % (for 40+ cement plants)	2.04	0.831

PAT GTG Energy Reduction

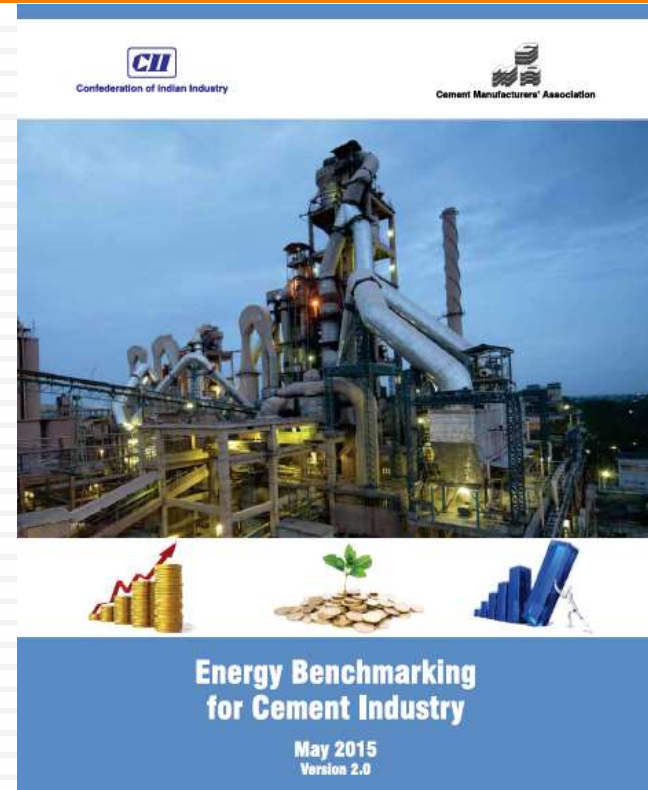
- ❖ Escerts gain (PAT cycle -1) – 50,000 +
- ❖ Main factors for achieving target
 - Improvement in clinker factor
 - ❑ From 0.741 to 0.640 in PPC
 - ❑ Flyash % : From 23% to 32.5 %
 - Reduction in energy consumption by various energy conservation measures
 - ❑ Clinkerization : 55.4 kWh/Mt clk to 52.3 kWh/MT clk
 - ❑ Cement grinding: 27.7 kWh/MT to 26.1 kWh/MT cement
 - ❑ Thermal: 714 kcal/kg clk to 705 kcal/kg clk
 - ❑ CPP heat rate: 3169 kcal/kWh to 3036 kcal/kWh
 - ❑ AFR utilization Increased by 4% +

Approach #1

Energy Benchmarking

Energy Benchmarking - Objective

- ❖ Awareness and identification of Best Available Technologies & Best Practices
- ❖ Assess our own energy performance
- ❖ Comparison with peers
- ❖ Identify gaps and possible solutions
- ❖ Formulate the strategies
- ❖ Monitor key parameters to maintain and sustain benefits

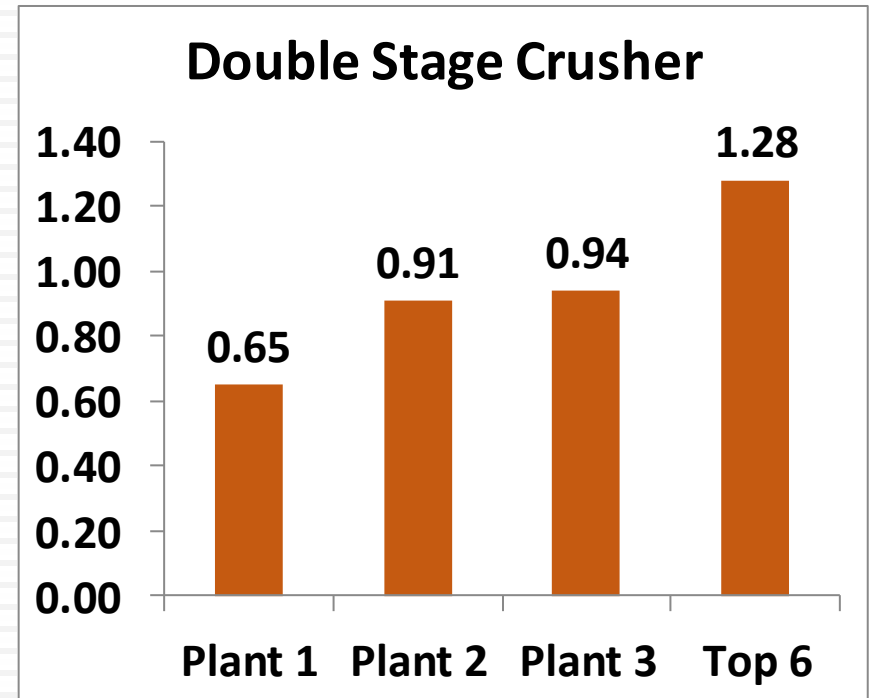
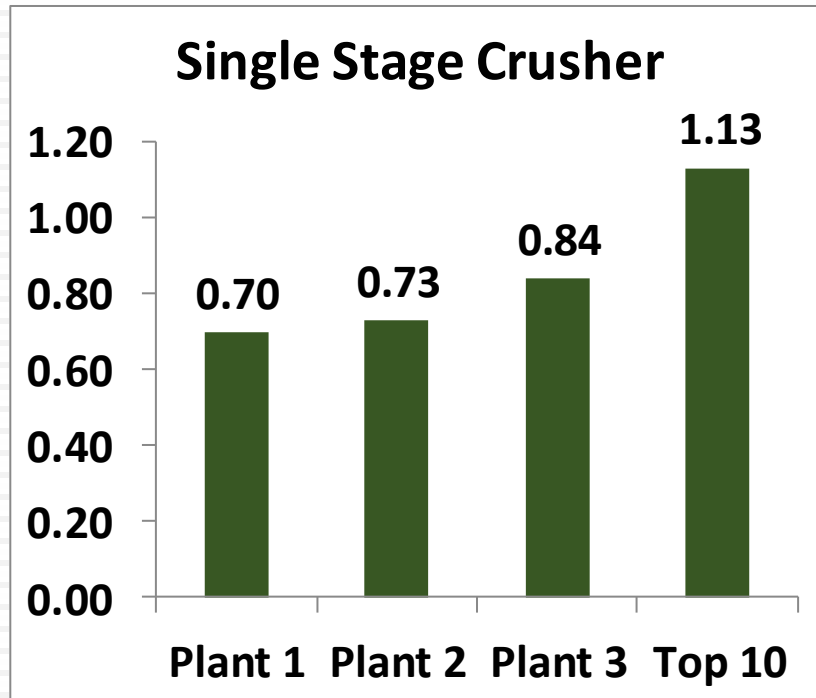


CII EE Benchmarking Manual contains...

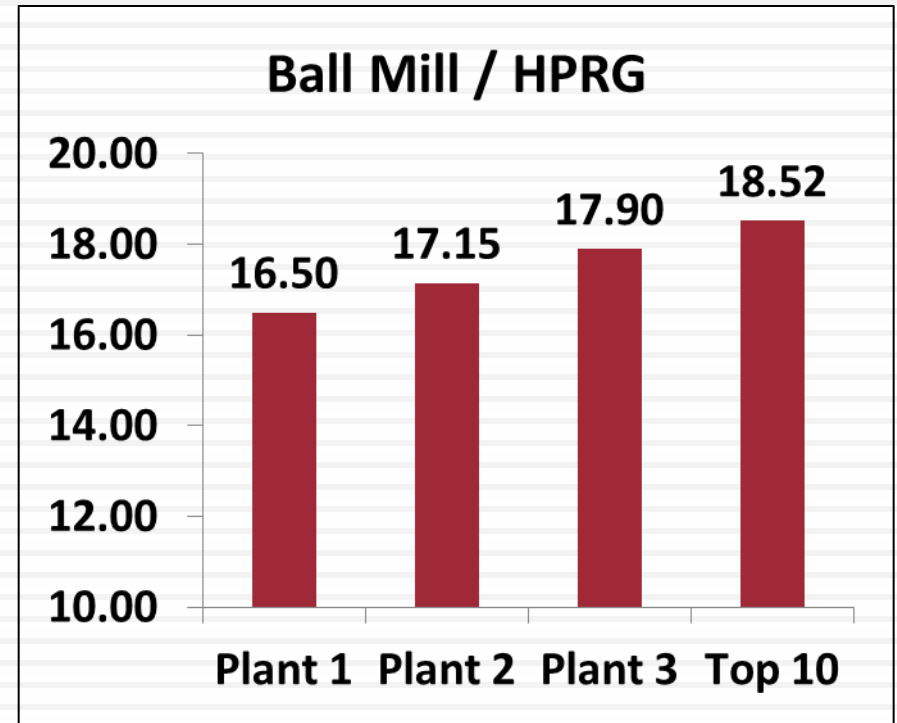
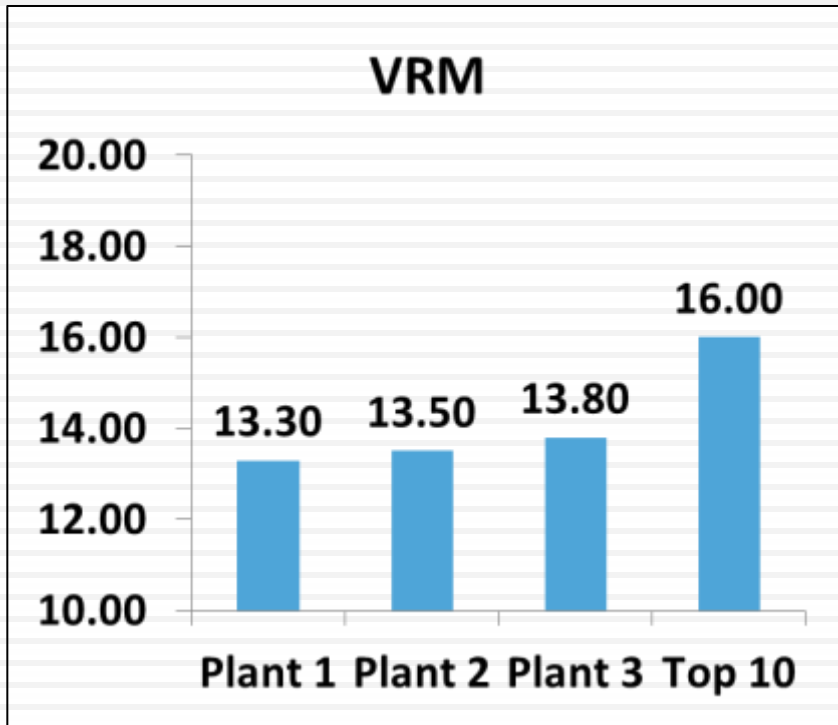
1. Performance of Top 10 Plants : Section wise & Technology Wise
2. Analysis and Potential areas of improvement with cost economics
3. Case studies to bridge the gap
4. 50 Energy Indicators – Islands of Excellence
5. 325 Best Practices
6. 139 Monitoring Parameters to achieve EE

Benchmarking is Dynamic : It is highly possible that few plants may operate energy levels lower than best values mentioned in this manual !!!!!

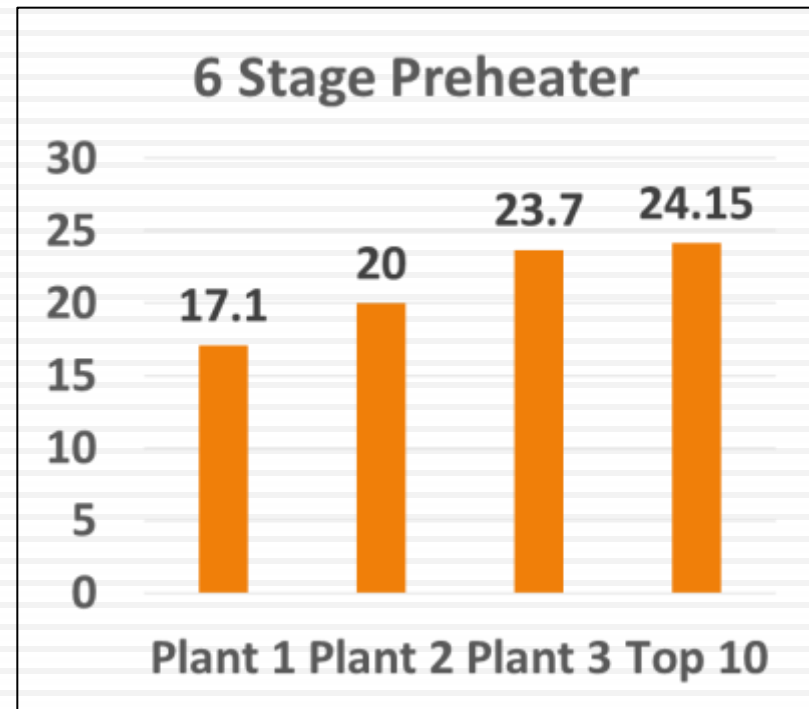
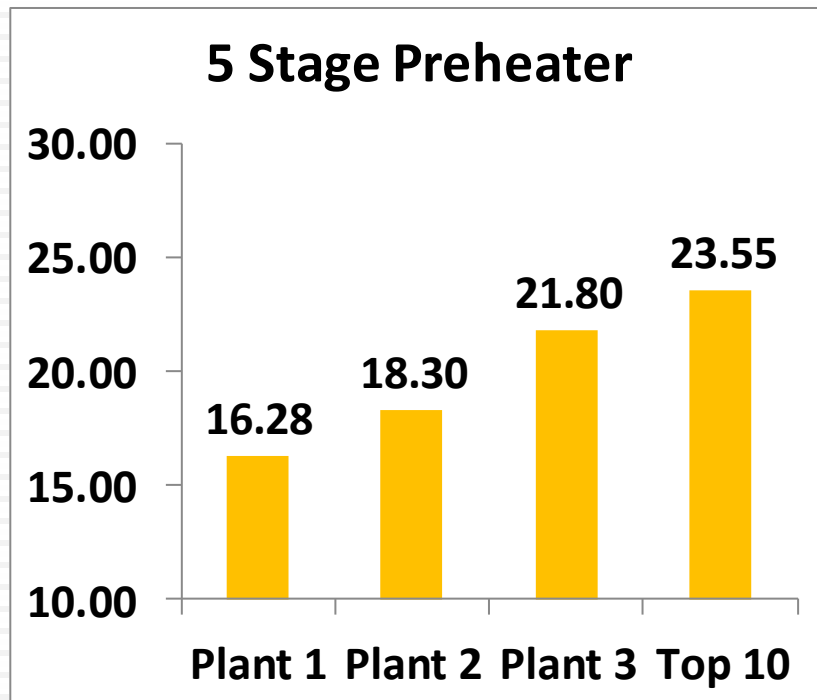
Crusher SEC : kW / MT Material



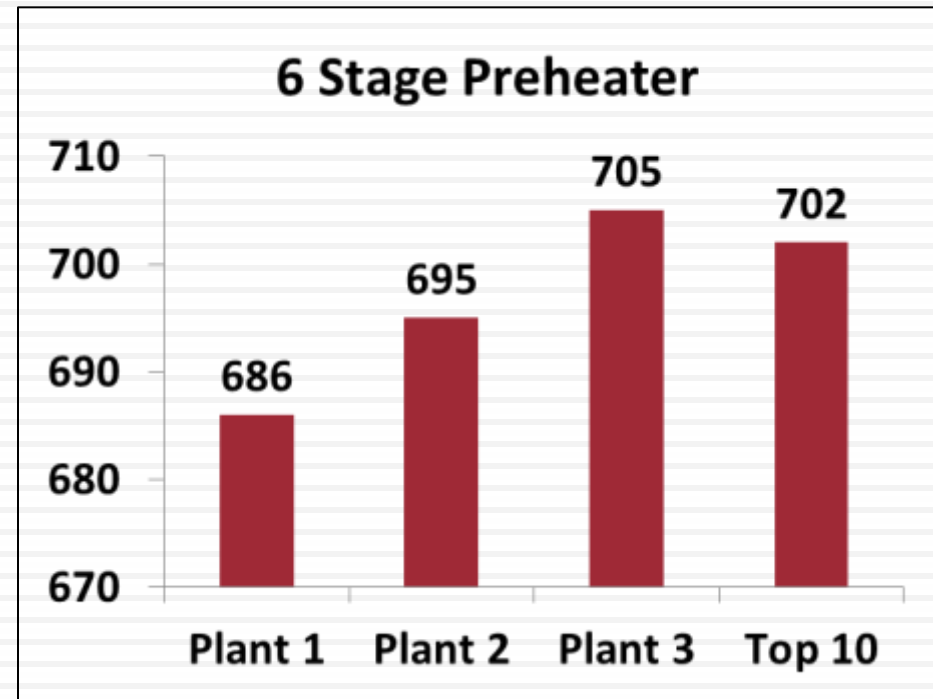
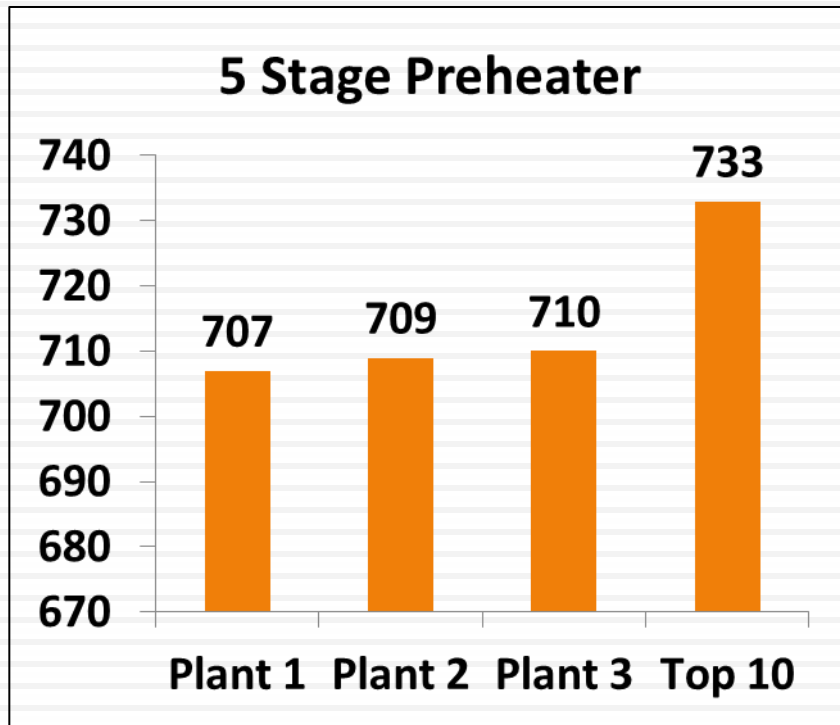
Raw Mill SEC : kW / MT Material



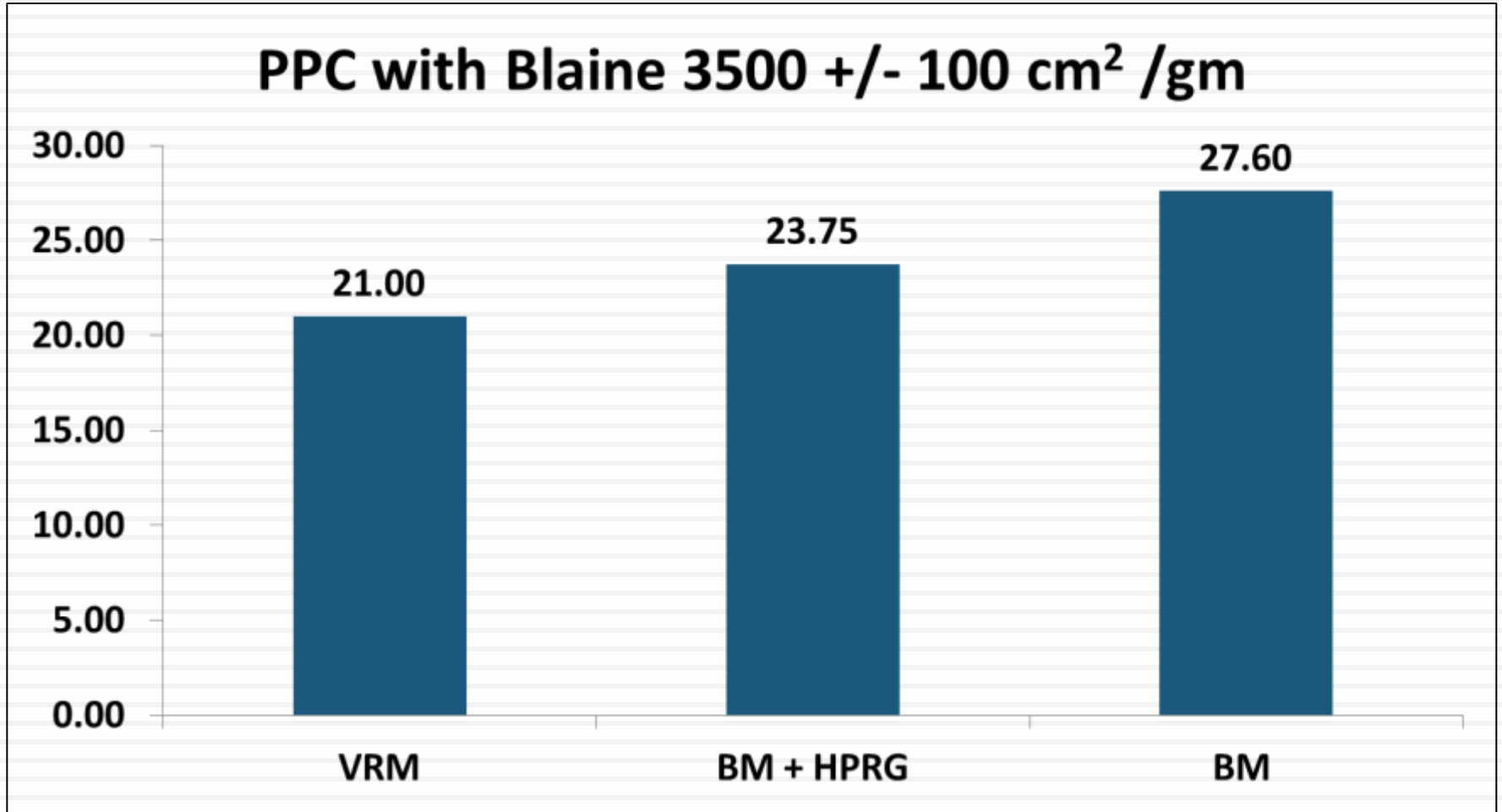
Pyro Section SEC : kW / MT Material



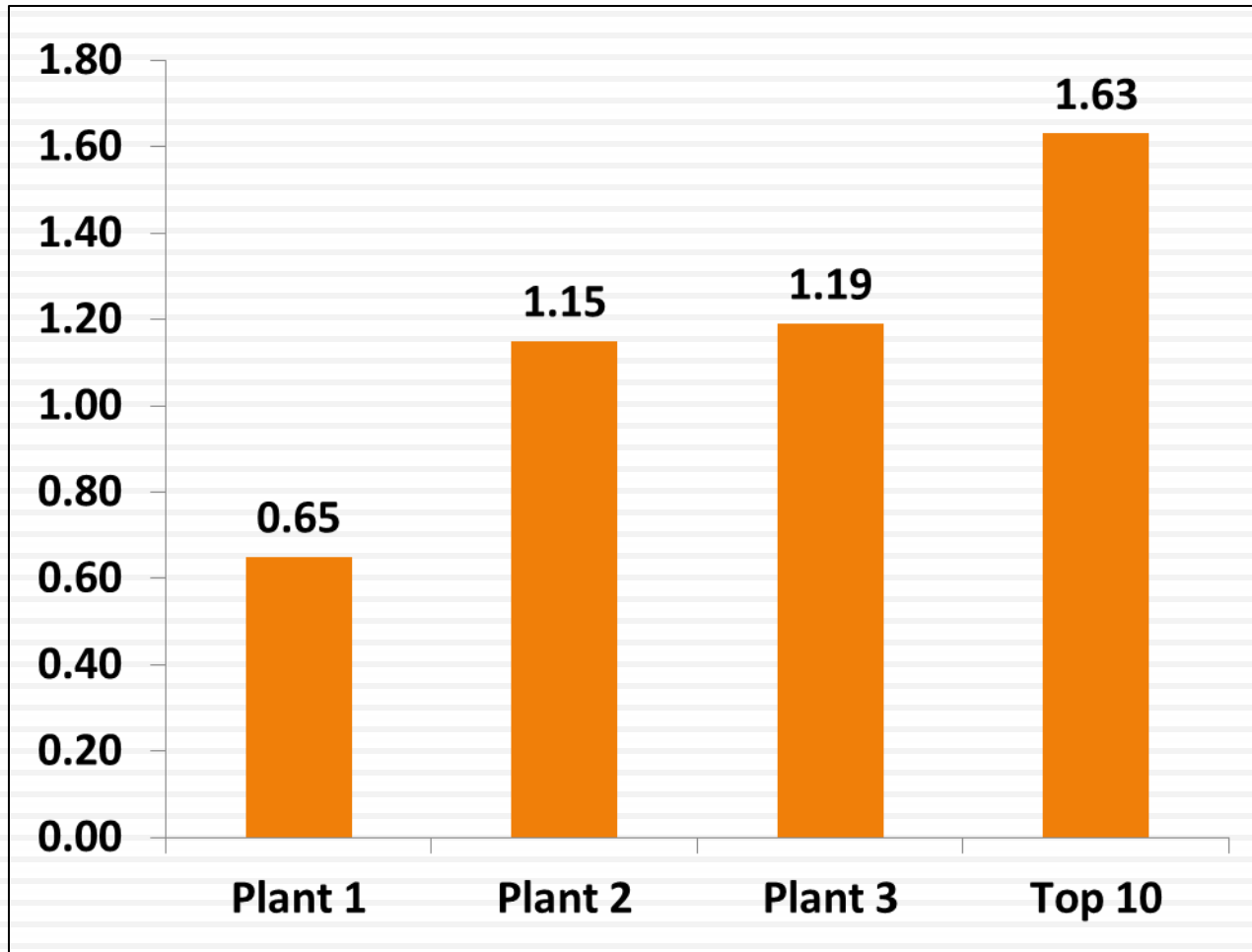
Thermal SEC: kcal/ kg Clinker



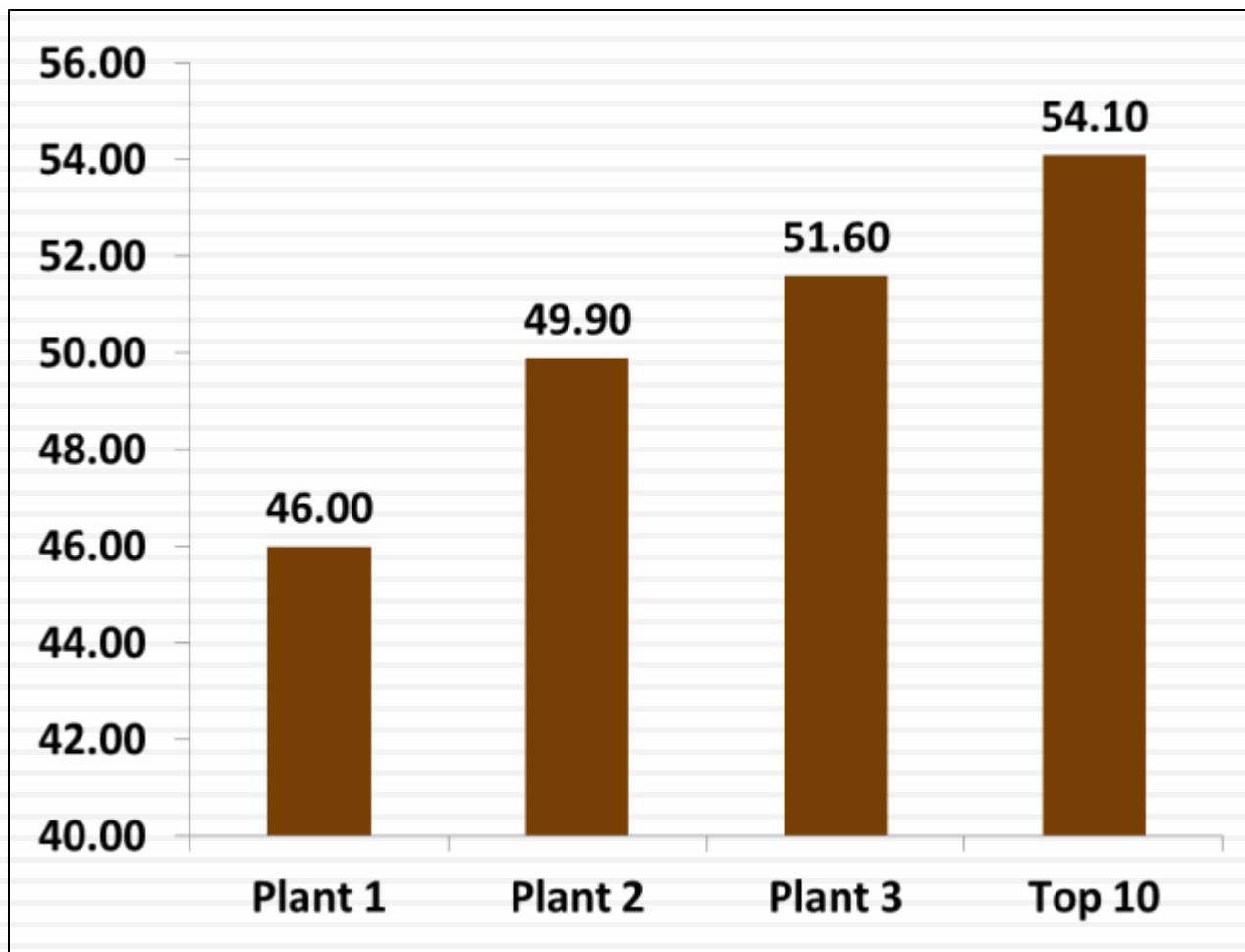
Cement Grinding SEC : kW / MT Material



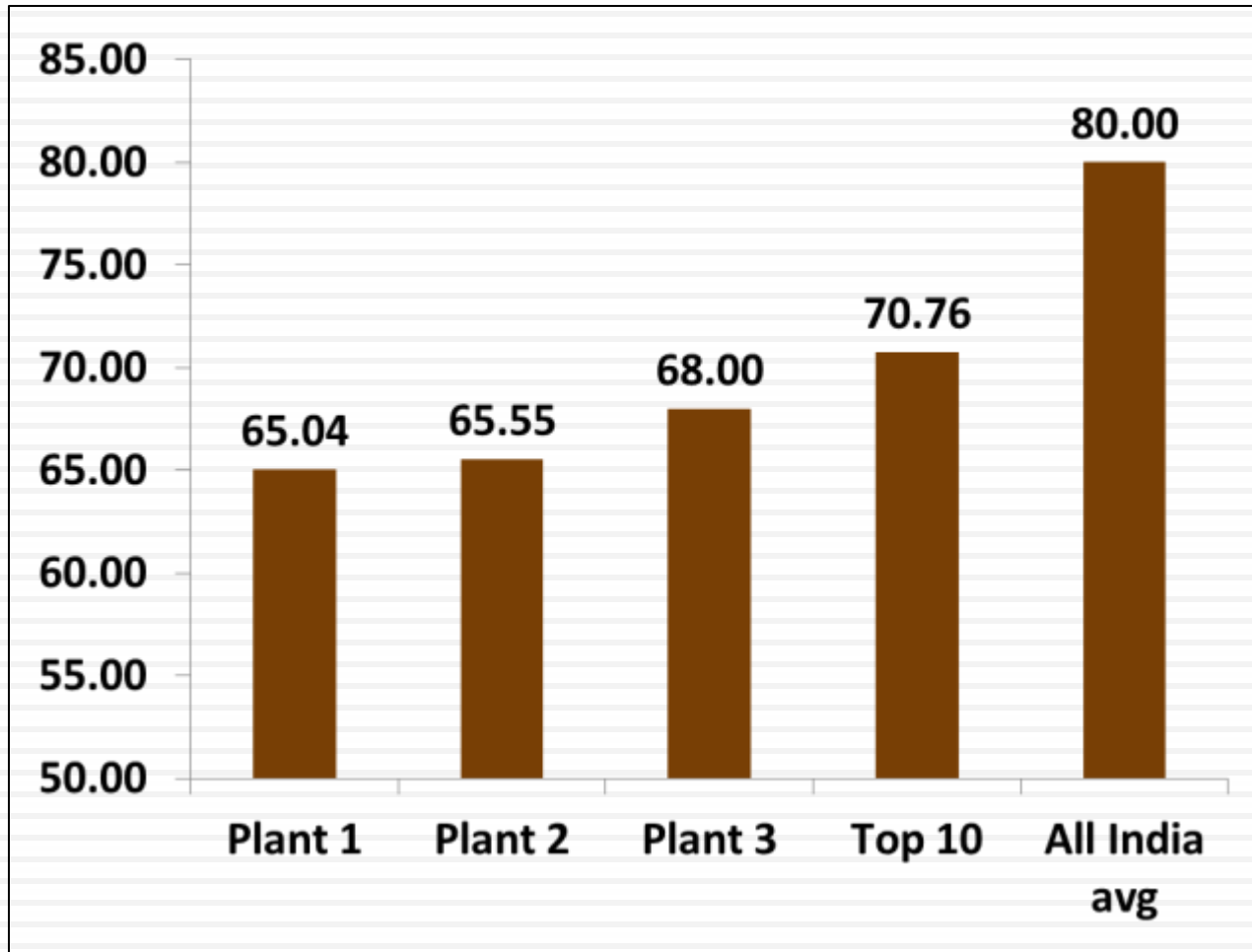
Packing SEC : kW / MT Material



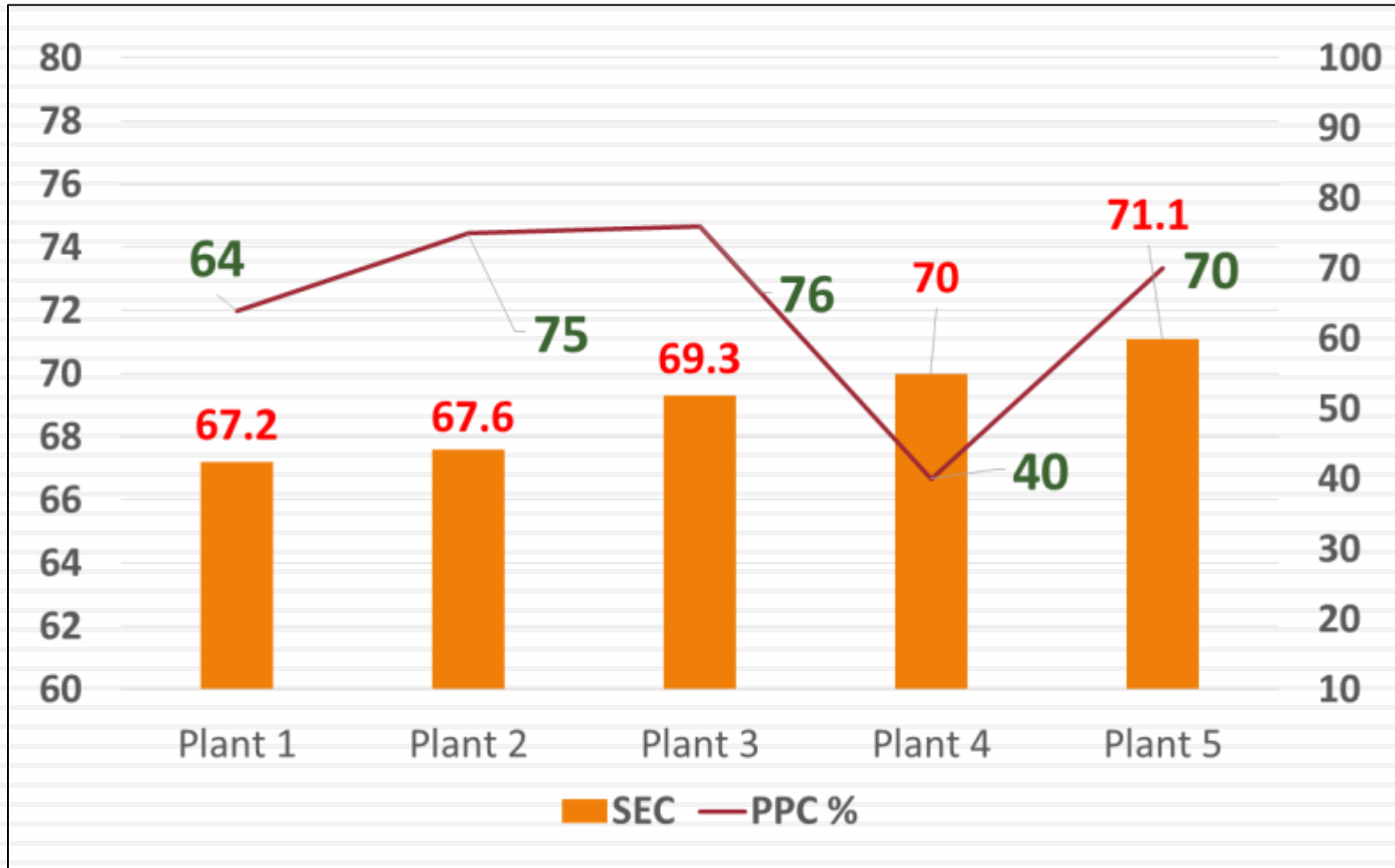
Electrical Energy – Upto Clinkerisation SEC : kW / MT Clinker



Electrical Energy – Overall SEC : kW / MT cement



Overall SEC kW / MT Cement- CII Energy Award 2014-15



Best Number possible with BAT- kW / MT OPC

SL No	Section	kW / Material	kW / MT Cement	kW / Material	kW / MT Cement
		5 Stage PH		6 Stage PH	
1	Crusher	0.7	1.03	0.7	1.03
2	Raw Mill - VRM	13.3	18.95	13.3	18.95
3	Coal Mill – VRM	23.9	2.97	23.9	2.97
4	Pyro	16.28	15.47	18.7	16.25
	Up to Pyro		38.42		39.20
5	Cement Mill VRM	21.00	21.00	21.00	21.00
6	Packing	0.65	0.65	0.65	0.65
7	Misc.	2.00	2.00	2.00	2.00
	Overall		62.07		62.85

Islands of Excellence

- ❑ PH fan lowest SEC – 3.88 kWh/MT clinker
- ❑ Lowest pressure drop in PH : 375 mmWc for 5 stage and 470 mmWc for 6 stage
- ❑ Fine coal phase density : 5.5 kg coal / kg air
- ❑ Lowest RM Cyclone pressure drop : 50 mmwc
- ❑ Lowest false air across RM circuit : 11%
- ❑ Lowest compressed air generation pressure for plant air requirement : 4.5 bar
- ❑ Lowest CA fan power : 1.2 kWh/Mt cement
- ❑ Lowest APC in CPP : 5.36%



Approach #2

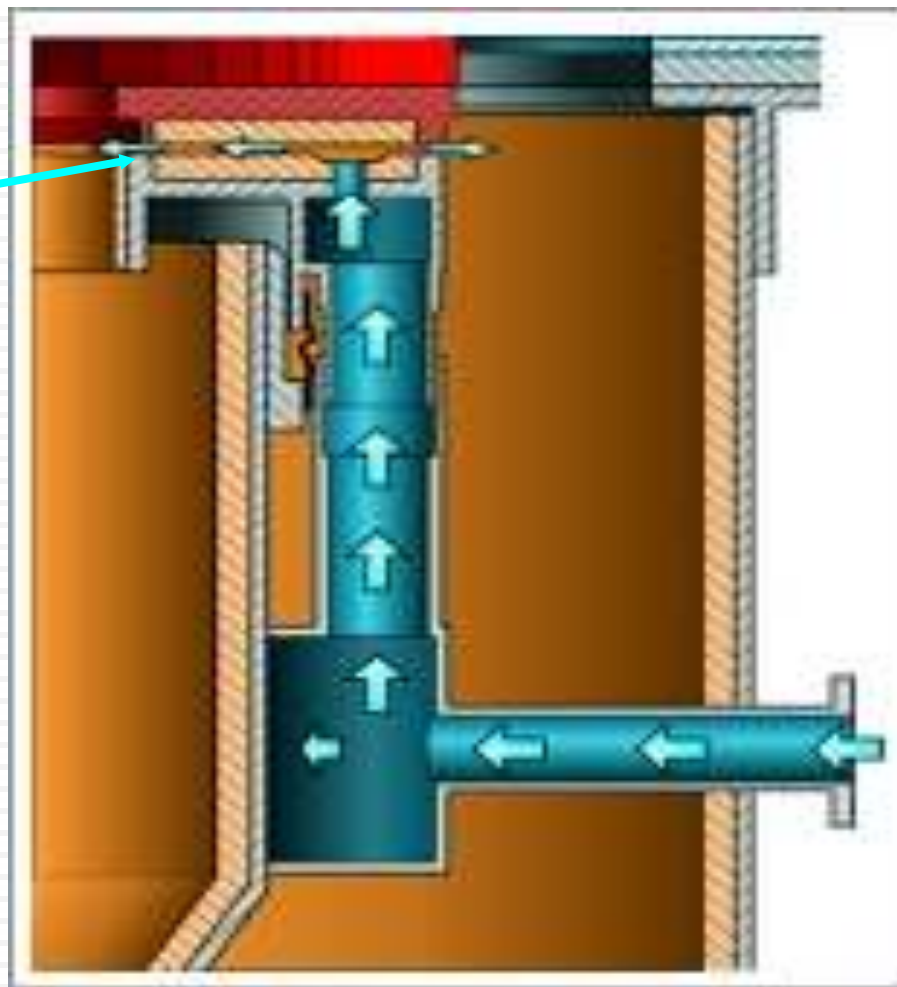
Innovative Projects to reduce SEC

CASE STUDY: Installation of High Efficiency Separators

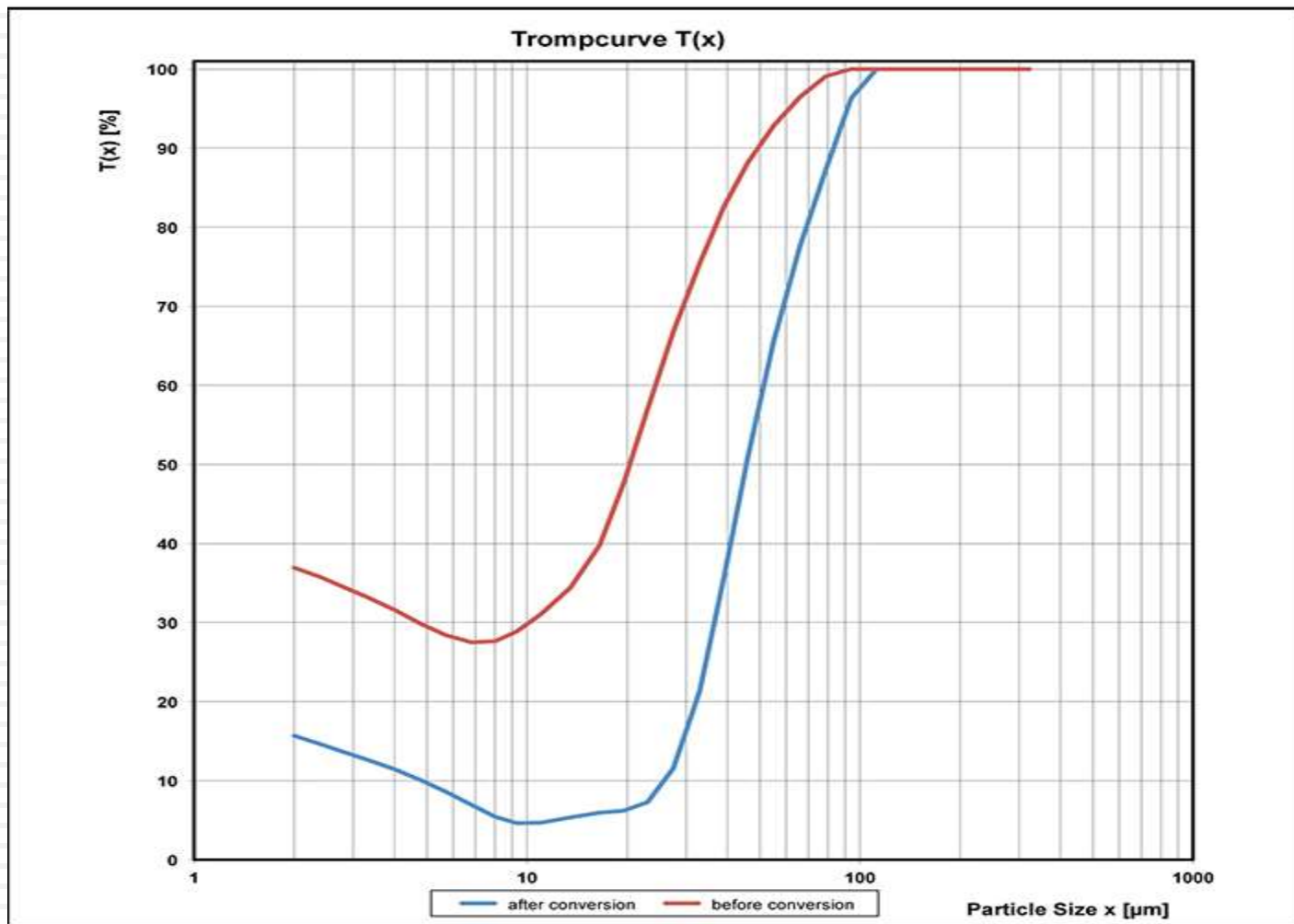
Seal Gap

Features:

Air is blown in this gap to avoid any bypass of coarse material to get into the fine product



CASE STUDY: Improving Separator Efficiency

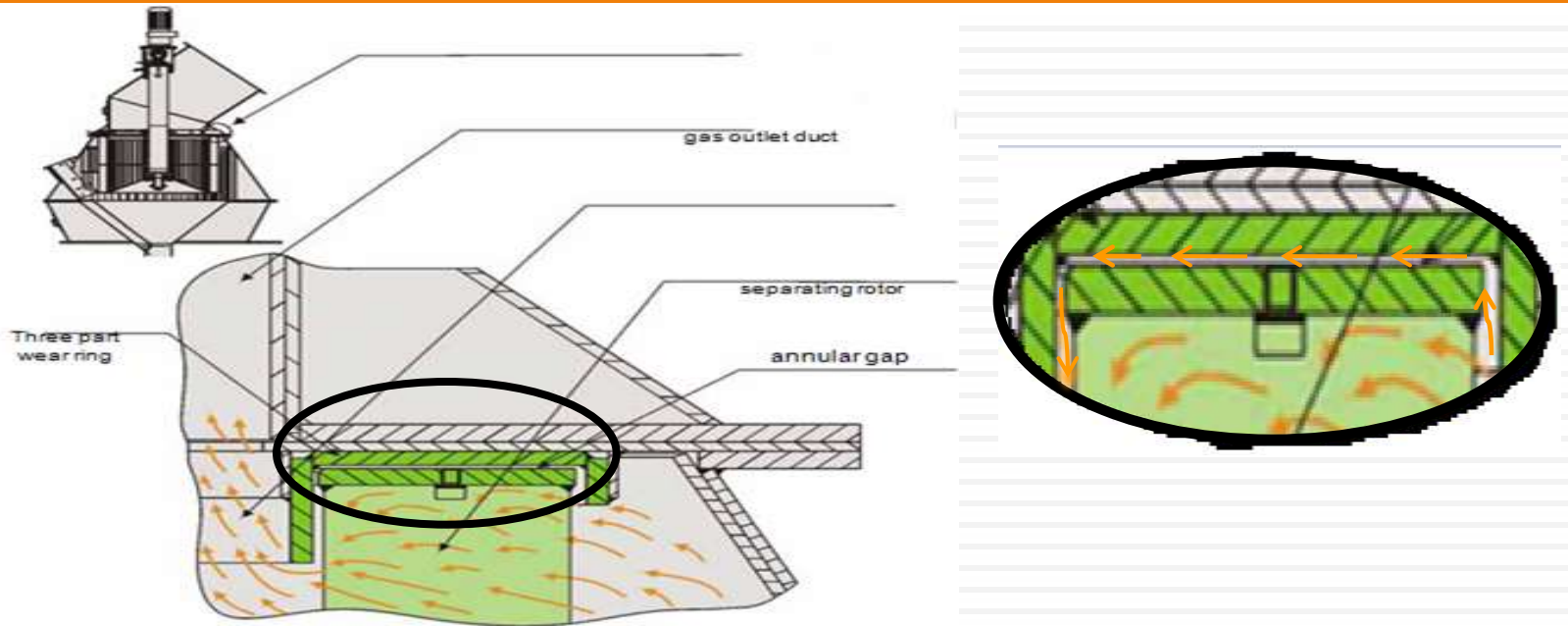


CASE STUDY: Improving Separator Efficiency

□ Benefits Achieved:

- Bypass is reduced from 28 % to 7 %.
- Production increase by 14 %
- Specific energy reduced by 13.8 %
- Blaine reduced from 3800 cm²/gm to 3600 cm²/gm
- Same early and final strength achieved with reduced blaine

Improving VRM classifier performance



Annular Gap between Dynamic seal and rotor to be close.

Additional Air – **“Sealing Air”** to be provided by a radial fan with a static pressure of 40 to 50 mbar to stop/direct passive particles

Saving & Benefits

Without seal air

Sep.speed (RPM)	Fan power (KW)	Main motor load (KW)	Grinding pressure (mbar)	Vibration	Feed (TPH)	Residue (212 μ)
80	834	1240-1260	120	3.8-4.2	170	4.6%

With seal air

Sep.speed (RPM)	Fan power (KW)	Main motor load (KW)	Grinding pressure (mbar)	Vibration	Feed (TPH)	Residue (212 μ)
80	820	1230-1250	120	3.8-4.2	175	3.6%

Through 4th Generation Classifier

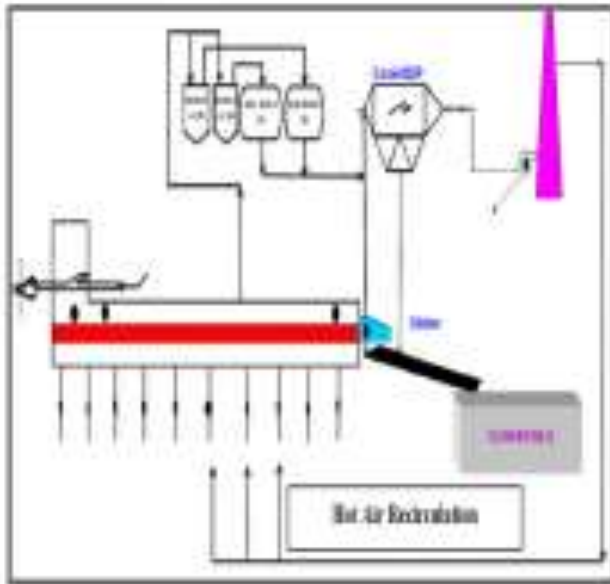
- Benefits in quality of raw mill product
- Power saving in VRM main fan & main drive
- Increase output of VRM

Through study we get that power saving of **30 kW/Hr** & Increase In production by **5 TPH**

Total Annual Savings – RS. 221 Lakhs

Cooler hot gas recirculation

- Recirculation of cooler stack hot air at 110-130°C inside cooler
 - Increase in steam generation
 - Increase in power generation



Boiler-A, B & C with hot air recirculation



Recirculation duct tapping from Stack



Entry at fan inlet

Cooler hot gas recirculation- J K Lakshmi Cement

With the use of waste hot air having temperature 110-130 deg.c to the cooler through Fan no. 6,7 and 8, we are able to produce 2.5 tph more steam contributing more green power generation.

Results-:

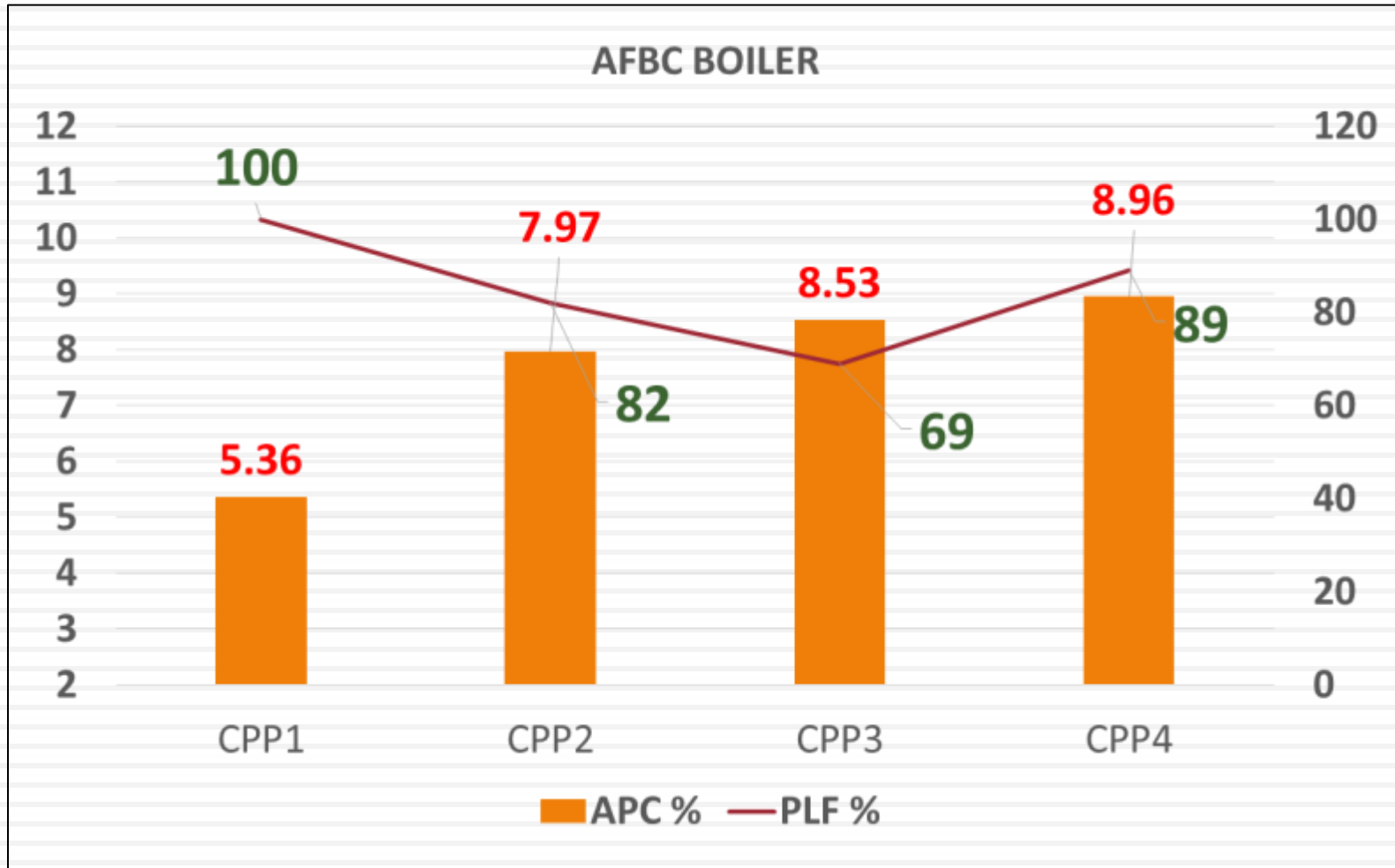
Parameters	Without Hot Air Recirculation	With Hot Air Recirculation
Total Steam Generation (TPH)	73.05	75.55
Net power generation (Units/day)	292153	300322

Increase in WHR power generation-: 8169 units/day

Approach #3

Performance Improvement in CPPs

CPP – APC % & PLF



APC % - Captive Power Plant Scenario

Sl. No	Operating Capacity, MW	APC %
Plant A	06	13.5
Plant B	15	9.82
Plant C	15	7.73
Plant D	15	7.57
Plant E	18	7.80
Plant F	25	8.15
Plant G	25	10.95
Plant H	27	7.69
Plant I	30	6.96
Plant J	33	11.0

Estimated potential available in Indian CPP

❖ Captive power plants

- ▣ APC % ranges : **5 – 12.5%**

- **Large Bandwidth**

❖ Example:

- ▣ Installed capacity : 34444.12 MW

- ▣ Operating Capacity : 27555.3 MW @ 80% PLF

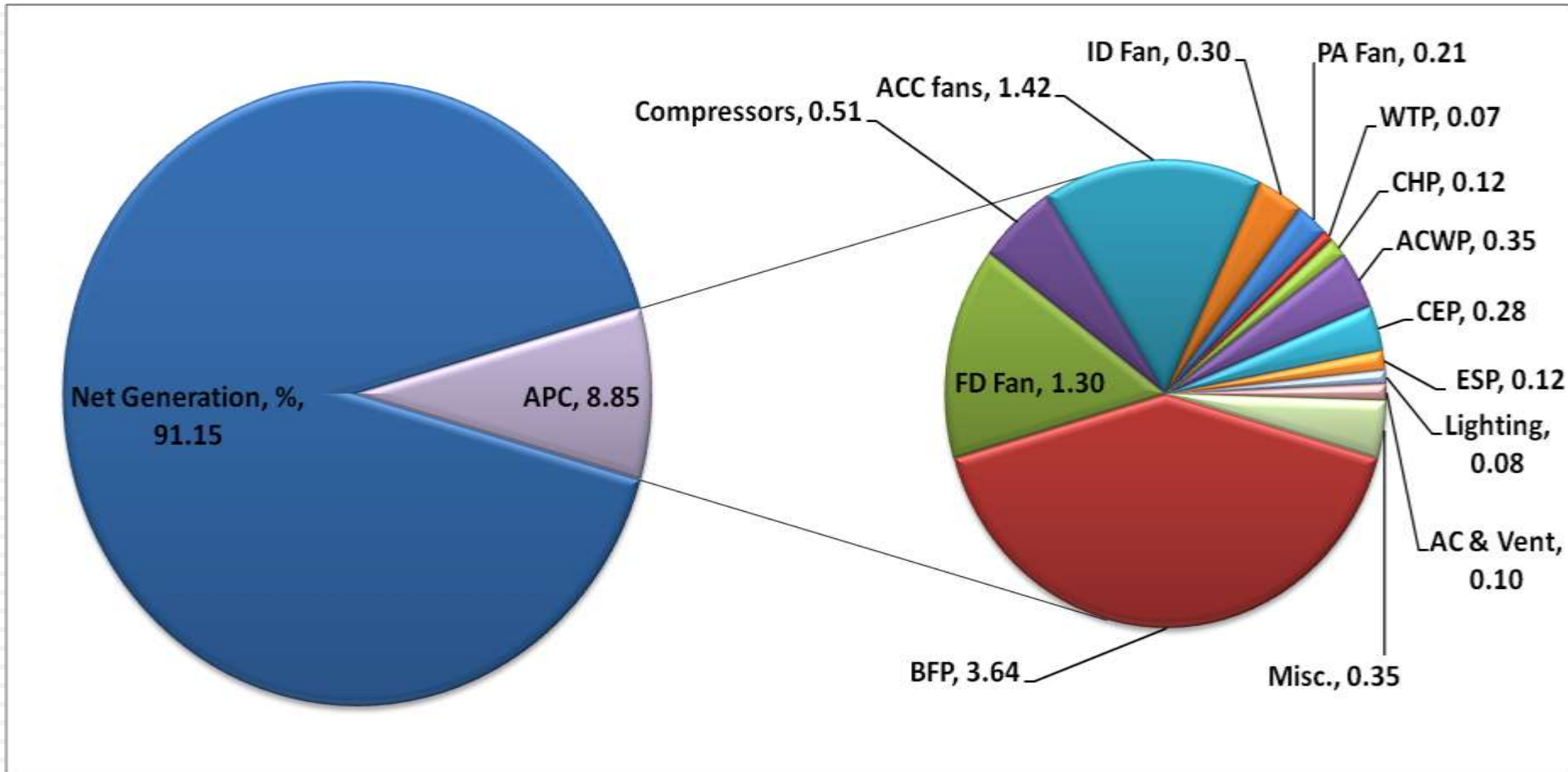
- ▣ APC power : 2342.2 MW @ 8.5% APC (average)

❖ At least 1% reduction in APC%

- ▣ Huge increase in the Net Power Generation

- **Approx. 275 MW**

Typical APC % Breakup



APC% Benchmarking - AFBC boilers

Sl. No.	Auxiliary Name	Specific Power Consumption, kW/MW
1	Fans (PA, SA, ID & ACC fans)	17.9
2	Pumps (BFP, CEP, & ACWP)	24.6
3	BOP (WTP, CHP, ESP, Lighting, AC, CHP, Compressors & Misc.)	11.1
	Total	53.6 (APC – 5.36%)

APC% Benchmarking - CFBC boilers

Sl. No.	Auxiliary Name	Specific Power Consumption, kW/MW
1	Fans (PA, SA, ID & ACC fans)	29.79
2	Pumps (BFP, CEP, & ACWP)	25.74
3	BOP (WTP, CHP, ESP, Lighting, AC, CHP, Compressors & Misc.)	9.83
	Total	65.36 (APC – 6.53%)



Approach #4

Innovative Ideas from Other Sectors

Shift-wise Energy Monitoring ...

COMMON GREASE LUBRICATION : Steam & Cond Totalizers

COMMON GREASE LUBRICATION:Str

STEAM & CONDENSATE TOTALIZERS

Input	Shift A Total	Shift B Total	Shift C Total	To Day Total	Today	Yesterday	Specific Consumptions	
LP Steam FT	19 TPH	153 Tons	32 Tons	0 Tons	185 Tons	194615 Tons	439 Tons	1.585 T/T
MP Steam FT	4.5 TPH	32.9 TONS	7.0 TONS	0.0 TONS	39.9 TONS	43499.9 TONS	93 Tons	0.370 T/T
Steam Profiler FT	0 TPH	0 Tons	0 Tons	0 Tons	0 Tons	7338 Tons	0 Tons	
Hood & PV FT	0 TPH	1 Tons	0 Tons	0 Tons	1 Tons	2764 Tons	2 Tons	
CONDENSATE	23.3 M3/Hr	186.1 M3	38.8 M3	0.0 M3	224.9 M3	280629.6 M3	520 m³	
NEW CONDENSATE	23.1 M3/hr	185.8 M3	38.8 M3	0.0 M3	224.6 M3	61297.8 M3	513 m³	
CONDENSATE RECOVERY		97.7%						
				Total Steam Specific Consumption	1.955 T/T			
				Yesterday Production	240.0 Tons	2.216 T/T		

Detailed monitoring of minor areas ...

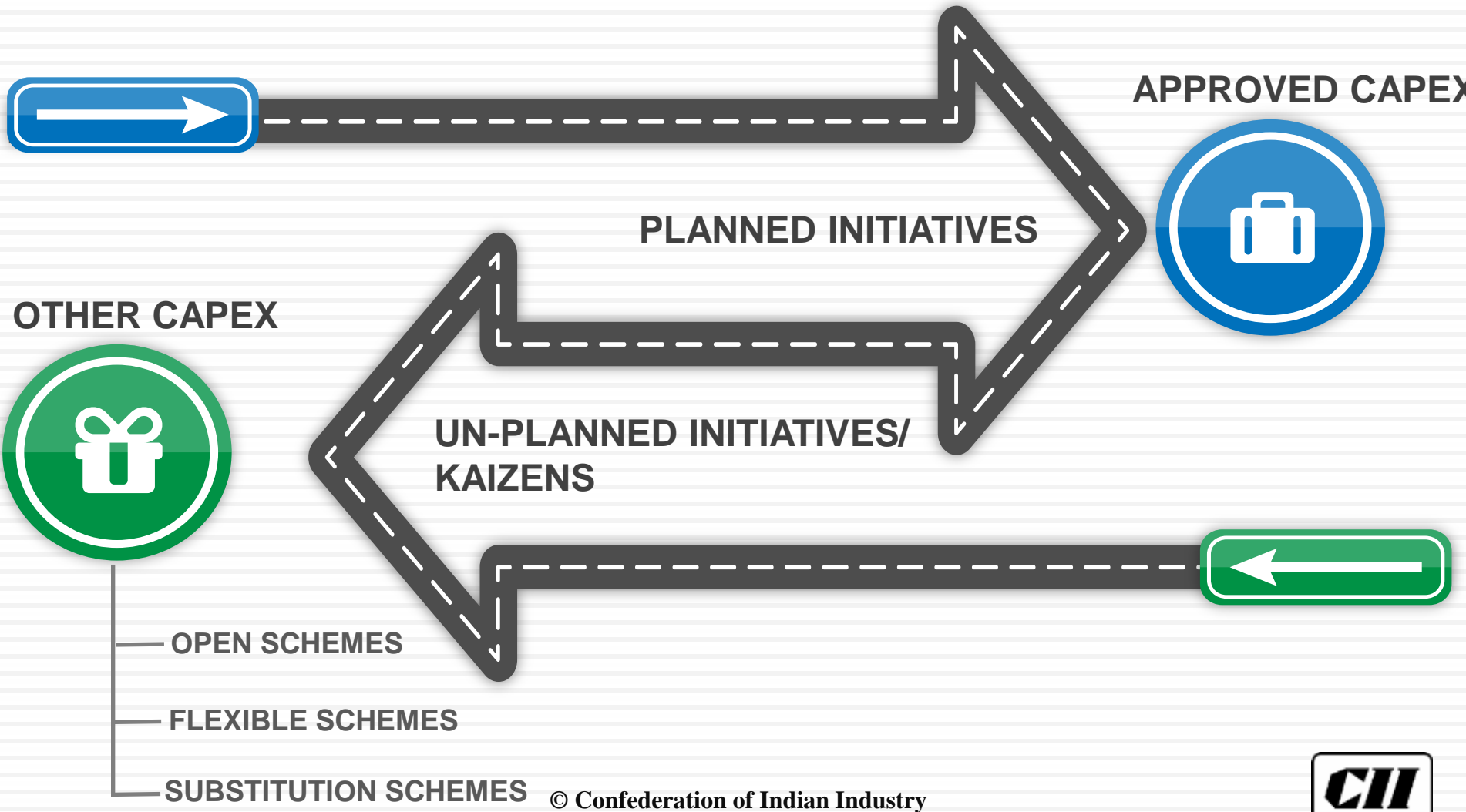
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INSTRUMENT AIR	PRESENT VALUE	YESTERDAY AVG	SERVICE AIR	PRESENT VALUE	YESTERDAY AVG
CENTAC2 TOT	113.50	114.48	CENTAC1 Flow	96.51	102.62
CENTAC3 TOT	177.12	177.84	Service Air PM4	65.48	68.53
CENTAC4 TOT			Service Air Cnetac	47.94	45.04
CENTAC TOTAL	389.77	394.95	TOTAL SERVICE AIR GENERATION	111.29	113.57
TOTAL INST AIR GENERATION	342.01	349.91	SERVICE AIR CONSUMPTION		
INST TOTAL AIR CONSUMPTION			PM1 SERVICE AIR	24.00	27.36
PM1 INST AIR	22.06	21.29	PM2&3 SERVICE AIR	4.07	4.54
PM2&3 INST AIR	9.67	9.60	PM1,2&3 SERVICE AIR	28.07	31.90
PM 4 INST AIR			PM 4 service AIR	13.84	8.19
PM5 INST AIR	20.02	8.77	PM 5 service AIR	9.60	8.07
PM6 INST AIR	50.00	50.04	PM6 SERVICE AIR	29.17	0.00
NFL1 AIR	21.72	21.79	SRB3 SERVICE AIR	0.04	3.66
NFL2 AIR	27.29	27.67	SRB4 SERVICE AIR	6.01	7.34
SRB3 INST AIR	8.07	8.19	AHP SERVICE AIR	0.00	0.00
SRB4 INST AIR	20.00	20.02	CAUSTICIZING SERVICE AIR	8.77	2.67
CFB4,5&6 INST AIR	13.84	14.17	CFB5 AHP AIR	0.00	0.00
CFB7 INST AIR	3.24	2.95	CFB6 AHP AIR	0.00	0.00
GB INST AIR	0.00	0.00	CFB7 AHP AIR	2.86	2.87
RO PLANT INST AIR	4.00	4.00	GB AHP AIR	0.00	0.00
PM4&5 INST AIR	74.64	75.11	Total	0.00	0.00
Total	132.96	129.68	AHP AIR PRESSURE	3.86	
INST AIR Pressure	5.80		MILL AIR PRESSURE	2.82	

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Resource Allocation for EE ...



Campaigns on EE ...



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Approach #5

Major Levers to achieve PAT Targets

Levers towards PAT targets

- 1. Increasing additives in blended cement**
- 2. Waste Heat Recovery**
- 3. Alternate Fuel Utilization**
- 4. On-site Renewable Energy options**

To sum up ...

- ❑ **Several opportunities to improve SEC**
- ❑ **Successful examples within this sector and beyond**
- ❑ **Newer innovative technologies also finding acceptance & adoption**
- ❑ **Energy managers play a vital role in units' performancee**

Thank you!

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