Sector Thematic

Cement

WHRS – A key cog in the flywheel

In this thematic, we analyse the Indian cement industry's environment friendly and structural cost reduction effort – Waste Heat Recovery System (WHRS). A WHRS part recycles kiln's exhaust heat to generate electricity at negligible op cost (hence attractive payback). This reduces fossil fuel consumption intensity and thus CO_2 emissions! The Indian cement industry scaled up WHRS additions by 4x during FY13-20 to 652MW and another 40% addition by FY23 is underway. This helps the Indian cement industry to sustain its global leadership on energy efficiency and to lower its carbon footprint while boosting op margins. Companies in the north-central region are the major gainers as most of them have ~15% of their electricity needs being met through WHRS.

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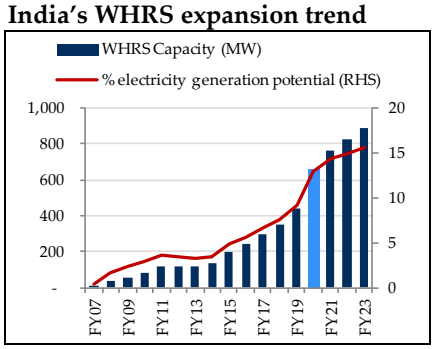
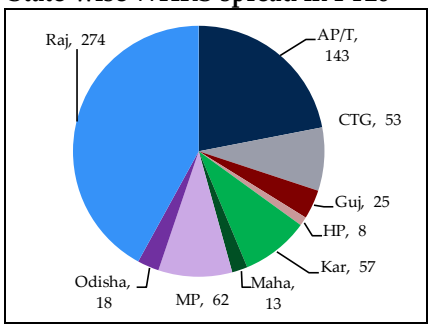
- **Indian cement industry – a global leader on energy efficiency map:** Indian Cement industry currently has one of the lowest fuel and electricity consumption intensity globally. Even in terms of CO_2 emission reduction, this industry met its energy intensive target for 2020 (5% reduction) in 2017 only. The industry achieved this through reduction in fuel /electricity consumption intensity, reduction in clinker consumption factor and increased replacement of clinker with waste products like fly-ash/slag.
- **Surge in WHRS installations in India:** To further reduce fossil fuel consumption and CO_2 emissions, under the government initiatives of Perform, Achieve and Trade (PAT) scheme, cement industry lapped on to Waste Heat Recovery System (WHRS) technology to generate electricity from waste heat from the kiln. During three PAT cycles starting FY13, WHRS capacity in India surged 4x to 652MW in FY20, thereby contributing to reduction in industry's fuel consumption intensity and CO_2 emissions.
- **Margin booster and attractive pay-back period:** This technology has a very attractive payback period of ~3 years, owing to large cost savings versus grid power. As against grid power cost of Rs 6-7/kWh, WHRS power costs ~Rs 0.7/kWh. An integrated WHRS can meet up to ~30-40% of the cement plant's power needs, and reduce opex by up to Rs 150/MT. Thus, WHRS installation boosts both operating margin and also bolsters overall return ratios. This drove industry wide surge in WHRS additions. WHRS capacity can potentially meet ~13% of industry's total power currently vs 3% until FY14. With another ~40% rise in WHRS addition over next three years, WHRS share in electricity requirement will increase to ~15% by FY23E.
- **North central regions are major beneficiaries:** As per our detailed plant-wise WHRS mapping for the industry, clinker plants in Rajasthan and MP account for ~50% of total WHRS capacities in India. Limestone in these regions has low moisture content, boosting WHRS' productivity. Shree Cement (29%), UltraTech (16%) and Penna (7%) together account for half of all WHRS capacity in India. Barring a few, all cement companies have some WHRS installed or are setting up one over next three years. Most of the companies in the north-central regions have WHRS accounting for ~15% of their electricity requirement thus bolstering their profitability and return ratios. As these regions also enjoy healthy pricing trends (high clinker utilisation), companies in these regions should continue to deliver industry leading margins (Refer our earlier note dated 5th March – ***Structural Tailwinds)***.

India's WHRS expansion trend



Source: Industry, HDFC sec Inst Research

State-wise WHRS spread in FY20



Source: Industry, HDFC sec Inst Research

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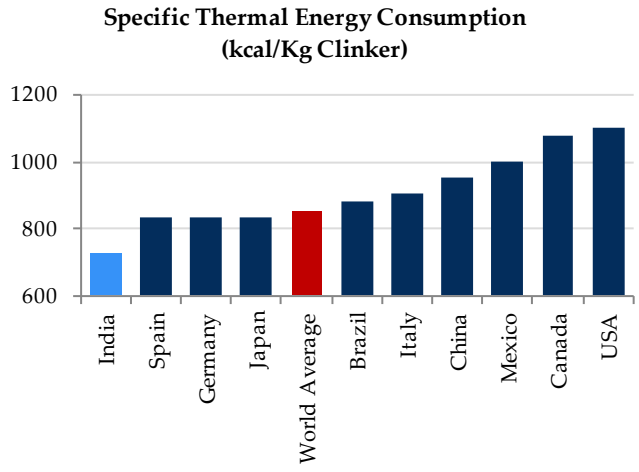
Indian cement industry – a global leader on thermal efficiency

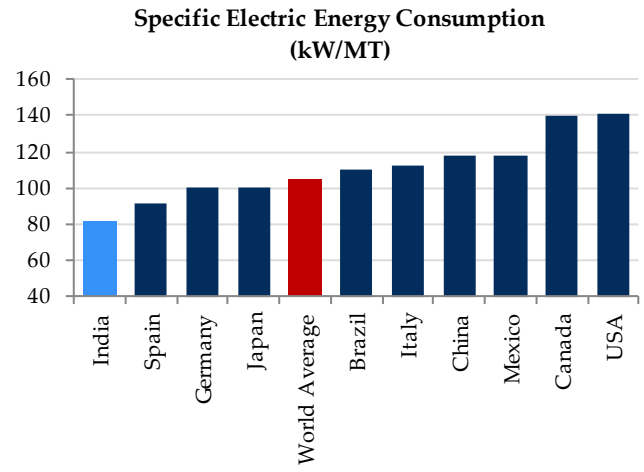
- Cement industry is a resource-intensive industry, as it uses large quantity of natural resources as raw materials and fuel – primarily limestone and coal. While the Indian cement industry is still in a growth phase, it is aware that both limestone and coal are finite resources in India. Thus, for sustainable long term growth, the Indian cement industry has been working hard on multiple fronts to reduce its consumption intensity of limestone and coal. The industry is also able to fulfil its social commitment towards sustainable reduction in consumption of fossil fuel and emission of greenhouse gases. The industry in turn is also benefitting financially as these initiatives have moderated the industry's input cost inflation.
- The Indian Cement industry currently is amongst the most efficient cement industries globally. The industry has been continuously taking multiple steps towards cost reduction by reducing its intake of fuel and limestone, and simultaneously contributing significantly to environmental protection. These ongoing efforts can be summarised as follows:
  - Reduction in energy consumption for clinkerisation /grinding
  - Increased substitution of limestone with alternative raw materials
  - Increased substitution of coal with combustible industrial wastes
  - Rise in share of electricity generation through Waste Heat Recovery System (WHRS)
- As per study by World Business Council for Sustainable Development (WBCSD), these steps (mainly the first three) helped reduce the direct CO_2 emission intensity ($kgCO_2$/MT of cement production) by 5% during 2010-2017 to 588kg/MT. The Indian industry in fact met its 2020 performance target in 2017 itself. The study suggests the sector will further need significant efforts to achieve the 40% reduction (vs 2010 base year) to meet 2050 objectives of CO_2 emission reduction.
- The Indian cement industry today is amongst the most efficient globally, in terms of its electricity and thermal energy consumption rate. Fuel consumption intensity for the Indian industry is well below the world average.

India leads the world on lower thermal heat consumption…



Source: Industry, HDFC sec Inst Research

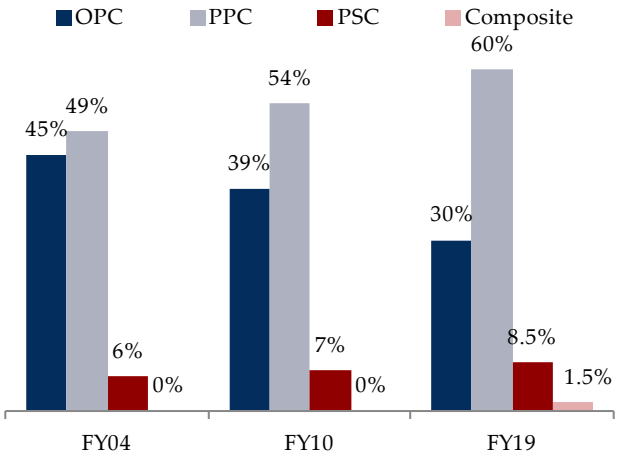
…and also on lower electricity consumption related to cement production



Source: Industry, HDFC sec Inst Research

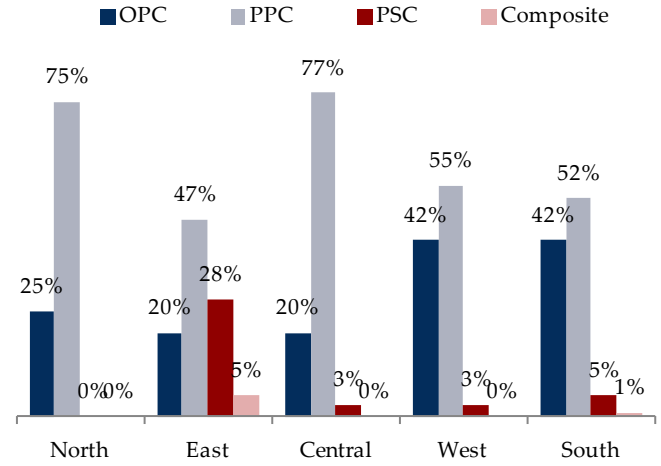
- Even in case of blending, Indian cement industry has successfully achieved greater substitution of clinker with fly-ash and slag (industrial wastes), thus elongating life of limestone reserves.
- On fuel side too, the cement industry has been striving hard to increase use of different alternative fuels (in the high temperature kiln to reduce coal consumption) and have also been setting up systems to effectively use alternative fuels. Even the central and state governments have been promoting the usage of alternative fuel by the industry. However, the absorption of the same has been lower than expected, primarily owing to logistics challenges in economic sourcing of alt fuels.
- However, over the past 5-6 years, consumption of petcoke (a by-product during crude oil refining) has significantly scaled up in the industry. Currently, petcoke is the most preferred fuel for clinkerisation (60-70% overall) by the industry, thus reducing dependence on thermal coal.
- The rising adoption of WHRS over the past 10 years is another major step by the industry to reduce both its coal consumption as well as reduce CO_2 generation.

Cement production mix trend: Share of blended cement has increased 9pp in the past 10 yrs to ~70%



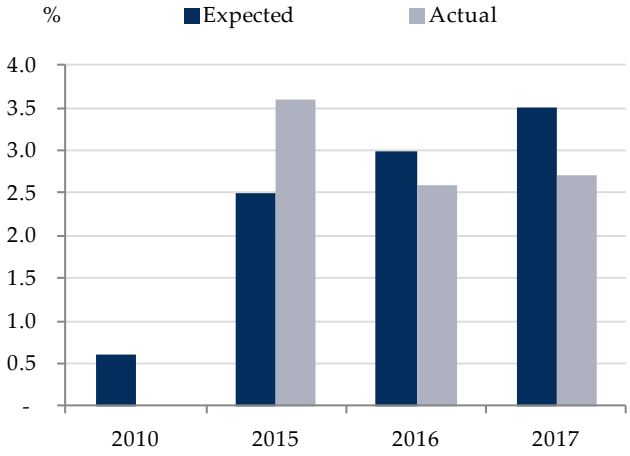
Source: Industry, HDFC sec Inst Research

Regional trends: Share of blended cement production highest in East and Central region



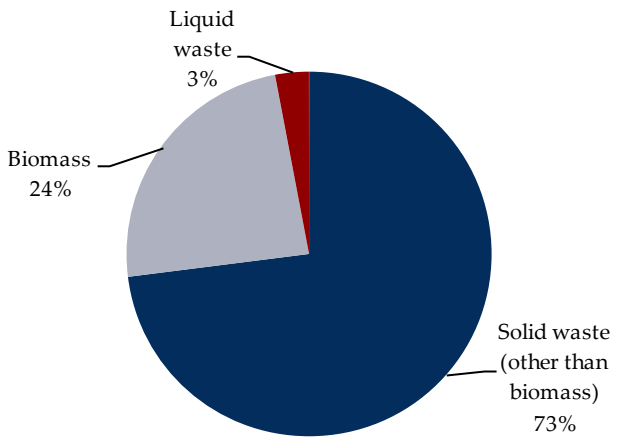
Source: Industry, HDFC sec Inst Research

Usage of Alternative fuel in kilns has been low in India and has lagged industry's expectations



Source: Industry, HDFC sec Inst Research

Alternative fuel types in use currently

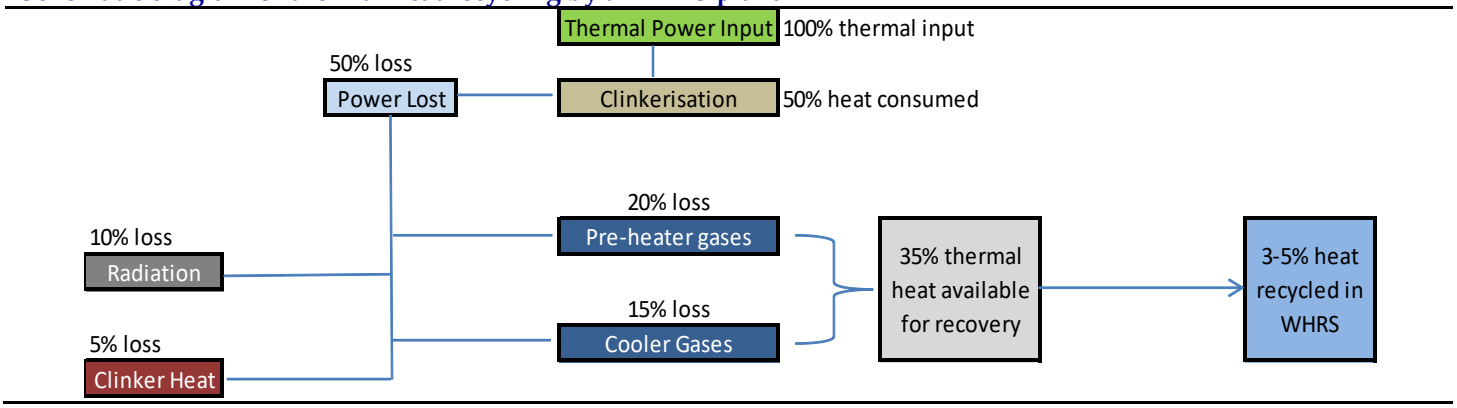


Source: Industry, HDFC sec Inst Research

WHRS system

- As the name suggests, a waste heat recovery system (WHRS) works by partly recycling the waste heat from the cement kiln. The hot exhaust gases leaving the kiln are fed into the pre-heater unit where a part of the heat is consumed to gradually heat up inward kiln feed materials, before it enters the kiln chamber. Post this, these hot gases which would otherwise escape in the atmosphere are fed into the WHRS system. Similarly, the hot gases from the clinker cooler unit are also directed to this WHRS system.
- The WHR system which consist of a heat recovery boiler and turbine. The residual exhaust gases reach WHR boiler to generate high pressure steam, which is then fed to a steam turbine, leading to electricity generation.
- A WHRS can recycle up to 15-20% of the waste heat from the kiln, leading to precious cost savings for the company. This can effectively generate about 4-5MW of electricity for every 1mn MT of clinker production. A total of 7000 Hrs of operations per annum (300days) is considered optimum utilisation of WHRS.

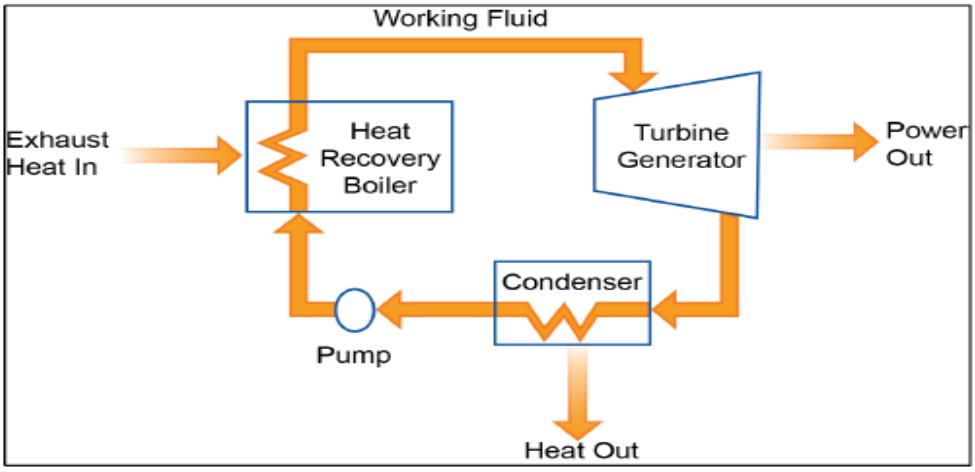
Schematic diagram of thermal heat recycling by a WHRS plant



Source: Industry, HDFC sec Inst Research

- There are three types of WHRS technology available in India - Steam Rankine cycle (SRC), Organic Rankine cycle (ORC) and Kalina cycle. The basic difference between the three types is the fluid which is being heated (from the recycled heat) to be finally fed in the turbine. In SRC water is used, while ORC uses oil to recover heat from the waste gases. In Kalina cycle, a mixture of Ammonia and water (ratio 82/18) is used. The SRC is preferred in high temperature atmosphere while the other two techs are more efficient in recycling heat from low temperature sources. Thus, SRC based WHRS is most popular in the Indian cement industry.

WHRS – Rankine Cycle Heat Engine



Source: Industry, HDFC sec Inst Research

Attractive payback period for cement companies

- A WHRS can effectively generate about 4-5MW of electricity for every 1mn MT of clinker production. This, in turn can potentially meet ~30-40% of total electricity requirement (for cement production), leading to significant cost savings. WHRS generated power costs ~Rs0.5-0.7/kWh which is much cheaper compared to grid power cost of ~Rs6-8/kWh and ~Rs3-4/kWh for CPP based generation. Thus, WHRS significantly reduces operating cost for cement cos, boosting operating margin.
- With improving availability of WHRS technology in India, the installation cost today works out at ~Rs80-100mn per MW of capacity. A WHRS plant would perform at optimum level when the associated clinker plant is running at 80%+ utilisation. This ensures attractive payback period of as low as three years, if the WHRS is able to operate at 70%+ utilisation!
- Thus, a WHRS project not only boosts the company's EBITDA margin (by up to Rs150/ MT) but also bolsters the company's return ratios.

Payback period analysis for WHRS

	Units of Description	Scenario 1	Scenario 2
Clinker capacity	mn MT	3.0	3.0
Cement capacity	mn MT	5.0	5.0
Associated WHRS installation	MW	15.0	15.0
Investment required	Rs mn	1,500	1,500
Grid power cost	Rs/kWh	7.0	7.0
WHRS power cost	Rs/kWh	0.7	0.7
Cost savings achieved vs grid power	Rs/kWh	6.3	6.3
Clinker/Cement Plant utilisation		80%	80%
Cement production achieved	mn MT	4.0	4.0
Optimal WHRS utilisation		**80%**	**70%**
Electricity generated from WHRS	mn KWh	96.0	83.0
Total energy cost saved	Rs mn	605	523
Cost saved per MT	Rs/MT	151	131
Payback period	**Years**	**2.5**	**2.9**

Source: Industry, HDFC sec Inst Research

- The pay back for both WHRS and CPP are equally attractive at less than three years (at optimal plant utilisation). Hence, companies have an option to set up either one of them or a combination of both. Almost all cement companies have been announcing both WHRS and CPP linked to their upcoming clinker expansions.
- On overall basis, the cement industry meets ~60-65% of its total electricity requirement through CPPs, ~10-15% through WHRS and the rest through grid purchases.

Similar payback period for both WHRS and CPP

WHRS			CPP		
Clinker capacity	3.0	mn MT	Clinker capacity	3.0	mn MT
Cement capacity	5.0	mn MT	Cement capacity	5.0	mn MT
Attached WHRS	**15.0**	**MW**	**CPP**	**15.0**	**MW**
WHRS Investment	1,500	Rs mn	CPP investment	750	Rs mn
Grid power cost	7.0	Rs/kWh	CPP power cost	7.0	Rs/kWh
WHRS power cost	0.7	Rs/kWh	CPP power cost	4.0	Rs/kWh
Cost saving	6.30	Rs/kWh	Cost saving	3.00	Rs/kWh
Plant utilisation	80%		Plant utilisation	80%	
Cement production	4.0	mn MT	Cement production	4.0	mn MT
WHRS utilisation	80%		CPP utilisation	80%	
Electricity generated	95	mn KWh	Electricity generated	95	mn KWh
Cost saved vs grid	597	Rs mn	Cost saved	284	Rs mn
Cost saved per MT	**149**	**Rs/MT**	**Cost saved per MT**	**71**	**Rs/MT**
Payback period	**2.5**	**Years**	**Payback**	**2.6**	**Years**

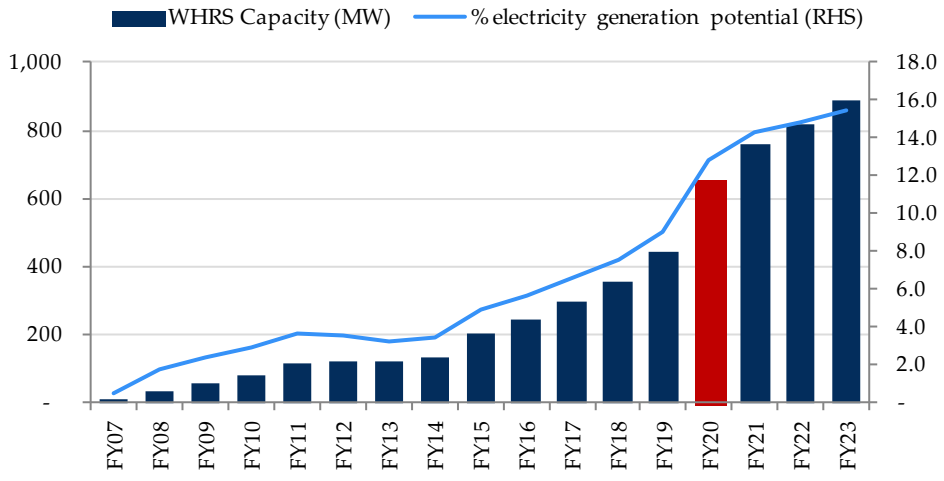
Source: Industry, HDFC sec Inst Research

- While both WHRS and CPP installations have similar payback periods, operating margin for companies with larger WHRS capacity is higher vs CPP of same capacity. A 15MW WHRS operating at 80% utilisation generates ~Rs600mn in annual cost savings vs grid power. At the same time, a 15 MW CPP will result in ~Rs 285mn in cost savings vs grid power. Hence, operating margin for WHRS based company will appear better than that of a company with similar sized CPP. This has also led to the industry (comprised of mostly listed companies) to add WHRS capacities around their clinker plants, in additions to their efforts to reduce carbon footprint.

Surge in WHRS installations in India

- With rising focus on reducing carbon footprint, Indian cement industry has significantly scaled up WHRS installation across India. Greater awareness and better availability of WHRS technology in India also boosted the absorption of this technology at a fast pace.
- The Perform, Achieve and Trade (PAT) is a flagship scheme launched by the Bureau of Energy Efficiency (BEE) in Apr 2012 under the National Mission for Enhanced Energy Efficiency. PAT scheme was one of the eight missions under the National Action Plan on Climate Change, aimed at improving the energy efficiency of large-scale industries including cement industry.
- As WHRS generates electricity through recycling waste heat, it reduces both coal consumption and in turn carbon dioxide generation (greenhouse gas) by the cement industry. Under various PAT cycles: Cycle I (FY13-15 period), Cycle-II (FY17-19 period) and Cycle-III (FY18-20 period), the Indian cement industry fast tracked WHRS capacity thus leading to 4x rise increase during FY14-20.
- During FY07-20, India added a massive 330mn MT of cement capacity (span of 12 years), thereby trebling total capacity to ~500mn MT by FY20. The industry also aggressively adopted WHRS installations along with these expansions. In this period, WHRS capacity also surged from 8MW in FY07 to 652MW in FY20.
- Installed WHRS capacity in India currently can potentially meet up to 13% of total electricity requirement by the Indian cement industry. While WHRS contribution was less than 5% until FY15, it has accelerated in the past five years. During FY20-23, we estimate further WHRS addition of 245MW (38% increase over FY20), leading to total installed capacity of ~900MW. This should further increase cement industry's low cost electricity generation potential to 15% by FY23.

WHRS capacity addition trend in India

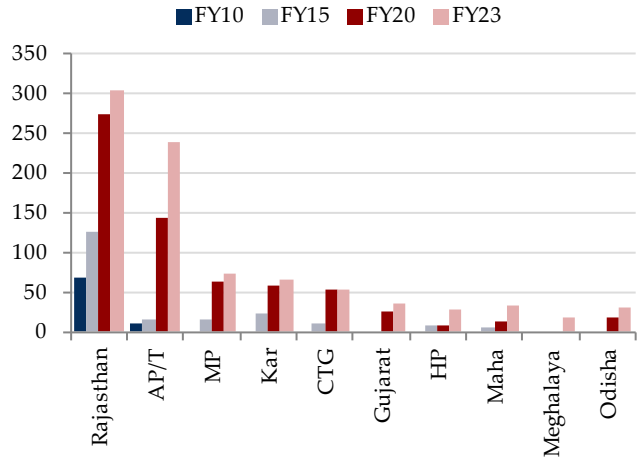


Source: Industry, HDFC sec Inst Research

Regional distribution of WHRS

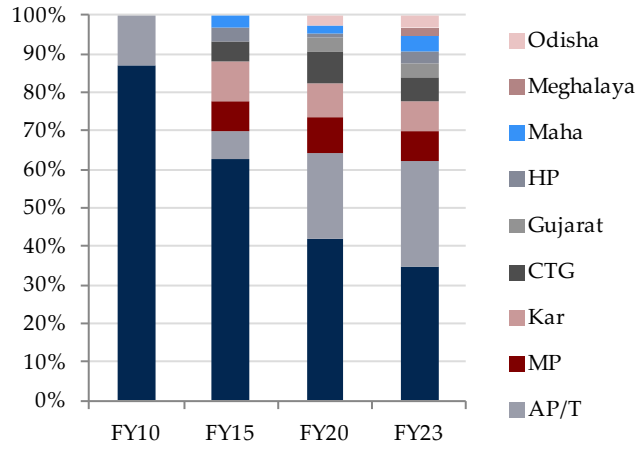
- Our exhaustive mapping of WHRS additions in the cement industry suggests that highest concentration of WHRS is in Rajasthan-based clinker units (274MW), followed by AP/T (143MW), MP (62MW), Karnataka (57MW), and Chhattisgarh (53MW). The north central based companies account for ~50% of total WHRS installation in India.
- A WHRS system works best in low humidity environment and where the moisture content in the limestone is low (and hence lower heat consumed in the pre-heater). Limestone clusters in Rajasthan, Andhra Pradesh and Karnataka contain less moisture (<2% in general and <5% in rainy seasons). Thus, they consume less thermal heat from the hot gases escaping from the clinker plant, leading to larger quantum of heat available to be recycled in the WHRS. Thus, WHRS in these regions have better yield and pay-back. This factor explains the large WHRS capacities in these four states. The productivity of a WHRS is also linked to the utilisation of the clinker plant it is linked to. Thus, Rajasthan and MP based WHRS plants have higher power yield vs those in other regions owing to high regional utilisation.
- The moisture content in limestone deposits in sedimentary belt (Gujarat, Tamil Nadu) is generally higher than 8% thus reducing the efficiency of the WHRS in the region. Thus, companies in these regions are lesser enthusiastic to add WHRS.

State wise WHRS capacity trend



Source: Company, HDFC sec Inst Research

State wise WHRS capacity share trend

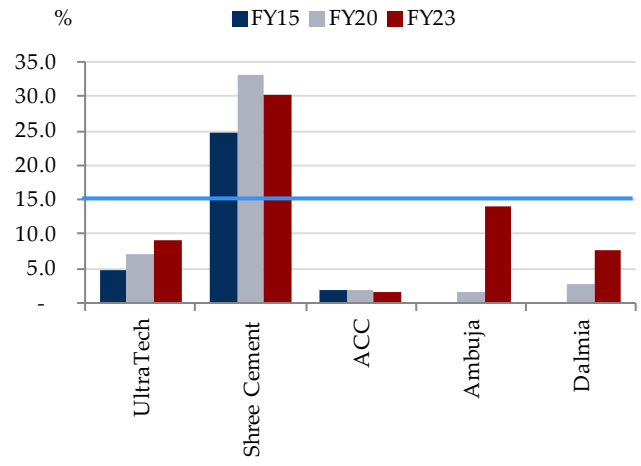


Source: Company, HDFC sec Inst Research

Company- wise analysis

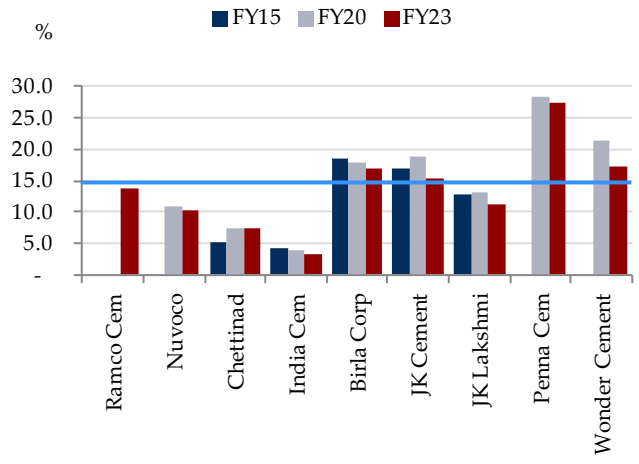
- As per our detailed company wise WHRS mapping, we see that barring a few, most of the cement companies have added WHRS to benefit from both lower costs and reduced carbon foot-print. As discussed earlier, companies in the north central markets have been more aggressive on this front, owing to less moisture content in the regional limestone.
- Back in FY07, only India Cements had a WHRS plant (of 8MW) in India. Thereafter, JK Cement, Shree Cement and KCP added 23MW, 21MW and 2.5MW respectively during FY08-09. While Shree Cement started off late, it fast tracked WHRS additions across its plants and became an industry leader FY10 onwards. Shree Cement continuously added WHRS along with cement capacity expansions. At the end of FY20, Shree Cement accounts for 29% of total WHRS capacity in India. UltraTech follows with a 16% WHRS capacity. Penna Cement is the third largest with 7% capacity share currently.
- Today most of the cement companies either already have a WHRS installation at their clinker plants or they are setting up one over the next three years. In our industry scan, we found there are still a few major companies which have no WHRS plans until FY23. There are JP Associates, JSW Cement, Kesoram and Vadraj Cement.
- Overall, clinker plants in Rajasthan and MP (north-central regions) account for ~50% of total WHRS capacity in India. This is also visible in the company-wise plot as below.
- In the exhibits below, we have plotted WHRS led electricity generation potential of 27 cement companies in India (both listed and unlisted), factoring in their installed cement capacity. Amongst the big cement companies (10mn MT+ capacity), Shree Cement, Birla Corp and JK Cement have WHRS capacities sufficient to meet 15%+ of their respective electricity requirements. UltraTech, Ambuja and Ramco Cements are also slowly ramping up their WHRS capacities to reduce opex.

WHRS share in electricity generation (20mn MT+ cement cap)



Source: Company, HDFC sec Inst Research

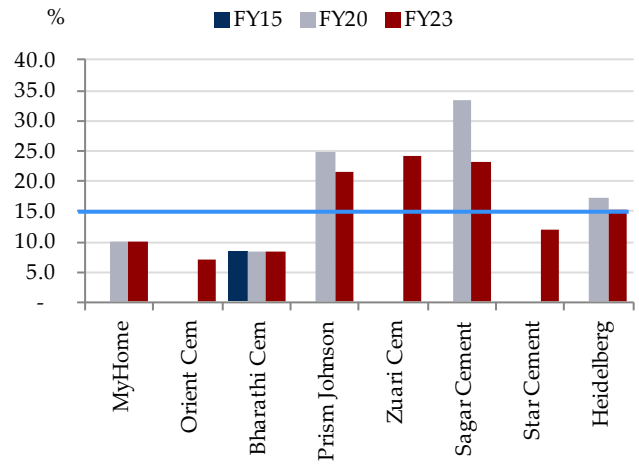
WHRS share in electricity generation (10-20mn MT cement cap)



Source: Company, HDFC sec Inst Research

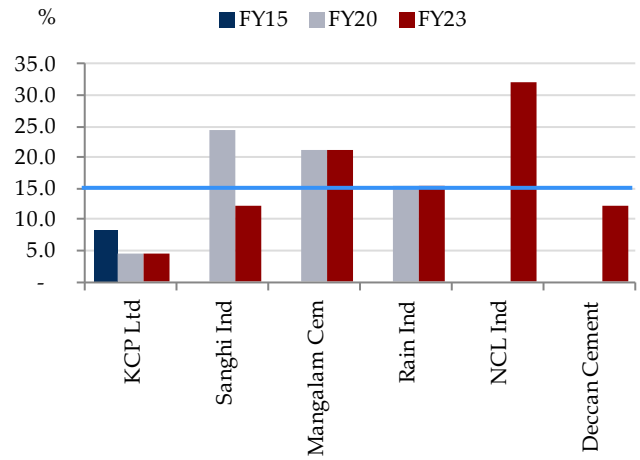
- In case of UltraTech, we expect WHRS to meet ~10% of electricity needs by FY23. Additionally, the company has also stated that it is working to source electricity from ~500MW wind/solar based power plants (with 15-20% PLF) over the next three years. These would further increase share of green power by 10%. Thus, 20% of its electricity requirement will be met through green power sources by FY23.
- Among the mid/small sized companies, Prism, Sagar, Heidelberg, Sanghi Ind and Mangalam cement have potential to source 15%+ of their electricity requirements through WHRS. Orient Cement, Star Cement, NCL Ind and Deccan Cements are also adding WHRS plants to reduce operating costs.

WHRS share in electricity generation (5-10mn MT cement cap)



Source: Company, HDFC sec Inst Research

WHRS share in electricity generation (< 5mn MT cement cap)



Source: Company, HDFC sec Inst Research

- We conclude this report with the following observations – The Indian cement industry has been quick to adopt the WHRS technology in a bid to both lower its operating costs as well as reduce their carbon footprint. Companies in the north-central region have been most aggressive in their adoption of this technology. Incidentally, clinker utilisation in these regions is also the highest at 80%+ which imply optimum WHRS utilisation and hence cost reduction. Thus, north-central region based players have the dual benefits of healthy pricing (on higher regional utilisation) as well as better cost savings (from higher share of WHRS).

Peer Set Valuations for our coverage universe

- In this report, we have not factored in the impact of Covid-19 led business disruptions, (owing to uncertainly amid ongoing pan-India lockdown), in our earnings estimates. We will review the same in a follow up note.

Company	Mcap (Rs bn)	CMP (Rs/sh)	Reco	EV/EBITDA			EV/MT			Net D:E (x)			RoE (%)		
				FY19E	FY20E	FY22E	FY20E	FY21E	FY22E	FY20E	FY21E	FY22E	FY20E	FY21E	FY22E
UltraTech Cement	835	3,042	BUY	17.5	10.4	9.1	141	132	120	0.5	0.3	0.1	12.0	12.8	12.8
Shree Cement	550	15,785	SELL	20.9	13.9	12.4	188	178	162	(0.3)	(0.3)	(0.3)	13.7	12.4	11.9
Ambuja Cements	304	153	BUY	15.9	6.5	5.7	73	69	67	(0.7)	(0.7)	(0.7)	6.8	6.9	7.0
ACC	181	963	BUY	12.0	5.6	5.6	65	66	65	(0.4)	(0.4)	(0.4)	11.6	12.3	12.5
Ramco Cements	112	474	ADD	16.9	10.9	9.4	110	104	93	0.4	0.4	0.2	13.5	14.2	15.0
Dalmia Bharat	81	422	BUY	13.9	5.5	5.6	70	59	48	0.4	0.4	0.3	2.8	2.4	3.1
JK Cement	71	913	BUY	9.3	8.2	7.0	80	79	82	0.9	0.8	0.8	16.2	17.3	18.2
Star Cement	29.1	69	BUY	10.1	6.3	4.9	97	83	93	(0.1)	(0.2)	(0.0)	16.7	17.7	18.2
JK Lakshmi	21.8	185	BUY	12.2	4.7	4.2	43	43	36	0.6	0.5	0.4	15.6	17.2	14.9
Orient Cement	8.7	43	BUY	10.6	5.7	4.9	40	39	44	1.1	0.9	1.0	7.4	11.1	15.0
Deccan Cements	2.63	188	BUY	5.3	2.7	1.7	16	13	21	(0.1)	(0.1)	0.1	11.5	12.7	13.8

Source: HDFC sec Inst Research

Rating Criteria

BUY:	>+15% return potential
ADD:	+5% to +15% return potential
REDUCE:	-10% to +5% return potential
SELL:	> 10% Downside return potential

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