



Confederation of Indian Industry

# Indian Cement Industry

## History, Growth Drivers & Key Learnings

May 2018

Initiative supported by

*Danfoss*

ENGINEERING  
TOMORROW



Confederation of Indian Industry

# Disclaimer

© 2018

All rights reserved

Indian Cement Industry: History, Growth Drivers & Key Learnings is published by Confederation of Indian Industry (CII) as an initiative supported by Danfoss. This publication showcases the history, growth drivers and key learnings from the Indian Cement industry along with key messages for other manufacturing sectors to emulate.

While every care has been taken in compiling this publication, CII does not accept any claim for compensation, if any entry is wrong, abbreviated, omitted or inserted incorrectly either as to the wording space or position in the Document. No part of this publication may be reproduced, stored in retrieval system, or transmitted, in any form or by any means electronic, mechanical, photocopying, recording or otherwise, without prior written permission from CII.

Published by:



**Confederation of Indian Industry**

CII - Sohrabji Godrej Green Business Centre  
Survey # 64, Kothaguda Post  
R R District, Hyderabad - 500084 India

# Introduction

The Indian cement industry started in the year 1904 when South India Industries setup India's first cement plant in Washermanpet near Chennai. The first successful cement plant was opened by the India Cement Company in Porbandar, Gujarat with a capacity of 10,000 tonnes per annum. Over time the Indian Cement industry has attained phenomenal growth to the current production level of 279.8 MTPA in 2017. The cement sector in India has evolved to become one of the most energy efficient and second largest cement manufacturer in the world with installed capacity of 460 MTPA in December 2017<sup>1</sup>

**Key message 1 - The transformation and growth of the sector is a befitting example for all other industrial sectors in India to emulate and adopt the best from the sector.**

The growth story of the cement sector has huge scope of replication in other manufacturing sectors and in turn inspire transformation through cross sector learning. The following are the key learnings that can be emulated and adopted in other sectors:

- ✓ Transparency, openness, learning through sharing within and outside the sector to improve technical competency
- ✓ Development of Low Carbon Technology Roadmap (LCTR)
- ✓ Improvement in Specific Energy Consumption (SEC) levels and rigorous monitoring of SEC
- ✓ Going beyond operations & maintenance in engaging with technology suppliers for technology & efficiency improvement
- ✓ Increased focus on monitoring and reduction in operating cost
- ✓ Readiness for engagement with government and other stakeholders for mandatory and voluntary commitments
- ✓ Sustained efforts to achieve excellence in environmental management; water conservation & waste management initiatives
- ✓ Automation, adoption of best technologies, application of IT tools in manufacturing processes including logistic
- ✓ Advanced monitoring and control systems for quality management- consistent improvement & upgradation
- ✓ Adoption of renewable energy for meeting energy demand
- ✓ Use of systematic training and capacity building by establishing regional training centres for employee training & development

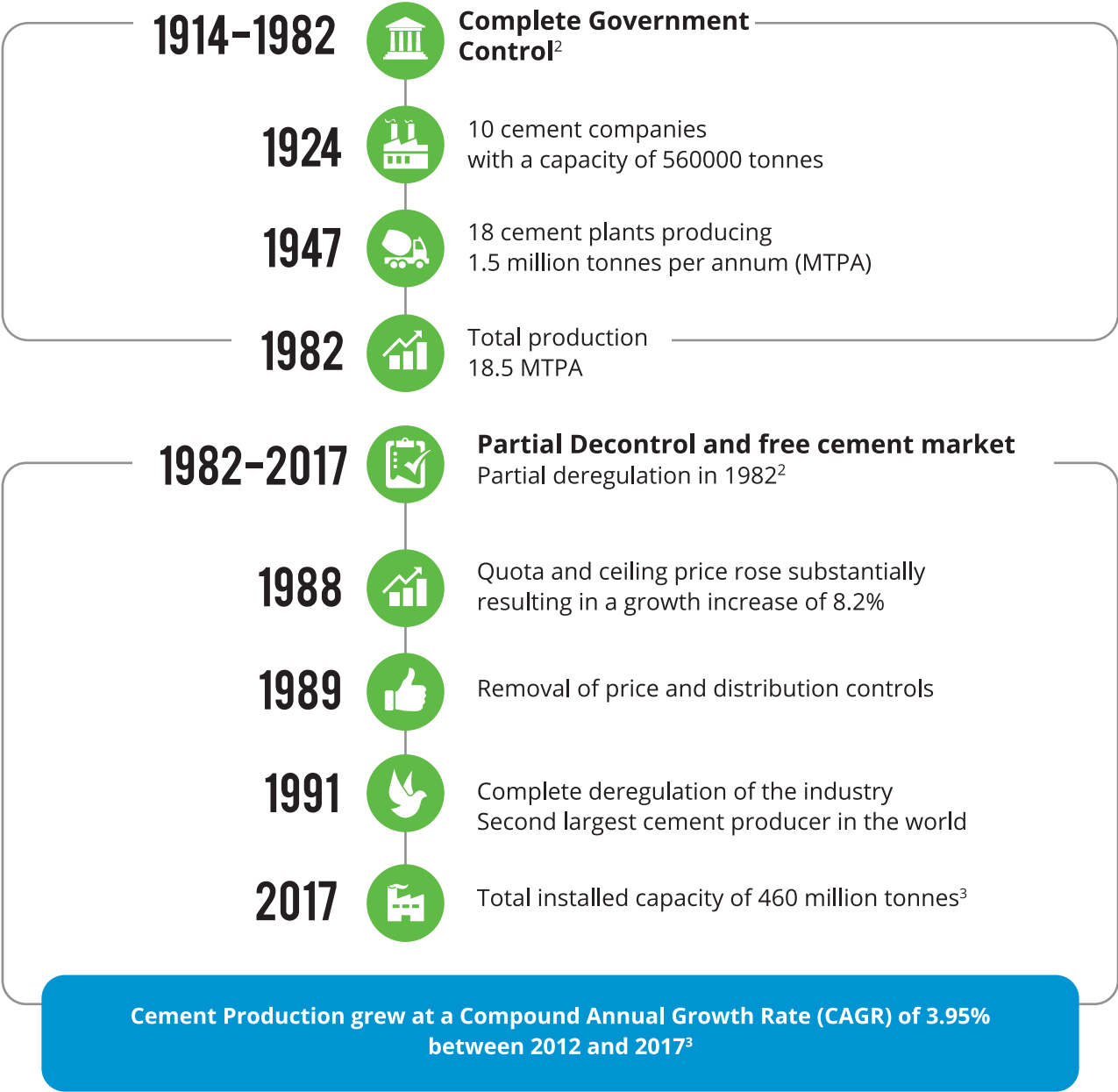
This document highlights 21 key messages for learning from the cement sector, covered under five broad growth drivers which enabled this ongoing journey towards excellence. The growth drivers are described ahead.

1- Source-IBEF Cement April 2018



# Growth Driver 1: Regulations and Active Engagement with the Government

## Regulations



2- Source- CII Cement Division

3- Source-DIPP data



## Government Engagement



Compliance with all government regulations



Recognised by BEE, Ministry of Power & Ministry of Environment, Forests & Climate Change for energy efficiency and environmental performance



Working with Municipal corporations for utilizing Municipal Solid Waste (MSW) & Refuse Derived Fuel (RDF)



Exceeded targets in PAT cycle 1, 1.48 MTOE against 0.815 MTOE, 81.6% higher<sup>4</sup>



Close engagement with CPCB & MOEF; trials for co-processing of wastes in cement kilns and use of waste as fuel in cement kilns

Regulation is recognized as an opportunity to innovate & improve



Sector (Private) values relationship with Government



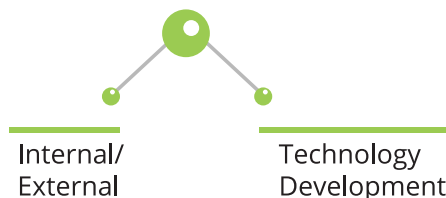
Sector has understood that compliance is cost effective



Regulations & Standards encourage innovations



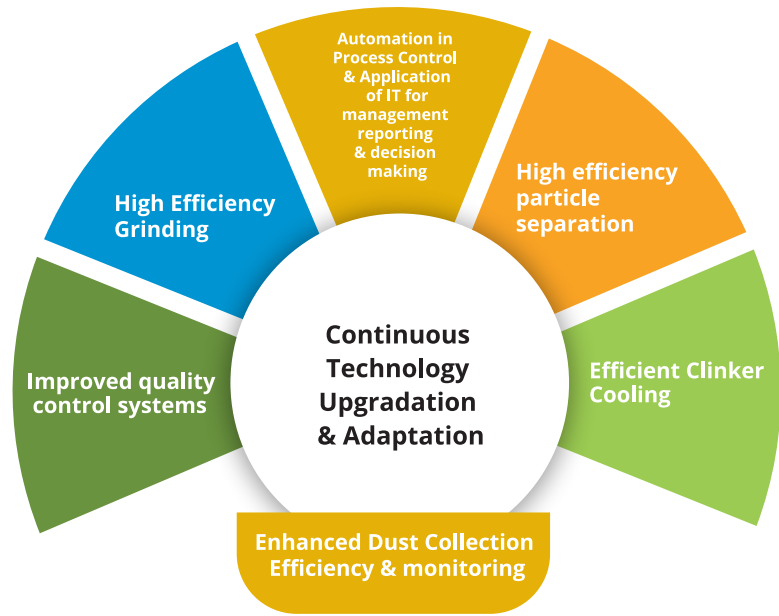
Openness & commitment towards compliance



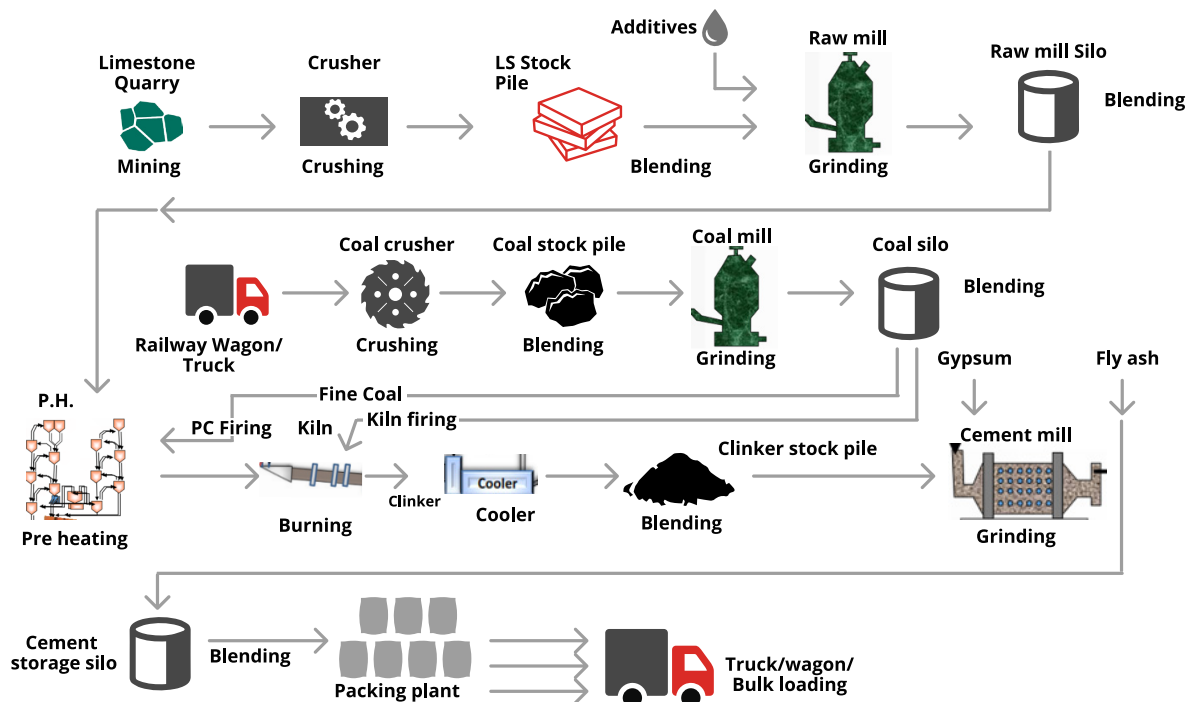
4- Achievements under Perform Achieve & Trade (PAT) May 2017 BEE- [https://beeindia.gov.in/sites/default/files/Booklet\\_Achievements%20under%20PAT\\_May%202017.pdf](https://beeindia.gov.in/sites/default/files/Booklet_Achievements%20under%20PAT_May%202017.pdf)

## Growth Driver 2: Energy Efficiency Improvements through Technology Interventions, Process Optimization and Supplier Engagement

Major technological change appeared in 21<sup>st</sup> century and today's Indian cement industries are incorporating the global standard of technological upgradation. New plants being built now are incorporating state - of - the - art technology and the latest in hardware, with an aim of achieving very low thermal and electric energy consumption, comparable to plants being built elsewhere in the world.

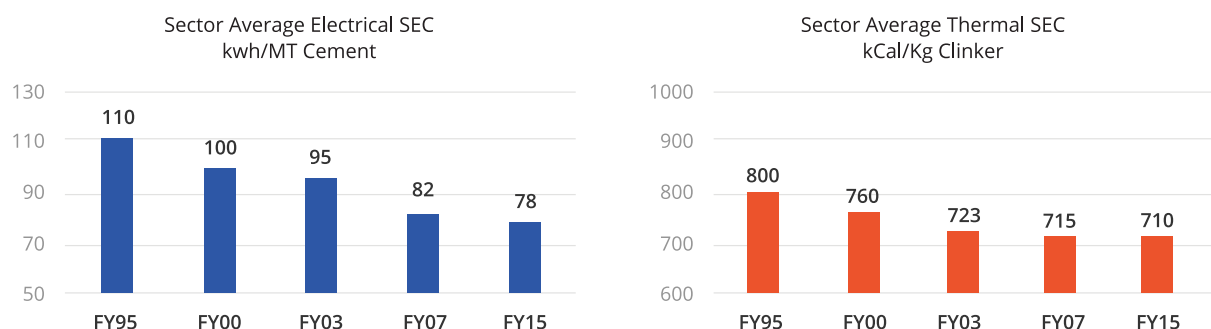


The various processes involved in cement manufacturing are depicted below:



**Reduction in specific electric energy consumption:  
32% reduction in 2015 from 1995 levels**

**Reduction in specific thermal energy consumption:  
11% reduction in 2015 from 1995 levels**



**Fig. 1 Trends of average electrical & thermal SEC in Indian Cement Sector**

(Source-CII Green Champions of India- Cement Sector 2016)

**Key message 2 - Several latest technologies have been implemented in Indian cement plants first before being introduced in other countries**

Continuous capacity upgradation through de-bottlenecking and optimal equipment operation have also resulted in increased efficiency levels. The sector has widely adopted the use of Variable Frequency Drives (VFDs), energy efficient utilities, best available manufacturing technology, bulk material analyzers, latest automation and control systems in process and utilities which can be replicated in other manufacturing industries like ceramics, sugar, paper etc.

**Key message 3 -The achievements of the cement sector is unparalleled in terms of the reduction in specific energy consumption. No other industrial or manufacturing sector in India has demonstrated this level of reduction in energy consumption.**

**Key message 4 -The technology providers & OEMs have gone beyond installation and maintenance of equipment and supported performance improvement of plants resulting in a mutually beneficial relationship between the supplier and the cement plant.**

**Key message 5 - 17% contribution to achievement of PAT cycle 1 target against an allocated target of 12.20% of the total PAT cycle 1 target.**

The industry has become one of the first in manufacturing sector in India to adopt Robotic based labs for quality control and analysis in laboratory. The Indian cement plants have worked in close cooperation with equipment suppliers and OEM's to develop new technologies, fine tune processes and undertake R&D for enhancing efficiency and performance. The inputs from cement plant personnel have also aided improvement in material technology revolutionizing the materials of construction used for cement plant equipment, significantly bringing down downtime, operation & maintenance costs. As a result of these interventions, the Indian machinery manufacturers have the requisite infrastructure supported by cement plants, with readiness and support for implementing latest technology, R&D facilities as well as investment capacity for continuous technology development. The industry is also working on ESCO & BOOT model for implementation of latest and new technologies.

**Key message 6 - Active collaboration of cement plants with technology suppliers, sharing inputs for technology upgradation for aiding design improvements**

## Growth Driver 3: Environmental Performance Improvement: Water Conservation & Waste Management

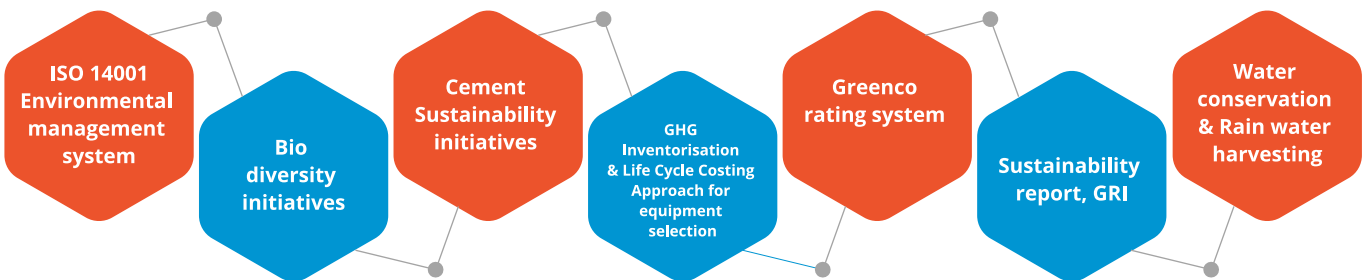
On the environmental front, the sector is making progress on improving in the best possible way. Several initiatives for water, energy and material conservation have been taken along with adoption of best environmental management systems. The Indian cement sector is adopting lifecycle analysis and other techniques to better understand the relative impacts of various resource productivity improvements.

**Key message 7 - The Cement Sector is working to achieve excellence in environment management and has been taking initiatives to go beyond compliance**

Cement industry was considered one of the highly polluting industries a few decades ago characterized by gaseous emissions, fugitive emissions, effluent discharge and mining emissions. The industry has adopted latest technologies thereby reducing emissions from 250 mg/Nm<sup>3</sup> to 30 mg/Nm<sup>3</sup> standards. Online continuous stack monitoring systems are installed in all cement units and they are connected to Pollution Control Board servers online for both stack emission and ambient air quality emission standards.

**Key message 8 - Reduction in total CO<sub>2</sub> emissions to an industrial average of 0.719 tCO<sub>2</sub>/t cement in 2010 from a substantially higher level of 1.12 tCO<sub>2</sub>/t cement in 1996**

The industry has adopted the following best practices:



### Water Conservation

**Key message 9 - Reduction in process water consumption by more than 90% by changing technology from wet technology to dry technology<sup>5</sup>**

- Further reduction in water consumption by 50% in gas conditioning towers with installation of Reverse Air Bag House (RABH), Pulse jet bag filters & Waste Heat Recovery
- Water cooled condensers have been replaced with air cooled condensers in captive power plants and chiller systems.
- Water conservation measures for domestic use in the plant and colonies have been undertaken on the lines of green building concepts.

**Key message 10 - From high water consumption status towards water positivity**

Extensive rain water harvesting practices are followed in mining pits. Many of the cement plants are meeting their water demand with rain water harvested from mine pits and also supplying to nearby community.

5 - Source ACC Reports



# Waste management: Alternate Fuel & Raw Materials Use

The Indian cement industry has proven that strong business growth can be achieved by sustainable manufacturing. Cement kilns are becoming incinerators for using hazardous and non-hazardous industrial wastes, Municipal Solid Wastes, plastic wastes etc.

## 1. Co-processing:

Indian cement industry has identified increased utilization of alternative fuels and raw materials (Co-Processing) as a key areas of focus in the recent years. Co-processing, which is the use of waste as raw material, energy, or both has resulted in dual benefits of resource conservation and sustainable solution for waste management in the country.

**Key message 11 - Thermal substitution rate in the Indian cement industry has increased from 0.6% to 4.0% in 2014-15<sup>6</sup>**



Utilization of more than **40%** of total fly ash generated in power plants



Utilization of **100%** of blast furnace slag for production of blended cement

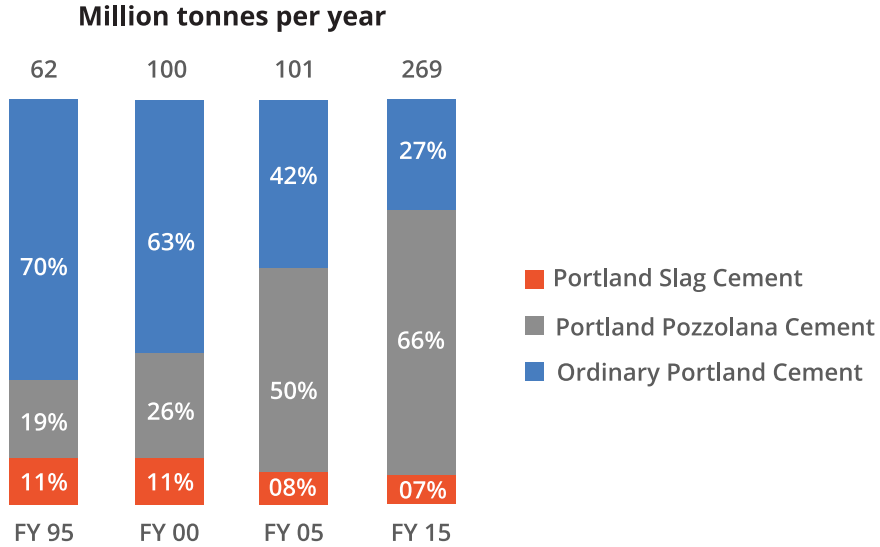


Utilization of petcoke in cement kilns



## 2. Utilization of Fly ash and slag in blended cement:

The environment-friendly blended cement is more cost-effective and less resource intensive to produce, as it requires lesser input of clinker and energy. The availability of fly-ash (from thermal power plants), blast furnace slag (from steel plants) and use of advance technology has increased the production of blended cement in the recent years. The production of blended cements in the country has increased from 19% in FY-95 to 66% in FY-15.

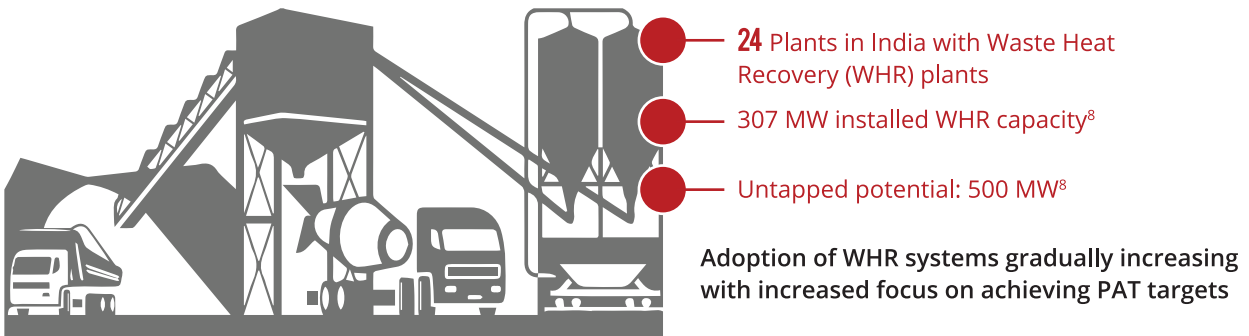


**Fig. 2 Production of blended cement in Million tonnes per year**

**Key message 12 - First manufacturing sector to invest in wind energy: more than 300 MW total solar and wind energy installed capacity<sup>7</sup>**

## Waste Heat Recovery

More than 60% of cement plants operate with 100% captive power generation<sup>7</sup>

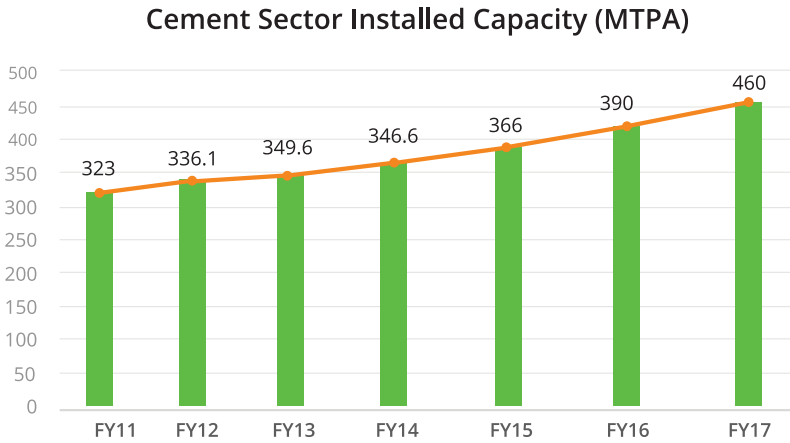


7 - CII cement division

8 - Waste heat recovery-Cement Industry- CII Publication May 2017

## Growth Driver 4: Operations Cost Optimization

**Capacity:** The cement sector installed capacity has been growing at a fast pace over the last 7 years as depicted below:



Source-IBEF April 2018

**Energy cost 40–50 % of the manufacturing cost**

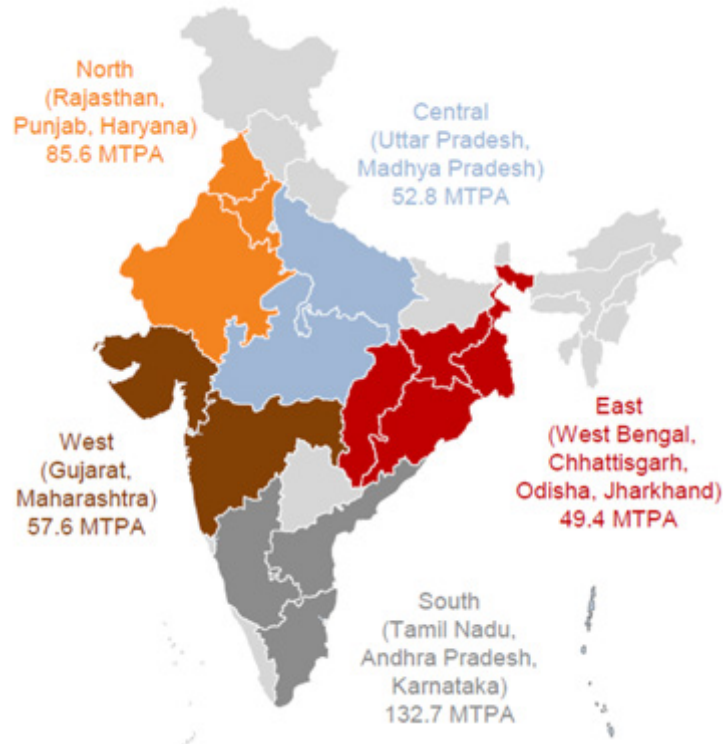
- ✓ A key driver to competitiveness
- ✓ Energy efficiency: a key priority across the sector



- Energy Efficiency
- Operating Cost & Emissions

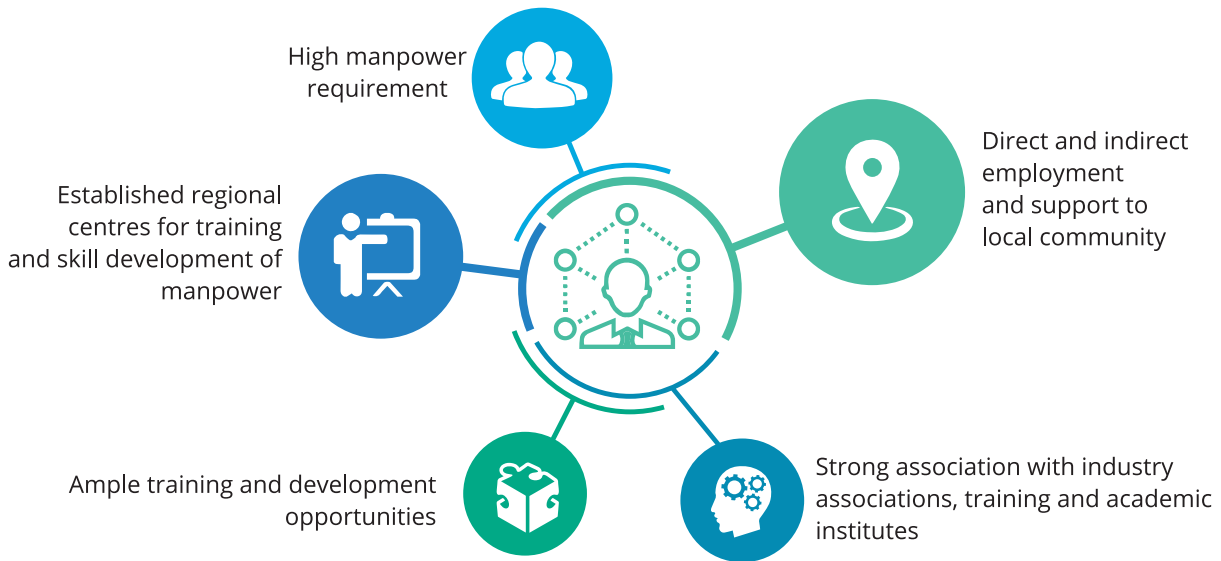
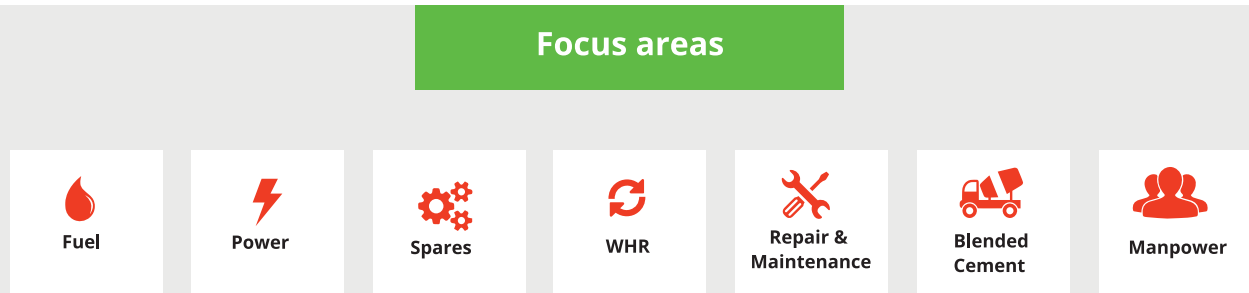
**Key message 13 - Focused measures to reduce the operating costs have contributed in making cement sector more competitive and profitable**

The geography wise distribution of major players in cement manufacturing major players is given below:



Source-IBEF April 2018

**Operating cost:** The operating cost is given high priority across all levels and is included as a Key Performance Indicator (KPI) at different levels of the plant team. Persistent efforts have been made to continue for improving energy efficiency and reducing the energy cost for the cement industry for sustainable growth.



**Logistics:** Cement, being a low value and high volume commodity, transportation costs form a significant proportion of its total cost. The selling and distribution costs account for around 18 percent of sales revenues.<sup>9</sup>

**Key message 14 - Use of road, rail and water ways for bulk transportation of raw materials, clinker and cement**

Considering the role of Industry in the economy's development, it is necessary to incentivise bulk transportation and thereby optimize cost, save fuel and reducing carbon emission while ensuring safe carriage. Using more railway routes than roads, shrinking lead distance (distance between the manufacturing facility and market) and opting for sea-routes wherever possible were some of the ways the industry explored.

**Key message 15 - Effective utilization of transportation through GPRS based monitoring leading to reduction in idle time during operation**

**Key message 16 - Standalone grinding and packing plants nearer to the markets, thermal power plants etc. (spilt plants)**

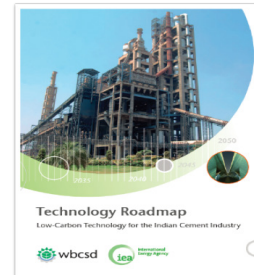
**Key message 17 - Promotion of Ready Mix Concrete (RMC) for specialized applications**

<sup>9</sup> - Logistics: A cost effective approach ([www.indiancementreview.com](http://www.indiancementreview.com))

## Growth Driver 5: Innovation, Learning Through Sharing & Cross Sector Learning

### Low Carbon Technology Roadmap

The Low Carbon Technology Roadmap was developed in association with International Energy Agency (IEA), World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI). The document outlines supportive policies, estimates financial requirements, and describes technical changes, along with recommendations to support R&D and decision-making for future investments.



**Key message 18 - 1<sup>st</sup> Sector in India to go in for development of Low Carbon Roadmap**

**Key message 19 - Targets reduction of direct CO<sub>2</sub> emissions intensity to 0.35 tons (t) of CO<sub>2</sub>/ton of cement**

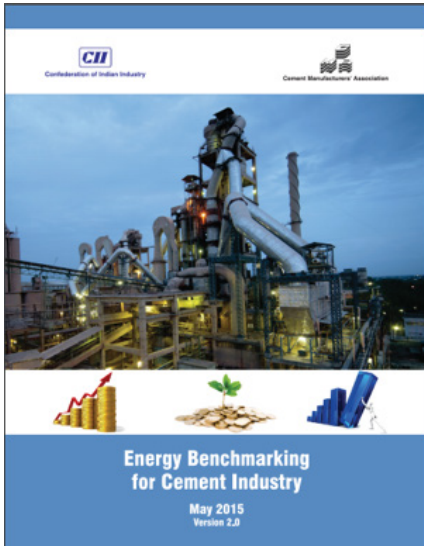
27 technical papers on 5 key levers:



**Key message 20 - Progress review of Low Carbon Technology Roadmap under way**

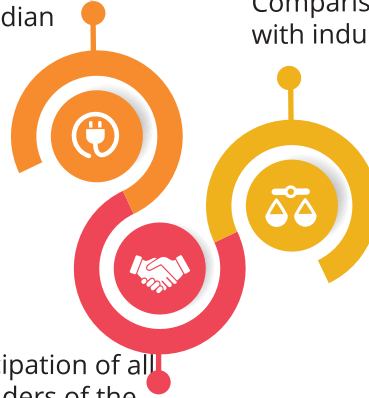


# Energy Benchmarking for Cement Industry



Collation of some of the best section wise specific energy consumption figures maintained in Indian cement plants

Comparison of plant performance with industry's best



Active participation of all the stakeholders of the Indian cement sector.

## Top 10 Efficient plants: CII Energy Awards 2016-17

S.No	Company Name	Specific Electrical Energy Consumption 2016-17	Specific Thermal Energy Consumption 2016-17
		kWh/MT total Cement	kWh/MT clinker
1	Plant 1	63.91 (18% OPC & 82% PPC)	676 (6 stage PH)
2	Plant 2	65.67 (61% OPC & 39% PPC)	677 (6 stage PH)
3	Plant 3	66.07 (32% OPC & 68% PPC)	682 (5 stage PH)
4	Plant 4	66.27 (26% OPC, 53% PPC & 21% others)	685 (5 stage PH)
5	Plant 5	67.66 (6% OPC & 94% PPC)	688 (6 stage PH)
6	Plant 6	68.7 (65% OPC & 35% PPC)	690 (6 stage PH)
7	Plant 7	69.8 (31% OPC & 69% PPC)	695 (6 stage PH)
8	Plant 8	70.58 (8% OPC, 47% PPC & 45% PSC)	699 (5 stage PH)
9	Plant 9	71.4 (64% OPC & 34% PPC)	699 (5 stage PH)
10	Plant 10	71.98 (49% OPC, 49% PPC & 2% PSC)	699 (5 stage PH)

## Learning Through Sharing

The cement industry is known for its openness and transparency for knowledge sharing amongst its peers, learning from its peers in cement and other manufacturing sectors and continuously improving the performance. The sector has been participating in public forums for sharing their knowledge and learnings. The cement sector companies have won many awards in various areas and has been recognised by many national and international agencies.

**Key message 21 - Cross Sectoral learning: Extensive use of Computational Flow Dynamics (CFDs) technique adopted from power plants for efficiency improvements.**

Industry Associations like CII, CMA and NCBM are continuously working for the benefit of cement industry. These associations are closely working with government in promoting the growth of the industry.

# Summary

The cement sector is on an upward growth trajectory and has undertaken several initiatives for water, energy, material conservation, along with adoption of best environmental management systems, latest innovative technologies to make the industry globally competitive in respect of production cost, protection of environment and enhancing resource efficiency. The sector is consistently working towards enhancing the performance on all fronts. The following are the key areas of action which if acted upon will add impetus to this continued journey towards excellence:

- ✓ Develop strategy and roadmap for reducing carbon emissions

---

- ✓ Increased adoption of alternate fuels & raw materials along with engagement with Government (including municipalities) & local communities to promote co-processing to address the issue of Municipal Solid Waste (MSW) and move towards zero land fills

---

- ✓ Install waste heat recovery by design to tap the available potential

---

- ✓ Minimize the production of GHG & resource intensive OPC through rigorous adoption of alternative raw materials with a focus on conserving natural resources like coal, high grade limestone etc.

---

- ✓ Step up R & D efforts to enhance market awareness for application specific products in line with growing requirements for Green buildings and develop methods for recycling of concrete

---

- ✓ Enhanced engagement with policy makers

---

- ✓ Implementation of resource efficiency and cleaner production projects

---

- ✓ Focus on developing innovative technologies to further enhance efficiency of cement grinding and blending

---

- ✓ Strategy to use end - of - life mines in cooperation with local community

---

- ✓ Engage with other manufacturing sectors as follows:

### Automobiles

- ✓ Effective waste management (circular economy)
- ✓ R & D in material of construction, mechanical equipment
- ✓ Manpower skill development

### Chemical Plants

- ✓ Effective waste management (circular economy)
- ✓ Learning and instilling safety practices

### Engineering

- ✓ R & D in material of construction, mechanical equipment
- ✓ Manpower skill development

### FMCG

- ✓ Effective waste management (circular economy)

### Refineries

- ✓ Learning and instilling safety practices

### Sugar

- ✓ R & D in material of construction, mechanical equipment
- ✓ Manpower skill development









# About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has around 9000 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 300,000 enterprises from around 265 national and regional sectoral industry bodies.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

With 65 offices, including 9 Centres of Excellence, in India, and 11 overseas offices in Australia, Bahrain, China, Egypt, France, Germany, Iran, Singapore, South Africa, UK, and USA, as well as institutional partnerships with 355 counterpart organizations in 126 countries, CII serves as a reference point for Indian industry and the international business community.

# About Danfoss

Danfoss Industries Private Limited, an industry leader focused on climate and energy efficient solutions is a 100-percent owned subsidiary of Danfoss Group. Danfoss India serves a wide range of industries that rely on Danfoss solutions for heavy industries, refrigeration, air conditioning, HVAC, district cooling and heating applications. Established in 1998, Danfoss India is headquartered in Chennai with a nation-wide sales and support network comprising 10+ offices, 3 manufacturing units, R&D centre and a strong network of channel partners. With a renewed brand promise of Engineering Tomorrow, Danfoss engineers technologies that enable the world of tomorrow do more with less.

Initiative supported by



**Confederation of Indian Industry**

## **CII - Sohrabji Godrej Green Business Centre**

Survey # 64, Kothaguda Post  
R R District, Hyderabad - 500084 India  
Tel: +91 40-44185111  
Fax: +91 40 44185189

## **Contact:**

P V Kiran Ananth  
Principal Counsellor  
kiran.ananth@cii.in  
+91 40-44185111

[www.greenbusinesscentre.com](http://www.greenbusinesscentre.com)  
[www.cii.in](http://www.cii.in)

