Portends of the Indian Cement Industry – 2010 and beyond

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1. INTRODUCTION

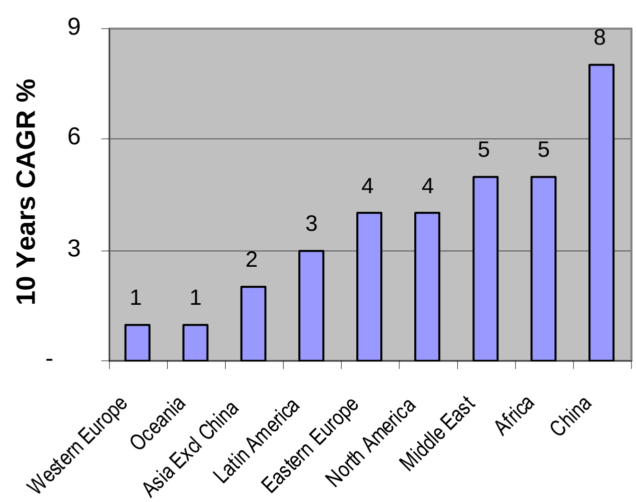
This paper is an endeavor at crystal ball gazing. Focusing primarily on strategic, rather than tactical, issues, it attempts to predict the multi-functional environment likely to prevail in the Indian Cement Industry between now and slightly beyond 2010.

2. THE MARKET FOR CEMENT

2.1 Cement Consumption

India ended FY 2006 (1 April 2005 – 31 March 2006) with a cement consumption of 142 mio t, registering a 10-year, cumulative growth rate of 8% pa. As can be seen in **Figure 1**, this compares very favourably with most economies of the world. However, India's per capita consumption, at about 130 kg, remains abysmal. This metric, alone, is a fair reflection of a high level of unfulfilled demand.

Figure 1 : World Cement Consumption Growth



Housing will continue to constitute the main application for cement consumption. The 2001 census showed only 34% of households living in cement-based housing. By 2010, this figure is estimated to touch 45%. Factors facilitating such a growth, include:

- Population growth, currently estimated at about 1.4% pa.
- A significant segment of the population is expected to enter the cement buyers' age category over the next few years.
- An expected growth of 12% pa in disposable incomes
- Accelerating rate of urbanization.
- Easy availability of housing credit
- Tax benefits for house building/ purchasing

The main inhibitor has been the high cost of building/ purchasing a house in relation to the current disposable income.

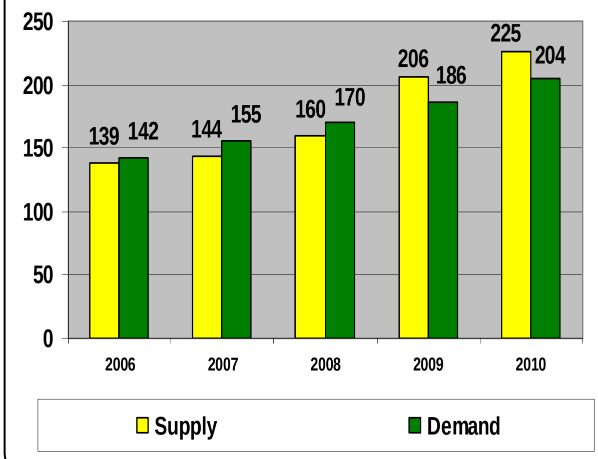
The commercial, industrial and infrastructure segments would also grow, though possibly at a slower rate than housing.

In India, growth in cement consumption has shown a very high correlation to the growth in Gross Domestic Product (GDP), irrespective of its sectoral composition. Based on an expected GDP growth of 7-8% over the next decade, which most economists seem to agree upon, conservative estimates place a cement consumption growth of 9-10% over the same period. With alternate projections, using end-use methods yielding similar results, we estimate a **cement consumption between 200-208 mio t in 2010 and 315-325 mio t in 2015**. This would result in a realistic per capita consumption of approximately 175 kgs per person in 2010

2.2 Cement Capacity, Production & Demand-Supply Balance

India's *effective* cement capacity is currently of the order of 170 mio t. This is derived from 137 production units, consisting of 106 integrated plants and 31 split located units (22 grinding units and 9 terminals). This figure takes into account plants producing consistently higher than their nameplate capacities as also inoperative capacities. As against this, about 150 mio t is expected to be produced in 2006. Applying our judgment about capacity likely to materialize from new projects (despite inflated announcements) and a certain degree of obsolescence, **cement capacity is likely to rise to around 250-260 mio t by 2010**. At this point of time, we estimate a total of 208 production units, consisting of 158 integrated plants and 50 split located units (30-35 grinding units and 15-20 terminals).

Figure 2 : Projected Demand - Supply Scenario



After adjusting our estimate for exports and considering an average capacity utilisation of 90%, we expect a domestic deficit situation upto 2008, changing to an **estimated surplus of about 21 mio t in 2010**. The demand-supply scenario, over the period 2006-2010 is shown in **Figure 2**.

Analysis indicates **a perpetuation of the trend of "capacity creation leading demand" in the time frame beyond 2010**.

2.3 Impact on Cement Markets

We have used two important metrics, Consumption Density (CD) and Supply Intensity (SI), to assess the impact on cement markets.

CD, which measures demand intensity per unit area, is a useful metric to consider in countries where outbound freight is high. We expect **CD growths to be particularly steep in three belts** - the **National Capital Region**, the **Western Maharashtra-South Gujarat belt** and the **Bangalore-Chennai belt**. High CD growths could also be witnessed in localized centres such as Hyderabad, Kolkata, Nagpur, Jaipur, Trichy, Indore and Chandigarh.

Supply Intensity (SI), measures the pressure on markets due to the proximity of supplying plants.

Figure 3 : Attractive Markets (2005)

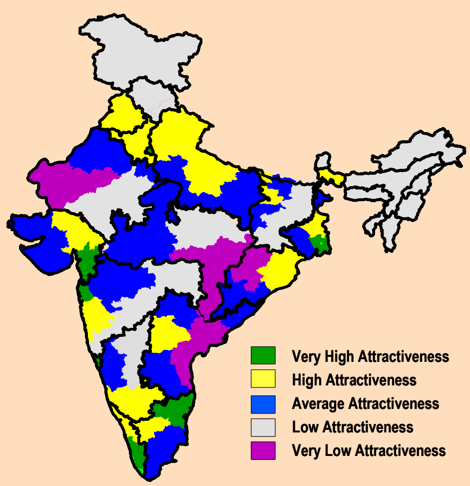
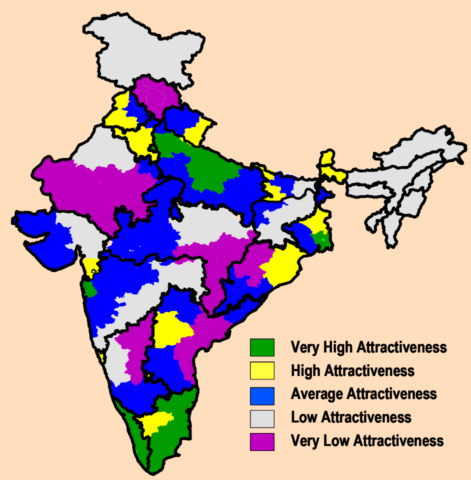


Figure 4 : Attractive Markets (2010)



Based on locational capacity projections, we expect **SI to increase in the states of Rajasthan, Himachal Pradesh, Haryana, Delhi, Maharashtra, Gujarat and the North East.**

Markets, which have a higher CD, and a lower SI, generally display higher prices and are consequently deemed more attractive. Based on our assessment of CD and SI, **Figures 3 & 4** are representations of attractive markets in 2006 and their progression into 2010. **States that would become more attractive are Uttar Pradesh, Tamil Nadu and Kerala while those that would become less attractive are Rajasthan, Himachal Pradesh, Karnataka and Gujarat.**

2.4 Exports & Imports

In FY 2006, India exported 9.4 mio t of clinker and cement, mainly to the Middle East, Africa and countries in the Indian subcontinent such as Bangladesh, Nepal and Sri Lanka. Imports were negligible.

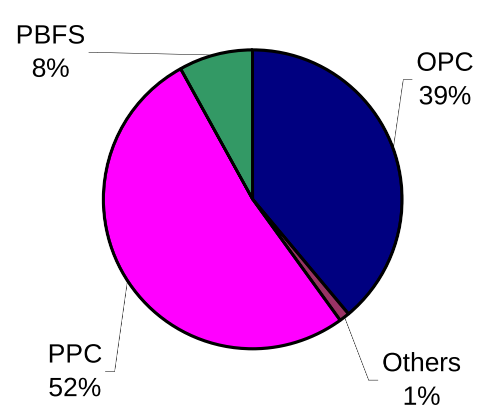
Indian exports suffer the disadvantage of high input costs, particularly influenced by their energy component. Additionally, given the poor developmental status of Indian ports, shipping charges (which factor in turnaround times) are high. With the looming surplus in the Middle East, between 2009-2013, Indian exports are likely to be severely curtailed. This surplus could also displace Indian exports from North Africa. However, with substantial capacity creation in North Eastern India, exports to Bangladesh could increase.

On an overall basis, we expect Indian exports of clinker and cement to decline to a level of around 5-6 mio t in 2010. **The Gujarat plants, which currently lead exports, are likely to be the worst hit**.

Imports are unlikely to attain significance. Logistical constraints and lower competitiveness, shall remain the major deterrents.

2.5 Product Mix

Figure 5 : Product Mix 2005



Blended cements constituted over 60% of the total cement sold in FY 2006, as shown in **Figure 5**. The imperatives to produce increased volumes of blended cement are many-clinker substitution by a cheaper material, freight reduction by split locating grinding capacity near blending sources, conservation of dwindling limestone reserves and the enhanced future availability of both flyash and slag.

However, in certain urban markets, we foresee a reversal of this trend. The Ready Mix Concrete and Ready Mix Mortar (RMM) segments, which are expeditiously gaining prominence, could prefer captive blending, rather than pay a higher tax (excise duty) on their total cement input. This, could inhibit the growth of blended cement.

On an overall basis **we foresee the share of blended cement, rising from its current level of 60%, to reach a peak of around 75% by 2010.** However, as explained later, in this paper, industry concerns about the diminishing, mineable reserves for limestone could lead to a higher share of blended cement in the years beyond 2010.

2.6 Prices

Cement prices have risen in the last 1-2 years after remaining stagnant for a very long time. Average retail prices of packed cement are currently hovering at around US $ 85/ t.

Factors facilitating an increase in future prices, include:

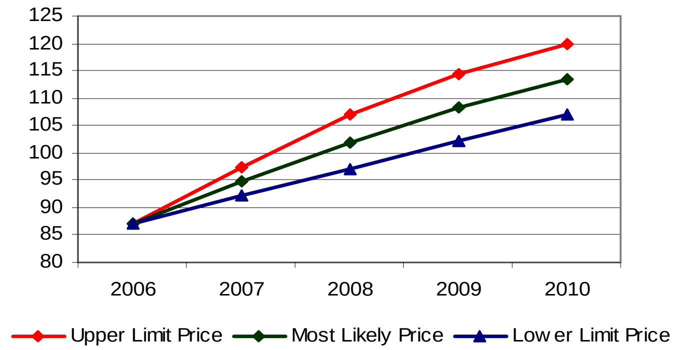
- Demand-supply scenario
- Returns (minimum 15%) expected from investment in capacity creation/ acquisition

- Increase in input costs
- Phasing out of incentives.
- Price discipline and check on unfettered capacity expansion induced by industry consolidation

Factors favouring a decrease in future prices, include:

- Economics of scale on account of larger plant sizes
- Higher volumes of low cost blended cement
- Industry move to take advantage of the price elasticity of demand. The attempt would be directed towards increasing sale volumes and its absolute money value, while forsaking % margin

Figure 6 : Projection for Future Price (US $ per t)



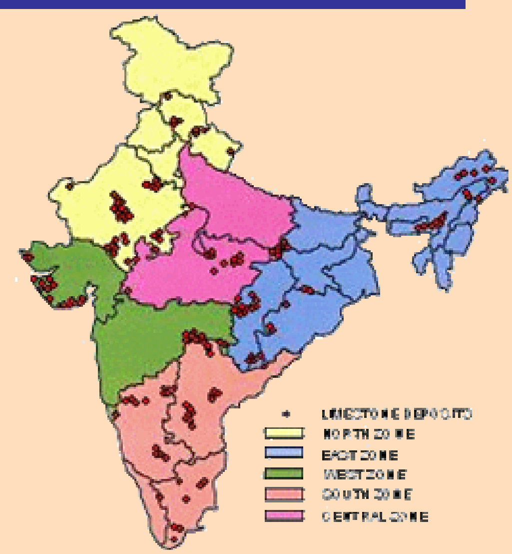
As depicted in **Figure 6**, our simultaneous analysis of all the above factors, using "goal-seek" to determine the price at which a 15% return could be ensured for new investment, seems to indicate **an average industry retail price between US 110-115 in 2010**. This translates into an average ex-factory price of US $ 60-62. Price differentiators, for obvious reasons, would however exist between players (image related) as well as markets (CD-SI related). Even at this high retail price, our analysis shows that the delivered cost of cement in India would still render imports, financially non-remunerative.

3. RAW MATERIALS

3.1 Limestone

Figure 7 depicts the dispersion of 272 limestone deposits within India. The total limestone reserves in these deposits, which have individual tonnages greater than 50 mio t and CaO values exceeding 42%, is estimated at 37 bio t. Of this, 4 bio t, fall in forest land and 18 bio t in areas that are otherwise statutorily blocked. This **leaves approximately 15 bio t of exploitable cement grade limestone. Given the expected industry growth rate and its current utilisation pattern of limestone, this reserve could be fully consumed by 2030!**

Figure 7 : The Limestone Map of India



Corroborative action that could be launched to defer such a "doomsday" prophecy, could include:

- Scouting and exploration of new deposits, negotiating the removal of certain statutory restrictions and redefinition & optimization of mining limits/ norms/ utilization patterns and could lead to an incremental reserve of 40 bio t. This would advance the "no limestone" eventuality to 2040.
- Conversion of the industry's product mix to 100% blended cement beyond 2015. This would extend limestone life by an incremental 5 years.
- Deliberately slowing down the industry growth rate to 7.5% pa between 2016-2020 and 6% pa beyond 2020. This, in tandem with the other measures, would postpone complete depletion to 2055.
- Active exploration of the use of calcareous industrial waste as a substitute for limestone. In the absence of sufficient research, life extension on this account is currently difficult to assess.

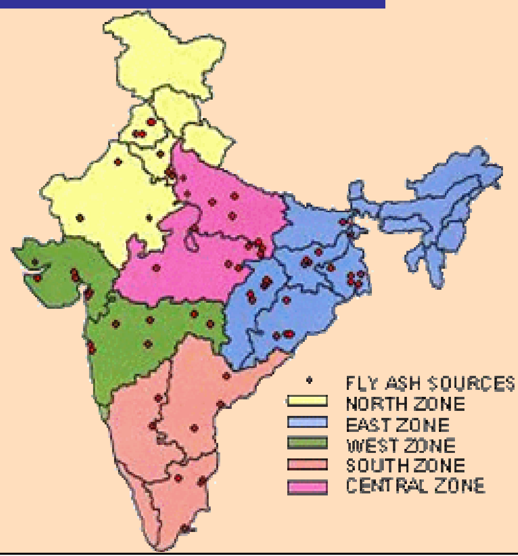
Whatever be the corroborative measures taken, **access to economically exploitable limestone resources would constitute a source of sustainable competitive advantage for individual players**. Planning and securing the availability of suitable limestone resources, much ahead of capacity expansion, thus, constitutes an immediate imperative.

3.2 Blending Materials

Pozzolanic Materials

Flyash, India's primary source of pozzolana is mainly derived from thermal power plants (TPPs), the locations of which are shown in **Figure 8**. TPPs currently generate about 100 mio tpa of flyash, 42 mio t of which is utilized-21 mio tpa by the cement industry. Based on the power projects, currently under execution, we estimate an incremental release of 80 mio tpa of flyash, 5 years from now. Despite the fact that cement producers, today, are seeking to secure, strategically-located, flyash supply well ahead of TPP commissioning, constraints in long-tem availability are unlikely. **Against a potential supply of 120-140 mio tpa of "specific quality" flyash in the next 5 years, the demand of the cement industry is slated to increase to only 40 mio tpa by 2010**, and 100 mio tpa, a decade thereafter.

Figure 8 : Fly Ash Sources



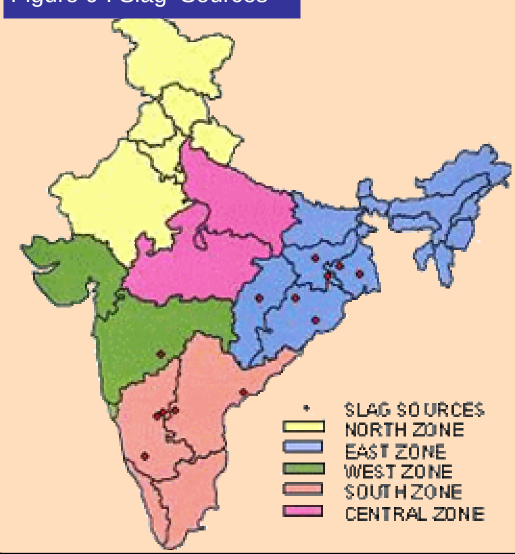
There are reports, however, of the state-owned, National Thermal Power Corporation (NTPC) creating a separate entity for flyash exports. It is understood that private players, even today, are engaged in flyash exports. Reliance Power, a private sector player, is also reported to have developed plans to separate flyash fines and sell it as a value added product. Given the change in its "value-perception", **flyash supplies, which till now had been offered free of cost, could possibly be priced in the times to come.**

Other than flyash, laboratory trials have shown **alternate pozzolanic materials such as rice husk, bamboo dust, calcined clay, etc to have acceptable cementitious properties**. Our studies indicate the strength characteristics of rice husk-based cement, in particular, to be well in line with market expectations. Logistical constraints of collection & distribution have currently inhibited usage on a commercial scale. Outsourcing this activity, through appropriate contracting, could well increase future usage.

Slag

After flyash, slag, produced as a waste material by steel plants, is the next most popular blending material. **Figure 9** depicts the slag map of India. Due to source concentrations, freight considerations dictate its geographic usage. Against a current availability of 10 mio tpa, usage by the cement industry is of the order of 6 mio tpa. This **usage is expected to grow to 10 mio tpa by 2010 against an availability of 17 mio tpa**. Mega steel projects, currently under conception by the Mittal Group, POSCO and others, would further increase its availability and should be **abundant to satisfy the cement industry's requirement of 25 mio tpa in 2020**.

Figure 9 : Slag Sources



Due to the pressing need to dispose slag, there are recent moves by steel producers (e.g. Steel Authority of India, Jindal Vijayanagar Steel, etc.) to enter the cement industry, either through a joint venture with an existing cement player, or independently. While this, by no means establishes a trend, **specific players in the cement and steel industries may enter into mutually beneficial strategic alliances**. In addition to this, several steel producers are currently contemplating the **production of ground slag to meet domestic and export demand**.

4. INFRASTRUCTURE & UTILITIES

4.1 Land

The selection of a site for a cement plant is primarily dictated by its logistical access to raw materials, markets, infrastructure and utilities. Despite India being a very large country, the dwindling number of locations that meet acceptable standards for these criteria, and the large number of small private land holdings involved, would make **land acquisition, for future greenfield units, an increasingly cumbersome and time-consuming pre-project activity**.

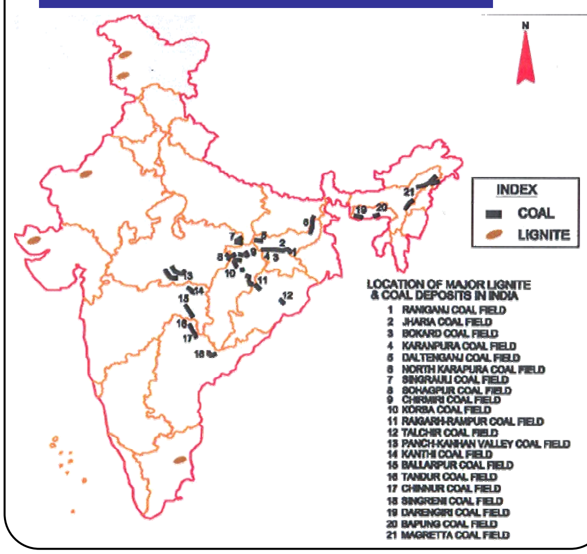
For projects conceived upto 2010, our estimates place the total land requirement at 18,500 hectares. Over the past two years, realty rates have increased by over 100 %. In certain states such as Himachal Pradesh, escalation percentages have been particularly steep. Thus, land acquisition, which till now had constituted a relatively insignificant project component, will assume a much more significant dimension in the times ahead, both in terms of the time it would take as also its cost.

4.2 Fuel

The primary fuel used in India is coal. Its proven reserves are of the order of 100 bio t. Post 1998, its demand has sharply increased and a coal shortfall of around 160 mio t has been projected in 2010. While the impact of this shortfall on the Indian Cement Industry is currently unspecified, a **major crisis is clearly foreseen in the future availability of domestic coal**. Further, as the demand pressure on coal increases, industry observers foresee a **minimum price increase of 12-15%pa**. This would significantly impact cement production costs.

Since coal deposits are mainly in eastern and central India, as seen in **Figure 10**, cement plants in other parts of the country, wherever feasible and commercially viable, have been making arrangements for alternate fuel. Already, many plants in Gujarat, Rajasthan and South India, use pet coke, imported coal and lignite. The use of lignite in the times ahead would remain restricted, mainly on account of its poorer calorific value and difficulties in storage. In light of the shortages expected in domestic coal, the demand for pet coke and imported coal are, thus, bound to escalate.

Figure 10 : The Coal Map of India



Reliance is the only significant pet coke producer in the country with a capacity of 2.7 mio tpa. Indian Oil's refinery at Panipat is likely to start producing 0.7 mio tpa, soon. While exact figures are not available, the cement industry is currently estimated to be consuming about 1.3-1.4 mio tpa. Power plants constitute the other main user segment. It is estimated that the **cement industry's demand for pet coke would possibly exceed 3 mio tpa in 2010**. In the absence of other potential sources, **a shortage in the domestic supply of pet coke appears imminent**.

India's main sources of coal imports, in recent times, have been Indonesia (38%) South Africa (21%), China (19%), Australia (17%) and Russia (5%). The advantages of imported coal are its relatively high calorific value, low ash content, low moisture and the availability of credit at international rates. While precise estimates for future availability are not available, **the demand for imported coal by the Indian Cement Industry is likely to exceed 6-7 mio tpa in 2010**.

Anticipating a severe shortage in the future domestic availability of solid fuel, large users, in both cement and power, are understood, **to be already negotiating possible investments, directly or through joint ventures, in coalfields outside India.**

The usage of waste fuels has not yet picked up in India, primarily on account of a lack of organized collection systems. Among these, municipal and agricultural wastes appear to have the most significant usage potential. Given the shortages foreseen in conventional fuel, the availability of facilitating combustion technologies and the presence of international majors with past experience in waste fuel usage, future utilisation is bound to increase. With pioneering attempts already afoot, **it is our view that by 2010, these fuels would supply approximately 5-7% of the total thermal energy requirements of future cement plants**.

Gas, as a principal fuel, has been rarely used by any cement plant in India. The HBJ gas line was intended, to service a variety of prospective consumers, including cement plants. The problem, apart from logistics, was a lack of agreement on pricing. A 2 mio tpa cement plant is estimated to require about 4 MMSCMD (mio standard m^3/ day) of gas. 85% of India's gas production of 87 MMSCMD, is understood to be consumed, 73% by the power and fertilizer sectors. With new gas discoveries in the Krishna Godavari basin (in the order of 5 trillion standard m^3/ day), **we foresee at least some cement plants in the southern states switching over to gas**. In addition, if the proposed gas pipeline from Iran actually materializes, there could be prospective consumers in North India, as well. The timing for gas use by the cement industry, as well as specific volumes, remain uncertain.

4.3 Power

The worsening power situation in the country, both with respect to reliable availability and cost, has forced the cement industry to take pro-active steps aimed at self-sufficiency. Plants are increasingly relying on captive generation to meet their entire power needs. In 2005, approximately 45% of the domestic cement production used captive power as compared to 21% in 1995. This trend is growing and most greenfield plants are being set up with full-capacity, captive thermal power plants. **The power generating capacity of TPPs in the Indian Cement Industry is currently estimated at 1,800 MW. This is likely to grow to 3,000 MW by 2010**. The growth would be in both existing and new plants.

An important consideration is the fuel these power plants are likely to use. With solid fuels getting scarce and the upward spiral of global prices for liquid fuel, **combi-fuel options are possibly the best bet**. **Waste fuel supplements** are also likely to be used. **Wind power** has been used in some southern plants and could also find some usage in Gujarat. Gujarat has also considered the use of **tidal power**. We understand that some plants have been also considering the use of **solar power** to meet lighting and auxiliary loads. The cost economics, however, remain uncertain.

The government has been trying to get the private sector to invest in power. In order to reduce generation costs, **multi-unit cement companies, we understand are exploring the feasibility of setting up mega thermal plants at locations where fuel can be conveniently sourced, delivering the power to the national grid, drawing it at its own consumption points and selling the excess to the government**. The chances of success of such a scheme would, undoubtedly involve a fair amount of legislation and negotiation. **Alternatively, cement producers could investigate contracting alliances with independent power producers (IPPs), to source uninterrupted power**.

4.3 Water

The industry currently uses approximately 61 mio m^3 of water, annually. Despite selecting water-conserving plant equipment, **the industry's requirement for water is expected to grow to 102 mio m^3 by 2010**. Natural water bodies and ground water have been the usual sources. Some coast-based producers in Gujarat use RO based desalination to process sea water. However, the growth of population & industry, coupled with poor water management, has severely depleted existing sources**. A water shortage could well be faced by the industry in the times to come**.

Recognizing the pressing need to address these issues, the government has constituted various bodies to lay down policy guidelines and programs for the development & regulation of the country's water resources. **In the years to come water is likely to be included in the list of environmentally sensitive items and it is likely**

that cement companies will need to submit a water management plan and institute measures to mitigate the deleterious impact that a plant has on water resources.

4.4 Logistics

Transportation cost, both inbound and outbound, accounts for almost 50% of the cost of delivered cement. Long leads, from both input sources (other than limestone) and markets, constitute the primary cause. Solid fuel, which in volume terms forms the bulk of procured inputs, is usually transported by rail. For cement despatches, however, rail has only a 33% share, which is further shrinking. Apart from the reduced and unreliable availability of railway rolling stock, road transport offers greater flexibility in terms of routing, reach and transshipment efficiency. With plant sizes getting bigger, the need to reliably access distant markets will increase. The major initiatives launched by the government in the highways sector could result in improved road conditions that would enable larger vehicles to be used. **In terms of volumes, we foresee the share of road transport increasing from the present 67% to 80% for cement despatches in 2010**.

While better transport infrastructure and greater industry attention to logistics would create a downward pressure on operating costs, we expect enhanced fuel prices to still result in a **net 7-9% pa increase in freight costs in the times ahead**.

Plate 1 : Cement Terminal

Apart from road transport, we expect sea transport of clinker/ cement, especially from the Gujarat plants to grinding plants/ cement terminals in other parts of India, to go up substantially. One such existing terminal is shown in **Plate 1**. Despite an increase in the state demand from 10 mio t in 2006 to 14.3 mio t in 2010, capacity additions of about 10 mio t and an export decline of 3 mio t would lead to surplus of about 11 mio t in 2010. This surplus would be pushed, primarily to the west coast and possibly, lower parts of the east coast. Given a reasonable coastal unit size of 0.5-1 mio tpa, **12-15 such coastal units, either in the form of terminals or grinding units, would need to be created**. The proposed policy, on corporatisation of major ports and privatisation of minor ports, would facilitate this endeavour. Already, 17 projects worth approximately US $1 bio, have already been approved and are under different stages of implementation. An additional eight, approximating US $ 700 mio, are under active consideration.

5. IMPLEMENTATION PERIODS

Implementation periods for cement projects in India have been getting progressively shorter. Projects have been implemented within 18 months of order placement for main equipment. However, in the times ahead, this trend is likely to reverse. We are of the opinion that **cement projects will need at least 24-30 months to be implemented after the main equipment has been ordered**. The reason for this is the global capacity constraint being faced by equipment suppliers in coping with inflated order books.

The **overall period for project implementation is also likely to be much longer - in excess of 42 months**. The respective durations for pre-project activities, such as land acquisition, obtaining prospecting & mining rights, environmental clearance, etc., are expected to significantly increase. The main reasons for this are environmental concerns, legislative bottlenecks and specific resource scarcity.

We also foresee a shift in the mode of project execution, from the erstwhile shopping mode (multi-packages, multi-suppliers) to the semi-turnkey mode. While the former is believed to be more economical, it requires much more intervention and control by the project owner. Worldwide, the latter mode is preferred, considering its twin advantage of a single point responsibility and possible reduction in implementation time.

6. PROJECT CONCEPT, TECHNOLOGY AND OPERATIONS

Changes expected by us in project concept, technology and operations, are mentioned below:

- Given the price elasticity of cement demand, as measured by us in various markets, cement manufacturers could increasingly recognize the possibility of enhancing absolute values of realization through lower delivered prices. **Cost reduction efforts could therefore target improving cement affordability**, and thus its per capita consumption, rather than targeting profit margin.
- The **range of products available, progressive volumes and respective quality specifications could undergo significant change** on account of market forces, cost imperatives and alignment of quality standards to those accepted globally. A large component of this change could be effected through technology intervention.
- **Operations would be increasingly dominated by environmental considerations** with issues such as more demanding emission levels, conservation of scarce natural resources, lower human dependency, etc., being factored into normal operations.
- Scale economics would continue to dictate clinkerization capacity. While 10,000 tpd kilns would be set up, wherever possible, **we foresee average kiln sizes exceeding 6,000 tpd**.
- To conserve transport costs and improve delivery times, **split locating grinding capacity**, proximate to blending material sources & markets, and **creation of bulk terminals** at coastal locations, would become more common. As against 31 split located units with an effective capacity of 28 mio tpa today, **we expect the number to grow to 50 by 2010 with a capacity of about 51 mio tpa**. Of these, we expect at least **12-15 new locations to be created on the western/ lower eastern coast**.
- To address the steeply growing demand of downstream industry, the **proportion of bulk cement would increase from its current level of 5% to about 12-15% in 2010**.
- A variety of technological advancements would lead to significant improvements in energy consumption. As against current “best” values of 680 kcal/ kg clinker and 74 kwh/ t of OPC 43 respectively, **we see thermal energy consumption dropping to 670 kcal/ kg clinker and electric energy consumption dropping to about 60 kwh/ t of OPC 43** for new capacities.
- **Developments in Unit Operations**
  - **Mining**: Increasing use of surface miners; utilisation of marginal grade limestone by employing flotation processes to reduce silica and adding calcareous industrial waste for enriching lime; improved drilling & blasting operations through better drilling geometry and explosive technology; choice of larger and more fuel efficient mining & transport equipment, etc.
  - **Crushing**: Availability of larger crushers capable of handling 1.9 m X 1.9 m boulder sizes; throughputs exceeding 2,000 tph for a product size of 75 mm which is acceptable to technologically advanced, raw grinding system.
  - **Raw Grinding**: Adoption of larger (motor sizes ~ 6,300 KW) and more energy efficient VRMs with longer roller/ table lives and improved material bed development; throughput augmentation through higher residues acceptable by technologically advanced, pyroprocessing equipment.
  - **Pyroprocessing**:

    Preheaters: 6-stage, single string preheaters with clinkering capacities upto 6,000 tpd; increased cyclone efficiency from 92 - 94%; reduction in cyclone dimensions resulting in a pressure drop reduction from 700 to 400 mm WG and a tower height reduction of 10 - 15 m; reduction in the total air requirement from to 1.6 to 1.45 Nm^3/ kg clinker; improvement in fan efficiencies from 72 - 76%.

    Precalciners: Degree of calcination pegged at 94% to prevent the onset of liquid phase; calciner to kiln fuel ratio of 70:30; increased residence time from 2 to 5 seconds to improve combustion efficiency of fuel mix would result in more acceptable NOx values.

    Kilns: Redefinition of operating parameters - volumetric loadings upto 7 tpd/ m^3, thermal loadings upto 5.5 Gcal/ m^2/ kg clinker, filling % of 14-16 and kiln speeds upto 5.5 rpm; 2 pier installations with a drop in l/d ratios to 10-11; residence time reduction from 30 to 20 minutes; low primary air, multi-channel burners using sophisticated weighing systems; better refractory life through use of improved refractory technology and greater raw material homogeneity & controlled burning conditions.

    Coolers: Increased adoption of new generation (e.g. “walking-floor”) coolers resulting in increased cooler efficiency from 68-76%, a drop in air requirement from 2.2 to 1.6 Nm^3/ kg clinker, a temperature increase of secondary/ tertiary air to 1,000 ºC, increase in cooler loading to 55 t/ m^2 and significantly reduced, installation time.

- **Finish Grinding**: In view of their overall cost (capital and operating) effectiveness, large VRMs, with capacities upto 375-400 tph for OPC 43, seem to be flavour of the new decade; as against their current restricted use in blended cements, their usage in the times ahead could span all cements as well as slag; technology developments, including metallurgical interventions for reducing wear rates, formation of stabilized clinker beds, etc, seem to have helped their cause.
- **Packing & Despatch**: To meet increased demands, increased adoption of 240 tph, twin discharge, 16 spout packers are likely; to address variable market demands and despatch modes, flexibility in the despatch section would need to be significantly enhanced through appropriate automation.

- **Others:** Other areas of plant technology & operation, that could see significant changes, include:
  Automation, Instrumentation & Plant Control Systems aimed at reducing human intervention, automated maintenance (e.g. lubrication) and better process measurement & control. This includes new technologies such as intelligent MCCs, serial bus architecture, satellite communications, etc.
  Material Handling Systems targeted towards achieving higher capacity, smaller area requirements and lower wear rates.
  Integrated Quality Assurance Systems to ensure alignment to International Standards such as EN-197; market demands for higher 1-day strengths (by interventions in C_3S and product fineness), quicker initial setting (through C_3A and gypsum interventions), darker product colour (intervention in C_4AF), etc would assume increased importance.
  Operations Research and Statistical Tools are expected to be increasingly used; e.g. logistical applications such as the management of vehicle queues (seen mainly in limestone transport and cement despatch), transportation/ transshipment optimization, etc.
  Significant interventions would be made in **equipment choice, maintenance practices, materials' management and other associated systems**, targeted at enhancing plant/ equipment availability; larger plant/ equipment sizes and the consequent high opportunity cost of downtime would enhance the relevance of such interventions.
  Sophisticated supply chain management systems, using customized ERP packages would be increasingly adopted for inputs as well as outputs; benefits would include lead time reduction for inputs & outputs, optimization of inventories, etc.
  Environmental norms are likely to get more stringent and technology development & acquisition would need to keep pace; e.g. lowering of dust emission norms, from 50 mg/ Nm^3 to 10 mg/ Nm^3 may result in the increased adoption of hybrid filters; the pressure to reduce CO_2 emission could unleash a variety of clean technologies & practices such as cogeneration of power using waste heat, incineration in cement kilns of waste materials to meet the dual objectives of waste disposal & cost reduction, separation of CO_2 from kiln exhaust gas and its utilisation in value products, etc.
  Greenhouse gas emission in India, at a per capita level, is far less than the permissible limit allowed under the Kyoto protocol; hence, India, is exempted from the framework of the treaty. While this is not seen as a problem for capacity expansion, as in Europe, carbon trading has also not been a major source of revenue for cement companies, probably because of the complicated paperwork involved and the time and effort required to obtain a credit. In the years to come, we envisage a minimum increase of 30% in the degree of participation in carbon trading by the Indian Cement Industry. Technology & operational interventions would be initiated to realize this.

7. MANPOWER

The Indian Cement Industry currently employs approximately 35,000 persons. With an increase in plant/ equipment sizes, higher levels of automation, and a moderate degree of outsourcing (particularly in mining and packing & loading), the headcount per mio tpa of cement capacity has declined from about 350 in 1995 to about 200, today. It has already been stated that about 80 mio tpa of capacity is slated to be added by 2010, with an average plant size of 2 mio tpa. If a 40% increase in manpower productivity were targeted for new capacity, through automation and increased outsourcing, and a 15% improvement for old capacity, **an additional headcount of 4,000-5,000 would still be necessitated by 2010**.

Given its size, its vintage and its language skills, the Indian Cement Industry has historically been a source of trained manpower for the MENA region. Given a capacity explosion of almost 100 mio tpa in this region by 2010, conservative estimates place a **headcount flight of approximately 2,000-2,500** from India to various countries in this region.

Consequently, **by 2010, an incremental requirement of 6,000-7,500 persons is likely to be faced by the Indian Cement Industry**. This roughly translates into an annual, perpetuating requirement of roughly 400 managerial & supervisory staff and about 1,300 operatives, skilled, semi-skilled & unskilled staff between 2006 and 2010.

Strategies to address this huge shortage would include corroborating with educational & training institutes, extension of retirement age, enhancing emolument levels, accelerated development of outsourcing partners, etc. Even though the % share of salaries & wages in the total cost pie is not expected to significantly increase, **individual emolument packages, especially for managerial & supervisory manpower could increase by as much as 20-25%, annually**.

8. FINANCE

8.1 Investment

Investment costs in a cement project (excluding captive power) today, are of the order of US $ 80-85 per annual installed t. Despite the economies effected by increasing plant size, itemized analysis of likely escalations indicates that **investments costs would possibly go up by 20-25% between 2006 and 2010**. Steep escalations in the price of steel, high order bookings of equipment suppliers & construction contractors, increased outlays necessitated on infrastructure development, rising cost of borrowings and longer implementation periods constitute the primary reasons. Despite this, investment costs in India would continue to compare favourably with global costs, mainly on account of the high indigenous content of equipment and the domestic availability of adequate skills.

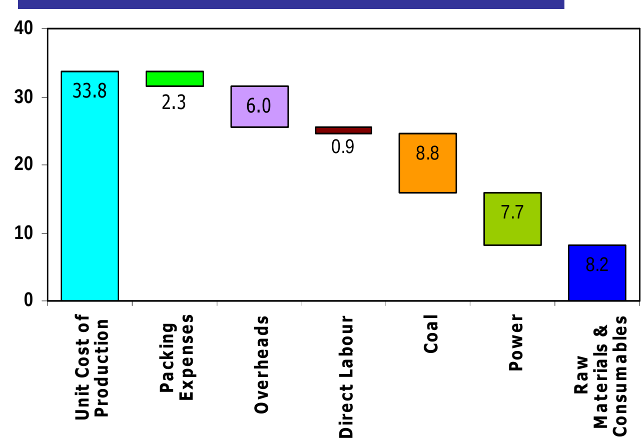
We do not expect Chinese equipment to make serious inroads into the Indian market because of the comparatively lower price differential as also the added costs for transportation. However, the threat of low priced Chinese equipment could force Indian manufacturers to keep a check on their prices.

Based on the capacity development foreseen, the likely unit investment costs, and the respective project durations, we estimate an investment spend exceeding US $ 9 bio over the period 2006-2010 for new capacity creation. In addition to this, as reported later in this paper, we expect an investment infusion of about US $ 3 bio in M&A activity. Creation of captive power facilities, plant rehabilitation, de-bottlenecking and performance enhancement could further consume about US $ 1.5-2 bio. Consequently, on an overall basis, the **total investment spend on the Indian Cement Industry would approximate US $ 14 bio between 2006-2010.**

8.2 Operating Costs

Figure 11 depicts the current cash cost of producing OPC by a typical cement plant. Cement production is an energy intensive process and energy costs account for almost 50% of the total cash cost.

Figure 11 : Unit Cost of Production (US $ per t)

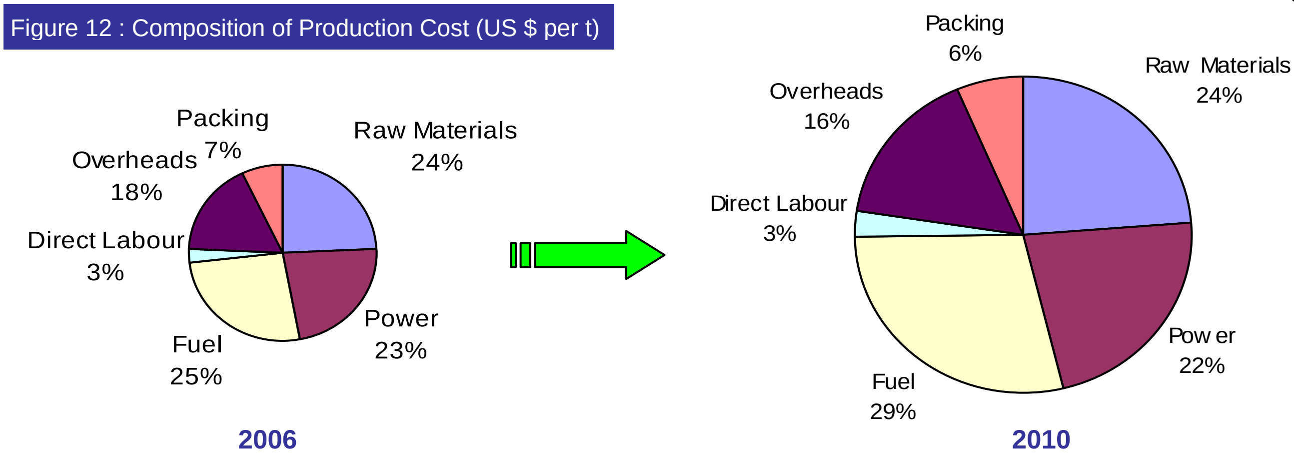


Componental analysis shows that the **cash costs are likely to increase by about 33% between 2006-2010**. The major increase would be due to the expected increase in the cost of fuel. This would have a direct impact on the cost of thermal energy and an indirect impact on the cost of electrical energy (since the cost of producing it by thermal power plants will go up).

The other major variable cost, that of raw materials, may go up primarily due to higher freight charges as diesel becomes more expensive. This will also have an impact on the cost of raising limestone as most mining equipment run on diesel. In addition, limestone costs would also go up as plants deplete their easily mineable reserves and subsequently need to exploit mineral with poorer recovery ratios.

Our analysis for the composition of the cost of production in 2006 and its progression to 2010 is depicted in **Figure 12**.

Figure 12 : Composition of Production Cost (US $ per t)



Profitability & Share Prices

Cement being a cyclical industry, returns shoot up in the good years and fall drastically in the bad years. Of the last 10 years, the period 1997-2001 was disastrous, with net margins in the industry ranging from negatives to low single digits. The fortunes of the industry revived in 2002 and net margins have since, steadily improved.

Our analysis shows that though production costs are expected to rise by 33% by 2010, sales price would increase by around 35% over the same period. Thus, **EBIDTA margins currently ruling at around 26-30%, could improve to 30-34% by 2010**. Presently, P/ E ratios in the industry have a wide range, 4.7 to 48, with a mean of 21 and a standard deviation of 9.3. Applying the same P/ E ratio to projected post tax earnings in 2010, we expect **share prices of cement companies to go up by an average of 50% in the period leading up to 2010**.

9. OWNERSHIP

9.1 Current Ownership

Presently, the Indian Cement Industry can be clearly divided into **three ownership segments**.

The **first segment** consists of the **country majors** - the Holcim controlled ACC & Ambuja (33 mio t) and the Aditya Birla Group controlled Grasim & Ultra Tech (31 mio t). We expect these two players to alternate leadership positions in the future, adding capacity both through greenfield/ brownfield enhancement and acquisitions.

The **second segment** consists of the **regional majors**, controlling a total capacity of approximately 70 mio t. This segment includes India Cements (South), Lafarge (East), Jaypee (North & Central), and groups like Century, Shree Cement, Birlacorp, Dalmia Cement, etc. The individual capacities of these players currently range between 5-10 mio t. Several of these players, have announced intentions of setting up new plants, not necessarily in their own region. Jaypee and Shree Cement appear to be the forerunners in this initiative. These players are, however, without resorting to acquisition, unlikely to attain the all-pervading status of a ‘country major’.

In the **third segment** are the **standalone players**, who together constitute around 20% of India’s total cement capacity. These players run the risk of getting marginalized. The few government-controlled companies, such as CCI, TANCEM, J&K Cement fall in this category.

The **international majors**, currently operative in India are Holcim, Lafarge, Italcimenti and Heidelberg. Of these only Holcim, despite its late entry, has been able to secure a dominant presence.

9.2 Ownership Change

The buoyant conditions being currently experienced by the cement industry has prompted several domestic companies, currently engaged in steel, chemicals and shipping, to announce aggressive intents to enter the cement industry in a large way through capacity creation. It is still to be seen whether these intents actually materialize into real capacity.

As far as capacity exchange is concerned, India represents a primary growth market. Therefore, the attempts at acquisition are likely to continue. The questions that arise are, therefore, **who would sell, who would buy, at what prices would the transactions occur and what would be their timing**?

Sellers: Companies constituting the third ownership segment, as described in the previous section, offer the greatest potential for a takeover. The takeover could either be in the form of a complete buyout or through the creation of a buyer-dominated Joint Venture (JV). The latter assumes a high possibility in cases where the seller wishes to expand its capacity base without possessing the required financial resources. We are of the opinion that some of the second segment companies too could enter into JV agreements for at least a part of their capacity expansion plans.

Buyers: International majors and domestic companies in the first ownership segment would certainly constitute prospective buyers. In a few cases, companies in the second segment could also be interested in acquisition. In addition, emerging cement majors, especially from the MENA region, could aspire for a stake in the Indian Cement Industry. International investment firms, apart from offering debt funds, could also be keen to purchase equity stakes, not only in existing companies, but also in the massive capacity expansion plans.

Transaction Price: Holcim's acquisition of ACC raised the bar for the valuation of Indian cement capacity. While earlier acquisitions were made at US $ 80-85 per t of cement capacity, Holcim paid over US $ 200 per t, ostensibly to carve out a large capacity space in an otherwise fragmented market. We expect this trend to continue with cement capacity offerings deriving value premiums based on their respective size. Factoring in the increased valuation due to the forecasted 50% increase in share prices, while the second segment players are likely to command valuations in the range of US $ 225-250/ t, the third segment players would probably offer capacity at US$ 150-175/ t.

Timing: The period 2006-2010 is indicative of robust margins. Consequently, we do not see any significant, standalone change in ownership for capacities created earlier to 2006. This is evidenced by the fact that while M&A discussions continue unabated, deals are not materializing on account of a dissonance between expected and offered price. What could however happen is that a buyer participation in capacity creation is invoked through a strategically linked, change in the existing ownership structure of older capacity. We are of the opinion that this would possibly happen in the period 2008-2010 where ownership changes could occur in 15 mio t of old capacity.

10. CONCLUSION

The demand for cement is expected to grow at 9-10% pa, rising from about 140 to over 200 mio between 2006 and 2010. The same momentum of growth is likely to continue over the subsequent 5 years. Due to higher export returns upto 2008, the country could well witness a cement shortage between now and 2008.

Capacity addition would be of the order of 80 mio t between 2006 and 2010. The number of operating cement units is expected to increase from about 140 today to almost 210 in 2010. Country majors and regional majors would spearhead this industry expansion. However, a few new players could also enter the industry. The planned capacity would require an investment inflow of about US $ 9 bio over the period 2006-2010. A further inflow of US $ 1.5-2 bio would be required for power generating facilities and plant improvements. Gestation periods for setting up capacity are expected to increase to 36-42 months, chiefly on account of environmental clearances, hurdles in land acquisition and higher equipment delivery times.

For new capacities, plant/ equipment sizes are expected to increase with the average size for a clinkerization being 2 mio tpa. Split located units would be increasingly preferred with a large number of such units coming up in coastal locations. Over 50 such units are expected to be operating in 2010. Technological innovation would possibly result in a thermal energy consumption of 670 kcal/ kg clinker and an electrical energy consumption of 60 kwh/ t of OPC 43. Blended cement consumption is expected to increase from 60% today to about 75%.

Capacity addition will put unprecedented pressures on input resources like land, limestone, fuel and manpower. Players would thus compete, not only in the market, but also in attaining strategic control over input resources.

While cash costs of production are expected to increase by 33% over the period 2006-2010, increase in selling price would be compensatory. An average retail price between US $110-115/ t is expected to prevail in 2010, up from its current value of US $ 80-85/ t. Increased EBIDTA margins, between 30-34%, would contribute to a possible increase in share prices by 50% between 2006-2010.

The prevailing buoyancy in the industry could deter M& A deals between 2006-2010 due to possible dissonances between expected and offered prices. However, due to fund requirements, Joint Venture agreements could be effected in new capacity creation. This could induce strategically-linked, ownership transfer in about 15 mio t of older capacity. The investment inflow in such transactions could be of the order of US $ 3 bio.

The cause-effect trends that we foresee in the Indian Cement Industry, over the period 2006-2010, are depicted in **Figure 13**. Successful companies would be those, which figure out the most effective & efficient processes to manage the links that are posed by these trends.

Figure 13 : Cause-Effect Trends in the Indian Cement Industry