Assessment of energy use and energy savings potential in selected industrial sectors in India

Indian industry uses energy more intensively than is the norm in industrialized countries. While selected modern Indians units often display very high efficiency that approaches the world's best practice levels, the average intensity tags behind

Indian industry has undergone a transformation since 1991, the year the economy was opened to foreign investment and competition. Energy per unit of value added in the industrial sector has declined since. However, there still remains considerable scope for continued improvement of energy efficiency in Indian industry, and for learning from best practices from India and worldwide.

This scoping study assesses the intensity of energy use in Indian industry, identifies national and worldwide best practice energy intensity levels, and based on the assessment suggests areas for improvement. This work focuses on five energy-intensive industrial sectors – fertilizers, textiles, chlor-alkali, cement, and petroleum refining (Table 1).

Table 1: Industrial energy consumption, India, 2001

	Net value Added M Rs	% of Industry	Final Energy (PJ)	% of Industry	Primary Energy (PJ)	% of Industry
Total Industry	1,443,021	100	4,477	100%	5,270	100%
Cement	42,137	3	352	8%	466	9%
Refineries	71,844	5	316	7%	316	6%
Fertilizers	50,430	3	524	12%	561	11%
Textiles	145,767	10	113	3%	163	3%
Chlor-alkali	NA	NA	29	1%	47	1%

Source: Annual Survey of Industries, 2001-2002; IEA, 2004; CEA, 2001; India Ministry of Coal, 2003; Indian Ministry of petroleum & Natural Gas, n.d.; Teri, 2001.
Note: Primary electricity calculated using an electricity conversion efficiency of 33%.

Cement Industry

While a large number of cement plants in India approach world best practice levels in terms of energy efficiency, most others are relatively inefficient (Engineering Staff College of India, 2003). See Table 2 for the average energy consumption values by process for Indian cement plants. In most cases, this value is significantly higher than the best practice value, indicating a strong potential for energy efficiency improvement.

There have been significant investments in new cement kilns and associate production equipment in the last few decades. India's cement industry comprises energy-efficient plants with the world's best practice facilities. The challenge for the Indian cement industry is to modernize or phase out the older, inefficient plants while acquiring the best possible cement production technology as production inevitably expands in the coming decades.

Table 2: Average and best practice energy consumption values for Indian cement plants by process

Process	Unit	India Average	World Best Practice
Raw Materials Preparation			
Coal mill	kWh/t clinker	8	2.4
Crushing	kWh/t clinker	2	1.0
Raw mill	kWh/t clinker	28	27
Clinker Production			

Kiln & cooler	Kcal/kg of clinker	770	680
Kiln & cooler	kWh/t clinker	28	22
Finish Grinding			
Cement mill	kWh/t cement	30	25
Miscellaneous Utilities: Mining & transportation	kWh/t clinker	1.6	1.5
Utilities: packing house	kWh/t cement	1.9	1.5
Utilities: miscellaneous	kWh/t cement	2.0	1.5
Total Electric	kWh/t cement	95	77

Source: Cement Manufacturer's Association 2003 Worrell, 2004.

Refining Industry

In terms of energy efficiency, Indian refineries have in general been able to improve their performance over the past 5 years despite the challenges of the installation of new energy intensive processing units at the same time as distillation capacity has expanded by over 75 percent. Further gains are possible, as indicated by the large efficiency gap between the MBN' benchmark values for selected refineries as shown in Figure 1. An estimated savings of 20 percent is possible in the process units at public-sector refineries, while saving of 15-43 percent are possible in the steam and utilities systems (Prasad, nd.).

The existing benchmarking approach for Indian refineries – the MBN - is currently under the re-evaluation based on new process unit operating conditions and values. As Indian refineries open up to international participation, refiners should consider adopting directly an internationally comparable measures performance such as the EII to provide them with a clear sense of their efficiency performance and improvement over time compared to their international competitors.

Fertilizer Industry

In terms of energy efficiency, the new policy is ending the right signals by inducing a changeover from naphtha/fuel oil-based plants to LNG/natural gas, as might be expected in more open fertilizer market. Natural gas is the most energy-efficient and economical feedstock for urea. The new urea policy will induce manufacturers to revamp their plants and place energy efficiency at the top of their priorities. To stay or become competitive in a decontrolled market, significant efforts will be needed. For the total energy consumption by type of fuel in the fertilizer on a second axis, see Figure 2 (see page 26).

In a more competitive market, it is expected that the maximum production of nitrogenous fertilizers will occur where raw materials are the cheapest and, that, country with scarce natural gas resources such as India will import most of their needs. However, fertilizer production has been a priority for India during its development, and it is now an important part of the local industry. The prospect of making available the infrastructure to import and use LNG will allow this industry to reduce its energy intensity and become competitive in an international market. Moreover, increased attention towards saving energy is essential for an energy-intensive industry. The former RPS policy allowed inefficient processes to linger, but this opens the possibility for large energy savings today.

Textile Industry

The textile sector in India faces new challenges. The expiration of the ATC intensifies the competition leading to shift towards more capital-intensive machinery. Electric energy consumption is expected to continue to rise over time due to increasing automation and higher running speeds for machines. However, the gain in productivity due to increasing mechanization will certainly overhaul the increase of electrical energy requirement. A smaller increase of energy will be required compared to the large amount of output that will be produced per unit of energy consumed. New developments also augment opportunities to spur energy conservation at the plant level.

The textile industry is fragmented and energy consumption can appear to be a minor factor at the plant level. However, the total consumption of the sector is considerable (3% of total industry). Eighty percent of the textile sector is composed of small and medium industries, making energy conservation measures more challenging to be diffused. Initiatives have been taken to inform industries on energy saving measures through the development of norms, reports and audits. These initiatives must be fost-ered and diffused to contractors too.

Chlor-Alkali

The chlor-alkali is very energy intensive sector. Energy represents approximately 60 percent of the total production cost. Since the cost of industrial electricity is high in India, industries using large quantities of electricity such as of caustic soda have been focusing greater attention on reducing energy consumption than others. Hence, some caustic soda companies are closely monitoring their energy consumption, resulting in overall moderate specific energy consumption. Internationally, India compares positively with a substantial share of membrane cell technology. Both caustic soda and soda ash production have energy potentials of around 17 percent. The main weakness in this sector seems to be its lack of production of indigenous technology equipment. For example, membrane cell equipment which needs to be changed every three years must be imported. There is no indigenous producer. The potential development of production of caustic soda through the new ODC technology is gradually emerging. India needs to take part in this future advancement.

Summary and Next Steps

In each study sector, Indian industry has made strides towards reducing its energy intensity using advanced technologies, upgradation and modernization of existing plants, and a shift towards less energy-intensive processes. Matters have improved because of stricter environmental regulations as in the case of chlor-alkali production, [2] driven by economic considerations as in the use of dry cement plants. The government's policy of shifting fertilizer production towards increased use of natural gas has also contributed. All these approaches have led Indian industry to acquire some of the best production technologies.

At the same time, however, these industries continue to own older plants that operate sub-par technologies with high specific energy consumption. In the case of each industry, there appears to be a 15 to 35 percent potential for improvement. Tapping this potential will require the installation of new equipment, better management practices, and an integrated systematic approach to the evaluation of energy use in plant.

The Indian government enacted the Energy Conservation Act in October 2001, which became effective in March 2002. The Act calls for the setting up of industry-specific task forces on energy conservation. In some sectors, BEE and others are already implementing benchmarking programs. BEE is currently leading the Indian industry programme for energy conservation. The activities of this project related to the cement industry include formation of a Cement Task Force, energy audits, identification of best practices, and development of energy consumption norms (BEE 2004). BEE has set up Task Groups for textiles, cement, pulp and paper, fertilizer, chlor-alkali and aluminum sectors. Industry members participate in this project to share information about best practices, declare their voluntary targets and adopt benchmarking for their processes. A benchmarking tool being developed through the indo-German Energy Efficiency & Environment Project will provide cement manufacturers with information regarding their relative energy consumption compared to peers and industry average (IGEEP, nd.).

A key tool for achieving improved energy efficiency is to build capacity, train encourage, and / or mandate the benchmarking of energy consumption at the plant level. Benchmarking will help plant owners to realize the level of their own specific energy consumption related to similar plants elsewhere in India and the world. Once a facility has participated in a benchmarking exercise, it requires more detailed information about the energy savings and costs of specific energy-efficiency improvement measures that can be adopted. Information from the Indian case studies and best practices examples, combined with international information on energy-efficiency technology energy savings and costs, could be provided to Indian manufacturers in the form of an energy management guide (similar to those produced by the U.S. Environmental Protection Agency's Energy Star Industry program). It could also be integrated into a benchmarking tool in order to provide projected savings for an individual plant given the adoption of a chosen set of energy-efficient technologies and practices.

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Reference Book:

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