

## SUSTAINABLE PRACTICES IN THE CEMENT INDUSTRY: A COMPARATIVE STUDY OF SELECTED CEMENT COMPANIES UNDER THE PAT SCHEME

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Nisha Meena\*

### ABSTRACT

*Cement industry is carbon intensive industry. Calcinations of limestone releases carbon dioxide in environment. It is responsible for approximately 13% in carbon emission released from industrial production. Ministry of Power, Bureau of Energy Efficiency (BEE) Govt of India started 'Perform, Achieve and Trade' (PAT) scheme in India in 2009 to fulfil the objective of National Mission for Enhanced Energy Efficiency (NMEEE). It covers almost 13 carbon intensive sector like steel, iron, cement etc. This scheme operates through the allocation of specific energy-saving targets to designated consumers (DCs) across various industrial sectors. Designated Consumers (DC) are those companies who register themselves under the scheme and got targets allotted to reduce emission level. It is expected from the industry to follow sustainable practices so as to ensure less damage to the environment. A sample of four leading Indian cement companies viz., Ambuja Cement, JK Cement, Shree Cement and Ultratech cement has been taken for the study purpose. The main objective of this research paper is to know the status of PAT scheme of Govt. of India in selected cement companies along with sustainable practices followed by them. After observing secondary data and performing statistical analysis, it can be concluded that all the four sample companies are a DC and follow sustainable practices. The PAT scheme plays a crucial role in enhancing the energy efficiency of the cement industry, which is vital for reducing operating costs and minimizing carbon emissions.*

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**Keywords:** Perform Achieve and Trade (PAT) Scheme, Indian Cement Companies, Sustainability Practices, Comparative Analysis, Environmental Impact.

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### Introduction

Increasing human activities are making environmental degradation more severe. Deforestation, burning of fossil fuel, urbanisation and many other such activities has polluted our environment in one and many ways. A global temperature rise has been noticed in average surface temperature which causes weather fluctuations like extreme weather conditions, rise in sea level etc. The situation is needed to be controlled to save the planet for greener tomorrow.

Cement industry is carbon intensive industry. India stood second in the race of cement production capacity. It is responsible for approximately 13% in carbon emission released from industrial production. Cement industry is expected to reach 4.83 billion tonnes by the year 2028. The process of cement manufacturing involves usage of electricity and burning of fossil fuels. Calcinations of limestone releases carbon dioxide in environment.

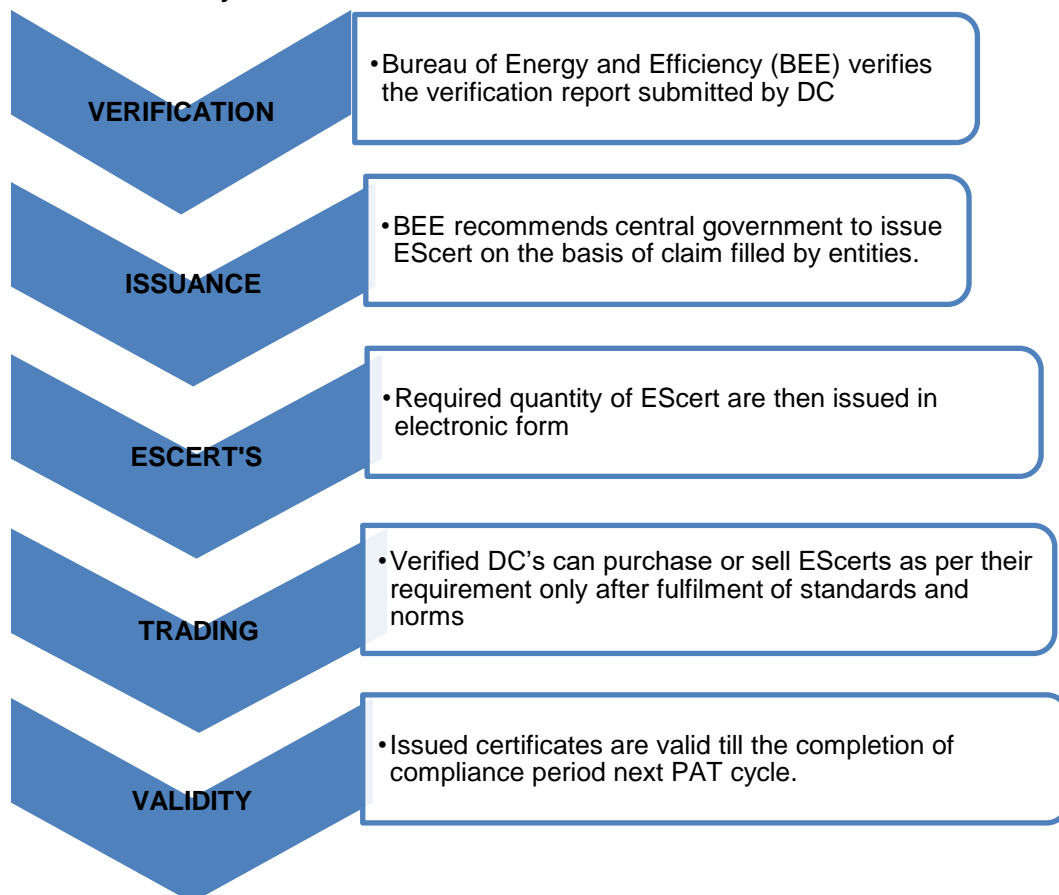
Ministry of Power, Bureau of Energy Efficiency (BEE), Govt of India started 'Perform, Achieve and Trade' (PAT) scheme in India in 2009 to fulfil the objective of National Mission for Enhanced Energy Efficiency (NMEEE). The PAT scheme is designed to reduce energy consumption by setting targets for energy savings, which is in line with India's goal to reduce carbon emissions and contribute to global climate commitments. It covers almost 13 carbon intensive sector like steel, iron, cement etc. This

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\* Assistant Professor-ABST, Government College, Deoli, Tonk, Rajasthan, India.

scheme operates through the allocation of specific energy-saving targets to designated consumers (DCs) across various industrial sectors. These targets are based on the energy performance of a facility and are determined using a benchmark that considers the energy use per unit of production. Designated Consumers (DC) are those companies who register themselves under the scheme and got targets allotted to reduce emission level. If DC's achieves this target by performing better than the prescribed energy efficiency targets, they are awarded with Energy Saving Certificates (ESCCerts) which can be used which they can trade with industries that fail to meet the targets and these certificates are also tradable in carbon market exchanges. If DC were failed to achieve their target, they have to purchase such certificates to fulfil their production target. These certificates are equal to one tonne of oil equivalent (toe) of energy savings. The scheme operates in cycles, each spanning three years. To complete the targets, DC were given a period of three cycles. In 2022, PAT's seventh cycle was in operation which was successfully completed by 1,104 DCs from 13 industrial and service sectors which contributes in almost 50%, of the country's energy requirements. It was reported that India reduced 100 million tCO<sub>2</sub>e in its first two cycles. Current cycle being PAT Cycle VIII, which commenced on 1st April 2023 and is scheduled to conclude on 31st March 2026. For regulation and resolving disputes, Bureau of Energy Efficiency (BEE) was assigned to overlook the whole mechanism. Process of generating certificate under PAT scheme can be understood as follows:

**Process under PAT Cycle**



Source: Policy Paper on Indian Carbon Market. (2022). Ministry of Environment, forest and Climate Change, Government of India.

**Research Objective**

Cement industry is a carbon intensive industry and is a big contributor in industrial pollution. It is expected from the industry to follow sustainable practices so as to ensure less damage to the environment. The main objective of this research paper is to know the status of PAT scheme of Govt. of India in selected cement companies along with sustainable practices followed by them.

### Hypothesis

**H1<sub>o</sub>** None of the selected cement companies are a designated consumer (DC) under PAT scheme of Indian Government and do not follow sustainable practices.

**H1<sub>a</sub>** At least one selected cement company is a designated consumer (DC) under PAT scheme of Indian Government and follow sustainable practices.

### Research Methodology

Sample comprises of four cement companies viz. Ambuja Cement, JK Cement, Shree Cement and Ultratech Cement. Annual Reports serve as the main source of secondary data. Other sources are website and other sustainability reports of the respective companies. To test the above hypothesis, binomial test of proportion will be used. Scores will be generated on a scale ranging from 1-5 point covering five parameters on sustainable practices. Companies will get scores on the basis of their performance.

### PAT Scheme and the Cement Industry

The cement sector is one of the most energy-intensive industries in India. It requires a lot of energy for processes like grinding, clinker production, and heating in kilns. Cement production is a key contributor to CO<sub>2</sub> emissions due to the high energy demand for limestone processing and clinker production.

Cement is a designated sector under the PAT scheme, and several cement plants across India have been mandated to achieve energy efficiency targets. The energy efficiency measures include the adoption of advanced technologies, optimization of processes, and improvements in plant operations. The target-setting process for the cement industry is based on past performance and energy consumption patterns, considering factors such as plant size, technology, and location. The cement industry has been adopting more energy-efficient technologies such as high-efficiency motors, waste heat recovery systems, and vertical roller mills. Cement plants have also focused on optimizing operations by improving combustion efficiency in kilns, enhancing the use of alternative fuels (such as industrial waste), and improving the grinding process. This creates an interesting dynamic for cement plants to decide on how much energy efficiency investment they should make.

### Cement industry and PAT Cycle

PAT Cycle	Description
I (2012-2015)	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 85 cement plants</li> <li>• <b>Energy Consumption:</b> 15.01 mtoe</li> <li>• <b>Energy Savings Target:</b> 0.815 mtoe</li> <li>• <b>Energy Savings Realized:</b> 1.48 mtoe</li> <li>• <b>Target Overachievement:</b> 81.6% above the set target</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> 7.2 million tons (app.)</li> <li>• <b>Monetary Savings:</b> Estimated at INR 9,500 crore</li> <li>• <b>Investments:</b> ₹ 26,100 crore in energy-efficient technologies</li> </ul>
II (2016-2019)	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 111 cement plants</li> <li>• <b>Energy Consumption:</b> 21.432 mtoe</li> <li>• <b>Energy Savings Target:</b> 1.117 mtoe</li> <li>• <b>Energy Savings Realized:</b> 1.56 mtoe</li> <li>• <b>Target Overachievement:</b> 48.6% above the set target</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> 5.47 million tones (app.)</li> <li>• <b>Monetary Savings:</b> Estimated at INR 2,878 crore</li> <li>• <b>Investments:</b> ₹ 6,962 crore in energy-efficient Technologies</li> </ul>
III (2017-2020)	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 14 cement plants</li> <li>• <b>Energy Consumption:</b> 1.743 mtoe</li> <li>• <b>Energy Savings Target:</b> 0.096 mtoe</li> <li>• <b>Energy Savings Realized:</b> Data indicates overachievement of targets</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> Contributed to the overall reduction of 5.59 million tonnes across sectors</li> </ul>

<b>IV (2018-2021)</b>	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 1 cement plant</li> <li>• <b>Energy Consumption:</b> 0.0741 mtoe</li> <li>• <b>Energy Savings Target:</b> 0.004 mtoe</li> <li>• <b>Energy Savings Realized:</b> Specific data pending final verification</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> Contributed to the overall reduction targets set for the cycle</li> </ul>
<b>V (2019-2022)</b>	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 12 cement plants</li> <li>• <b>Energy Consumption:</b> 1.6 mtoe</li> <li>• <b>Energy Savings Target:</b> 0.087 mtoe</li> <li>• <b>Energy Savings Realized:</b> Specific data pending final verification</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> Contributed to the overall reduction targets set for the cycle</li> </ul>
<b>VI (2020-2023)</b>	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 37 cement plants</li> <li>• <b>Energy Consumption:</b> 1.241 mtoe</li> <li>• <b>Energy Savings Target:</b> 0.062 mtoe</li> <li>• <b>Energy Savings Realized:</b> Specific data pending final verification</li> <li>• <b>CO<sub>2</sub> Emissions Reduction:</b> Contributed to the overall reduction targets set for the cycle</li> </ul>
<b>VII (2022-2025)</b>	<ul style="list-style-type: none"> <li>• <b>Coverage:</b> 120 cement plants</li> <li>• <b>Energy Consumption:</b> Data to be determined</li> <li>• <b>Energy Savings Target:</b> Data to be determined</li> <li>• <b>Energy Savings Realized:</b> Cycle currently in progress; achievements to be assessed upon completion</li> </ul>

Sources: Cement Manufacturers' Association, Bureau of Energy Efficiency, Press Information Bureau

\* mtoe- million tonnes of oil equivalent.

### Brief Profile of Companies

Ambuja Cement started its operation in 1983 and leads the cement industry of India with cement production capacity of 78.9 mntpa with 18 integrated cement plants. Showing its concern toward nature, company environment policy claims to use 60% of its power requirement from renewable source by 2028 and also declare an investment of ₹100 billion in renewable resources. It becomes a part of PAT scheme as DC in 2015.

JK Cement started cement production 1918 and holds a remarkable position in Indian cement industry. Presently company's combined cement production capacity is of 22.34 mntpa from its 07 integrated plants in India. Company's usage of green power stood at 51% and it claims to achieve a thermal substitution rate of 20% by 2029-30. JK Cement became a Directly Controlled (DC) entity under the Perform, Achieve and Trade (PAT) scheme during PAT Cycle II. This cycle began in 2016.

Shree Cements was established in 1979 and was listed on Bombay Stock Exchange with its first IPO in 1984. As of June 2024, the company's cement production capacity stood at 50.4 mtpa including overseas market and achieved an installed renewable power capacity of 1,000 MW, comprising solar, wind, thermal, and waste heat recovery power plants and commits to use 100% of its electricity requirements by renewable sources by 2050. Shree Cement became a Directly Controlled (DC) entity under the Perform, Achieve and Trade (PAT) scheme during PAT Cycle I, which began in 2012.

Ultratech cement is a corporation of Aditya Birla Group and started its operation in mid-1980. By the fiscal year 2024, the company had cement production capacity of 152.70 mtpa including overseas market and installed 612 MW of renewable energy capacity, including 262 MW from waste heat recovery systems (WHRS) and 429 MW from contracted renewable energy sources and aiming to meet 100% of its electricity requirements through renewable sources by 2050. It became a Directly Controlled (DC) entity under the Perform, Achieve and Trade (PAT) scheme during PAT Cycle I, which started in 2012.

### Comparative Performance of selected Cement Companies based on PAT Cycle

Company	PAT Cycle Involvement	Energy Efficiency Improvements	ESCCerts Status	Performance Summary
<b>Ambuja Cements</b>	PAT Cycle II (2016)	Significant reduction in	Earned ESCerts in	Ambuja Cements achieved high energy efficiency improvements in

		energy consumption across plants.	some years.	several plants, contributing to a lower carbon footprint and meeting the PAT targets efficiently.
<b>JK Cement</b>	PAT Cycle II (2016)	Major improvement in energy efficiency across plants.	Earned ESCerts.	JK Cement made significant progress in enhancing energy efficiency. They were able to reduce specific energy consumption and meet PAT targets successfully, benefiting from ESCert trading.
<b>Shree Cement</b>	PAT Cycle I (2012)	Early focus on energy-saving technologies, efficiency measures.	Earned ESCerts.	Shree Cement was a leader in the first PAT cycle, meeting and exceeding its energy targets. They earned ESCerts and continued to maintain energy-efficient practices in subsequent cycles.
<b>UltraTech Cement</b>	PAT Cycle I (2012)	Significant improvements in energy performance.	Earned ESCerts.	UltraTech, with its large operational scale, demonstrated a strong commitment to energy efficiency. It exceeded PAT targets and actively participated in the ESCert trading market.

Source: Annual Reports, website description and other reports of respective companies

Shree Cement and UltraTech Cement led the way in PAT Cycle I with their early adoption of energy efficiency practices, Ambuja Cements and JK Cement made significant strides in PAT Cycle II, following the same trend of reducing energy consumption and improving sustainability. All four companies have been successful in complying with PAT targets and have benefited from Energy Saving Certificates.

#### Statistical Analysis of Sustainable Practices of Sample Cements Companies

Aspect	Ambuja Cement	JK Cement	Shree Cement	Ultratech Cement
<b>PAT Performance</b>	<b>4</b> (Exceeds targets, earns ESCerts)	<b>5</b> (Exceeds targets, leading in energy efficiency)	<b>5</b> (Exceeds targets, leading in energy efficiency)	<b>5</b> (Exceeds targets, leader in energy management)
<b>Energy-efficient Technologies</b>	<b>4</b> (Waste heat recovery, alternative fuels)	<b>4</b> (Vertical roller mills, biomass use)	<b>5</b> (Waste heat recovery, renewable energy)	<b>5</b> (Pre-heater systems, waste heat recovery)
<b>Alternative Fuels</b>	<b>4</b> (Biomass, industrial waste)	<b>4</b> (Biomass, waste materials)	<b>5</b> (Biomass, pet coke)	<b>4</b> (Pet coke, biomass, waste-derived fuels)
<b>Renewable Energy</b>	<b>3</b> (Limited use)	<b>3</b> (Some adoption)	<b>5</b> (Strong focus on solar energy)	<b>5</b> (Significant investments in renewable energy)
<b>Sustainability Goals</b>	<b>4</b> (Low-carbon cement, reducing carbon footprint)	<b>4</b> (Reduce CO2 emissions, improve energy efficiency)	<b>5</b> (Net-zero carbon by 2050)	<b>5</b> (Eco-friendly cement, carbon footprint reduction)

#### Observations

Total Scores:

Company	Ambuja	JK	Shree	Ultratech
Score	19	20	25	24

- Number of companies meeting the DC criteria: All the four companies (100%).
- Companies scoring highly  $\geq 20$  out of 25 are likely to qualify as sustainable practices. JK Cement, Shree Cement, and Ultratech Cement have scores  $\geq 20$ , meaning 3 out of 4 companies meet the criteria.

### Hypothesis Testing

- Sample size = 4
- Successes = 3
- Null proportion = 0
- Test: One-tailed binomial test for  $p > 0$ .

The p-value = 0.0, which is significantly less than the standard significance level ( $\alpha = 0.05$ ). It is observed that proportion (100%) is much higher than 50%, the p-value from the test would likely be quite small (typically less than 0.05 for a significant result). This suggests we **reject the null hypothesis 'None of the cement company is a DC under the PAT scheme and follows sustainable practices ( $p \leq 0.50$ )** and accept the alternative hypothesis.

### Interpretation

- All companies meet the criteria for being a DC, a basic binomial test for a proportion to check whether the proportion (100%) of companies meeting the DC criteria and following sustainable practices is significantly higher than 50%.
- Ambuja Cement performed well, especially in energy efficiency and sustainability goals, but scored lower in renewable energy. It has also shown remarkable progress in adopting green technologies and reducing its carbon emissions.
- JK Cement showed good results in certain aspects like PAT performance and sustainability goals, but still has room for improvement in renewable energy and energy-efficient technologies. JK Cement is progressively improving its energy efficiency with modern technologies and alternative fuels, ensuring that it stays competitive and meets its energy savings targets.
- Shree Cement and Ultratech Cement scored the highest, with strong performances across most aspects related to sustainability and energy efficiency. Shree Cement stands out as a leader in low-energy consumption and renewable energy adoption, while UltraTech Cement has consistently demonstrated strong energy management practices.
- All four cement companies—Ambuja Cement, JK Cement, Shree Cement, and UltraTech Cement—have made significant strides in energy efficiency under the PAT scheme.

### Conclusion

The PAT scheme plays a crucial role in enhancing the energy efficiency of the cement industry, which is vital for reducing operating costs and minimizing carbon emissions. With continuous improvements and innovations in energy efficiency technologies, the cement sector can achieve not only compliance with national energy-saving targets but also contribute to India's broader goals of environmental sustainability and industrial competitiveness. Some cement plants are exploring innovative technologies like carbon capture to reduce emissions and improve energy efficiency.

If a cement plant surpasses its energy efficiency target, it can earn ESCerts, which can be traded in the open market. The trade of ESCerts offers an additional revenue stream, which, in turn, can help offset the costs of investment in energy-saving technologies. The price of ESCerts fluctuates based on demand and supply.

As the PAT scheme matures, there could be an expansion to cover more industries and make participation mandatory for smaller and medium-sized cement plants. The incorporation of solar, wind, or biomass energy in cement production could be an area for future growth in terms of achieving better energy performance. As the market for ESCerts grows, more robust mechanisms for verification and enforcement will be needed to ensure fairness and prevent misuse.

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