Industrial Energy Efficiency Improvements in India

Trickledown Transformation in the State of Gujarat

Anish Sugathan

1. Introduction

India’s primary contribution toward climate change mitigation is its commitment to reduce the emission intensity of the country’s rapidly growing GDP. India’s energy demand is projected to double by the year 2040, and the country’s ability to reduce emission intensity through a Nationally Determined Contribution under the Paris Agreement is contingent on economy-wide adoption of energy efficiency practices.

The National Mission for Enhanced Energy Efficiency (NMEEE) is India’s flagship program and has a focus on improving efficiency in energy intensive industries through market-based instruments. The policy push by NMEE and the incentives created by the market for energy efficiency have resulted in the trickle-down adoption of several energy efficiency technologies and production processes across industries. Since its inception in 2008, the NMEE in particular has yielded substantive efficiency gains across a wide spectrum of energy intensive industries in the country.

The flagship market-based program under the NMEE is Perform Achieve and Trade (PAT), which covers 846 units from 13 industry sectors and has had particularly significant impact in reducing specific energy consumption. The program is responsible for energy savings to the tune of 8.67 million tons oil equivalent (MTOE) or about 31 million tons of CO2 savings1. At the aggregate level, an estimated 300 million tons of CO2 emissions, or about 15 percent of overall energy demand, has been avoided during the 2000-2018 period owing to improvements in energy efficiency2. Despite the low energy intensity of India in comparison to other comparable developing economies (Figure 1), the country’s energy efficiency market is pegged at about INR 1.6 trillion.3

3. Press Information Bureau, “World Bank Study pegs India’s Energy Efficiency Market at Rs. 1.6 Lakh Crores,” Government of India,
With the goal of understanding the political economy, governance structures, and institutional setting that led to the substantive industrial energy efficiency gains, a contextually grounded comparative analysis of the NMEE and PAT is presented in this paper. The paper uses a comparative case analysis approach to examine the energy intensive industries of the state of Gujarat.

**Figure 1: Energy Intensity among Developing Economies**

![Energy intensity of economies, 1990 to 2015](https://ourworldindata.org/energy)

The rest of the paper is organized as follows. Section 2 presents the development and evolution of energy efficiency (Section 2.1), and the NMEE is described in the context of these institutions (Section 2.2). In Section 3, the PAT scheme is described in detail. The PAT program is the primary instrument investigated in greater detail in this paper. Section 3.1 describes the salient features of the PAT program that contribute to the program’s success and widespread adoption. Section 4 shows how the initiatives under the PAT program trickle down to the state of Gujarat by focusing on the cement sector in the state (Section 4.1) and further studies the energy efficiency programs undertaken by the Ambuja Cements Ltd.— one the identified industries under the PAT program—to understand how policy-level objectives are eventually adopted by companies through specific technological and business choices (Section 4.2). Finally, the paper concludes in Section 5 by drawing lessons from PAT program implementation and comparing these with the case of the Surat cluster of micro-, small and medium-sector enterprises in Gujarat to highlight the need for contextual sensitivity for successful broader application.
2. Policy Instruments for Industrial Energy Efficiency

2.1. ENERGY CONSERVATION IN INDUSTRIES: INSTITUTIONAL DEVELOPMENT

The Indian government’s developmental policies and interventions since the late-1980s and early 1990s actively emphasized energy conservation and environmental prudence in the industrial sector. A series of government-led programs during this period laid the institutional foundation for energy conservation. These included initiatives such as the National Energy Efficiency Program (NEEP), setting up of Energy Management Center in 1989, gradual deregulation of energy markets since 1991, provisions for accelerated depreciation of energy efficiency equipment, and a package of policy measures in 1995 to incentivize the energy efficiency of industries.\(^4\)

Active promotion of energy efficiency in industrial projects financed by multilateral bodies such as the World Bank and Asian Development Bank (ADB), which made loan terms conditional on achieving energy and environmental performance, further built up the momentum. The energy intensity of India since the 1990s closely matches the global average, faring comparatively better than other large developing economies.

The efficiency initiatives acquired legal standing when the government enacted the Energy Conservation Act of 2001.\(^5\) The act laid down the legal, institutional, and regulatory framework for the promotion and enforcement of energy efficiency programs at the state and central government levels. The provisions of the act apply to energy conservation measures through five major areas: (1) energy-intensive designated consumers, (2) standards and labeling of appliances, (3) setting up of statutory bodies and institutional frameworks, and (4) the establishment of an energy conservation fund.

The efficiency programs in the country received substantial impetus and direction when the Bureau of Energy Efficiency (BEE) was established as a statutory body under the provisions of the Energy Conservation Act. Relevant sections of the act empower the central government on recommendation of the BEE to prescribe standards and consumption norms for energy intensive industries. The BEE acts as the nodal agency for all major energy efficiency initiatives of the central government.

The next major milestone in the evolution of institutions happened in 2008, when the Prime Minister’s Council on Climate Change conceived and published the National Action Plan on Climate Change (NAPCC) with the objective of creating awareness among all major public stakeholders of the threats posed by climate change and outlining India’s plans to contend with the challenge. Notably, the document also declares India’s promise to actively engage in global negotiations under the UN Framework Convention on Climate Change in a constructive manner.\(^6\) The NAPCC set forth eight national missions: (1) a National Solar Mission, (2) a National Mission for Enhanced Energy Efficiency, (3) a National Mission on Sustainable Habitat, (4) a National Water Mission, (5) a National Mission for Sustaining the Himalayan Ecosystem, (6) a National Mission for a Green India, (7) a National Mission for Sustainable Agriculture, and (8) a National Mission on Strategic Knowledge for Climate Change. The eight national missions form the core of the country’s multi-pronged strategies and the time-bound action plan to achieve key national goals and international commitments.

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Among these eight missions, the NMEEE develops the institutional foundation for all major government-led initiatives on economy-wide improvements in energy conservation and efficiency, with special focus on efficiency in high-energy industries.

2.2. NATIONAL MISSION FOR ENERGY EFFICIENCY: THE ENABLING POLICY FRAMEWORK

Under the legal framework of the Energy Conservation Act of 2001, the NMEEE is one of the eight mission plans developed under the National Action Plan on Climate Change. The overall objective of the NMEEE is to promote energy efficiency practices across multiple sectors of the economy. A key distinguishing feature of the policies and instruments developed under the mission is the use of innovative new market-based policy instruments designed to align economic business decisions with larger national policy goals in a cost-efficient manner. The mission document was approved by the cabinet in June 2010, which estimated the energy efficiency potential of the country at about INR 740 billion. Through energy efficiency measures, the mission envisaged savings through avoided supply capacity of 19,598 MW and a reduction in greenhouse gas emissions to the tune of about 99 million tons per year upon full implementation of the mission objectives.

The NMEEE implementation framework was prepared through extensive stakeholder consultations. The participatory process of evolution is one of the distinguishing features of the framework and possibly contributes to its widespread adoption and relative success. The participatory consultation process involved the relevant ministries of the central and state governments, major industry associations such as the Federation of Indian Chambers of Commerce & Industry (FICCI) and Confederation of Indian Industry (CII), academics and independent experts, financial institutions, NGOs, and the public. Several nationwide workshops were organized from 2010 through 2012 to encourage wider participation of stakeholders in the formulation of the frameworks. During this period baseline data was also collected, and the targets and timelines for the mission were defined.

The NMEEE framework developed four targeted initiatives to achieve overall energy efficiency goals in energy intensive industries, summarized in Table 1. Among these four sub-initiatives, the market-based, flagship PAT scheme is one of the most unique and innovative energy efficiency regulation instruments anywhere in the world. The PAT scheme has several distinguishing features that incorporate the contextual idiosyncrasies of Indian industries that set it apart from other energy savings instruments elsewhere such as the Top-1000 enterprise program in China and the White Certificates program in Europe.

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Table 1: Four Sub-Initiatives under the NMEE

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Objective and Description</th>
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<tbody>
<tr>
<td>1. Perform Achieve and Trade Scheme (PAT)</td>
<td>The flagship market-based instrument targets energy intensity industries through energy savings certificates which can be traded.</td>
</tr>
<tr>
<td>2. Market Transformation for Energy Efficiency (MTEE)</td>
<td>Promotes energy efficient appliances and equipment through business model innovations. Two programs were developed under MTEE: (1) Bachat Lamp Yojana (BLY), which promotes large-scale adoption of energy efficient LED bulbs by driving down costs through supply-side large-scale procurement; and (2) the Super-Efficient Equipment Programme (SEEP), which accelerates market development and adoption of energy efficient appliances such as ceiling fans and air conditioners through financial interventions at key value chain stages.</td>
</tr>
<tr>
<td>4. Framework for Energy Efficient Economic Development (FEEED)</td>
<td>Encourages private capital and sharing of risk in financing energy efficiency projects by providing partial coverage/support. The initiative has created two funds for this purpose: (1) the Partial Risk Guarantee Fund for Energy Efficiency (PRGFEED), and (2) the Venture Capital Fund for Energy Efficiency (VCFEE).</td>
</tr>
</tbody>
</table>

This paper focuses exclusively on the PAT program, and its evolution and successful implementation in the first few cycles, to glean generalized learnings about the underlying success factors and challenges in the future sustainability of the program. The program will be viewed through an institutional development angle to understand key success factors.

3. **Perform Achieve and Trade (PAT)**

The PAT program is essentially a cap and trade instrument in energy intensity with target setting based on baseline studies and issuance of energy saving certificates commensurate to savings in excess of targets that can be traded in a market. In theory, the scheme should yield the social optima in a cost-efficient manner, as each industry can make the private choice of either investing in energy saving technology or buying energy savings certificates to make up the shortfall. The scheme thus allows the private agent to make an optimal choice based on their private cost structure while simultaneously achieving overall national energy savings targets.

PAT covers 846 units from 13 industry sectors and has had particularly significant impact in reducing specific energy consumption. The program is attributed to energy savings to the tune of 8.67 million tons oil equivalent (MTOE) or about 31 million tons of CO2 savings.9 At the aggregate level, an estimated 300

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millions of CO2 emissions, or about 15 percent of overall energy demand, have been avoided during the 2000-2018 period owing to improvements in energy efficiency.\textsuperscript{10}

Four cycles of the PAT program have been completed as of the year 2020. Over these four cycles, the program has gained much depth and breadth of coverage. The various enabling actors of the ecosystem have also now acquired sufficient maturity to transact among themselves with minimal friction. Table 2 shows the sectoral coverage and energy savings of PAT through cycles I through IV.

Table 2: Achievements of the Four PAT Cycles

<table>
<thead>
<tr>
<th>PAT Cycle</th>
<th>Period</th>
<th>DC Covered</th>
<th>Sectors</th>
<th>Energy Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2014-2015</td>
<td>478 DCs</td>
<td>8 sectors</td>
<td>6.68 MTOE</td>
</tr>
<tr>
<td>II</td>
<td>2015-2017</td>
<td>621 DCs</td>
<td>11 sectors</td>
<td>8.869 MTOE</td>
</tr>
<tr>
<td>III</td>
<td>2017-2018</td>
<td>116 DCs</td>
<td>6 sectors</td>
<td>1.1 MTOE</td>
</tr>
<tr>
<td>IV</td>
<td>2018-2020</td>
<td>109 DCs</td>
<td>8 sectors</td>
<td>0.699 MTOE</td>
</tr>
</tbody>
</table>


The PAT intervention has clearly resulted in substantive energy savings across major energy intensive industries. Further, the savings projections into the future, estimate a cumulative energy savings of 165.23 MTOE for all sectors by the year 2030.\textsuperscript{11}

3.1. PAT SUCCESS FACTORS

3.1.1. Elaborate Institutional Framework

The PAT scheme’s success is partly attributable to the elaborate institutional framework and support ecosystem for the design of operating mechanisms, monitoring and enforcement systems, and a trading mechanism. In a policy-mandated, target-based system, the effectiveness of these systems and the perceived transparency and fairness of critical activities such as target setting, and sectoral norm setting become a key factor in determining the overall success of the program. Studies have also observed a high degree of role clarity among the stakeholders of the PAT program. The key institutional functions and the respective designated actors responsible for them are tabulated in Table 3.


Table 3: PAT Institutional Functions and Stakeholders

<table>
<thead>
<tr>
<th>Institutional Functions</th>
<th>Responsible Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policymaker, Administrator</td>
<td>Ministry of Power (MoP)</td>
</tr>
<tr>
<td>Nodal Agency</td>
<td>Bureau of Energy Efficiency (BEE)</td>
</tr>
<tr>
<td>Implementation Agency</td>
<td>Designated consumer (DC)</td>
</tr>
<tr>
<td>State Administrator</td>
<td>State designated agency (SDA)</td>
</tr>
<tr>
<td>Adjudicator</td>
<td>State electricity regulatory commission (SERC)</td>
</tr>
<tr>
<td>Verifier</td>
<td>Empaneled accredited energy auditors (AEAs)</td>
</tr>
<tr>
<td>Trading Regulator, Registry</td>
<td>SERCs, CERC/POSOCO, Power exchanges - IEX and PXIL</td>
</tr>
<tr>
<td>Trading Platform</td>
<td>Power exchange – IEX</td>
</tr>
</tbody>
</table>


3.1.2. Contextually Grounded Design and Extensive Stakeholder Consultations

The PAT scheme particularly stands out in development of sector-specific energy consumption reduction norms and normalization for target setting incorporating unique sectoral factors and contextual realities of industries in India. The normalization factors are critical in fair administration of targets through detailed matching of plants with sector-specific factors such as fuel quality variations, capacity utilization factors, and differences in final product mix. Transparency and perception of fairness is critical in mandatory target-based regulatory instruments.

By systematically consulting with various affected parties both during the baseline-setting phase and subsequent assessment phases, the PAT program is able to develop trust and cooperative participation from the various industries. The participatory stakeholder workshops conducted by the BEE in association with the respective state-designated agencies (SDAs) is attended by representatives from the notified DUs, their industry association members, state regulatory bodies, and independent energy efficiency experts. The minutes of one such workshop organized in Ahmedabad, Gujarat on May 30, 2019 show that DUs raise several detailed queries and provide suggestions to facilitate adoption of the PAT targets.12

3.1.3. Systematic Development of Human Capital and Pro-conservation Behavioral Change

Training and capacity development are systematically carried out at the levels of the designated consumers (DCs), SDAs, state electricity regulatory commissions (SERCs), and accredited energy auditors (AEA).

At the DC-level, this included facilitating the sharing of experiences among DCS in a sector, providing knowledge and access to efficient technologies specific to the sectors, and educating key energy managers and decision making personnel at the DCs on the guidelines of measurement, verification, and verification.

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normalization procedures. Platforms for networking and knowledge exchange between the DCs are also facilitated by the BEE, SDAs, and respective industry association bodies.

For the SDAs and SERCs, training is provided to ensure role clarity, and detailed guidelines documents are provided on the various tasks to be performed on a routine basis. Special attention is also paid to train the state regulators on matters of penalties, computation procedures, adjudication, imposition, compliance, and collection mechanisms.

Under the aegis of the program, a large pool of AEAs and advisory firms are developed with good sectoral understanding and training in the processes of PAT compliance. The AEA is an accredited individual as per the regulations, and only AEAs affiliated with authorized AEA firms are allowed to conduct the energy audits of DUs. They are also trained in matters of independence when conducting monitoring and verification checks.

3.1.4. Adoption of International Best Practices and Technology Sharing

The development of the PAT framework happened through an extensive consultation process. During this process, several international agencies and experts have also been involved so as to incorporate international best practices and mechanisms from similar energy efficiency instruments deployed elsewhere. In particular, the role played by the Indo-German Energy Programme (IGEN) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) through GIZ in India in providing technical cooperation on development and implementation of the PAT scheme is noteworthy. The collaboration is an example of a well-functioning international North-South partnership in the area of industrial energy conservation programs. The IGEN collaboration continues through the design phase and extends to training for skill development activities of the BEE for increasing the overall capacity of the PAT ecosystem.13

4. Trickle-down Transformation: The Case of Gujarat

The state of Gujarat, located on the western cost of India, is one of the leading industrialized states of India. The state’s economy, primarily driven by industries, churned out a gross state domestic product of about INR 18.85 trillion (about $270 billion) for the fiscal year 2020-2021, which has been growing at the compound annual growth rate (CAGR) of 13.24 percent since 2011. As of February 2020, Gujarat had a total installed power generation capacity of 35,013.11 MW, of which the state consumed more than 50 percent across industrial, commercial, and residential sectors while exporting surplus power to the neighboring states of Rajasthan, Madhya Pradesh, and Maharashtra.14

The economy of Gujarat is driven by industries across multiple sectors. A significant portion of India’s textiles, petrochemicals, chemicals, pharmaceuticals, gems and jewelry, dairy, cement, and engineering industries are located in Gujarat. The state is the world’s largest producer of processed diamonds, the largest producer of denim in the country (third largest in the world), and is often referred to as the petroleum capital of the country owing to its large refining capacity.

The state is also home to several clusters of micro-, small, and medium enterprises (MSMEs) located in designated industrial zones or special economic zones (SEZs). Clustered growth and development of

industries is a defining feature of the state’s industrialization model. The state has about 106 product-based industry clusters and 60 SEZs notified by the state government. A majority of the MSMEs are involved in the direct export of goods and services. The total exports from the state during the period 2018-2019 were valued at about $67.40 billion.

Due to the high proportion of industrialization, Gujarat is also home to several large energy intensive industries. Many companies operating in the MSME clusters employ inefficient and crude technology for production, with significant scope for improvement in energy conservation. At the consumption rate of 2,279 kWh per year, Gujarat is also among the top five states in terms of per capita electricity consumption. Consequently, the state is also the target for several energy efficiency missions and programs championed by the central nodal agencies.

The following section narrows down on how the PAT program initiatives trickle down to the state of Gujarat. This analysis will look at the energy efficiency improvements in the cement industry following the PAT intervention and illustrate salient aspects using the case of Ambuja Cement Ltd., located in the city of Kodinar in Gujarat.

4.1. THE CASE OF CEMENT SECTOR: PAT TRICKLE DOWN IN GUJARAT

India is the second-largest cement producer in the world, and the cement industry in India is one of the most energy intensive sectors of the country. A cement plant is notified under the PAT scheme as a designated consumer if it exceeds the threshold limit of 30,000 TOE of energy consumption per year. During the first cycle of PAT, 85 DCs were identified across several states, of which nine were located in Gujarat.15

The baseline-specific energy consumption levels and sector-specific efficiency targets were set in consultation with various stakeholders relevant to the cement sector. In the state of Gujarat, the SDA for PAT implementation is the Gujarat Energy Development Agency (GEDA). The GEDA, in consultation with the BEE, conducted several stakeholder workshops in Gujarat and facilitated the baseline data collection process for the DCs situated in the state. The GEDA is also the nodal state agency for renewable energy use and energy conservation in Gujarat. Promotion of energy efficiency in industrial units is one of the major mandates of the agency.

The GEDA played a leading coordination role in the stakeholder consultations organized by the BEE. The key stakeholders who were involved in the consultation process for PAT implementation in the cement industry includes:

- Cement industries (including PAT and non-PAT).
- Government agencies such as the Ministry of Power, Ministry of Environment and Climate Change, BEE, and National Council of Cement and Building Materials.
- The Cement Manufacturing Association.
- Industry associations such as the CII and FICCI; and
- Energy technology expert bodies such as the TERI and GIZ.

Based on the stakeholder consultations and baseline data collection, a wide variation in the specific energy consumption within the cement industry was discovered. While such a wide variation indicates greater potential for energy savings, this also implied that much greater heterogeneity has to be accounted for in the target setting for each industry. Consequently, target setting was based on product groups. Further, variations in vintage, production capacity, raw material quality, and final product mix were also taken into account to set the targets.

The fine-grained target-setting process for the cement industry illustrates the efficacy of the participative process and extensive baseline data collection employed for PAT implementation. Such a comprehensive process eventually led to the development of specific energy consumption standards as well targets that were perceived to be fair and transparent by the DCs.

Extensive benchmarking with global best practices also led to the development of a knowledge bank. These best practices were widely shared among the industries for facilitating their own energy efficiency technology choices. The development and dissemination of industry-level best practices were coordinated by the BEE, the Cement Manufacturing Association, other industry association bodies such as the CII and FICCI, and energy technology expert entities such as the TERI and GIZ. The energy efficiency technologies and best practices adopted by the cement industries are listed in Table 4.

Table 4: Energy-efficient Technologies and Best Practices Adopted by the Cement Industries

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Energy-efficient technologies &amp; best practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Installation of waste heat recovery systems</td>
</tr>
<tr>
<td>2</td>
<td>Installation of vertical grinding mill</td>
</tr>
<tr>
<td>3</td>
<td>Installation of VAM</td>
</tr>
<tr>
<td>4</td>
<td>Installation of high recuperation efficiency hydraulic cooler</td>
</tr>
<tr>
<td>5</td>
<td>Installation of high-efficiency screw compressor</td>
</tr>
<tr>
<td>6</td>
<td>Provided baffle plate (guide plate) inside twin cyclone</td>
</tr>
<tr>
<td>7</td>
<td>Increasing the usage of AFR in the kiln</td>
</tr>
<tr>
<td>8</td>
<td>Increasing the number of stages of pre-heater</td>
</tr>
<tr>
<td>9</td>
<td>Installation of high-efficiency third generation air-separator</td>
</tr>
</tbody>
</table>


4.2. THE CASE OF AMBUJA CEMENT LTD.

Ambuja Cements Ltd. is India’s leading cement manufacturer and a household name due to its wide distribution networks and the presence of its brand across the country. Ambuja Cements Ltd. is a part of the Lafarge-Holcim global conglomerate. The company has a total cement manufacturing capacity of 29.65 million tons spread across five integrated cement plants and eight cement grinding units throughout the country.
Ambuja Cements Ltd. has an integrated cement manufacturing plant in the Gir Somnath district of the state of Gujarat, which is one of the largest plants in the state, with a capacity of 20 million tons per year. Owing to its large energy intensity, this plan was identified as a DC under the PAT Cycle-II. The baseline-specific energy consumption of the plant was set at 0.0752 TOE per ton of product for the year of 2014-2015, and a target of 0.0715 TOE per ton of product was set for the year 2018-2019—a reduction of 4.9 percent in energy intensity (see Table 5 for details).

Table 5: Energy Efficiency Targets for Ambuja Cement Ltd. under the PAT Cycle II

<table>
<thead>
<tr>
<th>Designated Consumer</th>
<th>Registration No. Under PAT</th>
<th>Baseline energy consumption standards in metric ton of oil equivalent (TOE) per unit of product for the baseline year 2014-2015</th>
<th>Energy consumption standards in metric ton of oil equivalent (TOE) per unit of product for target year 2018-2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Specific energy consumption (TOE per ton of product)</td>
<td>Equivalent major product output (tons)</td>
</tr>
<tr>
<td>Ambuja Cement Ltd. Ambujanagar,</td>
<td>CMT0025GJ</td>
<td>0.0752</td>
<td>5,478,340</td>
</tr>
<tr>
<td>Dist.-Junagadh, Gujarat, India</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Examination of the published document on best practices in energy efficiency of Ambuja Cements shows a series of technological as well as organizational interventions taken by the company to achieve the stringent targets set by the PAT program.16 In addition, the company’s website on sustainability and energy efficiency makes explicit claims on concerted efforts put in by the company to achieve global benchmarks in energy efficiency.17

These documents also show that the best practices and technologies adopted by the company—such as grinding mill optimization, clinker quality improvement and fly ash absorption, optimization of blowers, fans, and compressors, and proactive plant maintenance practices—are diffused through technology exchanges facilitated by the Cement Manufacturing Association and industry associations such as the CII.

The company also voluntarily acquired the ISO 50001-2011 certification with clear alignment with its energy efficiency improvement agenda. The company documents the following benefits from the certification process18:

- “To meet current and future voluntary/ mandatory energy efficiency targets or GHG emission reduction legislation. It will help to reduce greenhouse-gas (GHG) emissions and carbon footprint.”
- “Increased energy savings which will reduce energy costs for producing one ton of cement via a structured approach of managing energy consumption.”

• “With this system we know better about equipment efficiency. By integrating our existing management systems, we can align our Energy Management System (EMS) with existing management systems for additional organizational benefits.”

• “Increased energy awareness among staff members at all levels.”

• “Improved corporate image and credibility with all stakeholders and customer.”

• “Enhanced security of energy supply as we have identified our energy risk exposure in areas within the organization and getting remedial measure against it.”

• “Improved operational efficiencies and maintenance practices.”

The case of energy efficiency improvements undertaken by Ambuja Cements Ltd. demonstrates several facets of the trickle-down process, from a top-down mandate for increasing energy efficiency to the eventual assimilation of many industry best practices by a specific company. The salient process is summarized below.

The incentives created by the market-based instruments leads to energy-efficient technology investments by companies when the supporting institutional structure is functioning well. Notably, fair and transparent target setting is required. An effective monitoring and verification system should be manned by AEAs who are well qualified and well versed with the idiosyncrasies of the sector.

A participatory process is facilitated by state-level designated agencies and industry associations to incorporate feedback and suggestions from the industry. This extends with the creation of a platform for effective communication between the industries and regulators.

Multiple channels are opened for the diffusion of knowledge and industry best practices. The industry associations and a pool of energy experts and consultants facilitate faster adoption of the most appropriate technologies for the respective industry contexts.

Mechanisms are employed for risk mitigation of the financing of energy efficiency projects by commercial banks and private equity. This is partly made possible by using energy savings certificates that can be traded. Similarly, other risk-offsetting instruments create energy efficiency-linked collaterals that can be used to underwrite project financing.

5. Conclusion: Comparative Analysis of Institutional Enablers and Success Factors

The investigation of PAT shows the importance of institution building and ecosystem development for the effective diffusion of energy efficiency improvement targets. It is noteworthy that PAT is specifically targeting very large industries with high energy intensity. As a consequence, almost all the targeted industries operate at large scale, have a relatively lower cost of capital, have higher financial slack to invest in riskier energy efficiency projects, typically have access to global technological knowhow and skilled manpower for complex project implementation, and are usually run by professional managers.

These factors substantially enhance the success rates of the PAT-driven efficiency improvement projects in these companies. They also show far less reluctance and inertia in adoption of newer technologies when the business case is evident—even if the payback period is over three years.

In contrast, there are a vast number of MSMEs in the country contributing substantially to the economy that may have a different experience. The fourth economic census of the MSME sector estimates their total
number at 26.1 million, employing over 59 million people. The MSMEs contribute about 40 percent of total industrial output in the country.

Despite their vast numbers and share of economic contribution, most operate at suboptimal scales and employ traditional energy-inefficient production technologies. There is vast potential to improve the energy efficiency of this sector. Yet, the smaller scale of operation and financial precariousness of most of these enterprises make them extremely risk averse. In addition, they almost entirely rely on external sources for knowledge on best practices and technologies suitable for improving energy consumption. For the MSME sector, the hurdle of transition to efficient technologies is much higher, while the potential economy-wide gains in energy savings is enormous.

Recognizing these key differences, the BEE has initiated an energy efficiency program exclusively for the MSME sector. The primary focus of the program is to exploit demand-side management opportunities to reduce specific energy consumption in the smaller MSME units. The BEE has identified 25 geographic clusters of MSMEs in the country for intervention in the areas of energy efficiency technology adoption, capacity building for stakeholders in the cluster, and facilitation of innovative financing mechanisms for energy efficiency projects.

One example is the textile cluster of Surat, Gujarat. The state of Gujarat has a culture of cooperatives and cluster-based development of industries. The city of Surat itself is identified as one of the most dynamic city regions in the country by a United Nations Industrial Development Organization (UNIDO) study. The entrepreneurial spirit of the city is also evident in their proactive engagement with the BEE energy efficiency program. In particular, the MSMEs are geographically clustered, and they organize themselves through very active industry associations to represent their causes with the local governments and to organize to seek benefits of programs such as the energy efficiency improvement program.

In December 2019, the Surat textile cluster received an 80 percent cost-sharing grant from UNIDO to upgrade traditional plants and equipment with energy efficiency automation technologies. The project was jointly implemented by union power ministry’s Energy Efficiency Services Limited (EESL) and the South Gujarat Textile Processors Association (SGTPA). While typically the associations liaise with government bodies on behalf of its member MSMEs, in this case they actively took steps to transfer knowledge and technical knowhow to maximize the gains from such financial grants for capital investments in technology upgrading. An identical role of liaison and facilitation was played by the Vatva Industries’ Association (VIA), another cluster of MSMEs in Gujarat largely operating in the chemical sector.

A quote on the SGTPA website addresses the members’ concerns about the energy efficiency program:

In general, there has always been a feeling in the industry that environment and energy should be a secondary consideration but now it is the time to realize that we cannot look forward these aspects otherwise future viability of our industries will come to stake. To tackle such situations and to keep Surat textile cluster as fertile as on today, all the member firms can make extensive use of practices suggested in this center. In case of any information loss or viability problems, we request all the firms to make full use of forums to discuss their issues. It is a promise that association will work at its best to solve problem in least possible time.21

The statement clearly shows the primary concern of the MSMEs as business viability of energy efficiency projects and a need for technical expertise for successful implementation. This is in sharp contrast with the concerns of the larger industries under the PAT program, whose concerns are more to do with impact on competitiveness due to differential target setting within the industry.

These differences underline the importance of contextual sensitivity and the need for design of bespoke institutional support structures to ease adoption of energy efficiency practices. The comparison of adoption hurdles between larger companies and MSMEs shows that certain institutional functions such as stakeholder engagement, knowledge assimilation and dissemination, conflict arbitration, and human capital development are essential and common across both types of enterprises. Yet, the differences in scale, geographical proximity, technical expertise, financial slack, and managerial capital mandates keen attention to the context for the success of energy efficiency programs.

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