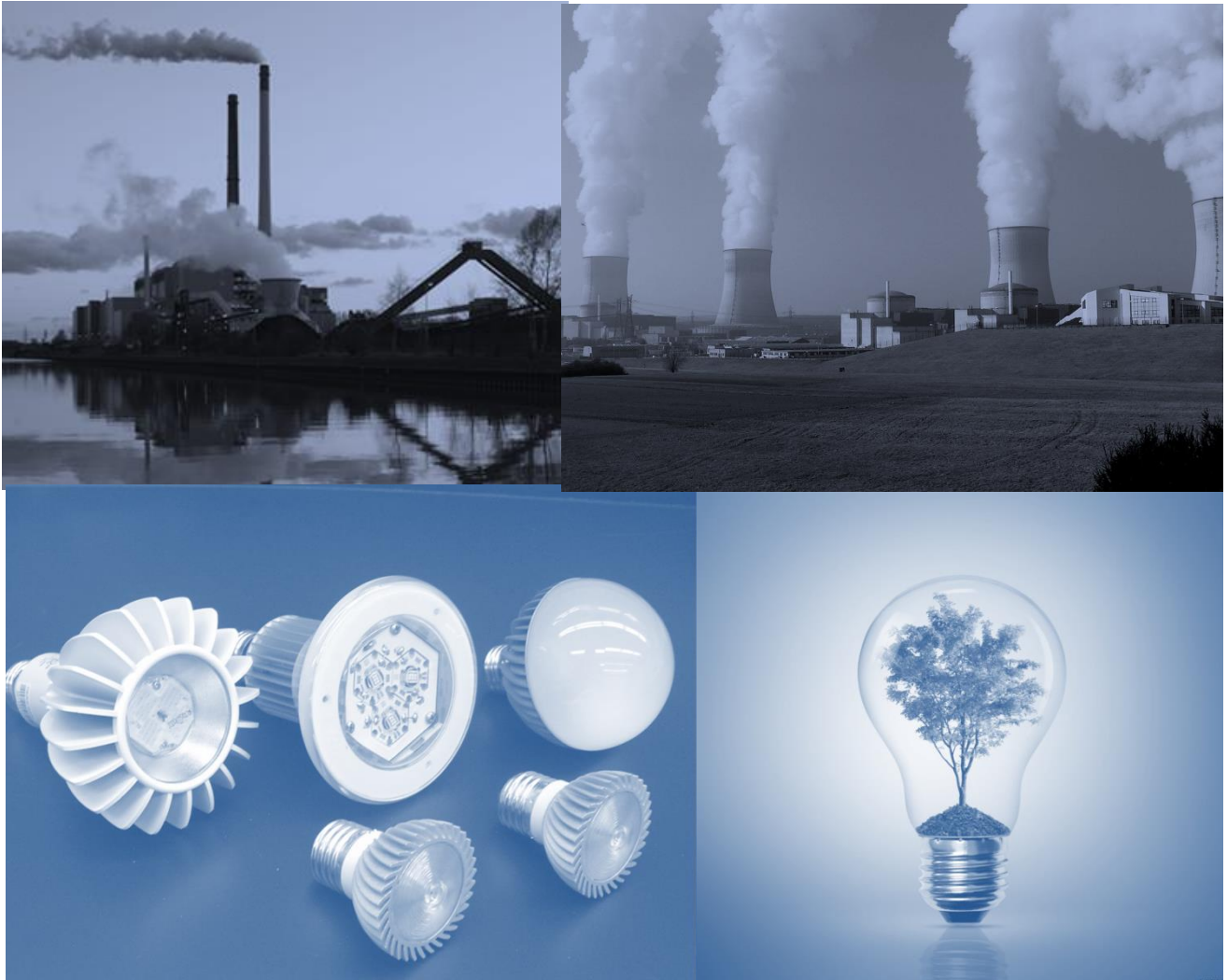


# PAT Pulse

Tracking the Perform-Achieve-Trade Scheme for Energy Efficiency

January 2016



## **KEY HIGHLIGHT**

**Project Watch: Cross-Sectoral Learning  
& Process Innovation will drive PAT  
Phase-2**

## **IN THIS PAT PULSE BRIEF**

- Event Round-up: PAT 2016-Learnings from Phase 1 & Outlook for 2nd Cycle
- Policy Update: PAT rules amendments
- Innovation Lens
- News Wire
- Datebook

Achieving energy efficiency in industries is a priority for India from the perspective of cost savings as well as climate change. The Perform-Achieve-Trade (PAT) scheme was formulated to achieve this objective by facilitating a market based mechanism for promoting energy efficiency.

'PAT Pulse' is a quarterly briefing series on PAT with DCs, policy makers, catalysts and industry experts to capture the pulse of the energy efficiency market in India created by Sustainability Outlook and Alliance for Energy Efficient Economy (AEEE) in collaboration with Shakti Sustainable Energy Foundation. The objective of this stakeholder briefing series is to provide evidence based, market assessment tool to present the stakeholder view point, enable higher uptake of PAT through peer learning and incubate industry and policy action on energy efficiency.

## In this brief

The first cycle of PAT came to an end with the verification and reporting phase getting completed by August. As the scheme moves into its second phase, this brief assesses some of the key aspects of the types of projects that were undertaken by Designated consumers (DCs) in Phase 1 and highlights the potential outlook of the stakeholders for Phase 2 of the PAT scheme.

### Inside view from Designated Consumers

Sustainability Outlook and AEEE conducted a survey with a sample of 47 Designated Consumers (DCs) from the 8 PAT sectors and reviewed 426 projects undertaken. The survey revealed that DCs in the first phase were focused on addressing efficiency mainly through retrofits and routine optimization. Thus the first phase was characterized by low capex, short pay-back projects.

The outlook for the second phase is tilting towards process innovation and focusing on system efficiency. There is also a significant potential to exploit cross-sectoral learnings.

In the survey, DCs have also expressed a need for enhanced action on financing models and ESCerts trading.

### Policy updates

The issue also provides updates policy regarding proposed amendments in PAT rules as well as a timeline for widening of PAT Scheme.

### Innovations

It also provides a sneak peek into some of the upcoming innovative solutions such as IoT (Internet of Things) driven Smart Energy Analytics Systems, automated cleaning of condenser & heat exchanger tubes, wireless occupancy sensors etc which will help improve energy efficiency in industries.

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## CROSS-SECTORAL LEARNINGS & PROCESS INNOVATIONS WILL DRIVE PAT PH-2

The verification and reporting cycle of phase-I of the PAT scheme finally ended on 17<sup>th</sup> August, 2015 and the industry is now awaiting the announcement of targets for the next cycle. An analysis<sup>1</sup> of the projects done by the Designated Consumers was carried as a part of this briefing series.

### Highlights

- **Low cost retrofit projects dominated Phase-I.** Almost 65% of the projects fell in this category. The focus was primarily on driving utility and component efficiency rather than process and/or systems efficiency.
- **More than 60% of projects carried out were relevant across sectors** (and not sector specific). There remains a potential for cross-sectoral learning that is likely to be tapped into in the next couple of years.
- Interviews with the Designated Consumers reveal that process innovation, availability of low cost finance and ESCerts trading hold the key to success of second cycle of PAT.

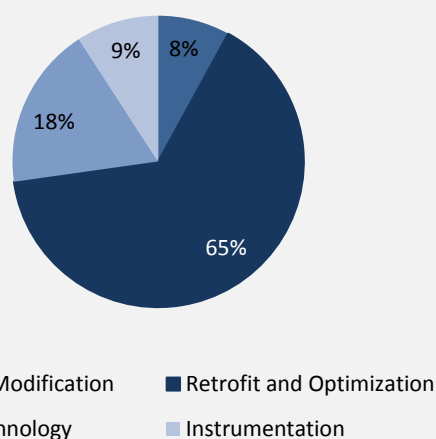
### Most projects implemented by DCs in phase-I of PAT were incremental

In order to illustrate the better understanding of underlying trends influencing the sentiment and action of DCs, an analysis has been done regarding projects carried out by a sample of the Designated Consumers.

Out of the 426 projects assessed, almost 65% were focussed on retrofit and optimization. Mostly dominated by cement, aluminium and iron and steel sectors, these projects were primarily linked to utility operations, motors operations, upgrade of technology components, optimization in process parameters; retrofits in plant electrical & thermal utilities; up-gradation of technology components especially in drives (like energy efficient motors, use of VFDs etc.), air compressors, HVAC systems and pumps. Similarly, adoption of waste heat recovery projects in many sectors as an EE improvement option. We also observe that enhancement of capacity utilization of plant (or equipment) has impacted in resulting low SEC in many cases.

Broadly, it can be concluded that most of the low-

Figure: Types of Energy Efficiency Projects undertaken in PAT phase-I



Source: Survey result, Sustainability Outlook-AEEE Analysis

<sup>1</sup> Sustainability Outlook and AEEE conducted a detailed survey with a sample of 47 Designated Consumers from the 8 PAT sectors

hanging fruits were tapped in this class, which required low investments and had a short term pay-back.

The focus was found to be more on component efficiency (which can be achieved by installation of individual components with guaranteed payback) rather than system efficiency.

This led to significantly less projects with major technology change in the first cycle of the PAT and so, only concentrated on harnessing the potential of low-hanging fruits with relatively less CAPEX.

For the purpose of this analysis, energy efficiency (EE) projects undertaken by the surveyed DCs under PAT scheme have been classified into four categories:

1. **Process Modifications:** These projects include changes in operating modalities of the process which leads to improvement in efficiency. Some of the actions include excess air control in fuel combustions, eliminating redundant / idle equipment operations etc. etc.
2. **Retrofit and Optimization:** The projects that require replacement of inefficiently operating technology by either energy efficient or newer component. For instance some of the PAT projects included introduction of variable frequency drives, rebuilding of coke oven and introduction of energy efficient computerised combustion control system for heating, chiller up-gradation with less steam consumption.
3. **New Technology:** These projects were linked to adoption of technological changes (either cross cutting or sector-specific installations). Some of the PAT projects under this category include commencing coal dust and coal tar injection in Blast Furnace, replacement of old open type motors with EE motors, changing from Soderberg to Pre-bake technology in Aluminum smelter, use of vertical roller mills in cement sector etc.
4. **Instrumentation and Control:** These include automated systems and management techniques deployed for monitoring and data collection for smooth and efficient operation of the processes. The project undertaken by the DCs under these categories are Thermo-compressor automation, up-gradation of meters, installation of oxygen analysers in the flue path of boilers, etc.

### More than 60% of projects carried out were cross-cutting rather than sector specific

A significant proportion of the projects carried out in Phase-I were found to be cross-cutting with generic applicability rather than sector-specific. Almost 70% of the retrofit and optimization projects were cross cutting in nature and included installation of VFDs etc. Other technology focussed projects included adoption of energy efficient pumps, air compressors, burners and thermal insulation systems, waste heat recovery systems etc.

#### Cross-cutting projects were about 65% of total projects surveyed

	Total Projects Studied	Cross cutting projects	Cross cutting as a % of total projects
Instrumentation projects	39	34	87%
Retrofit and Optimization projects	276	187	68%
New Technology projects	77	52	68%
Process modification projects	34	5	15%
<b>Total</b>	<b>426</b>	<b>278</b>	<b>65%</b>

**Instrumentation and Control projects: Low adoption in Phase-I but high potential for replicability across sectors in phase-II**

In the category of instrumentation more than 85% of the projects are cross-cutting, but their application in phase-I has seen one of the lowest adoption across all the 8 sectors covered under the PAT scheme. The table below illustrates the type of projects that are adopted by various sectors, but also has significant replicability potential in other sectors too.

**Cross-cutting instrumentation related projects that have a potential of replicability**

Name of Cross-Cutting Instrumentation Projects	Sector of Adoption in Phase-I					
	Aluminium	Cement	Fertilizer	Iron & Steel	Pulp & Paper	Thermal
Installation of oxygen analysers in the flue path of fuel combustion process.	✓		✓	✓		
Implementation of automated process control in digestion and evaporation systems to reduce steam consumption.	✓					
Common Utility – PLC based compressed air system monitoring and automated control to save electrical energy.						✓
Automation of Hydro-cyclone for throughput improvement.		✓				
Power saving from rewinder BCP trim blower of motor					✓	
Commissioned HT & LT APFC panels to improve Power Factor.		✓				
Installation of multistep controllers in Raw Mills dust collector compressors for better control of outlet pressure.		✓				
Dust collector cleaning operation converted from timer based to differential Pressure based cleaning to avoid excessive cleaning and optimising compressed air consumption.		✓				
Regular monitoring by thermograph for all electrical feeders and panels to avoid breakdowns.		✓				
Continuous monitoring and elimination of false air to reduce fan power consumption and reduction in specific heat consumption in pyro-processing and grinding system.		✓				
Interlocking for condensate separator pumps with condensate level to reduce power consumption.					✓	

**Key retrofit and optimization projects where cross-sectoral learning can play a role**

As indicated above almost 70% of the retrofit and optimization projects carried out under PAT phase 1 were non-sector specific and can be leveraged across multiple sectors. The table below highlights some of the key projects undertaken by specific sector in the first cycle which lend themselves to cross sectoral applications. As per the survey, installation of Variable Frequency drives was one of the most dominant retrofit project across all sectors in PAT Phase 1.

**Retrofit projects that have a potential of replicability**

<p style="text-align: center;"><b>Cement</b></p> <ul style="list-style-type: none"> <li>• Installation of Medium/Low Voltage Variable Speed Drives in fan of bag filter fans and compressors, positive displacement blower, kilns, calciner compressor, mill vent fan, separator vent fan, dust collector fan, belt conveyors forced draft fans of cooler, and vacuum pumps.</li> <li>• Installation of waste heat recovery systems</li> <li>• Optimization of compressors</li> </ul>	<p style="text-align: center;"><b>Paper and Pulp</b></p> <ul style="list-style-type: none"> <li>• Chiller upgradation with less steam consumption</li> <li>• Changing the TAP position of the lighting transformer</li> <li>• Vacuum Pump optimization</li> <li>• Installation of VFD for hood blower, steam feed water pump, stoker motor, secondary sludge pump etc.</li> </ul>
<p style="text-align: center;"><b>Iron and Steel</b></p> <ul style="list-style-type: none"> <li>• Rebuilding of Coke oven Battery and introduction of energy efficient computerised combustion control system for heating</li> <li>• Waste heat recovery from sinter cooler</li> <li>• Thermal insulation of steam lines</li> <li>• Improvement in bath temperature by replacement of heat exchanger tubes</li> <li>• Installation of Variable Voltage Variable Frequency (VVVF) drives</li> </ul>	<p style="text-align: center;"><b>Textile</b></p> <ul style="list-style-type: none"> <li>• Installation of Variable frequency drives for boiler accessories (like FD/ID fans, FW pumps), Thermic Fluid Heaters, cooling fans</li> <li>• Modification of exhaust ducting of compressors to increase efficiency of compressor</li> <li>• Modification of compressed air piping by arranging air flow meter separately to reduce pressure drop</li> <li>• Adoption of module wise lighting</li> </ul>
<p style="text-align: center;"><b>Aluminium</b></p> <ul style="list-style-type: none"> <li>• Low pressure blower runtime optimisation</li> <li>• Modification in Induced Draft Fan</li> <li>• Optimization in Electrostatic Precipitator, Compressor</li> <li>• Installation of VFD in pumps and fans</li> <li>• Reduction of diesel consumption in production vehicles by improving engine efficiency</li> </ul>	<p style="text-align: center;"><b>Fertilizer</b></p> <ul style="list-style-type: none"> <li>• Installation of VFD in boiler feed water pumps, waste collection system, ammonia feed pump</li> </ul>

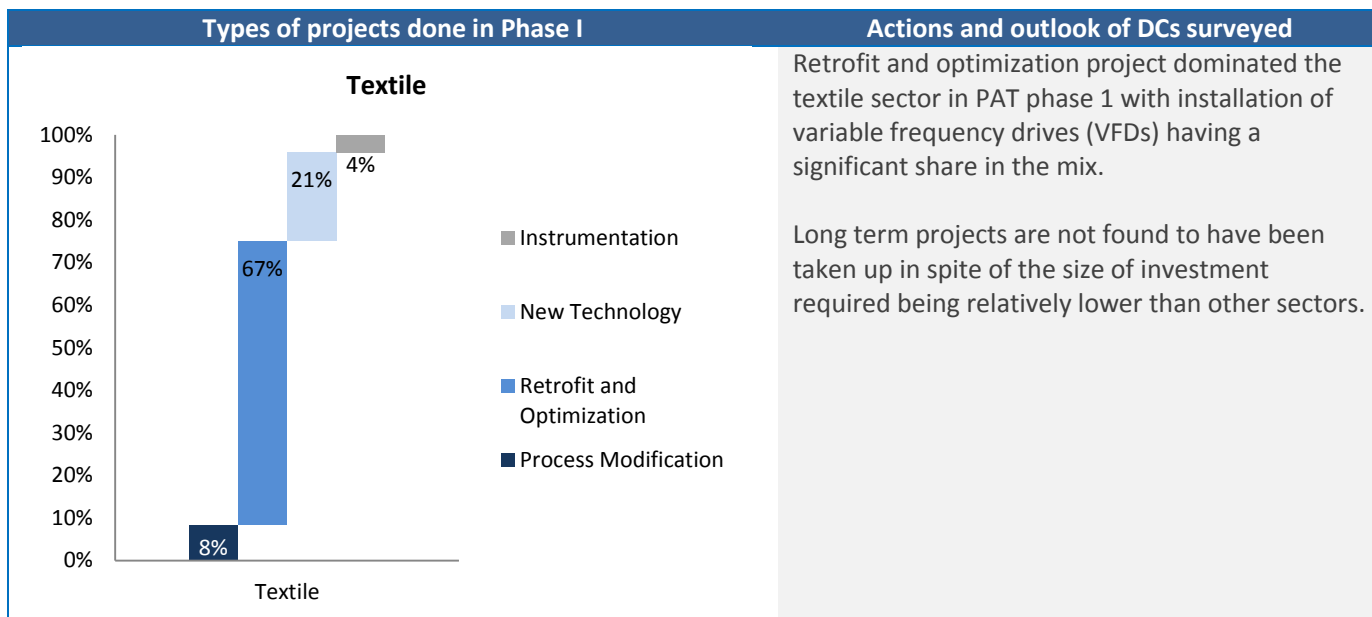
**Actions and outlook of Designated Consumers (DCs) in the sectors surveyed**

Types of projects done in Phase I	Actions and outlook of DCs surveyed										
<p style="text-align: center;"><b>Aluminium</b></p> <table border="1"> <caption>Aluminium Project Types</caption> <thead> <tr> <th>Project Type</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Process Modification</td> <td>24%</td> </tr> <tr> <td>Retrofit and Optimization</td> <td>61%</td> </tr> <tr> <td>New Technology</td> <td>14%</td> </tr> <tr> <td>Instrumentation</td> <td>2%</td> </tr> </tbody> </table>	Project Type	Percentage	Process Modification	24%	Retrofit and Optimization	61%	New Technology	14%	Instrumentation	2%	<p>The Aluminium sector, introduced new in-house technologies (such as CRYSTAL additive for dosing inside furnace by Hindalco, use of slotted anodes by NALCO) which have come to be regarded as best-in-class among its various industries.</p> <p>However, considering the long time required for in-house R&amp;D activities, capacity ramp-up and reaping the benefits of EE projects, a few DCs are found to have made a pitch for increasing the cycle duration for the second phase of PAT.</p> <p>The aluminium sector had the most number of process modification projects as compared to other sectors.</p>
Project Type	Percentage										
Process Modification	24%										
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<p style="text-align: center;"><b>Pulp and Paper</b></p> <table border="1"> <caption>Pulp &amp; Paper Project Types</caption> <thead> <tr> <th>Project Type</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Process Modification</td> <td>6%</td> </tr> <tr> <td>Retrofit and Optimization</td> <td>47%</td> </tr> <tr> <td>New Technology</td> <td>29%</td> </tr> <tr> <td>Instrumentation</td> <td>18%</td> </tr> </tbody> </table>	Project Type	Percentage	Process Modification	6%	Retrofit and Optimization	47%	New Technology	29%	Instrumentation	18%	<p>Paper and Pulp sector saw a significant adoption of energy efficient pumps and motors. This sector also had the largest sectoral share in instrumentation projects with 14 out of the total 27 such surveyed projects being carried out here.</p> <p>Almost 80% of all the projects assessed for this sector were cross-cutting in nature.</p> <p>With increased use of renewables through bagasse based/black liquor based energy generation, the paper and pulp sector has been vying for getting dual benefits of RECs and ESCerts.</p>
Project Type	Percentage										
Process Modification	6%										
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New Technology	29%										
Instrumentation	18%										
<p style="text-align: center;"><b>Cement</b></p> <table border="1"> <caption>Cement Project Types</caption> <thead> <tr> <th>Project Type</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Process Modification</td> <td>3%</td> </tr> <tr> <td>Retrofit and Optimization</td> <td>73%</td> </tr> <tr> <td>New Technology</td> <td>16%</td> </tr> <tr> <td>Instrumentation</td> <td>7%</td> </tr> </tbody> </table>	Project Type	Percentage	Process Modification	3%	Retrofit and Optimization	73%	New Technology	16%	Instrumentation	7%	<p>Even though the Indian cement industry is amongst the most energy efficient in the world, the focus was found to be more on retrofit and optimization projects.</p> <p>64% of the total projects assessed for this sector are cross-cutting across sectors. Low and Medium Voltage VSD and VFD, Energy efficient fans and motors are some of the generic interventions which form a major chunk of the optimization projects. DCs in this sector were predominantly categorized by large cash rich companies who have mostly used internal accruals to finance energy efficiency projects in Phase 1 of PAT.</p>
Project Type	Percentage										
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Types of projects done in Phase I	Actions and outlook of DCs surveyed										
<p style="text-align: center;"><b>Fertilizer</b></p> <table border="1"> <caption>Fertilizer Project Types</caption> <thead> <tr> <th>Project Type</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Process Modification</td> <td>0%</td> </tr> <tr> <td>Retrofit and Optimization</td> <td>59%</td> </tr> <tr> <td>New Technology</td> <td>35%</td> </tr> <tr> <td>Instrumentation</td> <td>6%</td> </tr> </tbody> </table>	Project Type	Percentage	Process Modification	0%	Retrofit and Optimization	59%	New Technology	35%	Instrumentation	6%	<p>Energy efficiency activities in industries in the fertilizer sector are largely driven by pre-set energy consumption norms (5.5 GCal/MT, 6.2 GCal/MT and 6.5 GCal/MT<sup>2</sup> are the set targets for 2018-19 for Group I, II and III companies respectively ) which are required to be met in order to access government subsidy.</p> <p>As it is a mandatory requirement for the Fertilizer industries to report the technical operating data to Fertilizer Industries Co-ordination committee (FICC), adoption of state-of the-art MIS/Energy Management systems is a necessity rather than a choice, which is evident in the high off-take of DCs and advanced process control systems in fertilizer industry. Owing to the stronger policy push outside of PAT scheme, the sector feels the scheme adds to its burden of reporting and doesn't incentivize it to adopt energy efficiency practices beyond the existing targets set for it by the government.</p>
Project Type	Percentage										
Process Modification	0%										
Retrofit and Optimization	59%										
New Technology	35%										
Instrumentation	6%										
<p style="text-align: center;"><b>Iron and Steel</b></p> <table border="1"> <caption>Iron and Steel Project Types</caption> <thead> <tr> <th>Project Type</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Process Modification</td> <td>7%</td> </tr> <tr> <td>Retrofit and Optimization</td> <td>65%</td> </tr> <tr> <td>New Technology</td> <td>15%</td> </tr> <tr> <td>Instrumentation</td> <td>13%</td> </tr> </tbody> </table>	Project Type	Percentage	Process Modification	7%	Retrofit and Optimization	65%	New Technology	15%	Instrumentation	13%	<p>The Iron and Steel industry has to be competitive in the Global market for its products to sell: hence increasing efficiency to beat global standards is another key driver.</p> <p>The response from DCs indicates that owing to the high investment (ranging from Rs 2 Cr to Rs 40 Cr) and lengthy payback times up to 45 months associated with making major technology changes; most projects have been limited to retrofits. The willing to pay penalties for not achieving their targets was highest in this sector.</p> <p>The DCs indicated that the sector is yet to figure out a breakthrough technology which will lead to a significant reduction in its specific energy consumption. Most projects in future would remain incremental in nature.</p>
Project Type	Percentage										
Process Modification	7%										
Retrofit and Optimization	65%										
New Technology	15%										
Instrumentation	13%										

<sup>2</sup> <http://fert.nic.in/sites/default/files/New%20Urea%20Policy%202015%20for%20existing%20based%20urea%20manufacturing%20units.pdf>

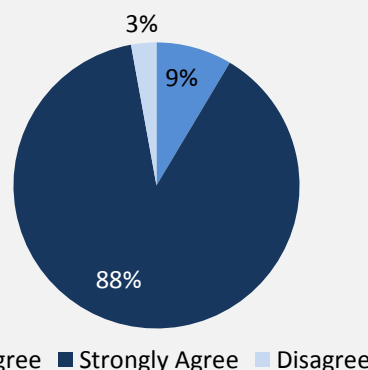




### What DCs thought of the M&V process

To a great extent, the effectiveness of PAT depends on the robustness of the Monitoring and Verification (M&V) protocol. The M&V protocol serves many purposes such as identification of controllable and uncontrollable variables, assessment of data and information need for monitoring of the variables, development of data & information protocol, development of regression equations and normalization methodology, development of systems for information flow in line with Bureau of Energy Efficiency (BEE) laid out criteria (Transparency, Acceptability, Measurability, Traceability & Verifiability) and development of organisational & institutional framework for management of the M&V process for the key stakeholders.

Figure: Survey response from DCs on transparency of M&V process

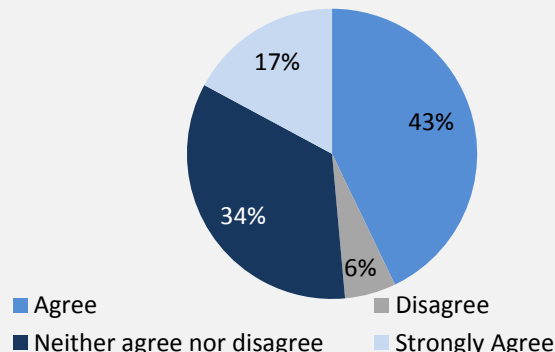


Source: Survey result, Sustainability Outlook Analysis

The survey response obtained from DCs indicated that the M&V design and process was transparent, They shared that this was enabled by extensive stakeholder consultation workshops conducted at regular intervals and handholding by the technical sub-committees for each sector.

However, given that 478 DCs had to be audited by 53 M&V agencies, the time of 3 months allotted for carrying out M&V was largely regarded as insufficient across all the industrial sectors, a fact which is also corroborated by anecdotal responses obtained in our survey. The additional factor that also affected was due to the delay caused in the duration of completion of M&V process itself, which only completed in mid-August 2015.

Figure: EmEAs level of familiarity with the job



Source: Survey result, Sustainability Outlook Analysis

More than 50% of the survey respondents agreed that the M&V agencies had desired level of capabilities to carry out the process. Some respondents indicated that sometimes there were differences in the interpretation of BEE guidelines by M&V agencies and lack of clarity/non-inclusion of normalization factors. Some of the sectors, Fertilizer in particular faced issues due to difference in accounting methodologies used conventionally (box approach) vs those used under the PAT scheme ( gate-to-gate approach) to report their energy performance. According to the DCs, few normalization factors in which they lacked clarity included fuel quality in cogeneration plant, membrane ageing factor, product mix and intermediary product and biomass and alternate fuel availability.

### *Availability of benchmarkable data can be improved through automated data management systems*

The survey indicates that a significant proportion of the DCs were lacking in terms of benchmarkable and quality data related to their energy performance which is not only beneficial from a compliance standpoint but also drives idea generation and in-house innovation within an organization. Though 97% of the Designated Consumers surveyed indicated that they had a formal mechanism – energy management systems (EnMS) in place for tracking of energy efficiency related projects, only 43% of these organizations had fully automated /partially automated systems of monitoring and tracking projects and timely reporting systems, such as Digital Control Systems and Advanced Process Control systems. According to BEE estimates, around 200 Designated Consumers were expected to take up ISO 50001 certification during the year 2014-15. This is expected considering PAT industries already fulfill majority of the prerequisites of ISO 50001 standards (such as plant boundary fixation, establishment of energy performance indicators and targets, normalisation of assessment year operating conditions with base line year etc.)

### **What DCs are thinking: Process innovation, Availability of low cost Finance and ESCerts trading hold the key to success of second cycle of PAT**

In the Cement and Fertilizer sectors, which constitute a major percentage of India's total industrial energy consumption, process innovation is the only way to avoid being penalized in the second cycle of PAT, as the performance as well as technology aspects are already best in the world. Process innovation is of no less importance in the Iron and Steel sector, in which BAT implementation projects as well as Retrofits have not happened to the extent desired due to high investment requirement and layout constraints respectively. Clearly, high quality R&D leading to disruptive process innovations and their quick mainstreaming is the need of the hour going in to the second cycle of PAT. In that context, incubating early stage technologies and carrying out demonstration programmes by catalyzing private sector co-investment into pre-commercial technologies could play a pivotal role by in the coming years.

An important reason that has emerged for the low adoption of BATs throughout all the sectors is the non-availability of low interest loans which makes the case for exploring green bonds as an alternate route (as suggested by a few DCs and financial institutions) even stronger. **Inclusion of non-energy benefits of energy efficiency projects**, which is a relatively nascent concept that is yet to gain traction in India, could also reduce the payback periods and help secure management buy-in. These benefits, which include productivity gains, improved product quality, lower non-energy operating costs, longer equipment life, reduced maintenance costs, less waste generation, better resource efficiency, improvement of workplace conditions and pollution reduction would make a significant percentage of stalled projects more palatable to

*Enhanced capacity of plant personnel is already getting recognized as one of the indirect/non-energy benefit linked to PAT*

the management in industries. Enhanced capacity of plant personnel is already getting recognized as one of the indirect/non-energy benefit linked to PAT. Respondents in our survey shared that the process of engaging employees across departments in an organisation and tapping their creativity to meet energy savings goals has spawned increasing number of in-house innovations. The

above cases also illustrate that some sectors are looking at adopting innovative technologies that are cost-effective in nature and that have short to medium –term return period.

### **Risk Analysis of Energy Performance Contracting projects needed to improve the take-up of ESCO model**

A significant majority of the DCs surveyed indicated that they had implemented the projects themselves rather than outsourcing the same to ESCOs which is an over-arching trend across all the sectors. The outlook for ESCOs remains grim amongst the surveyed DCs indicating lack of clarity about revenue sharing and credibility as the key issues. Financial Institutions surveyed during the survey stated the lack of knowledge on project risk, mismatch between ESCO size and project size and lengthy dispute resolution process as the aspects which need to be worked on collectively by the stakeholders to improve the climate for ESCO model in the second cycle of PAT. This subject will be delved in more detail in the upcoming brief of this series, which is focussed on ESCO model and financing challenges and learning during the first phase of the PAT; also looking at the opportunities that lie ahead for the second phase.

### **Accounting of PAT benefits in second cycle contingent on the smoothness of ESCerts' trading process in Phase-I**

With regards to ESCerts, the DCs response indicated need for clarity on ESCert allocation in case of plant expansion, ESCert allocation for new entrants in phase-II, status of ESCerts in case of Mergers and Acquisitions, tax and accounting treatment of ESCerts, netting and bubble provisions and cost basis of sold ESCerts. DCs belonging to the Pulp and Paper sector have made a call for a provision in the Energy Conservation Act to avail the benefits of both Renewable energy Certificates and ESCerts.. One of the next series will also cover the experience and market pulse of the ESCerts market and trading mechanism, once operational.

## **Way forward**

Overall, the DCs' sentiment from this survey gives mixed sense for the second cycle of PAT, with majority of them acknowledging the need and benefits of carrying out energy efficiency projects and yet on the look-out for incentives to aggressively push such measures in the expectedly stringent second cycle of PAT.

The survey also unveiled several opportunities. Key among them are:

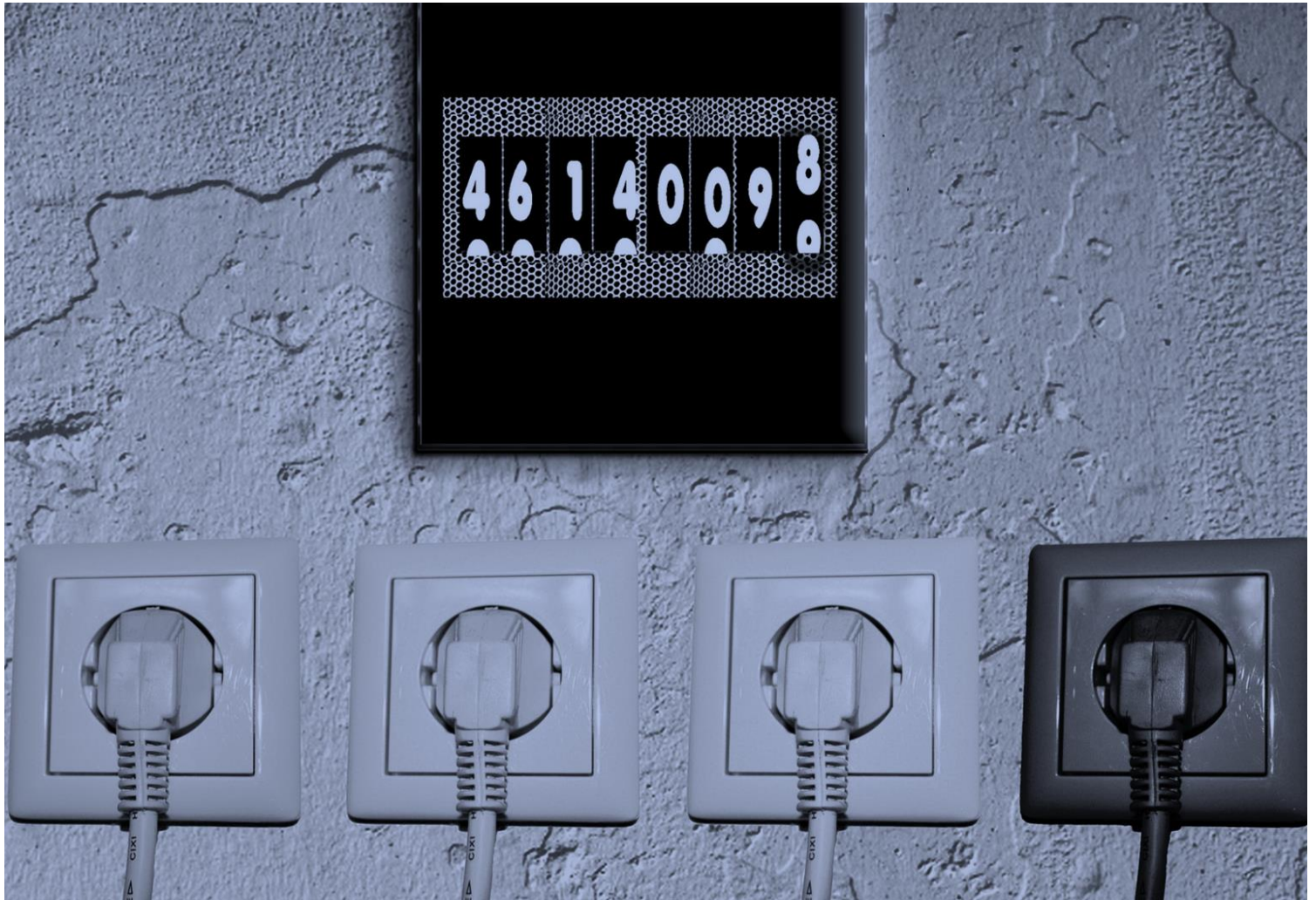
1. Opportunities for cross-sectoral learning especially for instrumentation and retro-fit projects.
2. Need to make benchmarks widely available; which in-turn have an ability to accelerate the pace of adoption of efficiency measures

Working of the ESCert trading mechanism and financing models for energy efficiency projects continue to remain a key area of uncertainty<sup>3</sup>. The upcoming briefs of PAT Pulse will delve deeper into some of these areas. The AEEE-Sustainability Outlook working group on Industrial Energy Efficiency will also be putting together workshops on cross-sectoral learnings from PAT Phase 1.

***We gratefully acknowledge the contribution of Dr. Sandeep Garg and Mr. Soumya Garnaik in reviewing this market brief.***

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<sup>3</sup> As on 6th August 2015, in terms of preparatory work for the trading phase of ESCerts, roles and responsibilities of entities and ESCert exchange regulations have been finalized, value of 1 ESCert has been determined and manuals on Penalty and Adjudication process as well as Business procedures for ESCert exchange have been prepared. These actions are expected to ensure the smoothness of the trading phase.



## PAT 2016-LEARNINGS FROM PHASE 1 & OUTLOOK FOR 2ND CYCLE

Sustainability outlook with AEEE convened a roundtable meeting 'PAT Next: Raising the Bar for Energy Efficient Manufacturing' to garner stakeholder view on the Perform Achieve and Trade Scheme, learning's from Measurement and Verification and Outlook for 2016 on 15<sup>th</sup> October, 2015 at the Grand Hotel, New Delhi as a part of the 5th Annual Summit of the Sustainable Business Leadership Forum.

The discussants, which comprised of sector experts, bankers and corporates, shared their experience during the implementation of PAT phase-I with regards to monitoring and verification systems on how PAT scheme in its upcoming form in Phase-II can further catalyze and foster industrial energy efficiency market in India. The excerpts of the key messages from various experts are shared below.

### Learning, Opportunities and Challenges: Phase-I

**Ms. Ritu Goswami, Chief Manager Tech, National Fertilizers Limited** stated that there is a strong need for more streamlining of appropriate reporting and documentation under PAT, particularly for the fertilizers sector which is otherwise also mandated by the Government of India to submit audited reports of annual performance on energy efficiency measures in order to access the subsidy. Since the PAT scheme also requires filling up of multiple forms and submission of similar data, the sector feels it is duplication of effort. A suggestion was made to appoint one nodal agency (such as an SDA) who would be responsible for all programmatic reporting and compliance of norms for the sector since that would save a lot of time, resources and avoid duplication. It was felt that since the fertilizers sector is well governed by the government policies, PAT doesn't provide any additional incentive and therefore the fertilizer sector should be excluded from PAT Mechanism.



**Mr. K. M. Tandon, V P, Shriram Fertilizers and Chemicals** was of the opinion that fertilizers sector in India is actually at the cutting edge technology and there is a very little scope for making any further innovation without incurring huge capital expenditure and he echoed the sentiment that the sector should be exempted from the next cycle of PAT.



According to **Mr. Tapendu Datta, Sr. GM (Energy Conservation and Renewable Energy projects at ACC)**, the scheme helped in capacity building, especially in activities related to M&V and in setting up of data management systems. He opined that since this was the first time such an elaborate exercise had been carried out, certain roadblocks were bound to arise.



### Outlook for Phase-II and ESCerts Trading

**Mr. Tapendu Datta** was of the opinion that success of PAT phase-II would be dependent on the performance of ESCerts trading. He also stated that the targets for Phase-II should be based on if the theoretical value of efficiency has already been achieved in that particular sector and also compares the existing energy efficiency levels with global benchmarks.

According to **Mr. Sandeep Garg, Chief Technical Specialist, SIDBI** target setting for PAT phase-II should consider the global achievable value of energy efficiency for the sectors in consideration. As per Mr. Garg, ESCO business has not taken-off in the country mainly due to longer litigation processes pertaining to their performance contracts, which makes it undesirable for the ESCOs to do business. In Phase-II the focus needs to shift to systems instead of components to achieve the desired

results.

Target-setting for PAT phase-II should be moderate as compared to the targets in phase-I as per **Mr. Sandeep Bhalla, General Manager, J K Paper Ltd** who also stated that ESCerts pricing should be based on a minimum price set by the government. REC market is a total failure, and currently dual benefits of REC and PAT are not allowed due to certain clauses of the Energy Conservation Act. Moreover, Government should provide Interest free funds (eg: Technology Upgradation Fund) for promoting energy efficiency and catalyzing industry action.



**Mr. Shashank Jain, Programme Manager (Industry), Shakti Sustainable Energy Foundation**

brought about an interesting point about the use of statistical tools for better measurement and planning by DCs, especially those which produce multiple products. He also suggested that setting more stringent targets

for PAT phase-II, would necessitate implementation of larger energy efficiency projects which will require greater capital investment. Hence, there would be a need for financing schemes which will help DCs in planning for larger projects.



**Mr. Udit Mathur, Sr. Advisor, DFID** was optimistic about the ESCerts trading mechanism under the PAT scheme and stated that as phase-II will see a bigger market (more no. of DCs) and stringent targets, it is expected that there will be better liquidity in the ESCerts market with this increase in demand.

In order for DCs to take up high investment projects to meet stringent target, there is a strong need for the issuance of ESCerts with a set initial pricing and early allowance. There has to be standardization of ESCerts issuance and trading procedure with

proper dispute resolution mechanisms in place. ESCerts should be made bankable. Buyer of last resort is not needed for ESCerts. There could be a programme similar to UK Accelerators (carbon trust) to bring together different industries on a single platform to get problem solved for specific process.

**Dr. Satish Kumar, Chairman AEEE** who was the session Chair summarized the key takeaways of the discussion and highlighted that there is a need for consistency of policy. Energy Saving Certificates (ESCerts) coming out at the end of the PAT phase-I will be in focus as there is a lot of interest around the market building and operational mechanics of this trading mechanism. The Indian industry is looking for more commitment from the government, both in terms of finance and policy.







# POLICY UPDATE

## Deepening & Widening of PAT Scheme and Provisions of EC Act Applicable to DCs

In its phase-I, the PAT scheme was applicable to 8 sectors which included about 478 designated consumers (DCs). In the second phase (2016-17 to 2018-19), there would be deepening (including more DCs from existing sectors) as well as widening (including additional sectors) of the PAT scheme. The three additional sectors, namely, Petroleum Refineries (with annual energy consumption threshold of 90,000 mtoe or above), Electricity Distribution Sectors (with annual AT&C loss of 1000 MU/ 86,000 mtoe or above) and Railways (including all zones with traction annual consumption of 70,000 mtoe or above and production/workshop units with annual energy consumption threshold of 30,000 mtoe or above) may include 175 new DCs to join the mix. The upcoming phase will have between 900-950 DCs with 11 sectors covering about 50% of the country's total primary energy consumption (2009-10 level) of. This will include deepening of PAT in existing sectors with additional 170 DCs from Iron and Steel, Pulp and Paper, Cement and Textiles combined, and about 100-110 DCs from Thermal Power Plant, Chlor-Alkali, Fertilizer and Aluminium.

Bureau of Energy Efficiency is also planning to finalize the normalisation parameters by assigned Expert Committee in June 2016. It also targets on notifying all DCs of SEC targets by March 31, 2016. The key milestones/activities have been detailed in the table below:

Activity Details	Time Frame
Notification of DCs	Sep 2015
Performa design/design of Form 1 with stakeholders and normalisation parameters	Oct 2015
Draft Target setting methodology and approach by experts	Nov 2015
Workshop after finalizing form 1	Nov 2015
Finalizing point 8 by committee	Dec 2015
Data collection/verification by 3rd party agency	Jan 2016
Notification of SEC targets	31st Mar 2016
Finalization of normalisation parameters by expert committee	Jun 2016

Source: [https://beeindia.gov.in/sites/default/files/Milind\\_Deore\\_widening\\_Deepening.pptx.compressed.pdf](https://beeindia.gov.in/sites/default/files/Milind_Deore_widening_Deepening.pptx.compressed.pdf)

## Proposed Amendments in PAT Rules

New provisions in the rules under the Energy Conservation Rules, 2012 (or the PAT rules) have been suggested for the phase-II of the PAT scheme. These changes will help SDAs, DCs and other relevant stakeholders in normalise further their energy efficiency actions by providing clarity and better understanding; remove any ambiguity and maintaining consistency.

Some of the amendments proposed to the Energy Conservation Rules 2012 are:

- Need for defining some of the terms stated in the Energy Conservation Rules 2012 to provide better clarity, remove ambiguity and maintain consistency, such as:
  - Definition of Accredited Energy Auditors – who carry out verification – and the name of the firms for further clarity;
  - Definition of the validity of ESCerts for compliance period
  - Definition of the term “Normalisation” and insertion of schedule II for incorporation of Normalisation factor – this is mainly due to the change observed during the implementation of phase-I that the conditions during the baseline and target years may be very different due to which SECs are not directly comparable. This schedule will provide formulae for Normalisation;
  - Definition of Central Electricity Regulatory Commission’s (CERC) function as market regulator for ESCerts trading – DCs will sell ESCerts through power exchange regulated by CERC
- Value of 1 ESCert shall be rounded off to the nearest whole number
- Provision for early issuance of ESCerts has been deleted . ESCerts can only be issued after the end of the target year
- Last financial year of three year reported data will be considered as baseline year for new DCs in PAT cycle II (for majority of DCs unless specific conditions are not met)

In addition to the ones listed above there are other modification and omissions made in the PAT rule.

Source: <https://beeindia.gov.in/sites/default/files/PAT%20Rules%20Amendments%20WS.pdf>



# INNOVATION LENS

Some of the latest innovations and development of new technology in the area of energy efficiency that have been successfully demonstrated their potential are listed here

## Online Automated Cleaning of Condenser & Tube Heat Exchanger Tubes

### Applicable sector:

- Small Power Plants (up to 60 MW)
- Process heat exchangers in industries
- Chemical & Petrochemical industries



### Likely impact:

This innovation helps save 20% of the energy utilized in water cooled HVAC systems and 3% improvement in the power output. This also results in a reduction in the O&M costs. Investment: Rs. 23 lakhs, Energy savings: Rs. 10 lakhs, Payback: 5~6 months

[www.ecogreensys.com](http://www.ecogreensys.com)

**Description:** The ECOMax-HE, innovation relates to the online cleaning of condenser/ shell & tube heat exchanger tubes; it uses the principle of periodic injection and collection of cleaning sponge balls at a predefined interval. It replaces the conventional method of offline acidic chemical descaling of the condenser tubes. The innovation helps to keep the condenser tubes clean always without any chemical usage and improves the heat transfer resulting into improved efficiency. The USP of this cost effective innovation is that it manages multiple condensers on one system easily.

## Waste Heat Recovery Products for Industrial and Commercial Applications

**Applicable sector:** The products are applicable to most industry segments which have a concurrent requirement of utilities (air compressors/chillers) and hot water. Applicable to hotels, hospitals, dairies, food and beverages, textiles, automotive among others.

**Likely impact:** Promethean Energy is a heat recovery system designer and manufacturer. While the company sells directly to certain high value customers, their primary audience is channels like ESCO's or OEMs. For channel sales, Promethean would be making capital sales, along with an annual AMC contract.



[www.chillermate.com](http://www.chillermate.com)

**Description:** Promethean Energy, makes unique waste heat recovery (WHR) products for industrial and commercial purposes to help reduce heating costs by upto 75%. They recover waste energy from utilities like chillers and air compressors, convert it to zero-cost hot water and give it back to the industry. This offsets the fuel requirement for generating this hot water.

After having started work on this product 8 months back, Promethean have already installed the products in Godrej Industries and Aditya Birla Group. They have secured an LOI from a dairy in Maharashtra as well as a hospital in Delhi, apart from enquiries for close to 10 orders in the past month.

## Wireless Occupancy Sensors for Eliminating Energy Wastage, BuildTrack – Surmount Energy Solutions

**Applicable sector:** Buildings in all sectors

- Conforms to NBC, IESNA, IGBC, GRIHA and USGBC Standards
- Switches will work, even if sensors fail or run out of battery
- Immediate return on investment
- No requirement of additional wiring
- Sensor can be freely placed where required, Single sensor can control multiple switches



[www.buildtrack.in](http://www.buildtrack.in)

**Description:** Occupancy sensors have long been considered a viable solution for reducing energy consumption in many residential and commercial settings. The challenges in implementing them in existing situations are many and these issues faced often deter from their usage in retrofit situations.

- Wiring that is visible stretching from every device needing to be controlled to the occupancy sensor which is both a cost and sore on aesthetics
- Difficulty in using a single sensor to sense occupancy and control multiple electrical devices (e.g. lights, fans, A/C)

The solution is a wireless occupancy sensor that "talks" to existing switches to operate electrical devices connected to them. The complementary device that enables the switch to "listen" to the sensor "talking" is a node that can fit behind most existing switches and it controls the switches. This solution consisting of the sensor and node work through wireless communication with each other with the sensor "talking" when it senses occupancy to inform the switch to "turn ON" and similarly to turn OFF once it senses that the occupant has left the space.

## IoT Driven Smart Energy Analytics System

**Applicable sector:** Currently, the focus is on commercial customers of electricity including:

- Offices
- Hotels
- Hospitals
- Schools or college campuses
- Retail outlets

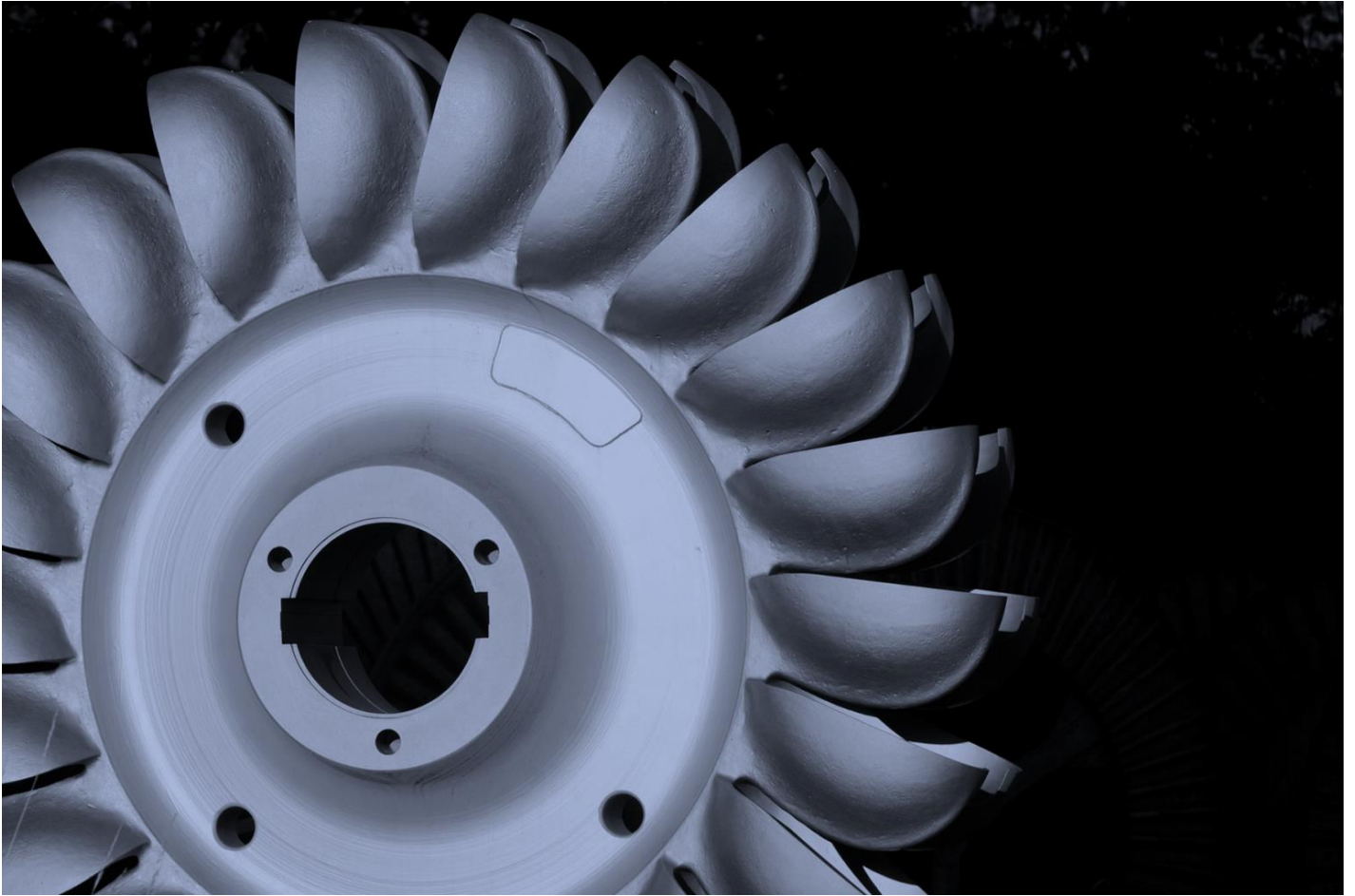


<https://zenatix.com/>

**Likely impact:** Zenatix has delivered 10% or more energy savings to more than 40 customers. Zenatix does not charge any Capex for deployment of its hardware or software. The customers are billed a fixed subscription fee (per month or per annum) based on the size of the infrastructure. The energy savings delivered by the solution is to the tune of 2 to 4 times the subscription fee.

**Description:** Zenatix, co-founded by alumni from IIT Delhi, IIM Ahmedabad and UCLA, provides an IoT driven energy analytics product that helps commercial consumers of electricity save at least 10% energy using intelligence from the energy data.

The product is a combination of hardware and software. The hardware includes sensors (smart energy meters, temperature/humidity sensors) and Zenatix controllers that acquire data in real time from these sensors. It is understood that raw data doesn't drive a change. Therefore, Zenatix software delivers actions or insights in form of automatic control or sms/email alerts. The actions or insights are based on analytics based use cases that Zenatix has developed for different kinds of electrical loads. The software also includes dashboards which allow customers get an understanding of consumption patterns in real time.



## NEWS WIRE

### Key News Highlights

#### **Indian Manufacturing Sector could increase efficiency by 17.9%: Siemens Financial Services**

**Aug 13, 2015:**

The recent study carried out by the research group of Siemens Financial Services showed that India has approximately 17.9% of untapped Electricity-Efficiency potential and optimizing Industrial Motor-driven systems could deliver overall savings up to 60% on industrial electricity consumption can provide a huge opportunity for cost-savings. This study included the global top 20 industrial equipment manufacturers. The research further illustrates an estimate on the untapped potential for electricity-efficiency (usage and cost-savings, expressed as a proportion of total electricity consumption) in the manufacturing sector, putting India in the second position following Russia and ahead of China in electricity-efficiency potential.

The study also suggests that in order to be on top of its game and remain competitive, the manufacturing sector must incessantly innovate and reinvent itself. The electricity consumption is one such potential area, given the rising demand and prices over the last decade. Electricity usage in the manufacturing sector has undergone huge growth over the last 40 years, rising three times faster than overall energy use, and now represents over a quarter of industrial energy consumption.

It also illustrates the opportunities and challenges in getting access to finance to fund investments in energy-efficient equipment. In India, this still remains relatively restricted as there are large base of smaller and medium-sized manufacturing operations. Tailored to catering these players with specific financing arrangements will prove fundamental to the Indian manufacturing sector in terms of energy-efficiency and thus, will boost the government's 'Make in India' initiative placing India as a manufacturing hub.

Source: [http://articles.economictimes.indiatimes.com/2015-08-13/news/65523924\\_1\\_manufacturing-sector-manufacturing-hub-consumption](http://articles.economictimes.indiatimes.com/2015-08-13/news/65523924_1_manufacturing-sector-manufacturing-hub-consumption)

#### **Charter signed between Bureau of Energy Efficiency and Yes Bank for Participating Financial Institutions Empanelment under PRGFEE**

**Oct 3, 2015:**

The Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) constituted by Ministry of Power and Bureau of Energy Efficiency for providing financial institutions (Banks/NBFCs) a partial coverage of risk involved in extending loans for energy efficiency projects.

Administered by Energy Efficiency Services Ltd. (EESL), during the meeting organised with Banks/FIs/ESCOs on 3rd October, 2015 in Mumbai, a charter was signed between BEE and Yes Bank for empanelment of Participating Financial Institutions (PFIs) under PRGFEE. This is expected to set the tone for other Banks/NBFCs to join this league and contribute in promoting Energy Efficiency in India. Speaking on the occasion, the Additional Secretary said that "Funds like PRGFEE and VCFEE shall help Government of India in meeting the voluntary targets set under India's Intended Nationally Determined Contribution, where India has declared a voluntary goal of reducing the emissions intensity of its GDP by 33 to 35% by 2030 from 2005 levels".

See more at: [https://beeindia.gov.in/sites/default/files/press\\_releases/Final%20Press%20release%20for%20RT.pdf](https://beeindia.gov.in/sites/default/files/press_releases/Final%20Press%20release%20for%20RT.pdf)

#### **Industrial Energy Management Systems to Grow to \$35.6 bn by 2024, Globally**

**Oct 6, 2015:**

The recent report by Navigant Research says that the market for global industrial energy management systems (IEMSs) is expected to grow from \$13.5 billion in revenue in 2015 to \$35.6 billion in 2024. As opposed to when only the need for

continuity in operations and production was given attentive care and energy efficiency measures a lower priority in industrial facilities, now with greater executive understanding of the value of enhanced visibility and insight into enterprise performance and site-level strategic energy management, the business case for IEMSs is growing.

The market is driven by the increasing customer demand for IEMS software and services. The North American and European markets are expected to continue to lead the market in terms of revenue, while Asia Pacific is expected to experience the fastest growth.

Source: <http://www.achrnews.com/articles/130770-industrial-energy-management-systems-market-to-reach-356-billion-by-2024>

## **Danfoss India inks MoU with National Productivity Council to promote Energy Efficiency**

**Nov 6, 2015:**

Danfoss Industries has announced that it has signed a Memorandum of Understanding with National Productivity Council, Government of India (NPC) to leverage common facilities for training in the area of energy efficiency, work towards improving the course modules and further on energy audit support on a case to case basis.

Under the agreement, Danfoss India will utilize NPC facilities to provide to its officials and personnel with practical and theoretical training in the field of energy efficiency. The Energy efficiency modules will be specifically designed towards but not limited to Refrigeration, Air conditioning, industries covered under PAT modules of Bureau of Energy Efficiency etc. This MoU will also help dissemination of experiences and relevant information on energy to have enhanced actions across various energy consuming divisions in energy intensive industries.

Source: [http://www.business-standard.com/content/b2b-manufacturing-industry/national-productivity-council-ropes-in-danfoss-to-promote-energy-efficiency-115110700200\\_1.html](http://www.business-standard.com/content/b2b-manufacturing-industry/national-productivity-council-ropes-in-danfoss-to-promote-energy-efficiency-115110700200_1.html)

## **LED bulbs price to come down to Rs 44 per unit: Piyush Goyal**

**Nov 25, 2015:**

After achieving a milestone of distributing 3 crore LED bulbs under domestic lighting scheme, Power Minister Piyush Goyal today said the price of these lights will be brought down to 44 per unit in coming days. "We will encourage the Make In India campaign and aim to bring down the prices of LEDs to Rs 44 per unit. Earlier I had talked about it in lighter vein. But now this is the new target for us," Goyal told reporters. The state-run EESL has been able to procure LED bulbs for Rs 73 as of June, down from Rs 310 in February 2014, a reduction of over 75 per cent.

The scheme is running in six states -- Rajasthan, Delhi, Maharashtra, Uttar Pradesh, Andhra Pradesh and Himachal Pradesh -- and is rapidly expanding across all other states, an EESL press release said. According to the statement, the three-crore bulbs distributed will result in an annual energy savings of 4 billion Kwh, capacity addition avoidance of 900 MW and cost savings of Rs 304 crore and has impacted 90 lakh consumers.

India has made an international commitment to reduce its carbon emission intensity by 30-35 per cent. Building capacities while adopting and deploying new energy efficient technology, and other technologies to reduce carbon emissions is one of the mitigation strategies that India has.

The target of the DELP is to replace all the 77 crore incandescent bulbs sold in India with LED bulbs. This will result in reduction of 20,000 MW load, energy savings of 105 billion KWh and Green House Gas (GHG) emissions savings of 80 million tonnes every year. The annual saving in electricity bills of consumers will be Rs 40,000 crore, considering an average tariff of Rs 4 per kWh.

Source: [http://articles.economictimes.indiatimes.com/2015-11-25/news/68560859\\_1\\_led-bulbs-power-minister-piyush-goyal-efficient-lighting-programme](http://articles.economictimes.indiatimes.com/2015-11-25/news/68560859_1_led-bulbs-power-minister-piyush-goyal-efficient-lighting-programme)



## **Cabinet gives nod to MoU between India, UK for cooperation in energy sector**

**Dec 9, 2015:**

The Union Cabinet, chaired by Prime Minister Narendra Modi, gave ex-post facto approval for signing of a memorandum of understanding (MoU) between India and the United Kingdom and Northern Ireland on cooperation in the energy sector. The areas of cooperation included market reforms, regulatory structures and the role of competition in the supply and distribution of electricity, including regulations and incentives for Renewable Energy deployment; the integration of renewable energy into the grid; energy efficiency policies and practice, including industrial energy efficiency and vehicular fuel efficiency; off-shore wind energy and solar energy; smart grids; energy storage and new energy technologies.

The MoU will provide an enabling framework for technical assistance, including in-kind grant, and other support, as mutually agreed, through relevant projects initiated by the United Kingdom.

Source: [http://www.business-standard.com/article/news-ani/cabinet-gives-nod-to-mou-between-india-uk-for-cooperation-in-energy-sector-115120901374\\_1.html](http://www.business-standard.com/article/news-ani/cabinet-gives-nod-to-mou-between-india-uk-for-cooperation-in-energy-sector-115120901374_1.html)

### **Other News Picks**

Validity of BEE's empanelled Energy Service Companies (ESCOs) that expired on 30th October 2015 is hereby extended up to 31st January, 2016.

<https://beeindia.gov.in/latest-news/temporary-extension-validity-escos>



# DATEBOOK

## **ELECRAMA 2016**

<b>Date</b>	13 - 17 February 2016
<b>Location</b>	Bangalore, India
<b>Type of event</b>	Conference
<b>Organiser</b>	ABB India
<b>Key themes</b>	Looking at technologies and business opportunity across various industrial sectors in India.
<b>Link</b>	<a href="http://www.abb.co.in">http://www.abb.co.in</a>

## **Fensterbau Frontale India 2016**

<b>Date</b>	25 - 27 February 2016
<b>Location</b>	Mumbai, India
<b>Type of event</b>	Event
<b>Organiser</b>	ift Rosenheim
<b>Key themes</b>	Architects, Fabricators, Developers and Specifiers converged at FENSTERBAU FRONTALE INDIA to discuss how aesthetics and design trends can be reconciled with energy-efficient building. New technologies and developments were displayed by exhibitors from India and across the world.

An important event highlight this year was the "Centre of excellence - Seeing is Believing" pavilion initiated by ift Rosenheim. Experts from ift Rosenheim demonstrated through a testing rig, factors which influence the product quality of windows such as construction principles, frames, glass, sealing, hardware etc.

ift Rosenheim is a world renowned institute for testing, surveillance and certification of façade and fenestration products.

**Link** <http://www.frontale-india.com/>

## **ACEEE Energy Efficiency Finance Forum**

<b>Date</b>	22 - 24 May, 2016
<b>Location</b>	Newport, USA
<b>Type of event</b>	Conference
<b>Organiser</b>	ACEEE
<b>Key themes</b>	This conference focuses on the state of financing in the energy efficiency arena. The Finance Forum has been held for nearly a decade, bringing together the leading minds of the industry and serving as an invaluable networking opportunity. Each year, the conference features over 20 sessions lead by experts in the field. A "Deal Room" is set up for the duration of the conference, providing a private venue for energy efficiency project leaders and investors to meet and discuss financing.
<b>Link</b>	<a href="http://aceee.org/conferences/2016/eeff">http://aceee.org/conferences/2016/eeff</a>

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## About Shakti Sustainable Energy Foundation

Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support energy efficiency and renewable energy

## About Sustainability Outlook

Sustainability Outlook, a division of cKinetics is a market access, insight and collaboration platform tracking actions related towards enhanced resource management in the Indian economy. Sustainability Outlook provides market analysis and data tracking services, news and intelligence updates, and creates momentum towards specialised sustainability interventions by facilitating a structured process for multi-party collaboration.

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## About AEEE

AEEE is an industry association created for the specific purpose of convening companies and organizations (manufacturing companies, end users, service providers, utilities, academic and R&D institutes and other non-profit organisations) interested in creating a thriving energy efficiency sector in India and providing a unique platform to actively participate and support in energy efficiency policy formulation and analysis.

### Contact

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