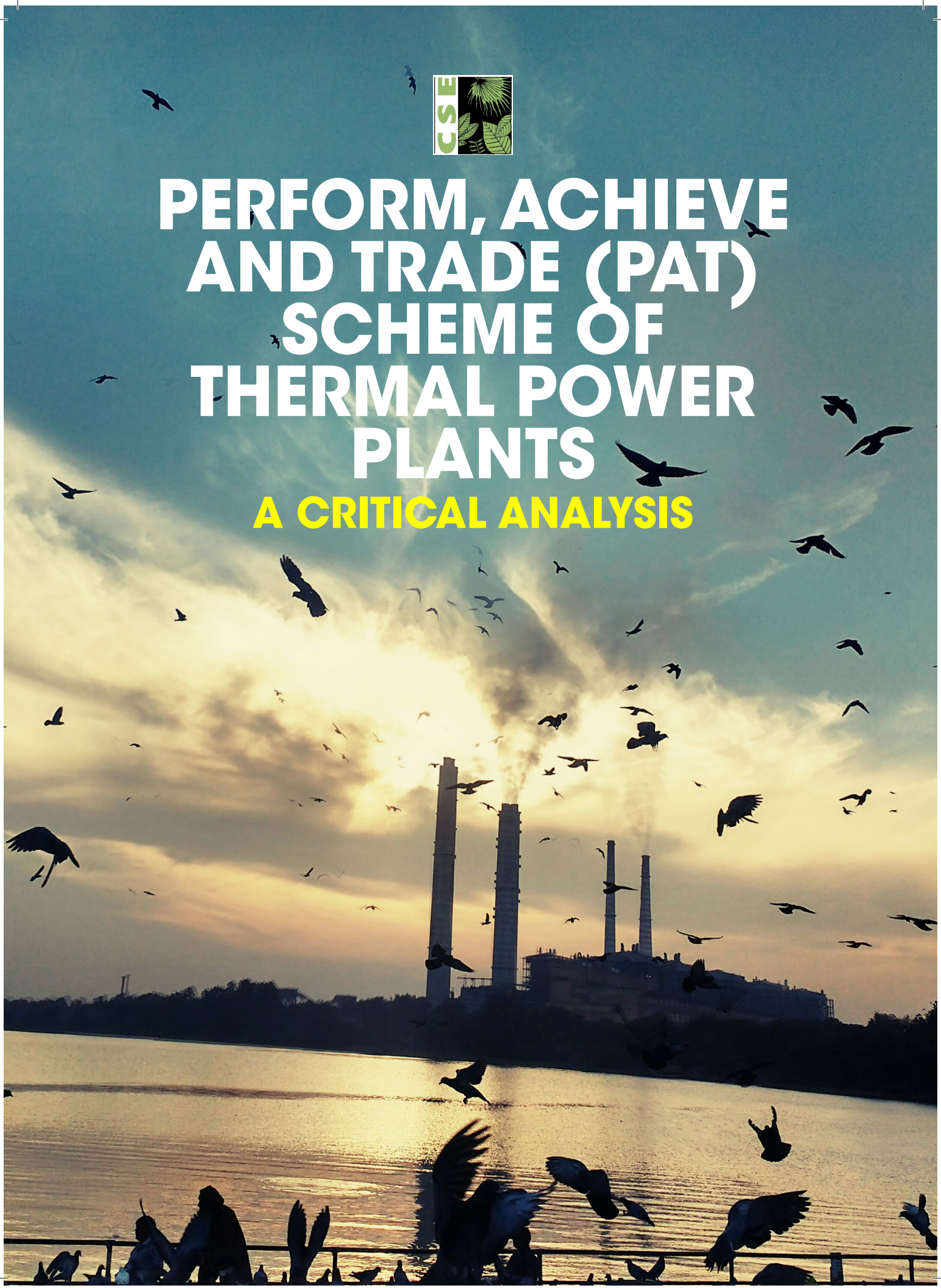

PERFORM, ACHIEVE AND TRADE (PAT) SCHEME OF THERMAL POWER PLANTS

A CRITICAL ANALYSIS

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Production: Rakesh Shrivastava and Gundhar Das

Maps in this report are indicative and not to scale.

Citation: Citation: Nivit Kumar Yadav, Sowmiya Kannappan, Soundaram Ramanathan and Sugandha Arora 2021, *Perform, Achieve and Trade (PAT) Scheme in Thermal Power Plants: A Critical Analysis*, Centre for Science and Environment, New Delhi

Published by
Centre for Science and Environment
41, Tughlakabad Institutional Area
New Delhi 110062
Phones: 91-11-40616000
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E-mail: sales@cseinida.org
Website: www.cseindia.org

Printed at

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A CRITICAL ANALYSIS

Contents

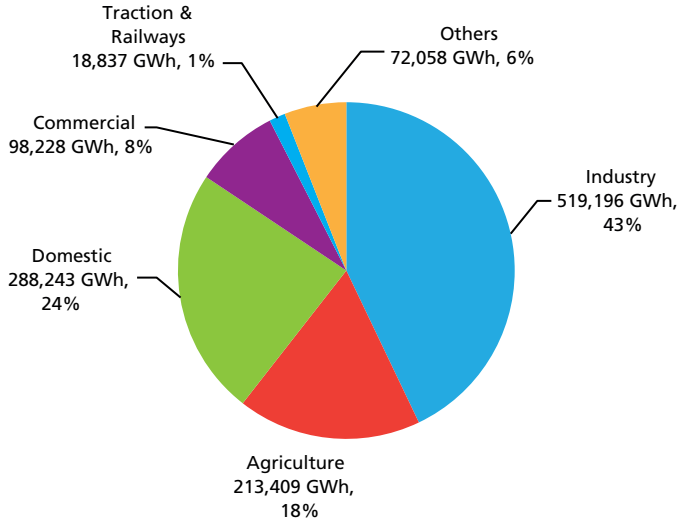
1. BACKGROUND

India is industrializing rapidly, with commensurately rising energy consumption. The industrial sector consumes the most energy in the country—accounting for 43 per cent of overall consumption (see *Graph 1: Breakup of electricity consumption*)—making it the major contributor to the country's energy and environmental footprint.

For energy supply, India relies greatly on coal-based thermal power plants. Though renewable energy sources of power generation are increasing, thermal power plants stand as the most reliable source of power in the country.

Graph 1: Breakup of electricity consumption

Industrial sector is the highest energy consumption sector in India



Source: Data from Energy Statistics India 2021, 28th Issue by National Statistical Office Ministry of Statistics and Programme Implementation, Government of India

In 2008, the Government of India released, in the context of increasing energy consumption and related carbon emissions, the National Action Plan on Climate Change (NAPCC). The aim of the plan was to promote and enable sustainable development through a low-carbon and high-resilience development pathway. Under NAPCC, eight National Missions were formed—to focus on various aspects related to water, solar energy, sustainable habitat, agricultural, energy efficiency, ecosystems and others—among which is the National Mission for Enhanced Energy Efficiency (NMEEE). The Ministry of Power (MoP) and Bureau of Energy Efficiency (BEE) were entrusted with the task of preparing the

implementation plan for the National Mission for Enhanced Energy Efficiency (NMEEE), which was rolled out under four subheads:

- Perform, Achieve and Trade (PAT)
- Market Transformation for Energy Efficiency (MTEE)
- Energy Efficiency Financing Platform (EEFP)
- Framework for Energy-Efficient Economic Development (FEEED), or developing fiscal instruments to promote energy efficiency
-

Figure 1: Programmes of the National Mission for Enhanced Energy Efficiency (NMEEE)

Source: Press Information Bureau, https://www.pib.gov.in/PressReleasePage.aspx?PRID=1744431 (last viewed November 26, 2021)

The PAT scheme emerged as the most accessed amongst the stakeholders of the four schemes as it involved several stakeholders—designated agencies, auditors, energy consumers, vendors and suppliers working to improve energy efficiency—creating an ecosystem. It reached thousands of industries and aspiring professionals to enter the energy auditing space and the Ministry of Power and other experts for baseline, verification and certification settings. Other schemes in contrast were targeted at niche stakeholders and not many programmes were planned under them. For instance, under MTEE only two programmes were developed, i.e. Bachat Lamp Yojana (BLY) and the Super-Efficient Equipment Programme (SEEP). Similarly the Energy Efficiency Financing Platform (EEFP) in its first phase conducted only four training of trainer programmes to serve especially bankers and financial institutions.

This paper analyses the efficiency of the PAT scheme, whether it has served the intended purpose of achieving energy efficiency in the industry, whether there is scope to improve, current achievements of the scheme, challenges and charts the strategy to sharpen this mechanism with special case reference to thermal power stations. It analyses the mechanism's efficacy for the thermal power sector because it is the largest energy consumer and air polluter of industrial sectors in the country.

2. OVERVIEW

Perform, Achieve and Trade (PAT) is a competitive mechanism for reducing energy use in large industries. Under PAT, the government shortlists industries, restricts the amount of energy they can consume, and defines a time limit by when this restriction should be met. The industries are chosen after in-depth sector-wise analysis by the government. Industries have in turn to work to improve their energy efficiency; industries that participate in the scheme are called designated consumers. Those that overachieve their targets are issued energy savings certificates that can be traded with industries that have not achieved their targets. The certificates that are issued are called ESCerts.

Industries are given three years to achieve the targets set by the agency. Non-achievers have to buy the ESCerts after the three years. This time given to comply with the energy-reduction targets is called one cycle. Announcements for six cycles since 2012 have been made so far; PAT covered about 13 energy-intensive sectors. Sectors included are thermal power plants, cement, aluminium, iron and steel, pulp and paper, fertilizer, chlor-alkali, petroleum refineries, petrochemicals, DISCOMs, railways, textile and commercial buildings (hotels and airports).

The Bureau of Energy Efficiency (BEE), a wing of the Ministry of Power, selects the sector and industry on which targets are placed. Accredited BEE-empanelled energy auditors are engaged by the industry to present the audit statements post the cycle. The firms scrutinize, monitor and verify to ascertain achievements and target shortcomings. Based on the verification results, the industries trade in power-exchange portals, i.e. online market platforms where energy is bought and sold by consumers and generators.

Sectors are selected on the basis of the BEE feasibility study. BEE-empanelled accredited energy auditors survey the numbers of units in a sector and study the energy consumption pattern to set the minimum threshold of energy consumption to the selected sector. Cumulatively, so far 1,569 (including 448 repeated DCs in PAT Cycles 1 and 2) industries and/or designated consumers under 13 energy-intensive industries have been specified reduction in energy-use targets under the PAT mechanism. For setting targets, BEE considers the average energy consumption of three years as the baseline years and three years for DCs to comply with targets. After completion of the PAT cycle, measurement and verification of achieved energy savings is carried out and the year in which it is performed is referred to as assessment year (see *Table 1: Baseline year, assessment year and number of DCs listed and current status of each PAT cycle*).

Table 1: Baseline year, assessment year and number of DCs listed in each PAT cycle

The majority of industries were included in the beginning of PAT cycles

PAT cycle	Baseline year	Assessment year	No. of sectors involved	No. of DCs involved	Status of cycle
Cycle 1	2007–10	2014–15	8	478	Trading of ESCerts done
Cycle 2	2014–15	2018–19	11	621	Evaluation of ESCerts
Cycle 3	2015–16	2019–20	6	116	Under evaluation
Cycle 4	2016–17	2020–21	8	109	Implementation phase
Cycle 5	2017–18	2021–22	8	110	Ongoing
Cycle 6	2018–19	2022–23	6	135	Ongoing

Source: Data from Bureau of Energy Efficiency, 2021 compiled by CSE

In 2012, the PAT cycle included 478 designated consumers (DCs) from eight different sectors. This was followed by 621 DCs from 11 energy-intensive sectors (eight existing sectors and three new sectors) in Cycle 2 (448 industries were repeated in Cycle 2 from Cycle 1, with revised targets), 116 DCs from eight sectors (six existing sectors and two new sectors) in Cycle 3, 109 DCs from eight sectors in Cycle 4, 110 DCs from eight sectors in Cycle 5, and 135 DCs from six sectors in Cycle 6.

PAT Cycles 1 and 2 included more DCs—478 and 621, respectively—which reduced in subsequent cycles as the majority of industries were included in Cycles 1 and 2. Industries that achieve the targets are not included in subsequent cycles; only defaulters are included.

HOW THE CYCLE WORKS

The PAT mechanism has four phases:

1. Target setting;
2) Notification;
3) Implementation; and
4) Monitoring, reporting and verification.

Initially, a feasibility study is done to analyse the number of units under a sector and energy consumption pattern to set the minimum threshold energy consumption limit to the selected sector.

In the target-setting phase, the Bureau of Energy Efficiency (BEE) will involve its empanelled accredited energy auditors (EmAEA) to conduct a baseline audit at each individual unit under selected sectors for their study on energy use. BEE selects the EmAEA for conducting baseline study through tenders. The targets are set based on their energy use study for the last three years. The targets are communicated to the industries via a notification prepared by BEE. The industry and/or designated consumers (DCs) are

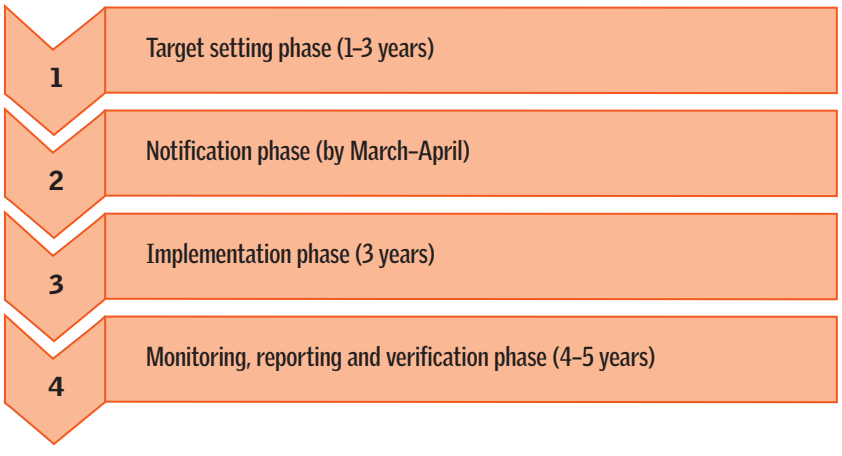
given three years to implement the energy conservation measures (ECMs). The industry in this duration engages vendors and other experts striving to reduce its consumption. This phase is called the implementation phase (see *Figure 2: The four phases of PAT cycle*). During this phase, designated consumers are supposed to submit energy audit reports and various forms to BEE and the state-designated agency (SDA) as mandated.

Post this phase is the monitoring, reporting and verification phase when designated consumers with the help of BEE-empanelled accredited energy auditors perform measurement and verification (M&V) for reporting and verifying the energy savings achieved by implementing various energy-conservation measures. On the completion of M&V, DCs submit performance assessment documents to BEE and the SDA after being verified by EmAEA. These documents are then re-verified by BEE and sent to the Ministry of Power (MoP) for issuance of ESCerts based on the tonne of oil equivalent (TOE) savings achieved by DCs. All the energy consumed in a facility is converted to a common unit of TOE.

If DCs surpass the assigned TOE reduction, they are recommended for availing Energy Savings Certificates (ESCerts). For each additional TOE saving, one ESCert is provided to DCs. Check verification will be carried out by EmAEA finally for declaring a DC is complied with BEE targets.

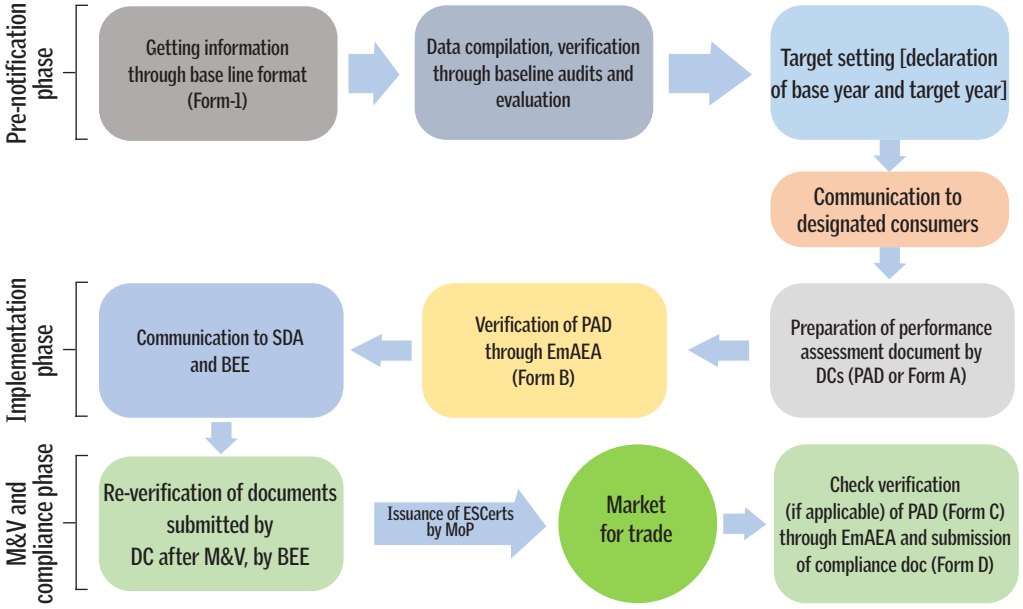
Designated consumers that do not meet BEE targets are to buy ESCerts for compliance. Those who neither meet targets by energy reduction nor buy ESCerts are declared non-compliant and penalty is imposed on them.

Figure 2: The four phases of PAT cycle
The process is a decade-long



Source: Centre for Science and Environment, 2021

Figure 3: Detailed activity of PAT



Source: Introduction to Perform Achieve and Trade (PAT) Scheme, 2nd Workshop for Best Practices in Energy Efficiency in Textile Sector, PAT Rules and Status Overview

PAT CYCLE 1

Thermal power plants were the major stakeholders—with 30 per cent stake—who participated in the Cycle 1 energy reduction exercise. They were also the major energy consumers, accounting for 60 per cent of the overall energy consumption among various sectors.

The overall target of energy reduction in absolute numbers for thermal power plant sector was the highest, at 3.211 million tonne of oil equivalent (MTOE). The percentage reduction target assigned to them was, however, the least, at 3.07 per cent when compared to the sector's baseline energy consumption while for the other sectors the target percentage was nearly double (see *Table 2: Sector-wise energy consumption and target reduction set by BEE in PAT Cycle 1*).

Table 2: Sector-wise energy consumption and target reduction set by BEE in PAT Cycle 1

Thermal power plants were given the least per cent energy reduction targets despite being the highest energy consumer among all other selected sectors in India

PAT Cycle 1 sector	No. of identified DCs	Energy consumption (mMTOE)	Energy-saving targets under PAT Cycle 1 (in mMTOE)	Target reduction assigned against energy consumption (per cent)
Thermal power plant	**144**	**104.56**	**3.211**	**3.07**
Iron and steel	67	25.32	1.486	5.87
Cement	85	15.01	0.816	5.44
Aluminium	10	7.71	0.456	5.91
Fertilizer	29	8.2	0.478	5.83
Paper and pulp	31	2.09	0.119	5.69
Textile	90	1.2	0.066	5.50
Chlor-alkali	22	0.88	0.054	6.14
Total	478	164.97	6.686	4.05

Source: Data from document "PAT Overview and Status", obtained from Bureau of Energy Efficiency, prepared for National Workshop on PAT, May 30, 2019, analysed by CSE.

In contrast with other sectors, thermal power plants failed to achieve their targets. The other sectors had taken serious measures and outperformed their targets by 41.3 per cent to 142.9 per cent.

Table 3: Result of PAT Cycle 1

Thermal power plant sectors is the least scorer among the other sectors of PAT– 1

Sectors listed in PAT Cycle 1	Target set by BEE (million TOE)	Target achieved (million TOE)	Percentage increase in achievement (per cent)
Aluminium	0.456	0.73	60.1
Cement	0.815	1.48	81.6
Chlor-alkali	0.054	0.093	72.2
Fertilizer	0.477	0.78	63.5
Steel	1.486	2.1	41.3
Pulp and paper	0.119	0.289	142.9
Textile	0.066	0.129	95.5
Thermal power plants	**3.211**	**3.06**	**-4.7**

Source: Data from Bureau of Energy Efficiency, Achievements under Perform, Achieve and Trade (PAT), May 2017

But BEE mentions this may be due to the delay in the verification exercise by 13 DCs in Cycle 1. Achievement of 3.06 million TOE in energy efficiency targets relates to only 118 DCs who carried out the Monitoring and Verification (M&V) exercise. These 118 DCs were given an energy reduction target of 2.58 million TOE. Under such a circumstance, the DCs have overachieved their target by 19 per cent. This overachievement of 19 per cent shows how PAT targets are unambitious. Additionally, 12 facilities are closed, and 13 plants have not completed measurement and verification of savings (M&V) to verify and report energy savings. This explains how BEE is liberal with DCs when it comes to M&V that was to be completed by the year after PAT Cycle 1, i.e. 2016. Also, questions arise regarding the need to give targets to stations that are at the verge of closure.

PAT CYCLE 2

PAT Cycle 2 also has the highest number of DCs among thermal power plants, accounting for 25 per cent of the total stakeholders. In Cycle 2, as in Cycle 1, thermal power plants consumed the most energy—about 120 million TOE—among all sectors. Though the target reduction of thermal power plants was 3.13 million TOE—the highest among all sectors—this is only 2.6 per cent of the total energy consumed by thermal power plants. Overall, all the other sectors of PAT Cycle 2 were given targets in the range of 4.4–5.6 per cent.

Table 4: Sector-wise energy consumption and target reduction set by BEE in PAT Cycle 2

Thermal power plants were given the least per cent energy reduction targets despite being the highest energy consumer among all other selected sectors in India

Sectors listed in PAT Cycle 2	No. of identified DCs	Energy consumption (mMTOE)	Energy-saving targets under PAT Cycle 2 (mMTOE)	Target reduction assigned against energy consumption (per cent)
Thermal power plants	**154**	**120.16**	**3.13**	**2.6**
Iron and steel	71	40.44	2.14	5.3
Cement	111	21.43	1.1	5.1
Fertilizer	37	8.25	0.447	5.4
Aluminium	12	10.66	0.47	4.4
Paper and pulp	29	2.68	0.15	5.6
Textile	99	1.48	0.087	5.9
Chlor-alkali	24	1.77	0.102	5.8
Petroleum refineries	18	18.5	1.009	5.5
Railways—zonal and production unit	22	1.39	0.077	5.5
DISCOMs	44		4.67	
Total	**621**		**13.382**	

Source: Data from Bureau of Energy Efficiency, 2021 PAT Cycle 2 Outcomes June 2020

In PAT Cycle 2, the thermal power plant sector achieved a reduction of energy consumption of 3.519 million TOE against a target of 3.13 million TOE, a 14.9 per cent increase over the Bureau of Energy Efficiency's target. The other sectors, except for the fertilizer sector and DISCOMs, achieved over the target (see *Table 5: Result of PAT Cycle 2*) and thermal power stations had the least overachievement at 12 per cent.

Table 5: Result of PAT Cycle 2

Thermal power plants overachieved by 12.43 per cent, implying that the PAT targets are lenient

Sectors listed in PAT Cycle 2	Target set by BEE (million TOE)	Target achieved (million TOE)	Percentage increase in achievement (per cent)
Thermal power plants	**3.13**	**3.519**	**12.43**
Iron and steel	2.14	2.913	36.12
Cement	1.1	1.56	41.82
Fertilizer	0.447	0.383	-14.32
Aluminium	0.47	0.573	21.91
Paper and pulp	0.15	0.315	110.00%
Textile	0.087	0.136	56.32
Chlor-alkali	0.102	0.136	33.33
Petroleum refineries	1.009	1.48	46.68
Railways—zonal and production unit	0.077	0.196	154.55
DISCOMs	4.67	2.077	-55.52

Source: Data from Report on the Outcome of Cycle 2 under Perform, Achieve and Trade (PAT) Scheme, June 2020

According to BEE, forms submitted by DCs for PAT Cycle 3 are under evaluation, and PAT Cycle 4 DCs are implementing energy-saving measures for reduction of energy consumption. PAT Cycle 5 will end in 2022, and PAT Cycle 6 in 2023.

3. EFFECTIVENESS OF PAT MECHANISM IN THE THERMAL POWER PLANT SECTOR

It is clear from the analysis of PAT Cycles I and II that thermal power plants had the most lenient target and underperformed in meeting the target amongst other sectors. According to experts, targets can be assigned up to design value of the thermal power stations however the cumulative target set remains around 3 million TOE in PAT Cycles 1 and 2, which is very low compared to the overall energy consumption of the sector (see *Table 6: Summary of thermal power plants in PAT Cycle 1–6*). Fewer thermal power plants participate in the assessments. According to BEE, except for a handful of power stations, the rest have conserved the maximum energy possible.

Table 6: Summary of thermal power plants in PAT Cycle 1–6

Reduction in TOE achieved by thermal power plants is feeble compared to their consumption

PAT cycle	Assessment year	No. of thermal power plants	Energy consumption (million TOE)	Energy target (million TOE)	Achieved energy savings (million TOE)	% energy saved above target	Total CO_2 reduction ($MtCO_2e$)
PAT I	2014–15	144	104.56	3.211	3.06	-5.00	13.6
PAT II*	2018–19	154	120.16	3.13	3.519	12.96	11.9
PAT III	2019–20	37	23.86	0.402	Under evaluation	-	-
PAT IV	2020–21	17	10.75	0.237	Implementation phase	-	-
PAT V	2021–22	17	9.02	0.15	On-going	-	-
PAT VI	2022–23	No thermal power plants have been notified					

*131 numbers of thermal power plants from PAT Cycle 1 are given revised targets and listed in Cycle 2.

Source: Data from Bureau of Energy Efficiency

Comparison of CO_2 emission reduction in TPPs

The energy sector emits about 2,064 million tonne of CO_2. Electricity generation contributes to 40 per cent of this total emission, which is 825.6 million tonne of CO_2. The overall CO_2 emission reduction achieved by thermal power plants in PAT Cycles 1 and 2 is 13 and 11.9 million tonne respectively. Total emission reduction from thermal power plants is 24.85 million TOE, which is only 3 per cent of the total emission from the sector.

Table 7: Comparison of CO_2 emission and emission reduction from electricity generation

Per cent CO_2 emission reduction is insignificant

CO_2 emission from electricity generation (million tonne)	CO_2 reduction in PAT 1		CO_2 reduction in PAT 2	
	(in million tonne)	(per cent)	(in million tonne)	(per cent)
825.6	13.6	1.57	11.9	1.44

Sources: Data from India—Biennial Update Report and Bureau of Energy Efficiency

According to the India Biennial Update Report, CO_2 emission from electricity generation in India during 2016 accounts for about 825.6 million tonne while reduction in CO_2 emission achieved through PAT Cycle 1 is only 1.57 per cent, which is very feeble. Similarly, only 1.44 per cent CO_2 reduction has been achieved through PAT Cycle 2. The reductions rolling out from PAT Cycles 1 and 2 were achieved in three-year cycles each, with the per cent reduction achieved in one year negligible.

PROFILE OF THERMAL POWER STATIONS PARTICIPATING IN PAT SCHEME

The targets under the PAT schemes are given to thermal power plants that use coal, gas and diesel as fuel. The majority of power plants—74 per cent of the total stations—that received the targets were coal-fired; gas- and diesel-fired power plants were 22 and 10 per cent respectively. The majority of plants included in the scheme—44 per cent of the stations—were run by the state, 35.5 per cent were run by the private players and 20 per cent by the Central government-owned utilities.

Table 8: Thermal power plants of PAT 1

The majority of plants that received targets in Cycle 1 were coal-fired plants and those run by state governments

Fuel-based power plant	State	Central	Private	Total
	Total no.	Total no.	Total no.	
Coal	56	23	18	97
Gas	20	9	11	40
Diesel	4	0	3	7
Total	80	32	32	144

Source: Data from Bureau of Energy Efficiency

Table 9: Thermal power plants of PAT 2

Coal plants and those run by the state government were the majority of plants that received targets in Cycle 2

Fuel-based power plant	State	Central	Private	Total
	Total no.	Total no.	Total no.	
Coal	56	29	32	117
Gas	13	5	16	34
Diesel	1	0	2	3
Total	70	34	50	154

Source: Data from Bureau of Energy Efficiency compiled and analysed by CSE

Table 10: Thermal power plants of PAT 3

The majority of plants that received targets in Cycle 3 were coal-fired plants and those run by private entities

Fuel-based power plant	State	Central	Private	Total
	Total no.	Total no.	Total no.	
Coal	6	4	20	30
Gas	2	1	4	7
Diesel	0	0	0	0
Total	8	5	24	37

Source: Data from Bureau of Energy Efficiency compiled and analysed by CSE

Table 11: Thermal power plants of PAT 4

The majority of plants that received targets in Cycle 4 were coal-fired plants and those run by private entities

Fuel-based power plant	State	Central	Private	Total
	Total no.	Total no.	Total no.	
Coal	2	2	12	16
Gas	0	1	0	1
Diesel	0	0	0	0
Total	2	3	12	17

Source: Data from Bureau of Energy Efficiency compiled and analysed by CSE

Table 12: Thermal power plants of PAT 5

The majority of plants that received targets in Cycle 5 were coal-fired plants and those run by private entities

Fuel-based power plant	State	Central	Private	Total
	Total no.	Total no.	Total no.	
Coal	2	1	12	15
Gas	1	0	1	2
Diesel	0	0	0	0
Total	3	1	13	17

Source: Data from Bureau of Energy Efficiency compiled and analysed by CSE

HOW THE TARGET WAS SET

Initially, a baseline energy audit was conducted by BEE-appointed experts for individual units in thermal power stations. The audit team studied the energy consumption patterns of the entire plant—excluding the housing colony, residential complex and transportation systems—by collecting the required data of the previous three years to arrive at the Specific Energy Consumption (SEC) of the unit.

The SEC calculation is referred as the gate-to-gate concept. The three-year average SEC arrived at in this study was the baseline energy consumption of the plant notified in a gazette. The baseline SEC/net operating heat rate is then compared to the design heat rate/ SEC of the unit. The targets are set such that design heat rates are achieved by the plant. Heat rate is the amount of energy (in kCal) used by a power plant to generate one kilowatt hour (kWh) of electricity. The Specific Energy Consumption (SEC)/heat rates of thermal power plants in India are found to be in the range of 2,300–3,400 kCal/kWh.

Depending on the deviations in the heat rate, targets are set to reduce energy use in the assigned plant. If the deviation is higher, the reduction target per cent is also higher; for smaller deviations, the reduction target per cent is smaller. If the variation of the thermal power plants operating net heat rate is more than 5 per cent from the design net heat rate, it is given a target of reducing 10 per cent from the deviation percentage. Similarly, for the other bands of thermal power plants respective percentage of energy reduction were assigned (see *Table 13: Classification and targets for various bands of thermal power stations*).

Table 13: Classification and targets for various bands of thermal power stations

Target percentages are lenient for all bands of defined deviations

Variation in operating net heat rate from design net heat rate	Reduction target based on % deviation between operating and design net heat rate (in per cent)
Up to 5%	10
More than 5% and up to 10%	17
More than 10% and up to 20%	21
More than 20%	24

Source: Data from Bureau of Energy Efficiency

For instance, if a design heat rate of a plant is 2,500 kCal/kg but it is operating at a deviation of 2,625 kCal/kg (5 per cent higher than the design heat rate), the scope to reduce energy use by the unit in this case is 125 kCal/kg, but the target by the government for such units is only 12.5 kCal/kg (which is 10 per cent of this 5 per cent deviation).

According to experts, a power-generating unit can operate very close to its design heat rate provided it gets coal of similar quality as per the design. As plants are designed taking into count the availability of coal of similar properties, it must not be impractical to tighten the reduction targets.

DISCREPANCIES IN THE TARGET

Centre for Science and Environment analysed the list of thermal power station in the BEE Gazette Notification for Cycles 1 and 2 and found that out of 156 plants in Cycle 2, 131 generating units were repeated from Cycle 1 with revised targets. The baseline consumption and target set for each of these repeated thermal power plants were analysed and it was found that:

i. Energy consumption and targets of thermal power plants increased in Cycle 2 despite listing in Cycle 1; and

ii. Plants had similar energy use in Cycles 1 and 2.

Energy consumption and targets of thermal power plants increased in Cycle 2 despite listing in Cycle 1

For 40 per cent of the generating units (57 units of 131 units), energy consumption increased in Cycle 2 by 4 per cent; the corresponding assigned target heat rate was also increased thus made it lenient. These thermal power units failed to achieve their energy reduction target assigned to them in Cycle 1. Actual achieved heat rate in Cycle 1 was considered as the baseline energy consumption in Cycle 2 with the revised targets; 39 of 57 units were run by the government (see *Table 14: Increase in energy consumption despite listing in Cycle 1*).

Table 14: Increase in energy consumption despite listing in Cycle 1

Energy consumption of nearly 40 per cent of thermal power plants increased

Thermal power plants in both Cycles 1 and 2	PAT 1		PAT 2		D/B targets	D/B baseline	Commission-ing year	Sector
	Base line	Target	Baseline	Target				
Gas Turbine Power Station, Andhra Pradesh Gas Power Corporation Ltd, Vijjeswaram, Andhra Pradesh	1,936	1,931	1,943.2	1,943.2	-12.15	-7.15	1990, 1997	State
Lanco Kondapalli Power Private Limited, Ida Kondapalli, Ibrahim Patanam, Krishna District 521228, Andhra Pradesh	2,007	1,988	2,059.6	2,052.9	-64.86	-52.55	2000, 2009	Private
NTPC-Simhadri, Vishakhapatanam 531020, Andhra Pradesh	2,490	2,468	2,482.0	2,472.1	-4.14	8	2002, 2011, 2012	Central
Ramagundam Thermal Power Station Ramagundam, Dist. Karim Nagar 505208, Andhra Pradesh	2,885	2,885	2,907.9	2,907.9	-22.92	-22.92	1983, 1984, 1984, 1988, 1989, 1989	State
Reliance Smalakot Thermal Power Station,Ida Peddapuram, Samalkot, Andhra Pradesh	2,106	2,080	2,787.7	2,593.9	-513.91	-681.73	2002	Private
Spectrum Power Generation Ltd, East Godavari, Uppada Beach Road, Kakinada-533448, Andhra Pradesh	2,123	2,117	2,210.9	2,201.4	-84.39	-87.89	1997, 1997, 1997, 1998	Private
Vijaywada (Dr Narla Tata Rao) Thermal Power Station, Ibrahimpatnam, Krishna District 521456, Andhra Pradesh	2,571	2,566	2,686.2	2,650.4	-84.36	-115.19	1979, 1980, 1989, 1990, 1994, 1995, 2009	State
Kathalguri Gas Based Power Plant NEEPCO, AGBP, NEEPCO Ltd, Bokuloni Chariali, Dibrugarh 786191, Assam	2,683	2,561	2,732.4	2,602.0	-41.02	-49.38	1995, 1996, 1998	State
Namrup Thermal Power Station, Apgcl, P.O. NTPS , Namrup Dibrugarh786622, Assam	3,808	3,759	4,251.3	4,124.8	-365.75	-443.29	1965, 1985, 2017, 2020	State
Hasdeo Thermal Power Station Korba (West), CSPGCL, Korba West, Darri, Korba 495450, Chhattisgarh	2,871	2,802	2,880.3	2,838.4	-36.39	-9.26	1983, 1984, 1985, 1986	State
Jindal Power Limited, Tamnar, O.P. Jindal Super Thermal Power Plant, P.O. Tamnar, Tahsil Tamnar, Raigarh 496107, Chhattisgarh	2,526	2,518	2,530.1	2,522.0	-4	-4.09	2014, 2015	Private
Korba (East) Thermal Power Station, Korba East, Dist. Korba-495677, Chhattisgarh	3,334	3,199	3,864.3	3,636.4	-437.37	-530.29	1966, 1967, 1968, 1976, 1981	State
NTPC Ltd, Korba, Vikas Bhawan, Jamnipali, Korba 495450, Chhattisgarh	2,526	2,515	2,527.2	2,517.8	-2.76	-1.16	1983, 1984, 1987, 1988, 1989, 2010	Central

Thermal power plants in both Cycles 1 and 2	PAT 1		PAT 2		D/B targets	D/B baseline	Commission -ing year	Sector
	Base line	Target	Baseline	Target				
R.R. Energy Ltd, Raigarh, Nh-200, Jharsuguda Road, Near KIT College, Garhumaria, Raigarh 496001, Chhattisgarh	4,084	3,985	4,193.9	4,085.1	-100.14	-109.86	2004	Private
NTPC Ltd Badarpur Badarpur, New Delhi, 110044, Delhi	2,988	2,942	2,998.0	2,961.8	-19.79	-10	1973, 1974, 1975, 1978, 1981	Central
Pragati Power Station 1, IP Estate, Ring Road, New Delhi 110002, Delhi	2,068	2,061	2,100.7	2,082.0	-20.97	-32.68	2003, 2004	State
Dhuvaran CCPP Anand,Ta-Khambhat, Dist. Anand, Gujarat	2,183	2,096	2,276.9	2,223.1	-127.06	-93.93	1964, 1965, 1972	State
Gujurat Paguthan Energy Co. Pvt. Ltd, Bharuch, Village Paguthan, Bharuch Palej Road, Bharuch-392015, Gujarat	2,010	2,004	2,356.6	2,247.9	-243.88	-346.61	2002	State
NTPC Ltd, Jhanor Gandhar, Bharuch, P.O. Urja Nagar, Dist. Bharuch-392215, Gujarat	2,075	2,072	2,120.2	2,114.3	-42.28	-45.17	1994, 1995	Central
NTPC Ltd, Kawas, Surat, P.O. Aditya Nagar, Kawas, Surat 394516, Gujarat	2,070	2,062	2,096.8	2,087.4	-25.36	-26.76	1992, 1993	Central
Surat Combined Cycle Power Station, Gujarat State Electricity Generation (GSEC), Village Mora, P.O. Bhatha, Surat Hazim Road, Surat 394510, Gujarat	2,071	2,049	2,250.8	2,197.1	-148.13	-179.83	1999, 2010	State
Surat Lignite Power Plant (Gujarat Industries Power Company Ltd), Surat, GIPCL, Nani Naroli, Tk. Mangrol, Dist. Surat 394110, Gujarat	2,898	2,866	2,974.6	2,961.3	-95.29	-76.62	1999, 2010	State
Ukai Thermal Power Station, Gsecl, Vidyut Bhawan, Race Course, Vadodara 390007, Gujarat	3,050	2,953	3,050.9	2,959.0	-6.01	-0.92	1976, 1979, 1985, 2013	State
Vadodara Gas Power Station, (Gujarat Industries Power Company Ltd), P.O. Petro Chemicals , Vadodara 391346, Gujarat	2,173	2,166	2,367.4	2,315.0	-148.95	-194.36	1992, 1997	State
Wanakbori Thermal Power Station, Kheda, Taluka Thasra, District Kheda 388239, Gujarat	2,887	2,820	2,905.0	2,836.7	-16.73	-17.99	1982, 1983, 1984, 1986, 1987, 1998, 2019	State
NTPC Ltd, Faridabad, Tigaon Road, Vill Mujedhi, Faridabad 121004, Haryana	2,001	1,983	2,018.2	1,998.3	-15.32	-17.18	1999, 2000	Central
Raichur Thermal Power Station (Karnataka Power Corp. Ltd), Shakti Nagar, Raichur 584170, Karnataka	2,807	2,743	2,881.7	2,802.3	-59.27	-74.72	1986, 1994, 1999, 2002, 2013	State

Thermal power plants in both Cycles 1 and 2	PAT 1		PAT 2		D/B targets	D/B baseline	Commission-ing year	Sector
	Base line	Target	Baseline	Target				
Toranagallu Thermal Power Station (JSW Energy Ltd), Bellary (600 MW), Toranagallu (P.O.), Bellary (Dist.) 583123, Karnataka	2,422	2,420	2,425.1	2,414.6	5.4	-3.09	2000, 2009, 2012	Private
BSES Kerala Power Project, Udyogamandal, Kochi 683501, Kerala	1,969	1,965	2,009.7	2,004.7	-39.66	-40.7	2001	Private
Kozhikode Diesel Power Project, KSEB, Nallalam, Kozhikode 673027, Kerala	2,150	2,115	2,167.1	2,141.1	-26.11	-17.14	1997, 1998	State
NTPC Ltd , Kayamkulam (Rajiv Gandhi Combined Cycle Power Plant), P.O. Choolatharuvu, Dist. Alappuzha 690506, Kerala	1,994	1,988	2,054.8	2,035.1	-47.06	-60.81	1998, 1999	Central
Trombay Thermal Power Station (Coal & Oil) (TATA Power Company), Chambur 400074, Maharashtra	2,570	2,547	2,689.6	2,652.4	-105.44	-119.57	1984, 2009	Private
Uran Gas Power Station, MAHAGENCO, Raigarh 400702 , Maharashtra	2,046	2,038	2,078.8	2,034.6	3.41	-32.84	1985, 1994	State
IB Thermal Power Station, Orissa Power Gen. Co. Ltd, Jharsuguda-768234, Odisha	2,708	2,699	2,710.7	2,702.5	-3.47	-2.7	1994, 1995, 2019	State
NTPC Ltd., Talcher Kaniha, P.O. Deepsika, Angul 759147, Odisha	2,492	2,480	2,513.4	2,492.5	-12.5	-21.41	1995, 1996, 2003, 2004, 2005	Central
Puducherry Gas Power Plant (Puducherry Power Corporation Ltd, Puducherry), Puducherry	2,699	2,697	3,199.4	3,093.7	-396.67	-500.43	2000	State
Guru Gobind Singh Super Thermal Power Station, Ropar, Roop Nagar-140113, Punjab	2,922	2,830	2,931.7	2,833.3	-3.34	-9.67	1988, 1989, 1992, 1993	State
Dholpur Combined Cycle Power Station, Dholpur-328001, Rajasthan	2,184	2,184	2,379.1	2,249.0	-64.96	-195.1	2007	State
Giral Lignite Power Limited, Barmer-344001, Rajasthan	4,337	4,058	4,804.1	4,413.3	-355.27	-467.08	2007, 2008	State
NTPC Ltd., Anta, Dist. Baran-325209, Rajasthan	2,091	2,081	2,122.8	2,101.5	-20.48	-31.75	1989, 1990	Central
Suratgarh Super Thermal Power Station, Sri Ganga Nagar 335804, Rajasthan	2,740	2,687	2,825.4	2,746.7	-59.73	-85.39	1998, 2000, 2001, 2002, 2003, 2009, 2016	State
Kuttalam Gas Turbine Power Station, Nagapattanam, Tamil Nadu	2,170	2,067	2,429.0	2,345.3	-278.32	-259.01	2003	Private

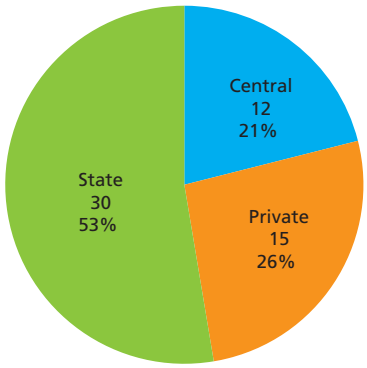
Thermal power plants in both Cycles 1 and 2	PAT 1		PAT 2		D/B targets	D/B baseline	Commission-ing year	Sector
	Base line	Target	Baseline	Target				
Lanco Tanjore Power Co. Ltd, ABAN Power Co.Ltd, Karuppur, Thanjabur District, Tamil Nadu	2,127	2,127	2,265.1	2,242.5	-115.47	-138.14	2005	Private
Madurai Power Corporation Pvt Ltd Samayanallur, Madurai 625402, Tamil Nadu	2,141	2,141	2,160.1	2,160.1	-19.14	-19.14	1995	Private
Mettur Thermal Power Station Salem, Tamil Nadu	2,739	2,715	2,780.1	2,751.3	-36.27	-41.14	1987, 1989, 1990, 2013	State
North Chennai Thermal Power Station, Tneb, Chennai 600120, Tamil Nadu	2,696	2,684	2,770.0	2,739.2	-55.23	-74.02	1994, 1995, 1996, 2014	State
PPN Power Generating Co. Ltd, Chennai, Tamil Nadu	1,879	1,857	1,880.9	1,858.1	-1.09	-1.92	2001	Private
Samalpatti Power Company Pvt. Ltd, Krishnagiri, Krishnagiri District, 635206, Tamil Nadu	2,124	2,124	2,155.0	2,155.0	-31.03	-31.03	1995	State
ST-CMS Electric Company Pvt. Ltd., Uthanjal, Cuddalore Dist. 607804, Tamil Nadu	2,963	2,939	3,007.8	2,978.4	-39.4	-44.79	2002	Private
Thirumakottai (Kovil Kalapal) Gas Turbine Power Station, Mannargudi-614017, Tamil Nadu	2,216	2,113	2,609.1	2,475.2	-362.17	-393.07	2001	Private
Tuticorin Thermal Power Station, Tuticorin, Tamil Nadu	2,777	2,738	2,791.6	2,756.3	-18.32	-14.58	1979, 1980, 1982, 1991, 1992	State
Valuthur Gas Turbine Power Station Ramanathapuram, 623536, Tamil Nadu	2,144	2,058	2,179.0	2,133.2	-75.19	-35	2003, 2008	Private
Agartala Gas Turbine Power Plant NEEPCO, Agartala 799008, Tripura	3,788	3,707	3,831.6	3,737.1	-30.1	-43.58	1998, 2015, 2016	State
NTPC Ltd., Dadri Gas,Gb Nagar Dist-201008, Uttar Pradesh	2,037	2,031	2,062.8	2,054.7	-23.65	-25.82	1992, 1994	Central
NTPC Ltd., Rihand ,P.O. Rihand Nagar, Sonebhadra 231223, Uttar Pradesh	2,512	2,491	2,539.5	2,517.8	-26.75	-27.51	1988, 1989, 2005, 2012, 2013	Central
NTPC Ltd, Tanda, Dist. Ambedkar Nagar-224238, Uttar Pradesh	3,083	3,051	3,143.9	3,102.0	-50.97	-60.86	1988, 1989, 1990, 1998, 2019, 2021	Central
NTPC Ltd, Unchahar (Feroze Gandhi Thermal Power Project), Raibareli, Raibareli-229406, Uttar Pradesh	2,596	2,586	2,649.8	2,637.4	-51.38	-53.84	1988, 1989, 1999, 2006, 2017	Central
Southern Replacement Thermal Power Station, C.E.S.C. Ltd, Kolkata, West Bengal	3,154	3,057	3,182.8	3,151.2	-94.16	-28.81	1990	State

Source: Data from Bureau of Energy Efficiency, 2021, analysed and compiled by CSE

State players are the highest over 53 per cent among the other sectors with increased energy consumption. Central and private sector contribute to 21 per cent and 26 per cent respectively (see *Graph 3: Break-up of thermal power plants (based on age) common to Cycles 1 and 2 with increased energy consumption*).

Graph 2: Sector-wise break-up of thermal power plants for which baseline energy consumption increased

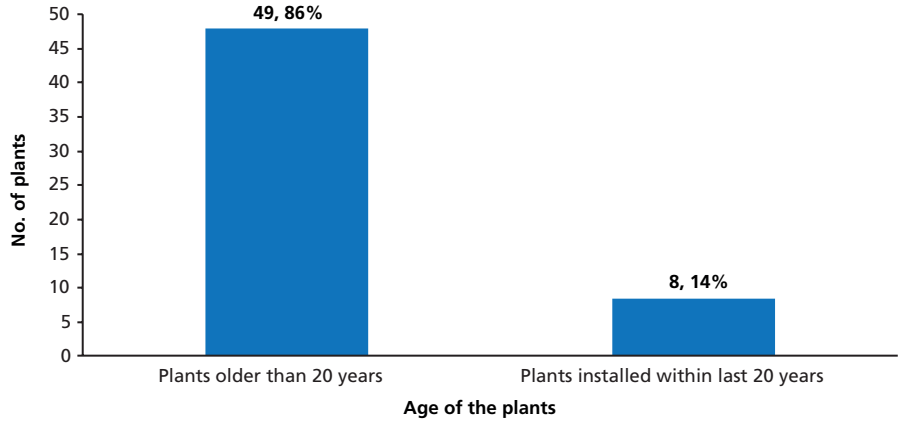
Energy consumption of state-owned thermal power plants is the highest among all sectors



Source: Data from Bureau of Energy Efficiency analysed by CSE

Graph 3: Break-up of thermal power plants (based on age) common to Cycles 1 and 2 with increased energy consumption

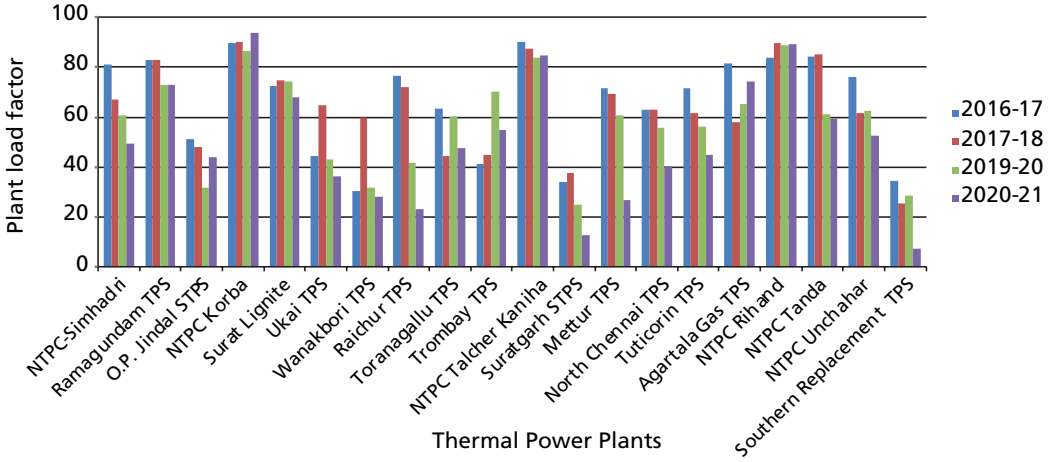
Majority of the plants are more than 20 years old



Source: Details from Bureau of Energy Efficiency, commissioning year from the respective thermal power plants' website and analysed by CSE

Graph 4: Analysis of thermal power plants based on plant load factor

Plants have decreasing trend in their baseline energy consumption



Source: Data from Centre Electricity Authority and compiled by CSE

Out of the 57 plants, 20 plants had representative data on plant load factor. Sixteen of the 20 plants had plant load factor (PLF) decreasing year-on-year. Decreasing plant load factor means increased energy consumption. And this could be one of the probable reasons for increased baseline energy consumption between PAT Cycles 1 and 2. In this scenario, while current thermal power plants are operated at low PLF, new power plants are being built, which is incongruent. The Ministry of Power and the Central Electricity Authority must ensure that current power plants are operated at higher PLFs in order to achieve higher energy efficiency and lower carbon emissions than when they are operated at lower PLFs.

Power plants had similar energy use in Cycles 1 and 2

Ideally, energy use for plants in Cycle 2 must reduce as they had reduced their consumption in Cycle 1. But CSE analysis reveals for 10 per cent of the generating units (14 units of 131 units), energy use reduction targets remained constant in both cycles. Thirteen of these 14 units were run by the government (see *Table 16: Plants whose energy use has unchanged*). Seven of the 14 plants listed were shut down; hence the baseline energy consumption remained unchanged.

Table 15: Plants whose energy use remains unchanged

Ideally, energy use in Cycle 2 must reduce

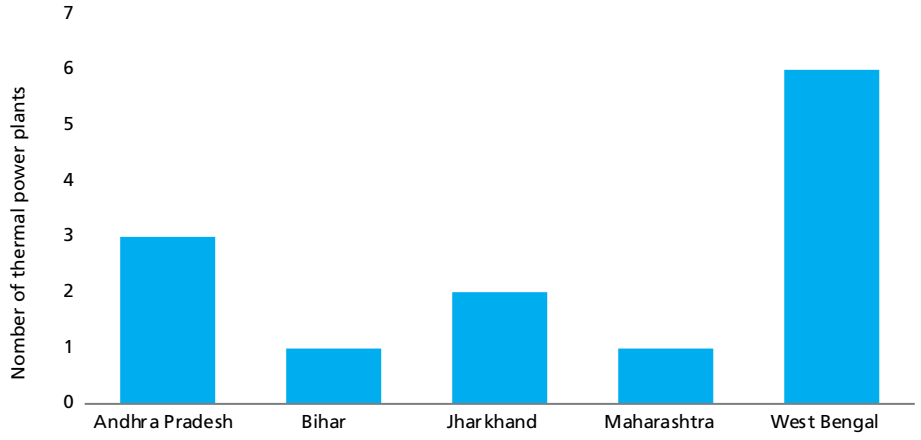
List of thermal power plants with same baseline	PAT 1	PAT 2
Kothagudam Thermal Power Station (Combined, 720 MW), Paloncha, Khammam District-507115, Andhra Pradesh	2,973	2,973
Kothagudam Thermal Power Station Stage V (500 MW), Paloncha, Khammam District-507115, Andhra Pradesh	2,565	2,565
Rayalaseema Thermal Power Project, V.V. Reddy Nagar, Kadapa District-516312, Andhra Pradesh	2,529	2,529
Barauni Thermal Power Plant, Begusarai, Bihar	5,134	5,134
Patratu Thermal Power Station, Hazaribagh, Jharkhand*	3,534	3,534
Tenughat Thermal Power Station, TVNL, Bokaro, Jharkhand	2,936	2,936
Chandrapur Super Thermal Power Station, MAHAGENCO ,Urja Nagar, Chandrapur-442404, Maharashtra	2,920	2,920
Baramura Gas Thermal Power Plant, Baramura, Teliamura, West Tripura-799205, Tripura	3,639	3,639
Bakreswar Thermal Power Station, Birbhum-731104, West Bengal	2,974	2,974
Bandel Thermal Power Station, Tribeni, Hoogly, West Bengal	3,731	3,731
Durgapur Thermal Power Plant (Durgapur Projects Ltd.), Durgapur, West Bengal	3,317	3,317
Kolaghat Thermal Power Station, WBPDCL, Salt Lake City, Kolkata-700098, West Bengal	3,246	3,246
Sagardighi Thermal Power Station, Murshidabad District, West Bengal	3,584	3,584
Santaldih Thermal Power Station, District Purulia-723146, West Bengal	3,768	3,768

Source: Data from Bureau of Energy Efficiency, 2021 analysed and compiled by CSE

*Closed now

Eleven thermal power plants common to Cycles 1 and 2 have the same baseline consumption. This means that these thermal power plants have not shown any improvement in their operation for reducing their energy consumption. West Bengal has the highest number of thermal power plants that had not taken any steps to improve their energy efficiency.

Graph 5: State-wise break-up of thermal power plants with similar baseline energy consumption in Cycles 1 and 2



Source: Bureau of Energy Efficiency analysed by CSE

WHAT HAS THE ACHIEVEMENT BEEN?

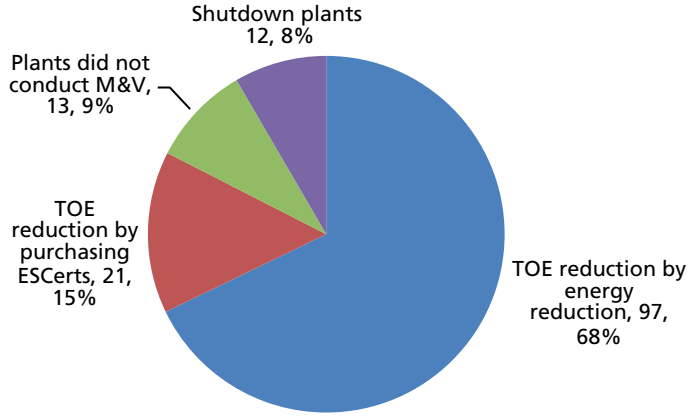
Despite such loose and controversial reduction targets, power stations have shown poor efforts to comply. Nearly half the thermal power stations have not met even the smallest targets (see *Graph 6: Results of Cycles 1 and 2*). According to BEE experts, among 144 plants in Cycle 1, 97 plants complied by energy reduction and 21 by purchansing ESCerts. In Cycle 2, of 154 thermal power plants, 118 plants complied with the target and the remaining 36 plants were defaulters. Among 118 thermal power plants that complied, 72 plants showed their compliance by energy reduction and the remaining 46 plants by purchasing ESCerts. Issuance of ESCerts is under progress for the Cycle 2.

About 131 plants, i.e. 85 per cent of the participants in Cycle 1, were again given targets in Cycle 2. They were given ample to time to comply despite which 82 plants did not meet their targets in Cycle 2 and might enter with fresh targets in Cycle 7.

Graph 6: Results of Cycles 1 and 2

PAT Cycle 1

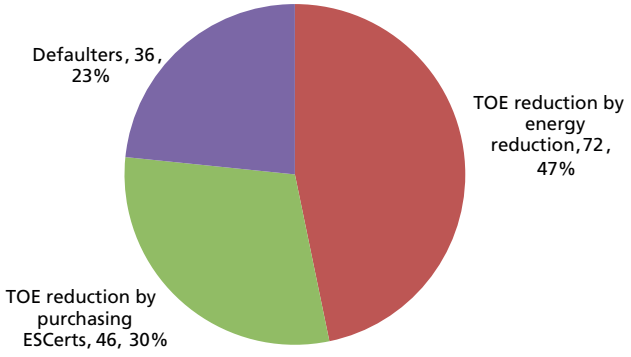
Only 97 out of 144 plants have achieved target TOE reduction



Source: Data from Bureau of Energy Efficiency

PAT Cycle 2

Only 72 out of 154 plants (nearly 46 per cent) achieved target TOE reduction



Source: Data from Bureau of Energy Efficiency, 2021

According to BEE, forms submitted by designated consumers (DCs) for PAT Cycle 3 are under evaluation, and PAT Cycle 4 DCs are implementing energy-saving measures for their energy consumption reduction. PAT Cycle 5 is ending in 2022 and PAT Cycle 6 have no thermal power plants listed. Compliance has been declared through purchase of ESCerts by non-achievers.

ESCERTS

ESCerts are Energy Savings Certificates, in electronic form, issued by the Central Government in the Ministry of Power to designated consumers under Sub-section (1) of Section 14(A) of EC Act, 2001. The value of one ESCert is equal to one tonne of oil (TOE) equivalent of energy saved. The ESCerts issued in a cycle period remain valid till the end of the compliance period of the next cycle.

ESCerts are issued to the Designated Consumers (DCs) who have achieved over their target set by the Bureau of Energy Efficiency (BEE). The number of ESCerts is based on the TOE reduction achieved by DCs above the target TOE. ESCerts are traded on special trading platforms to be created in the two power exchanges, i.e. Indian Energy Exchange Ltd (IEX) and Power Exchange India Limited (PXIL).

ESCerts come into play in the last phase of the PAT mechanism. After the implementation of energy-saving measures during the PAT cycle for reduction of TOE, DCs perform measurement and verification of savings (M&V) to measure the energy savings they have achieved during the PAT cycle. Following M&V, performance assessment documents are submitted to state designated agencies (SDA) and BEE. Based on these documents, BEE evaluates the energy savings achieved and recommends Ministry of Power to issue the ESCerts.

The ESCerts can also be banked for next PAT cycles of the respective DCs to contribute towards meeting future targets as the PAT programme expands. The Central Electricity Regulatory Commission acts as the market regulator by defining the regulatory framework for trading of ESCerts, while the Power System Operation Corporation is responsible for the centralized ESCert registry.

Trading of ESCerts

ESCerts owned by designated consumers (DCs) can be traded with other designated consumers who could use these certificates to comply with their SEC reduction targets. Both the seller and buyer DCs have to register themselves in any of the power exchanges for trading. Energy Conservation Rules, 2012 (PAT Rules 2012), notified on March 30, 2012 by Ministry of Power, has specified that the ESCerts to be issued/entitled to purchase will be in electronic form and tradable on power exchange.

For thermal power plants, the value of one ESCert is calculated as:

$$\frac{(\text{Heat rate notified for the target year} - \text{Heat rate achieved in the target year})}{10} * \text{Notified generation in baseline year}$$

Value of one ESCert is equal to one metric ton of oil equivalent of energy saved. The value of per metric ton of oil equivalent of energy consumed is prescribed by the Central government, in consultation with BEE, under Section 14 B of the Energy Conservation Act 2001.

ESCerts purchase value

IEX witnessed a total trade of 12,98,904 ESCerts under PAT Cycle 1 which commenced on September 26, 2017 and continued until January 16, 2018. The total buy requirement for PAT Cycle 1 for thermal power plants was about 14.25 lakh out of which 12.98 lakh ESCerts were actually purchased. ESCerts traded during the period represented 90 per cent of the total obligation. The ESCert market at IEX saw price variation from Rs 200 per ESCert to maximum of Rs 1,200 per ESCert.

Table 16: Sector-wise volume of ESCerts bought by Cycle 1 DCs registered at IEX

Thermal power plants were the highest buyers of ESCerts among sectors in Cycle 1

Sector	No. of DCs that bought ESCerts	No. of plants in Cycle 1	% of DCs that complied by purchasing ESCerts	DCs registered with IEX	No. of EScerts available for purchase	Purchased	Compliance** (in per cent)
Aluminium	1	10	10	1	42,550	42,550	100
Cement	17	85	20	15	122,126	122,126	100
Chlor-alkali	3	22	14	3	6,944	6,944	100
Fertilizer	1	29	3	1	881	881	100
Iron and steel	10	67	15	9	43,145	43,325	100
Textiles	30	90	33	24	21,143	18,417	87
Thermal power plants	46	144	32	44	1,064,636	1,064,661	100
Others (including pulp and paper)*	2	31	6	0	123,575	0	0
Total	110	478	23	97	1,425,000	1,298,904	91

* There are no DCs registered from the pulp and paper sector in IEX in ESCerts segment

** Compliance is based on registered DCs at IEX

Source: Data from Indian Energy Exchange

The thermal power plant sector is the highest after the textile sector among the DCs who had shown compliance to PAT targets with the purchase of ESCerts (see *Table 16: Sector-wise Volume of ESCerts bought by Cycle 1 DCs registered at IEX*). Out of 144 TPPs listed in Cycle 1, 46 thermal power plants, i.e. 32 per cent of the total thermal power plants listed in Cycle 1, purchased ESCerts for compliance rather than reducing their energy consumption.

Excess availability of ESCerts

ESCerts compliance is increasing with cycles. The Bureau of Energy Efficiency conducted in August 2021 an online programme for issuance of ESCerts for PAT Cycle 2 in the presence of Shri Alok Kumar, Secretary, Ministry of Power, Government of India.

Though Cycle 2 was completed in 2019, its ESCerts trading was in 2021. This demonstrates how the system displays gradual progress. A summary of the programme reveals that the availability of ESCerts for all the sectors of Cycle 2 is higher than the actual demand. An excess of 584,111 ESCerts over actual demand is available for the thermal power plant sector. Hence, the need for DCs to reduce their energy consumption by implementing energy efficiency measures becomes less ambitious.

Table 17: Sector-wise ESCerts demand and availability of PAT Cycle 2

Availability of ESCerts far exceeds demand

Sectors	No. of DCs	No. of ESCerts needed to be purchased for compliance	No. of ESCerts available in market	No. of ESCerts available in excess
Aluminium	11	4,541	775,517	7,70,976
Cement	99	2,93,174	801,511	5,08,337
Chlor-alkali	24	24,384	54,639	30,255
DISCOM	39	15,86,937	3,21,706	-12,65,231
Fertilizer	36	1,86,432	2,12,556	26,124
Iron and steel	67	2,18,643	7,96,439	5,77,796
Petroleum refinery	17	63,312	5,30,826	4,67,514
Paper and pulp	24	5,600	2,00,005	1,94,405
Railway	22	3,631	1,22,421	1,18,790
Textile	85	18,236	74,742	56,506
Thermal power plant	**118**	**12,63,722**	**18,47,833**	**5,84,111**

Source: Data from Ministry of Power, 2021

Cheaper to be energy inefficient

Initially, designated consumers (DCs) are only allowed to purchase a specific number of ESCerts—that they could not accomplish through energy savings—for compliance. On the basis of CSE's discussions with BEE, it is understood that BEE is now taking efforts to allow DCs to purchase any number of ESCerts for future usage. This is because of the surplus availability of ESCerts over the demand. This again makes DCs less ambitious to comply with BEE targets by energy reduction.

For instance, GMR Warora Thermal Power Plant has invested around Rs 32 million for Energy Conservation (ENCON) projects in 2014–15 and resulted in achieving reduction of 7,960 TOE. Since one TOE achieved is equal to one ESCert, this rolls out to be Rs 4020 per ESCert. But, actual average purchase value of one ESCert in PAT Cycle 1 is Rs 700, which is only 17 per cent of cost value to be spent for energy reduction.

Table 18: Details of ENCON projects by GMR Warora TPP in 2015–16

Average cost per TOE reduction is HIGHER than the cost of one ESCert

GMR ENCON Projects	
Description	**Value**
Investment	32 million
Electricity savings	
Achieved electricity savings	5,203,000 kWh
Achieved electricity savings (A)	447 TOE
Thermal savings	
Achieved coal savings	18,335,000 kg
Achieved coal savings (B)	7,334 TOE
Achieved diesel savings	183,000 l
Achieved diesel savings (C)	179 TOE
Total achieved savings = A + B + C	7,960 TOE
Average cost per TOE by energy reduction	**Rs 4,020**
Average cost per TOE by purchasing ESCert	**Rs 700**

Source: Data from GMR Warora Energy Limited and analysed by CSE

4. THE WAY FORWARD

Non-transparent data and deadlines overlooked

The objective of reducing energy consumption has not been achieved beyond 3 per cent. It is also seen that BEE demands that all the designated consumers (DCs) submit various performance assessment documents during and after the three year PAT cycles until the end of their compliance. Deadlines for each of the documents to be submitted are also formulated by BEE. But, the assessment documents by DCs are not submitted in a timely manner—they are submitted any time during the PAT cycle. This information is not available for the public view and is kept confidential.

Lenient targets

Detailed analysis of the PAT mechanism revealed that the energy reduction target set for the sectors are lenient. This is evident from the fact that sectors have overachieved the target in the range of 41.3–142.9 per cent in Cycle 1 and 12.4–154.6 per cent in Cycle 2. The thermal power plant sector is the least scorer among the sectors listed in Cycle 1 and 2; this is despite them being given the least per cent energy reduction target with respect to their overall energy consumption. Thermal power plants were given 3.07 and 2.6 per cent energy reduction targets in Cycle 1 and 2 respectively, which is very low compared to the energy consumption of the sector.

Insignificant CO_2 reduction

As a result, CO_2 emission reduction from Cycle 1 and Cycle 2 are 13.6 and 11.9 million tonne of CO_2 while emissions from the entire energy production sector is 825.6 million tonne of CO_2. So, CO_2 emission reduction from Cycle 1 and Cycle 2 is only 1.64 and 1.44 per cent respectively, which are very low compared to the overall emission reduction from the sector. So, the energy reduction target should be made stringent in order to meet up with the global climate commitments with respect to GHG emission mitigation. Targets must be interlinked to material CO_2 reduction.

Non-compliance made cheaper

Even though the target is low, only 68 per cent and 47 per cent of the total thermal power plants listed in Cycles 1 and 2 have achieved their targets by energy reduction respectively. Target compliance by purchasing ESCerts increased from 21 DCs in Cycle 1 to 46 DCs Cycle 2. The purchase value of ESCert was also very low, in the range of Rs 200–1,200 in Cycle 1. So, being energy inefficient while showing compliance is cheaper for plants than achieving energy reduction.

Considering these issues, CSE recommends following measures for streamlining the process and realizing better energy conservation in the sector:

- **Bring data transparency:** The Bureau of Energy Efficiency plays the main role in the PAT mechanism right from setting the target phase to monitoring and verification. BEE handles the entire data and information of designated consumers. Very little information such as baseline and target energy consumption, methodolgy for target setting, and basis of consideration of normalization factor is available on the internet. But important data of designated consumers such as capacity of thermal power plants, achieved energy consumption by individual DC in each PAT cycle, list of non-compliant DCs, and number of ESCerts awarded and purchased by individual DCs is not available in the public domain and is kept confidential. Even after CSE filed an RTI, this information has not been disclosed. BEE should be more transparent with regard to data and ensure that all the details are available in the public domain. Though PAT is a government scheme, the most important data is kept undisclosed.
- **Need for stringent targets across sectors:** Detailed analysis of energy reduction targets and achieved energy reduction of PAT Cycles 1 and 2 reveal that the targets are very low across sectors. So, the energy reduction achieved is very high, which led to increased availability of ESCerts. This made the cost of ESCerts as cheap as low as Rs 200–1,200 per ESCert in Cycle 1. So, units that could not show compliance by energy reduction purchased ESCerts and showed compliance at no risk. Since ESCerts is a market-based mechanism, it can be purchased across the sectors; this is again in favour of designated consumers. To increase the value of ESCerts, its supply has to be lesser than the demand, so DCs tend to go with the energy reduction option for target compliance. In order to increase the ESCerts value, targets across the sectors have to be made stringent.
- **Changing the target setting process for thermal power plants:**

Table 19: Classification and targets for various bands of thermal power stations

Target percentages are lenient for all bands of defined deviations

Variation in operating net heat rate from design net heat rate	Reduction target based on % deviation between operating and design net heat rate (in per cent)
Up to 5%	10
More than 5% and up to 10%	17
More than 10% and up to 20%	21
More than 20%	24

Source: Data from Bureau of Energy Efficiency

Table 20: Examples for target setting mechanism for each of the bands defined by BEE

Target percentages are lenient for all bands of defined deviations

Description	Unit	Up to 5%	More than 5% and upto 10%	More than 10% and upto 20%	More than 20%
Assumed design rate	kCal/kWh	2,500	2,500	2,500	2,500
Actual NHR	kCal/kWh	2,625	2,750	3,000	3,125
Deviation from design heat rate	%	5	10	20	25
Deviation heat rate value	kCal/kWh	125	250	500	625
Target reduction set	% of deviation from heat rate	10	17	21	24
Target heat rate reduction	kCal/kWh	13	43	105	150
Target set	kCal/kWh	2,612.5	2,707.5	2,895.0	2,975.0
Difference b/w target and design HR	kCal/kWh	112.5	207.5	395.0	475.0

Source: Data from Bureau of Energy Efficiency, analysed and compiled by CSE

Currently, target for the thermal power plants is set based on the deviation between design and operating net heat rate (see *Table 21: Analysis of BEE target operating heat rate with national benchamark heat reate set by Central Electrical Authority*). CSE infers that for 5 per cent deviation, 112.5 kCal/kWh, which can be reduced, is left untouched in the least case. On the higher side, for more than 20 per cent deviation, 475 kCal/kWh still leaves a gap between design and target heat rate. The gap is added in later cycles, with targets further reduced.

CSE analysed the targets set by BEE for thermal power plants with the national benchmark value set by Central Electricity Authority (CEA) for the operation of the thermal power plants. On the basis of the analysis, it is seen that the targets set by BEE are more lenient than the benchmark value set for the given capacity of plants (see *Table 21: Analysis of BEE target operating heat rate against national benchmark heat rate set by Central Electricity Authority)*:

Table 21: Analysis of BEE target operating heat rate against national benchmark heat rate set by Central Electricity Authority[1]

80 per cent of thermal power plants are given targets much lower than the national benchmark

BEE target and CEA benchmark Difference range (in kCal/kWh)	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Total
0–500	53	78	27	15	14	187
1,000–2,000	19	12	-	-	-	31
500–1000	32	42	2	1	1	78
Over 2,000	1	-	-	-	-	1

Overachievement over 500	16	1	3	1	2	23
Overachievement upto 500	23	21	5	-	-	49
Total	**144**	**154**	**37**	**17**	**17**	**369**

Source: Data from Centre Electricity Authority analysed and compiled by CSE

Hence, CSE recommends that setting targets based on the national benchmark value defined by Central Electricity Authority will be more ambitious for thermal power plants.

- **PAT governance to be made stricter:** In view of the fact that 13 thermal power plants in PAT Cycle 1 still have not conducted monitoring and verification of savings though the cycle was completed in 2015, governance of PAT by Bureau of Energy Efficiency should be made stricter than the existing system.
- **Default needs to be defined and deterrence brought in to check non-compliance:** Default and what attracts penalty has not been defined clearly in the law. This loophole has been pointed in 2014 in a report '*The PAT Scheme Analysis Insights and Way Forward*'. According to the report, "Clause 1A, section 26 of the EC Act, provides for a penalty not exceeding rupees 10 lakhs for non-compliance of the PAT targets (energy consumption norms and standards). In case of continuing failure, an additional penalty is to be imposed, not less than the price of every MTOE of energy that is in excess of the prescribed norms. It is unclear how 'continuing failure' is defined in the case of PAT."

  This loophole persists. On the basis of discussion with a BEE sector-expert, it is clear that no thermal power plant has been penalized so far for default. The penalty is also minuscule as power stations receive fixed cost in crores of rupees even while they are not operating but declare availability to operate; even a fine of Rs10 lakh is levied, it would not bring the desired change. CSE proposes that BEE fix this loophole and increase the penalty amount for defaulting in thermal power sector.

Table 22: Fixed cost versus penalty defined by BEE for non-compliance

A negligible amount of penalty is fixed for non-compliance

Unit size (in MW)	Fixed cost collected in a year (in Rs crore)	Penalty imposed by BEE for non-compliance
500	298	Rs 10 lakh + price of every MTOE energy on continuous default
250	149	
210	125	

- **Need for online monitoring system:** Online monitoring of the plant efficiency can be installed by thermal power plants to keep track of their plant performance. This monitoring system needs to be supported with an alert system in case plant performance is poor for a prolonged time..

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The thermal power plants sector is the largest energy consumer and air polluter of all the industrial sectors in the country. This paper examines whether the Perform, Achieve and Trade (PAT) scheme has served the intended purpose of achieving energy efficiency in the industry, whether there is further scope to improve, current achievements of the scheme, challenges and charts the strategy to sharpen this mechanism with special case reference to thermal power stations.

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