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MINISTRY OF POWER
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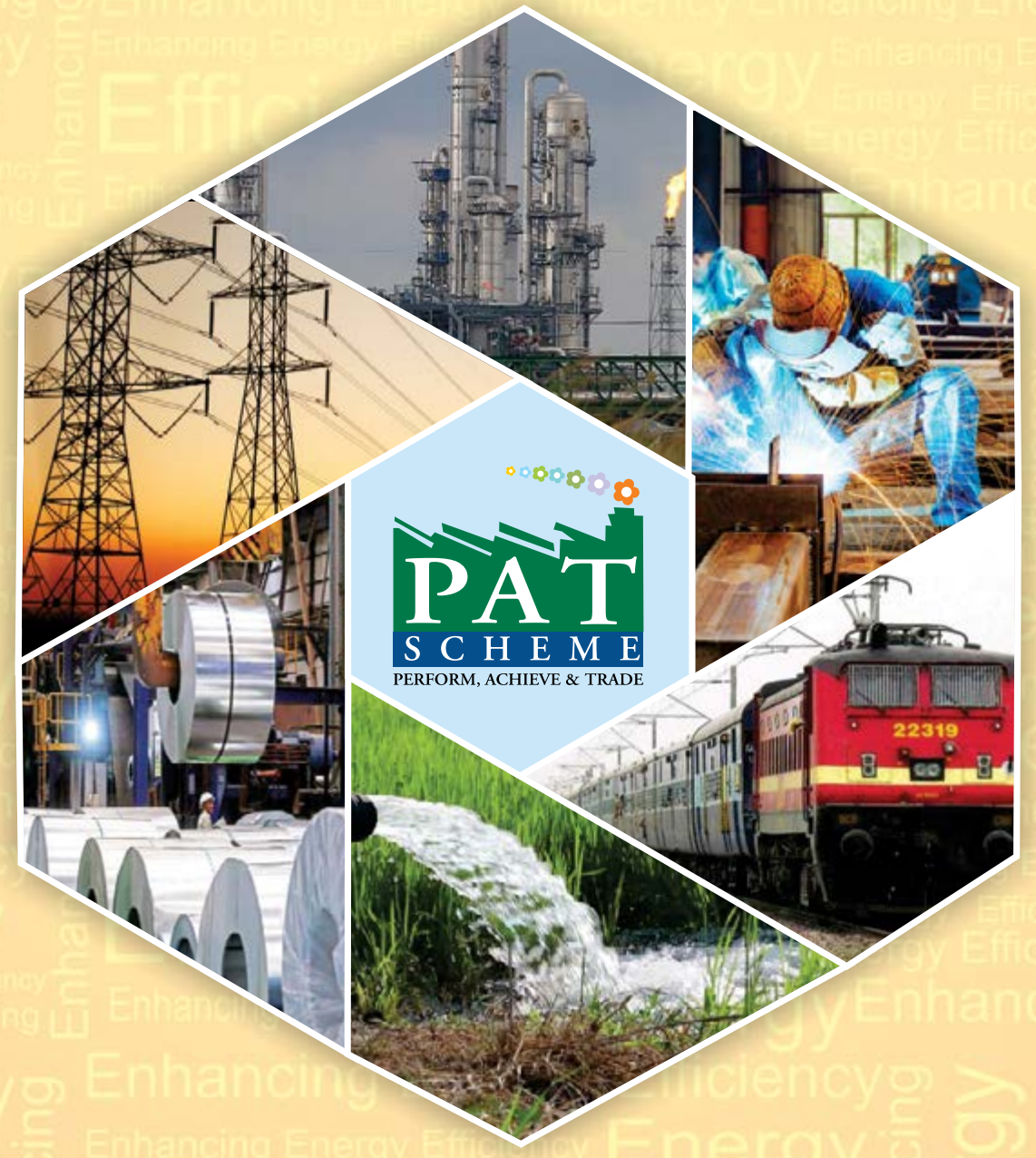
BUREAU OF ENERGY EFFICIENCY

Pathways for Accelerated Transformation in Industry Sector



A Report on the Outcome of Cycle-II under Perform, Achieve and Trade (PAT) Scheme

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Imprint

Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India
4 th Floor, Sewa Bhawan, Sector-1, R.K. Puram, New Delhi, 110066, India

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Indo-German Energy Programme (IGEN)
C/o Bureau of Energy Efficiency
West Block-2, Sector- 1 R.K. Puram, New Delhi, 110066, India
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Contribution
Bureau of Energy Efficiency (BEE)
Abhay Bakre, R.K Rai, Ashok Kumar, Sunil Khandare, Milind Deore, Ajay Tripathi

Indo-German Energy Programme (IGEN)
Arvind Kumar Asthana, Piyush Sharma

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Industry Associations
Sectoral Technical Committee

Preface

Perform Achieve and Trade (PAT) is the flagship program under National Mission for Enhance Energy Efficiency (NMEEE). The mission is implemented by Bureau of Energy Efficiency (BEE) under Ministry of Power.

PAT is a cyclic scheme where certain notified energy intensive units having threshold energy consumption are given Specific Energy Consumption (SEC) reduction targets over a cycle of three years.

The first cycle of PAT which ended in 2015 included 478 units from eight sectors including Aluminum, Cement, Chlor-Alkali, Fertilizers, Iron & Steel, Pulp & Paper, Textiles and Thermal Power Plants. The energy saving achievements in this cycle was 8.67 million tonne of oil equivalent that is equivalent to reduction of about 31 million tonne of CO_2 .

Subsequent to PAT cycle – I, PAT Cycle - II was notified in 2016 and it ended in 2019.

This cycle included almost all DCs of PAT Cycle-I and New DCs from the running sectors and also new DCs from three new sectors such as Railways, Petroleum, Refinery and DISCOM. In total 621 units from these 11 sectors participated and upon completion of Monitoring and Verification (M&V), energy saving of 13.28 million tonne of oil equivalent (MTOE), which corresponds to avoidance of over 60 million tonne of CO_2 . Quantum of the saving from PAT cycle II is contextualize to highlight that it is more than total primary energy supply of a country like Sri Lanka.

This scheme has been very well received and adopted by the industry who have invested substantial amount in energy efficiency measures. I put on record, appreciation to the DCs for their contribution towards energy saving and mitigating global challenge of climate change.

This document presents the detailed outcome of PAT Cycle-II including energy savings, investment reported, technology up gradation as well as reduction in CO_2 emission.

I sincerely acknowledge the guidance of the Ministry for this flagship program under the leadership of Hon'ble Minister. I am also thankful to all officials at Ministry of Power, led by Secretary (Power) and Energy Conservation Division under the Economic Adviser, Ministry of Power.

Finally, I congratulate all BEE Directors, Joint Directors, Sector Experts, Project Engineers, GIZ Officials and the auditing agencies involved under PAT Scheme for their hard work for the success of program.

New Delhi
June 30th, 2020

Abhay Bakre
Director General, BEE

Abbreviations

BEE	Bureau of Energy Efficiency
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Authority
DC	Designated Consumer
DISCOM	Distribution Company
EC Act	Energy Conservation Act, 2001
EE	Energy Efficiency
EmAEA	Empanelled Accredited Energy Auditor
ESCerts	Energy Savings Certificate
BY	Baseline year
TY	Target year
INDC	Intended Nationally Determined Contribution
toe	tonnes of oil equivalent
kWh	Kilowatt Hour
M&V	Monitoring & Verification
$MtCO_2$	Million tonne of Carbon di Oxide
MTOE	Million Tonne of Oil Equivalent
MU	Million Unit
BU	Billion Unit
MWh	Megawatt Hour
NAPCC	National Action Plan on Climate Change
NDC	Nationally Determined Contribution
NMEEE	National Mission for Enhanced Energy Efficiency
PAT	Perform Achieve and Trade
POSOCO	Power System Operation Corporation Limited
PXIL	Power Exchange of India
SDA	State Designated Agency
SEC	Specific Energy Consumption

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Executive Summary

The Perform Achieve and Trade (PAT) Scheme is one of the initiatives under the National Mission for Enhanced Energy Efficiency (NMEEE), which was notified on 30th March 2012. PAT scheme is a market-based compliance mechanism to accelerate implementation of cost-effective improvements in energy efficiency in large energy-intensive industries, through certification of energy savings that could be traded. The genesis of the PAT mechanism flows out of the provision of the Energy Conservation Act, 2001 (Amended in 2010).

The key goal of the PAT scheme is to mandate specific energy efficiency improvements for the most energy intensive industries. The scheme builds on the large variation in energy intensities of different units in almost each notified sector, ranging from amongst the best in the world to some of the most inefficient units. The scheme envisages improvements in the energy intensity of each unit covered under it. The energy intensity reduction target mandated for each unit is dependent on its current efficiency with reduction target being lower for the more efficient units and higher for the less efficient units.

BEE has rolled out six PAT cycles till 31st March, 2020, with a total of 1073 industries, referred to as “Designated Consumers” (DC's), covering 13 sectors. PAT Cycle-I concluded in 2015, covered eight industrial sectors, namely Aluminium, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Pulp & Paper, Thermal Power Plant, and Textile with 478 industries. PAT Cycle-I resulted in energy savings of 8.67 million tonnes of oil equivalent (MTOE), monetary savings of INR 9,500 crore from saved energy consumption, emission reduction of 31 million tonnes of CO_2 equivalent, capacity building of over 5,000 engineers and operators, and encouraged investments of about INR 26,100 crore in energy efficient technologies. Cumulatively, PAT Cycle-I realized 30 percent more than the targeted energy saving. The achievements and outcome of PAT-I were released by Shri R.K.Singh, Hon’ble Minister of State (IC) Power and New & Renewable Energy, on 24th September 2018.

For over 300 odd DC's who have exceeded their energy savings beyond the assigned targets where issued about 38 lakhs energy saving certificates (ESCerts). At the same time over 100 DC's were entitled to purchase ESCerts to comply with the efficiency norms. In this process of compliance for PAT Cycle-I, around 12.98 lakhs ESCerts were traded resulting in business transaction of about INR 100 crores.

PAT Cycle-II (2016-2019) included three more sectors, namely Railways, Petroleum Refineries, and Electricity Distribution Companies (DISCOMs), covering 621 DC's in total. The M&V activities have been completed and the final evaluation is under progress. The reports of PAT-II have been evaluated and the initial findings as on as on 30th June 2020, are as follows:

Total Coverage of PAT-II	
Number of Sectors	11
Number of Industries (DC's)	621
Reduction target	13.38 million tonnes of oil equivalent

Initial Findings as on 30th June, 2020, from the evaluation of Monitoring and Verification (M&V) reports for 86 % of the DC's	
Number of DC whose M&V has been analysed	538
Achieved Energy Savings	13.28 million tonnes of oil equivalent
Achievement w.r.t. overall target	(-) 0.7% shortfall from the overall target
Achievement w.r.t. overall target of the DC's whose M&V has been analysed	18.70% above the target
Monetary savings	INR 31,445 crores
Investment	INR 43,721 Cr. (reported by 390 DC's)
Emission reduction	61.34 million tonnes of CO2 equivalent

DISCOMs and fertilizer sectors, were the only two sectors which could not achieve their overall assigned targets.

1. Introduction

Policy Framework

India is one of the few economies in the world to have robust framework for promoting energy efficiency and energy conservation. The framework includes a statutory Act of Parliament, The Energy Conservation Act (EC Act) 2001; an elaborate action plan on climate change in the form of NAPCC and well-defined goals under the NDCs.

National Action Plan on Climate Change (NAPCC)

The NAPCC released in June 2008, recognized the need to maintain a high growth rate for increasing the living standards of most people and reducing their vulnerability to adverse impacts of climate change. The Action Plan enunciated the following principles;

- Protecting poor and vulnerable sections of society through an inclusive and sustainable development strategy sensitive to climate change
- Achieving national growth objectives through a qualitative change in the direction that enhances ecological sustainability, leading to further reduction in emissions of GHGS.
- Devising efficient and cost-effective strategies for end-use demand size measures.
- Deploying appropriate technologies for both adaptation to and mitigation of the adverse effects of emissions of GHGs extensively as well as accelerated pace.
- Engineering new and innovative forms of market, regulatory, and voluntary mechanisms to promote sustainable development.

The National Action Plan for Climate Change outlined eight national missions that represents multi-pronged, long-term, and integrated strategies for achieving key goals in the context of climate change. The missions are listed below:

I. National Solar Mission

II. National Mission for Enhanced Energy Efficiency

III. National Mission on Sustainable Habitat

IV. National Water Mission

V. National Mission for Sustaining the Himalayan Ecosystem

VI. National Mission for Green India

VII. National Mission for Sustainable Agriculture

VIII. National Mission for Strategic Knowledge of Climate Change

National Mission on Enhanced Energy Efficiency (NMEEE)

National Mission for Enhanced Energy Efficiency is built on the Energy Conservation Act 2001. Ministry of Power was entrusted with the responsibility of implementing the mission for which BEE was designated as a secretariat for the Mission. The Mission has four major components:

- Perform Achieve and Trade (PAT): Assigning specific energy consumption reduction targets to large energy intensive industries and issueing Energy Saving Certificates (ESCerts) on achievements over the targets. These ESCerts can then be traded.
- Market Transformation for Energy Efficiency (MTEE): Promoting adoption of energy efficient equipment and appliances through innovative business models.

- Energy Efficiency Financing Platform (EEFP): Increasing the confidence of financial institutions and investors to support energy efficiency initiatives.
- Framework for Energy Efficiency Economic Development (FEEED): Promoting energy efficiency initiatives by hedging against investment risks.

NMEEE is the key component of National Action Plan on Climate Change (NAPCC) which reflects the intention of Government of India on achieving energy efficiency in India from all sectors of the economy having substantial potential of energy efficiency improvement. NMEEE aimed to strengthen the market for energy efficiency by creating a conducive regulatory and policy regime and has envisaged fostering innovative and sustainable business models to the energy efficiency sector.

NMEEE was successful in pushing many energy intensive sectors to enhance energy efficiency. Many of the activities under this mission found prominent role in meeting NDC goals and reducing GHG emissions. The desirability of continuing NMEEE is also recognized by the Parliamentary Standing Committee on Energy, the Executive Committee on Climate Change (ECCC) under PMO as well as the Group of Secretaries for Energy Conservation and Efficiency. The Mission contributed to more than 30 million tonnes of CO_2 mitigation till 2016-17. The mission also contributed significantly towards development and capacity building of energy professionals, ESCOs and financial institutions. The mission has also helped in the market transformation for efficient lighting which transformed the face of lighting industry initially through introduction of CFLs, and subsequently deployment of LEDs in large quantity.

PAT Cycle-I

PAT Cycle-I, which concluded in 2015, had 478 units, known as "Designated Consumers" (DCs), from eight energy-intensive sectors, viz. Aluminium, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Pulp & Paper, Thermal Power Plant, and Textile. The baseline annual energy consumption of these DCs was around 164 million toe.

Some of the key highlights of PAT Cycle-I are as tabulated below:

Particulars	Unit	Value
Total number of DCs	Nos.	478
Baseline Energy consumption in PAT Cycle-I	Million TOE	164.97
Energy reduction target	Million TOE	6.685
Energy savings achieved in PAT Cycle-I	Million TOE	8.67
Energy savings achieved in excess of target	Million TOE	1.985
Reduction in GHG emissions in PAT Cycle-I	Million Tons of CO2 eq.	31

TABLE 1: PAT CYCLE-I HIGHLIGHTS

The success of PAT cycle-I was attributed to the efforts of the DCs pushing enormous amount of time and resources in various energy efficient projects. While some chose to tap the low hanging fruits, others invested in major projects. The DCs also improved their O&M practices. Some of the measures were even inhouse, involving little or no investment, and hence could not be quantified. The reported investment figure from the DCs of PAT cycle - I was approx. Rs. 26100 Cr. PAT cycle-I not only witnessed huge investment, but also huge savings. These savings were in terms of coal, oil, gas, electricity and other fuel sources. The equivalent monetary value derived from these fuel savings was about Rs. 9500 Cr.

The success of PAT cycle-I resulted in 8.67 million toe of energy savings. In lieu of these savings, over and above the target, the DCs were awarded with tradable Energy Saving Certificates (ESCerts). From the assessment of PAT-I, around 309 DCs achieved in excess to their targets, thereby, adding to a total of 38.25 Lakh positive ESCerts. On the other hand, 110 DC could not achieve their target and were entitled to purchase a total of 14.25 lakh ESCerts. For PAT-I, out of 110 DCs who failed to achieve their target, 96 complied by purchasing ESCerts. A trading worth 100 Cr INR took place in 17 sessions with 12.9 lakh ESCerts being traded.

PAT Cycle II

In PAT Cycle–II (2016-19), three more sectors, viz., DISCOMS, Railways, and Refineries were added to the existing 8 sectors. The total number of DCs notified in this cycle was 621. Some of the key aspects of PAT Cycle-II are indicated below:

- Cycle-II commenced from 2016-17, with target year in 2018-19.
- 89 additional DCs from the existing 8 sectors were included.
- 3 new sectors included were Refineries, Railways and DISCOMs. Thus, a total of 11 sectors were included
- 84 DCs from the new sectors were included.
- Around 30% of the total primary energy supply of the country as per 2014-15 level was covered under the scheme.

S. No.	Sector	No. of DCs from PAT-I	Additional DC in PAT Cycle-II	Total no. of DCs in PAT-II
1	Aluminium	10	2	12
2	Chlor-Alkali	21	3	24
3	Textile	85	14	99
4	Pulp & Paper	25	4	29
5	Iron & Steel	62	9	71
6	Fertilizer	29	8	37
7	Cement	84	27	111
8	Thermal Power Plants	132	22	154
9	Refinery	-	18	18
10	DISCOMS	-	44	44
11	Railway	-	22	22
Total				**621**

TABLE 2: SECTOR WISE DC'$_S$ IN PAT CYCLE-II

PAT Cycle-III

Since a decision was taken to put PAT scheme under the rolling cycle from PAT-II onwards, the third cycle was notified on 31st March, 2017, with following coverage:

S. No	Sector	No of new DCs	Energy Consumption (million TOE)	Energy Savings (million TOE)
1	Aluminium	1	1.02	0.061
2	Cement	14	1.74	0.096
3	Iron & Steel	29	7.648	0.457
4	Pulp & Paper	1	0.06	0.003
5	Textile	34	0.668	0.04
6	Thermal Power Plant	37	23.86	0.402
Total		**116**	**35**	**1.06**

TABLE 3: SECTOR WISE DCS UNDER PAT-III

The baseline year for Cycle-III was taken as 2015-16, and the target year is 2019-20. The total number of DCs notified were 116 from six sectors, namely, Thermal Power Plants, Iron & Steel, Cement, Aluminium, Pulp & Paper, and Textile. No new sectors were added in this cycle. The total savings target was given as 1.06 million tonnes of oil equivalent, which corresponds to a reduction of around 3 million tonnes of CO_2.

PAT Cycle-IV

The fourth cycle of PAT was notified on 28th March, 2018, with following details:

S. No	Sector	No of DCs	Energy Consumption (million TOE)	Energy Saving Target (million TOE)
1	Cement	1	0.0741	0.004
2	Chlor Alkali	2	0.0501	0.003
3	Commercial Buildings (Hotels)	37	0.0625	0.0037
4	Iron & Steel	35	3.2268	0.1926
5	Petrochemical	8	3.8224	0.2293
6	Pulp & Paper	2	0.1642	0.0098
7	Textile	7	0.3418	0.0204
8	Thermal Power Plant	17	10.75	0.237
Total		**109**	**18.5**	**0.6998**

TABLE 4: SECTOR WISE DCS UNDER PAT-IV

The baseline year is taken as 2016-17 and the target year is 2020-21. A total of 109 DCs are likely to achieve a total reduction target of 0.6998 million tonnes of oil equivalent. These DCs are from eight sectors, consisting of six existing sectors and two new sectors. The new sectors are Petrochemicals and Commercial Buildings. Under Commercial Building sector, hotels have been identified as the potential designated consumer sub-sector for this cycle. Other sub-sectors in the commercial building sector may come up in future. Under Petrochemical sector, naphtha crackers and gas crackers have been considered under this cycle of PAT. The total expected CO_2 emission reduction from PAT-IV is around 2 million tonnes.

PAT Cycle-V

PAT Cycle-V has commenced with effect from 1st April, 2019. Under PAT Cycle-V, 110 DCs from the existing sectors of PAT i.e. Aluminium, Cement, Chlor-Alkali, Commercial Buildings (Hotels), Iron & Steel, Pulp & Paper, Textile and Thermal Power Plant have been notified. The total energy consumption of these DCs is about 15.244 million TOE and they are expected to achieve a total energy savings of 0.5130 million TOE, the details of which are mentioned below:

S. No	Sector	No of DCs	Energy Consumption (million TOE)	Energy Saving Target (million TOE)
1	Aluminium	1	1.2375	0.0739
2	Cement	12	1.6	0.087
3	Chlor-Alkali	2	0.0282	0.0017
4	Commercial Buildings (Hotels)	31	0.0223	0.0013
5	Iron & Steel	23	2.8256	0.1687
6	Pulp & Paper	8	0.2837	0.0169
7	Textile	16	0.2267	0.0135
8	Thermal Power Plant	17	9.02	0.15
Total		**110**	**15.244**	**0.513**

TABLE 5: SECTOR-WISE TARGETS PAT CYCLE-V

PAT Cycle-VI

PAT Cycle-VI has commenced with effect from 1st April 2020. Under PAT Cycle-VI, 135 DCs from six sectors, i.e. Cement, Commercial buildings (hotels), Iron and Steel, Petroleum Refinery, Pulp and Paper and Textiles, have been notified. Cement grinding units has been notified separately as a sub-sector of cement with threshold of 10,000 toe. The total energy consumption of these DCs is about 23.298 million TOE and they are expected to achieve a total energy savings of 1.277 million TOE, the details of which are mentioned below:

Sr. No.	Sector	Number of Designated Consumers	Total Energy Consumption (Million TOE)	Proposed Saving target (Million TOE)
1 (a)	Cement	4	0.533	0.027
1 (b)	Cement Grinding Units	33	0.708	0.035
2	Commercial Building (Hotel)	64	0.070	0.004
3	Iron and Steel	5	0.515	0.031
4	Petroleum Refinery	20	21.304	1.169
5	Pulp and Paper	2	0.055	0.003
6	Textile	7	0.112	0.007
Grand Total		**135**	**23.298**	**1.277**

2. PAT CYCLE-II – Key highlights

After the successful completion of PAT Cycle-I, the Parliamentary Standing Committee on Energy, Executive Committee on Climate Change (ECCC), and the Group of Secretaries for energy efficiency and energy conservation, recommended to put PAT under rolling cycle. Hence, PAT cycle gets notified on annual basis since 2016. This means that every year, the new DCs of existing and new sectors, as per the EC Act will get notified. Therefore the "Deepening", by way of including new DCs by decreasing threshold and "Widening", by way of including new sectors, had been carried out with an objective of increasing the number of Designated Consumers under the second cycle of PAT.

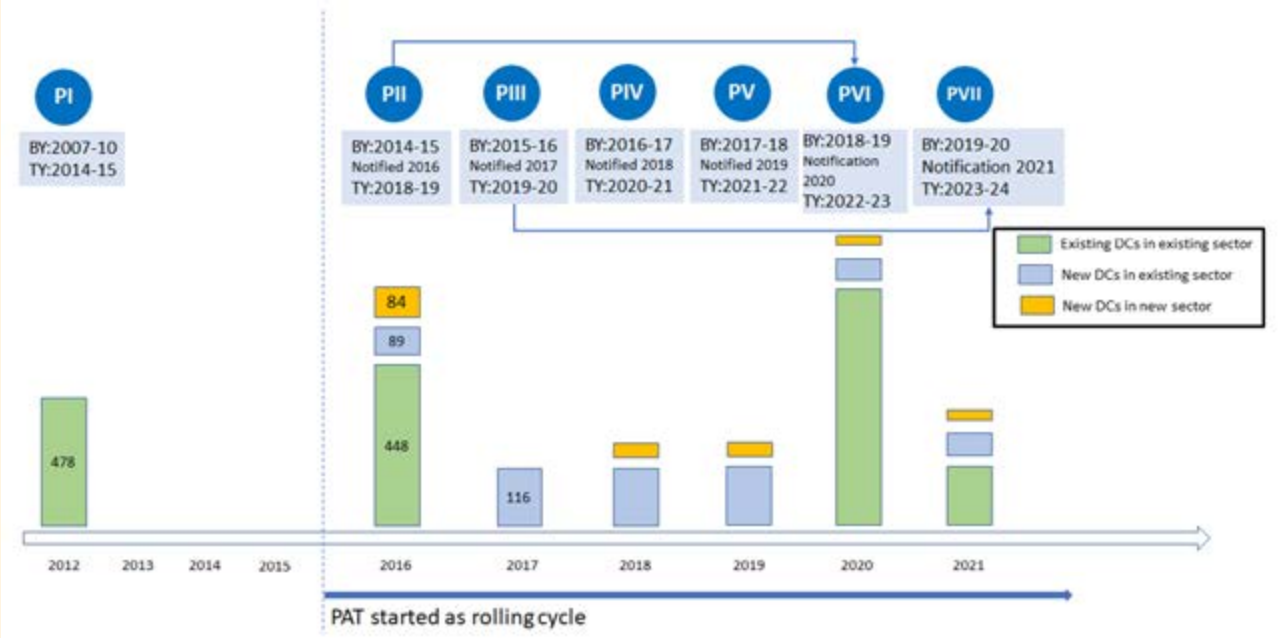


FIGURE 1 PAT AS ROLLING CYCLE SINCE 2016

It could be seen from the figure above that every DC will get its next target in the fourth cycle notified, from its 1st notification. For example, PAT-II DCs will get their next target notified in PAT Cycle-VI, and PAT-III DCs will get their next target in PAT Cycle-VII. As this concept of rolling cycle came after PAT cycle-I, the DCs in PAT-I got next target in PAT-II.

Under the deepening exercise, 89 DCs were identified from the existing sectors and notified under PAT Cycle-II. Under the widening initiative, three new sectors, Railways, Petroleum Refineries, and Electricity Distribution Companies (DISCOMs), were added. A total of 84 Designated Consumers from these three newly notified sectors were included under PAT Cycle-II.

The distribution of target energy consumption for each sector is as shown in table below:

Sector	Total Number of DCs	Reduction target (million TOE)
Aluminium	12	0.47
Cement	111	1.1
Chlor-Alkali	24	0.102
DISCOM	44	4.67
Fertilizer	37	0.447
Iron and Steel	71	2.14
Petroleum Refinery	18	1.009

Sector	Total Number of DCs	Reduction target (million TOE)
Pulp and Paper	29	0.15
Railways	22	0.077
Textile	99	0.087
Thermal Power Plant	154	3.13
Total	**621**	**13.38**

TABLE 7 DISTRIBUTION Of ENERGY CONSUMPTION

The maximum energy reduction target was given to the thermal power plants at (35%), followed by iron & steel (24%), refinery (13%), and cement (12%) in broad proportion to the sectoral energy consumption. This share of energy consumption is given in figure 2.

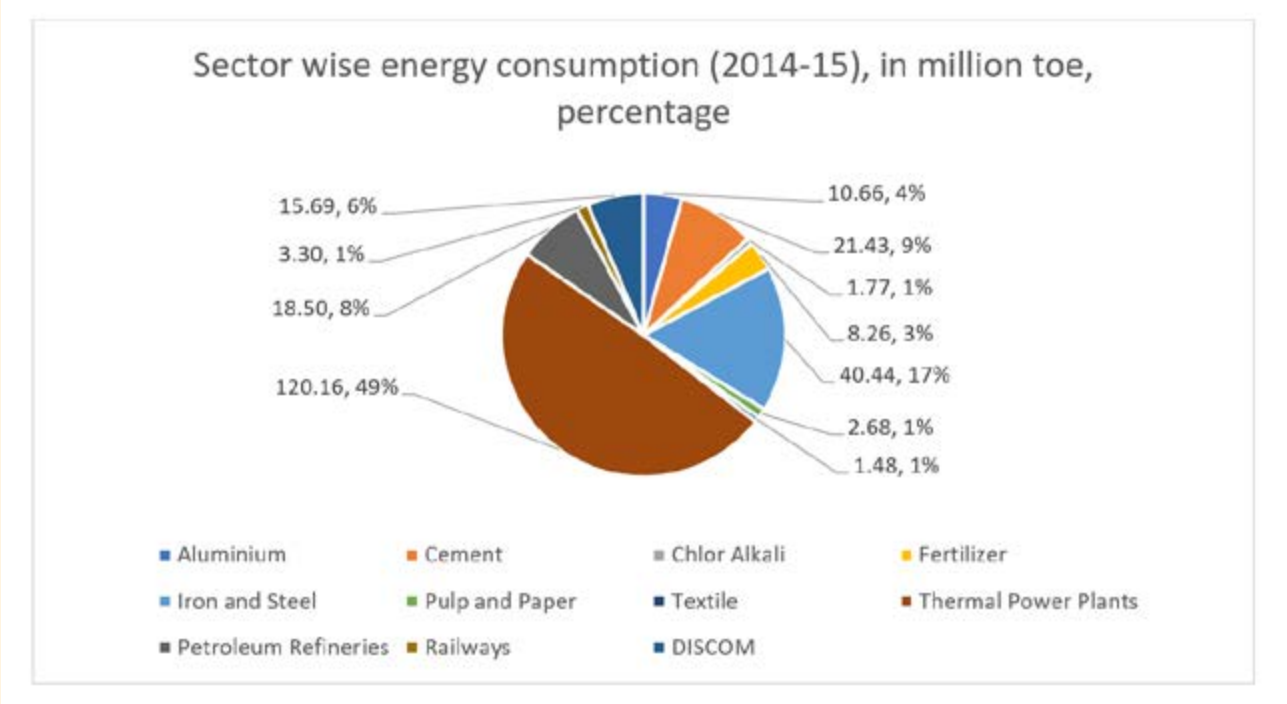


FIGURE 2: SECTORWISE ENERGY CONSUMPTION SHARE

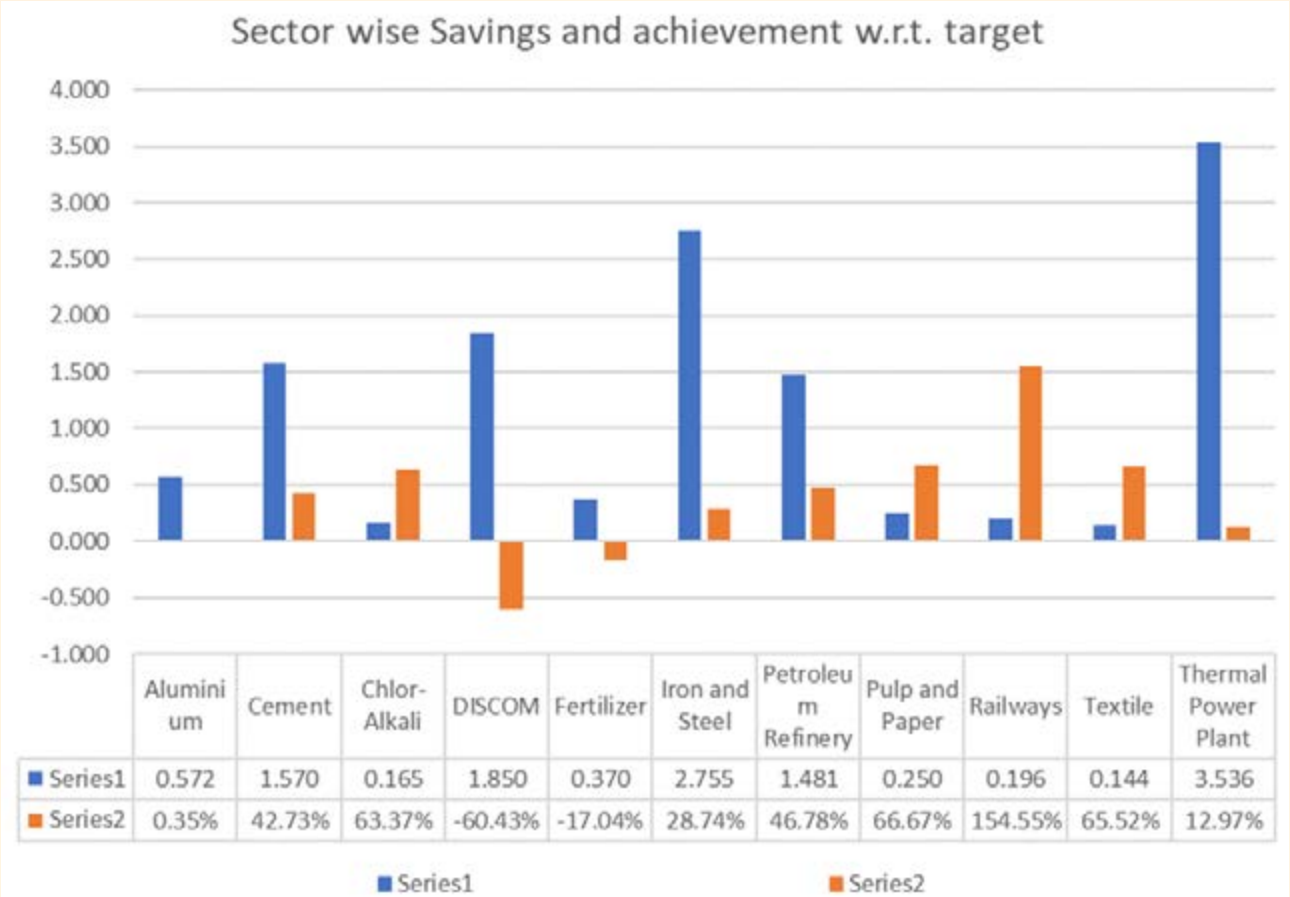
PAT Cycle-II targeted to achieve an overall energy consumption reduction of 8.8 million toe. The estimated emission reduction from this was around 32 million tonnes of CO2. The expected investment on energy efficient project and technologies under PAT cycle-II was around INR 30,000 Cr.

The reports of PAT-II have been evaluated and the initial findings as on as on 30th June 2020, translates to the following final numbers:

Total units (Assessment completed)	Target (million TOE)	Achieved (million TOE)	Investment	Million tCO2 savings
538	13.38	13.28	43,721	61.34

TABLE 8 PRELIMINARY ACHEIVEMENTS Of PAT CYCLE 2

The sector-wise distribution of this energy savings is explained in the bar chart below:



	Aluminium	Cement	Chlor-Alkali	DISCOM	Fertilizer	Iron and Steel	Petroleum Refinery	Pulp and Paper	Railways	Textile	Thermal Power Plant
Series1	0.572	1.570	0.165	1.850	0.370	2.755	1.481	0.250	0.196	0.144	3.536
Series2	0.35%	42.73%	63.37%	-60.43%	-17.04%	28.74%	46.78%	66.67%	154.55%	65.52%	12.97%

Sector wise energy savings (in million toe) Achievement over the target assigned (in %)

FIGURE 3 SECTORWISE DISTRIBUTION Of ENERGY SAVINGS

It could be observed from the chart above that Thermal Power Plant and Iron and Steel share the maximum contribution in the overall savings, despite not being the maximum overachiever w.r.t. to the target assigned. On the other hand, sectors like railways and paper have maximum achievement w.r.t. to the assigned target but contributes only about 1% and 3% respectively in the overall energy savings of PAT-II. This could be explained by the fact that these sectors are not the most energy intensive sectors among sectors notified under PAT, and hence the proportionate savings are also not very huge.

The coverage of PAT Cycle-II in terms of the total energy consumption of the country as of 2014-15 levels is as shown below:

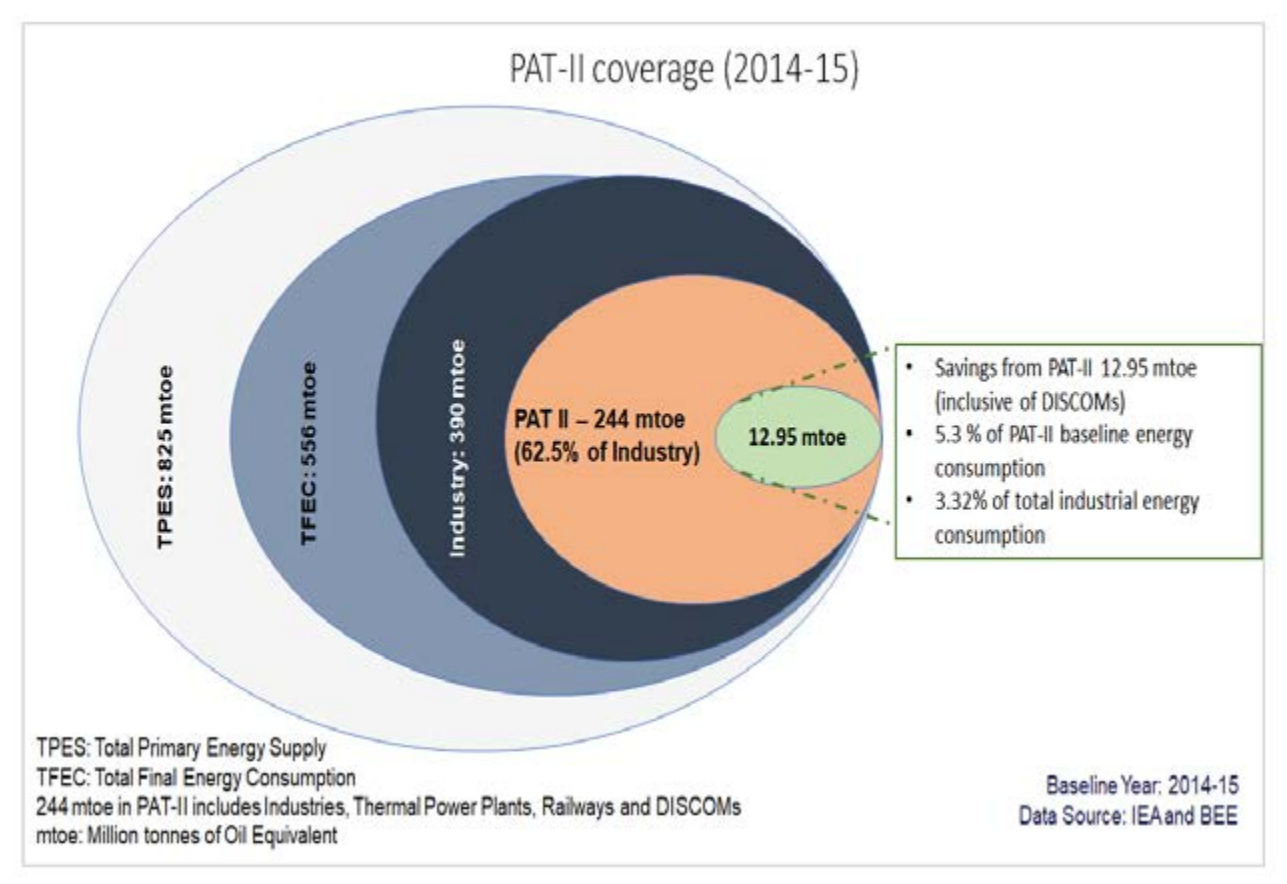


FIGURE 4: OVERALL COVERAGE Of PAT CYCLE-II

The overall target, targets of the DCs whose M&V were evaluated and the overall achieved energy saving for each sector is shown in the figure below:

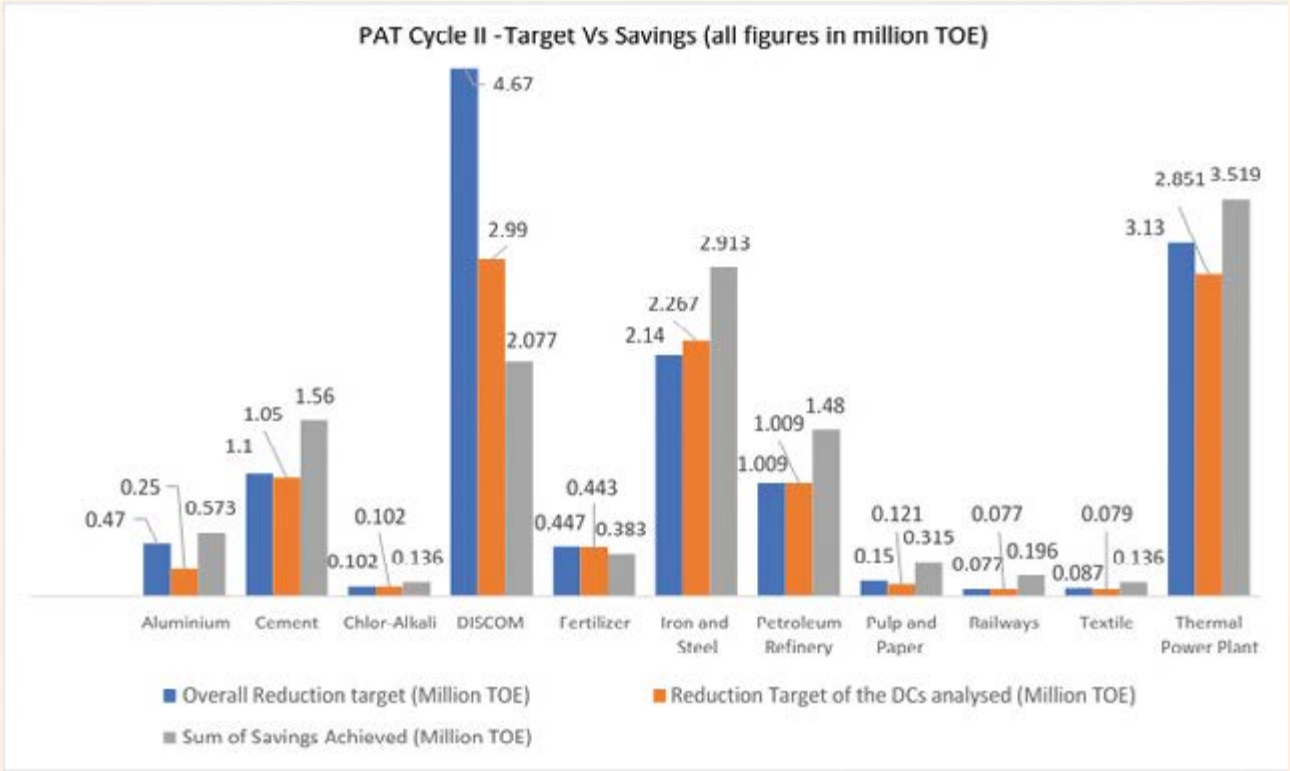


FIGURE 6 SECTORWISE INVESTMENT

The details of PAT-II preliminary assessment w.r.t. energy savings target, energy savings achieved, emission reduction, monetary savings and investment is given in table 9:

Sector	Total Number of DCs	Overall Reduction target (million TOE)	Number of M&V analysed	Reduction Target of the DCs analysed (Million TOE)	Sum of Savings Achieved (Million TOE)	Total Emission reduction (Million Tonne of CO2)	Total savings in monetary terms (INR Cr.)	Number of DCs reported investment	Investment (in INR Cr)
Aluminium	12	0.47	9	0.25	0.573	1.96	1055	7	75
Cement	111	1.1	99	1.05	1.56	5.47	2878	88	6962
Chlor-Alkali	24	0.102	24	0.102	0.136	0.56	250	13	419
DISCOM	44	4.67	36	2.99	2.077	19.8	10807	18	21374
Fertilizer	37	0.447	36	0.443	0.383	1.18	704	26	2366
Iron and Steel	71	2.14	67	2.267	2.913	12.13	5360	38	4396
Petroleum Refinery	18	1.009	18	1.009	1.48	5.38	2725	16	4312
Pulp and Paper	29	0.15	24	0.121	0.315	1.35	580	15	232
Railways	22	0.077	22	0.077	0.196	1	360	6	37
Textile	99	0.087	85	0.079	0.136	0.662	250	72	729
Thermal Power Plant	154	3.13	118	2.851	3.519	11.85	6476	91	2821
Total	**621**	**13.38**	**538**	**11.20**	**13.28**	**61.34**	**31445**	**390**	**43721**

TABLE 9: OVERALL SUMMARY Of PAT CYCLE-II

The sector-wise distribution of the total investment done in each sector is as shown in 6. The total investment done in all the sectors on energy efficiency related projects to improve the performance in terms of specific energy consumption is INR 43,721 crores, as reported by 390 units.

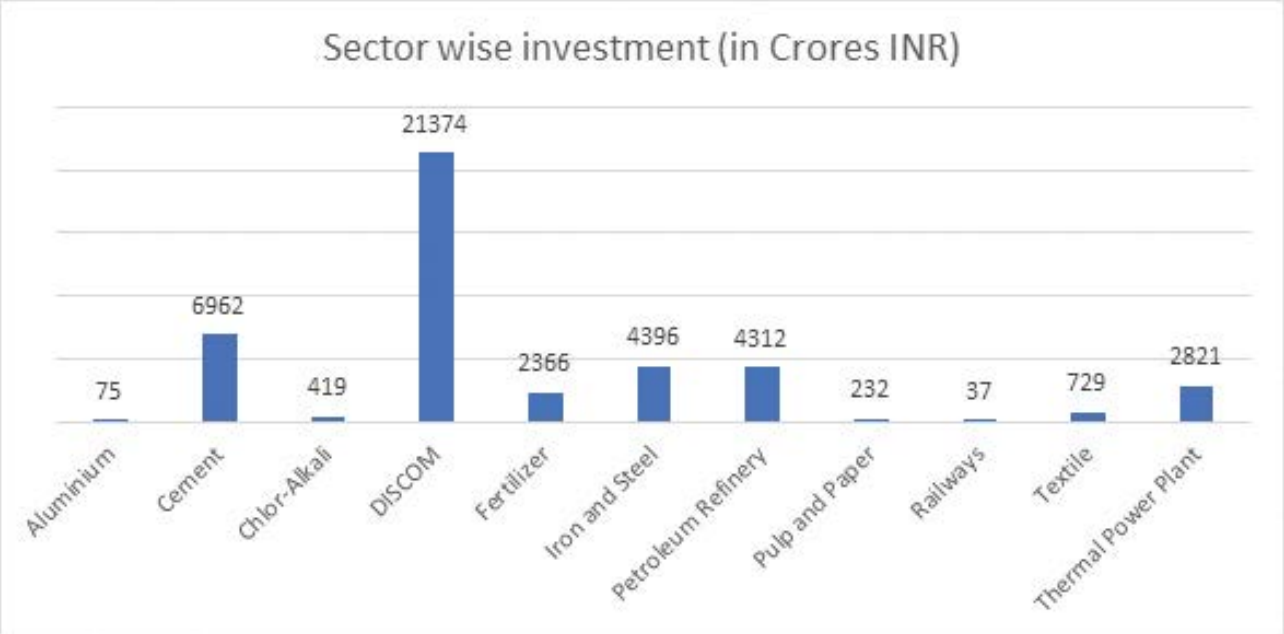


FIGURE 6 SECTORWISE INVESTMENT

The emission reduction through the implementation of PAT Cycle-II is about 61.34 million tonnes of CO2 . The sector-wise distribution of emissions is shown in figure 7:

It could be observed from the chart above that DISCOMs, Thermal Power Plant and Iron and Steel shares the maximum contribution in the overall emission reduction owing to the maximum savings in million toe, whereas chlor alkali, railways and textile has the least share in the overall emission reduction.

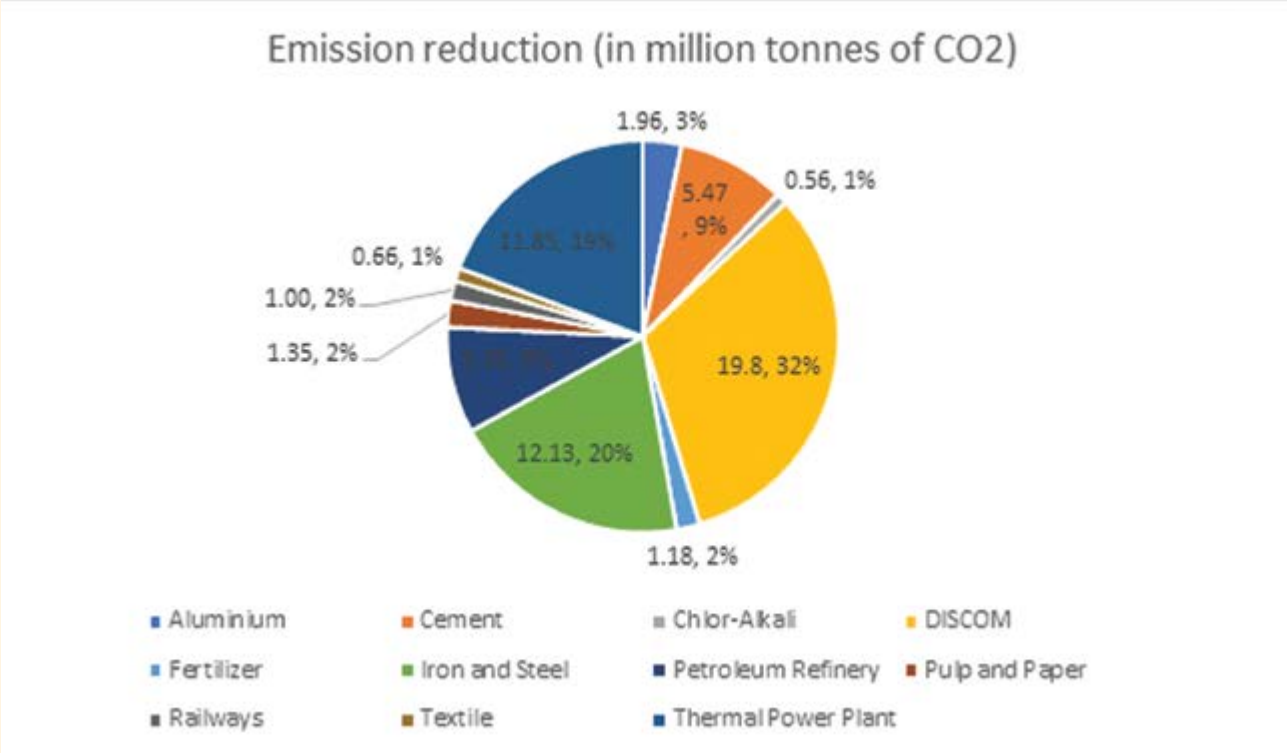


FIGURE 7: SECTORWISE EMISSIONS REDUCTION (EXCLUDING DISCOMS)

3. Sector Specific Achievements

3.1 Aluminium Sector

India stands fourth in the volume of aluminium production globally, with a substantial share of 5.33% of global output, as of January 2019. However, the Indian aluminium industry is largely driven by a handful of major companies. India also has the seventh largest bauxite reserves in the world, at 2,908.85 million tonnes, as per data for FY-17 from the Ministry of Mines. Over the course of the last four years, India's aluminium production capacity has increased to 4.1 MMTPA, thanks to investments worth INR 1.2 lakh crore (USD 18.54 billion).

Aluminium Consumption in India at 2.5 kg per capita[1] as of 2017, much below the global average of 11kg per capita. To reach the global average of 11 kg per capita, India will require an additional annual consumption of 16mn tonnes, thus, making it the second largest consumer in the world (absolute terms)

Industries that consume aluminium, such as infrastructure, transportation, and power, are set to see further growth led by consumer demand in the coming years. From 2.08 million tonnes in 2017-18, the consumption of aluminium in India is slated to more than double by 2020-21, reaching 5.30 million tonnes as per estimates.

The principal user segment in India for aluminium continues to be the electrical and electronics sector, followed by automotive and transportation, building, construction, packaging, consumer durables, industrial and other applications, including Defence.

The aluminium sector has been categorized, based on the basic process involved, as Refinery, Smelter, Integrated, and Cold Sheet.

Coverage of DCs under PAT (till PAT cycle VI)

There are 14 large Aluminium smelter and refineries in India. The smaller production units like scrap melting, etc. have not been considered. Of these 14, all have been taken under the PAT scheme.

1 As per need for an Aluminium Policy in India, NITI Aayog

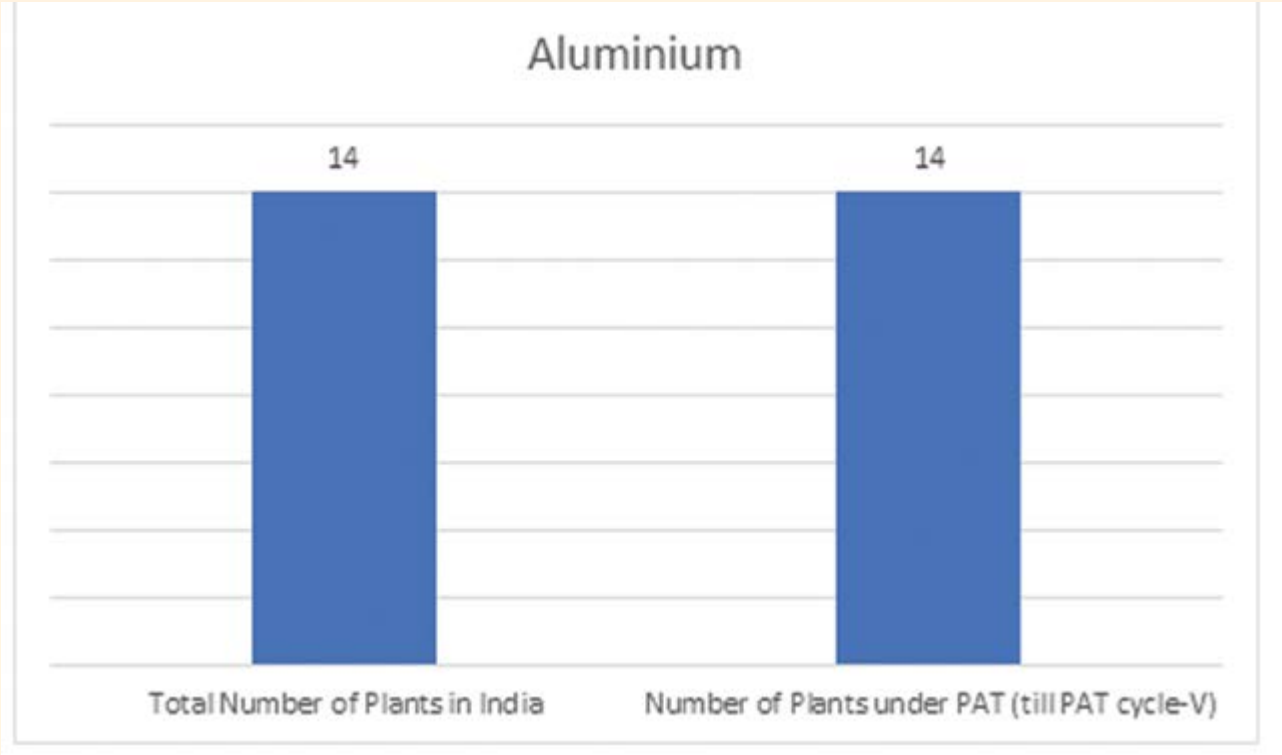


FIGURE 8 NUMBER Of ALUMINIUM PLANTS IN INDIA AND PLANTS COVERED UNDER PAT

State-wise categorisation of DCs (under PAT-II)

A total of 12 designated consumers from the aluminium sector were covered in PAT Cycle-II to reduce their specific energy consumption from baseline year. Majority of the DCs are in state of Odisha (6 nos) with other states having just one DC each.

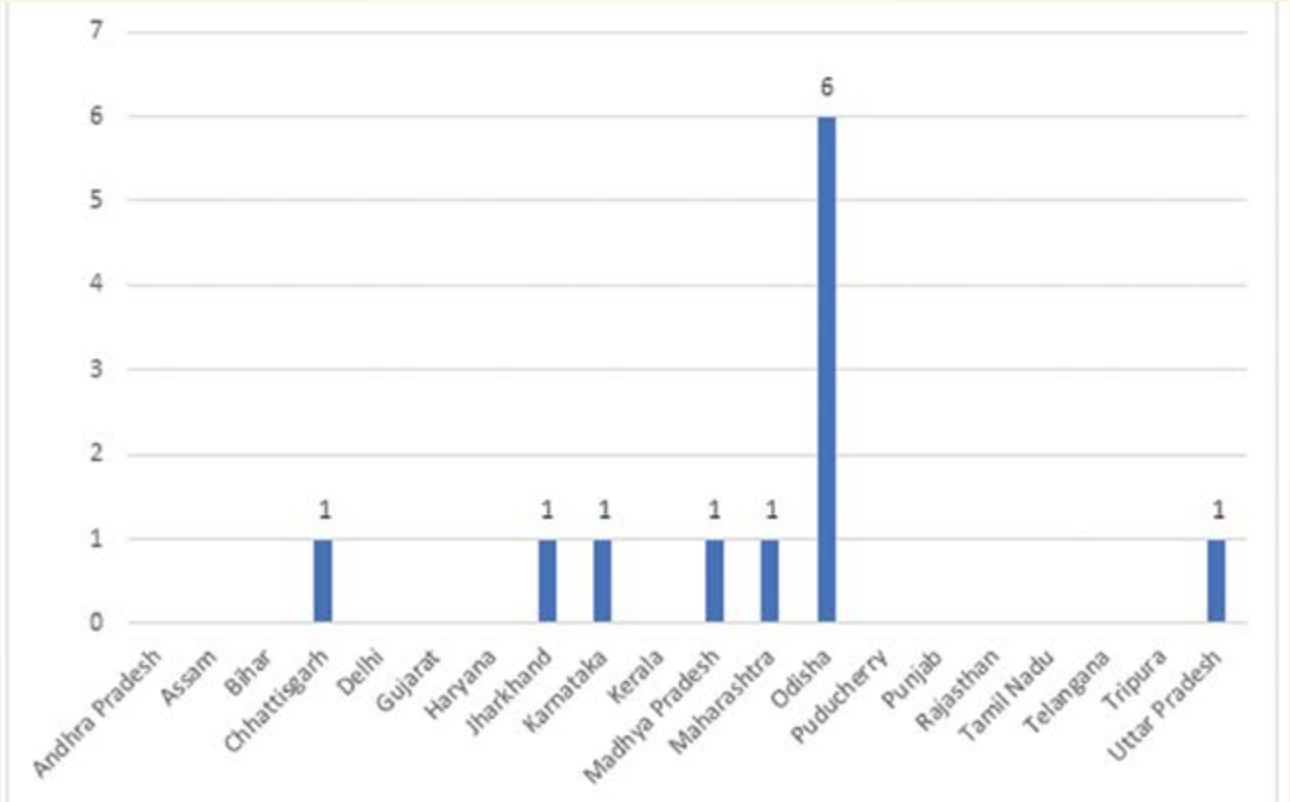


FIGURE 9: DISTRIBUTION Of DC -STATE WISE IN ALUMINIUM SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	Savings above the target
Aluminium	12	0.47	9	0.573	21.91%

TABLE 10: SAVINGS IN ALUMINIUM SECTOR

The total investment reported by 7 DCs on energy efficiency projects, is INR 75 crores.

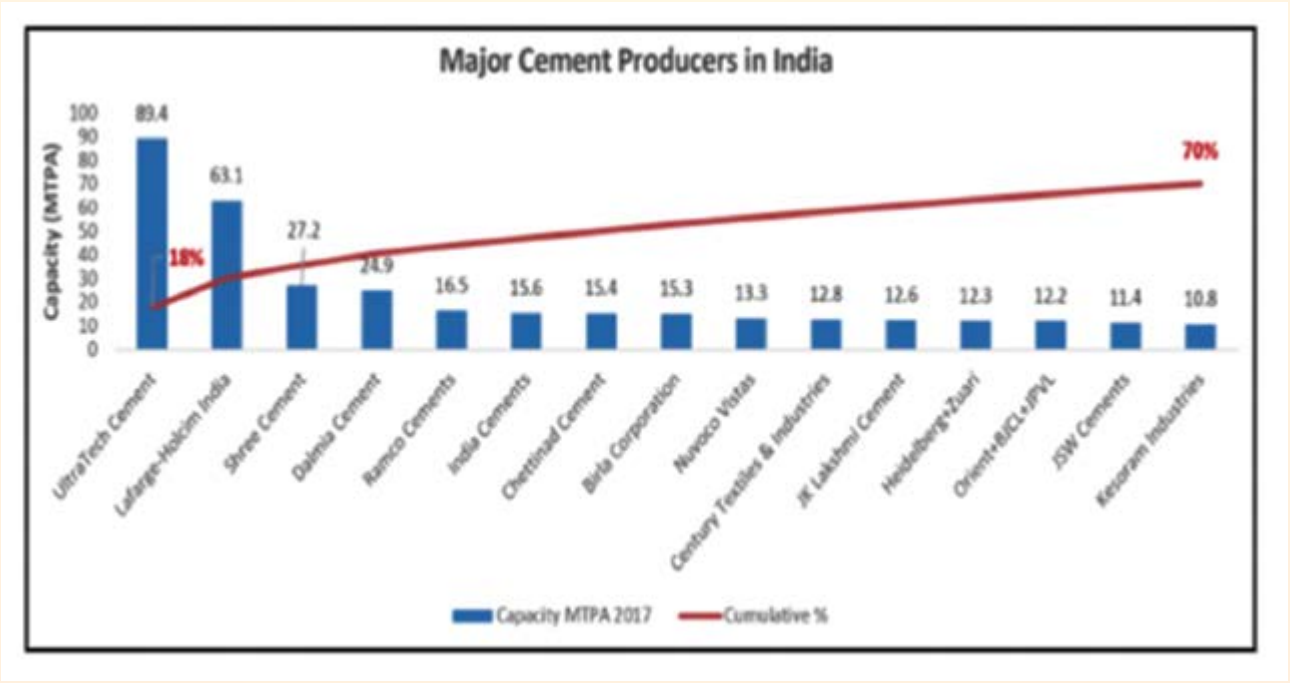
Best practices, upgradation and low carbon technologies

1. Calciner main burner nozzle replacement.
2. Use of cold sealing paste for pot relining.
3. Corro-coat coating of pump to increase its efficiency.
4. Hot water generator to replace steam boiler in Tension Leveller process.
5. Solar heating system for hot mill emulsion.
6. APC reduction and operation optimization.
7. Inert Anode Technology
8. Wetted Cathode Technology
9. Multipolar Cell Technology
10. Hydro power or other renewal energy based Smelter plant

3.2 Cement Sector

In a rapidly developing nation such as India, there is no dearth of demand for new infrastructure. The Indian cement industry is hence one of the fastest growing industries and is also humungous in its volume of production as compared to volumes worldwide. A recent example to demonstrate this fact is the stupendous 22.9% growth in the cement industry in India seen between February 2017 and February 2018. India's cumulative index (index of eight core industries), on the other hand, increased by 5.7% during over the same period, indicating the cement sector's dominant position in the growth of the Indian industry. With a total of 206 large integrated cement plants and about 350 mini cement plants making up a total capacity of 539 Million Tonnes Per annum in 2018-19 , the Indian cement sector is a formidable giant. Indian cement consumption is around 235 kg per capita against global average of 520 kg per capita[1].

There is no foreseeable reason for any slowdown in the juggernaut of the cement industry in India. Estimates have marked a 5% compound annual growth rate (CAGR) for the sector for the period of FY 2017-20. By 2020, the annual cement production is estimated to reach 550 million tonnes (MT).



1 https://www.business-standard.com/article/news-cm/domestic-cement-consumption-around-235-kg-per-capita-against-global-average-of-520-kg-per-capita-119020600509_1.html

Coverage of DCs under PAT (till PAT cycle VI)

Out of 206 large cement plants in india, 175 plants have been covered under the PAT scheme. There are no sub-sectors in cement.

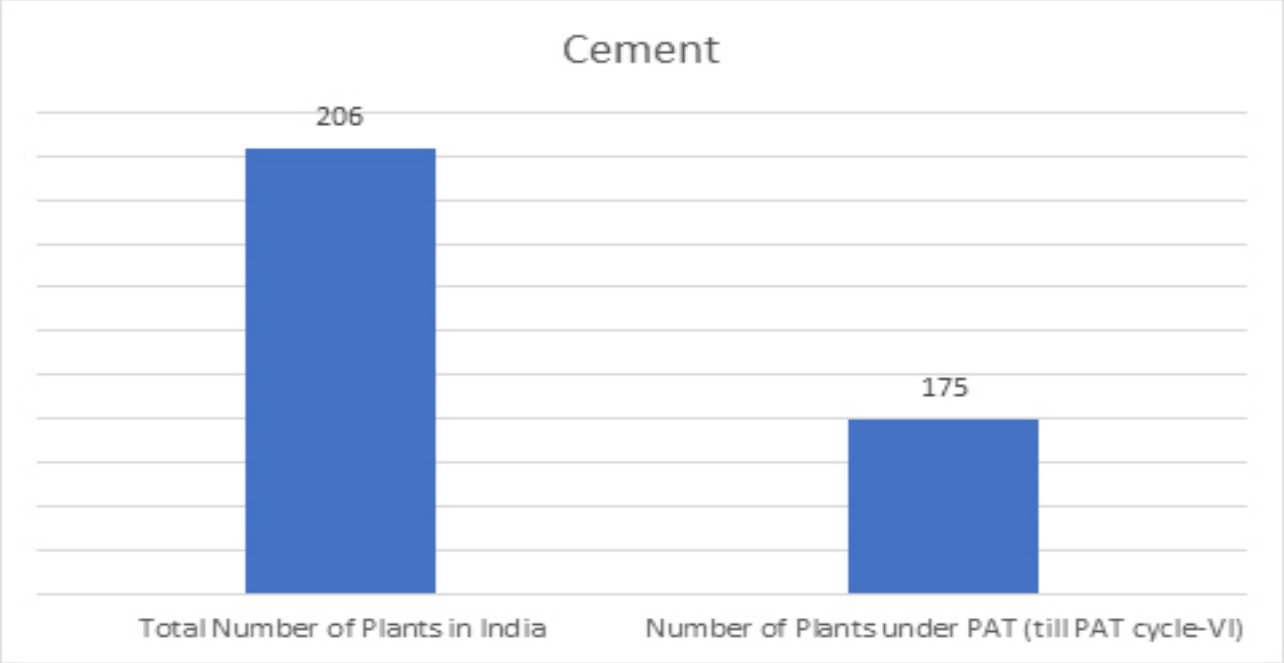


FIGURE 10 NUMBER Of CEMENT PLANTS IN INDIA AND PLANTS COVERED UNDER PAT

It could be also seen from figure below that PAT has covered around 70% of the total cement production in India. The higher energy consuming units of remaining 30% units would be targeted in the future cycles of PAT through deepening exercises.

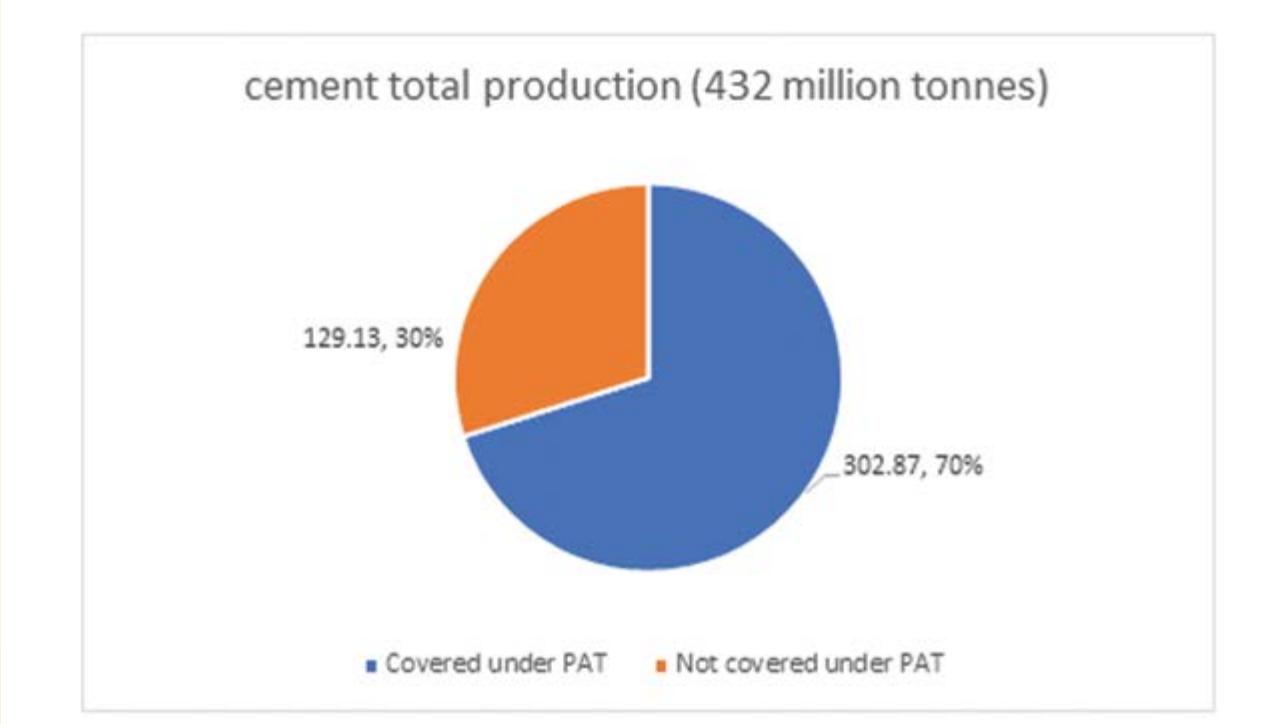


FIGURE 11 COVERAGE Of CEMENT PLANTS UNDER PAT SCHEME (PRODUCTION WISE). FIGURES IN MILLION TONNES AND PERCENTAGE

State-wise categorisation of DCs (under PAT-II)

Majority of cement plant DCs were located in Rajasthan, Andhra Pradesh, Tamil Nadu, Telangana and Madhya Pradesh.

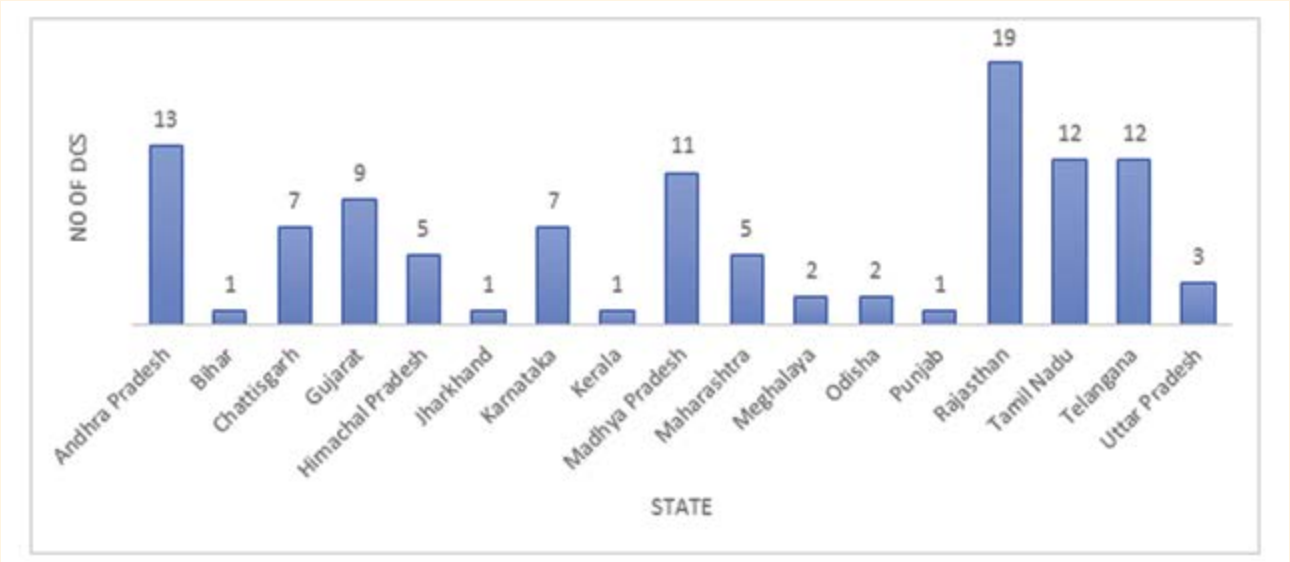


FIGURE 12: DISTRIBUTION Of DC – STATE WISE IN CEMENT SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Cement	111	1.1	99	1.56	41.82%

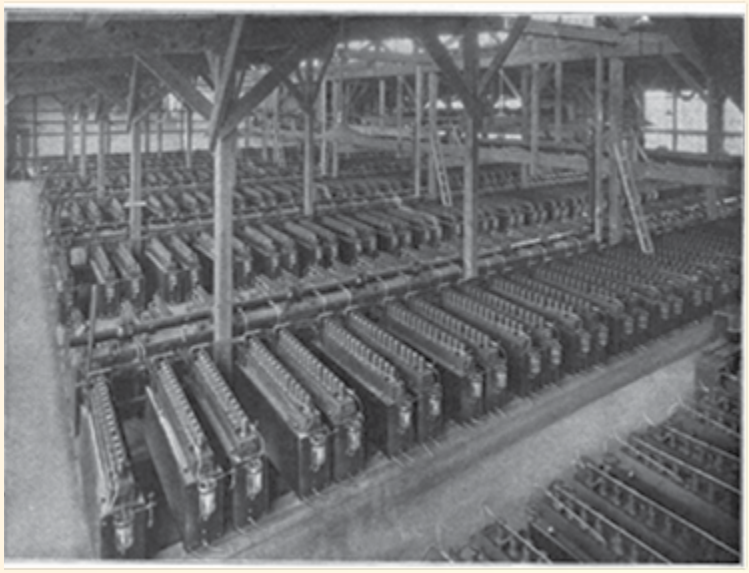
TABLE 11: SAVINGS IN CEMENT SECTOR

The total investment reported by 88 DCs on energy efficiency projects, is INR 6,962 crores.

Best practices, upgradation and low carbon technologies

1. Increase in AFR utilization.
2. Waste heat recovery from pre-heater outlet.
3. Installation of Kiln Shell radiation recovery system in Kiln for CPP makes up water heating.
4. Calcium looping as Carbon Capture technology
5. Reduction of Clinker Factor in Pozzolona Portland Cement

3.3 Chlor-Alkali sector



The Chlor-Alkali industry in India produces about 69% of the basic chemicals in India, making it an important sector in manufacturing. Caustic soda, Chlorine, Hydrogen and Hydrochloric Acid are the main components of the Chlor-Alkali industry. There are 32 plants in the country, with 56% of capacity in Western India alone. Alkali chemicals production rose by 4.32%[1] in FY 2017-18, with growth being steady over the years.

With a capacity of 2 million tonnes, Gujarat is the largest State for the manufacturing of Caustic Soda. Gujarat also accounts for about half of India's annual Caustic Soda production, pegged at 35.39 Lakh MT[2] for 2018-19.

Among the 32 plants of the Chlor-Alkali industry in the country, most are merchant units, with an average plant size of about 150 tonnes per day (TPD).

The Chlor-Alkali sector has been categorized on the basis of basic process availability of captive power plant (CPP). Subsectors: Units with CPP & Units without CPP

Coverage of DCs under PAT (till PAT cycle VI)

Out of 32 plants in the Chlor Alklai Sector, 28 has been covered under the PAT scheme, which is more than 85% of the total plants in the sector in India, as shown in figure 13 below.

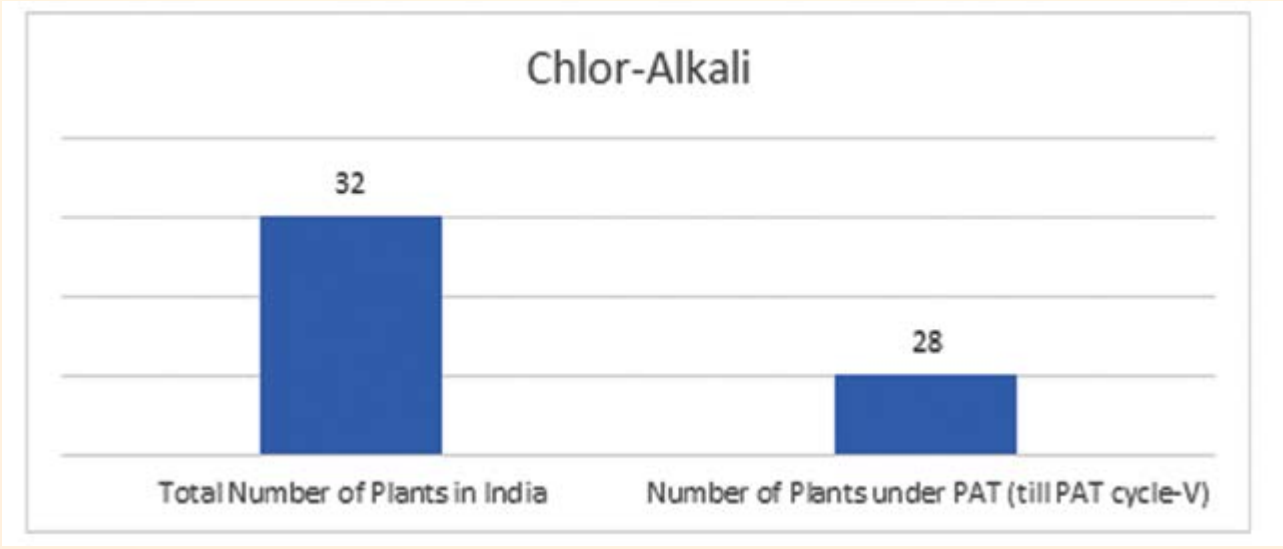


FIGURE 13 NUMBER Of PLANTS IN CHLOR ALKLAI SECTOR IN INDIA AND PLANTS COVERED UNDER PAT

1 Ministry of Chemicals & Petrochemicals (Annual report 2017-18)
2 Data from AMAI website

However, there 85% plants contribute more than 93% of total production in India, which has been shown in figure 14 below.

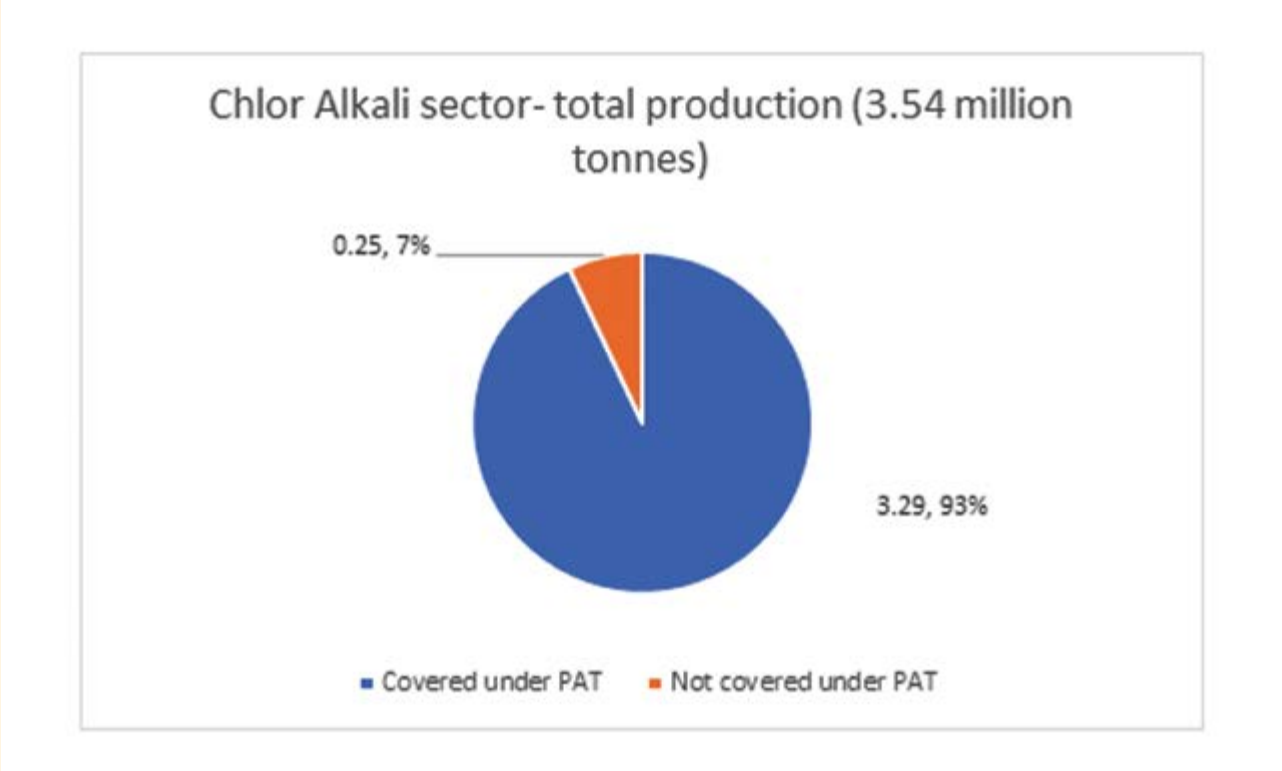


FIGURE 14 COVERAGE Of CHLOR ALKLAI SECTOR UNDER PAT SCHEME (PRODUCTION WISE). FIGURES IN MILLION TONNES AND PERCENTAGE

State-wise categorisation of DCs (under PAT-II)

Out of 24 DCs in PAT-II, majority of the Chlor-Alkali DCs were located in Gujarat (10), Tamil Nadu (3), Punjab (2) and Andhra Pradesh (2).

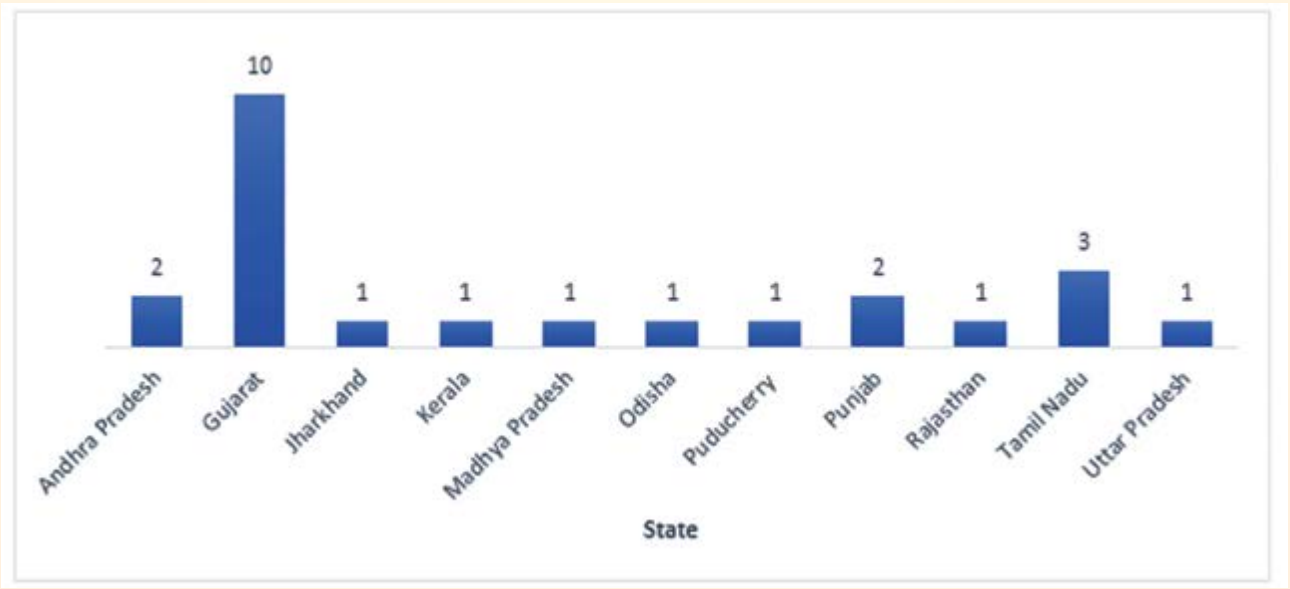


FIGURE 15: DISTRIBUTION Of DC -STATE WISE IN CHLOR ALKALI SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Chlor-Alkali	24	0.102	24	0.136	33.33%

TABLE 12: SAVINGS IN CHLOR-ALKALI SECTOR

The total investment reported by 13 DCs on energy efficiency projects, is INR 419 crores.

Best practices & technology upgradation

1. Technology upgradation to Zero-gap technology.
2. Installation of micro-turbine.
3. Feeding of 48% hot Caustic Soda Lye direct to flaker plant.
4. Change over of fuel from Furnace Oil (FO) to Hydrogen in process heating/steam requirement.
5. Utilizing Hydrogen in Captive Power Plant
6. PEM Fuel Cell Technology using Hydrogen
7. Hydrogen Compressed Natural Gas (HCNG) (Hydrogen blending with CNG)
8. Hydrogen Co-firing in Indsutrial Gas Turbines

3.4. Fertilizer

The fertilizer sector of the Indian industry has been registering double-digit growth rates over several years, and to nobody's surprise. In a major developing economy heavily aligned with agriculture, India has immense and growing need for fertilizers, beginning with the Green Revolution and going on to help farmers in sustainable and large-scale food-grain production. Fertilizer consumption and sustainable production of food grains go hand-in-hand in India, and the outlook for future growth remains favourable.

Fertilizer production in India was pegged at 41.4 MT for the FY 2017-18, forming a Y-o-Y increase of 11%. Apart from demand, the growth of the fertilizer sector has also benefited from favourable government policies, which have catalysed investments in the public, co-operative and private sectors alike. There are a total of 32 large size plants in the country for manufacturing ammonia/urea, 21 units producing DAP and complex fertilizers, and another two units producing Ammonium Sulphate as a by-product.

India is the second largest consumer of fertilizers globally, with a consumption of 28.12 MT of nitrogen (N), phosphate (P) and potash (K). Also, the fertilizer industry in India is world-class, in terms of plant size, technology used, and efficiency levels achieved.

The fertilizer sector has been categorized on the basis of major product types. Subsectors: Ammonia/ Urea, and Complex fertilizer.

Coverage of DCs under PAT (till PAT cycle VI)

There are around 165 Fertilizer plants in India. Out of this PAT has covered 37 plants. However, these plants are the large plants which has the maximum energy consumption and has the maximum share in India's total production. Figure 16 shows the share of DCs in Fertilizer sector under the PAT scheme, which his around 22% (plant wise).

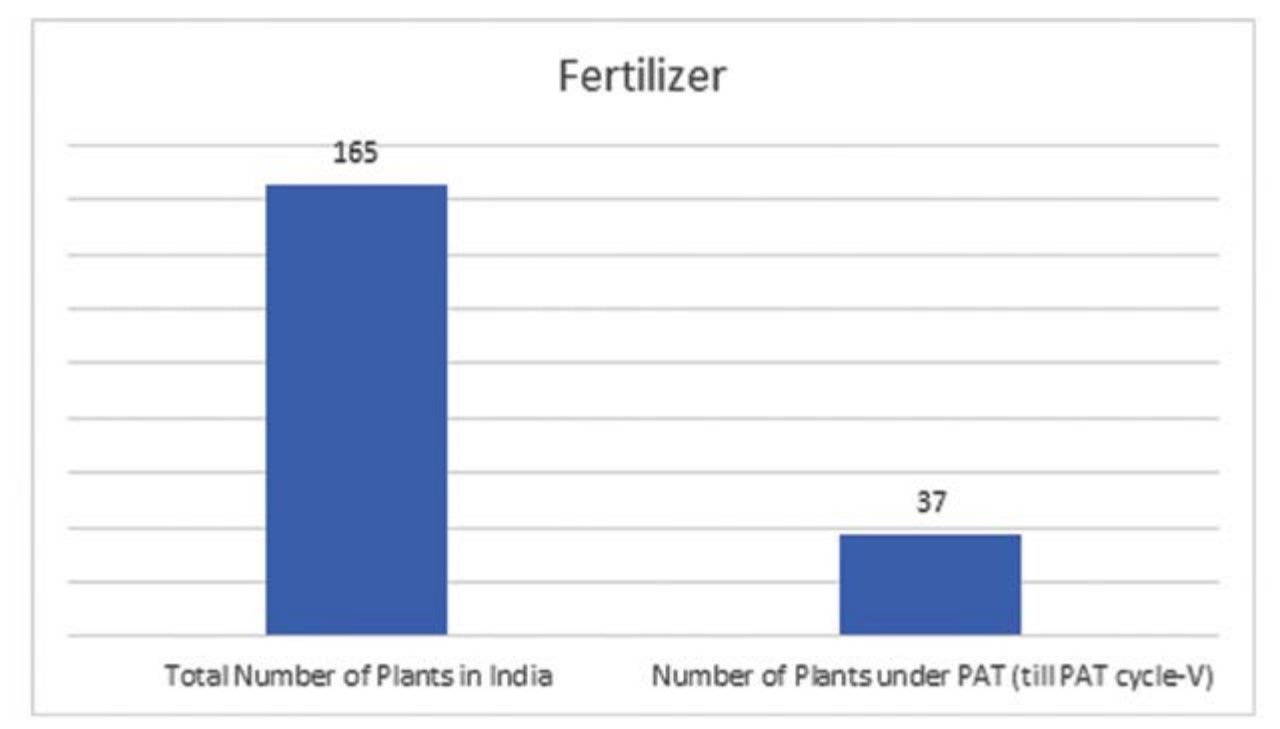


FIGURE 16 NUMBER Of PLANTS IN FERTILIZER SECTOR IN INDIA AND PLANTS COVERED UNDER PAT

It is evident that the large producers which are also the large energy consumers in the sector has been covered under PAT as 22% of the plants covered under the PAT scheme captures 99% of energy consumed in entire fertilizer sector and produces more than 67% of the total Fertilizer in the country, also shown in figure 17.

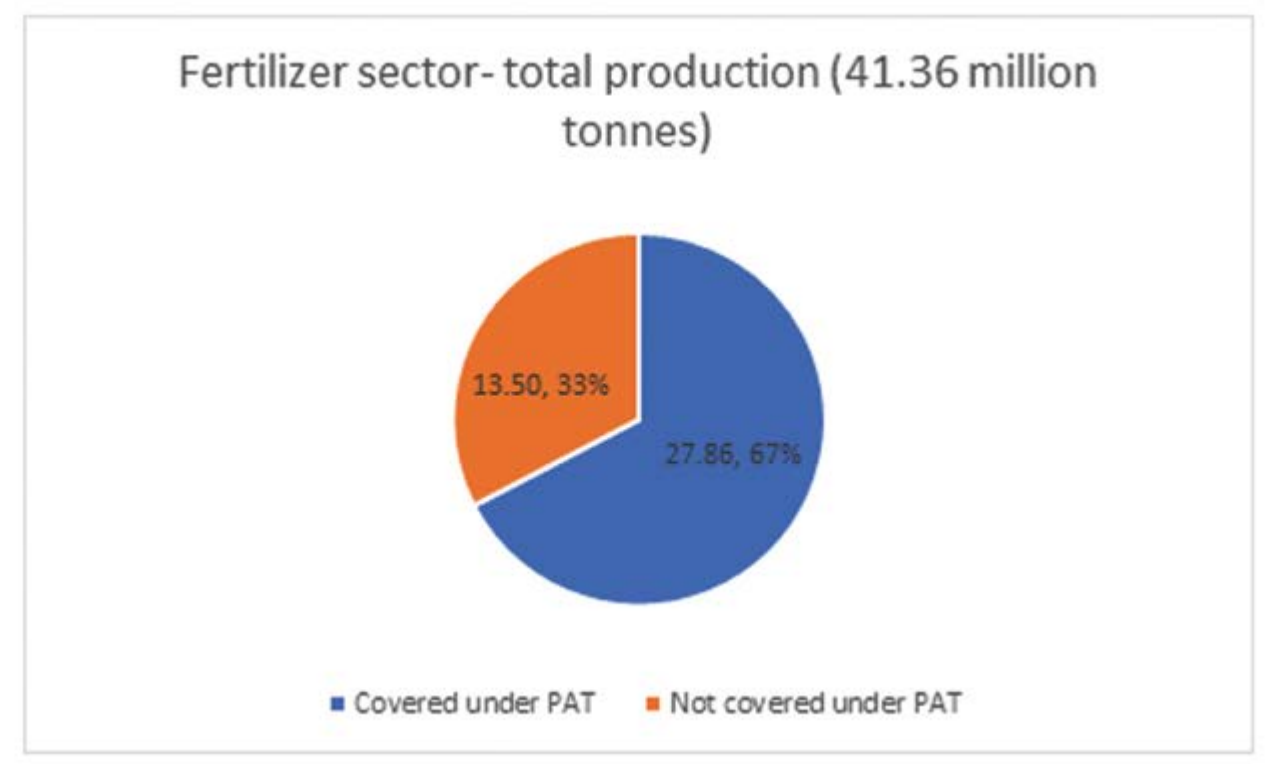


FIGURE 17 COVERAGE Of FERTILIZER SECTOR UNDER PAT SCHEME (PRODUCTION WISE). FIGURES IN MILLION TONNES AND PERCENTAGE

State-wise categorisation of DCs (under PAT-II)

A total of 37 designated consumers were covered in PAT Cycle-II to reduce their specific energy consumption from the baseline year. Majority of fertilizer DCs were in Uttar Pradesh (8), Gujarat (6), Maharashtra (4) and Rajasthan (3).

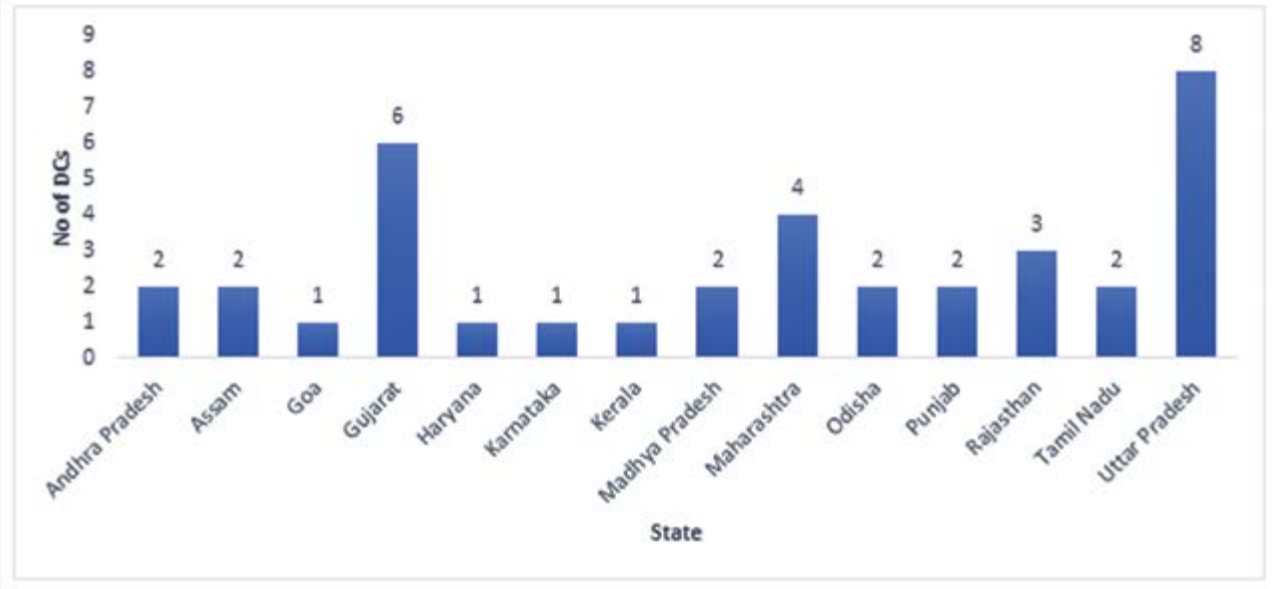


FIGURE 18: DISTRIBUTION Of DC -STATE WISE IN FERTILIZER SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Fertilizer	37	0.447	36	0.383	-14.32%

TABLE 12: SAVINGS IN FERTILIZER SECTOR

The total investment reported by 26 DCs on energy efficiency projects, is INR 2,366 crore.

Best practices, upgradation and low carbon technologies

1. Installation of VAM for chilling of gas at suction of Ammonia Synthesis gas compressor, process air compressor, CO_2 compressor & air compressor for Gas turbine.
2. Coal fired boiler are being substituted with gas-based turbo-generator and associated HRSG.
3. CO_2 as feed for urea production
4. Changeover of feedstock from FO to NG, Naphtha to NG, Coal to NG
5. CO_2 Recovery units

3.5. Iron & Steel

The Indian Iron and steel segment offers a product mix which includes hot rolled parallel flange beams and columns rails, plates, coils, wire rods, and continuously cast products such as billets, blooms, beam, blanks, rounds, slab and metallics, and ferro alloys.

India was the world's second-largest steel producer with production standing at 106.5 MT in 2018, with China still being at the first position. The global average per capita consumption of steel is 225kg, with India having 75 kg while China at 594kg.

In FY 2018, India's crude steel production crossed 100 MT for the first time, reaching 106.5 MT and registering a 4.5% year-on-year growth rate, and becoming the 2nd largest producer of steel in the world after China. It is forecast to grow at the rate of 5% in FY 2019. The ministry of Steel has also kept a target for 300 MT of installed capacity by 2030.

India is also among the largest iron ore producers in the world, ranking 4th globally in 2017. Iron ore is a key input product for manufacturing steel and primary iron. More than 85% of the iron ore reserves in the country are of medium or high-grade and are directly used in blast furnace and Direct Reduced Iron (DRI) plants, in the form of sized lumps, sinters, or pellets.

Coverage of DCs under PAT (till PAT cycle VI)

There are more than 3500 steel plants in India, comprising of Integrated Steel Plants (ISP), sponge iron, rolling mills, induction furnaces, electric arc furnaces, etc. These plants are categorised in large, small and medium enterprises. PAT covers 163 plants, but a direct comparison based on number of plants would not give a true picture, because less than 200 plants out of these 3500, contributes over 85% of the total production in the country. The plants under PAT contributes around 82% of the total steel production in India, shown in figure 19 below. PAT has covered almost all large plants and only SMEs and rolling mills have been left out.

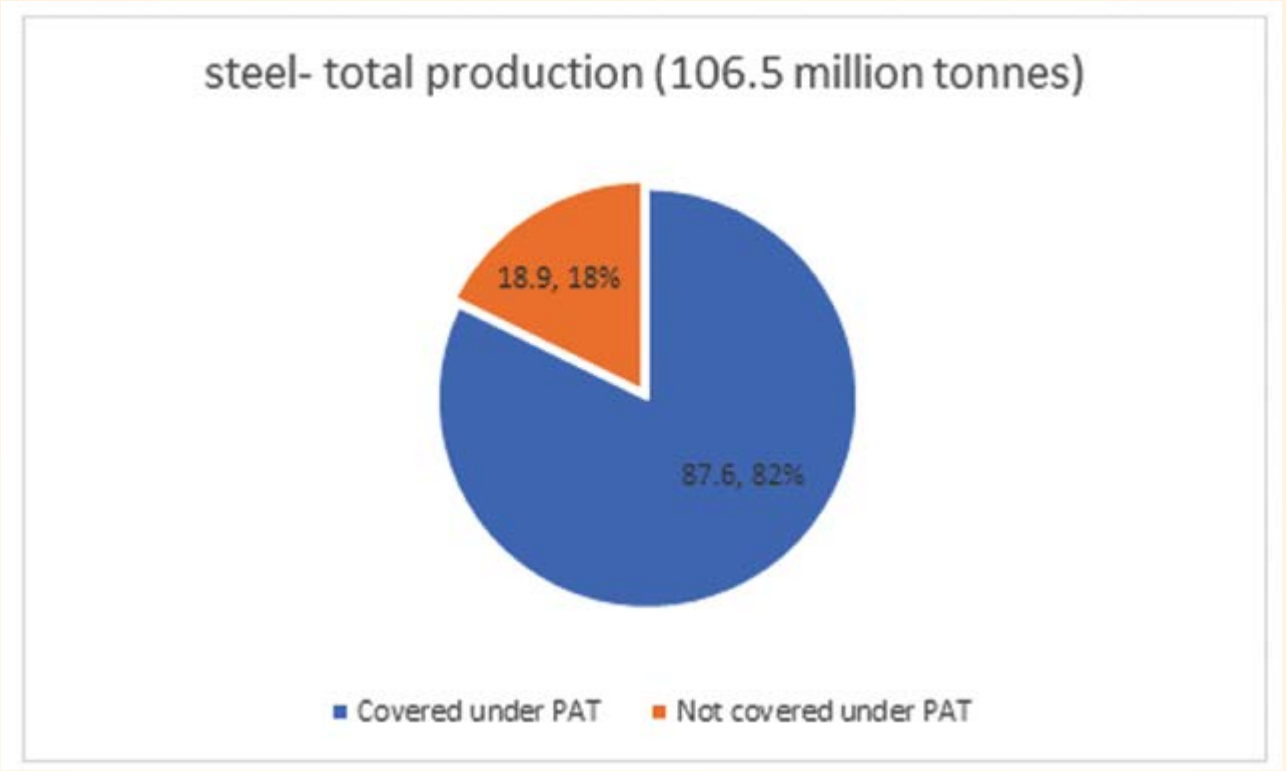


FIGURE 19 COVERAGE Of IRON AND STEEL SECTOR UNDER PAT SCHEME (PRODUCTION WISE). FIGURES IN MILLION TONNES AND PERCENTAGE

State-wise categorisation of DCs (under PAT-II)

A total of 71 plants were covered in PAT II from the Iron & Steel sector, which has been categorized on the basis of products/processes into eight sub-sectors, i.e., Integrated Steel plant, Sponge Iron, Sponge Iron + Steel Melting Shop, Sponge Iron + Steel Melting Shop + Others, Ferro alloys, Ferro chrome, Mini Blast Furnace, and Steel Processing units.

Majority of Iron & Steel DCs were in Chhattisgarh (23), Maharashtra (11), Odisha (10), Gujarat (5) and Karnataka (5), with lesser number of DCs in other states. State wise number of DCs has been mentioned in the Chart below:

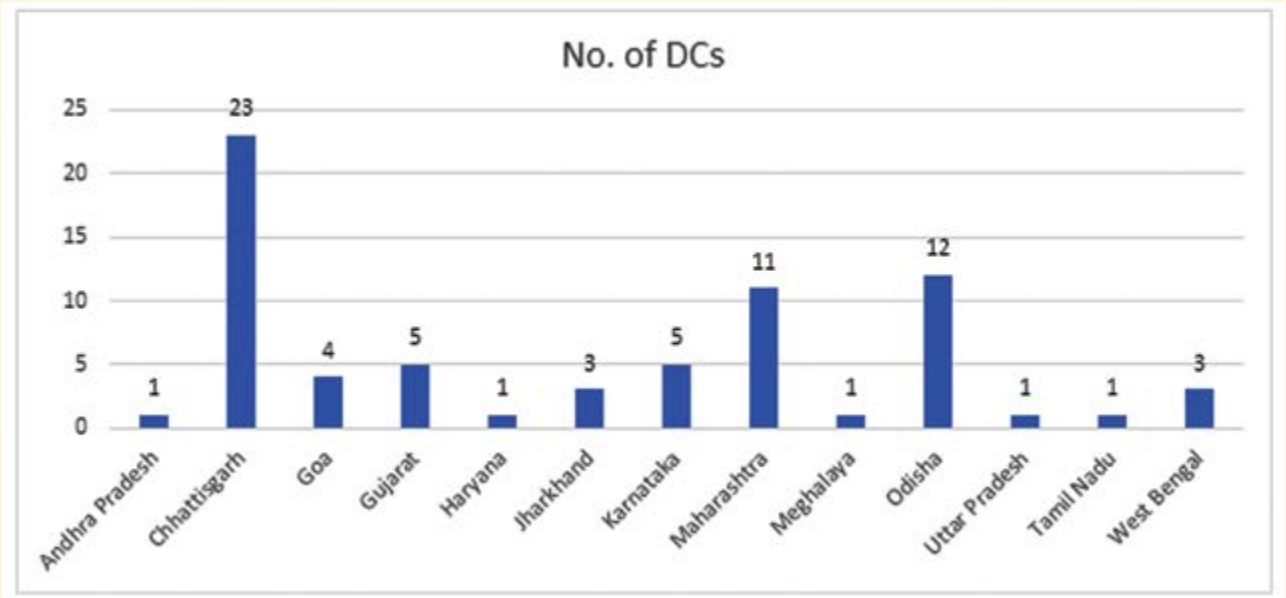


FIGURE 20: DISTRIBUTION Of DC -STATE WISE IN IRON & STEEL SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Iron & Steel	71	2.14	68	2.921	36.5%

TABLE 14: SAVINGS IN IRON & STEEL SECTOR

The total investment reported by 38 DCs on energy efficiency projects, is INR 4,396 crore.

Best practices, upgradation and low carbon technologies

1. Installation of Top Recovery Turbine and Pulverized Coal Injection in Blast Furnace.
2. Commissioning of LD Gas recovery Plant in Steel melting shop.
3. Use of Hydrogen in steel making, reheating furnaces
4. Use of Plastics to replace PCI in Blast Furnace
5. Direct Rolling in mini steel plants
6. Hot charging of DRI in EAF

3.6. Petroleum Refinery

The oil and gas sector is among the eight core industries in India, thus holding an influential position in the decision-making processes at the top government level that affect all other important sectors of the Indian economy.

With a massive capacity 247.57[1] MMTPA, the Indian Refinery sector is next only to the US and China in global volumes. Within the country, the sector is the second-largest energy consumer.

Of the total refining capacity, more than half comes from public sector refineries.

India's economic growth and demand for energy are strongly interlinked, and hence the forecast for growth in the refinery sector remains positive for several years in the future.

Coverage of DCs under PAT (till PAT cycle VI)

There are around 23 Petroleum refineries plants in India. Out of this PAT has covered 20 plants.

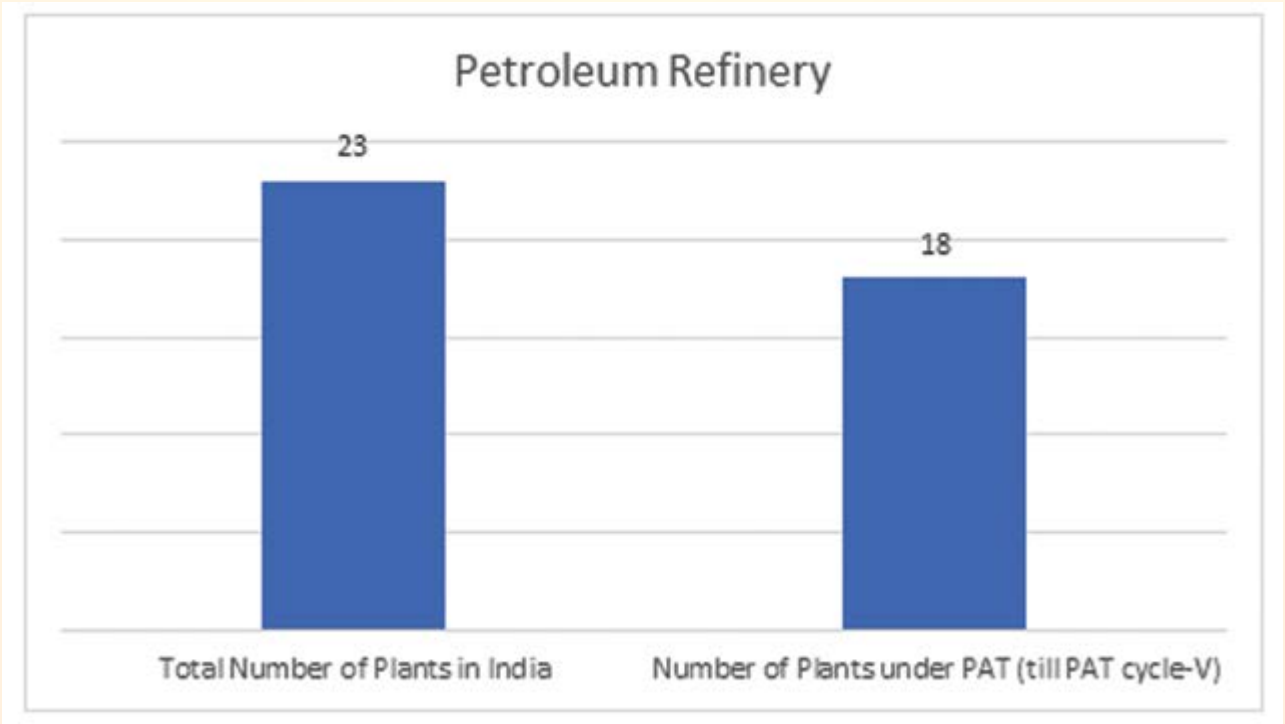


FIGURE 21 NUMBER Of PLANTS IN PETROLEUM REFINERY SECTOR IN INDIA AND PLANTS COVERED UNDER PAT

1 As per AR by MoPNG

However, these plants are the large plants which has the maximum energy consumption and has the maximum share in India's total production. Figure 21 shows the share of DCs in Petroleum refineries under the PAT scheme, which his around 87% (plant wise).

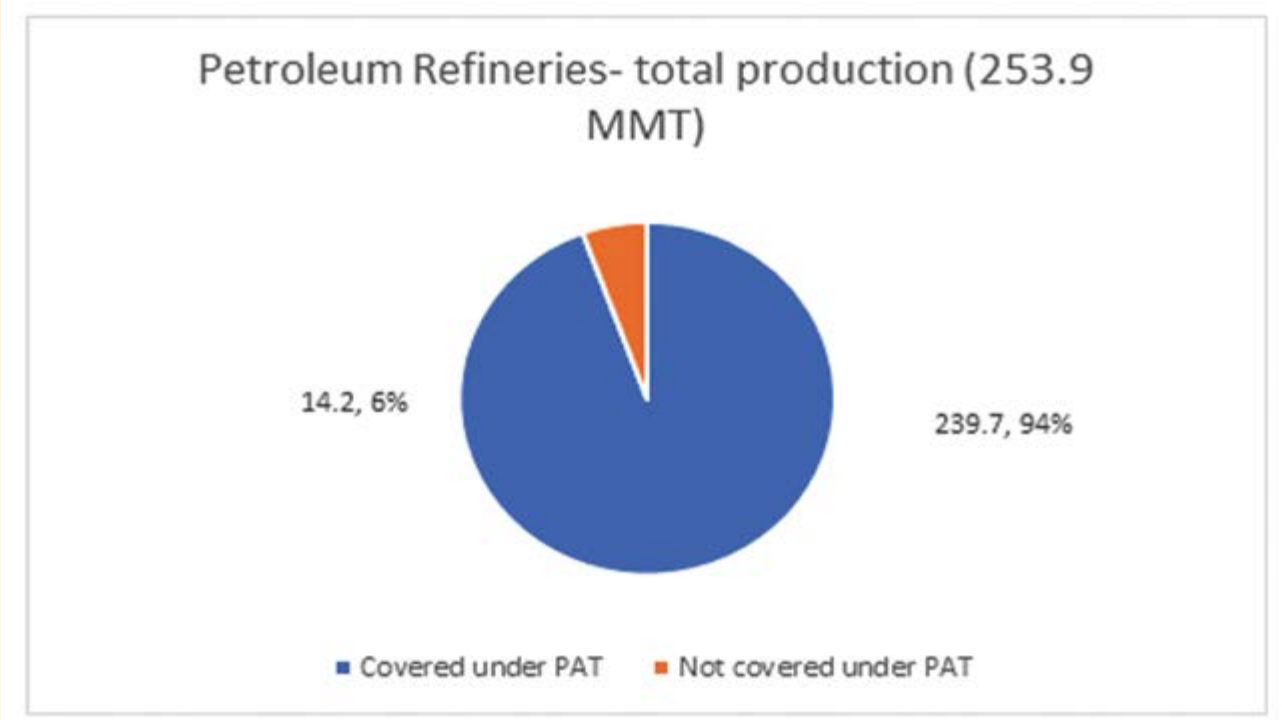


FIGURE 22 COVERAGE Of PETROLEUM REFINERY SECTOR UNDER PAT SCHEME (PRODUCTION WISE). FIGURES IN MMT, PERCENTAGE

It is evident that the large producers which are also the large energy consumers in the sector has been covered under PAT as 87% of the plants the PAT scheme produces more than 94% of the total production in country, also shown in figures above.

State-wise categorisation of DCs (under PAT-II)

Of the total 18 refineries given targets, four refineries are located in Gujarat, and two refineries each are located in Assam and Maharashtra. The remaining states have one DC each. The state wise distribution of refineries is as shown below:

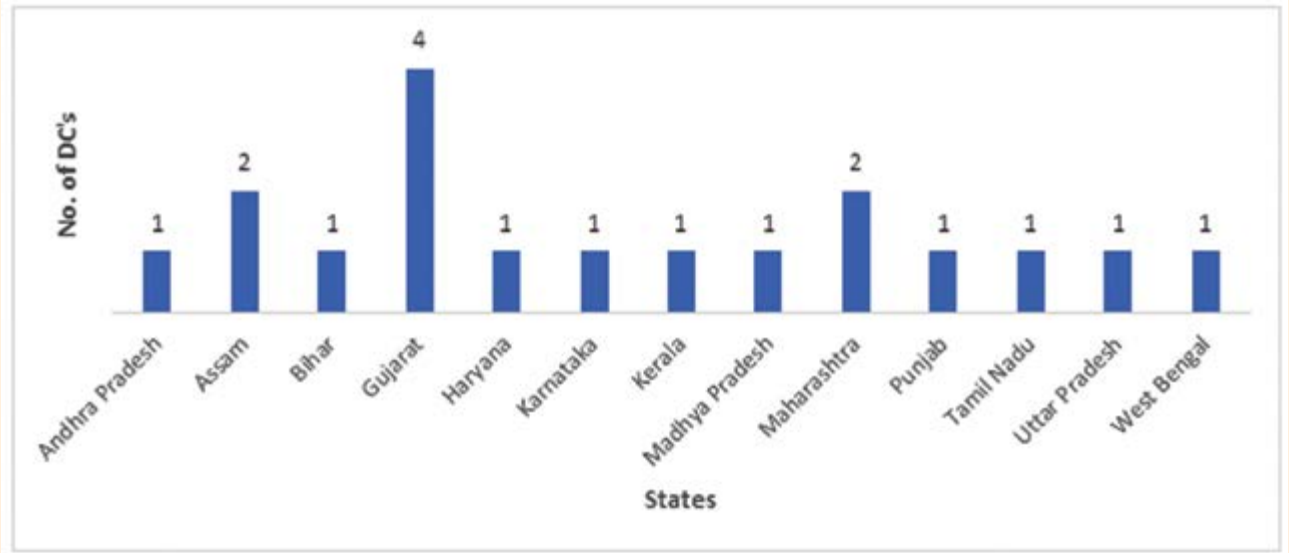


FIGURE 23: DISTRIBUTION Of DC -STATE WISE IN PETROLEUM REFINERY SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Refinery	18	1.009	18	1.48	46.68%

TABLE 15: SAVINGS IN PETROLEUM REFINERY SECTOR

The total investment reported by 16 DCs on energy efficiency projects, is INR 4312 crore.

Best practices & technology upgradation

1. Commissioning of heat integrated, energy efficient crude distillation unit (CDU).
2. Implementation of Advance process control (APC) in CCR.
3. Replacement of third stage ejector system by Liquid ring vacuum pump (LRVP) in vacuum distillation unit (VDU).
4. Furnace efficiency improvement of CDU heater.
5. Process parameters and APC optimization.
6. "indeDiesel Technology" - DHDT Hydrotreatment for Euro-IV & V diesel (S < 50 & 10 ppm, CN > 51)
7. "indeHex Technology"- Food Grade Hexane Hydrotreatment of hexane for benzene removal (< 100 ppm)
8. "indJet Technology" - ATF Hydrotreating - Selective Removal of Mercaptan Sulfur in ATF / desulphurisation of kerosene
9. NDMAX Technologies- A novel technology to produce high yield of light olefins / LPG and high octane gasoline from various petroleum fractions
10. Innovative methodology for prediction of Refining Characteristics of Oil (BPMARRK)
11. indSelectG Technology- Selective desulphurization of full range FCC & other cracked gasoline streams to meet BS-VI S spec with minimum loss of RON (~3 units)
12. One Divided wall column in place of 2 columns in FCC Naphtha splitter.
13. LP steam superheating with MP steam in shell and tube exchanger in place of direct mixing
14. Energy real time optimizer (ERTO software).
15. Substituting N2 blanketing in place Fuel gas in Naphtha splitter receiver.

3.7. Pulp & Paper

The Indian paper industry accounts for about 3.7% of the world's production of paper. The estimated turnover of the industry is INR 60,000 crore (USD 8.5 billion), and its contribution to the Exchequer is around INR 4,500 crore. The industry employs more than 0.5 million people directly, and 1.5 million people indirectly.

Most of the paper mills are in operation for a long time, with their technology spectrum ranging from the oldest to the most modern equipment. The mills use a variety of raw materials, viz., wood, bamboo, recycled fibre, bagasse, wheat straw, rice husk, etc.

Of the total production, about 25% paper produced is based on wood, while recycled fibre constitutes the largest portion, 58%. Agro-residues also have a major share as raw material, at 17%.

Coverage of DCs under PAT (till PAT cycle VI)

There are more than 550 Pulp an paper plants in India, comprising of wood based, agro based, and recycles fibres, producing various kinds of papers such as writing-printing, newsprint, packaging paper, speciality paper, etc. These paper plants are spread across India categorised in large, small and medium enterprises. PAT covers 48 plants out of these. However, most of the paper plants are smaller plants and either falls under SME or uses biomass as fuels and do not cross the threshold defined under PAT. The plants covered under the PAT covers almost 30% of the sector- both capacity wise and production wise, as shown in figure 24.

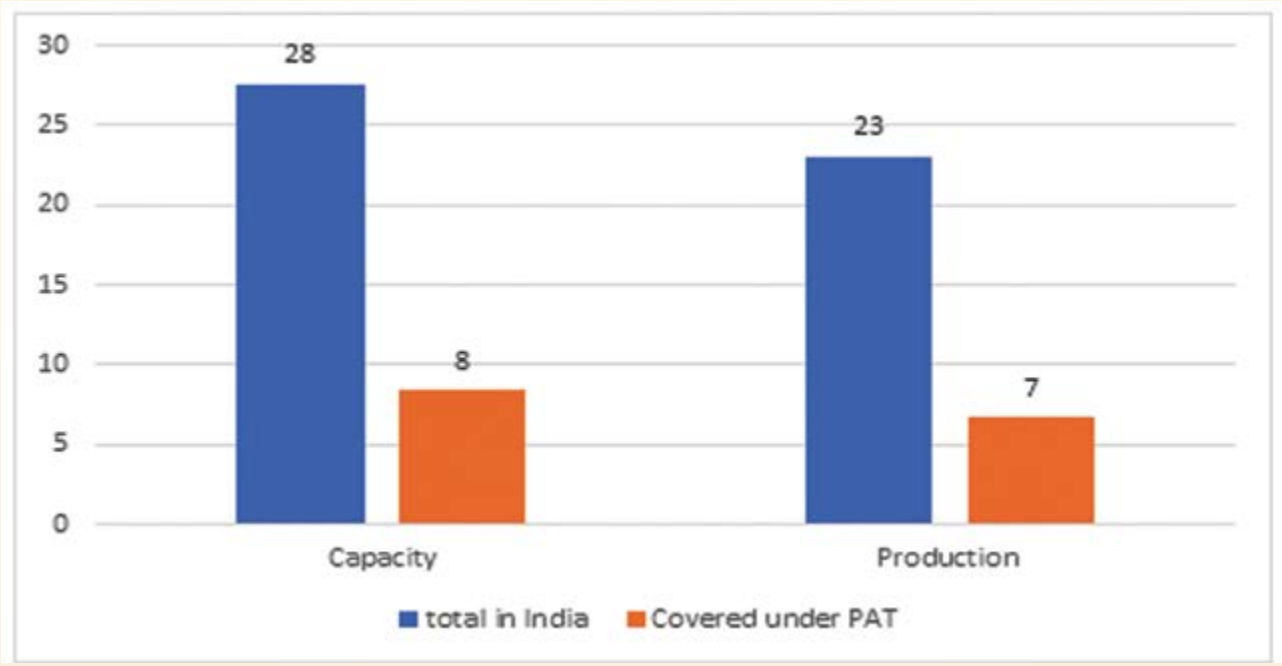


FIGURE 24 COVERAGE Of PULP AND PAPER SECTOR UNDER PAT SCHEME (CAPACITY AND PRODUCTION WISE). (ALL FIGURES IN MILLION TONNES)

State-wise categorisation of DCs (under PAT-II)

A total of 29 plants were covered in PAT II from Pulp & Paper sector. There are four sub sectors: Wood Based, Agro Based, RCF Based & Imported Pulp Based.

Majority of Pulp & Paper DCs were located in Tamil Nadu (4), Uttar Pradesh (3), Odisha (3), Punjab and (3).

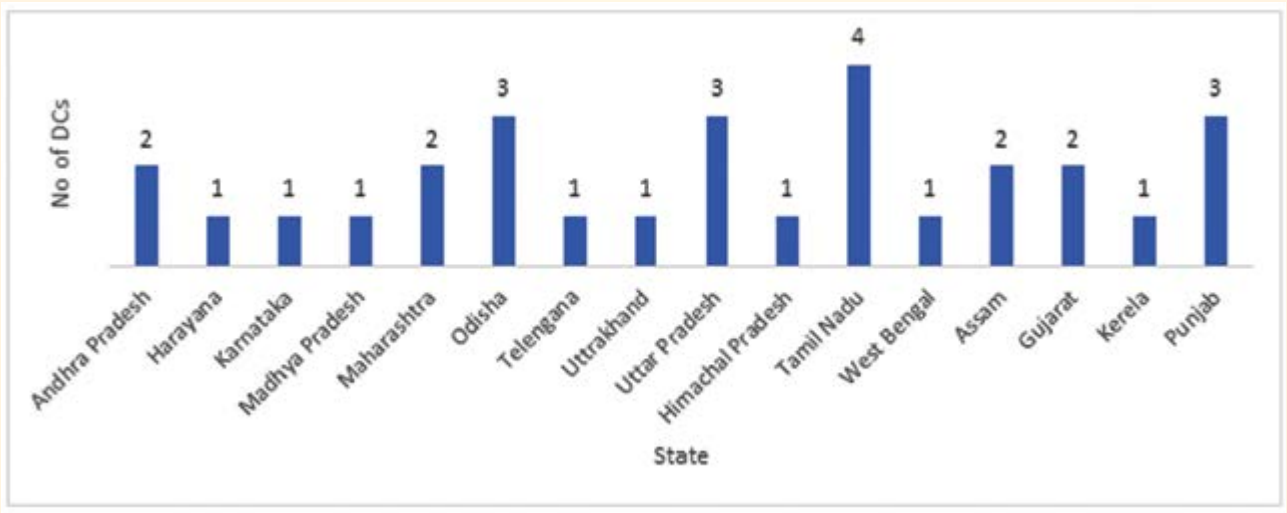


FIGURE 25: DISTRIBUTION Of DC – STATE WISE IN PULP & PAPER SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Pulp & Paper	29	0.15	26	0.250	66.67%

TABLE 16: SAVINGS IN PULP & PAPER SECTOR

The total investment reported by 15 DCs on energy efficiency projects, is INR 232 crores.

Best practices & technology upgradation

1. Super Batch Cooking.
2. Two Stage Oxygen Delignification – OxyTrac.
3. BCTMP Process (bleached chemi-thermomechanical pulp).
4. Super Batch Cooking.
5. Ultra-Low Intensity Refining.
6. Opti Batch Process.
7. Bio gas firing in rotary lime kiln (Replacement of Furnace Oil)
8. Boiler Converison: Fluidised bubbling to Spouted bed
9. Solar Energy Utilization for Process Heating at Low and Intermediate temperature (Repalcement of LP Steam) i.e 50°C to 250°C
10. Oxyfuel burning in lime kiln and black liquor boilers
11. Installation of Extended Delignification System for cooking of wood (to reduce steam consumption)

3.8. Indian Railways

Indian Railways is a state-owned enterprise, operated by the Government of India through its Ministry of Railways. It is the most energy intensive organization in the country, with a consumption of 18.18 billion units of electricity annually (FY 2018-19 figures). To provide more context, 18 billion units of electricity is about 1.3% of the entire country's power consumption. To pay for this humungous power consumption, the Indian Railways spends about INR 10,500 crore per annum. From this total consumption and expenditure, the Indian Railways consumes approximately 2.27 billion units of power for non-traction applications, costing about INR 1,700 crore per annum.

However, the Indian Railways has been taking major steps towards enhancing energy efficiency, and has been reducing its specific electricity consumption by about 3% on a year-to-year basis, in both traction and non-traction areas.

Coverage of DCs under PAT (till PAT cycle VI)

There are 16 zonal railways and 8 production units in the country. Out of these all the zonal railways, and 6 production units has been covered under the PAT scheme, as shown in figure 26. The other 2 production units have been planned to be added to the future cycles of PAT under the deepening exercise.

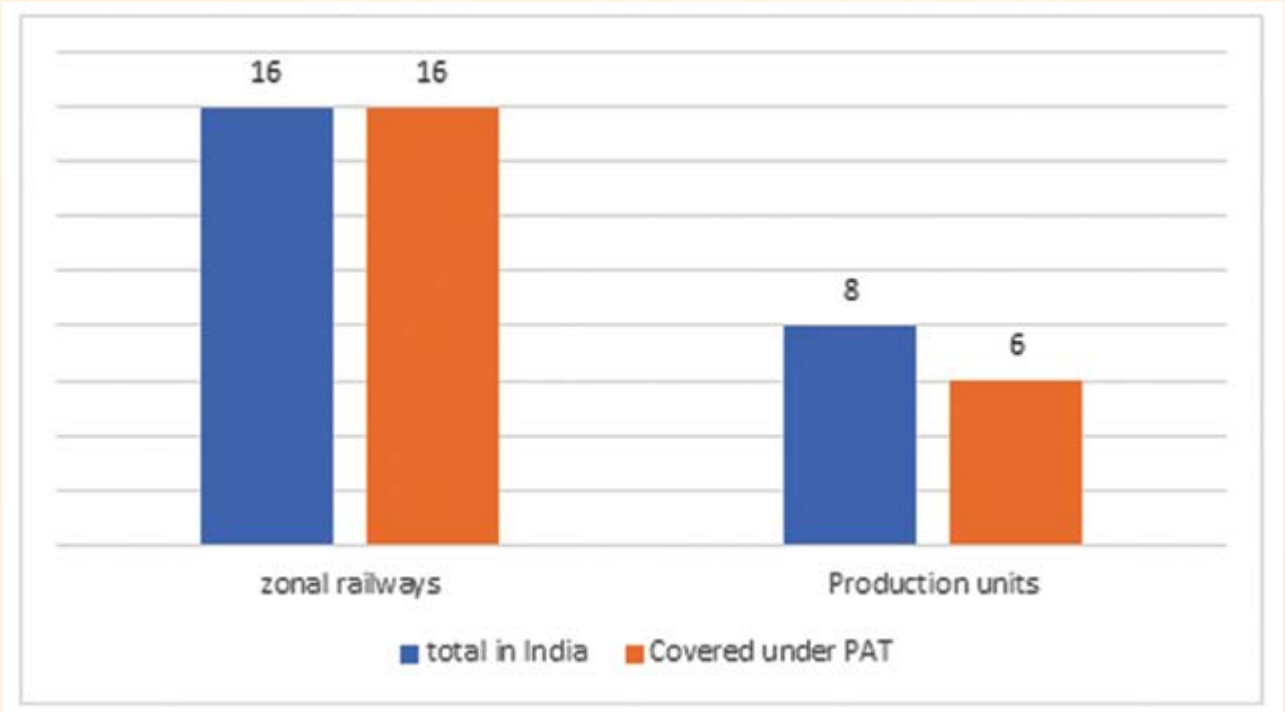


FIGURE 26 COVERAGE Of THE RAILWAYS SECTOR UNDER THE PAT SCHEME (IN NUMBERS)

State-wise categorisation of DCs (under PAT-II)

A total of 22 designated consumers were covered in PAT Cycle-II to reduce their specific energy consumption from the baseline year.

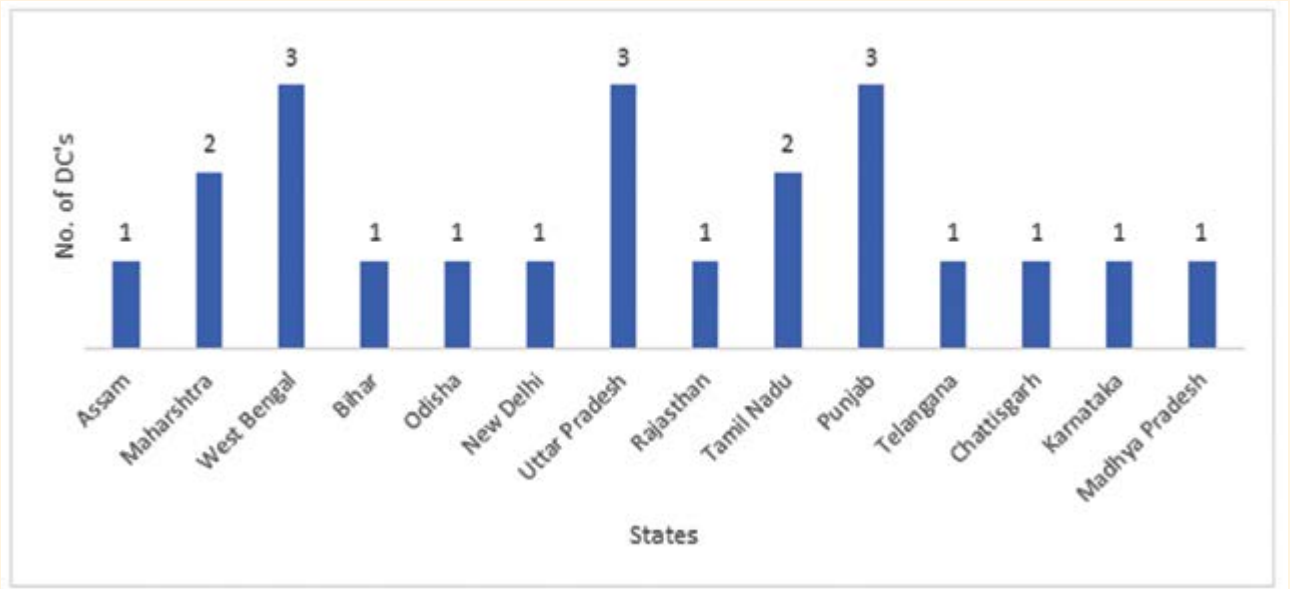


FIGURE 27: DISTRIBUTION Of DC-STATE WISE IN RAILWAY SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Railway	22	0.077	22	0.196	154.55%

TABLE 17: ENERGY SAVINGS IN RAILWAYS

Best practices & technology upgradation

1. 3 Phase Regenerative braking System in Locomotive.
2. Use of APU (Auxiliary Processing Units).
3. Head on Generation.
4. Switching off Diesel and Electric Locos in siding if standing ideal for more 30 minutes.
5. Electrification of railway network
6. Conversion of Diesel loco to Electric Loco
7. Installation of APUs in loco

3.9. Textile Sector

The textile sector of the Indian industry employs 45 million people, making it the second largest industry by manpower. By 2020[1], the sector is slated to provide 55 million jobs. Data for as late as FY 2018-19 shows that the textile sector has an immense contribution to the country's export earnings, at 12% of the total earnings, and also to its GDP, at 2.3%. From the total industrial production in India, textiles make up about 13%.

There is a wide range of segments under the textile sector, ranging from traditional handloom and handicrafts to wool and silk products. There is also the 'organized textile industry', marked by its use of capital-intensive technology for mass production of textile products. This mass production spans apparel manufacturing, spinning, weaving, processing, etc.

Coverage of DCs under PAT (till PAT cycle VI)

There are thousands of textile plants in the country, producing various types of fabrics, having different thread count, going in the production of a variety of clothes. This is one of the most complicated sector as a single product could have different counts based on the quality requirement. Also, there are number of post processing operation based on requirement. In India this sector is mainly in MSME with very limited number of large players in the market. The total production in the country is 14 million tonnes of which PAT covers 2 million tonnes. Similarly, the total energy consumption of the sector is approximately 24 million toe of which the DCs under PAT consumes around 2.7 million toe. However, such comparison in this sector would not give a true picture as most of the industries are under MSME and consumes less than the threshold defined under PAT for textile sector. It must also be noted that there are more than 2.4 million power loom in the country which adds to eth total production but could not be taken under PAT for same reasons. The energy and production numbers in India as compared to that covered under PAT scheme has been shown in figure below.

1 https://www.investindia.gov.in/sector/textiles-apparel

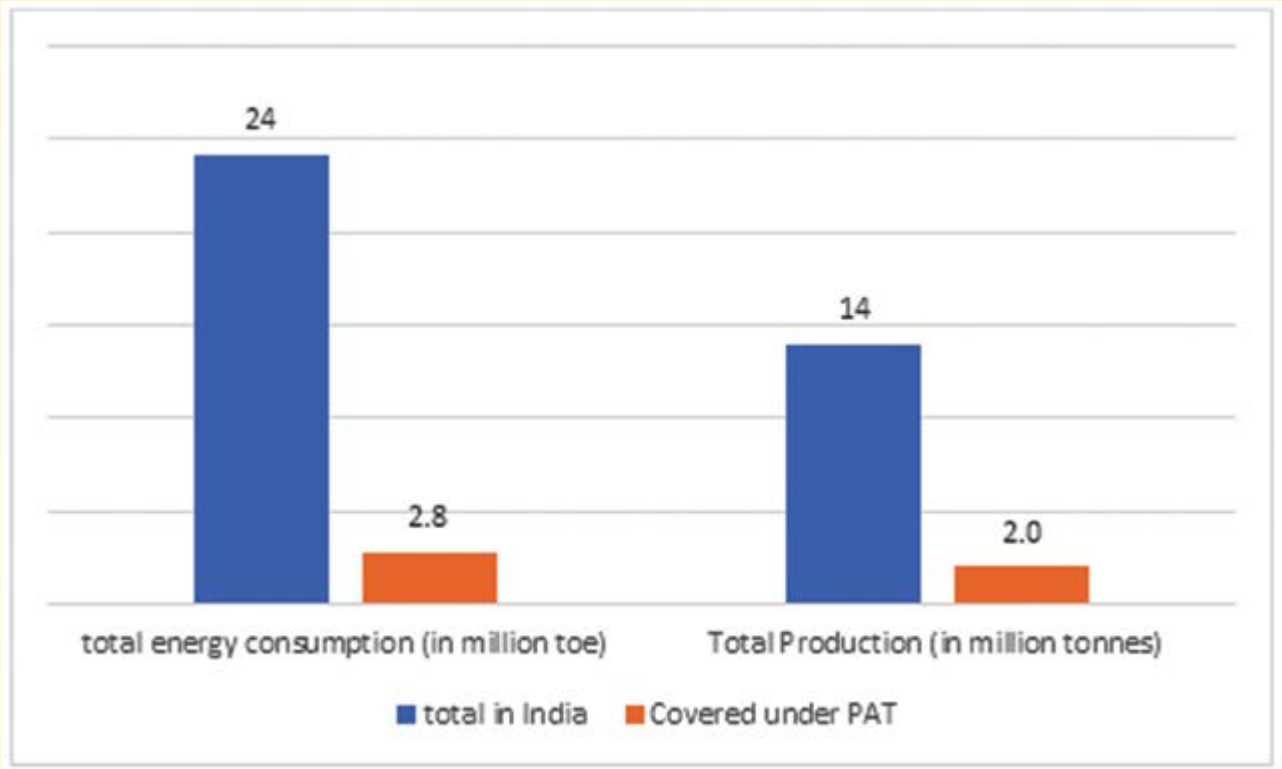


FIGURE 28 COVERAGE Of TEXTILE SECTOR UNDER PAT SCHEME

State-wise categorisation of DCs (under PAT-II)

A total of 99 plants were covered in PAT Cycle-II from the textile sector. There are four sub-sectors: Composite, Fibre, Spinning & Processing. Majority of textile DCs were located in Rajasthan (29), Punjab (17) & Maharashtra (15). The distribution of units is as shown below:

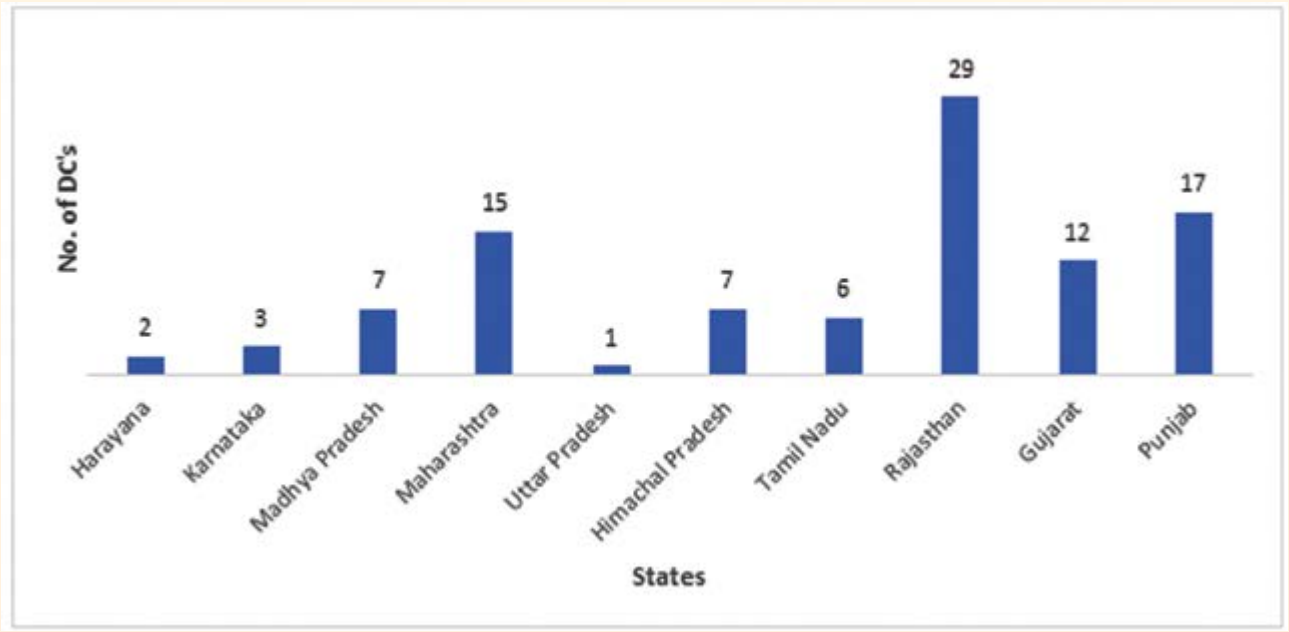


FIGURE 29: DISTRIBUTION Of DC – STATE WISE IN TEXTILE SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
Textile	99	0.087	85	0.136	56.32%

TABLE 18: SAVINGS IN TEXTILE SECTOR

The total investment reported by 72 DCs on energy efficiency projects, is INR 729 crores.

Best practices, upgradation and low carbon technologies

1. Pulser dyeing technique.
2. Waste heat recovery in centrifugal comp.
3. Wind recovery turbine from humidification exhaust.
4. Microbial fuel cells technology to generate electricity from Textile waste water treatment.
5. Solar paint for the textile industries.
6. Energy Recovery from H-Plant exhaust air by providing a special turbine which generates grid connected electricity to be used for lighting purpose.
7. Power generation from sewage treatment of municipal bodies and industries

3.10. Thermal Power Plant

Thermal power plants still make up the largest portion of electricity production capacity in India, with a share of 94% in 2012. Even as renewable energy gains popularity and government support, it is projected that the thermal power sector will constitute about 60% of India's total electricity demand for the foreseeable future.

With the growth of infrastructure demand in India, the demand for power remains high, addressed largely by thermal power plants. With an installed capacity of 367 GW (as of Dec, 2019), India continues its dependency on fossil fuels. The installed capacity of thermal power plants in India increased at a CAGR of 6.44% over the last three decades.

Coverage of DCs under PAT (till PAT cycle VI)

The total installed capacity for power generation in india stands at 370 GW as of 31st May, 2020. Out of this around 230 GW capacity comes from thermal, i.e., coal, oil and gas. Of this 230 GW, PAT has covered around 164 GW, which is more than 71% of the total installed thermal capacity, shown in figure 30. The remaining units being mostly the newer ones would be covered under the future cycles of the PAT scheme.

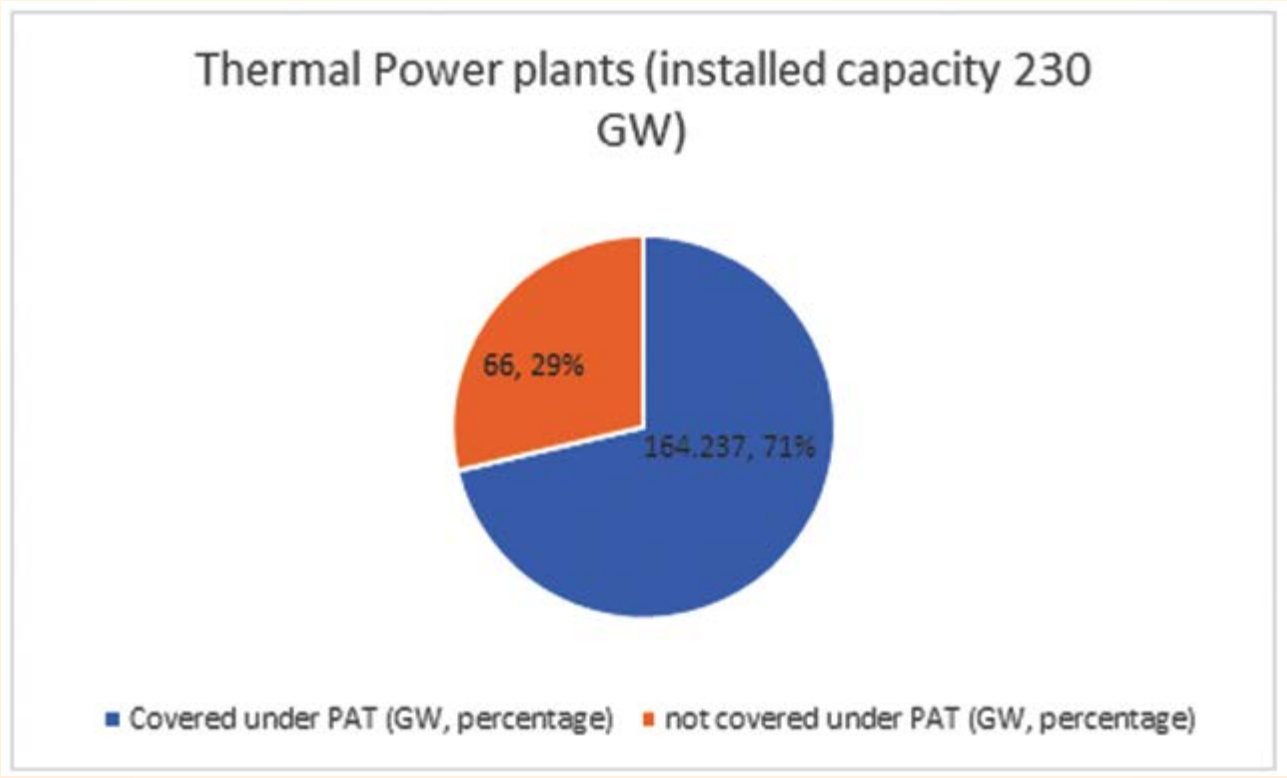


FIGURE 30 COVERAGE Of THERMAL POWER PLANTS UNDER PAT SCHEME

State-wise categorisation of DCs (under PAT-II)

A total of 154 plants were covered in PAT Cycle-II from the thermal power sector, of which data from 95 has been considered for the preliminary study. There are three sub-sectors: Coal, Gas & Diesel power plants. Majority of DCs are located at UP (14), West Bengal (12), Bihar, Chhattisgarh & Gujarat (10).

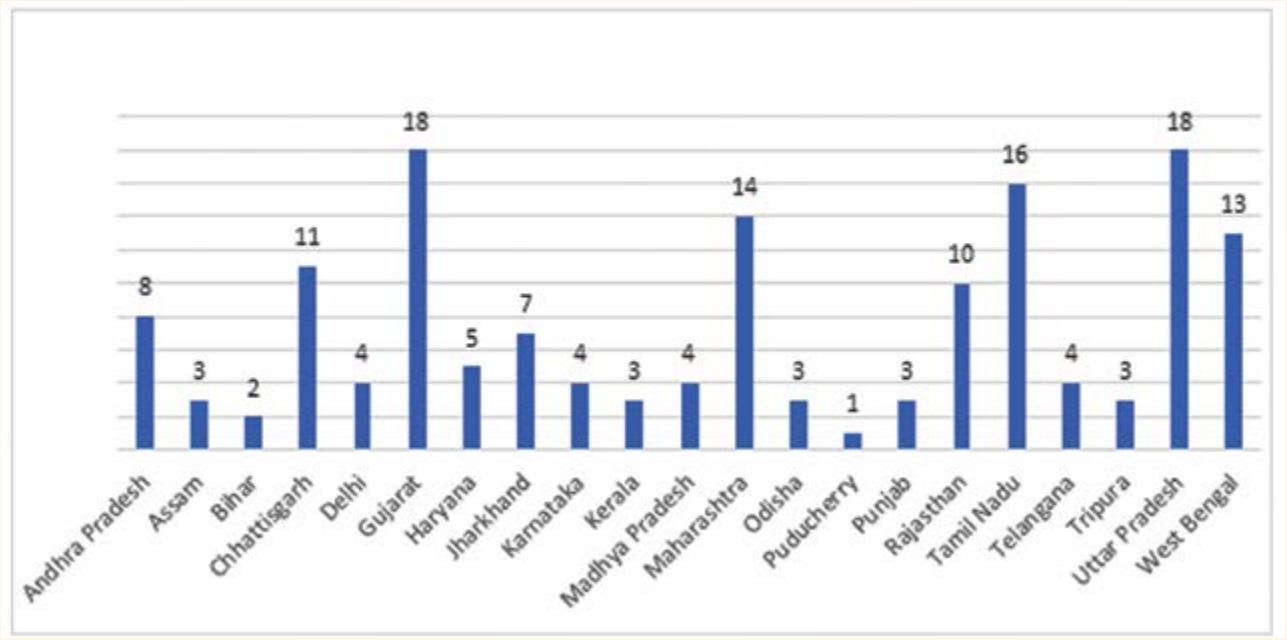


FIGURE 31: DISTRIBUTION Of DC- STATE WISE IN THERMAL POWER SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
TPP	154	3.13	118	3.519	12.43%

TABLE 17: SAVINGS IN POWER SECTOR

The total investment reported by 91 DCs on energy efficiency projects, is INR 2,821 crores.

Best practices, upgradation and low carbon technologies

1. Old, small and inefficient units closed/ replaced with supercritical units.
2. Renovation and modernization of old units.
3. Uprating small units with better design guarantee.
4. Use of imported coal.
5. Auxiliary Power Consumption (APC) optimization by use of efficient motors, Variable frequency drives (VFDs) , lightings, stage reduction in pumps, etc.
6. Utilization of low temperature waste heat from flue gas for generating chilled water, desalinating water

3.11. DISCOM

India has become the world's third largest power producer, rising on the back of steadily growing demand from infrastructure, oil & gas, as well as other fast-growing sectors of the Indian industry. The country's installed power generation capacity increased from 124 GW in 2006 to 364 GW in 2019.

While peak demand rate increased at 5%, the rate of capacity addition has been even higher. The latest draft National Electricity Plan, 2016, projects a peak demand of 235 GW by the end of 2021-22, and it can be safely presumed that the country's power sector is already prepared for the same.

Transmission of power has shown great growth numbers too, with a CAGR of 7.2% over the six-year period from FY 2012-18. India's transmission line capacity is now about 3.9 Lakh CKM (circuit km).

DISCOMs, or the power distribution sector, is the most important component of the electricity industry. The DISCOM sector makes electricity reach its end consumers, and brings in the revenue, but continues to be hampered by substantial losses.

There has been considerable progress in power demand, urbanization, rural electrification, and private sector participation, but transmission and distribution (T&D) losses remain high. T&D losses account for 20.68% of total electricity generated at utility end in the country, i.e., 193,750 MU (as on FY 2013-14). Loss minimization in power systems has hence assumed great significance.

In order to improve energy efficiency in the power system, State Electricity Distribution Companies have been included in PAT Cycle-II. DISCOMs having AT&C losses of 1,000 Million Unit (MU) (Equivalent to 86,000 million toe) and above are notified as Designated Consumers, and targets were assigned to 44 DISCOMs for reducing the T&D losses under PAT Cycle-II.

Coverage of DCs under PAT (till PAT cycle VI)

There are total 102 DISCOMs in India, of which 44 has been covered under the PAT scheme, as shown in figure 32. The other DISCOMs might be added in the future cycles of PAT.

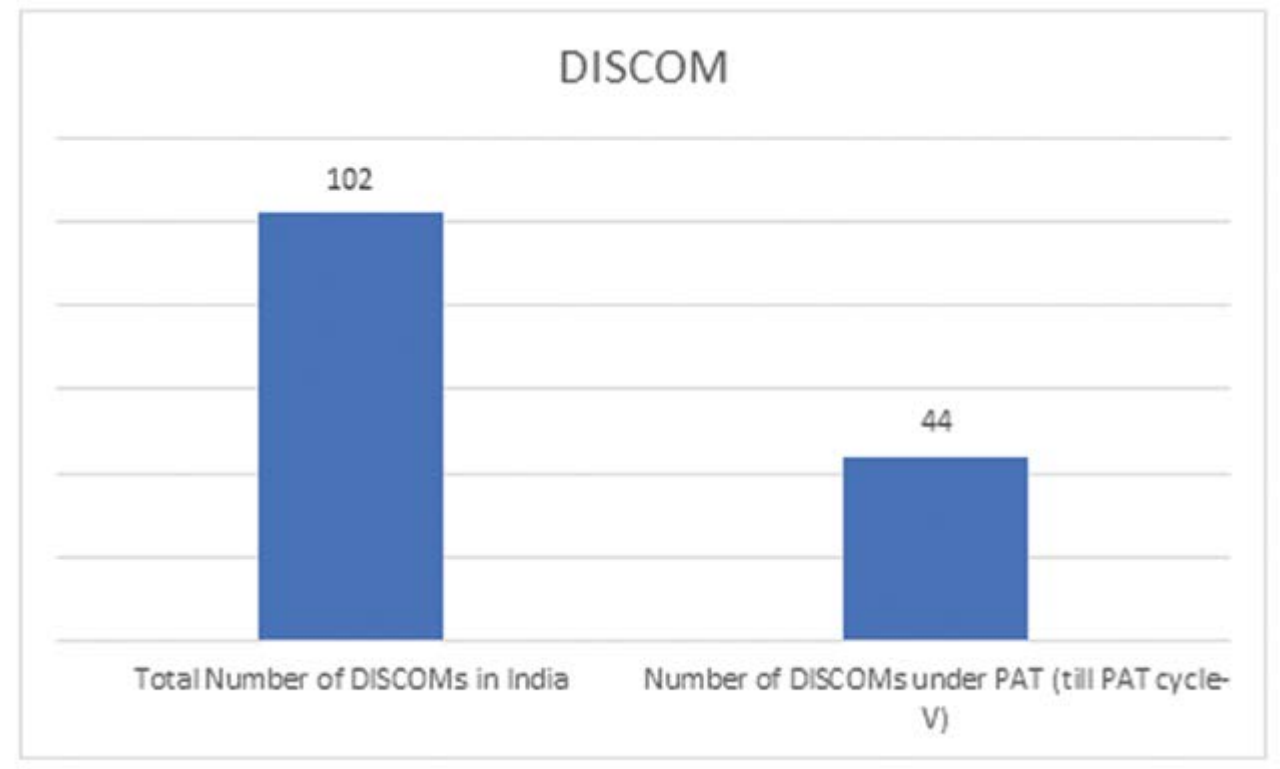


FIGURE 32 COVERAGE Of DISCOM SECTOR UNDER PAT SCHEME

State-wise categorisation of DCs (under PAT-II)

The state-wise distribution of units is as shown below:

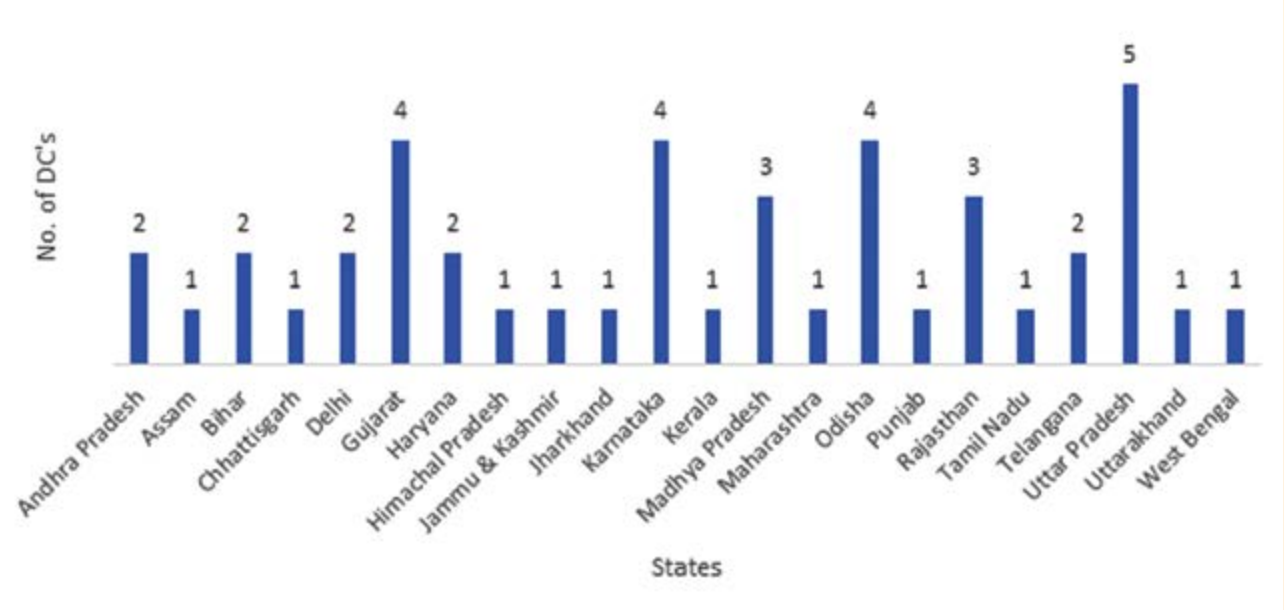


FIGURE 33: DISTRIBUTION Of DC-STATE WISE IN DISCOM SECTOR

Energy savings in the sector in terms of million toe

Sector	Notified DCs	Target (million toe)	No of units were assessment completed	Achieved (million toe)	% energy saving above the target
DISCOM	44	4.675*	36	2.077*	-55.52%

TABLE 20: SAVINGS IN DISCOMS

DISCOMs doesn't have a direct target in million toe. The reduction target for DISCOMs, if converted to Billion Units based on T&D loss in baseline, was around 54 BU. Similarly, the target for the DISCOMS whose M&V has been evaluated comes to be around 34.84 BU. Against this, the 36 DISCOMs has collectively saved 24.14 BU.

If we convert the T&D loss percentage of each DC to million units and ultimately in million toe, based on the input energy of 2014-15 (baseline year), it comes to 4.675 million toe. Similarly, the savings in 2018-19 (target year) has been calculated in terms of million toe and shown in the table above.

Table 20 shows that the DISCOM sector could not achieve its target by around 55%. However, it must be noted that out of 44 DC the analysis presented is for only 36. If we compare the target of these 36 DISCOMs w.r.t their savings, they have a shortfall of round 30%.

The total investment reported by 18 DCs on energy efficiency projects, is INR 21,374 crores.

Best practices & technology upgradation

1. Improvement in metering system.
2. System improvement & automation.
3. Demand Side Management (DSM) Activity.
4. Replacement of non-star rated transformers,
5. Eliminating chances of unaccounted energy by replacing faulty / sluggish consumer energy meters,
6. Integrated Power Development Scheme (IPDS) scheme,
7. Re-conducting (Under BRGF Scheme),
8. Improvement in power factor of 33KV feeders

BUREAU OF ENERGY EFFICIENCY (BEE)

(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R.K. Puram New Delhi -110 066 (INDIA)
Tel. +91 11 26766700, Fax No. : +91 11 26178328/52
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