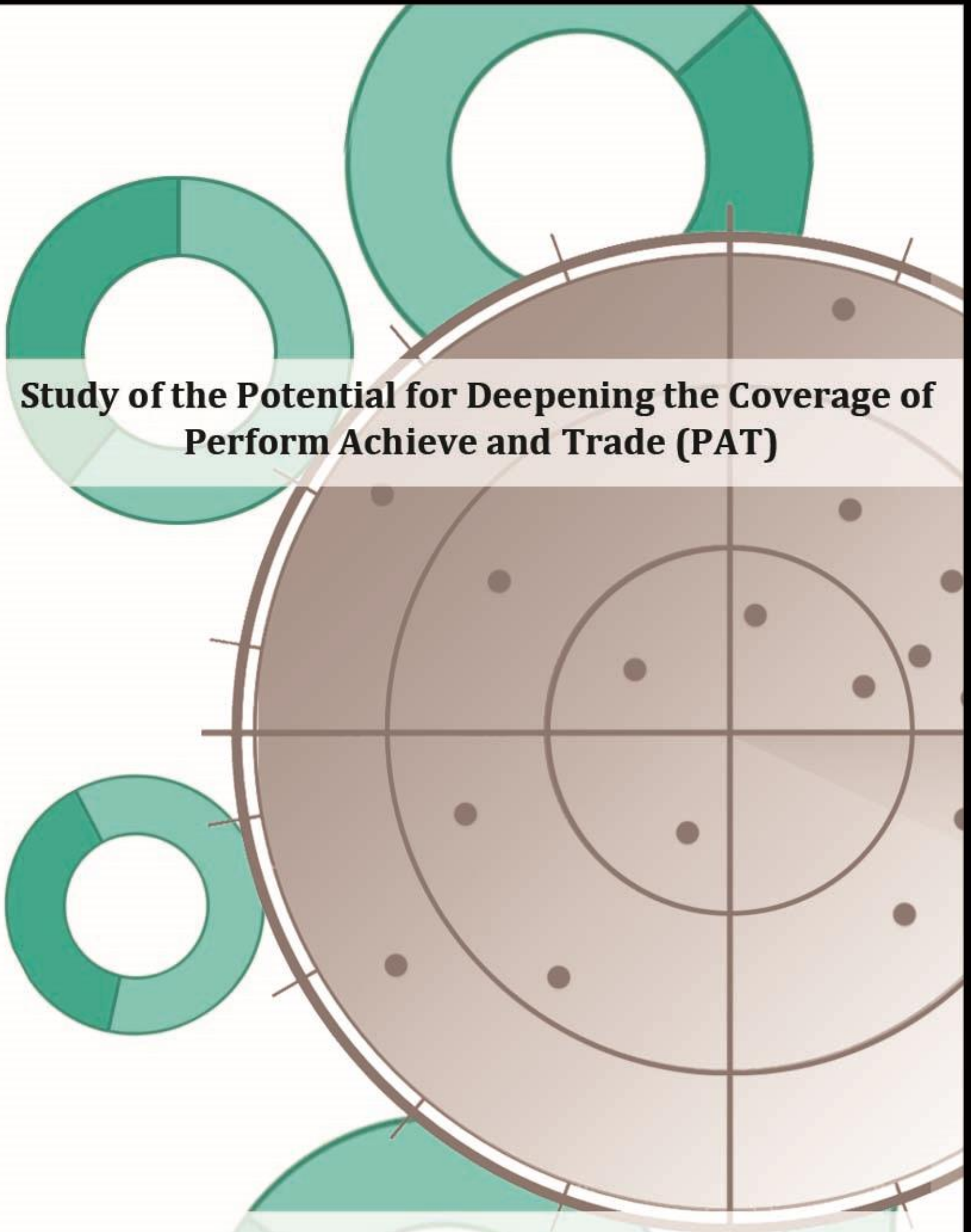
Study of the Potential for Deepening the Coverage of Perform Achieve and Trade (PAT)



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Study of the Potential for Deepening the Coverage of Perform Achieve and Trade (PAT)

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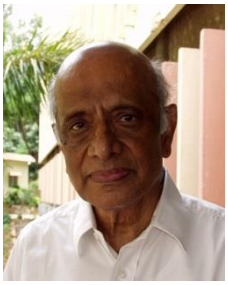

Preface

India is facing two major challenges, one in conflict with the other. Concerns on global warming and climate change implore the abandonment of fossil fuels for industries including power generation. On the other hand fossil fuels and specially coal are the chosen ones for power generation. India has plans to increase its generation manifold and it is impossible to completely abandon coal. Reduction in the generation of CO_2 should therefore come from all sectors, especially from industries that are one of the largest emitters of CO_2. The National Action Plan on Climate Change released by Honourable Prime Minister addresses this issue by advocating the use of efficient technologies. The Bureau of Energy Efficiency (BEE) has taken this forward with an imaginative scheme Perform Achieve and Trade, PAT for short. The plan is to initially choose 478 industrial units across eight energy intensive sectors and identify specific energy consumption norms for these units and encouraging them to achieve these. The next step would be to reward the efficient units by encouraging them to trade the energy units saved with laggards. This initiative would encourage the industrial units to become more efficient and competitive, and can create a national awareness in every industry big or small.

CSTEP has undertaken this study with support from Shakti Foundation and encouragement from the Bureau of Energy Efficiency with active cooperation from industrial units who readily parted with their performance data and often expressed their enthusiasm to processes with higher energy savings. I commend Dr. S.S. Krishnan and his colleagues at CSTEP for their active contributions to this project that have grown to other areas of industrial sectors as well. CSTEP is encouraged by the response and look forward to further pursuits in this area. Energy is too vital an asset to be wasted.

V.S. Arunachalam
Chairman, CSTEP
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ENERGY IS LIFE
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(भारत सरकार, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
CONSERVE IT (Government of India, Ministry of Power)

अजय माथुर, पीएच.डी
महानिदेशक
Ajay Mathur, Ph.D
Director General

Foreword

The Perform, Achieve and Trade (PAT) scheme is a flagship programme of National Mission for Enhanced Energy Efficiency (NMEEE) programme of Govt. of India. Currently, the first cycle of the scheme i.e. from 2012-13 to 2014-15, is being implemented in 8 industrial sectors covering 478 designated consumers all over the country. In the long course of identification, analysis and setting of the baselines of these designated consumers, lot of diversity was observed. The diversity is not only in terms of sectoral characteristics, but also in the levels of specific energy consumption within a sector. Some of the factors contributing to this diversity are the variations in their processes, product mix, material input, vintage etc. This Sectoral diversity is a strong indicator of the higher potential option of energy conservation and efficiency in the industrial sectors.

In view of the diversity of the sectors and the available higher potential options, there is an urgent need to further deepen the threshold limits of the existing industrial sectors under the PAT scheme. This is the time to strengthen and accelerate this process at a faster pace by covering a larger number of industrial units in these sectors under this umbrella which will further enhance both the reduction of energy intensity of the economy and its energy security.

This study of assessing the potential for deepening the coverage of PAT by introducing a larger number of industrial units within six out of the eight existing sectors will provide an understanding of the energy use and technology dynamics in the units that are as-yet outside the orbit of PAT. I congratulate CSTEP on this work, which has based on a wide consultations with the industrial segments and the industrial associations. I particularly compliment Dr. S. S. Krishnan and his team for their hard work, which has made this report possible.

(Ajay Mathur)

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The support and encouragement from Dr. V.S. Arunachalam, Chairman, and Dr. Anshu Bharadwaj, Executive Director of CSTEP is immensely appreciated. We are especially grateful to our advisors Dr Ramakrishnan N. and Dr. N. Balasubramanian for their valuable suggestions and inputs on a continuous basis, their diligent review and invaluable feedback. We thank Dr. K.C. Bellarmine, Chief Financial Officer, for guidance on project management and deliverables.

The financial support of Shakti Sustainable Energy Foundation during the course of this study is gratefully acknowledged.

Sincere thanks to the communication and policy engagement team led by Dr. Annapoorna Ravichander for their efforts towards quality dissemination.

Executive Summary

The objective of this study is to explore the possibility of deepening the scope of energy savings by introducing more industrial units into PAT from within the existing sectors. PAT is one of the initiatives of the National Mission on Enhanced Energy Efficiency (NMEEE), which in turn is one of the eight missions in the Prime Minister's National Action Plan on Climate Change (NAPCC). NMEEE aims to promote an increased use of energy efficiency, environment friendly and sustainable technologies. 478 industrial units across 8 energy intensive sectors (*Thermal Power Plant, Cement, Iron and Steel, Pulp and Paper, Chlor-Alkali, Aluminium, Textile and Fertilizers*) were notified as Designated Consumers (DCs) in the first multi-cycle process of PAT. A reduction of about 6.686 million tons of oil equivalent (Mtoe) of energy consumption by the DCs by 2015 has been targeted and seems achievable. The methodology of arriving at targeted energy savings is through Specific Energy Consumption (SEC) norms, which were issued to the DCs after examining the energy consumption data. In addition, PAT has introduced a trading environment to incentivise the achievers and gently penalise the laggards. The report starts with an overview of the working mechanism of PAT, followed by the methodology used in creating a database and provides statistical analysis by sector. Some of the key challenges and barriers which the researchers have faced in constructing the data base during the course of the study have also been presented. The later chapters cover sectoral analysis of the potential energy savings from all industrial unit as well as the sectors. The data base generated could find usefulness in the forthcoming cycles of PAT as well.

The present study has reviewed 1357 additional units with estimated energy consumption of about 86 Mtoe from Cement, Fertilizer, Iron and Steel, Textile, Pulp and Paper and Chlor-Alkali sectors. Following the earlier norms, a 3% SEC reduction target is assumed for these new units for the purpose of energy savings calculations. Notably, about 600 new units have been identified in the textile sector and 567 in the Iron & Steel sector which are significant in terms of numbers as well as energy consumption. The energy savings estimated from the additional units identified in this study is about 2.585 Mtoe and a large chunk of it is from the Iron and Steel sector (1.523 Mtoe).

Energy savings from industries could probably be achieved by pursuing global best practices or by adopting best technologies. Each industrial unit has a potential to operate more efficiently and therefore be more competitive. The study, on the one hand, shows PAT deepening possibilities targeting energy savings in the industrial sector, and on the other hand, sends motivating signals to the individual units for improvement.

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1 Introduction

Energy conservation as per the specific energy consumption norms is one of the novel policies and the first of its kind introduced under the National Mission on Enhanced Energy Efficiency (NMEEE). NMEEE is one of the eight missions in the National Action Plan for Climate Change (NAPCC) and follows a strategic long-term goal in the context of climate change.

The Ministry of Power and Bureau of Energy Efficiency (BEE) are tasked to prepare and regulate the mission to enhance the energy efficiency across energy intensive sectors. Perform Achieve and Trade (PAT) is one of the four broad initiatives under NMEEE with an objective to accelerate cost effectiveness in energy efficiency among the energy intensive sectors through certification of energy savings which could be traded in a market based environment.

In March 2012, 478 energy intensive industrial units across eight industrial sectors were identified and notified as Designated Consumers (DCs) and given targeted reduction in specific energy consumption within three year time frame. The total energy consumption of DCs in the first PAT cycle is about 165 Million tonne of oil equivalent (Mtoe). By end of the first PAT cycle (2014-15) a saving of 6.686 Million ton of oil equivalent needs to be achieved (1) (2).

India's total energy consumption during 2009 was 449.27 Mtoe where the residential and industrial sectors consumed energy about 38 and 30% respectively (3). Figure 1 shows the total energy consumption by these sectors. A similar review on Greenhouse Gas (GHG) emissions from various sectors indicated Indian overall sectoral emission was about 1904.73 $MtCO_2$, amongst which 38% (719.31 $MtCO_2$) and 22% (412.55 $MtCO_2$) were from electricity generation and industry sector respectively (4).

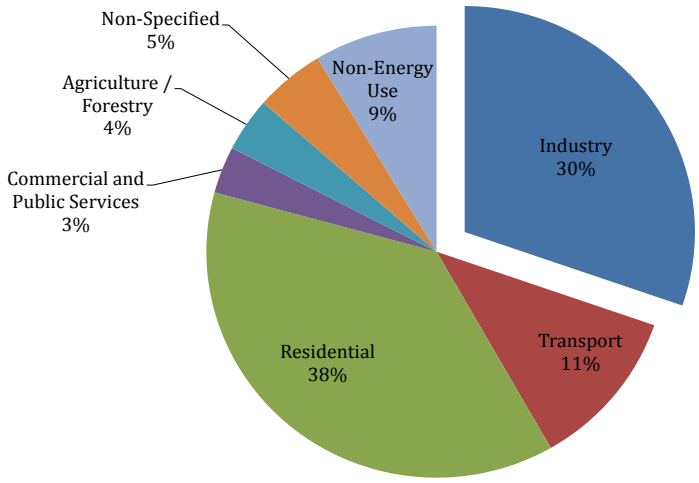


Figure 1: Total Energy Consumption in 2009 (449.27Mtoe)

1.1 PAT Mechanism

PAT is a market-based mechanism focussed on incentivises improvements in energy efficiency in energy intensive large industries. Energy Saving Certificates (ESCs) are given to DCs who are able to reduce their Specific Energy Consumption (SEC) beyond the specified target. The

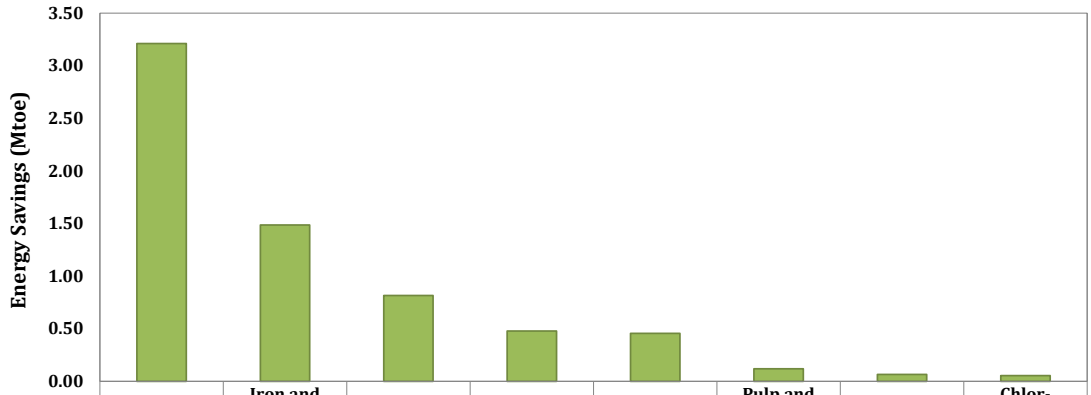
mechanism is being implemented in compliance with the Energy Conservation Act 2001, situational analyses of DCs and consideration of the national energy saving goals.

ESCs earned by one DC can be traded on platforms with other DCs. DCs who find it difficult to comply with the whole or a part of their targets can purchase these ESCs. The PAT methodology involves setting up a baseline SEC for a DC, and provides a norm or target for reducing it over a three year time period. It also includes processes for data collection, data verification, and verification of SEC for each of the DC in the baseline year and target year. In the target year ESCs will be issued to eligible DCs. Figure 2 shows the sectors and number of DCs which are currently in the first PAT cycle and this was notified on March 30, 2012. The sectors consumed about 165 Mtoe of energy in the first PAT Cycle (1). The illustration provides the holistic comparison by sector, Iron & Steel, Cement and Aluminum sectors are the largest consumers of energy after Thermal Power Plants (TPP). The energy intensity for TPP are estimated as net heat rate, varies from 1774 kcal/kWh to 5134 kcal/kWh for these 144 designated consumers.

- ***Designated Consumers (DCs)***

The criteria for each industrial unit to be identified as energy intensive units or designated consumers are indicated in Figure 2 based on minimum annual energy consumption. The number of units is not limited, but it would be beneficial to include more units in the future cycles and such new units would be able to improve their competitiveness through the enabling framework of PAT.

Based on the above threshold limit criteria (MAEC –Minimum Annual Energy Consumption criteria), about 478 industrial units were notified as DC's. An estimated cumulative energy savings of 6.686 Mtoe was estimated for these 478 DCs. The methodology of assigning unit specific target under each sector is discussed in the PAT consultation document released by BEE (5). Figure 2 illustrates the energy savings expected to be achieved from each sector and the baseline SEC of each sector (which is the key parametric assumption used in this study).



	TPP	Iron and Steel	Cement	Fertilizer	Aluminium	Pulp and Paper	Textile	Chlor-Alkali
Savings (Mtoe)	3.211	1.486	0.816	0.478	0.456	0.119	0.066	0.054
BL-SEC (toe/t)		0.549	0.088	0.394	2.005	0.656	0.166	0.393
Numbers of DCs	144	67	85	29	10	31	90	22
MAEC (toe)	30000	30000	30000	30000	7500	30000	3000	12000
Baseline Energy Consumption (Mtoe)	104.1	25.32	15.01	8.2	7.71	2.09	1.2	0.88

Figure 2: Summary of sectoral energy savings from first PAT Cycle (2)

1.2 Study Objective

The objective of this project is to study and deepen the scope of potential energy savings from energy intensive sectors already included in first cycle of PAT. In the first PAT cycle 478 DCs have been identified in the first multi-cycle process. This study has been proposed to create a database of new manufacturing unit under PAT which could add benefits. This study could subsequently support BEE in a similar objective of inclusion of new industrial units in the forthcoming cycles. The study also aims to provide extensive data and analysis on estimated energy savings from each sector with the addition of new industrial units. The key objectives are listed below:

- Mining specific industrial manufacturing units production information
- Studying and compiling a database
- Providing PAT focussed technical and policy analysis
- Assessing energy savings potential

We find this study to be a beneficial exercise/process to encourage both:

- Manufacturing units which could be included under the criteria of PAT rules, and were not included in the first PAT cycle
- If the criteria is reduced to lower limits, more industrial units could take part in the PAT mechanism and avail the benefits from PAT

We anticipate that the result and estimated savings could serve BEE in planning the next PAT cycle.

1.3 Data Mining and Analysis

The study examined the industry specific energy related information from annual reports, ministerial reports, press documents and news articles. Simultaneously, study gathered contact details of personnel from industrial associations and industries. The key activities mentioned below were followed:

- **Developed a questionnaire:** A spread sheet form, capturing most of the production, energy consumption and related information was designed and verified internally. It was also ensured that the questionnaire enabled to capture information that BEE would find useful, such as fuel types, quantity and more. (Refer to Appendix-I).
- **Interaction with stakeholders:** Interactions through meetings and workshops, conferences with industrial sectors members provided information relevant to the study.
- **Accessing online databases:** Identified a list of online database/repositories required for purchase (6).
- **Collation and Validations:** The collected data was collated and organised in a specific spread sheet. The numbers were verified from annual reports, newsletters and other recent published articles.
- **Analysis:** Once the verified data sets were created, PAT perspective analyses were performed applying some of the critical assumptions.

- ***Assumptions***

Following are assumptions taken for this study in order to estimate the energy savings.

- It is observed that about 2.25%, i.e., average of the minimum target SECs in the first PAT Cycle (2). The assumption is based on the review of minimum, average and maximum target SEC's in the first PAT Cycle. Although the target reduction for industrial sectors is between 4-5%, a 3% SEC reduction target is assumed for this study. The savings could easily be re-evaluated for different reduction target percentages.
- The SEC for new plants is assumed to be same as the average sectoral SEC in the first PAT Cycle. This is one of the critical assumptions taken due to lack of energy data from the survey and databases. The benefit of this particular assumption yield in estimating the energy consumption and energy savings from each industrial unit.
- For the new units with only production and capacity information, the numbers were verified from the company websites or recent web news in order to validate the numbers. In this case we assumed the production of the units as 80% of the capacity.
- The new plants identified were segregated by lower bands of minimum energy consumption to estimate the potential units falling in the new criteria. (Ex: If 30000toe is the minimum threshold energy consumption, for scenario purposes the limit is lowered to 25000, 20000, 15000, 10000 and 5000). The objective of this particular assumption was to identify the potential new manufacturing units which could be included in the future cycle depending on the lower threshold limit

- ***Barriers***

Data acquisition and compilation were the key activities in this study. There were several challenges and barriers faced, some of them are:

- Only prominent industrial units or company had websites providing brief information on industrial activity
- In a few cases database was expensive to purchase with no guarantee of accuracy
- Energy and plant performance data were not sufficient
- Industrial reports and web pages were not updated during the survey
- Responses from stakeholders were not up to the expectations
- Responses on questionnaires sent to various industrial units and associations contained incomplete information
- Identifying the specific personnel for each association, industry who could support the study was the most difficult process
- Unavailability and delayed responses from personnel over phone/emails

Energy Questionnaire and SEC Calculator

A detailed industry specific questionnaire was developed to circulate among the industries and associations. The questionnaire is a spread sheet calculator or tool designed to assess the energy intensity of large industrial units. The tool is a single page questionnaire which extracts some of the key information such as production, energy consumptions by fuel types, and characteristics of fuel (Gross Calorific value, Density).

Basic Sheet

- Section [A] Inputs on production information in tonnes
- Section [B] Electrical energy consumption and generation by sources

- Section [C] Raw fuel consumption by types such as coal, lignite, gaseous fuels and fuel properties

Calculator Sheet

- Section [D] Calculation of total energy consumption by fuel types used for process heating and electricity generation

Section [E] and [F], the tool calculates the total energy consumption and SEC by taking the given inputs in the Basic Sheet.

This questionnaire was designed to suit policy makers, auditors in the estimation of plants SEC. This tool could be developed with more parameters in order to enhance the calculations incorporating any normalisation factors. Appendix I includes the detailed questionnaire.

Note:

- *The names, contact details of the identified industrial units have been treated confidential and is alternatively provided as 'Plant code'. The information could be shared up on request*
- *Location of industrial units has been limited to 'state' known city or district capital.*
- *The accuracy of the numbers presented in this report, are directly resulted values evolved from calculations.*
- *The bar graphs in the impact assessment sections under each sector, Yi-axis is for the Blue bar and Y2 axis is for the Red Bars.*

2 Cement Sector

Cement is one of the materials produced in large quantities and is manufactured by an energy intensive process. The sector largely produces clinker and cement products. According to the Cement Manufacturing Association (CMA), the industry is sustaining an annual growth of 8% over the last two decades (7). In order to meet the growing demand, most of the major and large scale units have set up captive power plants. Apart from these plants, kiln waste heat recovery for co-generationis are also employed. Nowdays, renewable energy has also become a driving force and a great opportunity to reduce and conserve natural resouces such as coal and lignite (8).

2.1 Cement Sector in PAT Cycle – I

In the first PAT cycle, about 85 units were notified as DCs consuming more than the minimum threshold limit of 30000 tonnes of oil equivalent (toe) as defined for cement sectors. Cement sectors have been categorised on the basis of their product as well as process into seven subsectors i.e. Portland Pozzolana Cement (PPC), Ordinary Portland Cement (OPC), Portland Slag Cement (PSC), Wet Plants, White Plants, Grinding Plants and Clinkerisation Plants. By the end of the first PAT cycle, the energy savings of 0.816 Mtoe is expected achieve around 12% of the total energy saving targets assessed under PAT.

2.2 Additional Units Location and Energy Estimates

There were 57 new cement plants identified in this study. The total energy consumption of 57 new units sums to 3.30 Mtoe. If a target SEC norm of 3% is applied (i.e. reduction in the SEC to 0.085 toe/t), the targeted energy savings is expected to touch 0.10 Mtoe, which is 12% of the energy savings from the cement sector in PAT-I. This could be a significant indicator where some of the major units could be included in the forthcoming PAT Cycle. Figure 3 shows the number of newly identified cement plants, under this study, located across states.

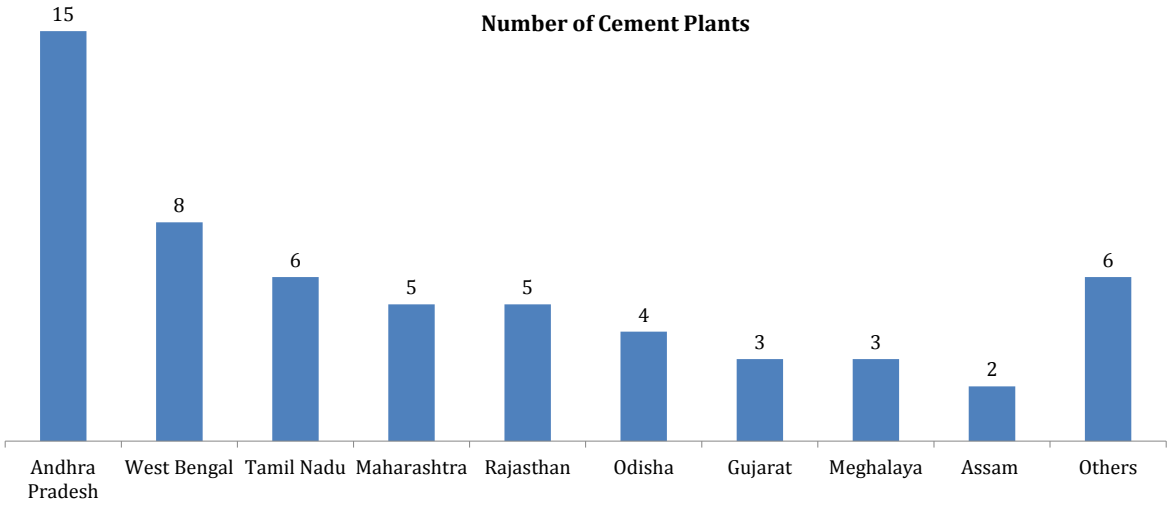


Figure 3: Location of potential cement plants across the country

2.3 Summary Analysis from PAT Perspective

Table 1 provides a comparative summary of additional units with PAT-I. The summary illustrates that the additional units add further 20% energy consumption to the sector, if each units operated at 80% capacity utilization factor. The average energy intensity of the new

cement units is assumed to be similar to cement sectoral energy intensity in PAT Cycle-I, which is 0.087 for cement sector.

Table 1: Estimated specific energy consumption in comparison with PAT Cycle -I units

Summary	No. of Plants	Total production (Mt)	Total Energy Consumption (Mtoe)	BL SEC Estimates (toe/t)
PAT Cycle-I	85	193.7	17.02	0.0878
New Plants*	57	37.6*	3.30*	0.0878**
Total	**142**	**231.6**	**20.32**	**0.0878**
**Estimated ** Assumption*				

As a scenario, about 3% SEC reduction is applied to the 57 units. The resulting estimates shows energy savings to be about 0.10 Mtoe, which is about 12% of the savings of cement sector in the first PAT Cycle. Figure 4 shows the overall comparison of energy consumption, savings in PAT Cycle-1 from the identified cement units.

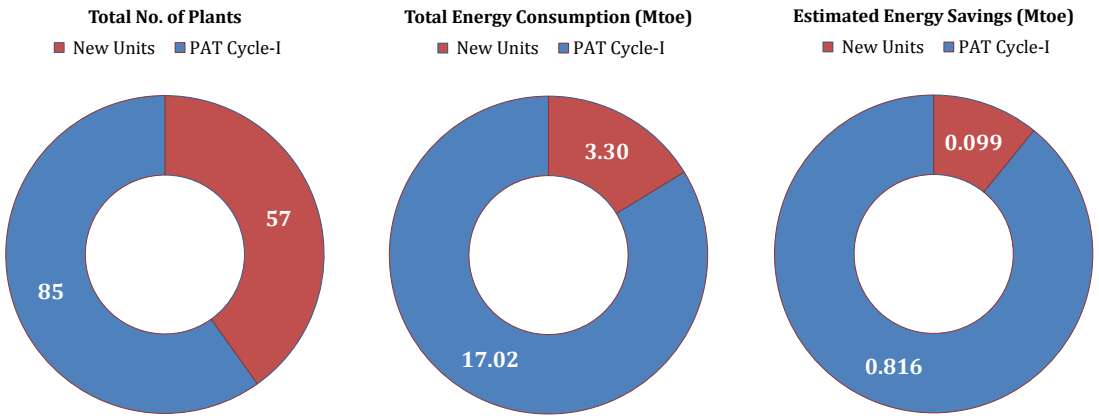


Figure 4: Energy consumption and savings from additional units in comparison with PAT-I

2.4 Impact of Variation of Minimum Annual Energy Consumption Norms

As per the BEE PAT rules and guidelines, the minimum threshold energy consumption for cement sector is 30000 Mtoe. However, BEE has identified 85 units in this sector, if the threshold energy limit is brought down to 25000. 20000. 15000 and 10000 Mtoe, the additional units qualified are analysed from Table 2 to Table 7.

- ***Energy Savings Potential***

In addition to the above, around 24 cement units which were unidentified, consumed more than 30000 Mtoe and could bring an estimated savings of 89536 toe if 3% SEC reduction is implicated. There are significant numbers of units under the lower energy consumption criteria range. Though the energy consumption and savings are relatively small, within the small scale industries, the consumptions and savings could be collectively large. Figure 4 illustrates the potential energy savings from additional industrial units captured under a range of energy consumptions.

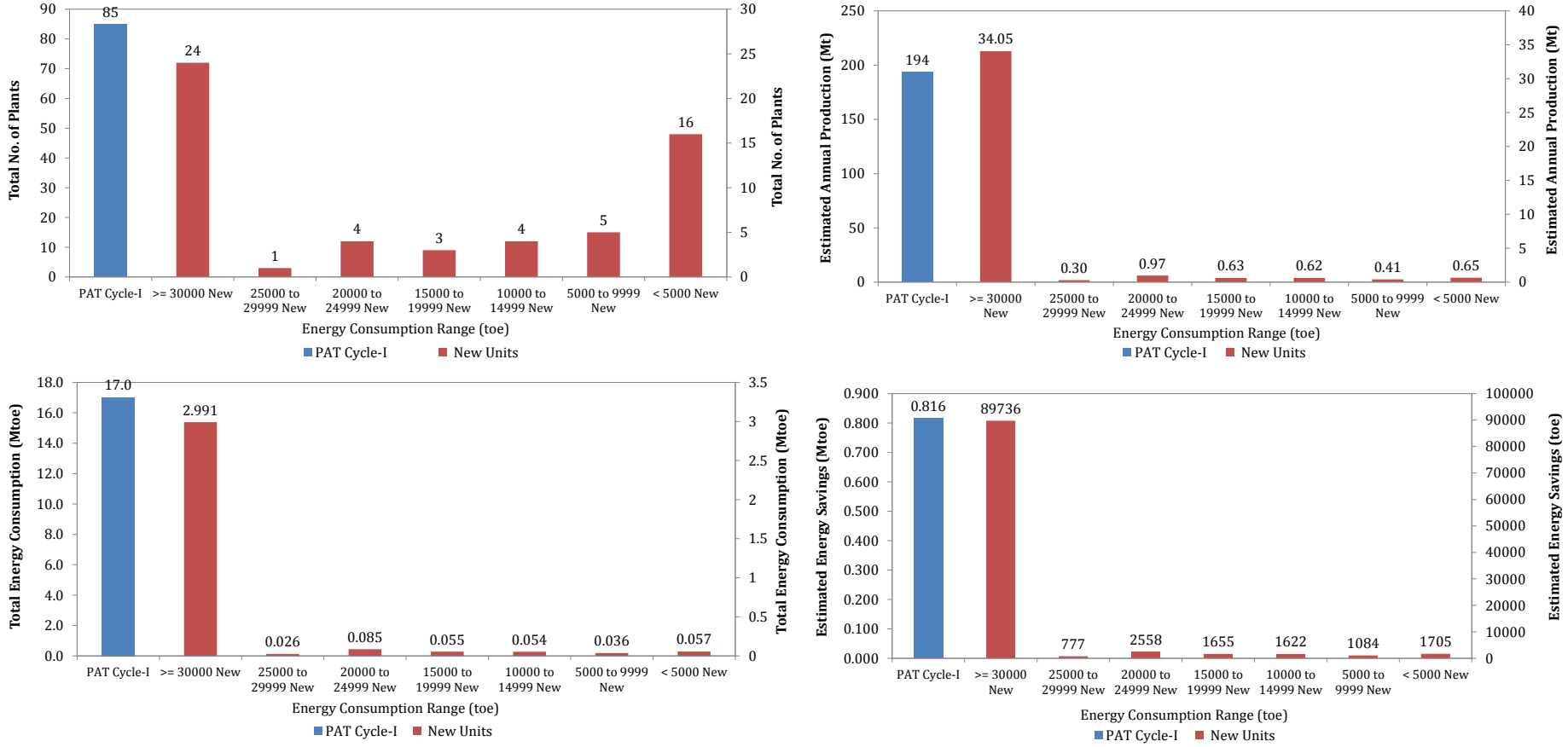


Figure 5: Parametric assessment of plants based on minimum energy consumption range

- ***Energy Consumption >=30000 toe***

Identified cement plants with energy consumption greater than 30000 toe are given in Table 2 and 24 plants have total energy consumption of 2.9 Mtoe and the energy saving potential is 89736 toe.

Table 2: Plants with Energy Consumption >~30000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN1	West Bengal	7701760	676550	20297
CN2	Delhi	3118400	273932	8218
CN3	Maharashtra	2400000	210825	6325
CN4	Andhra Pradesh	2320000	203797	6114
CN5	Punjab	2157200	189496	5685
CN6	Rajasthan	1949110	171217	5137
CN7	Andhra Pradesh	1557600	136825	4105
CN8	Maharashtra	1200000	105412	3162
CN9	Tamil Nadu	1200000	105412	3162
CN10	Gujarat	1200800	105483	3164
CN11	Andhra Pradesh	1040000	91357	2741
CN12	Andhra Pradesh	928000	81519	2446
CN13	Tamil Nadu	896000	78708	2361
CN14	Orissa	788780	69289	2079
CN15	West Bengal	800000	70275	2108
CN16	Tamil Nadu	724740	63664	1910
CN17	Rajasthan	720000	63247	1897
CN18	Rajasthan	684000	60085	1803
CN19	West Bengal	496000	36894	1107
CN20	Kerala	475200	43570	1307
CN21	Meghalaya	475200	41743	1252
CN22	Andhra Pradesh	420000	41743	1252
CN23	Andhra Pradesh	401070	35231	1057
CN24	Andhra Pradesh	397600	34853	1048
24		**34051460**	**2991130**	**89736**

- ***Energy Consumption 25000 to 29999 toe***

Plants with energy consumption range in the range 25000 to 29999 are given in Table 3 and only one plant has total energy consumption of 25956 toe. The energy saving potential is 777 toe.

Table 3: Plants with energy consumption in the range 25000 to 29999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN25	Andhra Pradesh	295480	25956	777
1		**295480**	**25956**	**777**

- ***Energy Consumption 20000 to 24999 toe***

Plants with energy consumption in the range 20000 to 24999 is given in Table 4 and 4 plants have a total energy consumption of 85260 toe .The energy saving potential is 2558 toe.

Table 4: Plants with Energy Consumption in the range 20000 to 24999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN26	Andhra Pradesh	252990	22224	666
CN27	West Bengal	240000	21082	632
CN28	Andhra Pradesh	240000	21082	632
CN29	Meghalaya	237600	20872	626
4		**970590**	**85260**	**2558**

- ***Energy Consumption 15000 to 19999 toe***

Cement plants with energy consumption in the range 15000 to 19999 and is given in Table 5. Here in this range 3 plants with combined energy consumption of 55150 toe could bring potential energy saving of 1653 toe.

Table 5: Plants with Energy Consumption in the range 15000 to 19999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN30	West Bengal	224400	19712	591
CN31	Andhra Pradesh	205420	18045	541
CN32	Assam	198000	17393	521
3		**627820**	**55150**	**1653**

- ***Energy Consumption 10000 to 14999 toe***

Plants with energy consumption in the range 10000 to 14999 are given in Table 6 and 4 plants have a total energy consumption of 54058 toe. The energy saving potential is 1622 toe.

Table 6: Plants with Energy Consumption in the range 10000 to 14999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN33	Meghalaya	165000	14494	435
CN34	Bihar	160000	14055	422
CN35	Orissa	158400	13914	417
CN36	West Bengal	132000	11595	348
4		**615400**	**54058**	**1622**

- ***Energy Consumption 5000 to 9999 toe***

Plants with energy consumption in the range 5000 to 9999 are given in Table 7 and 5 plants have a total energy consumption of 36120 toe. The energy saving potential is 1084 toe.

Table 7: Plants with Energy Consumption in the range 5000 to 9999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN37	Orissa	107990	9486	285
CN38	Karnataka	84000	7379	221
CN39	Andhra Pradesh	79200	6957	209
CN40	Andhra Pradesh	72000	6325	190
CN41	West Bengal	68000	5973	179
5		**411190**	**36120**	**1084**

- ***Energy Consumption< 5000 toe***

Plants with energy consumption less than 5000 are given in Table 8 and 16 plants have a total energy consumption of 56838 toe. The energy saving potential is 1705 toe.

Table 8: Plants with Energy Consumption <=5000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN42	Tamil Nadu	55500	4875	146
CN43	Tamil Nadu	52800	4638	139
CN44	Rajasthan	52800	4638	139
CN45	Andhra Pradesh	52800	4638	139
CN46	Maharashtra	52800	4638	139
CN47	Orissa	50400	4427	133
CN48	Maharashtra	48000	4216	126
CN49	Gujarat	48000	4216	126
CN50	Gujarat	48000	4216	126

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CN51	Andhra Pradesh	36000	3162	95
CN52	Assam	31200	2735	82
CN53	Tamil Nadu	26400	2319	70
CN54	West Bengal	26400	2319	70
CN55	Maharashtra	26400	2319	70
CN56	Rajasthan	26400	2319	70
CN57	Uttaranchal	13200	1160	35
16		**647100**	**56838**	**1705**

The estimated savings are significantly less due to small scale plants with limited production and relatively less energy consumption. If industrial energy efficiency gets its focus at a micro level, the saving from such small scale plants will collectively yield a greater impact. From this analysis, 24 additional plants can be value addition in the PAT mechanism with the addition of 3 Mtoe of energy to the cumulative sectoral energy consumption.

3 Chlor-Alkali Sector

Chlor-Alkali sector consist of manufacturers largely producing inorganic chemicals such as caustic soda (NaOH), chlorine (Cl_2) and soda ash (Na_2CO_3). The Indian Chlor-alkali industry is driven by the demand for caustic soda. Chlorine is considered a by-product (2).

3.1 Chlor-Alkali sector in PAT Cycle I

In PAT Cycle-1, Chlor-Alkali sector had a criterion of a minimum annual threshold limit of 12000 toe, and about 22 manufacturing units were notified as designated consumers. About 0.054 million toe of energy saving target is expected from the 22 plants collectively, which is about 1% of total energy saving in the First PAT Cycle.

3.2 Additional Units Location and Energy Estimates

The study has identified 7 additional plants, three of which are located in Chennai, Tamil Nadu. Figure 6 below illustrates the location of plants geographically. However, most of the units in this sector have already been captured, the estimated energy consumption from these 7 units collectively amounts to 0.271million ton of oil equivalent energy, which is 30% of the total energy consumption units in PAT Cycle-I of Chlor-Alkali sector.

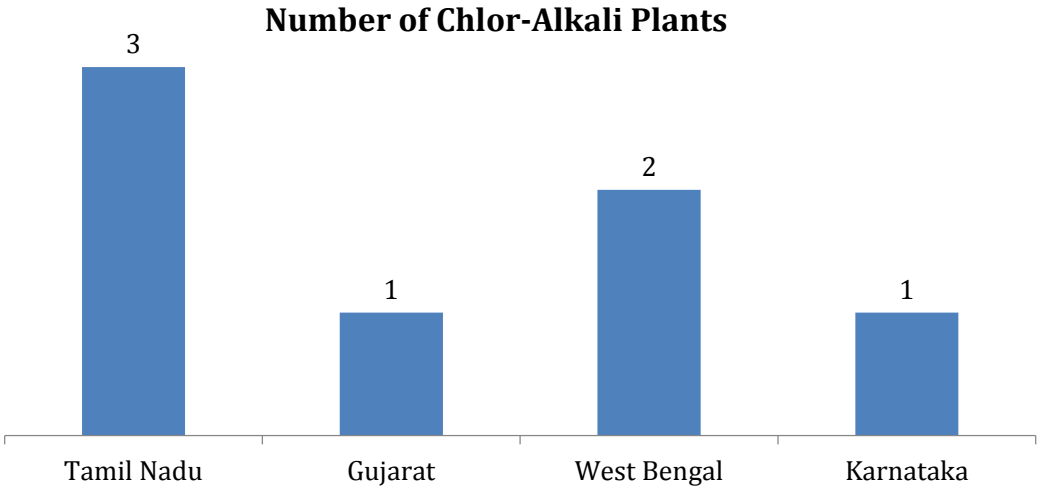


Figure 6: Location of potential Chlor-Alkali plants across states

3.3 Summary Analysis from PAT Perspective

Table 9 provides a brief summary of additional plants in PAT Cycle-I. The summary illustrates that there are 30% energy consumption from seven new units to be part of unlocking energy efficiency mechanism. The average SEC of the seven new units is estimated to 0.3931 toe/t. From the summary, four plants out of the seven could add value to the sector within the existing criteria. Further, three plants with lower capacity and energy consumption appears to be small scale industries.

Table 9 Summary and comparison of SEC estimates

Summary	No. of Plants	Production (Mt)	Energy Consumption (Mtoe)	SEC Estimates (toe/t)
PAT Cycle-I	22	2.25	0.885	0.393
New Plants	7	0.69*	0.272*	0.393**
Total	**29**	**2.94**	**1.157**	**0.393**
**Estimated **Assumption*				

For this study, the average SEC of seven Chlor-Alkali units is assumed to be 0.393 toe/t which is same as the sector's average in PAT-I. A 3% targeted SEC reduction is applied to these identified units resulting in an estimated energy savings of 8156 toe , which is 15% of the sector energy savings compared to PAT-I. Figure 7 provides the overall comparison of energy consumption, savings from number of units in First PAT Cycle and additional units.

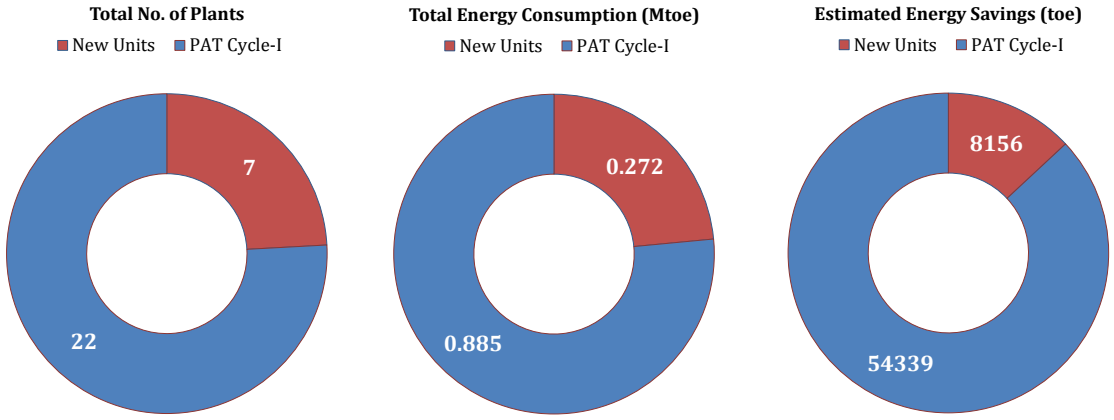


Figure 7: Energy consumption and savings from additional units in comparison with PAT-I

3.4 Impact of Variation of Minimum Annual Energy Consumption Norms

The minimum threshold energy consumption criteria for Chlor Alkali sector is 12000 and above. However, BEE has identified 22 units in this sector. If the threshold energy limit criterion is lowered the PAT mechanism will have the ability to draw more units for the next cycles. The impact of inclusion of additional units could bring larger energy savings. The section below discusses the impact on energy savings from the additional units. Table 10 to Table 12 show the plant-wise energy saving under lower energy consumption limits.

- ***Energy Savings Potential***

As articulated in the earlier section, PAT Cycle-I has captured most of the Chlor-Alkali units. About 4 units whose consumption is more than 12000 Mtoe could add benefits in the next cycle of PAT. The four units could add 7468 toe of energy savings. The total annual energy consumption from these four units is 248922 toe. The remaining three units fall under lower energy consumption range; hence a further deepening in this sector could not contribute in larger energy savings. . Substantial energy savings can be achieved by taking program to the plants with lower levels of energy consumption.

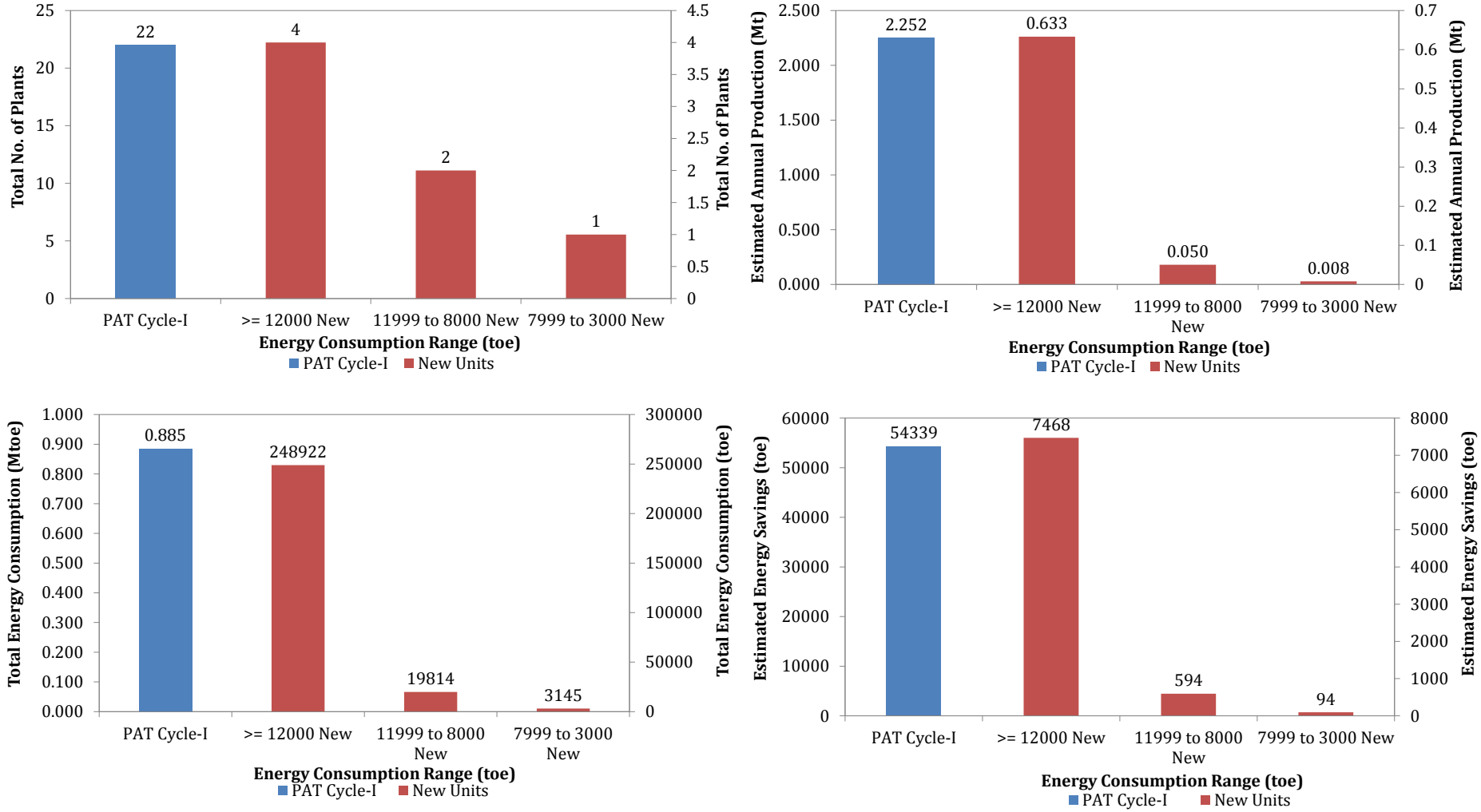


Figure 8: Parametric assessment of plants based on minimum energy consumption range

- ***Energy Consumption >=12000 toe***

Plants with an energy consumption of more than 12000 toe are given in Table 10. 4 plants have a total energy consumption of 0.24 Mtoe. The energy saving potential is 7468 toe.

Table 10: Plants with Energy Consumption >=12000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CAN1	Ahmedabad	520000	204434	6133
CAN2	Kolkata	42560	16732	502
CAN3	Chennai	40000	15726	472
CAN4	Karnataka	30600	12030	361
4		**633160**	**248922**	**7468**

- ***Energy Consumption 11999 to 8000 toe***

Plants with energy consumption in the range 11999 to 8000 toe are given in Table 10. There are only two with a total energy consumption of 19814toe. The energy saving potential is 594 toe.

Table 11: Plants with Energy Consumption in the range 11999 to 8000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Estimated Energy Savings (toe)
CAN5	Chennai	26400	10379	311
CAN6	Durgapur	24000	9435	283
2		**50400**	**19814**	**594**

- ***Energy Consumption 7999 to 3000 toe***

Plants with energy consumption in the range 7999 to 3000 toe are given in Table 12. There is only one unit having a total energy consumption of 3144 toe. The energy saving potential is 94.35 toe.

Table 12: Plants with Energy Consumption in the range 7999 to 3000 toe

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
CAN7	Chennai	8000	3144	94.35
1		**8000**	**3144**	**94.35**

4 Fertiliser Sector

Fertilisers play an important role in the yield of agricultural food grains. The Indian fertilizer sector is the third largest fertilizer producer in the world with a capacity of 120.41Mt of nitrogen and 56.19 Mt of phosphatic nutrients. There are 30 large scale plants *(29 are functioning, which are already identified in the PAT Cycle-I)* and more than 85 medium and small scale plants (9).

4.1 Fertiliser Sector in PAT Cycle 1

Total energy consumption of Fertilizer sector in PAT Cycle- 1 is about 7% accumulating from 29 units. By the end of the first multi-cycle process, an energy savings of 0.478 million toe/t is expected to yield by 2014-15.

4.2 Additional Units Location and Energy Estimates

The study identified 87 fertilizer producing units widely spread across states (more than 3 times the number of units in First PAT Cycle). About 16 units are located in the state of Rajasthan and more than 8 units are located in the states of Andhra, Maharashtra and Madhya Pradesh. Figure 9 illustrates the spread of identified fertilizer production units in India. The estimated energy consumption from the identified 87 units cumulates to 5.5 Mtoe, 67% of the sector's energy consumption in PAT Cycle-I.

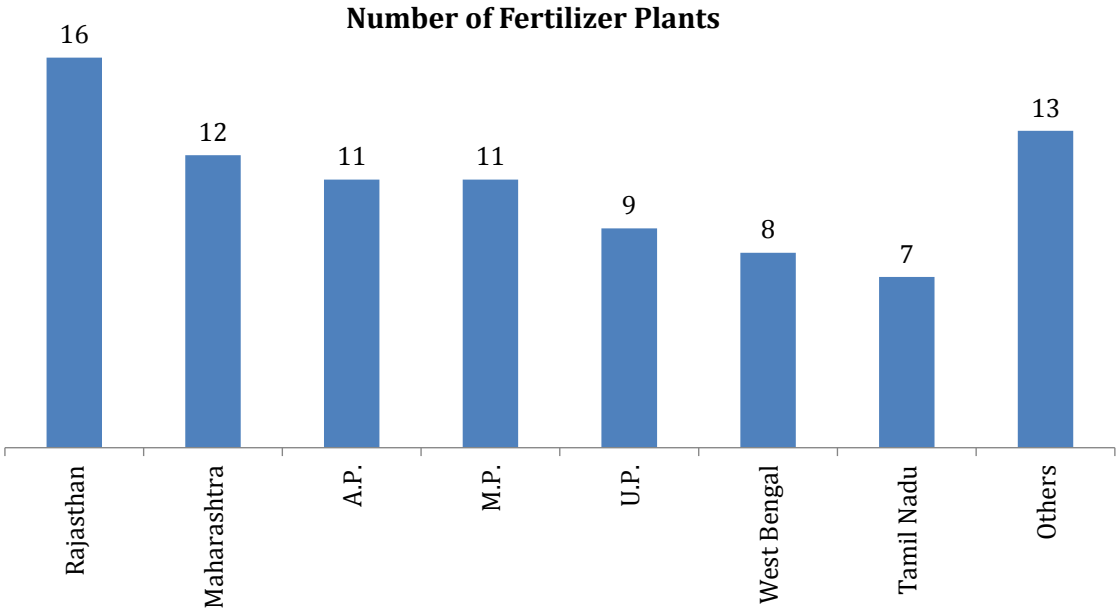


Figure 9: Numbers of identified fertilizer units across states

4.3 Summary Analysis from PAT Perspective

The SEC of each units in this sector is estimated as per the assumption discussed in the introduction chapter. About 87 fertilizer units have been identified in this study. The average SEC of these 87 units is assumed to be same as the first PAT cycle sectoral SEC which is about 0.349 toe/t. Table 13 below provides the comparative summary of additional plants in fertilizer industry with plants in PAT-I.

Table 13: Summary and comparison of SEC estimates

Summary	No. of Plants	Total production (Mt)	Total Energy Consumption (toe)	SEC Estimates (toe/t)
PAT Cycle-1	29	20.68	8149569	0.394
New Plants	87	13.96*	5501212*	**0.394
Total	116	34.64	13650781	0.394
**Estimated ** Assumption*				

Figure 10 provides an overall comparison of energy consumption and savings from identified units with reference to PAT Cycle-I. It is identified that about 3% additional energy savings could be visualized with 3% SEC reduction from 87 units 116 plants have total energy consumption is 13.65 Mtoe.

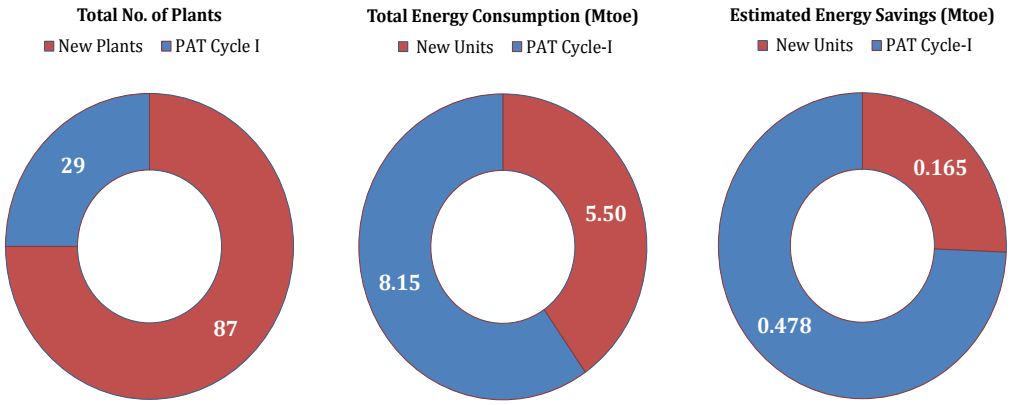


Figure 10: Estimated energy consumption and saving comparisons

4.4 Impact of Variation of Minimum Annual Energy Consumption Norms

In First PAT Cycle, 29 units which consume energy of more than 30000 Mtoe per year were notified as DC. If the threshold energy limit criteria is lowered to below (25000, 20000, 15000 and 10000), there could be a potential inclusion of more players in the PAT program and more energy savings could be envisaged. Table 14 to **Error! Reference source not found.** tabulates the impact of such move and magnitude of energy saving benefits from each plant.

- ***Energy Savings Potential***

About 42 fertilizer product based units which appears consuming more than 30000 toe are identified in this study. The collective energy consumption from these 42 units estimates to 4.732 Mtoe (58% of the sector's energy consumption in PAT Cycle-I) and correspondingly about 30% additional energy savings could be visualised from these 42 units with 3% reduction in SEC. Figure 11 provides the comparative assessment of energy consumption and savings with reference to units in PAT Cycle-I. It is also observed that in this sector, there are numerous small-scale units with lesser energy consumption. Savings from these units are significantly small in comparison to large industries. A micro level energy savings from such small-scale units could bring value among the cluster and enhance them towards best operating characteristics in the competitive environment.

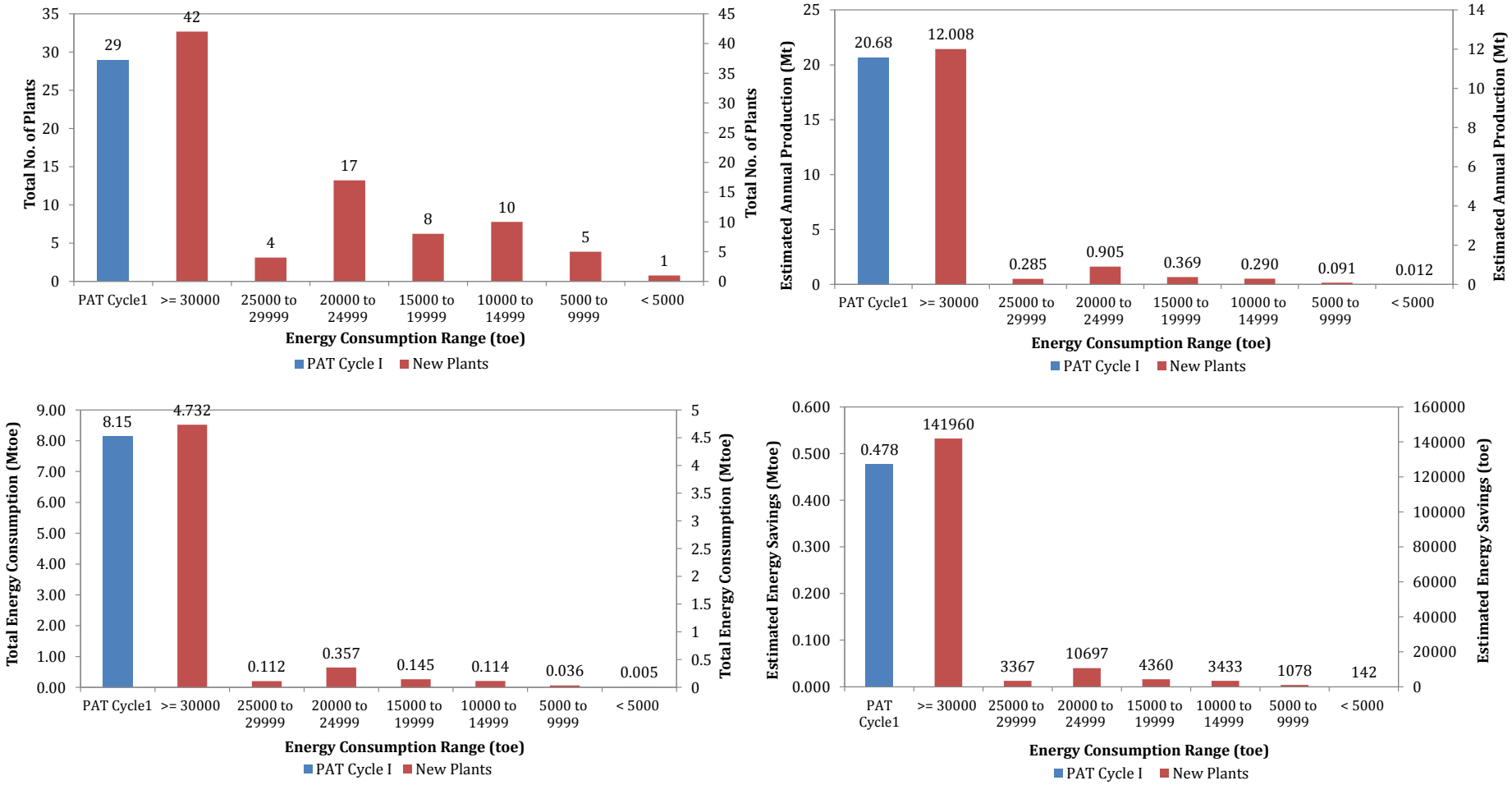


Figure 11: Parametric assessment of plants based on minimum energy consumption range

- ***Energy Consumption >=30000 toe***

Plants with an energy consumption of greater than 30000 toe are given in Table 14. The total number of plants is 42 with a total energy consumption of 4.7Mtoe. The energy saving potential is 0.142 Mtoe.

Table 14: Plants with Energy Consumption >= 30000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN1	Chennai	1468000	578492	17355
FN2	Kakinada	1088800	429062	12872
FN3	Shahjahanpur	1009600	397851	11936
FN4	Vishakhapatnam	953600	375784	11274
FN5	Kanpur	840000	331017	9931
FN6	Haldia	593600	233919	7018
FN7	Orissa	576000	226983	6810
FN8	Raigad	352000	138712	4161
FN9	Khargone	320000	126102	3783
FN10	Rourkela	288000	113492	3405
FN11	Talchar	264000	104034	3121
FN12	Ramagundam	264000	104034	3121
FN13	Ramagundam	264000	104034	3121
FN14	Namrup	264000	104034	3121
FN15	Udaipur	240000	94576	2837
FN16	Thane	232848	91758	2753
FN17	Raigad	204000	80390	2412
FN18	Udaipur	160000	63051	1892
FN19	Ambabari	158400	62420	1873
FN20	Namrup	152000	59898	1797
FN21	Durgapur	147200	58007	1740
FN22	Durgapur	138400	54539	1636
FN23	Jalpaiguri	132000	52017	1561
FN24	Pune	132000	52017	1561
FN25	Cuddalore	121600	47919	1438
FN26	Udaipur	116800	46027	1381
FN27	Wardha	108000	42559	1277
FN28	Udaipur	105600	41614	1248
FN29	Bhilwara	105600	41614	1248
FN30	Udaipur	105600	41614	1248
FN31	Ennore	105600	41614	1248
FN32	Gajraula	105600	41614	1248
FN33	Rampur	105600	41614	1248
FN34	Midnapore	105600	41614	1248

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN35	Tuticorin	104800	41298	1239
FN36	Hooghly	96000	37831	1135
FN37	Udaipur	80000	31525	946
FN38	Udaipur	80000	31525	946
FN39	Ahmedabad	80000	31525	946
FN40	Udaipur	80000	31525	946
FN41	Visakhapatnam	80000	31525	946
FN42	Udaipur	79200	31210	936
42		**12008048**	**4731991**	**141960**

- ***Energy Consumption 25000 to 29999 toe***

Plants with energy consumption in the range 25000 to 29999 toe are tabulated in Table 15. Four plants with energy consumption of 0.112 Mtoe appear within this criterion. The estimated energy saving potential from this group of plants is 3367 toe.

Table 15: Plants with energy consumption range in the range 25000 to 29999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN43	Kolkata	74400	29318	879
FN44	Medak	72000	28372	851
FN45	Nanded	72000	28372	851
FN46	Maharashtra	66400	26166	784
4		**284800**	**112231**	**3367**

- ***Energy Consumption 20000 to 24999 toe***

Plants with energy consumption in the range 20000 to 24999 toe are depicted in Table 16. About 17 plants with a total energy consumption of 0.356 Mtoe have been grouped in this range. The energy saving potential for this category is 0.0106 Mtoe.

Table 16: Plants with Energy Consumption in the range 20000 to 24999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN47	Neemuch	60000	23644	709
FN48	Gadchiroli	52800	20806	624
FN49	Bhilwara	52800	20806	624
FN50	Madhya Pradesh	52800	20806	624

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN51	Maharashtra	52800	20806	624
FN52	Udaipur	52800	20806	624
FN53	Amreli	52800	20806	624
FN54	Udaipur	52800	20806	624
FN55	Ennore	52800	20806	624
FN56	Uttar Pradesh	52800	20806	624
FN57	West Bengal	52800	20806	624
FN58	Bilaspur	52800	20806	624
FN59	Sagar	52800	20806.	624
FN60	Neemuch	52800	20806	624
FN61	West Godavari	52800	2080	624
FN62	West Godavari	52800	20806	624
FN63	Surendranagar	52800	20806	624
17		**904800**	**356553**	**10697**

- ***Energy Consumption 15000 to 19999 toe***

Plants with energy consumption in the range 15000 to 19999 toe are given in Table 17. Eight plants with a combined energy consumption of 0.145 Mtoe are grouped under this criteria with an estimated energy savings of 4359 toe.

Table 17: Plants with Energy consumption in the range 15000 to 19999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN64	Ranipet	48800	19230	576
FN65	Coimbatore	48000	18915	567
FN66	Gajraula	48000	18915	567
FN67	Jhabua	48000	18915	567
FN68	Koppal	48000	18915	567
FN69	Ujjain	48000	18915	567
FN70	Gauripatnam(A.P)	40000	15762	472
FN71	Nasik	40000	15762	472
8		**368800**	**145332**	**4359**

- ***Energy Consumption 10000 to 14999 toe***

Plants with energy consumption in the range 10000 to 14999 toe are listed in Table 18 and the number of plants is 10 with a total energy consumption of 0.114 Mtoe. The energy saving potential for this category is 3433 toe.

Table 18: Plants with Energy Consumption in the range 10000 to 14999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN72	Khargone	36000	14186	425
FN73	Madhya Pradesh	36000	14186	425
FN74	Visakhapatnam	29600	11664	349
FN75	Visakhapatnam	28800	11349	340
FN76	Jhansi	28000	11033	331
FN77	Sultanpur	26400	10403	312
FN78	Muzaffarbad	26400	10403	312
FN79	Junagarh	26400	10403	312
FN80	Dhar	26400	10403	312
FN81	Bhilwara	26400	10403	312
10		**290400**	**114437**	**3433**

- ***Energy Consumption 5000 to 9999 toe***

Plants with energy consumption in the range 5000 to 9999 toe are shown in Table 19. The number of plants is 5 with a total energy consumption of 35939 toe. The energy saving potential for this category is 1078 toe.

Table 19: Plants with Energy Consumption in the range 5000 to 9999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
FN82	Nanded	24000	9457	283
FN83	Jalna	20000	7881	236
FN84	Sagar	20000	7881	236
FN85	Udaipur	14400	5674	170
FN86	Chandigarh	12800	5044	151
5		**91200**	**35939**	**1078**

5 Textile Sector

The Indian textile industry is playing a pivotal role in enhancing the economy by contributing largely to production and employment. According to the Ministry of Textile the industry is growing at 14% in production and 4% GDP and 11% of the earnings from exports. There are four major categories observed to include spinning, weaving, processing and, garmenting. There are 1762 units of spinning mills, 196 of composite mills (10).

5.1 Textile Sector in PAT Cycle 1

The Indian Textile industry is classified into organised sector and the decentralised sector/rural sector. About 90 textile units have been identified in the first PAT cycle. The estimated energy savings of 0.066 Mtoe is expected from this sector, which is about 1% of total savings from eight sectors.

5.2 Additional Units Location and Energy estimates

The study has identified around 600 textile units, largely spread within the states of Tamil Nadu, Maharashtra, Gujarat and others. Largely about 143 units are located in Tamil Nadu, which is higher than any other states in India. The collective energy consumption of these identified plants estimates to about 24.6Mtoe. Figure 12 below shows the state-wise locations of identified textile units.

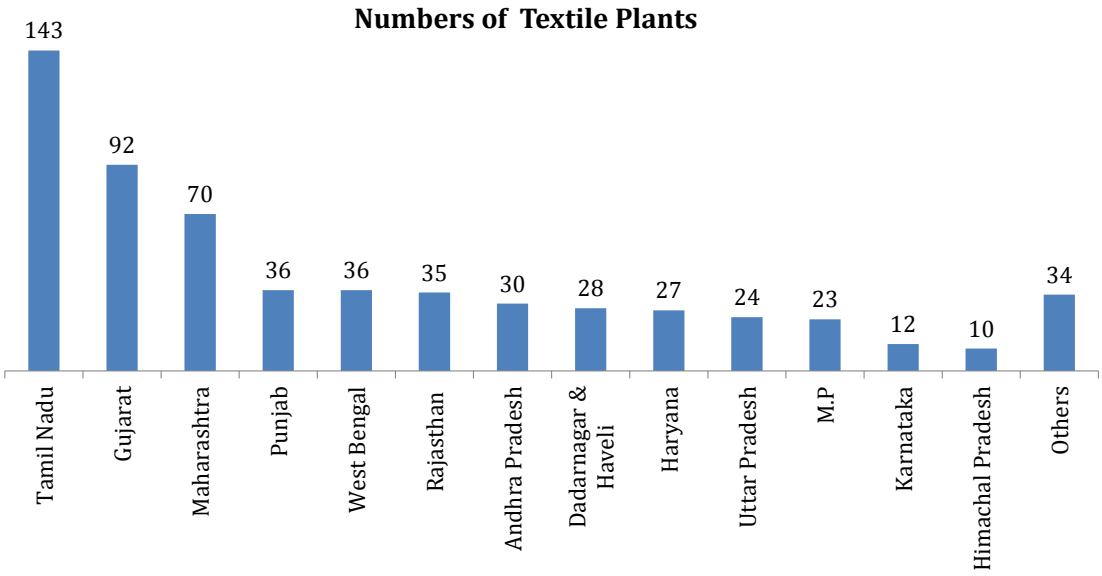


Figure 12: Location of potential textile plants across states

5.3 Summary Analysis from PAT Perspective

The comparative summary of additional plants from the PAT Cycle-I is provided in Table 20. The total energy consumption of 600 units is 20 times more than the PAT-1 sectoral energy consumption. This is a good value addition to PAT for the next cycle. The assessment is carried out by taking into account of assumption as discussed, average SEC of each textile units is assumed to be same as the sectoral average in First PAT Cycle.

Table 20: Estimated specific energy consumption in comparison with PAT Cycle -I units

Summary	No. of Plants	Total production (Mt)	Total Energy Consumption (Mtoe)	BL SEC Estimates (toe/t)
PAT Cycle-I	90	7.2	1.206	0.0166
New Plants*	600	147.8*	24.589*	0.0166**
Total	**690**	**155**	**25.795**	**0.0166**
**Estimated ** Assumption*				

A 3% SEC reduction is applied to these additional units. Figure 13 gives an overview of the sector comparing the energy consumption and savings from units in First PAT Cycle and additional units. The comparison shows that there is large scope of deepening of PAT especially in the textile sector. A saving of 0.738Mtoe of could be achieved, which is 11 times sector savings in PAT-1 for textile sector.

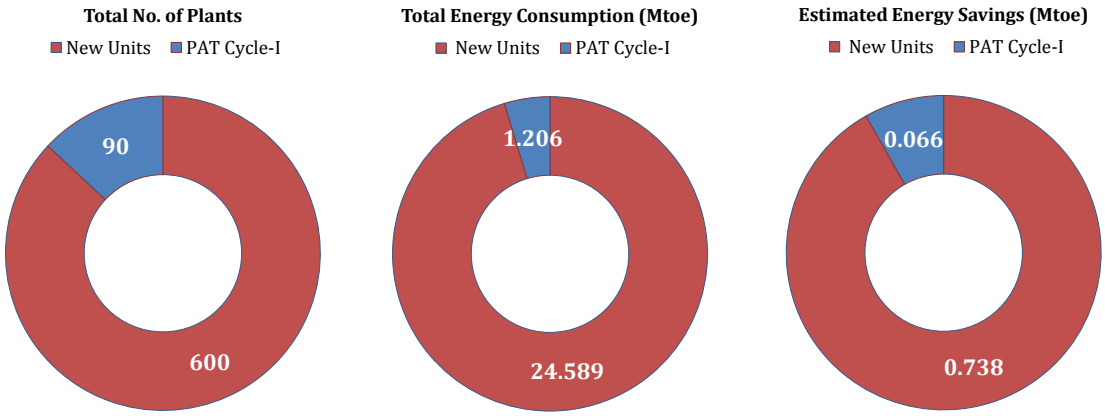


Figure 13: Comparisons of PAT Cycle1 and New Plants

5.4 Impact of Variation of Minimum Annual Energy Consumption Norms

The impact of lowering the threshold of annual energy consumption is reflected in drawing more manufacturing units. Table 21 to Table 24 provides an exhaustive list of textile units grouped by a range of energy consumption.

- ***Energy Savings Potential***

There is a scope of saving 0.7288 Mtoe of energy from 74 units, which are falling under current PAT criteria of minimum energy consumption (3000 toe). These 74 units collectively consume 24.29 Mtoe of energy (20 times higher than sector energy consumption in PAT Cycle-I).

The remaining 526 units are relatively at lower energy consumption limit and appear as small scale units. If energy efficiency mechanism is evenly considered among the small and medium scale enterprises, then there exists a large potential of sector shift towards efficiency methods of manufacturing textile products. This assessment shows relatively lower savings but among the similar group the savings could be different.

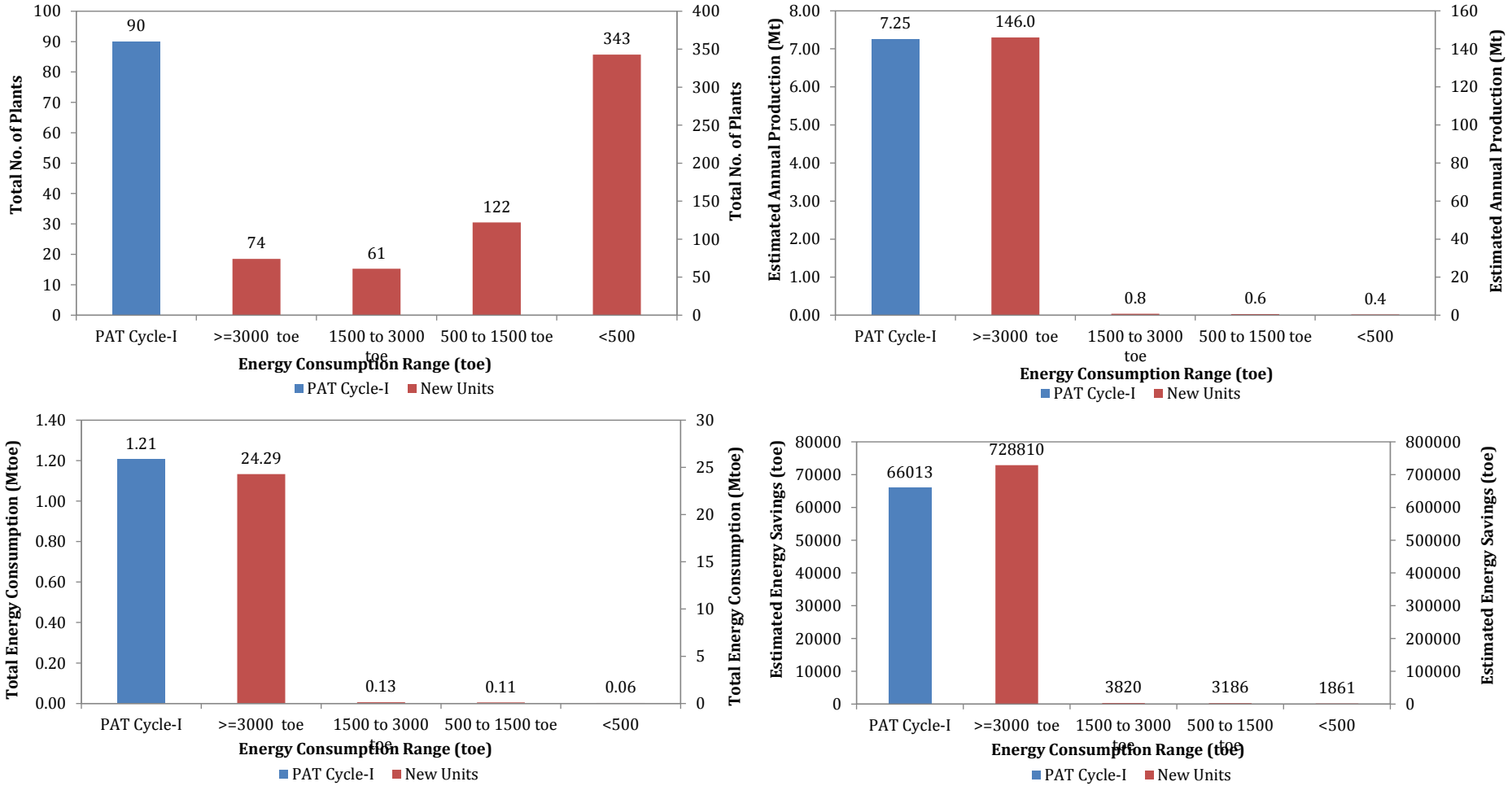


Figure 14: Parametric assessment of plants based on minimum energy consumption range

Energy Consumption >=3000 toe

Plants with an energy consumption of more than 3000 toe are given in Table 21 and the total number of plants is 74 with a total energy consumption of 24.29 Mtoe. The energy saving potential is 0.72 Mtoe.

Table 21: Plants with Energy Consumption >= 3000toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings
TN1	Ahmedabad	40000000	6656438	199693
TN2	Mumbai	32400000	5391715	161751
TN3	West Bengal	24000000	3993863	119816
TN4	Mumbai	16000000	2662575	79877
TN5	Mumbai	11000000	1830520	54916
TN6	Maharashtra	9148298	1522377	45671
TN7	Bangalore	6000000	998466	29954
TN8	Mumbai	2191944	364763	10943
TN9	Gurgaon	1200000	199693	5991
TN10	Maharashtra	409869	68207	2046
TN11	Tamil Nadu	290869	48404	1452
TN12	West Bengal	290431	48331	1450
TN13	Gujarat	265423	44169	1325
TN14	Kerala	168490	28039	841
TN15	New Delhi	144000	23963	719
TN16	Dadra & Nagar Haveli	117947	19628	589
TN17	Chennai	112000	18638	559
TN18	Maharashtra	99275	16520	496
TN19	Tamil Nadu	88000	14644	439
TN20	Gujarat	86964	14472	434
TN21	Daman & Diu	84337	14035	421
TN22	Gujarat	82087	13660	410
TN23	Gujarat	77268	12858	386
TN24	Gujarat	75562	12574	377
TN25	Gujarat	73360	12208	366
TN26	Uttar Pradesh	62920	10471	314
TN27	Andhra Pradesh	55085	9167	275
TN28	West Bengal	51910	8638	259
TN29	West Bengal	51056	8496	255
TN30	Maharashtra	50046	8328	250
TN31	West Bengal	46181	7685	231
TN32	Karnataka	42737	7112	213
TN33	Dadra & Nagar Haveli	41310	6874	206
TN34	West Bengal	41225	6860	206
TN35	West Bengal	40402	6723	202

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings
TN36	Gujarat	39087	6504	195
TN37	Madhya Pradesh	38351	6382	191
TN38	West Bengal	38093	6339	190
TN39	Punjab	36636	6097	183
TN40	Tamil Nadu	34523	5745	172
TN41	West Bengal	33958	5651	170
TN42	West Bengal	33298	5541	166
TN43	West Bengal	32566	5419	163
TN44	Punjab	32317	5378	161
TN45	Gujarat	32080	5338	160
TN46	Orissa	31971	5320	160
TN47	Mumbai	31632	5264	158
TN48	Uttar Pradesh	31490	5240	157
TN49	Dadra & Nagar Haveli	31155	5185	156
TN50	Uttar Pradesh	30116	5012	150
TN51	Andhra Pradesh	30101	5009	150
TN52	West Bengal	28923	4813	144
TN53	Rajasthan	28749	4784	144
TN54	Andhra Pradesh	28716	4779	143
TN55	Punjab	28672	4771	143
TN56	West Bengal	28373	4722	142
TN57	Punjab	28019	4663	140
TN58	Uttar Pradesh	27863	4637	139
TN59	Gujarat	26831	4465	134
TN60	Tamil Nadu	26522	4413	132
TN61	Dadra & Nagar Haveli	25619	4263	128
TN62	Madhya Pradesh	25158	4187	126
TN63	West Bengal	24673	4106	123
TN64	Rajasthan	23146	3852	116
TN65	Gujarat	22806	3795	114
TN66	West Bengal	22538	3751	113
TN67	Tamil Nadu	21822	3631	109
TN68	Andhra Pradesh	21493	3577	107
TN69	Gujarat	21054	3504	105
TN70	West Bengal	20543	3419	103
TN71	Gujarat	20044	3336	100
TN72	Himachal Pradesh	20001	3328	100
TN73	West Bengal	19340	3218	97
TN74	West Bengal	18634	3101	93
Total	**74**	**145985909**	**24293655**	**728810**

- ***Energy Consumption 1500 to 2999 toe***

Plants with energy consumption in the range 1500 to 2999 toe are depicted in Table 22 and there are 61 plants with a total energy consumption of 0.12 Mtoe. The energy saving potential for this category is 3820 toe.

Table 22: Plants with Energy Consumption in the range 1500 to 3000toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings
TN75	Dadra & Nagar Haveli	17498	2912	87.35
TN76	Andhra Pradesh	16617	2765	82.96
TN77	Gujarat	16573	2758	82.74
TN78	Punjab	16306	2714	81.41
TN79	West Bengal	16181	2693	80.78
TN80	Punjab	16101	2679	80.38
TN81	Rajasthan	16000	2663	79.88
TN82	West Bengal	15842	2636	79.09
TN83	Himachal Pradesh	15795	2628	78.85
TN84	Dadra & Nagar Haveli	15557	2589	77.66
TN85	Haryana	15441	2570	77.09
TN86	Gujarat	15398	2562	76.87
TN87	Rajasthan	15259	2539	76.18
TN88	Dadra & Nagar Haveli	15120	2516	75.48
TN89	Orissa	14505	2414	72.41
TN90	Tamil Nadu	14475	2409	72.27
TN91	Gujarat	14206	2364	70.92
TN92	Andhra Pradesh	13919	2316	69.49
TN93	Madhya Pradesh	13692	2278	68.35
TN94	Tamil Nadu	13584	2261	67.82
TN95	Gujarat	13554	2256	67.67
TN96	Punjab	13418	2233	66.99
TN97	Dadra & Nagar Haveli	13366	2224	66.73
TN98	Himachal Pradesh	13148	2188	65.64
TN99	Gujarat	13096	2179	65.38
TN100	Daman & Diu	12784	2127	63.82
TN101	Gujarat	12725	2118	63.53
TN102	Andhra Pradesh	12647	2105	63.14
TN103	West Bengal	12534	2086	62.57
TN104	Tamil Nadu	12470	2075	62.25
TN105	West Bengal	12330	2052	61.56
TN106	Bihar	12078	2010	60.30
TN107	Punjab	12067	2008	60.24
TN108	Tamil Nadu	12040	2004	60.11

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings
TN109	Gujarat	12000	1997	59.91
TN110	West Bengal	11993	1996	59.87
TN111	Gujarat	11056	1840	55.20
TN112	Tamil Nadu	11051	1839	55.17
TN113	Gujarat	10944	1821	54.64
TN114	Maharashtra	10917	1817	54.50
TN115	Tamil Nadu	10857	1807	54.20
TN116	Dadra & Nagar Haveli	10826	1802	54.05
TN117	Rajasthan	10782	1794	53.83
TN118	Rajasthan	10574	1760	52.79
TN119	Maharashtra	10461	1741	52.22
TN120	Tamil Nadu	10451	1739	52.18
TN121	Maharashtra	10306	1715	51.45
TN122	Haryana	10275	1710	51.29
TN123	Punjab	10187	1695	50.85
TN124	Jammu & Kashmir	10178	1694	50.81
TN125	Gujarat	10107	1682	50.46
TN126	Uttar Pradesh	10107	1682	50.46
TN127	Punjab	10095	1680	50.40
TN128	Uttar Pradesh	9748	1622	48.66
TN129	Tamil Nadu	9742	1621	48.64
TN130	Gujarat	9600	1598	47.93
TN131	Uttar Pradesh	9563	1591	47.74
TN132	Rajasthan	9413	1566	46.99
TN133	Maharashtra	9296	1547	46.41
TN134	Goa	9199	1531	45.92
TN135	Maharashtra	9113	1516	45.49
Total	**61**	**765165**	**127332**	**3820**

- ***Energy Consumption 500 to 1499 toe***

Plants with energy consumption in the range 500 to 1499 toe are depicted in Table 23. The number of plant is only 122 with a total energy consumption of 106215 toe. The energy saving potential for this category is 3186 toe.

Table 23: Plants with Energy Consumption in the range 500 to 1500 toe

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN136	Andhra Pradesh	8777	1461	43.82
TN137	Maharashtra	8661	1441	43.24
TN138	Gujarat	8659	1441	43.23

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN139	West Bengal	8613	1433	43.00
TN140	Tamil Nadu	8604	1432	42.95
TN141	Maharashtra	8497	1414	42.42
TN142	Gujarat	8463	1408	42.25
TN143	Madhya Pradesh	8367	1392	41.77
TN144	Haryana	8063	1342	40.25
TN145	Dadra & Nagar Haveli	8013	1333	40.00
TN146	Madhya Pradesh	8000	1331	39.94
TN147	Gujarat	8000	1331	39.94
TN148	Delhi	7922	1318	39.55
TN149	Uttar Pradesh	7617	1268	38.03
TN150	Dadra & Nagar Haveli	7589	1263	37.89
TN151	Madhya Pradesh	7395	1231	36.92
TN152	Punjab	7391	1230	36.90
TN153	Tamil Nadu	7377	1228	36.83
TN154	Maharashtra	7344	1222	36.67
TN155	Tamil Nadu	7315	1217	36.52
TN156	Maharashtra	7256	1207	36.22
TN157	Punjab	6977	1161	34.83
TN158	Punjab	6966	1159	34.78
TN159	Tamil Nadu	6891	1147	34.40
TN160	Tamil Nadu	6889	1146	34.39
TN161	Uttar Pradesh	6886	1146	34.38
TN162	West Bengal	6826	1136	34.08
TN163	Rajasthan	6799	1131	33.94
TN164	Madhya Pradesh	6786	1129	33.88
TN165	Tamil Nadu	6761	1125	33.75
TN166	Madhya Pradesh	6706	1116	33.48
TN167	Maharashtra	6598	1098	32.94
TN168	Punjab	6502	1082	32.46
TN169	Haryana	6477	1078	32.34
TN170	Rajasthan	6408	1066	31.99
TN171	West Bengal	6373	1061	31.82
TN172	Maharashtra	6251	1040	31.21
TN173	Kerala	6245	1039	31.18
TN174	Maharashtra	6236	1038	31.13
TN175	Gujarat	6120	1018	30.55
TN176	Gujarat	6096	1014	30.43
TN177	Tamil Nadu	5814	968	29.03
TN178	Maharashtra	5769	960	28.80
TN179	Gujarat	5687	946	28.39

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN180	Maharashtra	5673	944	28.32
TN181	Himachal Pradesh	5611	934	28.01
TN182	Haryana	5607	933	27.99
TN183	Tamil Nadu	5581	929	27.86
TN184	Tamil Nadu	5540	922	27.66
TN185	Tamil Nadu	5474	911	27.33
TN186	Punjab	5457	908	27.24
TN187	Punjab	5383	896	26.87
TN188	Haryana	5353	891	26.72
TN189	Rajasthan	5218	868	26.05
TN190	Punjab	5150	857	25.71
TN191	Tamil Nadu	5045	839	25.18
TN192	Uttar Pradesh	5025	836	25.09
TN193	Rajasthan	5013	834	25.03
TN194	Tamil Nadu	5012	834	25.02
TN195	Gujarat	4925	820	24.59
TN196	West Bengal	4861	809	24.27
TN197	Tamil Nadu	4814	801	24.03
TN198	Haryana	4814	801	24.03
TN199	Andhra Pradesh	4777	795	23.85
TN200	Tamil Nadu	4720	785	23.56
TN201	Himachal Pradesh	4716	785	23.54
TN202	Andhra Pradesh	4712	784	23.52
TN203	Dadra & Nagar Haveli	4512	751	22.53
TN204	Gujarat	4473	744	22.33
TN205	Gujarat	4460	742	22.27
TN206	West Bengal	4424	736	22.09
TN207	Tamil Nadu	4398	732	21.95
TN208	Gujarat	4379	729	21.86
TN209	Himachal Pradesh	4350	724	21.72
TN210	Tamil Nadu	4332	721	21.63
TN211	Tamil Nadu	4293	714	21.43
TN212	Maharashtra	4256	708	21.25
TN213	Tamil Nadu	4252	708	21.23
TN214	Tamil Nadu	4207	700	21.00
TN215	Tamil Nadu	4149	690	20.71
TN216	Gujarat	4114	685	20.54
TN217	Daman & Diu	4109	684	20.52
TN218	Tamil Nadu	4105	683	20.50
TN219	Uttar Pradesh	4070	677	20.32
TN220	Punjab	4033	671	20.13

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN221	Tamil Nadu	4022	669	20.08
TN222	Andhra Pradesh	3885	646	19.39
TN223	Dadra & Nagar Haveli	3847	640	19.21
TN224	West Bengal	3846	640	19.20
TN225	Haryana	3840	639	19.17
TN226	Punjab	3840	639	19.17
TN227	Rajasthan	3817	635	19.05
TN228	Kerala	3812	634	19.03
TN229	Madhya Pradesh	3809	634	19.02
TN230	Rajasthan	3779	629	18.86
TN231	Punjab	3685	613	18.40
TN232	Tamil Nadu	3671	611	18.33
TN233	Tamil Nadu	3501	583	17.48
TN234	Madhya Pradesh	3371	561	16.83
TN235	Gujarat	3361	559	16.78
TN236	Punjab	3360	559	16.77
TN237	Maharashtra	3359	559	16.77
TN238	Karnataka	3349	557	16.72
TN239	Tamil Nadu	3322	553	16.59
TN240	Punjab	3311	551	16.53
TN241	West Bengal	3287	547	16.41
TN242	Punjab	3193	531	15.94
TN243	Tamil Nadu	3180	529	15.87
TN244	Himachal Pradesh	3169	527	15.82
TN245	Punjab	3154	525	15.75
TN246	Assam	3147	524	15.71
TN247	Gujarat	3145	523	15.70
TN248	Gujarat	3134	522	15.65
TN249	Himachal Pradesh	3129	521	15.62
TN250	Dadra & Nagar Haveli	3128	521	15.62
TN251	Tamil Nadu	3115	518	15.55
TN252	Haryana	3106	517	15.51
TN253	Gujarat	3062	510	15.29
TN254	Tamil Nadu	3061	509	15.28
TN255	Maharashtra	3044	506	15.19
TN256	Tamil Nadu	3025	503	15.10
TN257	Andhra Pradesh	3022	503	15.08
Total	**122**	**638267**	**106215**	**3186**

- ***Energy Consumption <=500 toe***

Plants with an energy consumption of less than 500 toe is given in Table 24. The numbers of plants are 343 with a total energy consumption of 62049 toe. The energy saving potential for this category is 1861 toe.

Table 24: Plants with Energy consumption <=500 toe

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN258	Gujarat	2980	495.90	14.877
TN259	Tamil Nadu	2949	490.67	14.720
TN260	Rajasthan	2841	472.70	14.181
TN261	Maharashtra	2832	471.28	14.138
TN262	West Bengal	2828	470.61	14.118
TN263	Haryana	2817	468.75	14.062
TN264	Tamil Nadu	2803	466.48	13.994
TN265	Tamil Nadu	2795	465.04	13.951
TN266	Tamil Nadu	2795	465.04	13.951
TN267	Maharashtra	2762	459.62	13.789
TN268	Andhra Pradesh	2752	458.04	13.741
TN269	West Bengal	2752	457.99	13.740
TN270	Punjab	2747	457.15	13.714
TN271	Tamil Nadu	2730	454.30	13.629
TN272	Gujarat	2726	453.64	13.609
TN273	Gujarat	2708	450.61	13.518
TN274	Rajasthan	2700	449.29	13.479
TN275	Maharashtra	2694	448.34	13.450
TN276	Andhra Pradesh	2649	440.86	13.226
TN277	Rajasthan	2646	440.34	13.210
TN278	Tamil Nadu	2614	435.05	13.052
TN279	Tamil Nadu	2601	432.83	12.985
TN280	Karnataka	2525	420.22	12.607
TN281	Tamil Nadu	2498	415.74	12.472
TN282	Tamil Nadu	2486	413.73	12.412
TN283	Punjab	2437	405.55	12.167
TN284	West Bengal	2435	405.25	12.157
TN285	Andhra Pradesh	2433	404.96	12.149
TN286	Tamil Nadu	2421	402.88	12.086
TN287	Madhya Pradesh	2400	399.39	11.982
TN288	Haryana	2393	398.23	11.947
TN289	Punjab	2380	396.03	11.881
TN290	Haryana	2358	392.36	11.771
TN291	Maharashtra	2337	388.98	11.669

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN292	Tamil Nadu	2334	388.42	11.653
TN293	Haryana	2311	384.55	11.536
TN294	Haryana	2310	384.38	11.531
TN295	Haryana	2293	381.66	11.450
TN296	Tamil Nadu	2286	380.48	11.414
TN297	Madhya Pradesh	2284	380.08	11.402
TN298	Tamil Nadu	2256	375.43	11.263
TN299	Karnataka	2226	370.43	11.113
TN300	Madhya Pradesh	2196	365.44	10.963
TN301	Uttar Pradesh	2162	359.70	10.791
TN302	Madhya Pradesh	2159	359.34	10.780
TN303	Dadra & Nagar Haveli	2129	354.33	10.630
TN304	Tamil Nadu	2122	353.12	10.594
TN305	Tamil Nadu	2118	352.46	10.574
TN306	Tamil Nadu	2101	349.68	10.490
TN307	Tamil Nadu	2101	349.67	10.490
TN308	Maharashtra	2079	345.91	10.377
TN309	Haryana	2077	345.68	10.370
TN310	Madhya Pradesh	2062	343.11	10.293
TN311	Andhra Pradesh	2030	337.82	10.135
TN312	Tamil Nadu	2025	336.98	10.109
TN313	Tamil Nadu	2019	336.01	10.080
TN314	Tamil Nadu	2015	335.27	10.058
TN315	Punjab	2013	335.06	10.052
TN316	Madhya Pradesh	2012	334.83	10.045
TN317	Tamil Nadu	2010	334.49	10.035
TN318	Tamil Nadu	2004	333.45	10.004
TN319	Tamil Nadu	1998	332.49	9.975
TN320	Tamil Nadu	1985	330.32	9.910
TN321	Andhra Pradesh	1976	328.86	9.866
TN322	Madhya Pradesh	1952	324.87	9.746
TN323	Madhya Pradesh	1942	323.17	9.695
TN324	Tamil Nadu	1919	319.40	9.582
TN325	Daman & Diu	1913	318.37	9.551
TN326	Maharashtra	1885	313.68	9.411
TN327	Haryana	1882	313.19	9.396
TN328	Haryana	1879	312.73	9.382
TN329	Uttar Pradesh	1867	310.71	9.321
TN330	Rajasthan	1861	309.69	9.291
TN331	Rajasthan	1853	308.39	9.252
TN332	Maharashtra	1826	303.84	9.115

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN333	Gujarat	1814	301.84	9.055
TN334	Tamil Nadu	1779	296.05	8.881
TN335	Gujarat	1756	292.25	8.767
TN336	Gujarat	1743	290.08	8.702
TN337	Tamil Nadu	1729	287.74	8.632
TN338	Tamil Nadu	1680	279.61	8.388
TN339	Andhra Pradesh	1674	278.59	8.358
TN340	Tamil Nadu	1650	274.64	8.239
TN341	Maharashtra	1627	270.78	8.123
TN342	Haryana	1621	269.81	8.094
TN343	Kerala	1611	268.11	8.043
TN344	Gujarat	1611	268.01	8.040
TN345	Rajasthan	1592	264.92	7.947
TN346	Rajasthan	1585	263.69	7.911
TN347	Tamil Nadu	1561	259.77	7.793
TN348	Tamil Nadu	1561	259.77	7.793
TN349	Uttar Pradesh	1560	259.60	7.788
TN350	Maharashtra	1549	257.71	7.731
TN351	Rajasthan	1544	256.90	7.707
TN352	Dadra & Nagar Haveli	1533	255.11	7.653
TN353	Dadra & Nagar Haveli	1529	254.45	7.633
TN354	Maharashtra	1521	253.08	7.592
TN355	Orissa	1518	252.57	7.577
TN356	Tamil Nadu	1508	251.03	7.531
TN357	Maharashtra	1500	249.63	7.489
TN358	Tamil Nadu	1479	246.19	7.386
TN359	Karnataka	1458	242.57	7.277
TN360	Andhra Pradesh	1444	240.36	7.211
TN361	Maharashtra	1429	237.74	7.132
TN362	Tamil Nadu	1426	237.24	7.117
TN363	Haryana	1425	237.19	7.116
TN364	Tamil Nadu	1412	234.97	7.049
TN365	Gujarat	1399	232.79	6.984
TN366	Madhya Pradesh	1387	230.85	6.926
TN367	Kerala	1378	229.26	6.878
TN368	Tamil Nadu	1365	227.14	6.814
TN369	Gujarat	1351	224.80	6.744
TN370	Tamil Nadu	1347	224.23	6.727
TN371	Maharashtra	1342	223.28	6.698
TN372	Gujarat	1333	221.80	6.654

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN373	Tamil Nadu	1320	219.74	6.592
TN374	Tamil Nadu	1308	217.71	6.531
TN375	Gujarat	1306	217.35	6.520
TN376	Tamil Nadu	1301	216.52	6.495
TN377	Tamil Nadu	1300	216.29	6.489
TN378	Maharashtra	1298	216.00	6.480
TN379	Tamil Nadu	1297	215.80	6.474
TN380	Tamil Nadu	1296	215.59	6.468
TN381	Punjab	1292	215.05	6.451
TN382	Tamil Nadu	1290	214.72	6.442
TN383	Gujarat	1290	214.65	6.440
TN384	Tamil Nadu	1283	213.54	6.406
TN385	Andhra Pradesh	1283	213.47	6.404
TN386	Tamil Nadu	1279	212.88	6.386
TN387	Maharashtra	1279	212.76	6.383
TN388	Gujarat	1264	210.26	6.308
TN389	Tamil Nadu	1259	209.49	6.285
TN390	Rajasthan	1252	208.41	6.252
TN391	Gujarat	1250	208.03	6.241
TN392	Rajasthan	1241	206.52	6.195
TN393	Maharashtra	1232	204.94	6.148
TN394	Tamil Nadu	1222	203.28	6.098
TN395	Gujarat	1200	199.69	5.991
TN396	Maharashtra	1165	193.79	5.814
TN397	Maharashtra	1155	192.20	5.766
TN398	Gujarat	1152	191.70	5.751
TN399	Maharashtra	1152	191.70	5.751
TN400	Maharashtra	1147	190.90	5.727
TN401	Chhattisgarh	1147	190.88	5.727
TN402	Haryana	1135	188.88	5.666
TN403	Dadra & Nagar Haveli	1127	187.60	5.628
TN404	West Bengal	1126	187.38	5.621
TN405	Haryana	1122	186.73	5.602
TN406	Andhra Pradesh	1113	185.26	5.558
TN407	Tamil Nadu	1113	185.24	5.557
TN408	Madhya Pradesh	1106	184.08	5.523
TN409	Tamil Nadu	1091	181.59	5.448
TN410	Gujarat	1090	181.38	5.441
TN411	Dadra & Nagar Haveli	1088	181.05	5.431
TN412	Tamil Nadu	1082	180.04	5.401

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN413	Himachal Pradesh	1078	179.36	5.381
TN414	Gujarat	1076	179.06	5.372
TN415	Tamil Nadu	1073	178.56	5.357
TN416	Jharkhand	1070	178.10	5.343
TN417	Tamil Nadu	1069	177.88	5.336
TN418	Uttar Pradesh	1066	177.43	5.323
TN419	Gujarat	1052	175.02	5.251
TN420	Tamil Nadu	1041	173.27	5.198
TN421	Madhya Pradesh	1023	170.31	5.109
TN422	Tamil Nadu	1020	169.72	5.091
TN423	Tamil Nadu	1018	169.34	5.080
TN424	Maharashtra	1016	169.11	5.073
TN425	Gujarat	1010	168.03	5.041
TN426	Gujarat	1002	166.77	5.003
TN427	Maharashtra	998	166.14	4.984
TN428	Gujarat	987	164.22	4.927
TN429	Rajasthan	972	161.73	4.852
TN430	Tamil Nadu	968	161.06	4.832
TN431	Kerala	958	159.43	4.783
TN432	Gujarat	948	157.81	4.734
TN433	Tamil Nadu	941	156.56	4.697
TN434	Rajasthan	928	154.38	4.631
TN435	Andhra Pradesh	918	152.73	4.582
TN436	Rajasthan	909	151.28	4.539
TN437	Maharashtra	909	151.23	4.537
TN438	Maharashtra	900	149.70	4.491
TN439	Haryana	898	149.44	4.483
TN440	Karnataka	897	149.29	4.479
TN441	Tamil Nadu	893	148.57	4.457
TN442	Gujarat	889	148.00	4.440
TN443	Tamil Nadu	881	146.65	4.399
TN444	Himachal Pradesh	875	145.58	4.367
TN445	Gujarat	875	145.56	4.367
TN446	Gujarat	873	145.33	4.360
TN447	Maharashtra	873	145.25	4.358
TN448	Tamil Nadu	870	144.78	4.343
TN449	Gujarat	866	144.17	4.325
TN450	Tamil Nadu	864	143.86	4.316
TN451	Punjab	862	143.45	4.303
TN452	Andhra Pradesh	856	142.45	4.273
TN453	Gujarat	855	142.25	4.268

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN454	Tamil Nadu	845	140.58	4.218
TN455	Tamil Nadu	843	140.28	4.208
TN456	Gujarat	814	135.41	4.062
TN457	Punjab	799	132.97	3.989
TN458	Tamil Nadu	795	132.29	3.969
TN459	Tamil Nadu	794	132.05	3.961
TN460	Tamil Nadu	793	132.00	3.960
TN461	Pondicherry	788	131.21	3.936
TN462	Tamil Nadu	782	130.09	3.903
TN463	Maharashtra	778	129.43	3.883
TN464	Tamil Nadu	767	127.64	3.829
TN465	Dadra & Nagar Haveli	758	126.12	3.784
TN466	Rajasthan	747	124.28	3.728
TN467	Tamil Nadu	736	122.40	3.672
TN468	Dadra & Nagar Haveli	726	120.82	3.625
TN469	Dadra & Nagar Haveli	717	119.25	3.577
TN470	Madhya Pradesh	710	118.23	3.547
TN471	Maharashtra	709	117.91	3.537
TN472	Tamil Nadu	695	115.61	3.468
TN473	Tamil Nadu	661	109.95	3.299
TN474	Rajasthan	660	109.89	3.297
TN475	Tamil Nadu	650	108.21	3.246
TN476	Daman & Diu	645	107.26	3.218
TN477	Gujarat	645	107.25	3.218
TN478	Andhra Pradesh	629	104.62	3.139
TN479	Maharashtra	626	104.21	3.126
TN480	Maharashtra	613	102.07	3.062
TN481	Dadra & Nagar Haveli	606	100.90	3.027
TN482	Tamil Nadu	604	100.44	3.013
TN483	Rajasthan	602	100.17	3.005
TN484	Karnataka	590	98.22	2.947
TN485	Maharashtra	587	97.60	2.928
TN486	Gujarat	582	96.90	2.907
TN487	Uttar Pradesh	580	96.52	2.896
TN488	Tamil Nadu	560	93.20	2.796
TN489	Tamil Nadu	555	92.29	2.769
TN490	Tamil Nadu	550	91.54	2.746
TN491	Maharashtra	550	91.53	2.746
TN492	Rajasthan	545	90.63	2.719

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN493	Andhra Pradesh	532	88.53	2.656
TN494	Gujarat	526	87.59	2.628
TN495	Dadra & Nagar Haveli	523	87.10	2.613
TN496	Punjab	512	85.20	2.556
TN497	Tamil Nadu	496	82.58	2.477
TN498	Gujarat	495	82.31	2.469
TN499	Tamil Nadu	477	79.40	2.382
TN500	Uttar Pradesh	475	79.05	2.371
TN501	Tamil Nadu	474	78.80	2.364
TN502	Uttar Pradesh	471	78.30	2.349
TN503	Karnataka	468	77.85	2.335
TN504	Tamil Nadu	464	77.21	2.316
TN505	Delhi	455	75.70	2.271
TN506	Haryana	446	74.25	2.227
TN507	Gujarat	446	74.19	2.226
TN508	Uttar Pradesh	442	73.61	2.208
TN509	Andhra Pradesh	437	72.77	2.183
TN510	Gujarat	421	70.10	2.103
TN511	Tamil Nadu	419	69.74	2.092
TN512	Uttarakhand	416	69.18	2.075
TN513	Rajasthan	411	68.40	2.052
TN514	Tamil Nadu	409	68.05	2.042
TN515	Gujarat	406	67.54	2.026
TN516	Maharashtra	391	65.07	1.952
TN517	Gujarat	391	65.07	1.952
TN518	Tamil Nadu	388	64.53	1.936
TN519	Rajasthan	375	62.45	1.873
TN520	Andhra Pradesh	365	60.77	1.823
TN521	Gujarat	346	57.55	1.726
TN522	Tamil Nadu	338	56.18	1.685
TN523	Tamil Nadu	336	55.87	1.676
TN524	Tamil Nadu	334	55.57	1.667
TN525	Daman & Diu	334	55.54	1.666
TN526	Tamil Nadu	333	55.34	1.660
TN527	Dadra & Nagar Haveli	317	52.83	1.585
TN528	Maharashtra	307	51.05	1.531
TN529	Gujarat	293	48.81	1.464
TN530	Punjab	270	44.94	1.348
TN531	Gujarat	263	43.78	1.314
TN532	Tamil Nadu	260	43.27	1.298

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN533	Rajasthan	259	43.03	1.291
TN534	Dadra & Nagar Haveli	242	40.27	1.208
TN535	Uttar Pradesh	239	39.72	1.192
TN536	Gujarat	233	38.80	1.164
TN537	Andhra Pradesh	233	38.76	1.163
TN538	Gujarat	226	37.65	1.130
TN539	Maharashtra	224	37.24	1.117
TN540	Gujarat	213	35.46	1.064
TN541	Gujarat	207	34.45	1.033
TN542	Maharashtra	194	32.28	0.969
TN543	Haryana	194	32.21	0.966
TN544	Maharashtra	186	30.87	0.926
TN545	Orissa	184	30.66	0.920
TN546	Karnataka	181	30.15	0.904
TN547	Maharashtra	180	30.03	0.901
TN548	Tamil Nadu	175	29.16	0.875
TN549	Punjab	170	28.34	0.850
TN550	Maharashtra	165	27.48	0.825
TN551	Uttar Pradesh	161	26.84	0.805
TN552	Jammu & Kashmir	160	26.55	0.796
TN553	Maharashtra	155	25.81	0.774
TN554	Punjab	150	25.03	0.751
TN555	Gujarat	143	23.72	0.712
TN556	Gujarat	139	23.14	0.694
TN557	Goa	120	20.04	0.601
TN558	Maharashtra	116	19.27	0.578
TN559	Tamil Nadu	113	18.73	0.562
TN560	Kerala	107	17.80	0.534
TN561	Uttar Pradesh	101	16.83	0.505
TN562	Rajasthan	100	16.71	0.501
TN563	Maharashtra	87	14.48	0.434
TN564	Gujarat	84	14.06	0.422
TN565	Maharashtra	84	13.99	0.420
TN566	Madhya Pradesh	83	13.82	0.415
TN567	Dadra & Nagar Haveli	78	12.97	0.389
TN568	Tamil Nadu	76	12.58	0.377
TN569	Rajasthan	73	12.07	0.362
TN570	Andhra Pradesh	72	11.95	0.359
TN571	Andhra Pradesh	66	10.98	0.329
TN572	Daman & Diu	64	10.71	0.321

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
TN573	Haryana	62	10.33	0.310
TN574	West Bengal	58	9.69	0.291
TN575	Maharashtra	58	9.64	0.289
TN576	Uttar Pradesh	48	8.06	0.242
TN577	Tamil Nadu	45	7.52	0.226
TN578	Gujarat	44	7.38	0.221
TN579	Gujarat	40	6.59	0.198
TN580	Tamil Nadu	38	6.30	0.189
TN581	Tamil Nadu	37	6.22	0.187
TN582	Karnataka	37	6.20	0.186
TN583	Dadra & Nagar Haveli	36	6.04	0.181
TN584	Andhra Pradesh	36	5.99	0.180
TN585	Gujarat	33	5.54	0.166
TN586	Tamil Nadu	33	5.51	0.165
TN587	Tamil Nadu	23	3.80	0.114
TN588	Gujarat	21	3.50	0.105
TN589	Tamil Nadu	21	3.48	0.104
TN590	Maharashtra	17	2.88	0.086
TN591	West Bengal	17	2.83	0.085
TN592	Andhra Pradesh	17	2.82	0.085
TN593	Tamil Nadu	16	2.65	0.079
TN594	Karnataka	9	1.49	0.045
TN595	Chandigarh	9	1.47	0.044
TN596	Tamil Nadu	8	1.38	0.041
TN597	Gujarat	4	0.74	0.022
TN598	Gujarat	4	0.69	0.021
TN599	Delhi	4	0.60	0.018
TN600	Uttar Pradesh	0	0.03	0.001
Total	**343**	**372869**	**62049**	**1861**

6 Pulp and Paper Sector

The Indian Pulp and Paper industry is one of the industrial sectors contributing to the economy. According to an article in the Indian Pulp and Paper Technical Association (IPPTA), there are 759 paper mills in India with a capacity of 12.7 million. The average per capita consumption is 9.3 kgs. The industry projects its demand of 24 million tonnes by 2025, amongst which 22 Mt would be manufactured in India. Globally, more than 7745 mills are estimated producing 192 Mt of pulp and 402 Mt of Paper (11). There is a large scope of deepening the sector for further cycles.

6.1 Pulp and Paper Sector in PAT Cycle-1

About 31 Pulp and Paper manufacturing units were identified and notified as DCs in this sector, consuming more than 30000 toe of energy annually. By the end of the PAT Cycle-1, the energy savings of 0.119 Mtoe is expected to be achieved, which is around 2% of total national energy saving targets assessed under PAT. Figure 15 illustrates the identified P&P units located in major Indian states. More than 5 units are located in Maharashtra and Gujarat.

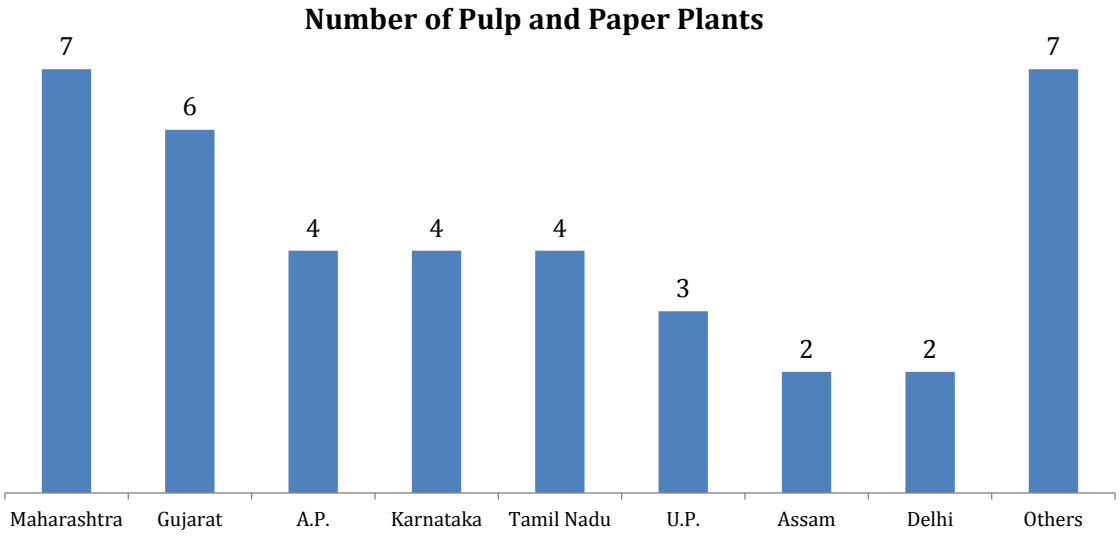


Figure 15: Numbers of Pulp and Paper units' location by state

6.2 Additional Units Location and Energy Estimates

A review of ministry reports and news articles gave a fair idea of maximum units in this sector. It is found 31 large pulp and paper plants have already been captured in first PAT Cycle. The new list of plants from this study survey indicates that there are numerous small scale units. In order to estimate the energy consumption and savings, the SEC of individual units is assumed to be same as the average sectoral SEC in PAT Cycle-I.

6.3 Summary Analysis from PAT Perspective

Table 25 provides a comparative summary of additional plants with that of first PAT Cycle. The summary illustrates that there are 30% additional energy consumption from thirty nine new units and this could be part of energy efficiency mechanism. Figure 16 illustrate the overall comparison of energy consumption and savings between PAT Cycle-I and identified units. About

41% of additional energy savings could be tapped from this sector when compared with existing estimated savings in the first PAT Cycle.

Table 25: Estimated specific energy consumption in comparison with first PAT Cycle units

Summary	No. of Plants	Production (t)	Energy Consumption (toe)	SEC Estimates (toe/t)
PAT Cycle1	31	3406442	2235130	0.656
New Plants	39	2375287*	1558188*	0.656**
Total	70	5781729	3793318	0.656
** Estimated ** Assumption*				

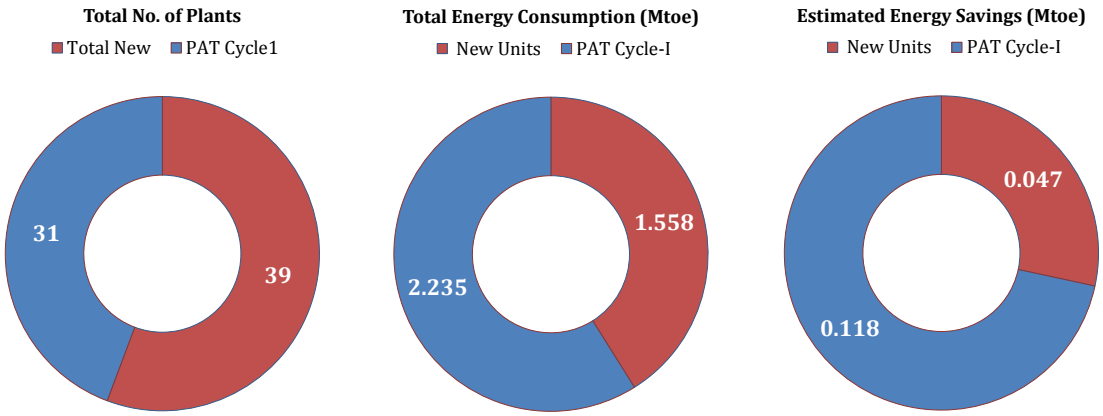


Figure 16: Energy consumption and Savings comparison

6.4 Impact of Variation of Minimum Annual Energy Consumption Norms

In the PAT Cycle-1, 31 P&P units were identified based on the PAT criteria of minimum energy limit. The impact assessment is performed to study the potential P&P units and this could be referred to the forthcoming cycle of PAT if the threshold energy limit is brought down to lower limits. The scenario is inclusive of additional units under the respective range of energy limits and is analysed from Table 26 to Table 32.

- ***Energy Savings Potential***

The review of additional plants showed, about 15 units consume more than 30000 toe, which brings a saving of 35295 toe of energy at 3% SEC reduction (an additional 30% savings). It is also evident that units are falling under low energy limits due to small scale units. The savings from such small units may not be neglected, if the initiatives expands to the SME level, the savings could collectively prove effective.

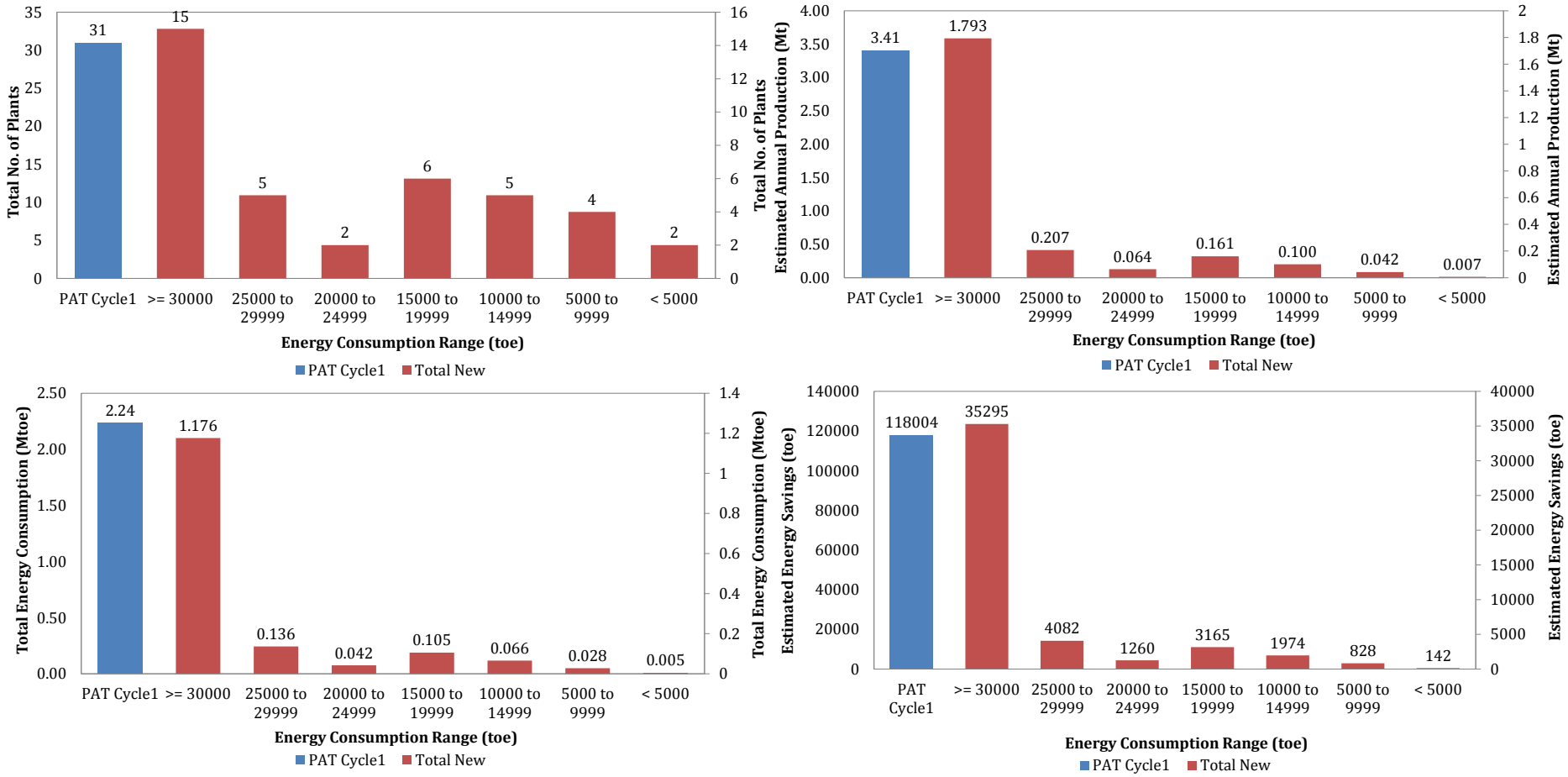


Figure 17: Parametric assessment of plants based on minimum energy consumption range

- ***Energy Consumption >=30000 toe***

Plants with an energy consumption of more than 30000 toe is given in Table 26. The total number of plants is 15 with a total energy consumption of 1.17 Mtoe. The energy saving potential is 35294 toe.

Table 26: Plants with Energy Consumption >=30000 toe

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
PN1	Bangalore	300000	196800	5904
PN2	Assam	268000	175808	5274
PN3	Gujarat	192800	126476	3794
PN4	Tamil Nadu	192000	125952	3778
PN5	Rajanagaram	96000	62976	1889
PN6	Tamil Nadu	96000	62976	1889
PN7	Ahmedabad	80000	52480	1574
PN8	Mumbai	80000	52480	1574
PN9	Uttar Pradesh	80000	52480	1574
PN10	Punjab	80000	52480	1574
PN11	Assam	72000	47232	1416
PN12	Kerala	72000	47232	1416
PN13	Tamil Nadu	70400	46182	1385
PN14	Tamil Nadu	66240	43453	1303
PN15	Madhya Pradesh	48000	31488	944
15		**1793440**	**1176496**	**35294**

- ***Energy Consumption 25000 to 29999 toe***

Plants with an energy consumption in the range 25000 to 29999 toe are given in Table 27. The total number of plants is 5 with a total energy consumption of 0.13 Mtoe. The energy saving potential is 4082 toe.

Table 27: Plants with Energy Consumption in the range 25000 to 29999 toe

Code	Location	Annual Production	Total Annual Energy Consumption (toe)	Energy Savings
PN16	Delhi	43200	28339	850
PN17	Himachal Pradesh	42240	27709	831
PN18	Mumbai	42000	27552	826
PN19	Andhra Pradesh	40000	26240	787
PN20	Andhra Pradesh	40000	26240	787
5		**207440**	**136080**	**4082**

- ***Energy Consumption 20000 to 24999 toe***

Plants with energy consumption in the range 20000 to 24999 toe are given in Table 28. The total number of plants is 2 with a total energy consumption of 41984 toe. The energy saving potential is 1259 toe.

Table 28: Plants with Energy Consumption in the range 20000 to 24999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN21	West Bengal	32000	20992	629
PN22	Pune	32000	20992	629
2		64000	41984	1259

- ***Energy Consumption 15000 to 19999 toe***

Plants with an energy consumption in the range 15000 to 19999 toe are given in Table 29. The total number of plants is 6 with a total energy consumption of 0.10 Mtoe. The energy saving potential is 3164 toe.

Table 29: Plants with Energy Consumption in the range 15000 to 19999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN23	Haryana	31200	20467	614
PN24	Uttar Pradesh	28800	18892	566
PN25	Gujarat	28800	18892	566
PN26	Uttar Pradesh	24000	15744	472
PN27	Orissa	24000	15744	472
PN28	Gujarat	24000	15744	472
6		160800	105484	3164

- ***Energy Consumption 10000 to 14999 toe***

Plants with an energy consumption in the range 10000 to 14999 toe are given in Table 30. The total number of plants is 5 with a total energy consumption of 0.06 Mtoe. The energy saving potential is 1974 toe.

Table 30: Plants with Energy Consumption in the range 10000 to 14999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN29	Gujarat	22000	14432	432
PN30	Gujarat	21120	13854	415
PN31	Karnataka	20000	13120	393

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN32	Karnataka	20000	13120	393
PN33	Maharashtra	17200	11283	338
5		**100320**	**65809**	**1974**

- ***Energy Consumption 5000 to 9999 toe***

Plants with an energy consumption in the range 5000 to 9999 toe are listed in Table 31. There are four plants with an estimated total energy consumption of 0.027Mtoe. The energy saving potential is 828 toe.

Table 31: Plants with Energy Consumption in the range 5000 to 9999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN34	Gujarat	13440	8816	264
PN35	Bangalore	9600	6297	188
PN36	West Bengal	9600	6297.	188
PN37	Maharashtra	9447	6197	185
4		**42087**	**27609**	**828**

- ***Energy Consumption< 5000 toe***

Plants with an energy consumption of less than 5000 toe are given in Table 32 . The total number of plants is 2 with a total energy consumption of 4723 toe. The energy saving potential is 141 toe.

Table 32: Plants with Energy Consumption < 5000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
PN38	Andhra Pradesh	6000	3936	118
PN39	Maharashtra	1200	787	23
2		**7200**	**4723**	**141**

7 Iron and Steel Sector

Iron and Steel have been among the world's most critical engineering materials and will continue as such for a long time to come. With strong backward and forward linkages, the steel industry is an engine of economic growth and a symbol of economic prosperity. Moreover, steel is vital to the nation's economic security as it is extensively used in strategic areas such as defence, power, atomic energy, and in the creation of social and economic infrastructure of the country (12). The production of Iron and Steel comes from an energy intensive process due to large process heating to reduce ore to iron and to a variety of steels thereafter. The iron and steel sector is one among the eight sectors in PAT due to the reason mentioned above. This sector consumes 25% of the total industrial energy consumption (13).

7.1 Iron and Steel Sector in PAT Cycle-1

About 67 Iron and Steel Industries were identified and notified as designated consumers in PAT Cycle-I. The Indian iron and steel industry is broadly classified as Integrated Steel Industry, Direct Reducing Iron, Secondary steel Manufacturing and Ferro-Alloys. By the end of PAT Cycle-1, the energy savings of 1.486Mtoe is expected to be achieved, which is around 22% of the targeted energy saving under PAT Cycle-I.

7.2 Additional Units Location and Energy estimates

The study has identified 567 potential industrial units. About 111 units are located in the state of Maharashtra. Figure 12 illustrates the geographical location of identified units across various states. It is evident that more than 20 identified units are located in major states. The total energy consumption from the identified plants cumulates to 50.8 Mtoe. For the energy and savings assessments, we have assumed the average SEC of identified units based on the following two categories:

- ISP/DRI Plants
- Mini Steel/Steel Processing Plants

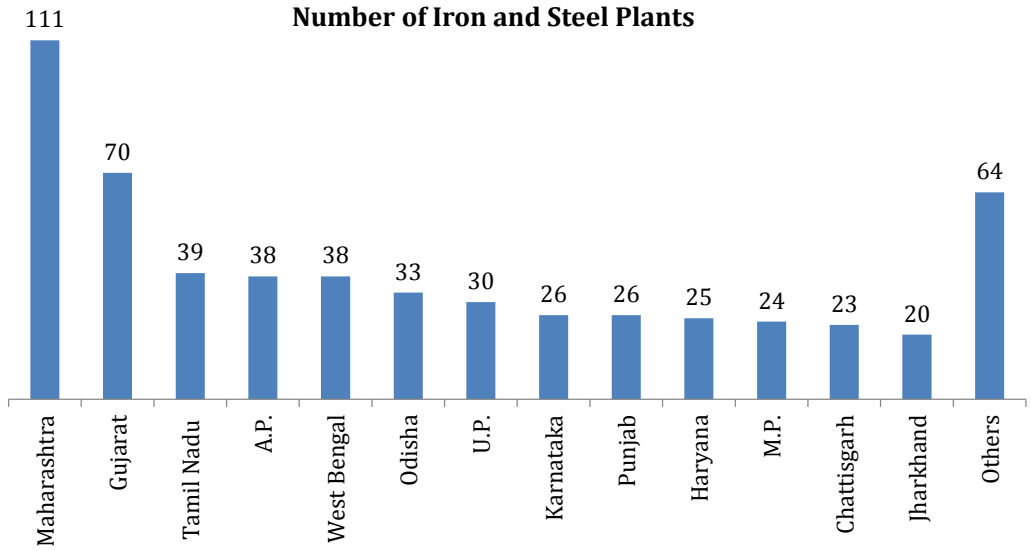


Figure 18: Location of potential Iron and Steel plants across states

7.3 Summary Analysis from PAT Perspective

A comparative review of additional identified steel plants with reference to PAT Cycle-I is provided in Table 33. For ISP/DRI units the average SEC is 0.830 toe/t, and for Mini Steel/Steel processing units is 0.800 toe/t. The applied SEC are average values of categorised units in PAT Cycle-I. About 567 Iron and Steel unidentified plants are reviewed in this study, the average energy consumption is estimated to be about 50.8 Mtoe (twice the sectors consumption in PAT Cycle-I). There is a large scope in deepening this sector as there are additional 225 units consuming more than 30000 Mtoe.

Table 33: Estimated specific energy consumption in comparison with PAT Cycle -I units

Summary	No. of Plants	Total production (Mt)	Total Energy Consumption (Mtoe)	BL SEC Estimates (toe/t)
PAT Cycle-I	67	46.21	25.379	0.5492
New Plants*	567	62.81*	50.79*	0.8086**
Total	**634**	**109**	**76.17**	**0.6986**
*Estimated ** Assumption				

If these 567 units precede with 3% SEC reduction, the estimated energy savings yield to about 1.52 Mtoe. The savings appears 1.02 times higher than the savings from PAT Cycle-I.

The energy consumption and energy saving potential of new plants is depicted in Figure 19 The energy consumption of I&S units in PAT Cycle-I estimates to 25.379 Mtoe whereas with the new units, the energy estimates to around 50.79 Mtoe.

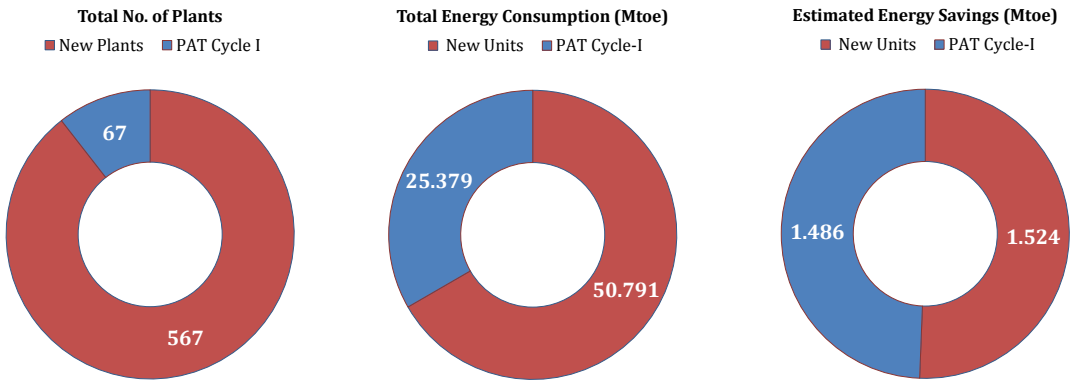


Figure 19: Energy and Savings comparison with the units from PAT-I

7.4 Impact of Variation of Minimum Annual Energy Consumption Norms

In the PAT Cycle-1, 67 units of iron and steel plants were notified as DC. If the threshold energy limits is brought down to 25000 or even further to 10000, about 567 units could play a collective role in larger energy savings. Table 34 to Table 40 tabulates the savings from each plant. Figure 20 provides the overall impact assessment of plants grouped under lowered energy consumption limits, showing the estimated energy savings under each level.

- ***Energy Savings Potential***

About 567 I&S units, which were unidentified in the first round, consume more than 30000 Mtoe and could bring an estimated savings of 1.524 Mtoe toe if a 3% SEC reduction is implicated. It is found that about 225 units consume more than 30000 Mtoe per year. This is a good haul of plants which could be examined in the next round. The collective energy savings of these plants estimates to 1.44 Mtoe (94% of the energy savings of 567 units).

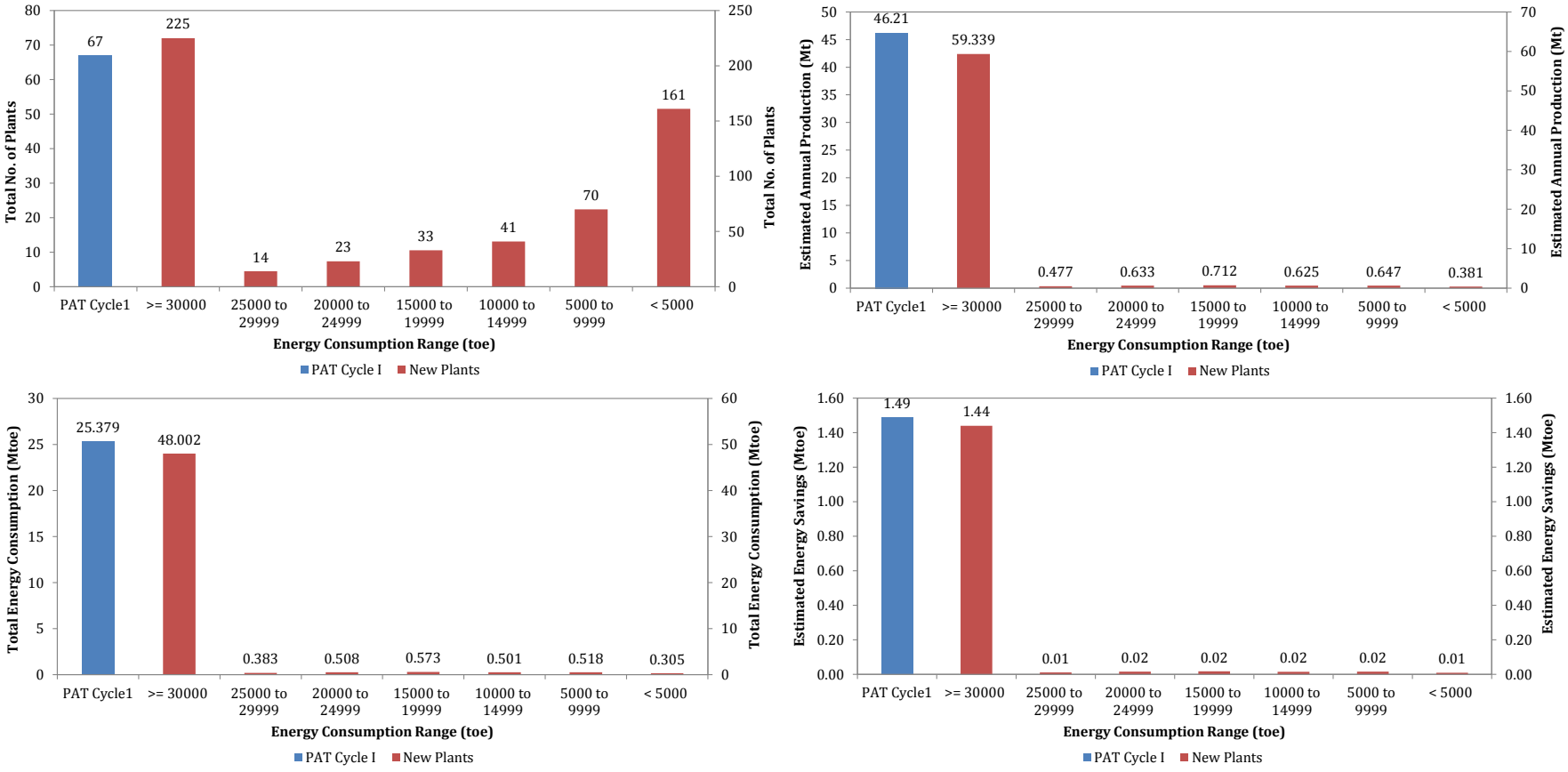


Figure 20: Parametric assessment of plants based on minimum energy consumption range

- ***Energy Consumption >=30000 toe***

Plants with an energy consumption of greater than 30000 toe is given in Table 34. The total number of plants identified is 225 with a total energy consumption of 48Mtoe. The energy saving potential is 1.44 Mtoe.

Table 34: Plants with Energy Consumption >= 30000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN1	Goa	3291560	2731994	81959
ISN2	Maharashtra	2561740	2126244	63787
ISN3	Maharashtra	1399430	1161526	34845
ISN4	Chhattisgarh	1319840	1095467	32864
ISN5	Mumbai	1152000	956160	28684
ISN6	Chandigarh	749710	622259	18667
ISN7	Maharashtra	720000	597600	17928
ISN8	Orissa	573380	475905	14277
ISN9	Chhattisgarh	370800	307764	9232
ISN10	Karnataka	300110	249091	7472
ISN11	Jharkhand	292990	243181	7295
ISN12	Maharashtra	286760	238010	7140
ISN13	Goa	280000	232400	6972
ISN14	Karnataka	279820	232250	6967
ISN15	Chhattisgarh	279440	231935	6958
ISN16	West Bengal	276000	229080	6872
ISN17	Uttar Pradesh	220000	182600	5478
ISN18	Chhattisgarh	219140	181886	5456
ISN19	Chhattisgarh	158190	131297	3938
ISN20	Andhra Pradesh	146280	121412	3642
ISN21	Chhattisgarh	120240	99799	2993
ISN22	Orissa	115200	95616	2868
ISN23	West Bengal	97640	81041	2431
ISN24	Orissa	96000	79680	2390
ISN25	Hyderabad	96000	79680	2390
ISN26	Punjab	96000	79680	2390
ISN27	Gujarat	93690	77762	2332
ISN28	Orissa	93000	77190	2315
ISN29	Orissa	87440	72575	2177
ISN30	West Bengal	87280	72442	2173
ISN31	West Bengal	87200	72376	2171
ISN32	West Bengal	85050	70591	2117
ISN33	Kolkata	84000	69720	2091

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN34	Maharashtra	80000	66400	1992
ISN35	Chhattisgarh	80000	66400	1992
ISN36	Nagpur	80000	66400	1992
ISN37	Orissa	80000	66400	1992
ISN38	West Bengal	80000	66400	1992
ISN39	Orissa	78970	65545	1966
ISN40	Orissa	72280	59992	1799
ISN41	Andhra Pradesh	72000	59760	1792
ISN42	Gujarat	71740	59544	1786
ISN43	Orissa	67200	55776	1673
ISN44	Orissa	66330	55053	1651
ISN45	Jharkhand	60873	50524	1515
ISN46	Maharashtra	60000	49800	1494
ISN47	Maharashtra	54210	44994	1349
ISN48	Bangalore	48000	39840	1195
ISN49	Chhattisgarh	48000	39840	1195
ISN50	West Bengal	48000	39840	1195
ISN51	Orissa	48000	39840	1195
ISN52	Chhattisgarh	48000	39840	1195
ISN53	West Bengal	48000	39840	1195
ISN54	West Bengal	48000	39840	1195
ISN55	Orissa	48000	39840	1195
ISN56	Orissa	48000	39840	1195
ISN57	Andhra Pradesh	48000	39840	1195
ISN58	Orissa	48000	39840	1195
ISN59	Orissa	41430	34386	1031
59		**17688963**	**14681839**	**440455**
Mini Steel Plants / Steel Processing Units				
ISN77	Uttar Pradesh	10738000	8590400	257712
ISN78	Gujarat	3836250	3069000	92070
ISN79	Bangalore	2790400	2232320	66969
ISN80	Maharashtra	1202980	962384	28871
ISN81	Chandigarh	1089600	871680	26150
ISN82	Chennai	1000000	800000	24000
ISN83	Chhattisgarh	856470	685176	20555
ISN84	Bangalore	800000	640000	19200
ISN85	Maharashtra	800000	640000	19200
ISN86	Karnataka	744360	595488	17864
ISN87	West Bengal	630930	504744	15142
ISN88	Tamil Nadu	607740	486192	14585

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN89	Haryana	600000	480000	14400
ISN90	Maharashtra	528820	423056	12691
ISN91	Maharashtra	518238	414590	12437
ISN92	Orissa	494600	395680	11870
ISN93	Andhra Pradesh	480000	384000	11520
ISN94	Haryana	420980	336784	10103
ISN95	Maharashtra	326840	261472	7844
ISN96	Maharashtra	311130	248904	7467
ISN97	Pune	280000	224000	6720
ISN98	Mumbai	280000	224000	6720
ISN99	Gujarat	267860	214288	6428
ISN100	West Bengal	239590	191672	5750
ISN101	Chhattisgarh	236400	189120	5673
ISN102	Punjab	232350	185880	5576
ISN103	Maharashtra	217030	173624	5208
ISN104	Chhattisgarh	204910	163928	4917
ISN105	Jharkhand	201820	161456	4843
ISN106	Chhattisgarh	183010	146408	4392
ISN107	Mumbai	168000	134400	4032
ISN108	Uttar Pradesh	165350	132280	3968
ISN109	Uttar Pradesh	163030	130424	3912
ISN110	Gujarat	160000	128000	3840
ISN111	Orissa	158160	126528	3795
ISN112	Jharkhand	154730	123784	3713
ISN113	Maharashtra	152840	122272	3668
ISN114	West Bengal	152170	121736	3652
ISN115	Maharashtra	150120	120096	3602
ISN116	Orissa	149070	119256	3577
ISN117	West Bengal	143090	114472	3434
ISN118	Gujarat	138040	110432	3312
ISN119	Rajasthan	134030	107224	3216
ISN120	Punjab	133100	106480	3194
ISN121	Delhi	131360	105088	3152
ISN122	Andhra Pradesh	131180	104944	3148
ISN123	Maharashtra	128070	102456	3073
ISN124	Gujarat	127060	101648	3049
ISN125	Maharashtra	126230	100984	3029
ISN126	Mumbai	124000	99200	2976
ISN127	Gujarat	121690	97352	2920
ISN128	Madhya Pradesh	120000	96000	2880

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN129	West Bengal	117770	94216	2826
ISN130	Haryana	115200	92160	2764
ISN131	Chhattisgarh	112880	90304	2709
ISN132	West Bengal	112240	89792	2693
ISN133	Gujarat	108510	86808	2604
ISN134	Haryana	105480	84384	2531
ISN135	Maharashtra	105260	84208	2526
ISN136	Bihar	105210	84168	2525
ISN137	Maharashtra	104340	83472	2504
ISN138	Jharkhand	104000	83200	2496
ISN139	Rajasthan	101400	81120	2433
ISN140	Uttar Pradesh	100000	80000	2400
ISN141	Goa	98570	78856	2365
ISN142	Tamil Nadu	96850	77480	2324
ISN143	Maharashtra	96630	77304	2319
ISN144	Uttar Pradesh	96420	77136	2314
ISN145	Uttar Pradesh	94030	75224	2256
ISN146	Madhya Pradesh	94020	75216	2256
ISN147	Uttar Pradesh	92000	73600	2208
ISN148	Orissa	90580	72464	2173
ISN149	Uttar Pradesh	90400	72320	2169
ISN150	Rajasthan	90260	72208	2166
ISN151	Andhra Pradesh	88020	70416	2112
ISN152	Chennai	87840	70272	2108
ISN153	Uttarakhand	86640	69312	2079
ISN154	Maharashtra	86540	69232	2076
ISN155	Maharashtra	84190	67352	2020
ISN156	Uttar Pradesh	83880	67104	2013
ISN157	Gujarat	83000	66400	1992
ISN158	Uttar Pradesh	82190	65752	1972
ISN159	Rajasthan	80000	64000	1920
ISN160	Punjab	78960	63168	1895
ISN161	West Bengal	76800	61440	1843
ISN162	Gujarat	74490	59592	1787
ISN163	Orissa	74000	59200	1776
ISN164	Kerala	72900	58320	1749
ISN165	Jharkhand	72000	57600	1728
ISN166	Goa	71080	56864	1705
ISN167	Maharashtra	70980	56784	1703
ISN168	Karnataka	69560	55648	1669

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN169	Rajasthan	68670	54936	1648
ISN170	Andhra Pradesh	68640	54912	1647
ISN171	Gujarat	68260	54608	1638
ISN172	Haryana	67610	54088	1622
ISN173	Uttar Pradesh	67380	53904	1617
ISN174	Maharashtra	66720	53376	1601
ISN175	Chhattisgarh	65360	52288	1568
ISN176	Orissa	65200	52160	1564
ISN177	Chhattisgarh	65120	52096	1562
ISN178	Maharashtra	64000	51200	1536
ISN179	Gujarat	62400	49920	1497
ISN180	Andhra Pradesh	60283	48226	1446
ISN181	New Delhi	60000	48000	1440
ISN182	Maharashtra	60000	48000	1440
ISN183	Goa	60000	48000	1440
ISN184	Gujarat	60000	48000	1440
ISN185	Goa	59960	47968	1439
ISN186	Andhra Pradesh	59200	47360	1420
ISN187	Tamil Nadu	58310	46648	1399
ISN188	Jharkhand	58220	46576	1397
ISN189	Gujarat	58000	46400	1392
ISN190	Punjab	57600	46080	1382
ISN191	Uttar Pradesh	55600	44480	1334
ISN192	Andhra Pradesh	55530	44424	1332
ISN193	Uttar Pradesh	54720	43776	1313
ISN194	Uttar Pradesh	54080	43264	1297
ISN195	Maharashtra	52824.82	42259	1267
ISN196	Gujarat	52800	42240	1267
ISN197	Rajasthan	52730	42184	1265
ISN198	Maharashtra	51200	40960	1228
ISN199	Tamil Nadu	50520	40416	1212
ISN200	Madhya Pradesh	50050	40040	1201
ISN201	Punjab	49440	39552	1186
ISN202	Andhra Pradesh	49410	39528	1185
ISN203	Maharashtra	48800	39040	1171
ISN204	Tamil Nadu	48000	38400	1152
ISN205	Madhya Pradesh	48000	38400	1152
ISN206	Gujarat	48000	38400	1152
ISN207	West Bengal	47890	38312	1149
ISN208	Bihar	47200	37760	1132

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN209	Andhra Pradesh	47080	37664	1129
ISN210	Punjab	47080	37664	1129
ISN211	Haryana	46700	37360	1120
ISN212	Maharashtra	46570	37256	1117
ISN213	Tamil Nadu	46170	36936	1108
ISN214	Tamil Nadu	46070	36856	1105
ISN215	Madhya Pradesh	45920	36736	1102
ISN216	Haryana	45810	36648	1099
ISN217	Maharashtra	45720	36576	1097
ISN218	Kerala	45500	36400	1092
ISN219	Karnataka	45130	36104	1083
ISN220	Maharashtra	44880	35904	1077
ISN221	Uttar Pradesh	44030	35224	1056
ISN222	Maharashtra	43720	34976	1049
ISN223	Madhya Pradesh	43700	34960	1048
ISN224	Punjab	43200	34560	1036
ISN225	Bihar	43060	34448	1033
ISN226	Tamil Nadu	42690	34152	1024
ISN227	Gujarat	42250	33800	1014
ISN228	Haryana	40960	32768	983
ISN229	Punjab	40720	32576	977
ISN230	Uttar Pradesh	40400	32320	969
ISN231	West Bengal	40120	32096	962
ISN232	Assam	40040	32032	960
ISN233	Madhya Pradesh	40000	32000	960
ISN234	West Bengal	40000	32000	960
ISN235	Tamil Nadu	39720	31776	953
ISN236	Maharashtra	39280	31424	942
ISN237	Uttar Pradesh	38840	31072	932
ISN238	Chhattisgarh	38610	30888	926
ISN239	Rajasthan	38410	30728	921
ISN240	Andhra Pradesh	37840	30272	908
ISN241	Tamil Nadu	37670	30136	904
ISN242	Gujarat	37610	30088	902
166		**41649976**	**33319981**	**999599**
Total				
225		**59338939**	**48001820**	**1440055**

- ***Energy Consumption 25000 to 29999 toe***

Plants with an energy consumption in the range 25000 to 29999 toe are listed in Table 35. The numbers of plants are 14 with a total energy consumption of 0.383 Mtoe. The energy saving potential for this category is 11487toe.

Table 35: Plants with Energy Consumption in the range 25000 to 29999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN60	Orissa	34240	28419	852
1		**34240**	**28419**	**853**
Mini Steel Plants / Steel Processing Units				
ISN243	Gujarat	37320	29856	895
ISN244	Haryana	36380	29104	873
ISN245	Orissa	36150	28920	867
ISN246	Maharashtra	35120	28096	842
ISN247	Delhi	34870	27896	836
ISN248	Gujarat	34070	27256	817
ISN249	Chhattisgarh	34030	27224	816
ISN250	Uttarakhand	33790	27032	810
ISN251	Maharashtra	33380	26704	801
ISN252	Haryana	33150	26520	795
ISN253	Maharashtra	31790	25432	762
ISN254	Rajasthan	31540	25232	756
ISN255	West Bengal	31530	25224	756
13		**443120**	**354496**	**10635**
Total				
14		**477360**	**382915**	**11487**

- ***Energy Consumption 20000 to 24999 toe***

Plants with an energy consumption in the range 20000 to 24999 toe are depicted in Table 36. The numbers of plants are 23 with a total energy consumption of 0.508 Mtoe. The energy saving potential for this category is 15253 toe.

Table 36: Plants with Energy Consumption in the range 20000 to 24999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN61	Uttar Pradesh	27230	22600	678
ISN62	Madhya Pradesh	25910	21505	645

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN63	Jharkhand	25040	20783	623
3		**78180**	**64889**	**1947**
Mini Steel Plants / Steel Processing Units				
ISN256	Punjab	30530	24424	732
ISN257	Gujarat	30314.8	24251	727
ISN258	Punjab	29970	23976	719
ISN259	Gujarat	29330	23464	703
ISN260	Uttar Pradesh	29040	23232	696
ISN261	Uttar Pradesh	28930	23144	694
ISN262	Karnataka	28830	23064	691
ISN263	Assam	28650	22920	687
ISN264	Pondicherry	28190	22552	676
ISN265	Maharashtra	28080	22464	673
ISN266	Tamil Nadu	27480	21984	659
ISN267	Jharkhand	27430	21944	658
ISN268	Gujarat	26930	21544	646
ISN269	Patna	26400	21120	633
ISN270	Andhra Pradesh	26270	21016	630
ISN271	Maharashtra	26000	20800	624
ISN272	Andhra Pradesh	26000	20800	624
ISN273	Karnataka	25430	20344	610
ISN274	Pondicherry	25340	20272	608
ISN275	Jharkhand	25270	20216	606
20		**554415**	**443532**	**13306**
Total				
23		**632595**	**508421**	**15253**

- ***Energy Consumption 15000 to 19999 toe***

Plants with an energy consumption in the range 15000 to 19999 toe are listed in Table 37. The numbers of plants are 33 with a total energy consumption of 0.572Mtoe. The energy saving potential for this category is 17181toe.

Table 37: Plants with Energy consumption in the range 15000 to 19999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN64	Goa	24000	19920	597
ISN65	Orissa	21290	17670	530

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN66	Karnataka	20430	1695	508
ISN67	Jamshedpur	19200	15936	478
ISN68	Orissa	19200	15936	478
5		**104120**	**86420**	**2593**
Mini Steel Plants / Steel Processing Units				
ISN276	Goa	24470	19576	587
ISN277	Tamil Nadu	24380	19504	585
ISN278	Maharashtra	24140	19312	579
ISN279	Maharashtra	24000	19200	576
ISN280	Rajasthan	23700	18960	568
ISN281	Maharashtra	23595	18876	566
ISN282	Gujarat	23430	18744	562
ISN283	Gujarat	23370	18696	560
ISN284	Rajasthan	23350	18680	560
ISN285	Bihar	22990	18392	551
ISN286	Andhra Pradesh	22580	18064	541
ISN287	Gujarat	22390	17912	537
ISN288	Punjab	22360	17888	536
ISN289	Himachal Pradesh	21710	17368	521
ISN290	Andhra Pradesh	21500	17200	516
ISN291	Rajasthan	21040	16832	504
ISN292	Haryana	20630	16504	495
ISN293	Gujarat	20630	16504	495
ISN294	Orissa	20610	16488	494
ISN295	Gujarat	20440	16352	490
ISN296	Maharashtra	20300	16240	487
ISN297	Punjab	20000	16000	480
ISN298	Maharashtra	20000	16000	480
ISN299	Maharashtra	19860	15888	476
ISN300	Andhra Pradesh	19330	15464	463
ISN301	Gujarat	19160	15328	459
ISN302	Jharkhand	19070	15256	457
ISN303	Delhi	18810	15048	451
28		**607846**	**486277**	**14588**
Total				
33		**711966**	**572696**	**17181**

- ***Energy Consumption 10000 to 14999 toe***

Plants with an energy consumption in the range 10000 to 14999 toe are depicted in Table 38. The number of plants are 41 with a total energy consumption of 0.50 Mtoe. The energy saving potential for this category is 15043 toe.

Table 38: Plants with Energy Consumption in the range 10000 to 14999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN69	Karnataka	17060	14159	424
ISN70	Andhra Pradesh	17060	14159	424.
ISN71	Andhra Pradesh	12090	10034	301
3		**46210**	**38354**	**1151**
Mini Steel Plants / Steel Processing Units				
ISN304	Pondicherry	18510	14808	444.24
ISN305	Chhattisgarh	18300	14640	439.2
ISN306	Maharashtra	18000	14400	432
ISN307	Punjab	17840	14272	428
ISN308	Karnataka	17723	14178	425
ISN309	Uttarakhand	17340	13872	416
ISN310	Kerala	17280	13824	414
ISN311	Haryana	17230	13784	413
ISN312	Karnataka	17056	13644	409
ISN313	Gujarat	16920	13536	406
ISN314	Delhi	16840	13472	404
ISN315	Maharashtra	16360	13088	392
ISN316	West Bengal	16270	13016	390
ISN317	Andhra Pradesh	16240	12992	389
ISN318	Andhra Pradesh	15710	12568	377
ISN319	Madhya Pradesh	15680	12544	376
ISN320	Maharashtra	15590	12472	374
ISN321	Tamil Nadu	15080	12064	361
ISN322	Maharashtra	14900	11920	357
ISN323	Punjab	14850	11880	356
ISN324	Gujarat	14720	11776	353
ISN325	Madhya Pradesh	14400	11520	345
ISN326	Maharashtra	14400	11520	345
ISN327	Assam	14380	11504	345
ISN328	Madhya Pradesh	14280	11424	342
ISN329	Kerala	14250	11400	342
ISN330	Bihar	14100	11280	338
ISN331	West Bengal	14070	11256	337

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN332	West Bengal	13840	11072	332
ISN333	Maharashtra	13781	11024	330
ISN334	Punjab	13550	10840	325
ISN335	Jharkhand	13300	10640	319
ISN336	Gujarat	12940	10352	310
ISN337	Orissa	12840	10272	308
ISN338	Maharashtra	12670	10136	304
ISN339	Punjab	12570	10056	301
ISN340	Gujarat	12570	10056	301
ISN341	Tamil Nadu	12500	10000	300
38		**578880**	**463104**	**13893**
Total				
41		**625090**	**501458**	**15044**

- ***Energy Consumption 5000 to 9999 toe***

Plants with an energy consumption in the range 5000 to 9999 toe are shown in Table 39. The numbers of plants are70 with a total energy consumption of 0.518 Mtoe. The energy saving potential for this category is 15547toe.

Table 39: Plants with Energy Consumption in the range 5000 to 9999 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN72	Tamil Nadu	11900	9877	296
ISN73	Tamil Nadu	9880	8200	246
ISN74	Jharkhand	9480	7868	236
3		**31260**	**25946**	**778**
Mini Steel Plants / Steel Processing Units				
ISN342	Maharashtra	12140	9712	291
ISN343	Gujarat	12100	9680	290
ISN344	Gujarat	12000	9600	288
ISN345	Madhya Pradesh	11660	9328	279
ISN346	Maharashtra	11540	9232	276
ISN347	Maharashtra	11480	9184	275
ISN348	Madhya Pradesh	11360	9088	272
ISN349	Gujarat	11340	9072	272
ISN350	Gujarat	11200	8960	268
ISN351	West Bengal	11170	8936	268

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN352	Maharashtra	11140	8912	267
ISN353	Gujarat	11140	8912	267
ISN354	Kerala	11030	8824	264
ISN355	Uttar Pradesh	11000	8800	264
ISN356	Jharkhand	10890	8712	261
ISN357	Madhya Pradesh	10820	8656	259
ISN358	Punjab	10540	8432	252
ISN359	Maharashtra	10510	8408	252
ISN360	Tamil Nadu	10400	8320	249
ISN361	Tamil Nadu	10400	8320	249
ISN362	Jharkhand	10200	8160	244
ISN363	Karnataka	10110	8088	242
ISN364	Maharashtra	10060	8048	241
ISN365	Kerala	10000	8000	240
ISN366	Orissa	9990	7992	239
ISN367	Maharashtra	9990	7992	239
ISN368	Maharashtra	9950	7960	238
ISN369	Orissa	9720	7776	233
ISN370	Haryana	9706	7764	232
ISN371	Punjab	9670	7736	232
ISN372	Gujarat	9600	7680	230
ISN373	Madhya Pradesh	9460	7568	227
ISN374	Madhya Pradesh	9340	7472	224
ISN375	Karnataka	9220	7376	221
ISN376	Chhattisgarh	9100	7280	218
ISN377	Rajasthan	9020	7216	216
ISN378	Chhattisgarh	8940	7152	214
ISN379	Gujarat	8840	7072	212
ISN380	Gujarat	8440	6752	202
ISN381	Haryana	8410	6728	201
ISN382	Maharashtra	8330	6664	199
ISN383	Uttar Pradesh	8309	6647	199
ISN384	Maharashtra	8300	6640	199
ISN385	West Bengal	8250	6600	198
ISN386	Madhya Pradesh	8190	6552	196
ISN387	Andhra Pradesh	8030	6424	192
ISN388	Punjab	8010	6408	192
ISN389	Maharashtra	8000	6400	192
ISN390	Maharashtra	7970	6376	191
ISN391	Andhra Pradesh	7961	6369	191

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN392	Gujarat	7640	6112	183
ISN393	Rajasthan	7580	6064	181
ISN394	Gujarat	7560	6048	181
ISN395	Tamil Nadu	7440	5952	178
ISN396	Gujarat	7430	5944	178
ISN397	Rajasthan	7340	5872	176
ISN398	Gujarat	7210	5768	173
ISN399	Tamil Nadu	7200	5760	172
ISN400	Chhattisgarh	7080	5664	169
ISN401	Gujarat	7020	5616	168
ISN402	Uttar Pradesh	6990	5592	167
ISN403	Maharashtra	6840	5472	164
ISN404	West Bengal	6800	5440	163
ISN405	Karnataka	6770	5416	162
ISN406	Karnataka	6630	5304	159
ISN407	Tamil Nadu	6560	5248	157
ISN408	Maharashtra	6280	5024	150
67		**615348**	**492278**	**14768**
Total				
70		**646608**	**518224**	**15547**

- ***Energy Consumption< 5000 toe***

Plants with an energy consumption of less than 5000 toe are depicted in Table 40. The number of plants are 161 with a total energy consumption of 0.305 Mtoe. The energy saving potential for this category is 9162 toe.

Table 40: Plants with Energy Consumption <=5000 toe

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISP / DRI Plants				
ISN75	Maharashtra	4700	3901	117
ISN76	Jharkhand	3480	2888	86.65
2		**8180**	**6789**	**204**
Mini Steel Plants / Steel Processing Units				
ISN409	Maharashtra	6110	4888	146
ISN410	Punjab	6000	4800	144
ISN411	Tamil Nadu	5950	4760	142
ISN412	Gujarat	5900	4720	141

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN413	Andhra Pradesh	5860	4688	140
ISN414	Maharashtra	5770	4616	138
ISN415	Punjab	5520	4416	132
ISN416	Haryana	5440	4352	130
ISN417	Himachal Pradesh	5410	4328	129
ISN418	Maharashtra	5280	4224	126
ISN419	Maharashtra	5220	4176	125
ISN420	Tamil Nadu	5200	4160	124
ISN421	Punjab	5100	4080	122
ISN422	Haryana	5020	4016	120
ISN423	Hyderabad	5000	4000	120
ISN424	Maharashtra	4990	3992	119
ISN425	Maharashtra	4890	3912	117
ISN426	Andhra Pradesh	4800	3840	115
ISN427	Kerala	4650	3720	111
ISN428	Gujarat	4630	3704	111
ISN429	Tamil Nadu	4570	3656	109
ISN430	Madhya Pradesh	4400	3520	105
ISN431	Maharashtra	4398	3519	105
ISN432	Uttar Pradesh	4350	3480	104
ISN433	Jharkhand	4340	3472	104
ISN434	Andhra Pradesh	4320	3456	103
ISN435	Maharashtra	4250	3400	102
ISN436	Andhra Pradesh	4180	3344	100
ISN437	West Bengal	4160	3328	99.84
ISN438	Karnataka	4120	3296	98.88
ISN439	West Bengal	4090	3272	98.16
ISN440	Andhra Pradesh	4090	3272	98.16
ISN441	Goa	4070	3256	97.68
ISN442	Maharashtra	4000	3200	96
ISN443	Tamil Nadu	3830	3064	91.92
ISN444	Chhattisgarh	3810	3048	91.44
ISN445	Maharashtra	3750	3000	90
ISN446	Jharkhand	3720	2976	89.28
ISN447	Haryana	3712	2969	89.08
ISN448	Maharashtra	3710	2968	89.04
ISN449	Karnataka	3650	2920	87.6
ISN450	Maharashtra	3600	2880	86.4
ISN451	Gujarat	3542	2833	85.01
ISN452	West Bengal	3530	2824	84.72

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN453	Gujarat	3360	2688	80.64
ISN454	West Bengal	3330	2664	79.92
ISN455	Tamil Nadu	3310	2648	79.44
ISN456	Madhya Pradesh	3290	2632	78.96
ISN457	Maharashtra	3250	2600	78
ISN458	West Bengal	3250	2600	78
ISN459	West Bengal	3190	2552	76.56
ISN460	Maharashtra	3030	2424	72.72
ISN461	Tamil Nadu	3010	2408	72.24
ISN462	Orissa	3000	2400	72
ISN463	Madhya Pradesh	2980	2384	71.52
ISN464	Maharashtra	2910	2328	69.84
ISN465	Haryana	2910	2328	69.84
ISN466	Gujarat	2890	2312	69.36
ISN467	Maharashtra	2820	2256	67.68
ISN468	Karnataka	2810	2248	67.44
ISN469	Gujarat	2810	2248	67.44
ISN470	Tamil Nadu	2800	2240	67.2
ISN471	Maharashtra	2590	2072	62.16
ISN472	Haryana	2570	2056	61.68
ISN473	Haryana	2550	2040	61.2
ISN474	Maharashtra	2510	2008	60.24
ISN475	Gujarat	2500	2000	60
ISN476	Haryana	2410	1928	57.84
ISN477	Orissa	2400	1920	57.6
ISN478	Himachal Pradesh	2400	1920	57.6
ISN479	Jharkhand	2380	1904	57.12
ISN480	Maharashtra	2380	1904	57.12
ISN481	Gujarat	2304	1843	55.29
ISN482	Karnataka	2280	1824	54.72
ISN483	Gujarat	2200	1760	52.8
ISN484	Himachal Pradesh	2160	1728	51.84
ISN485	Gujarat	2140	1712	51.36
ISN486	Madhya Pradesh	2120	1696	50.89
ISN487	Maharashtra	2120	1696	50.88
ISN488	Maharashtra	2110	1688	50.64
ISN489	Maharashtra	1980	1584	47.52
ISN490	Gujarat	1970	1576	47.28
ISN491	Maharashtra	1950	1560	46.8
ISN492	Delhi	1920	1536	46.08

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN493	Kerala	1920	1536	46.08
ISN494	Uttar Pradesh	1880	1504	45.12
ISN495	Uttar Pradesh	1850	1480	44.4
ISN496	West Bengal	1820	1456	43.69
ISN497	Kerala	1790	1432	42.96
ISN498	Uttar Pradesh	1750	1400	42
ISN499	Maharashtra	1730	1384	41.52
ISN500	Gujarat	1690	1352	40.56
ISN501	Haryana	1660	1328	39.84
ISN502	Rajasthan	1660	1328	39.84
ISN503	Orissa	1620	1296	38.88
ISN504	Madhya Pradesh	1490	1192	35.76
ISN505	West Bengal	1460	1168	35.04
ISN506	Haryana	1440	1152	34.56
ISN507	Gujarat	1390	1112	33.36
ISN508	Gujarat	1350	1080	32.4
ISN509	Uttar Pradesh	1350	1080	32.4
ISN510	Tamil Nadu	1310	1048	31.44
ISN511	Gujarat	1290	1032	30.96
ISN512	West Bengal	1240	992	29.76
ISN513	Madhya Pradesh	1240	992	29.76
ISN514	Maharashtra	1230	984	29.52
ISN515	Tamil Nadu	1180	944	28.32
ISN516	Andhra Pradesh	1150	920	27.6
ISN517	Delhi	1150	920	27.6
ISN518	Gujarat	1100	880	26.4
ISN519	Tamil Nadu	1080	864	25.92
ISN520	Gujarat	1050	840	25.2
ISN521	Maharashtra	1050	840	25.2
ISN522	Punjab	1030	824	24.72
ISN523	Maharashtra	1020	816	24.48
ISN524	Gujarat	1020	816	24.48
ISN525	Maharashtra	990	792	23.76
ISN526	Andhra Pradesh	970	776	23.28
ISN527	Maharashtra	960	768	23.04
ISN528	Gujarat	960	768	23.04
ISN529	Karnataka	940	752	22.56
ISN530	Maharashtra	935	748	22.44
ISN531	Maharashtra	820	656	19.68
ISN532	Himachal Pradesh	810	648	19.44

Code	Location	Annual Production (t)	Total Annual Energy Consumption (toe)	Energy Savings (toe)
ISN533	Maharashtra	740	592	17.76
ISN534	Maharashtra	720	576	17.28
ISN535	Andhra Pradesh	720	576	17.28
ISN536	Gujarat	720	576	17.28
ISN537	Tamil Nadu	720	576	17.28
ISN538	Madhya Pradesh	670	536	16.08
ISN539	West Bengal	650	520	15.6
ISN540	Andhra Pradesh	610	488	14.64
ISN541	Maharashtra	600	480	14.4
ISN542	Gujarat	600	480	14.4
ISN543	Tamil Nadu	589	471	14.14
ISN544	Maharashtra	580	464	13.92
ISN545	Bihar	520	416	12.48
ISN546	Himachal Pradesh	510	408	12.24
ISN547	Tamil Nadu	450	360	10.8
ISN548	Tamil Nadu	380	304	9.12
ISN549	Maharashtra	350	280	8.4
ISN550	Gujarat	340	272	8.16
ISN551	Haryana	330	264	7.92
ISN552	Maharashtra	280	224	6.72
ISN553	Uttar Pradesh	270	216	6.48
ISN554	Karnataka	270	216	6.48
ISN555	Tamil Nadu	270	216	6.48
ISN556	Karnataka	230	184	5.52
ISN557	Orissa	200	160	4.8
ISN558	Goa	180	144	4.32
ISN559	Andhra Pradesh	180	144	4.32
ISN560	Delhi	140	112	3.36
ISN561	Tamil Nadu	100	80	2.4
ISN562	Andhra Pradesh	90	72	2.16
ISN563	West Bengal	20	16	0.48
ISN564	Andhra Pradesh	10	8	0.24
ISN565	Gujarat	10	8	0.24
ISN566	Karnataka	10	8	0.24
ISN567	Haryana	9.53	7.62	0.22
159		**373273**	**298618**	**8959**
Total				
161		**381453**	**305408**	**9162**

It is also observed, that there are several small scale plants with a relatively lesser energy consumption and savings. If industrial energy efficiency gets its focus at a micro level, the saving from such small-scale plants collectively yield greater impact.

8 Sectoral Comparison with PAT Cycle-I

Annual Production Sectoral production estimates are comparatively illustrated in Figure 21. The study provided a notable addition of 600 new textile units with an estimated combined production of 147.76 Mt in textile sector. Similarly, other voluminous production numbers are followed by Cement, and Iron & Steel sectors. There were no significant additions in Chlor-Alkali and Pulp & Paper sector.

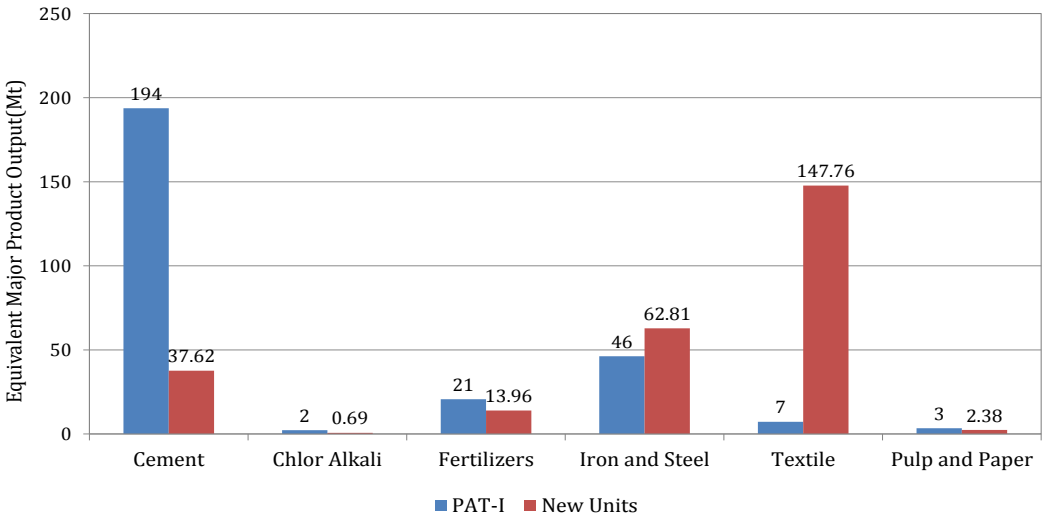


Figure 21: Sectoral Production Comparison

Energy Consumption A sector-wise baseline energy consumption comparison between units in the first PAT Cycle plants and with identified plants is depicted in Figure 22. Significant energy additions of 50.79 Mtoe have come from Iron & Steel sector from 567 units. It is observed that, Iron & Steel and Textile sectors show significant energy consumption additions. The energy addition from Iron & Steel is largely due to its energy intensive operations whereas in the textile sector it is due to the volume of industries captured.

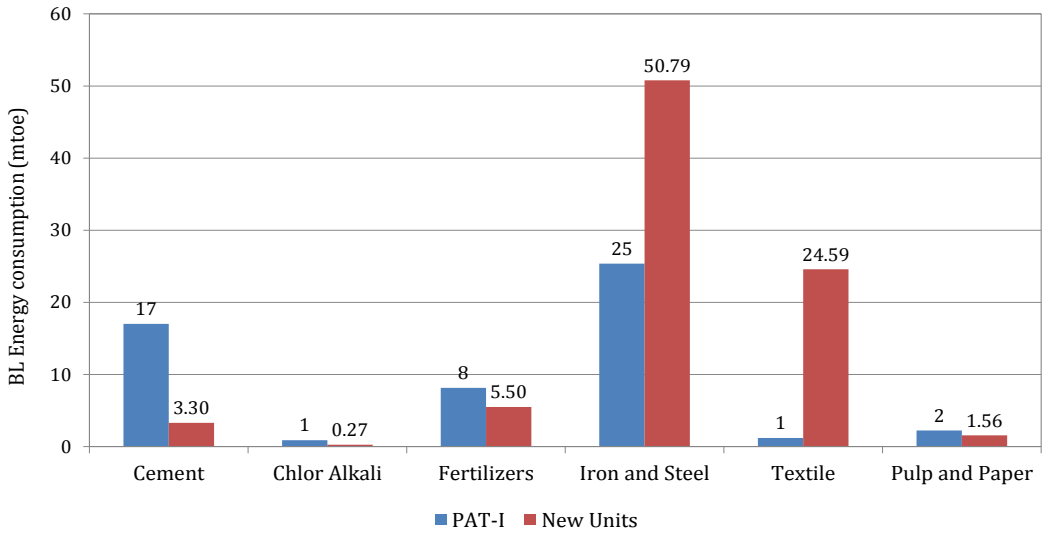
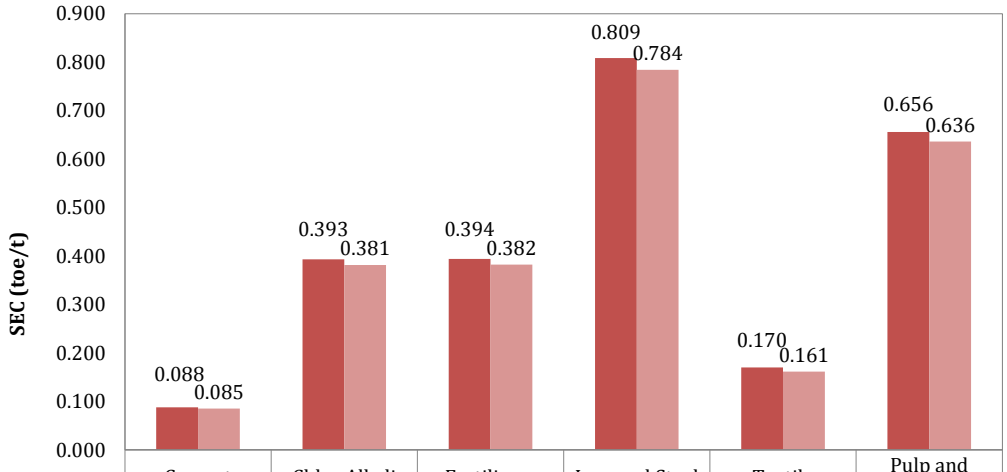


Figure 22: Sectoral Energy Consumption Comparison

Target SEC The overall targeted SEC of six sectors is compared in Figure 21. The illustration additionally compares the targeted SEC set in the First PAT Cycle. It is observed here

in the Iron & Steel sector that, about 5% SEC savings could be estimated from the additional units due to grouping the sector into two categories ISP/SI and Mini steel/Steel processing units.



	Cement	Chlor Alkali	Fertilizers	Iron and Steel	Textile	Pulp and Paper
New units - SEC (toe/t)	0.088	0.393	0.394	0.809	0.170	0.656
New Units - Norm SEC (toe/t)	0.085	0.381	0.382	0.784	0.161	0.636
PAT-I SEC (toe/t)	0.088	0.393	0.394	0.549	0.166	0.656
PAT-I Target SEC (toe/t)	0.084	0.369	0.371	0.517	0.157	0.622

Figure 23: Target sectoral SEC of additional plants

Energy Savings

The energy savings comparison between manufacturing units in first PAT Cycle and with the identified plants by sector is depicted in Figure 24. A major contribution is from textile sector due to a number of units identified, followed by Iron and Steel Sector with savings of 1.52Mtoe

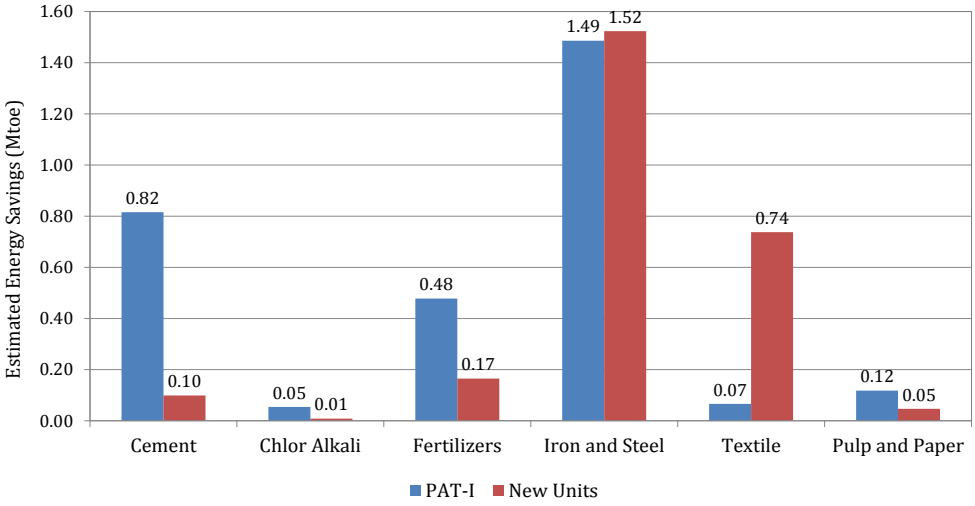


Figure 24: Sectoral Energy Savings Comparison

The following Figure 25 shows the overall view of the study, parallel comparing the analysis with the status of PAT. The overall SEC comparisons highlight opportunity exist in improving energy efficiency, also substantiate the deepening process could facilitate the PAT program for further more cycles.

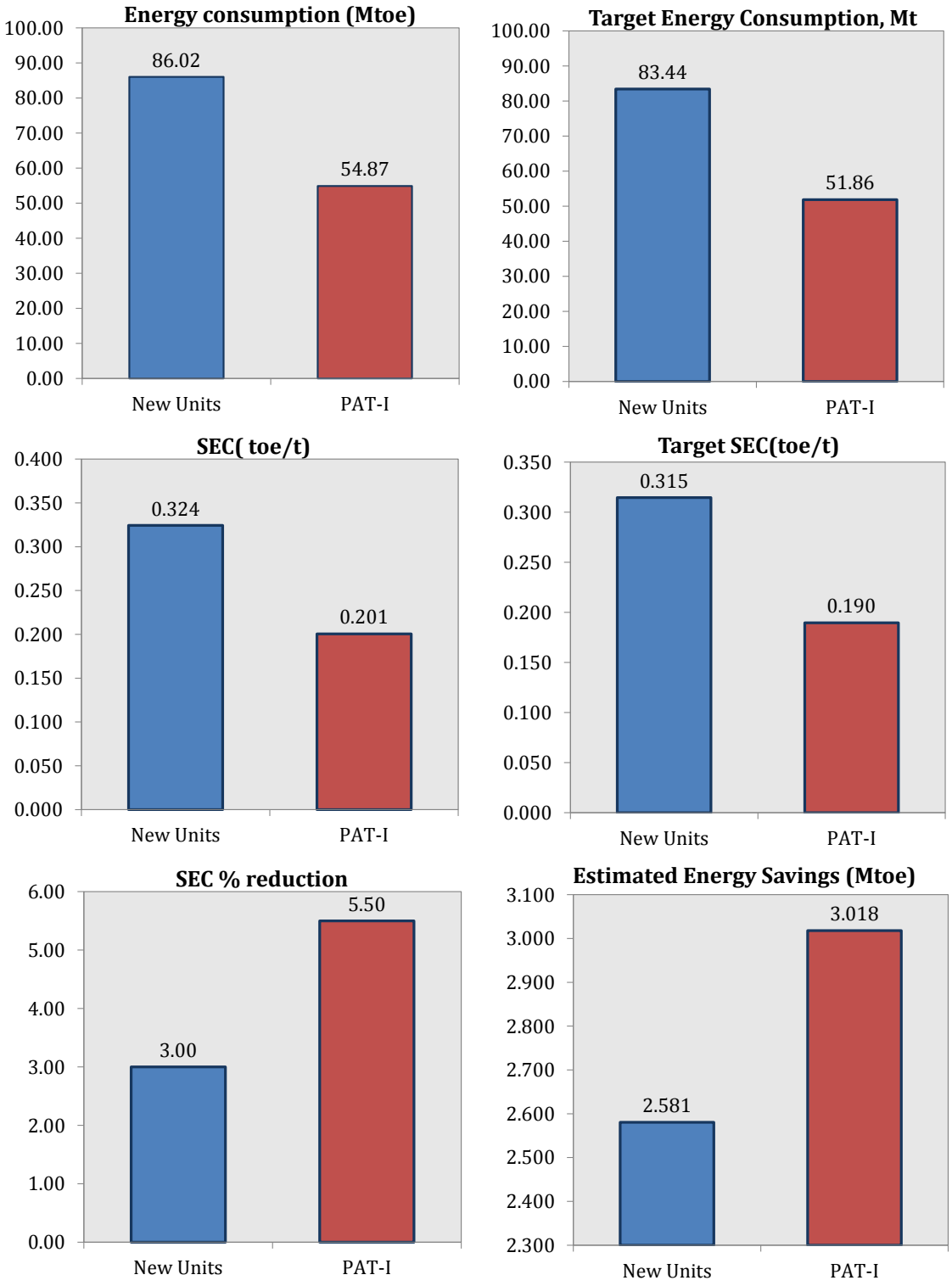


Figure 25: Overall comparison

9 Summary and Conclusion

In the introduction, we discussed the role of PAT by specifically identifying industrial units in six major sectors (Cement, Chlor-Alkali, Textile, Pulp & Paper, Fertilizer and, Iron & Steel) and setting sectoral target for energy efficiency along with an energy saving related trading procedure in order to achieve a significant reduction in energy consumption. In this context, a number of industrial units have already been identified (designated consumers) and targeted SEC reductions have been set which is expected to improve the energy efficiency by 2014-15. This study makes an attempt to identify if more units could be added to the existing list of sectors leading to PAT "deepening". In addition, the implications of PAT deepening in each sector were analysed. The study addresses the implications of PAT deepening with not only the new units qualified, based on the minimum consumption limit set by PAT, but also by identifying a set of new units which could qualify with successively lower minimum energy consumption norms. The latter kind, because of the large numbers, adds significance to the study.

The study provides a PAT focused analysis to estimate the energy savings from the newly identified designated consumers from the survey. The study has also reviewed 1357 additional units with an estimated energy consumption of about 86 million ton of oil equivalent (Mtoe) from cement, fertilizer, iron and steel, textile, pulp and paper and Chlor-Alkali sectors. If PAT is deepened, a significant amount of energy savings could be achieved especially in the sectors of Paper and Pulp, Textile and Iron & Steel. The study has proceeded with an assumption of a 3% target reduction to the entire 1357 units across six sectors. The estimated sectoral savings by PAT deepening is a useful indicator to PAT-policy makers in choosing appropriate areas of significance and potential.

Another important finding from this study there are a large number of small-scale units which do not fall under the PAT criteria of notifying as DC. The impact assessment shows these savings could be huge at a unit level and also benefit the industry to become efficient and competitive through the enabling framework of PAT. Following is a brief of each sector in this study.

The cement sector includes a total of 57 manufacturing units with an average SEC of 0.088 toe/t product. The total energy consumption of this sector is 3.3 Mtoe. The total energy consumption is about 3.3 Mtoe. The sector energy savings estimate is 0.01 Mtoe (99138 toe).

The new study includes a total of 7 manufacturing units in Chlor-Alkali with an average SEC of 0.393 toe/t of product. The total energy consumption estimated for this sector is 0.271 Mtoe. The estimated savings is 8252 toe.

The pulp and paper sector includes a total of 39 manufacturing units with an average SEC of 0.656 toe/t of product. The total energy consumption of this sector is 1.56Mtoe. The estimated savings is 46746 toe.

The fertiliser sector includes a total of 87 manufacturing units with an average SEC of 0.394 toe/t of product. The total energy consumption of this sector is 5.5Mtoe. The estimated savings is 0.165 Mtoe.

The textile sector includes a total of 600 manufacturing units with an average SEC of 0.166 toe/t of product. The total energy consumption of this sector is 24.59Mtoe. The estimated savings is 0.737 Mtoe.

The iron and steel sector includes a total of 567 manufacturing units with an average SEC of 0.8086 toe/t of product. The total energy consumption of this sector is 50.8Mtoe. The estimated savings is 1.523 Mtoe.

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11 Appendix I Questionnaire

	Industrial Production and Energy Consumption Questionnaire							
Name of the unit								**Code**
Address								
Contact								

[A] Production Information				
		Year 1	**Year 2**	**Year 3**
Primary Production	Mt			
Intermediate Production	Mt			
Import Intermediate Product	Mt			
Exported Intermediate Product	Mt			
Installed Capacity	Mt			
Capacity Utilization	Mt			

[B] Electrical Energy				
	Units	**Year 1**	**Year 2**	**Year 3**
Purchased	M KWh			
Generation through DG sets	M KWh			
Steam turbine	M KWh			
Gas turbine	M KWh			
Co-Generation	M KWh			
Colony/Utility	M KWh			
Exported	M KWh			
Consumed	**M KWh**	**0**	**0**	**0**

Heat rates	**Units**	**Year 1**	**Year 2**	**Year 3**
DG sets	Kcal/kwh			
Steam turbine	Kcal/kwh			
Gas turbine	Kcal/kwh			
Co-Generation	Kcal/kwh			

[C] Fuel Types and Consumption for Power Generation and Process Heating

Qunatity	**Units**	**Power Generation**	**Process heating**	**Power Generation**	**Process heating**	**Power Generation**	**Process heating**
Solid Fuel		**Year 1**		**Year 2**		**Year 3**	
Coal (Indian)	Tonnes						
Coal (Imported)	Tonnes						
Lignite	Tonnes						
Biomass	Tonnes						
Liquid Fuel							
Furnace oil	KL						
HSD	KL						
LDO	KL						
LSHS	KL						
HSHS	KL						
Gaseous Fuel							
LPG	Million SCM						
CNG	Million SCM						
Gas generated	Million SCM						
Others							
Fuel 1	Tonnes						
Fuel 2	Tonnes						
Fuel3	Tonnes						

	Year 1		**Year 2**		**Year 3**	
Fuel Properties	**GCV**	**Density**	**GCV**	**Density**	**GCV**	**Density**
	kCal/kg	**Kg/L**	**kCal/kg**	**Kg/L**	**kCal/kg**	**Kg/L**
Coal (Indian)						
Coal (Imported)						
Lignite						
Biomass						
Furnace oil						
HSD						
LDO						
LSHS						
HSHS						
LPG						
CNG						
Gas generated						
Fuel 1						
Fuel 2						

	Industrial Production and Energy Consumption Questionnaire							
[D] Energy Consumption Assessment								
Energy Consumption		**Year 1**		**Year 2**		**Year 3**		
	Units	**Power Generation**	**Process heating Energy**	**Power Generation**	**Process heating Energy**	**Power Generation**	**Process heating Energy**	
Solid Fuel								
Coal (Indian)	kCal							
Coal (Imported)	kCal							
Lignite	kCal							
Biomass	kCal							
Liquid Fuel								
Furnace oil	kCal							
HSD	kCal							
LDO	kCal							
LSHS	kCal							
HSHS	kCal							
Gaseous Fuel								
LPG	kCal							
CNG	kCal							
Gas generated	kCal							
Others								
Fuel 1	kCal							
Fuel 2	kCal							
[E] Total Energy Consumption								
		Year 1		**Year 2**		**Year 3**		
Solid Fuel	MkCal							
Liquid Fuel	MkCal							
Gaseous Fuel	MkCal							
Others/waste heat	MkCal							
Electrical Purchased Energy	MkCal							
Total Energy	**MkCal**							
[F] Specific Energy Consumption								
		Year 1		**Year 2**		**Year 3**		**Average**
Total Energy Consumtption	**MkCal**							
Total Energy Consumtption	**MTOE**							
Gate to Gate SEC	**MkCal/ t**							
Gate to Gate SEC	**MTOE/ t**							

Industrial Production and Energy Consumption Questionaire

Instruction

Basic Sheet

C4-C8, Please provide the plant names and contact details
[A] Production Information,
[B] Electrical Energy Data
[C] Fuel Types and Consumption
Only the '*Basic Sheet*' needs to be filled by the industry

Calculator Sheet

Programmed worksheet, calculates the following results utilizing the inputs from the information provided in basic sheet.
[D] Energy Consumption Assessment
[E] Total Energy Consumption
[F] Specific Energy Consumption

Note

If GCV have not provided, the values will be taken as per ministry of power gazetted notification Part 2, section 3 , [12th March 2007]

http://www.beeindia.in/miscellaneous/documents/useful_downloads/Background%20Note.pdf

List of Acronyms	
PAT	Perform, Achieve and Trade
BEE	Bureau of Energy Efficiency
NMEEE	National Mission on Enhanced Energy Efficiency
NAPCC	National Action Plan on Climate Change
DC	Designated Consumer
SEC	Specific Energy Consumption
GHG	Greenhouse Gas
ESC	Energy Saving Certificate
TPP	Thermal Power Plant
MAEC	Minimum Annual Energy Consumption
BL	Base Line
CMA	Cement Manufacturing Association
PPC	Portland Pozzolana Cement
OPC	Ordinary Portland Cement
PSC	Portland Slag Cement
NaOH	Caustic Soda
Na_2CO_3	Soda Ash
GDP	Gross Domestic Product
IPPTA	Indian Pulp and Paper Technical Association
P&P	Pulp and Paper
ISP	Integrated Steel Plant
DRI	Direct Reducing Iron
I&S	Iron and Steel

List of Units	
T	Ton
Mt	Million tons
toe	Ton of Oil equivalent
Mtoe	Million tons of Oil equivalent
toe/t	Ton of Oil equivalent/ton

Units Conversion	
1toe	10^7kCal
1kWh	860 kCal
1 kWh	36×10^5 J
1Mtoe	41.87 PJ
1kWh	3.6 MJ

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