camco

CII
Confederation of Indian Industry
Since 1895

ABPS INFRA

"Analysis of the potential of Mandatory Trading in energy saving certificates to drive energy efficiency in the Indian industrial sector"

Contents

I

1 Introduction

This report has been prepared for the Government of India Bureau of Energy Efficiency as part of the UK-India dialogue.

In preparing this report, the consortium of Camco, CII and ABPS have been guided and supported by the British High Commission / DFID India.

The report has several sections:

1. Executive summary
2. Background and context
3. Policy recommendations and observations
4. Lessons learned from international policy experience
5. Possible linking of the proposed PAT scheme with international "carbon markets"
6. Mandatory trading scheme analysis
7. Stakeholder analysis

Appendices include:

- Summary of international carbon/energy efficiency trading schemes
- Records of meetings
- Iron and steel sector case study
- Cement sector case study
- PAT scheme administration costs

The consortium would like to express thanks to the Government of India's Ministry of Power and Bureau of Energy Efficiency, the UK Government's Department for International Development and Department of Energy and Climate Change

We would also like to express our thanks to the many attendees of the various steering group meetings and stakeholder workshops, the informed contributions of whom have been key in building the recommendations and findings of this paper.

2 Executive summary and key recommendations

The manufacturing industry in India accounts for 28% of the national Gross Domestic Product (GDP) and 44.8% of commercial energy use. The power sector now produces over 700,000 GWh per annum from a high level of coal and oil (c50% and 30% respectively). This is forecast to increase as the economy grows at rates of up to 8% per annum. India's energy requirement will be nearly double its current level by 2020; over 1,000 million tonnes of oil equivalent (Mtoe) compared to 534 Mtoe in FY 2007.

In order to reduce the economy's reliance on increasingly competitive primary fuel resources, the Ministry of Power will introduce an industrial energy saving scheme. Initially, only the largest energy users in 9 energy intensive sectors will be covered by the scheme.

This paper sets out several aspects of the scheme's design that could be further developed to most efficiently meet the Ministry of Power's energy conservation objectives.

2.1 Perform achieve and trade

The "Perform, Achieve and Trade" (PAT) mechanism is an innovative and challenging initiative that will be introduced under NMEEE (National Mission on Enhanced Energy Efficiency). The PAT mechanism will assign energy efficiency improvement targets to the country's most energy-intensive industrial units. The targets will be set in such a manner that would reflect the current energy intensity of the installation vis a vis that of other installations in the same sector, and the economic effort involved in achieving the target.

Industrial units that achieve savings in excess of their target will be issued Energy Savings Certificates (ESCerts) for saving in excess of target. Units that underperform can buy these certificates to meet their target compliance requirement. This will ensure that the total desired savings are achieved in the most cost effective manner.

2.2 Scheme coverage

Under the Energy Conservation Act, 2001 (EC Act 2001), industrial units in nine sectors, with energy consumption exceeding specified thresholds, have been notified as Designated Consumers (DCs). Installations from Cement, Fertilizer, Iron & Steel, Paper & Pulp, Railways & Thermal Power Plant with energy consumption of 30,000 metric tonnes of oil equivalent per year or above are identified as DCs, where as for Chlor-Alkali, Aluminium and Textile sector this norm is 12000, 7500 & 3000 metric tonnes respectively. For the first Phase of the PAT scheme, BEE has identified 714 Designated Consumers (as on February 2010).

Over time, the scheme could be expanded to cover additional sites within the covered sectors (for example, by reducing the inclusion thresholds to 20,000 toe / annum). The scheme could also be expanded to other sectors with high energy intensities. In section 10 we set out the opportunity to expand the scheme to other sectors within the Indian economy.

2.3 Target setting using Banding

The proposed target setting methodology combines the use of historical performance factors (installed technology, SKU[1] production) that places the installation into one of multiple bands (Gold, Silver, Bronze, Tin). It then uses a benchmark approach to set targets within those

[1] *Stock Keeping Unit*

bands. It is recognised that some sectors may have only one band and that others may have less than 4.

This is a pragmatic and relatively equitable approach for the setting of targets in Phase 1. It avoids the downside of a purely historical or purely benchmarked approach both of which disadvantage efficient and inefficient installations, respectively. However, the banding approach may present problems over time as there is no provision to move the less efficient companies “up” the banding structure. In order to improve the performance of sites in lower bands with higher energy use statistics, it will be necessary to migrate from targets set with reference to historical performance towards increased use of benchmarking.

One approach could be to set the benchmark for the sites in the “tin” band at the “bronze” level in Phase 2. For Phase 3, “bronze” and “tin” sites could be targeted with reference to a benchmark previously used in the “silver” band. In this way, the Indian economy would transform towards Gold status over time. This approach reflects the trend seen over time in carbon trading schemes to move from historical performance based / grandfathering approaches to benchmark-based targets or full auctioning. 100% auctioning, for example, negates the need to set any targets at all.

There has been discussion of setting targets with reference to “site-specific benchmarking” This is a particularly data and resource intensive approach. The benefits of increased site engagement and participation may be outweighed by this additional resource cost and potential delays to target setting caused by appeals. There is also significant information asymmetry between Government and Industry, with an observed correlation between engagement and lower / looser targets outcomes.

2.4 Denominating the scheme in Energy Saving Certificates measured in metric tonnes of oil equivalent consumed.

As presently conceived, the PAT scheme will operate through the award of energy saving certificates to installations that exceed their targets. Those installations can then sell their certificates to sites that fail to meet their targets. It is envisaged that any certificates will be awarded at the end of the phase (perform, achieve, and trade).

This is a pragmatic approach and enables the scheme to start without necessarily needing a trading architecture in place. It also allows the scheme administrator to verify energy consumption performance before allocating or awarding valuable certificates to sites.

However, we do see two separate limitations with this approach, both of which risk the effectiveness of the scheme in the earlier phases.

1. The ex-post award of certificates will prevent any trading of actual certificates during the first phase (three years) of the scheme. This will mean that there will be no traded price for ESCerts, and the price signal for energy efficiency investments will not be present.

2. We estimate that 87,500 certificates might be issued in any one year[2]. With such a limited volume in circulation and available for trading between installations, there is a strong likelihood of low levels of liquidity, and hence a significant risk to highly volatile prices.

In combination, these issues will result in the benefits of the trading aspect of the scheme being significantly weakened.

By changing the denomination of the Energy Saving Certificate form energy saved to energy used, the scheme could be structured to reflect the allocation methodology used in the EU ETS.

[2] The target reductions set by BEE are expected to be approximately 1.7m in year 1 to 5m Mtoe per annum in year 3, with an average of 3.5m Mtoe over the first 3 years. Over-achievement of the target by 50% of installations at between 0%-10% (average 5%) will save 2.5% of 3.5m tonnes

By allocating a small proportion of the certificates “upfront”, a sizeable volume of certificates would be available for trading, and a clear price signal would be created.

There is also the option of auctioning certificates (however denominated) in order to create a tradable volume in the early phase of the scheme, but we broadly see this as feasible only where ESCerts are denominated in energy usage, and not energy saved.

2.5 Banking

Allowing full banking from Phase 1 to Phase 2 (or Phase 2 to Phase 3) will ensure that a positive and smooth price exists between phases. It will encourage the earliest possible adoption of energy efficiency technologies.

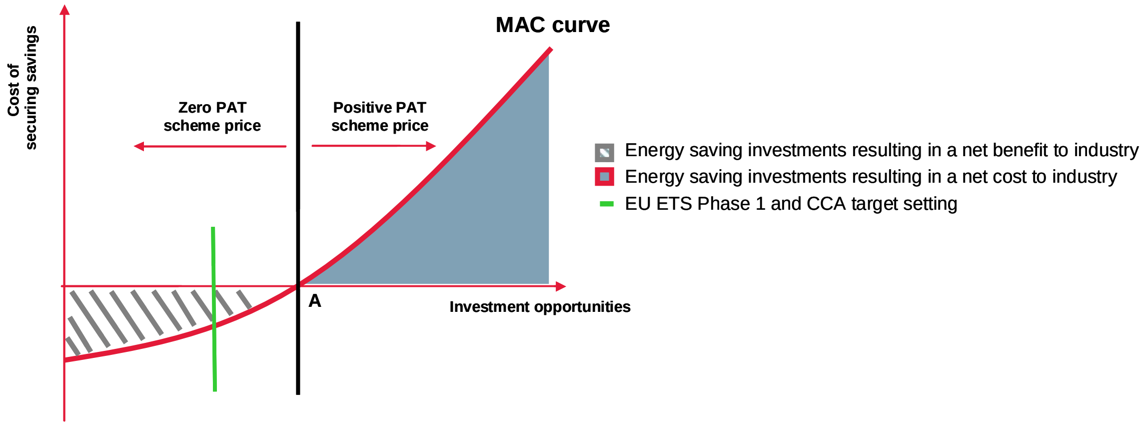
In situations where Phase 1 is over-allocated, there is a risk that banking may allow sites to carry forward large volumes of ESCerts that could reduce the actual performance required in a later phase.

Weak target setting, and not banking, is the cause of over-allocation. Therefore, we suggest that mechanisms are designed to fix the core problem (weak targets) and not reduce the effectiveness of banking by limiting its use. Full banking should be allowed, but with a mechanism to automatically tighten the subsequent phase by the amount of certificates carried forward.

If there is low confidence in the robustness of the target setting and if an automatic tightening mechanism in not feasible, then international experience points to two lessons:

1. that a pilot phase might sensibly be ring-fenced as a “learning by doing” phase, with no banking allowed. Without any flexibility for banking into Phase 2 of the scheme, the first Phase will close with either a zero price, or a very high price / non-compliance penalties being imposed.

2. that in subsequent phases (after a learning by doing phase), banking is a useful mechanism to retain a positive price signal where that phase’s target does still not create a price greater than zero (see diagram below).



3 Background and context

The manufacturing industry in India accounts for 25% of the national Gross Domestic Product (GDP) and 44.4% of commercial energy use. There is a significant level of coal and oil in the energy mix (50% and 30% respectively) with the power sector now producing over 700,000 GWh per annum.

These energy intensive sectors are therefore prime candidate for energy efficiency initiatives, and are the target of the Government of India's proposed trading scheme in energy saving certificates.

The National Mission on Enhanced Energy Efficiency (NMEEE) has been initiated by the Government of India (GOI) with the objective of enhancing energy efficiency in the country. One of the initiatives under NMEEE is development of a market based mechanism to drive delivery of additional energy savings cost-effectively. Following on from this, the Ministry of Power (MOP) has outlined a proposed Perform, Achieve and Trade 'PAT' scheme for Mandatory Trading in energy saving certificates for energy intensive industries.

FCO / DFID India has commissioned Camco, the Confederation of Indian Industry and ABPS Infrastructure Advisory to provide support to GOI's policy development by making recommendations based on a detailed operational review of international trading schemes, analysis and engagement with industry and international stakeholders, and economic / financial appraisal. The project also aims to support the GOI by providing analysis on the potential benefits and issues from linking the proposed PAT scheme to the international carbon markets, and the range of options through which this could be achieved. .

At the same time, it is fully understood that, given the energy security and cost saving benefits, the Government of India is committed to implementing the proposed PAT scheme irrespective of the state of the international carbon markets and the international climate negotiations.

The project deliverables / outputs are as follows:

- Report on lessons learned from the successes and failures of international policy experience on energy efficiency and emissions trading.
- Report on analysis of the risks and opportunities for mandatory trading in energy saving certificates in the Indian context – targeting 9 core sectors as identified by the GOI.
- Report on analysis of International and Indian stakeholders to inform policy recommendations on mandatory trading in energy saving certificates.
- Recommendations for potential policy design on extending trading in energy saving certificates – for example, to the 15 energy intensive sectors identified by GOI, alongside recommendations for securing carbon finance.
- Increased awareness within international government agencies, NGOs (WRI, E3G), and industry groups
- Increased awareness within Indian state and non-state actors on the details of the PAT proposals and development of acceptable mandatory trading proposals.

4 Explanation of the proposed PAT scheme and recommendations

Scheme coverage

The proposed Mandatory PAT scheme will cover in excess of 700 installations in 9 energy intensive Indian industrial sectors. As of February 2010, BEE has identified 714 Designated Consumers (DCs). Usefully, alongside major industrial energy consumers ("downstream") the proposed scheme includes large power stations ("upstream"), as these are large users of energy in their own right, and the application of a PAT target should serve to provide an additional focus on energy efficiency. Those installations covered by the scheme have been notified by the GOI that they are "designated consumers". The Energy Conservation Act 2001 allows the GOI to introduce programmes that target improved energy efficiency.

It should be noted that despite inclusion of the power sector (and other highly intensive energy consuming industries) in the PAT scheme, there are significant numbers of small, inefficient installations that will not be included within the PAT scheme.

There is scope in the future to deepen the scheme to cover additional (smaller) installations within the energy intensive sectors covered by the PAT scheme, or to broaden the scheme by including other sectors of the Indian economy. The project consortium has calculated the potential of this broadening and deepening opportunity, but note that the immediate focus of the GOI is to establish an effective Mandatory PAT scheme as set out above.

Recommendation: Scheme should be deepened and broadened over time for it to deliver against its ambition (of reducing the energy intensity of the Indian industrial sector) and for it to work effectively.

Banding

Given the wide variation of energy intensity within many of the 9 sectors, the GOI is likely to introduce a series of performance ranges as part of its approach to target setting. The approach will place installations in performance bands that are based on historical efficiency performance, and give each band an improvement target. In this way, all installations are likely to be required to improve, with the least efficient likely to be given deeper energy efficiency improvement target.

This approach combines elements of historical performance and comparative benchmarking to establish targets that take into account current technology employed and historical performance (including early actions taken to introduce more efficient technologies).

Alongside this approach is a potential mechanism to introduce further fairness to the process. The GOI is considering setting targets based on the payback period of energy efficiency investments. One sector (or band within a sector) with low investment (abatement) costs could be given a higher target than sectors with higher abatement costs and longer payback periods.

Recommendations:

1. This approach is slightly more complicated than has been adopted for schemes elsewhere. Plus, in case of the Indian industrial sectors, sectoral associations lack the institutional capacity to play a significant role in supporting the implementation of such a scheme. Focus for BEE should be both on internal capacity building to implement the scheme and on awareness generation.
2. There will be instances where, for certain sectors, the technological differences and therefore the bandwidth will be minimal and it is recommended that the banding approach is not adopted in such instances.
3. International benchmarks cannot be used directly in the banding approach. However, best practice international benchmarks should be considered for the "gold" band.

4. The right incentive structure should be put in place for installations to move "up" into a cleaner band. This will allow the scheme to progressively move away from the banding approach to a single benchmark for a sector.
5. One of the incentives could be the availability of international carbon finance. The scheme could be a potential NAMA subject to further work on appropriate MRV requirements and negotiation of baselines.

Energy intensity versus "absolute" energy usage

The PAT scheme as proposed is based on energy intensity rather than an absolute measure of energy usage. To translate energy intensity into absolute energy usage it will be necessary to multiply by actual volume of production. The advantage of an intensity-based scheme is that it allows absolute energy usage growth while rewarding improved energy efficiency. A further advantage is that savings made "downstream" are not automatically of benefit to the upstream producers (as they are in the EUETS, and similarly does not create challenges for upstream producers if consumption increases downstream). This is because the reduced consumption reduces the volume of electricity demanded from the power generation sector. It does not affect the intensity target, and so power producers do not benefit from downstream energy efficiency measures, and are neither adversely affected.

The PAT scheme will translate energy intensity performance into actual energy savings at the end of a period to enable the trading of a unit of energy saved: metric 'tonnes of oil equivalent' (toe).

Many international emission trading schemes developed to date have focussed on "absolute" limits on emission reductions. The EU-ETS is an absolute (capped) scheme that can be viewed as a special-case intensity scheme (one where forecast growth is set at zero). The UK Climate Change Agreements have instead adopted (primarily) energy intensity targets.

We note that it is also possible under a capped scheme like the EU ETS to set an absolute (known/ex ante) target that allows for future economic (volume) growth.

Energy saving certificates vs energy usage allowances

The second feature to note is that the proposed scheme will trade energy-saving certificates and not energy usage allowances. By contrast, the EU-ETS uses emission allowances (EUAs), rather than "emission reductions" as its base unit. By denominating the scheme in "energy saving certificates", the certificates issued match the objective of the scheme – energy *saving*, rather than targets on energy *usage*.

The notable difference is in the volume of units in circulation. Approximately 2bn EUAs (of any one vintage) circulate but the forecast "shortage" (i.e. the target overall emission reduction) is only c200m tonnes. Generally speaking, higher volumes will lead to higher market liquidity and less price volatility.

The use of energy saving certificates, coupled with an intensity-based target, has led the Government of India to adopt an ex-post allocation of tradable certificates. If the Government of India so wished, it would be feasible (though slightly more cumbersome) to instead denominate the scheme in "energy usage allowances" that could be allocated in advance.

The rationale for the adoption of an every savings unit is based on the decision to award energy saving certificates "ex-post" – i.e. once the savings have been made and verified such that there is low risk of erroneous (over) allocations of certificates. One of the main reasons for such an approach is the lack of reliable data regarding consumption by designated consumers. Issuance of certificates ex-post and in lower volumes (than energy usage allowances) may make the scheme more manageable.

There are some disadvantages of ex-post allocation of energy saving certificates:

- During the first period of scheme operating based on ex-post allocation, no certificates will be spot traded, dampening the market price signal. In theory, business may react by over (or under) investing, leading to a sub-optimal allocation of capital and resources.[3]
- During subsequent periods, there will be energy saving certificates available for trading, though volumes will be lower compared to a system based on energy usage allowances. CCA experience indicates this could create liquidity, price discovery and volatility problems – with trading (and price spikes) concentrated around the compliance period of the year. If the objective of the PAT scheme is to raise awareness of EE measures that have zero (or revenue enhancing) marginal cost of abatement opportunities amongst industry then it is not necessary to focus of the "trade" aspect of the scheme. However, if the Government of India see trading as the optimal route to securing least cost energy efficiency measures, then the trading aspect (and market confidence in it) should be given appropriate consideration.
- When certificates are issued at the end of the first period, there will be mismatch between the quantity of certificates issued and the quantity demanded by underperforming sites. CCA experience indicates it is likely that firms generally over-achieve their targets, with industry surprising itself once focus was turned towards energy efficiency. With over-supply, the certificate price would fall to zero and trading would cease. While also true of other trading schemes in early phases, setting targets that will create a shortage of certificates is possible if the Government / regulatory authority has sufficient knowledge and political will to adopt robust targets during negotiation with industry.

There are several intervention mechanisms that can be used to reduce this issue, including banking, and Government supply-side intervention. These are explained briefly below.

"Ex-ante" allocations vs "ex-post" allocation

If denominating the scheme in energy usage allowances it would be possible to issue for free tradable certificates ex-ante (even in an energy intensity scheme where volumes are not known upfront). It would probably not be appropriate to allocate (at no cost to the installation) energy saving certificates in advance, as there is much less certainty on the quantum of potential energy savings than energy usage.

The upfront allocation would have to be based on a forecast / current / recent production volume that could be flexed (further allowances issued or cancelled) during the period. Under such an approach, Indian industry would be under an obligation to surrender a quantity of "energy usage allowances" equal to its energy usage during the compliance period, i.e. after it has reported actual installation performance against the PAT targets.

Reconciliation could be an issue if allowances are wrongly allocated or over allocated. To reduce the risk of cancelling over-allocated allowances, only a proportion of energy usage allowances would be issued in advance (with the remainder issued "ex post" – after reporting actual installation performance against the PAT targets). For example, a percentage (e.g. 50%) of allowances could be issued in advance with the remainder issued ex-post. A (low)

[3] *In practice, the experience from UK CCAs suggests that PAT will have a significant "awareness raising" effect, focusing the attention of business on a major uptake of cost-effective energy efficiency opportunities that are worth taking irrespective of the PAT credit price (i.e. that have a Net Present Value marginal abatement cost below zero, so energy saving is commercially beneficial even when there is a zero PAT credit price alongside the much more important energy price).*

percentage is necessary to mitigate the risk of over-allocation due to inaccurate growth forecasts.

One additional advantage of ex-ante allocation (where the certificates have value) is that they can be used to underwrite investments in energy savings technology.

Recommendations

1. There is a risk that given the Indian industry's limited experience with trading schemes, there is a lack of supply of energy saving certificates in the market. The installations are unlikely to trade in surplus certificates where they lack capability to forecast production and future surplus/ shortage of certificates. Ex-post issuance of energy usage allowances creates liquidity in the market and helps with the price discovery.
2. Financial players other than just the industry participants should be allowed to trade and build the market.
3. Denominating the scheme in energy usage allowances creates more "value" (from the certificates) for the industry that can be used to underwrite investments.

An alternative to ex-ante free issuance: Partial auctioning

An alternative mechanism for introducing price discovery and the ability to trade in the early phases of the scheme would be to auction a series of energy saving certificates (or allowances).

Auctioning either energy saving certificates or usage allowances in advance would improve liquidity in the tradable commodity (in the early years), price discovery and the ability of installations to make appropriate investments decisions. In-year trading would reduce the potential for a large under-or-over supply at the end of any given compliance period because firms would be able to react during the year to market price signals.

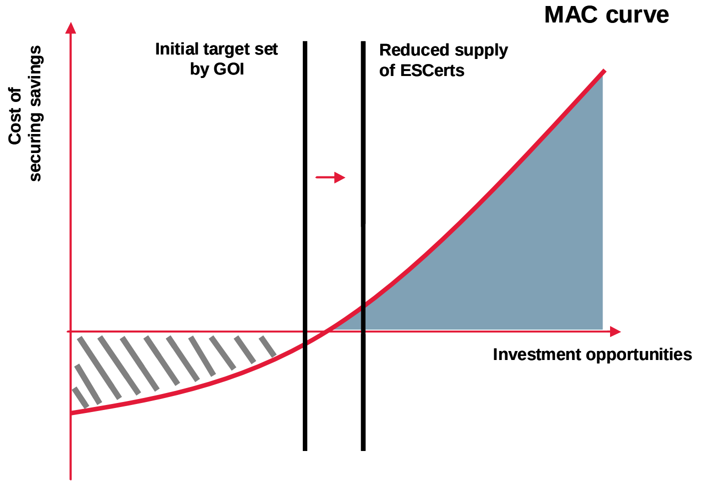
If denominating the scheme in energy saving certificates, the design of the auction process would need to carefully consider the expected level of energy efficiency / integrity of the PAT scheme. It would be necessary to either:

- Reduce by a corresponding number of certificates the "ex-post" issuance;
- Tighten the PAT targets upfront by an amount estimated to correspond to the number of certificates made available at auction;
- Use the auction revenue to buy and retire PAT allowances during the operation of the scheme.

Government intervention on the supply side of the scheme

There are several advantages in creating a fund to allow the GOI to intervene in the PAT scheme, such that price volatility and extreme pricing equilibriums are avoided. This would be "at risk" to the Government, depending on the type and scale of the potential intervention. Ensuring a shortage of certificates or allowances (by setting appropriately "tough" targets) would help guarantee the rewards for those companies making investments in energy efficiency technologies.

A fund (comprising auction revenue, carbon finance revenue or international public finance) could be used to buy and retire PAT allowances when the PAT price is too low, thus maintaining an incentive to Indian industry to invest in energy efficiency and over-achieve PAT targets. Low prices have been a significant issue with trading schemes (including the CCAs, UK ETS and EU ETS) – that there have been too many sellers and not enough buyers, resulting in low prices and the credibility of the market suffering.



- In order to create a shortage of certificates (and therefore a positive scheme price), the Government of India could take action on the supply side
- The Government of India would need to shift the target towards the right by reducing the supply of certificates in circulation

Recommendations

1. One of the main advantages of ex-ante issuance of certificates is price discovery. Setting up a floor price for the certificates will avoid the need for ex-ante issuance of certificates, and give more confidence to industry to make investment decisions.
2. GOI could potentially purchase certificates at floor price when the market is over-supplied.
3. GOI could consider tightening the targets in Phase 2 to manage over-supply.

Banking

Banking allows an installation that over-achieves its target to carry forward excess certificates to a later phase. Banking is seen as a tool to encourage earliest possible adoption of new technology and enable over-achieving companies to carry forward the benefits of their investments in a situation where prices fall to very low levels.

Banking does however have the disadvantage of allowing a scheme to be “polluted” beyond the first phase if there is a large over-achievement by industry against phase 1 targets (as has occurred in the CCAs, UK ETS and EU ETS). The EU ETS phase 1 did not allow banking of allowances from phase 1 (2005-7) into phase 2 (2008-2012) – which, critically, has helped to preserve the integrity of phase 2.

Recommendations

1. Allow full banking from Phase 1 to Phase 2, as the aim is to reduce energy intensity of the Indian industry as quickly as possible. Also the lack of banking may deter industry from making big investments.
2. New participants stand to be at a disadvantage as the scheme expands. This is particularly true in case of deepening due to their competitors having been included early in the scheme and having the economies of scale to implement energy reduction measures.

Penalties

We understand that the proposed penalty for failing to meet PAT targets (recognising that PAT targets can be met by buying sufficient PAT certificates to bridge any gap) will be proportional to the scale of the shortfall in meeting the PAT target – denominated in toe (metric tonnes of oil equivalent) – multiplied by a factor greater than the unit cost of oil.

The EU ETS (and the UK CRC energy efficiency trading scheme, which begins in April 2010) similarly operate on a basis of proportional fines – of €100/tCO2 (€40/tCO2 in the introductory phase) plus the requirement to retire additional CO2 allowances to bridge the gap. This approach to penalties has driven very high levels of compliance within the EU ETS. Given the Government of India's focus on energy efficiency, it may also want to consider similarly adding (alongside the proposed fine) a requirement to retire PAT certificates to bridge any shortfall.

Recommendation: Penalties should be both for failure to submit data as well as failure to buy certificates.

4.1 Definitions

Mandatory / Voluntary distinction

We note that the PAT scheme, whilst normally described as mandatory, has sometimes been referred to as a "Voluntary action". To be clear, the proposed PAT scheme will be Mandatory for those designated consumers the GOI has notified. It will be binding under Indian law, with penalties for non-compliance (e.g. for those who fail to report basic data, or fail to buy sufficient PAT certificates to meet their PAT target, if they have not improved their own energy efficiency sufficiently).

The proposed PAT scheme is only "Voluntary" in the sense that it is a policy action that the GOI intends to progress irrespective of the outcome of International Climate Change negotiations (and, clearly, the GOI is not required by the international climate negotiations to have a PAT scheme). Nonetheless, the GOI is committed to implementing the proposed mandatory PAT scheme as a domestic measure within the context of the NAPCC, given the energy security and cost saving benefits (alongside the climate co-benefit).

Extending the PAT scheme: Broadening, Deepening and Tightening

The GOI could extend the scheme either on a Mandatory (or Voluntary) participation basis to additional installations, given the substantial energy security and cost saving benefits from doing so. The GOI, if it so wished, could also decide to tighten the targets placed upon participants (again, on either a mandatory or voluntary basis), encouraging enhanced energy efficiency with covered installations. Under a mandatory approach, the GOI would decide those installations to be targeted (for example, applying to the 15 sectors notified by BEE). Under a voluntary extension, some incentives would need to be offered to encourage additional participation (or tighter targets). The UK CCAs have offered an 80% discount on the UK Climate Change Levy, resulting in extremely high levels of participation from UK industry – covering over 50 industry sectors (including steel, glass, cement, paper & pulp, chemicals, down to surface engineering and intensive pig and poultry farming).

A CER = 1 tonne of carbon dioxide equivalent

During this paper, we refer to a global unit of carbon currency as a "CER". It is entirely possible that a new global agreement would create a new unit measurement for carbon, but we use the familiar CER to indicate a metric tonne of carbon equivalent.

5 International trading and energy efficiency schemes

European Union Emission Trading Scheme (EU ETS)

The EU ETS is a mandatory emissions trading scheme covering over 10,000 energy intensive installations across the 25 Member States of the European Union. The Scheme is one of the EU's key measures for delivering its commitments under the Kyoto Protocol and for delivering its objective of demonstrating leadership in reducing emissions of greenhouse gases. Phase 1 of the scheme operated from 2005 to 2007. Phase 2 started in 2008 and will last until 2012, and phase III will operate from 2013 to 2020.

Climate Change Agreements (CCAs)

CCAs are voluntary mechanisms that encourage energy efficiency in energy intensive industries in the UK. The Government has provided an 80% discount from the Climate Change Levy for those industry sectors that agree challenging targets for improving their energy efficiency or reducing carbon emissions. CCAs cover ten major energy intensive sectors (aluminium, cement, ceramics, chemicals, food & drink, foundries, glass, non-ferrous metals, paper, and steel) and there are over thirty smaller sectors with agreements. CCAs were introduced in 2001 and are set to expire in March 2013. However, the Government intends for the scheme to continue until 2017.

CRC Energy Efficiency Scheme (CRC)

The CRC is the UK's mandatory energy saving scheme aimed at improving energy efficiency and reducing carbon dioxide emissions, as set out in the Climate Change Act 2008. It has been designed to raise awareness in large organisations and encourage changes in behaviour and infrastructure. The scheme will affect approximately 20,000 organisations, with around 5,000 of these required to participate in the scheme. The scheme is due to start in April 2010, with a three-year introductory phase.

Tradable White Certificates (TWCs)

Tradable White Certificates are part of mandatory schemes implemented in several EU countries, with varying scope. Under this mechanism, producers, suppliers or distributors of electricity, gas and oil are required to undertake energy efficiency measures for the final user. A white certificate also referred to as an Energy Savings Certificate (ESC) or Energy Efficiency Credit (EEC), is an instrument issued by an authorised body guaranteeing that a specified amount of energy savings has been achieved. The targets vary with countries, due to fragmented markets with different objectives and policy responses. The Italian (Jan 2005) and UK schemes (April 2002) were the first to be implemented followed by France (Jan 2006). TWCs have been implemented or being considered in other EU member states.

United Kingdom Emission Trading Scheme (UK ETS)

The UK ETS was a voluntary emission trading system created as a pilot prior to the mandatory EU ETS. The scheme aimed to secure cost-effective emissions reductions and gave UK companies early experience of emissions trading. Participants ranged from energy intensive industries to the service sector and encompassed both the public and private sector. The scheme ran from 2002-2006.

UK Renewables Obligation (RO)

The Renewables Obligation (RO) is the Government's main policy mechanism for incentivising renewable electricity in the UK. The RO places an obligation on UK suppliers of electricity to source an increasing proportion of their electricity from renewable sources. The RO was introduced in 2002.

Regional Greenhouse Gas Initiative (RGGI)

The RGGI is a mandatory scheme in the United States aiming to reduce greenhouse gas emissions. Ten Northeastern and Mid-Atlantic States have agreed to cap and will reduce emissions from the power sector by 10% by 2018. Approximately 225 fossil fuel-fired electric power plants (25 megawatts or greater) are covered by the scheme. Emission permit auctioning began in 2008, and the first three-year compliance period began in January, 2009.

New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS)

The NSW GGAS is a mandatory scheme aiming to reduce greenhouse gas emissions associated with the production and use of electricity. It aims to achieve this by using project-based activities to offset the production of greenhouse gas emissions. The scheme imposes benchmark targets on all NSW electricity retail suppliers, certain generators and all market customers that take electricity supply in NSW directly from the National Electricity Market. The scheme commenced in January, 2003.

Chicago Climate Exchange (CCX)

CCX is a voluntary, legally binding greenhouse gas reduction and trading system for emission sources and offset projects in North America and Brazil. The companies joining the exchange commit to reducing their aggregate emissions by 6% by 2010. CCX has more than 350 members ranging from corporations, educational institutions and government organisations. The exchange was launched in 2003.

US Acid Rain Programme (ARP)

The ARP is an initiative undertaken by the United States Environmental Protection Agency, aiming to reduce overall atmospheric levels of sulphur dioxide and nitrogen oxides, which cause acid rain. The program primarily targets coal-burning power plants. Phase 1 began in 1995 and Phase 2 began in 2000.

China's Top-1000 Energy-Consuming Enterprises Program

The National Development Reform Commission (NDRC) in China launched the 'Top-1,000 Program,' which targets energy efficiency improvements in the 1,000 largest enterprises that together consume one-third of all China's primary energy[4]. The scheme was launched and aims to save approximately 100 million tons of coal equivalent in 2010.

A brief summary of these schemes is appended at the end of this report.

[4] *Price, L, China's Top-1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China, June 2008*

6 Lessons learnt from international policy experience

This chapter outlines the key considerations for the design of the proposed Indian Mandatory Trading scheme drawing on the lessons learnt from the successes and failures of similar schemes focussing on energy efficiency/ emissions trading. It draws conclusions as to the applicability of elements of policies appraised to the current Indian context and keeping in mind the need for a growth metric to be integrated within the overall scheme.

The text below makes reference to a number of such international, regional or national policies. The analysis largely draws on published literature to draw relevant conclusions. However, where additional insight and clarification was considered useful, this has been supplemented by interviews with industry participants and government departments implementing these schemes. Notes from these interviews are also appended at the end of this chapter for reference.

The analysis covers aspects relating to –

- **Ambition and target setting methodology -** This section echoes the importance of consistent and comprehensive baseline data and discusses the pros and cons of alternative approaches to target setting - using benchmarking versus historical data as baseline, sector versus facility based approach, and absolute versus relative targets. It outlines the benefits of clarity on long term action with intermediate compliance timeframes to facilitate periodic review and enhance market liquidity.
- **Institutional capacity and governance -** This section reflects on the need for integration with existing local institutions, building institutional capacity and where possible avoiding conflict of interest between scheme assessor and regulator
- **Monitoring, reporting and verification -** Key issues discussed include the need to balance data accuracy against costs – plus the significance of creating incentives for self enforcement, and allowing for flexibility and different grades of accuracy to achieve this.
- **Trading arrangements -** This section discusses the parameters that are likely to affect market liquidity and transaction costs such as size and validity of certificate, plus arrangements for ring-fencing, banking or borrowing.
- **Inter-relationships with other international and national compliance schemes -** This section describes the precedents for bilateral or unilateral inter-linkages between schemes, and those with relative and absolute targets. It outlines the need to review the impact of such an arrangement on both schemes, and how unilateral links have been used previously as an effective safety valve.
- **Securing participation and ensuring compliance -** It outlines the mechanisms used to secure industry participation including taxes, penalties or incentives
- **Financial support for industry -** It discuses the relevance of financial support mechanisms such as funds and minimum support prices to facilitate investment in energy efficient technologies.

6.1 Scheme ambition

It is critical to define at the outset clear objectives for the policy instrument being designed. Although this may sound obvious, setting clear objectives can help define the framework within which the details of the policy design can be worked out. This also allows for other complimentary frameworks to be developed as part of the policy mix to deliver a common aim or vision. Policy objectives should, for instance, outline

- **What is being targeted – energy or carbon reduction, absolute or intensity of energy use/ carbon emissions?**

While most international and regional schemes such as the EUETS have focussed on absolute carbon reductions, national level schemes will inevitably need to respond to domestic agenda driven by concerns such as energy security and fuel costs.

- **Which sectors of the economy would be targeted, and what proportion of the total energy consumption, carbon emissions or proportion of national GDP from these sectors will be covered by the policy?**

While a number of schemes aim to make maximum impact by targeting the big emitters, it is important to consider competitiveness issues (such as where some firms within a sector may be covered while other may not) and the risk of leakage (that is, potentially newer plants being built just below the qualifying threshold) when defining scheme objectives. The UK 'Climate Change Levy' addressed the competitiveness issue by reducing the employer's national insurance contributions. This, together with reduction in energy use has marginally reduced overall costs for businesses in the last decade[5].

- **Define how it will impact business-as-usual; e.g. by putting a monetary value on carbon/ energy saving through trading mechanisms, taxation, or regulation.**

All three or combinations of these interventions have been used in a number of international policies, such as the overlap between CCL (taxes), CCAs (regulation) and UKETS (trading mechanism) in the UK. The benefit of trading mechanisms is that avoids the issue of price discovery required for taxation and in a well designed scheme should ensure that the scheme's objectives are delivered at the lowest cost.

- **What is the scale of impact/ energy reduction that is targeted and the timescales for achieving it?**

The policy objectives would need to respond to national agenda (such as reduction in energy intensity of the Indian economy), as well what can be realistically delivered within the targeted sectors of the economy.

6.2 Target setting methodology

To ensure that any scheme design is effective and successful, it is imperative that targets reflect the scheme objective and are

- set beyond 'business as usual', that is, over and above energy savings that are being delivered by existing polices and incentives
- realistic, that is, take account of the technical limitations and cost burden
- fair to all participants
- provide clarity to participants in terms of both short and long-terms action required thereby allowing them to factor in the cost of compliance in all investment decisions
- make allowance for growth in developing countries

The need for consistent and comprehensive baseline data: A key limitation experienced in the design of most international and national trading schemes has been the non-availability of reliable baseline data. During Phase 1 of the EUETS, emission caps were passed on to each sector and individual installations in line with NAPs (National Allocation Plans). The data supporting NAPs in different EU countries was of uneven quality and a number of countries greatly over-estimated their emissions. Phase 1 allowed for 95% of the allowances to be given

[5] *Independent analysis by Cambridge Econometrics showed that the CCL package reduced overall costs to UK business as a whole by 0.13%.*

away as opposed to being auctioned. Retrospectively the allowances were found to be excessive and as a result the carbon prices crashed. Not only did Phase 1 have very little impact on carbon emissions across the EU due to generous allocation of allowances, the resultant low market price of carbon failed to transform business strategies and technical processes[6]. The over-allocation issue was later addressed in Phase 2 of the EUETS. The quality of data supporting NAPs ended up being a critical factor to the success of the scheme. The lack of accurate data is also proving to be a limiting factor in designing an effective scheme in case of the proposed Western Climate Initiative.

Although current proposals under the PAT scheme are intensity based rather than absolute targets, this is quite a pertinent issue for the Indian scheme as well. The regulators are at an informational disadvantage in determining/ negotiating baselines with individual firms or sectors, but the aggregate effect of setting baselines too high for individual sources can undermine the effectiveness of a scheme. Accurate baseline data is extremely important to enable setting of realistic but ambitious targets to kick-start such a trading mechanism.

The UK ETS experience had also indicated that excessive generosity in setting the baseline for individual firms can expose the system to excessive allowance allocations and consequently a low permit value.[7] The UK NAP in Phase 1 of the EU ETS built on the lessons learnt from the UK ETS. Caps were based on both top-down data from 'National Atmospheric Emissions Inventory' and bottom-up data from companies participating in CCAs. Retrospectively, it emerged that unlike many other EU countries that greatly over-allocated allowances, the UK allowances in Phase 1 were largely in line with verified Phase 1 emissions.

The UK experience suggests that the reporting data in the initial years of a scheme will play a critical role in target setting for future phases. More recently, this opinion is reiterated in the way RGGI has built on the success of the US Acid Rain Program (ARP) by limiting its coverage to plants that were required to report data under the ARP. This allows RGGI to account for emissions accurately, thereby facilitating a more effective scheme design. This is not to argue for limited coverage – but rather to highlight the importance of using data where it is available.

Benchmarking (making best practice comparisons) versus historical data to set targets: A number of current schemes, whether these be emissions trading (such as the EU ETS or UKETS) or energy intensity based (such as the 'Climate Change Agreements' in the UK) have used the grandfathering approach for target setting wherein each organisation's target is determined relative to its baseline/ historical emissions. For instance, UK industry was considered so diverse in products and manufacturing techniques that benchmarking has not been used for setting targets under CCAs. In most instances, the targets were constructed using a 'bottom-up 'approach wherein each trade association collated information from companies within a sector with regard to the potential for energy efficiency improvements[8]. Targets for the whole sector as a single entity were then agreed with the government. Benchmarking has only been used to inform negotiations on best available technology and general standards to be aimed for. Each company or site has a set improvement to make over their own historical level of energy use. This grandfathering approach has also been used in Phase 1 and Phase 2 of the EU ETS while Phase 3 will use the experience gained from both phases to determine targets. It is intended that, where possible, Phase 3 allocations will take into account EU-wide product benchmarks based on the average performance of the top 10% installations.

[6] *House of Commons, Environmental Audit Committee, The EU Emissions Trading Scheme: Lessons for the Future, 2007*

[7] *Stephen Smith and Joseph Swierzbinski, Assessing the performance of the UK Emissions Trading Scheme", Environmental and Resource Economics, 2007*

[8] *While this is true for most sectors, some sectors with a large number of facilities, such as food and drink, used a top-down approach to set uniform targets across all facilities as the bottom-up approach was considered too cumbersome.*

As elsewhere, the diversity of performance within Indian industry means benchmarking sector wide targets may also prove challenging. The argument against benchmarking, for instance in case of the CCA's, has been that they fail to relate to the site specific characteristics. Using international best practice standards will reward the most efficient firms, but will be punitive on the least efficient installations which may have old technologies in place. On the other hand, allocations based on past emissions, fail to reward early action. The 'Benchmarking' approach overcomes this issue and offers a fairer approach and at the same time a higher degree of transparency to participants[9]. Benchmarking within Indian industrial sectors should therefore be a key consideration for the Indian scheme but at the same time such an approach can be a complex, costly and time-consuming exercise.

Given the wide variation of energy intensity across many of the 9 sectors covered by the PAT scheme, the GOI is considering to introduce a series of performance ranges as part of its approach to target setting. The approach will place installations in performance bands that are based on historical efficiency performance, and give each band an improvement target. The GOI propose the use of 4 'bands' (gold, silver, bronze and tin), with tougher targets for those in lower bands (giving credit for installations that have taken early action). Effectively, this may be seen as incorporating an element of comparative benchmarking (within each band). As performance within a sector or subsector converges, then it might be possible to move towards a single benchmark across all installations.

One approach to target setting being considered for use in determining PAT scheme targets is to keep payback periods for energy saving investments the same across all units and sectors. In the absence of consistent and reliable baseline data and also considering the complex range of technological options to deliver energy efficiency reductions across the sectors and sub-sectors, this will prove to be a very challenging exercise. Such a methodology for setting targets has not been attempted previously. It is an "equitable" approach that does not penalise early action. One sector (or band within a sector) with low investment (abatement) costs could be given a higher target than sectors with higher abatement costs and longer payback periods. The approach will be most effective for industrial sectors that have a wider bandwidth in 'specific energy consumption' (SEC).

Sector versus facility based approach to target setting: One of the main considerations for any scheme is to keep administrative burden to a minimum for both the regulatory authority and the participants. There is in effect a trade-off between efficient burden sharing and the costs of administering legally binding agreements. Agreements with individual forms/ facilities will inevitably have high administrative costs. Sectoral target setting approach offers a simplistic solution but at the risk of free-riding (that is, the potential option to do nothing at the expense of other firms over-performing to meet the collective target).

The experience with CCAs suggest that, in general, companies have been reluctant to enter into an agreement that incentives or penalises collective action. The majority of the sectors have opted for an umbrella agreement between the government and sector association coupled with underlying agreements between the government and each company. This simplifies the verification process and keeps administrative costs low (please refer to section 6.5 for discussion on MRV procedures and cost burden). A limited number of sectors have opted for the underlying agreements to be retained and managed by the sectors. For both these options, sector/ trade associations have a key role to play in terms of negotiating and/or managing these targets on behalf of their members. Specifically in the case of the Indian energy intensive sectors, the institutional capacity of sector associations required to take up such a leadership

[9] *See also Project Performance Corporation, Toward a US Emission Trading Scheme - Lessons learned and linkage to other systems, May 2009*

role needs to be appraised. Also, both these options still don't get around the issue of detailed facility specific performance data.

Clarity on long-term action required: Experience from a number of schemes highlights the benefits of setting targets for a longer-term horizon. Reasonable clarity about the future of the tradable asset, and stability in the policy parameters will be critical to the value of certificates. Policy uncertainty fails to give participants clear long-term price signals, and therefore the incentives to make energy use and investment decisions taking into account expected cost and benefits over that timeframe. The UK ETS has been affected by policy uncertainty in various ways, particularly as its incompatibility with the design of the EU ETS became clear. Feedback from participants in the UK ETS suggested that for some the timescales were short enough to prompt action and changes in behaviour that a longer scheme might not have incentivised as successfully. Others have noted that the timeframe for making and implementing investment decisions is longer than the scheme allowed[2].

Experience from the North American SO_2 market[10] suggests that whether the market reacts to short term surplus such as in the initial years of a scheme when the targets are low or anticipates higher prices in the future in response to long-term targets plays an important role in setting prices in the short term. Prices in the US sulphur market suggest that the market looks out as far out as 6-9 years into the future. This also explains the fact the EU ETS prices have not declined as much as expected despite the recession and accumulated surpluses. Long term targets or anticipation of long-term demand provide price support on the short to medium term thereby reducing market volatility.

Provision for regular review of targets in the initial years: Where targets are set over a long term horizon, it is important that the scheme design allows for future tightening of such targets especially where initial phase data shows they can easily be met, or where technological advancements make them easier to achieve.

Feedback from industry participants and government officials managing UK CCAs has highlighted the importance of periodic target reviews, which are based on learning from initial phases, technological advancements and a growing consensus on stronger climate action. In general, reviews have been much less frequent than compliance periods, (4-5 years for target reviews versus 1-2 year compliance periods). Ideally, the monitoring and reviewing framework should be clearly defined as part of the policy design to minimise policy uncertainty. However, this does create a potential risk that industry will make a cautious effort not to over-achieve to avoid being given tighter targets in subsequent reviews.

On other schemes, a separate inception phase (as with the UK CRC) or a pilot scheme (as was the case with the UK ETS) has been introduced to allow for both capacity building and data collation to inform future targets.

Intermediate compliance timeframes to enhance market liquidity: The other key aspect to consider in terms of target setting is regarding intermediate compliance timeframes. Different approaches have been adopted in different schemes to balance issues such as environmental integrity, monitor progress against targets and cost burden. For instance, compliance timeframes for White certificate schemes within the EU range from three to five years. In the UK, this is three years although energy suppliers report to OFGEM each quarter. In Italy as well, where the compliance timeframe is 5 years, a shorter reporting period is adopted and verification of redeemed white certificates is carried out by AEEG each year.

[10] *New Energy Finance, Carbon Markets – North America Research Note, 22nd October 2009*

Shorter compliance periods enhance market liquidity but tend to generally increase transaction costs and potentially the market price of the certificates. Regular reporting allows for effective monitoring against targets and any discrepancies to be detected well in advance of the compliance deadline. CCAs in the UK set a final target to be achieved at the end of 10 years but also interim two year targets with reporting frequency interlinked to the interim targets. Theoretically, these shorter compliance periods were designed to encourage participation of companies with CCA targets in the ETS market, although other reasons such as high transaction costs, prevented most companies from doing so.

Penalties and incentives could be linked to intermediate compliance targets. In case of the CCAs, this is linked to the Climate Change Levy with a final 2010 penalty to pay back exemptions for the entire period if the site fails to comply.

Allowing for a growth metric: Most current and proposed (emissions, green or white certificates) trading schemes work with absolute targets determined based on an overall cap. However, allowing for growth in the target setting approach is an important consideration in the design of an energy efficiency trading scheme within the Indian industrial sector given the anticipated increase in production across most industrial sectors. The advantage of relative targets is that they eliminate the risk of increase in output levels affecting compliance. It also facilitates setting of benchmark entrance points for new facilities. A further advantage of an intensity-based scheme is that savings made “downstream” are not automatically of benefit to the upstream producers (as they are in the EU ETS). This is because the reduced consumption reduces the volume of electricity demanded from the power generation sector. It does not affect the intensity target, and so power producers do not benefit from downstream energy efficiency measures.

The scheme most relevant in terms of target setting approach to the PAT scheme is the UK CCAs (Climate Change Agreements)[11], the majority of which have been based on relative targets[12] at installation level, i.e. site’s primary energy consumption / unit of production determined based on historical levels of energy use. The units of production itself vary. Some installations choose to measure performance against output such as GJ/ tonne production or GJ/m^2 material processed, whilst others may use an input variable as their throughput denominator i.e. GJ / tonne of raw materials processed. Different products with different units of measurement can be accommodated including relative or absolute energy/ carbon based targets[13].

6.3 Institutional capacity/ governance

The institutional set-up varies considerably depending on the scheme design and local context. Key considerations for effective on-going stable scheme operation are

- institutional capacity
- avoidance of conflict of interest between scheme administrator/ regulator and scheme assessor

[11] CCAs are primarily aimed at driving energy efficiency rather than trading per se, but allow for emissions trading by interfacing with the UK ETS. As such, CCAs are a market based mechanism.

[12] Targets under UK CCAs could be relative, i.e. per unit of output, or absolute, i.e. irrespective of their production level. Four types of targets could be adopted: relative energy (GJ primary energy per unit of output), relative carbon (tons of carbon per unit of output), absolute energy (GJ primary energy) or absolute carbon (tones of carbon).

[13] DECC, UK Climate Change Levy and Climate Change Agreements, Sep 2009

- where possible, integration with existing local institutions

In most circumstances, any conflict of interest between scheme administrator and assessor should be avoided to ensure that the scheme integrity is not compromised. Critical analysis of the Australian New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS) highlights the conflict of interest in IPART (Independent Pricing and Regulatory Tribunal) being the Scheme Administrator as well as the Compliance Regulator, with responsibility for assessing the Scheme with respect to its objectives. Separation of powers between the 'designer', 'operator' and 'assessor' would reduce conflicts of interest, especially where the assessor is publicly reporting on outcomes that are relevant to public welfare and lead to review of the scheme design[14].

The governance role may be shared across public and private sector organisations depending on how the targets are structured. Institutional capacity is critical to all actors in the overall process. As discussed above, sector based targets will require sector/ trade associations to take a more pro-active role. In case of the UK CCAs, sector associations negotiated targets with the government (formerly DEFRA and now DECC) and then allocated the target to units within their sectors either using a 'top down' or 'bottom-up' approach. The experience from CCAs highlights how sector associations act as a focal point of contact with industry, and can play a key role in the management and administration of the agreements, making the process more efficient. They can also support members by providing them relevant advice and guidance[15].

6.4 Simplicity in the scheme design and integration with other national policy instruments

Environmental (energy efficiency and emission reduction) schemes within Europe have been designed to meet differing policy objectives at different times over the past two decades. The result has been a series of policies (well conceived and carefully designed) that often have significant areas of overlap.

Within the UK, for example, one company may (at any one time) have installations that are (or were) covered inter-alia by the European Union Emissions Trading Scheme, the UK Emissions Trading Scheme, The Renewables Obligation, The Climate Change Levy and Climate Change Agreements and, more recently, The Carbon Reduction Commitment. This is in addition to other environmental policies covering water, various wastes, hazardous products and the like.

The Government of India has an opportunity to develop the Mandatory PAT energy efficiency scheme such that additional (overlapping) legislation and policies are not required. It is inevitable that additional legislation will be required to address energy efficiency in smaller enterprises. Where this is the case, the use of an energy intensity scheme upstream (as opposed to absolute caps as in the EU ETS) means that issues of "double counting" will not arise. We note that in future, an issue could arise were India to decide to introduce legislation to tackle carbon emissions while the PAT scheme was in place (because fuel switching can have carbon impacts that differ from the efficiency of fuel utilisation).

Each of the schemes has been designed following significant consultation with industry and the general public. Economists and consultants have been used extensively in the research, design, implementation and review phases. Inevitably, questions, special cases and other detailed complications have arisen that have required specific design features to be

[14] *CEEMA discussion paper, The NSW Greenhouse Gas Reduction Scheme: An analysis of the NGAC Registry for the 2003, 2004 and 2005 Compliance Periods, 2007*

[15] *DECC, Consultation on the form and content on New Climate Change Agreements, March 2009*

incorporated. Within the CCAs, product mix changes and fuel supply interruption risk were originally included in the agreements as transitionary concessions. For instance, targets could be adjusted if a facility switched to a more energy intensive product. This flexibility was withdrawn in 2006. There have also been review periods through which targets could be revised.

By way of further illustration, a key design feature within the UK CRC energy efficiency scheme – a new scheme in which 100% of the allowances will be auctioned, rather than given away for free – will be “performance payments” linked to company position in a published annual CRC Performance League Table. These performance payments are used to ensure the scheme is revenue-neutral to the UK Treasury, and to lower competitiveness impacts on UK business. Whilst this has added to the complexity of the scheme, making price discovery more complex, it provides for much stronger incentives (which, in turn, allows for Government to set tougher CRC caps) to drive energy efficiency improvement. UK Government has argued that these performance payments – linked to the Performance League Table – are key to motivating senior management on energy efficiency, as the CRC targets large non-energy intensive organisations where energy costs are typically just 1% of total operating costs. So, in this case, the additional complexity may be justified.

Overall, however, while certain special cases need to be considered in scheme design, and a degree of flexibility built into the regulatory system, it would be useful to consider the costs and institutional capacity required to implement a more complex scheme in the Indian context. This is especially the case where industry has limited awareness regarding the requirements and dynamics of trading schemes.

6.5 Monitoring, Reporting and Verification

The desirable attributes of a successful MRV framework are

- consistency and reliability
- reasonable accuracy
- flexibility
- low cost of implementation for both scheme participant and administering authority
- rigour that is consistent to establish inter-linkages with other similar schemes

Data accuracy and reliability: Auditing procedures are key to the quality assurance process and reliability of the data. Audits could be carried out by the government agency administering the scheme or by third party verifiers. For instance, under the CCAs, data on energy use and production is reported to DECC (Department for Energy and Climate Change) on a biannual basis. DECC will (commission an external agency to) check the information through site audits for a selected sample of installations. This appears to have worked well, in that audits have not uncovered many cases of significant error in reporting which would call into question the overall accuracy of reporting. However, the government pays for the audits because it would not be fair to have the sample pay a cost that those that were not audited would not have to pay.

Depending on the scale of the scheme and institutional capacity, such auditing procedures may prove to be quite onerous for an implementing agency. DECC have indicated that it is likely that if the CCAs are extended, a move to independent third party verification will be made. EU ETS also allows for third party verification governed by the guidelines issued by the European Commission but with provision for Member States to set up their own certification procedure for qualified verifiers.

Standard electronic reporting formats, as has been the case with US Acid Rain Program (ARP) and a number of other schemes, allow for audits to be performed more effectively. Reporting and checking of problems on a more frequent basis within the overall compliance timeframe allows for errors to be spotted and rectified ahead of the compliance deadline and ensures better quality and reliable data.

Creating incentives for self-enforcement: Experience from the US ARP and NOx Budget Training Programs (NBTP)[16] has highlighted the benefits of strong quality assurance procedures with built-in incentives for better accuracy and self-enforcement. This has included provisions for reduced quality assurance procedures to reward good performance, such as superior test results for monitoring equipment, or alternatively progressively stringent missing data requirements. Establishing clear performance standards has been, however, fundamental to this process.

Balancing accuracy and costs for MRV: In designing MRV framework and systems, balancing the accuracy of determining real savings and costs of monitoring and verification has been most challenging, in particular for energy efficiency focussed schemes such as tradable white certificate schemes in the EU. For such schemes, MRV costs inherently tend to be additional to the baseline cost of operation and therefore tend to be higher than other market systems, such as green certificates. Policy makers can influence MRV costs significantly, particularly in a domestic scheme where few inter-linkages are intended with other international schemes. They can also make them more responsive to the total scale of emissions, so having less complicated MRV procedures for small emitters to keep costs down, as has been the case with the UK CRC.

Most white certificates schemes (e.g. UK EEC – now called UK CERT) have tended to use ex-ante approach wherein energy/ carbon savings are compared to a hypothetical reference scenario for each eligible technology. The UK CERT essentially places an obligation on UK electricity suppliers, requiring them (or their associated third parties) to install measures collectively worth the target carbon saving (where each measure – e.g. a new boiler – has a ‘tagged’ carbon saving associated with it).

Self certification is an important component of the UK CCAs that helps minimise MRV costs. At the end of each interim target period, individual facilities report to their sector association who carry out basic data checks. Both sector associations and individual sites are subject to audit by DECC, chosen on a risk assessment basis. Sector associations are audited in order to check that they can manage and handle the data correctly; and how the targets are developed from the information supplied by the individual units. Sites are audited to ensure they have correctly reported their energy and production data. Verification by a third party is required only if an operator wants to sell it’s over achievement to another operator. In interviews with DECC it has been suggested that the site audits also show a high level of accuracy from self reporting, with very few errors of sufficient magnitude to change the status of a site as far as meeting its targets is concerned.

Allowing for flexibility and different grades of accuracy: The UK CCA’s allow for inter-linkages with ETS schemes, and any over-achievement that is sold or ring-fenced for off-setting against future targets has to be verified to convert it into allowances. Around 80% of the CCA companies have simply never traded using the ETS market while they have exceeded their

[16] John Schakenbach, Robert Vollaro, and Reynaldo Forte, Fundamentals of Successful Monitoring, Reporting, and Verification under a Cap-and-Trade Program, 2006

target by a large amount. This lack of trading is attributed by some to high verification costs which have hindered their entry in the market (surpluses have to be verified before they can be sold).[17] We note that (given the low prices prevailing in the scheme) it is not necessarily straightforward to draw any definitive conclusion from the action (or inaction) of participants.

In other schemes, wider MRV approaches have been developed with different grades of accuracy and resultant costs to allow for greater flexibility. The Italian white certificate scheme covers all energy end-use sectors and has allowed three different evaluation approaches in response to the wider range and complexity of energy saving measures covered under the scheme. AEEG, the Italian Regulatory Authority for Electricity and Gas, allow for energy savings to be determined ex-ante, based on field measurement or an energy monitoring plan. AEEG carries out sample controls to ensure the guidelines are followed. The MRV provisions in the EU ETS are also designed to give considerable flexibility both to Member States and individual installations, with different tiers of methodologies and different degrees of assumed accuracy. By default, the use of the top tiers with the highest rigour of MRV is assumed. However, installations can petition to use lower –tiered methods where it can be demonstrated that the default method cannot be achieved at reasonable cost.

US EPA (Environment Protection Agency) experience[6] from the ARP and NBTP schemes also suggests that a high degree of flexibility in the regulations is desirable although this usually comes at the expense of added complexity. To avoid unnecessary complexity a separate petition process for scheme participants to allow for any clarifications on rules was allowed for within these schemes. Compliance flexibility for low-emitting sources was seen as particularly desirable to reduce the cost and administrative burden.

Establishing interlinkages with other schemes: One of the key considerations for linking schemes is enforcement of common standards especially where bilateral interlinkages are being considered. To achieve this, it is critical that MRV mechanisms are equally rigorous for schemes linked together, which may have an implication on the overall administrative burden. Policy makers can influence MRV costs significantly, particularly in a domestic scheme where a few inter-linkages are intended with other international schemes. For instance, by only targeting emissions outside the EU ETS and CCAs, by exempting relatively small energy users, and taking a simple approach to the scheme rules (particularly monitoring and reporting), the proposed CRC scheme in the UK is expected to have a significantly lower administrative burden than the EU ETS. The administrative burden associated with the CRC is estimated to be approximately £1.7/tC covered per year[18] compared to approximately £9.9 - £25.7/tC covered per year for Group A installations (so called "small emitters") and £2.2 - £3.3/tC covered per year for larger Group B installations under the EUETS.[19]

The MRV procedures under the EUETS were developed to be in line with UNFCCC inventory requirements and may be relevant where interlinkages with international carbon markets are envisaged.

[17] *Glachant, M & Muizon, G de, Climate Change Agreements in UK: A Successful Policy Experience?, 2006*
[18] *Climate Change Simplification project; source: www.parliament.uk*
[19] *Cost of Compliance with the EU Emissions Trading Scheme (AEAT study commissioned by the Environment Agency), June 2006*

6.6 Trading arrangements

Key objectives in the design of certificate markets are to enhance market transparency and liquidity and keep transaction and administrative costs low. The main considerations are

- size of the certificates or credits
- standardised metric
- validity of certificates
- arrangements for ring-fencing, banking or borrowing, and implications on supply and demand

The size of the certificate affects the prices and tradability. The smaller the size of certificates, the higher the administration costs. On the other hand, where the threshold is set too high, certain technologies that deliver small energy savings may be excluded from the system. Emissions trading schemes to date have adopted a tCO_2 as the standardized metric. White certificate schemes in the EU have used fuel standardised, lifetime discounted kWh (UK EEC), kWh primary energy saved (Italy); or kWh lifetime discounted of avoided final energy consumption (France) which complies with the EU Directive on EE&ES (End-use Energy Efficiency and Energy Services). The CCAs use an energy or carbon metric per unit of output, for example, GJ/tonne or GJ/m^2 of product as the "target". In order to trade, conversion calculations are made to translate the saving into tonnes of carbon dioxide (tCO_2).The choice of performance metric will also affect the fungibility of the scheme with other domestic and international schemes.

Shorter lifetimes of certificates may significantly distort market prices as the market will tend to respond to short term demand and supply issues. Most schemes allow for borrowing and/or banking of excess savings across compliance periods – with the introductory phase an important exception to this rule. The fact that it was not possible to bank allowances from phase 1 of EU ETS into phase 2 prevented the over-allocation within phase 1 from "polluting" the integrity of phase 2 (i.e. the problem of phase 1 oversupply and low prices was usefully contained). The UK Government has applied this lesson in the design of the UK CRC – similarly forbidding any banking of allowances from the introductory phase into the subsequent phase. Over the longer term, the use of banking is perceived as being essential in building investor confidence and market stability, especially in multi-phase markets schemes such as the EU-ETS[20].

Such an arrangement in effect acts as a price support for future phases of a scheme and enhances price stability at period ends.

Banking/ borrowing will positively influence market liquidity and stability of prices but high levels (coupled with the expectation of price increase) may result in the hoarding of certificates. Therefore a restricted lifetime over two or more target periods is recommended. Where desirable, levies to banking and interest rates to borrowing may be considered to limit volumes.

Energy saving certificates versus energy usage allowances: Most international trading schemes, such as the EU-ETS, use emission allowances (EUAs), rather than "emission reductions" as its base unit. By contrast, the proposed PAT scheme will trade energy-saving certificates and not energy usage allowances. By denominating the scheme in "energy saving certificates", the certificates issued match the objective of the scheme – energy saving, rather than targets on energy usage. The notable difference is in the volume of units in circulation, especially since the current coverage of the PAT scheme is around 700 installations. As on

[20] *Sunderland J, Retrospective on Phase 1 of the European Union Emissions Trading Scheme (EU-ETS), 2008*

February 2010, BEE has identified 714 designated consumers. Approximately 2bn EUAs (of any one vintage) circulate but the forecast “shortage” (i.e. the target overall emission reduction) is only c200m tonnes. Generally speaking, higher volumes will lead to higher market liquidity and less price volatility.

When volumes are low, for example, compared to a system based on energy usage allowances, UK CCA experience indicates this could create liquidity, price discovery and volatility problems – with trading (and price spikes) concentrated around the compliance period of the year. However, these problems should not be over-stated, given the primary objective of PAT (and CCAs) on driving uptake of cost-effective energy efficiency measures, rather than trading per se.

The options available to address this issue include

- Allowing for trading of ‘energy consumption’ allowances as against ‘energy savings’. The total energy consumption of a facility and therefore the number of allowances will vary depending on the total production output of the facility which may vary/ fluctuate due to a number of external factors. It would therefore necessitate an end of year reconciliation (allocation of additional allowances or forfeiting of allocated allowances at the end of the reporting period) depending on actual production output of the facility.
- opening up the scheme to wider participants by integrating with a voluntary emissions trading scheme
- allowing of RECerts to be traded within the scheme through provision of standard conversion metric between the two types of certificates

The pros and cons of these alternatives are discussed in detail under scheme design recommendations.

6.7 Inter-relationships with other international and national compliance schemes

Linking schemes on a bilateral or unilateral basis will require creating confidence that the traded certificates are at par in terms of, firstly, scheme objectives (e.g. delivering energy savings or carbon savings) and, secondly, in terms of effort/ costs. The first aspect will require increased transparency and accountability, as well as enforcement of common standards. The choice of performance metric will also impact the ease with which proposed scheme interlinks with existing schemes. The second aspect is likely to impact supply and demand between schemes, and therefore the cost of the certificates/ allowances.

Inter-linkages may be established based on certain pre-conditions being satisfied to ensure that the basic scheme objectives are not compromised while allowing for overall abatement costs to be kept within limits. The proposed CRC (climate reduction commitment) in the UK is intended to focus on organisations that fall outside the EU ETS and CCAs. It is, however, intended to feature a “buy only” link (safety valve) to the EU ETS/ international (JI / CDM) carbon markets to ensure that CRC organisations do not face expensive abatement investments. RGGI has a unilateral link with the mechanisms under the UNFCCC, such as the Clean Development Mechanism (CDM) and Joint Implementation (JI), and with any other approved emissions trading scheme if its allowance price remains above $10. It does not include a provision for a bilateral link with another emissions trading scheme. The RGGI cap is designed to build on, and expand state clean energy policies. The scheme focuses on the power sector and GHG reductions in the sector depend in large measure on a foundation of clean energy policies, including energy efficiency programs, renewable portfolio standards, building codes, appliance standards, and the like. Allowing for open links with other international markets may fail to achieve what the scheme is inherently aiming for. This has parallels with the Indian context where energy efficiency in the Indian industrial sector is driven by wider issues of energy security.

There are precedents for overlaps between schemes with relative and absolute targets as has been the case between the CCAs and UK ETS (and now EU ETS) which may be of relevance in terms of how an Indian energy efficiency trading scheme could interlink with international carbon trading mechanisms. CCA participants that over-comply can receive emission credits which can be traded (sold) on the emission market. Alternatively, participants that under-achieve can buy emissions permits on the market to comply with their target. However, to preserve the environmental integrity of the UK ETS – to prevent the absolute carbon market being "flooded" with credits from the relative intensity market – the 'Registry Gateway' restricted CCAs with relative targets in terms of the extent to which they could sell over-achievement. Specifically, transfer of allowances between a relative participant and an absolute one was allowed only where net total flow of permits towards the relative sector was positive. In case of the EUETS, where there is any overlap with CCAs, the CCA target is adjusted to avoid double counting mechanism. However, DECC consultation on CCAs earlier this year proposes targets to be split where there is overlap with EU ETS to avoid complexity.

In the case of the Indian PAT regime, over-achievement could potentially be sold into the international carbon market. Mechanisms to encourage scheme wide over-achievement are outlined in Section 7.5. It is unlikely that over-achievement by individual installations will be sold externally (internationally) in the earlier phases of the scheme. Therefore such an option has been discounted in this work, Scheme or Government level international linkages have been considered, but are again discounted in the short term.

6.8 Securing participation and ensuring compliance

Mandatory trading schemes have been effective in securing industry participation through legal means, with powers to enforce penalties for non-compliance. The EU Emissions Trading Directive sets out how member states have the duty to ensure penalties are 'effective, proportionate and dissuasive,' for non compliance. Financial penalties are commonly enshrined in mandatory schemes: in the case of the EU ETS operators failing to surrender sufficient allowances in Phase I were penalised €40 per tonne CO_2 and in Phase II the EU increased the penalty to €100 per tonne CO_2. For European White Certificate schemes, penalties range from explicit fines to a percentage of the non-compliant party's turnover. For the UK CRC Energy Efficiency scheme, non-participation will be a criminal offence. It is intended to rely on self-certification of energy use, with harsh penalties deterring abuse.[21] The proposed penalties for non-compliance will vary according to the severity of the offence, and like the EU ETS, are planned to become more stringent with subsequent phases.

Ongoing stakeholder engagement is critical in understanding the underlying issues relating to non-compliance and to ensure that the requirements are clearly conveyed to participating firms. Effective communication with the industry will also inform regular reviews and ensure that the targets set are both ambitious and realistic.

In voluntary schemes, securing participation is primarily through tax reductions or lighter touch regulation for those that volunteer – which equally means a higher level of regulation or taxation (or at least the threat of this) applies to those that do not volunteer. The penalty for failing to meet the targets in UK CCAs is to lose the right to pay the lower rate of tax (CCL) for the following two years. The aim of this provision is to minimise the burdens on government and industry. If penalties were retrospective, companies would have to re-pay the difference in tax for the period, and this uncertainty could have an adverse effect on their business.

[21] *DECC, Final Impact Assessment on the Order to implement the CRC Energy Efficiency Scheme, October 2009*

Voluntary schemes dealing with non compliance without these mechanisms may have to rely on penalties for violating private contractual agreements. In the case of the Chicago Climate Exchange, these provisions provide for sanctions including fines and suspension of trading privileges when rules are violated, which could deplete goodwill and environmental reputation. However, these 'weaker' penalties have not been applied, calling into question the credibility of a voluntary approach that does not feature significant incentives (as opposed to an approach such as CDM crediting or the UK CCAs). To prevent opportunism and bad faith a credible and effective set of non-compliance sanctions are seen as not just important, but a necessity.[22]

China's Top-1000 Energy-Consuming Enterprises Program provides an example of penalising non compliance for public sector. In this program, regions and enterprises that do not meet the targets will not be given annual rewards or honorary titles, leaders in state-owned enterprises will not receive annual evaluation awards, and officials will not be promoted without meeting the energy conservation targets.[23]

6.9 Financial support mechanisms

Fiscal incentives such as funds could be considered to support energy efficiency projects (such as through reduced interest loans) and to promote clean energy technologies. Incentives could be structured so as to incentivise action and penalise non-compliance. Under the UK Renewables Obligation, non-compliance penalties[24] are collected in a 'buy-out' fund and redistributed to those suppliers that comply with their targets (with higher payments to those that have higher performance against their targets). The ROC price is therefore the sum of the buy-out price and the expected recycle value. This has resulted in the lifting the market price of the certificates higher than the penalty price. The 'league table' within the new UK CRC – ranking organisations in terms of their energy performance, with CRC auction revenue recycled according to league table position – intends to work in a similar fashion. The RGGI uses revenue from auction of allowances to provide consumer benefits by investing in energy efficiency and clean energy technologies.

Other fiscal incentives could include minimum support prices. Minimum support prices allow participants to factor in the cost of energy /carbon in their investment decisions, especially in the initial years when there is likely to be a lot of uncertainty on the price of the certificates.

In the context of the PAT scheme, the GOI could auction at the start of each phase (or each year) a quantity of PAT certificates. Auction revenue could be placed in a PAT fund, and used to buy PAT certificates when they fell below a certain value. This would provide additional liquidity and security to the PAT market.

[22] *Yang T, The Problem of Maintaining Emissions "Caps" in Carbon Trading Programs Without Federal Government Involvement: A Brief Examination of the Chicago Climate Exchange and the Northeast Regional Greenhouse Gas Initiative, 2006*
[23] *Price, L, China's Top-1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China, June 2008.*

[24] *Buy-out price is stipulated for each megawatt hour of renewable electricity generated which rises each year in line with the retail price index.*

7 Accessing international finance

7.1 The availability of international finance

This section introduces our thinking on how the Government of India might be able to secure international finance to support energy efficiency activities that are likely to lead to reduced emissions of greenhouse gases. We re-iterate that these are the views of the consortium, and do not reflect Government of India or the position of the UK Government We also note that international linkages (in whatever form) presents a medium to long term opportunity.

The international community of Annex 1 countries, through the Kyoto Protocol and associated programmes (both present and likely to be developed) will make finance available to support countries develop along a low-carbon path.

The PAT energy efficiency scheme is likely to have a carbon emission reduction potential (as a co-benefit of the targeting of energy savings) and the GOI / Indian industry would be able to reduce emissions if increased access to capital for clean-technology investment was available.

Several mechanisms for providing this finance have been set out. They include, broadly:

- International public finance
- Offset-based finance

“International public finance” is a collective phrase for the proposed provision of finance that is to be made available to developing countries by Annex 1 nations to help establish programmes to reduce emissions. The finance made available could be government to government, or be allocated through institutions such as the World Bank, EBRD, Fast Start Funds etc.

The distinction being made here is that International Public Finance (IPF) provided under these potential programmes will not generate carbon offsets that Annex 1 countries can use to meet their climate change liabilities. We note that there is already a high level of Venture Capital and Private Equity investments in this field. The consortium feels that this should be excluded from the definition of IPF because it is private sector money invested on existing commercial terms.

By comparison, offset-based finance will be made available on the understanding that emission reductions generated by the investment can be verified and ultimately transferred to an entity that will use the offset as a compliance tool. At present, the project-based flexible mechanisms (CDM and JI) are the most common offset-based programmes in operation.

It is of course possible that hybrid models will develop where IPF is used in the first instance to correct a market failure, and offset finance deployed later to implement projects. For example, IPF could be used to:

- build capacity within host countries that would enable NAMAs to be implemented
- fund research into locally appropriate mitigation technologies
- fund demonstration projects, or support the roll-out of new technology
- seed or de-risk private sector investment funds established to secure offsets from investments

The provision of International Public Finance or offset-based finance could “link” the PAT scheme to the International climate change architecture. It is important to note that the linking envisaged is much broader than the specific linking of two trading schemes (e.g. linking the EU ETS to a future US ETS). Linking can be very loose and may simply be provision of funds to develop capacity within Governments to implement a Nationally Appropriate Mitigation Action).

In this paper we use "linking", "indirect linking", and "connecting" as descriptions of how to create a bridge between the PAT scheme and the (carbon-based) objectives of international climate change policy. Offset-based finance creates a link between projects in developing countries and compliance-based trading schemes, as there is a direct relationship between the provision of funds and the underlying emission reduction performance. Finally, a mechanism through which PAT scheme energy saving certificates can be used for compliance purposes in other trading schemes would be a direct linkage akin to that being discussed between the EU and US trading schemes. While theoretically possible, this form of link is unlikely to be suitable in the short term, as it adds an additional level of administration to the scheme trading functions which is avoided through Government level integration.

7.2 Policy scenarios

The recent round of international negotiations at Copenhagen did not reach a global consensus on the successor to or the continuation of, the Kyoto Protocol. As such, uncertainty surrounds the way forward, and several different policy scenarios could unfold.

We note that given the energy security and cost saving benefits, the Government of India is committed to implementing the proposed Mandatory Energy Efficiency PAT scheme irrespective of any international climate change agreement. Equally, the carbon markets are set to continue, with at least the EU ETS providing a key source of demand for developing country CDM carbon savings. Given this context, it may be possible to link the PAT scheme to the international carbon markets or other sources of international finance.

If international public finance was to be made available, it could enable the scheme's administrator (GOI) or participants to access that finance to enable further efficiencies to be achieved.

This section sets out the different possible linkage options and at a high level, their potential benefits and difficulties.

Scenario 1: A global climate change deal and comprehensive carbon markets

Within a global agreement, it is likely that a global carbon-based currency would be established (similar to but not necessarily a "CER") to enable least cost emission reduction opportunities to be indentified by the market. We therefore describe two crediting mechanisms based on a common carbon currency.

- Project-based ("CDM") crediting under the UNFCCC (or similarly constituted body)
- NAMA-with-crediting (again under the UNFCCC or similarly constituted body)

Scenario 2: A patchwork of national commitments loosely co-ordinated at the international level

No global agreement is reached, but the EU, US and other Annex 1 nations, in partnership with leading emerging economies such an India China and Brazil agree to move forward with a range of bilateral agreements utilising a range of international financing mechanisms.

- Project-based crediting under a range of international / national standards
- Institution-level bilaterally negotiated agreements (e.g. between a developed country government and a developing country government)

We note that Scenario 2 has not been widely discussed at international meetings, and that there is still a strong desire to negotiate a global agreement. As such the linkage mechanism described under scenario 2 should be considered in terms of "indicative possibilities" rather than likely developments.

Scenario 3: No international agreement, and only limited / ad hoc international collaboration

Limited funds might be made available internationally, and therefore no linkage is foreseen. It is important that any potential international linkage mechanism does not impede the core functioning of the PAT scheme. The Government of India has made clear that PAT will proceed irrespective of the state of the international climate negotiations.

7.3 Linkage options under Scenario 1

7.3.1 Project-based (“CDM”) crediting (with high demand for CERs)

Explanation

Companies participating in the Mandatory trading scheme are able to access CDM finance to undertake projects that they would not otherwise have undertaken (the principle of additionality). If those projects improve energy efficiency then (as a by-product of the CDM investment) the project may also contribute to the company’s ability to meet its PAT scheme targets “in house”. For example, fuel switch from low-efficiency coal to new gas-fired boilers would improve both carbon and energy efficiency performance.

Some projects might not have EE co-benefits and would therefore continue to be wholly additional. For example, fuel switch projects might replace a high carbon fuel with a lower-carbon alternative, but may not result in an energy efficiency improvement. On-site renewable electricity generation projects (wind power, industrial waste gas or waste heat recovery) that replace grid-based power would not have EE benefits.

Benefits

- CDM is widely recognised / and relatively well understood within Indian industry
- International and national institutional capacity is in place
- Some projects have entirely independent EE and carbon impacts

Drawbacks:

- Project-by-project assessment of “additionality” has been criticised for its high transaction and administrative costs. Further, additionality concerns could deter some from seeking CDM finance
- Added (potential) complication that the mandatory nature of the scheme would lead to questioning of environmental integrity for some projects where hosts benefit twice from the same investment (firstly in terms of PAT certificates and secondly in terms of CDM credits)

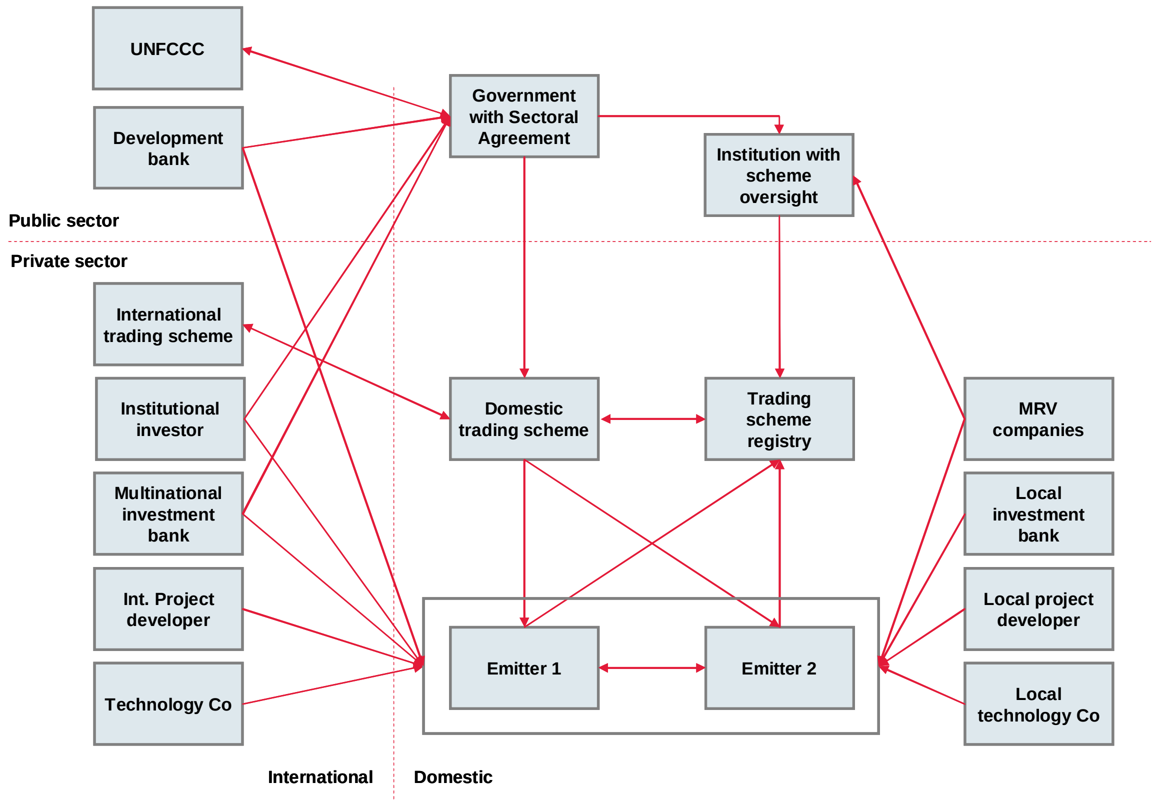
7.3.2 Registration of the PAT scheme as a “NAMA with crediting”

The GOI would register or pledge a certain level of action under the NAMA-with-crediting approach. It would then agree to tighten or go beyond this level – action for which it could receive carbon credits.

The Government of India would then be credited with the PAT scheme’s contribution to lower carbon emissions from the covered industrial sectors. The tightened PAT scheme would likely be credited with a number of CERs after the achievement of the tightened targets (i.e. ex-post), just as the GOI itself proposes to award PAT certificates to Indian industry ex-post.

The government could choose to forward sell these credits to create a cash reserve / investment fund (or it could choose to wait for the credits and take price risk, or it could choose to hedge the exposure by striking a balance between the two approaches). Volume risk would minimal if the scheme operates effectively and GDP growth is not significantly under/over-estimated.

Depiction of PAT scheme as a NAMA-with-crediting



The Government could choose to pass to industry the cash (or carbon credits) raised through a number of mechanisms – including direct allocations of credits or cash, provision of subsidised loans or accelerated capital depreciation allowances. The funds would support industry in meeting the targets.

Alternatively, the Government of India could use the funds to purchase (and potentially retire) energy saving certificates. This could keep the market price above a certain floor (providing certainty for investment decisions). By purchasing certificates, the Government would be (indirectly) rewarding stronger industry performers with an improved price for their excess certificates.

Benefits

- Issuance of credits to Government that can be used for a range of policy initiatives – the discretion would be with Government on how to allocate the funds
- The difference between BAU intensity and the PAT scheme target is “known” in advance and could be translated into a forecast carbon saving

Drawbacks:

- The translation of energy efficiency targets into expected carbon savings would be a challenge (though not insurmountable). It may be too problematic to attempt an ex-ante allocation (crediting in advance of the scheme on the basis of forecast energy efficiency improvement).

- If economic growth is over-estimated there could be an over-issuance of carbon credits (which are "absolute" rather than "relative"). However, this drawback could be addressed by the GOI receiving credits ex-post (i.e. after the PAT scheme has achieved, just as the GOI itself proposes crediting to Indian industry after they have met the PAT targets.[25]

Using the PAT scheme to secure crediting under an international "no-lose" target (NLT)

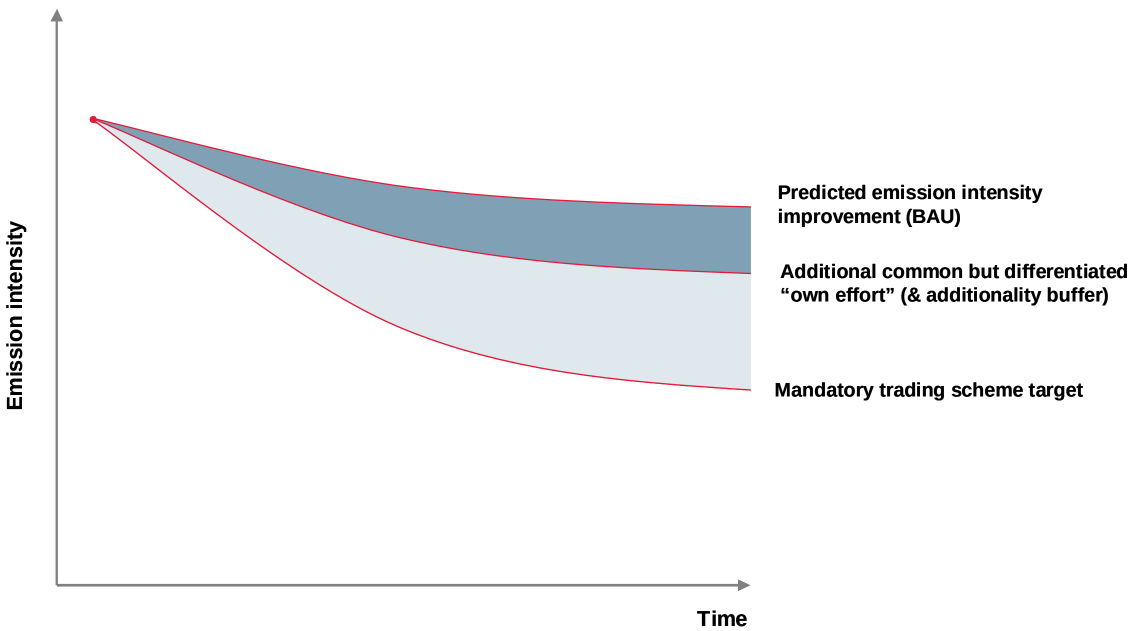


Figure 4.1 shows an intensity-based approach to setting a NLT and a domestic trading scheme. The Government of India establishes an intensity-based domestic trading scheme beneath a no-lose target - represented by the middle line. The agreed NLT is likely to be slightly underneath the BAU intensity (which is shown in this example to be improving over time). The gap between the top two lines represents "own effort" and reflects common but differentiated responsibilities (CBDR).

In order go beyond its agreed target and be eligible for crediting, the government could establish a domestic trading scheme with a target below the NLT / CBDR agreed baseline. The further below the no-lose target line the scheme is set, the more the government would secure in "carbon credit" revenue. The Government would be credited for all performance beyond CBDR and the trading scheme target.

Given the scheme and the NLT is intensity-based, there is no guarantee of absolute emission reductions.

The NLT approach is a subset of 3.1.2 and therefore has similar benefits and drawbacks. It should be noted that the use of a domestic trading scheme underneath a no-lose target does not create any form of "national cap". Rather, this approach gives the Government of India the opportunity to tighten the scheme in return for securing additional international finance.

[25] Technically, it might be possible to do some partial ex-ante allocation (e.g. to allocate credits for 50% of the expected carbon saving in advance, with the remainder allocated ex-post. This would reduce the risk of an over-issuance of carbon credits.

7.4 Linkage options under Scenario 2

7.4.1 Institution-level bilaterally negotiated agreements

Governments or (for example), World Bank, private carbon funds or Buyer collectives (IETA), could partner with developing country governments to develop large project - or entire sector - emission reduction agreements.

One example that has been discussed within the existing round of negotiations is REDD. Partially because Forestry is not seen as a "competitive" sector, proposals have been made to develop mechanisms through which funds are provided to host governments to tackle deforestation (or encourage improved forest management activities).

Wider application of sectoral carbon crediting could be envisaged whereby countries such as the UK (or private carbon credit procurement funds outside the IPF framework) work with developing country Governments to develop investment / emission reduction programmes for certain sectors. An extension of the Near Zero Emissions Coal (NZEC) China programme would be an example of the EU working with China to support the roll-out of CCS technology. Such a programme could be "credited", subject to appropriate agreement on MRV (given this Annex 1 financial support).

Returning to the Indian context, a programme, policy or equivalent "NAMA with crediting" approach could equally apply to the PAT scheme. This could potentially be a large-scale crediting undertaking, requiring the international co-operation of several governments of carbon credits buyers. The issue of acceptable MRV is unlikely to be a problem, since the Government of India (and Indian industry) will want to have robust MRV within the PAT scheme to secure the desired energy efficiency benefits (given the energy security imperative) and also to maintain a working PAT trading market (i.e. those parts of Indian industry buying PAT credits will want to be confident that they are paying for real energy efficiency improvements).

7.4.2 Project-based crediting under a range of international / national standards

The role of traditional CDM within a patchwork of international / national / bilateral agreements is not certain. With no internationally agreed consensus on project-based crediting, but some desire from with the US (in particular) and the EU to source carbon credits, additional project verification routes might develop. For example, the US EPA or Gold Standard organisations might be authorised by trading scheme administrators to create / issue credits for compliance in trading schemes.

While there is likely to be some demand from installations within the EU ETS and the US trading scheme, volumes (and prices) may be subdued. These risks mean that a continuation of CDM is most likely to focus on the least developed countries or sectors that cannot be part of bilateral (sectoral) agreements (see above).

The benefits and implementation difficulties of project based CDM would be similar to under the Scenario 1 policy outcome. It is possible that crediting of projects at installations that are also within a domestic mandatory (energy efficiency) trading scheme would come under increased scrutiny.

7.5 Mechanisms to encourage "over-achievement"

There are two broad approaches that could be utilised to secure "over-achievement":

1. Reducing the supply of certificates in the market such that the scheme tightens (while the scheme is in operation). This could take a variety of forms:

a. Allowing the banking of certificates from one phase into the next would shorten the current phase (but increase supply in the subsequent phase)

b. Allowing an international link where certificates can be exchanged for EUAs or CERs (a strong and direct form of linkage)

c. Government of India buys back certificates (for example so that a minimum price is always achieved)

d. Private sector speculators who are not part of the scheme buy certificates and then exchange it for a carbon credit offset

2. Tightening the overall targets upfront or during a periodic review

Not all of these approaches are consistent with international public finance or offset finance models. Banking, for example is only a temporary removal of supply and should not be credited or otherwise financially supported. The direct linkage approach is most suited to an off-set based link, whereby energy trading certificates are exchanged for carbon credits. A buy-back programme could be funded by either IPF or a carbon credit finance flow (for every certificate purchased by GOI or the private sector buyer, X offsets are generated).

An upfront tightening of the scheme targets is an attractive alternative approach and could be funded either through credits or IPF. The advantage is that it provides greater regulatory certainty to the participants, and it can also be combined with any of 1a, 1b or 1c.

Generally, these “over-achievement” mechanisms work well when a “whole-scheme” approach to crediting is taken. 1b requires neither government nor project-based crediting as the link is “direct” into another trading scheme.

It is likely to be easier to negotiate and structure a tightening of the scheme (for example from the start of Phase 2) where the financial incentive through offset finance is provided direct to GOI. GOI can then determine how to use this finance to support industry make the necessary investment decisions.

7.6 Initial conclusions

- If it is considered advantageous to secure off-set based finance, then the policy scenario (global agreement vs patchwork of bilateral deals) is less important than the choice of whether to build a link through the scheme as a whole or the individual participants. The Government of India alongside the international community should discuss which approach is preferred.
- The apparent advantage of directly financing scheme participants may not be as strong as the advantages of crediting the PAT scheme as a whole. Scheme participants will have the necessary investment incentives made available through the trading scheme pricing signal, and there are complimentary policy tools that can help with securing finance (soft loans, accelerated depreciation etc.)
- Further questions to be discussed / answered: What would you have to do to the scheme design to make this work and what are the pros and cons of each approach
    - Participant incentives
    - MRV
    - Efficacy / integrity
    - Industry engagement / participation

8 Energy saving potential for proposed PAT scheme

This section analyses the potential energy savings available from the proposed PAT scheme. It includes

- Overview of Proposed PAT Scheme
- PAT Scheme Coverage
- Approach for Estimation of Potential Savings
- Overview of Designated Sectors
- Estimation of Savings Potential

India's economic growth averages 8 percent over last five years and is projected to sustain the momentum in the medium term with a robust growth of 9%[26] as it was on before the global crisis. With supply of primary and commercial energy being the driving force in modern day economy, India's energy requirement is likely to grow to 1818 million tonnes of oil equivalent in FY 2032 from 534 million tonnes in FY 2007 in tandem with economic growth[27]. However, with limited energy resources in the country and performance of power sector below expectation, provision of reliable and cost effective energy supply is going to be uphill task.

Unless economic growth is decoupled from increased energy consumption, the energy shortage situation will continue to have adverse impact on economic growth. Further, greenhouse gas emissions associated with energy consumption will hamper vulnerable population in the country. In addition the fossil fuel reserves are finite and fast depleting, hence sustainability in energy sector can be ensured only through adoption of large-scale energy efficiency improvements in different sectors. Thus, the energy efficiency is the quickest, the cheapest and the cleanest way to extend India's energy supplies.

In view of this, Government of India has been promoting greater energy efficiency through various policy measures. With increasing awareness of climate change and ongoing discussions on way forward for reduction in GHG emissions, EE has assumed even greater attention and policy makers across the world are increasingly recognizing the urgency of improving energy efficiency. Increased attention at the policy level is also visible with the release of the National Action Plan on Climate Change (NAPCC) with "National Mission on Enhanced Energy Efficiency (NMEEE)" as one of the missions under NAPCC. The most important aspect of NMEEE is the Perform Achieve and Trade (PAT) initiative which is a market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.

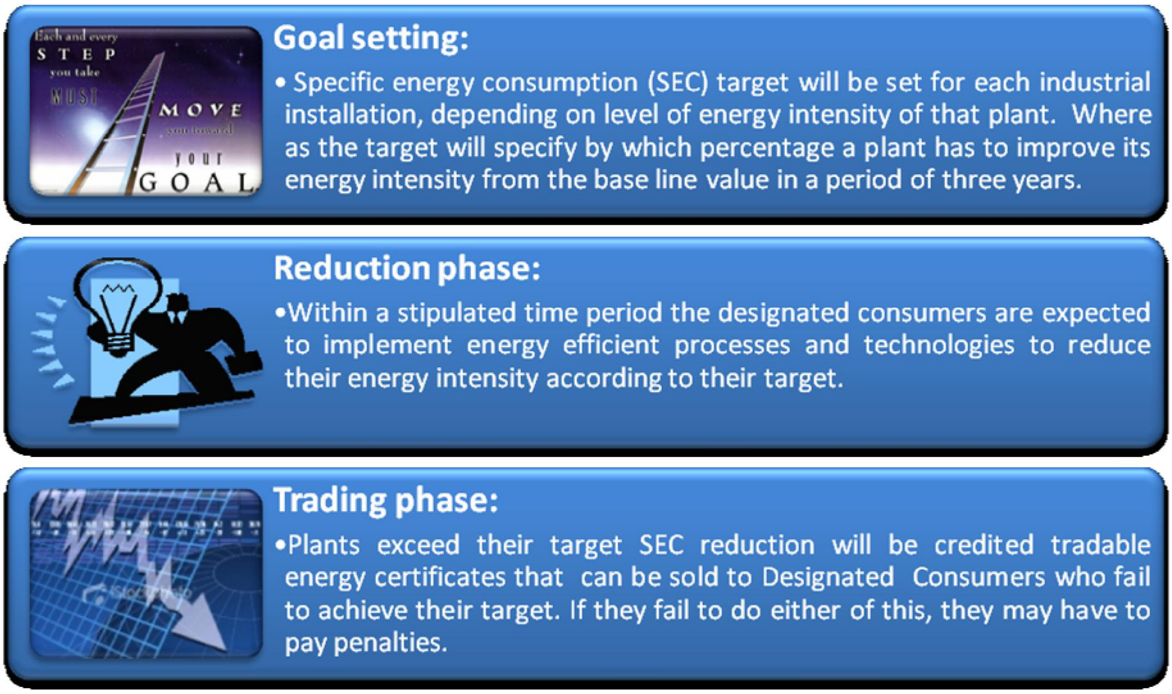
8.1 Overview of Proposed PAT Scheme

The "Perform, Achieve and Trade" (PAT) mechanism is probably the most innovative and challenging initiative that will be introduced under NMEEE. PAT mechanism would assign energy efficiency improvement targets to the country's most energy-intensive industrial units under section 14 of the Energy Conservation Act, 2001, The targets will be set in such a manner that would reflect the current energy intensity of the installation vis a vis that of other installations in the same sector, and the economic effort involved in achieving the target.

[26] *Economic Survey 2010*
[27] *Integrated Energy Policy Report*

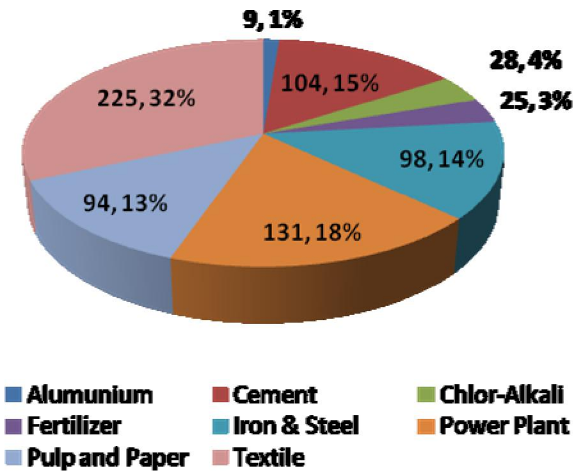
Industrial units that achieve savings in excess of their target will be issued Energy Savings Certificates for saving in excess of target. Units that underperform can buy these certificates to meet their target compliance requirement. This will ensure that the total desired savings are achieved in the most cost effective manner. The scheme is proposed to be implemented in three major steps provided in Figure 1 below,

Figure 8.1: Major Steps for PAT Scheme Implementation



8.2 PAT Scheme Coverage

Figure 8.2: Sector Wise Spread of 714 Consumes

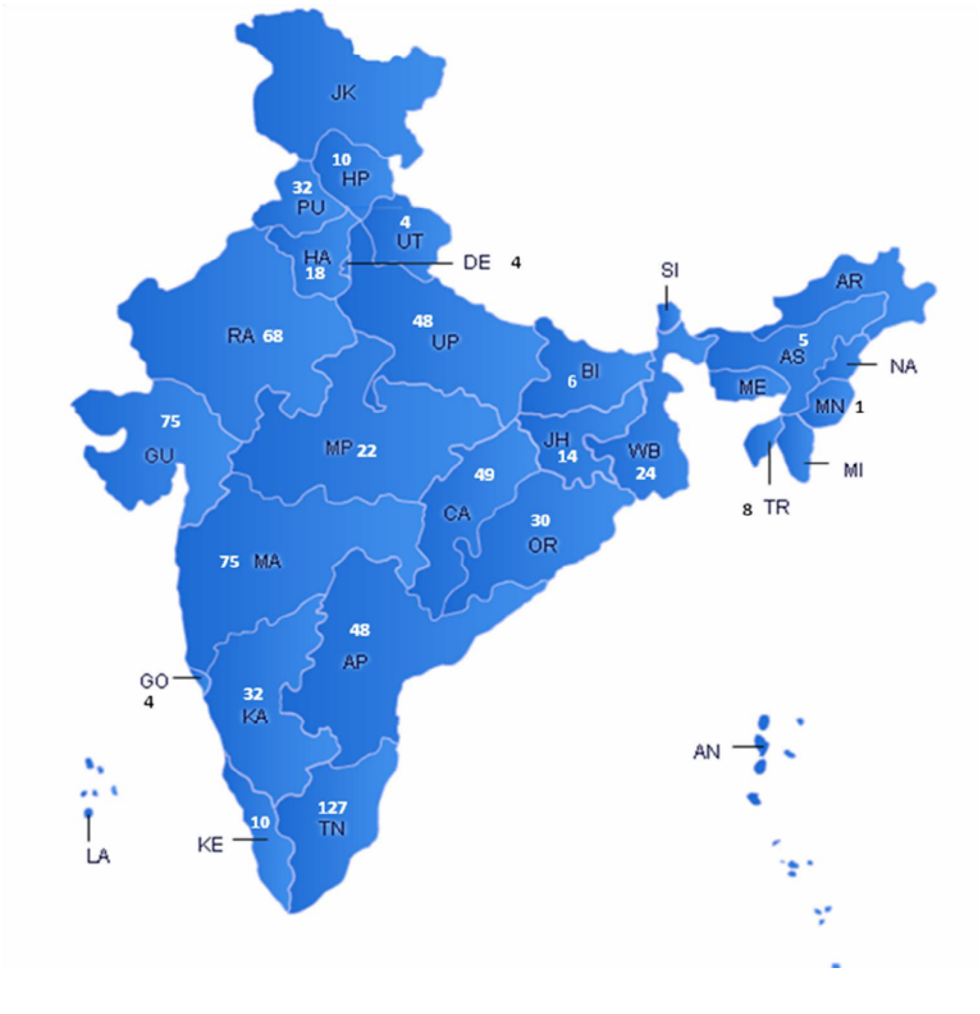


Under the Energy Conservation Act, 2001 (EC Act 2001), industrial units in nine sectors, with energy consumption exceeding specified thresholds, have been notified as Designated Consumers (DCs). Installations from Cement, Fertilizer, Iron & Steel, Paper & Pulp, Railways & Thermal Power Plant with energy consumption of 30000 metric tonnes of oil equivalent per year or above are identified as DCs, where as for Chlor-Alkali, Aluminium and Textile sector this norm is 12000, 7500 & 3000 metric tonnes of oil equivalent per year or above respectively. The Perform Achieve and Trade scheme is a market-based mechanism to enhance energy efficiency in these 'Designated Consumers'. For proposed PAT scheme, BEE has identified 714 Designated Consumers as on February 2010[28].

In order to understand the sectoral as well as regional spread of designated consumers, 714 designated consumers listed by BEE are segregated based on the basis of sector and the state to which they belong. The adjacent Figure 2 indicates the sectoral spread of these consumers. As indicated in Figure 2, 78 % (558) of these consumers belong to cement, iron & steel, power plant and textile sectors.

The state wise distribution of these consumers indicated in Figure 3, helps us to understand the level of industrialisation across various states in India. As indicated in Figure 3, Maharashtra, Gujarat, Rajasthan and Tamil Nadu are the most industrialised states with 345 designated consumers (48%) belonging to these four states.

Figure 8.3: Regional Spread of Designated Consumers



[28] www.bee-india.nic.in, *Accessed on 3rd March 2010*

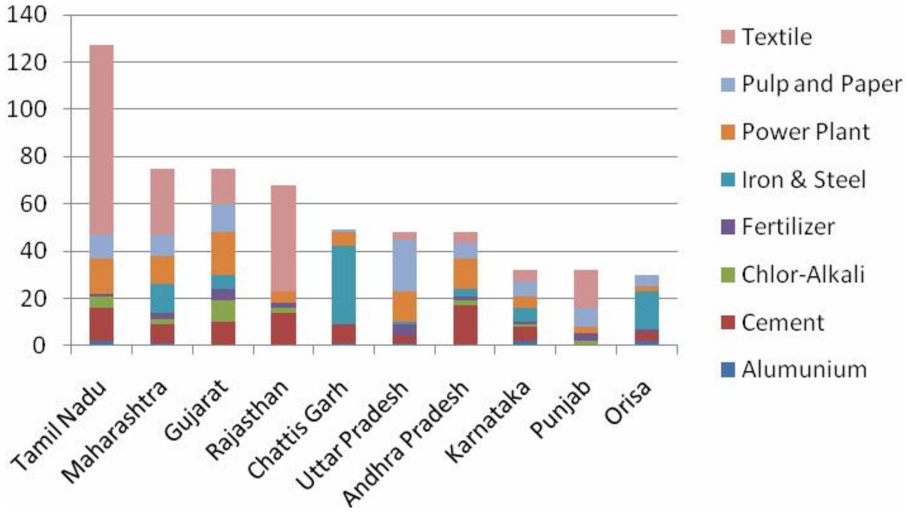
However, due to regional diversity in terms of raw material availability, availability of fuel sources, different climatic conditions etc, there are specific industry clusters that are more developed in one state as compared to other. To understand this, it is necessary to analyse the sector wise spread of 714 designated consumers for different states. State wise and sector wise spread of these consumers is provided in Table 1 below. As indicated in Table 1, in Andhra Pradesh 17 installations out of which 48 belong to Cement, in Chattisgarh 33 installations out of 49 belong to Iron & Steel sector, in Tamil Nadu 80 installations out of 127 belong to Textile sector whereas in Uttar Pradesh 22 installations out of 49 belong to Pulp & Paper.

Table 1: State Wise & Sector Wise Spread of Designated Consumers

States	Sector								Total
	Aluminium	Cement	Chlor-Alkali	Fertilizer	Iron & Steel	Power Plant	Pulp and Paper	Textile	
Andhra Pradesh		17	2	2	3	13	6	5	48
Assam						3	2		5
Bihar		2				4			6
Chattis Garh	1	8			33	6	1		49
Delhi						3		1	4
Goa					3	1			4
Gujarat		10	9	5	6	18	12	15	75
Hariyana						5	2	11	18
Himachal Pradesh		2						8	10
Jharkhand		4	1		5	4			14
Karnataka	2	6	1	1	6	5	6	5	32
Kerala		1	1	1		3	1	3	10
Maharashtra	1	8	2	3	12	12	9	28	75
Manipur		1							1
Madhya Pradesh		8	2	1		4	2	5	22
Orisa	2	4		1	16	2	5		30
Punjab			2	3		3	8	16	32
Rajasthan		14	2	2		5		45	68
Tamil Nadu	2	14	5	1		15	10	80	127
Tripura					4	4			8
Uttar Pradesh	1	3		5	1	13	22	3	48
Uttarancal							4		4
West Bengal		2	1		9	8	4		24
TOTAL	9	104	28	25	98	131	94	225	714

To identify the major states in terms of more number of designated consumers and to review the sectoral spread of consumers in that state a bar chart is provided in Figure 4 for top ten states.

Figure 8.4: Setoral Spread of Designated Consumers for Top Ten States



8.3 Approach for Estimation of Potential Savings

With overall objective to estimate the energy saving potential under proposed PAT scheme, the Macro Analysis was carried out for the nine designated sectors under EC Act 2001. The whole effort was to develop a simplified approach to estimate the energy saving potential across the designated sectors as a whole & for 714 designated consumers identified by BEE.

As a part of the analysis, all the nine designated sectors were reviewed for base year data collection i.e. FY 2008 and a sector specific analysis was carried out to study the specific energy consumption, production growth rates etc. The growth rates for different sectors as estimated by the respective Ministry/ Planning Commission, Industry Associations, etc were used for the purpose of calculation of annual production during compliance period and its overall impact on energy consumption and saving potential. A brief outline of all the sectors covered under PAT Scheme is provided in the section below.

8.4 Overview of Designated Sectors

8.4.1 Cement

With 148 large cement plants and a total installed capacity of around 231 million tonnes per annum (MTPA) as of September 2009, the Indian cement industry is the second largest in the world, accounting for about 6% of the world's production. In FY 2008, as per Cement Manufactures Association (CMA), the cement production in India was 170 million metric tonnes (MMT).

Over the last few years, the Indian cement industry has witnessed strong growth, with demand reporting a compounded annual growth rate (CAGR) of 9.3% and capacity addition a CAGR of 5.6% between 2004-05 and 2008-09[29]. The major demand drivers for cement industry are real estate boom during 2004-08, increased investments in infrastructure by both the private sector and Government, and higher Governmental spending under various social programmes. During the eleventh plan period (2007-12), cement production is targeted to grow by 8% annually[30].

[29] *ICRA industry outlook for cement sector*
[30] *Working Group Reports - Planning Commission*

The major energy source for cement production is coal, followed by electricity. For cement industry, energy cost accounts for as high as 40% to 45% of the total manufacturing cost. The average specific electrical and thermal energy consumption for cement plants in India is 98 kWh/tonne and 0.76 MKcal/tonne of cement respectively[31]. For proposed PAT scheme BEE has notified 104 installations in this sector.

8.4.2 Paper and Pulp

In India, there are about 666 paper industries engaged in the manufacturing of pulp, paper, and paperboards. About 38% of the total paper production is based on recycled paper, 32% on wood, and the remaining 30% on agri-residue. Apart from the writing and printing paper, 77 mills with an installed capacity of 1.59 MT produce newsprint in India. For 1% rise in per capita income, the demand for paper increases by 1.5%–2.5%[32]. With the rise in India's per capita income, the per capita paper consumption is expected to increase to 8 kg by 2010 and 8.75 kg by 2015, from 4.5 kg in 2002–04. The average capacity of a paper mill in India is about 10500 tonnes per annum. The Indian pulp and paper industry is highly fragmented, with top five producers accounting for 25% of the total capacity. Production of paper and paperboards in FY 2008 was 7.6 MMT. According to BEE Report on Paper and Pulp Industry, 2009, the annual growth rate of the industry is expected to be 8%.

The share of energy costs in the total manufacturing cost is close to 25%. Coal and electricity are two major energy sources used in paper production. Other fuels such as LSHS and FO are also used to fire boilers. LDO (light diesel oil) and HSD (high-speed diesel) are also used for captive power generation in diesel generator sets in plants. The specific energy consumption in Indian paper mills is very high. The average specific electrical and thermal energy consumption values for paper and pulp production in India are 1600 kWh/tonne and 5.4 MKcal/tonne respectively. For proposed PAT scheme BEE has notified 94 installations in this sector.

8.4.3 Fertilizers

India ranks third in the world, after China and USA, in the production and consumption of fertilizers. Nitrogenous, phosphatic, potassic, and complex fertilizers are the most widely used fertilizers. The projections of fertilizer nutrients based on various approaches show a range of demand figures of total nutrients between 25 and 29 MMT for the terminal year of XIth Plan i.e. 2012. The total nutrient consumption for 2011-12 is envisaged at 269 LMT. According to Department of Fertilizers, the total production of nitrogenous and phosphatic fertilizers during FY 2008 was 33 MMT[33]. The production from the Indian fertilizer industry is expected to grow at a rate of 5% in the future[34].

Production of nitrogenous fertilizers is highly energy intensive, and ammonia is used as the basic chemical in the production of nitrogenous fertilizer. The feedstocks used for ammonia production are natural gas, naphtha, and fuel oil. Feedstock accounts for 60% of the cost of production in the natural gas based units and about 75% of the cost of production in the case of naphtha and FO (furnace oil)/LSHS based units. The share of energy consumption for ammonia production is the highest (about 80%) among variety of fertilizer products. The average specific energy consumption of the industry is 8.97 Mkcal/tonne[35]. For proposed PAT scheme BEE has notified 25 installations in this sector.

[31] *IREDA, Investors Manual*
[32] *The Energy Data & Directory Year Book- 2009*
[33] *Department of Fertilisers*
[34] *Working Group Reports - Planning Commission*
[35] *IREDA, Investors Manual*

8.4.4 Aluminium

India has the fifth largest reserves of bauxite, with deposits of about 3.29 billion tonnes (5% of the world deposits). The share of total installed capacity of aluminium is about 3% of the global capacity. Per capita consumption of aluminium in India is only 1.6 kg compared with 8 kg in China and 30 kg in developed countries. Total production of aluminium in FY 2008 was 1.2 MMT, which is expected to register an annual growth rate of 7%[36].

Aluminium production is electricity intensive. The current average specific energy consumption in the Indian aluminium industry is approximately 14.4 Mcal/tonne, which is nearly two times that in the US, although significant reduction has been achieved over the years[37]. Electricity cost forms about 40% of the total production cost, and hence, energy efficiency continues to be a major area of focus for the Indian aluminium industry. For proposed PAT scheme BEE has notified 9 installations in this sector.

8.4.5 Iron & Steel

The iron & steel industry contributes about 2% to the GDP, and its weightage in the IIP (Index of Industrial Production) is 6.20%. India has risen to be the fifth largest crude steel producer in the world and the largest producer of sponge iron. However, the per capita consumption of steel in India is about 46 kg (2006) as compared to the global average of 150 kg and 400 kg in developed countries. Major energy input in this sector is from coking coal, non-coking coal, coke, and electricity.

According to Ministry of Steel, Government of India, production of crude steel was 53 MMT and 54 MMT in FY 2008 and FY 2009 respectively. Production of iron and steel industry is expected to grow at the rate of 7.3% over the future years. The growth is driven by capacity expansion from 43.91 MMT in 2003-04 to 64.4 MMT in 2008-09. The average specific energy consumption in India for crude steel production is 33 GJ/tonne[38] (equivalent to 7.8 MKcal/tonne). For proposed PAT scheme BEE has notified 98 installations in this sector.

8.4.6 Textiles

The Indian textile industry contributes about 14% to the industrial production, 4% to the GDP, and 17% to the country’s export earnings. The textile industry can be classified into organized sector and decentralized or rural sector. The organized segment of the textile industry manufactures 4% of the total fabrics produced in the country. During 2006/07, the capacity utilization in the spinning sector of the organized textile mill industry ranged between 80% and 93%, while the capacity utilization in the weaving sector of the organized textile mill ranged between 41% and 63%. The total production of cloth by all the sectors, i.e., mill, power loom, handloom, hosiery, khadi, wool, and silk, has, however, shown an upward trend in the recent years. During FY 2008 the total production of cloth was 56025 million m^2, whereas, in FY 2009 the production of cloth from the textile industry was 54966 million m2. The industry is expected to register an annual growth rate of 7%[39].

The textile industry is one of the most energy intensive sectors with Coal and FO as major sources for process heating. The energy requirement for production of cloth is about 0.021

36 The Energy Data & Directory Year Book- 2009
37 The Energy Data & Directory Year Book- 2009
38 LBNL, Study on Indian Manufacturing Industries – 2008 / 2009
39 Working Group Reports - Planning Commission

GJ/m^2 (equivalent to 0.00000583 MKcal/m^2)[40]. For proposed PAT scheme BEE has notified 225 installations in this sector.

8.4.7 Chlor Alkali

The chlor-alkali industry mainly comprises caustic soda, or sodium hydroxide; soda ash, or sodium carbonate; and chlorine manufacturing plants. Chlorine is a co-product of caustic soda manufacturing process and is used in large quantities for manufacturing plastics, pulp and paper, and aluminium, and in the treatment of waste water. Caustic soda is the main product of the industry, while chlorine and hydrochloric acid are treated as by-products. The total production of caustic soda in FY 2008 was 2.2 MMT which is expected to increase to 2.7 MMT by FY 2012 with an annual growth rate of 7%[41]. The capacity utilization factor of caustic soda manufacturing sector was about 80% in FY 2008.

Majority of caustic soda production is based on the membrane cell technology, as diaphragm cell and chemical processes have become obsolete. The membrane cell technology requires electricity in the range of 2500–2700 kWh/tonne as compared to 2900–3200 kWh/tonne required in the diaphragm technology and 3300–3700 kWh/tonne required in the mercury cell technology. The average specific energy consumption by the chlor alkali industry is about 2.57 Mkcal/tonne[42] of caustic soda.

In India there are five manufacturers of soda ash with a total installed capacity of 30.76 LMT. The production of soda ash is expected to increase from 2.6 MMT in 2007/08 to 3 MMT in 2011/12. Power cost accounts for 30% of the total input cost for manufacturing soda ash. The specific steam consumption and specific power consumption per tonne of soda ash are 3.5 tonnes/tonne and 300 kWh/tonne, and 2.2 tonnes/tonne and 600 kWh/tonne, respectively for Solvay process and dual Solvay process. For proposed PAT scheme BEE has notified 28 installations in this sector.

8.4.8 Railways

Rail transport is crucially dependent on the growth in Gross Domestic Product (GDP), especially those sectors which generate transport volumes through their forward and backward linkages.

The route-kms of the Railways stands at only 64,015 kms. In budget speech 2010, it is announced that the railways needs to provide connectivity for industries, ports, tourist centres, universities, religious places, coal mines etc. and that is the reason the Ministry has set a target to add 25,000 kms of new lines in the next ten years as outlined in Vision 2020. The targeted rate for growth for the railway sector is expected to keep pace with the GDP and show an annual growth rate of 8.10% over the future years.

However when it comes to energy consumption by railways, no material data is available in the public domain. Also the 714 designated consumers listed by BEE do not include railways. Hence, in the analysis carried out by ABPS Infra, the railways sector has been excluded due to unavailability of data on energy consumption and passenger kms.

8.4.9 Thermal Power Plant

Although gas is relatively a clean fuel, at present there is uncertainty about its availability; period, quantity as well as the price. Coal is expected to be main stay of power generation for

[40] *Indira Gandhi Institute for Development and Research*
[41] *Working Group Reports - Planning Commission*
[42] *LBNL, Study on Indian Manufacturing Industries – 2008 / 2009*

years to come. According to Central Electricity Authority (CEA), all India installed capacity of thermal power plants as on January 2010 is 100351 MW. Thermal capacity addition of 50,124 MW is expected during the XIth plan period. The total thermal power generation was 558815 MU and 5889915 MU in FY 2008 and FY 2009 respectively.

As per the Integrated Energy Policy Report (IEPR), prepared by the Planning Commission, GDP growth rate of 9% has been projected during the XIth Plan. Assuming this growth rate, and assuming the higher elasticity projected by the IEPR of around 1.0, thermal energy generation would be required to grow at 9.5% per annum during the XIth plan period. For Macro Analysis, average Station Heat Rate (SHR) of 2703.9 Kcal/kWh[43] has been assumed. For proposed PAT scheme BEE has notified 131 installations in this sector.

8.5 Estimation of Savings Potential

A simplified approach is followed to estimate the saving potential across the designated sectors and for 714 designated consumers identified by BEE. For the purpose of analysis, FY 2008 is considered as base year. Production details and specific energy consumption (SEC) details for each designated sector was collected for the base year. Specific energy consumption in 'tonnes of oil equivalent' (toe) per unit of production is estimated for each sector based on total electrical and thermal specific energy consumption of that sector. Total energy consumption by each designated sector in toe is estimated as product of 'Total Production' and specific energy consumption of that sector in 'toe / unit production'.

Due to unavailability of energy consumption and production details for 714 designated consumers listed by BEE, their energy consumption is estimated by assuming that production by designated consumers in the sector is 60 % of total production in that sector. However in case of Iron & Steel sector, it is assumed that the production by designated consumers from this sector is 100 % of total production by that sector, this is because only integrated steel producers are considered in iron and steel sector and all integrated steel plants in India are identified as designated consumers by BEE. It is also assumed that the specific energy consumption of designated consumers in each sector is same as that of the respective sector. Then the total energy consumption in TOE by all designated consumers in each sector is estimated as product of 'Total Production' and specific energy consumption in 'TOE / Unit Production'.

Production, specific energy consumption and total energy consumption in TOE in FY 2008 is provided for all designated sectors as well as for 714 designated consumers in Table 2 and Table 3 below.

Table 2: **Production, SEC & Total Energy Consumption of Designated Sectors, FY 2008**

Parameter	Unit	Cement	Paper and Pulp	Fertilizers	Aluminium	Iron and Steel	Textiles	Chlor Alkali	TPP
Total Production	Tonnes	170000000	7600000	33244100	1230000	53857000	-	2206000	-
	Sq. Meter	-	-	-	-	-	56025000000	-	-
	kWh	-	-	-	-	-	-	-	558815210000
Total Average SEC	TOE/tonne	0.084	0.68	0.90	1.44	0.79		0.26	
	TOE/Sq. m	-	-	-	-	-	0.000502	-	-
	kCal/kWh	-	-	-	-	-	-	-	2703.90
Total Energgy Consumption	TOE	14352760	5149760	29819958	1771200	42457740	28146531	565992	151098045

[43] www.cea.nic.in, *Accessed as on 3rd March 2010*

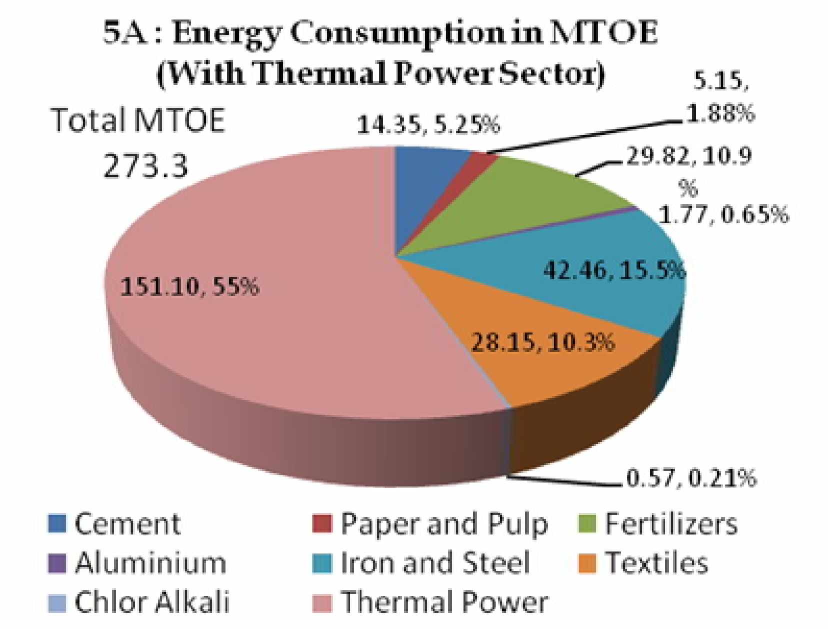
Table 3: Production, SEC & Total Energy Consumption of 714 Designated Consumers, FY 2008

Parameter	Unit	Cement	Paper and Pulp	Fertilizers	Aluminium	Iron and Steel	Textiles	Chlor Alkali	TPP
Total Production	Tonnes	102000000	4560000	19946460	738000	53857000	-	1323600	-
	Sq. Meter	-	-	-	-	-	33615000000	-	-
	kWh	-	-	-	-	-	-	-	335289126000
Total Average SEC	TOE/tonne	0.084	0.678	0.897	1.440	0.788		0.26	
	TOE/Sq. m	-	-	-	-	-	0.000502	-	-
	kCal/kWh	-	-	-	-	-	-	-	2703.90
Total Energgy Consumption	TOE	8611656	3089856	17891975	1062720	42457740	16887919	339595	90658827

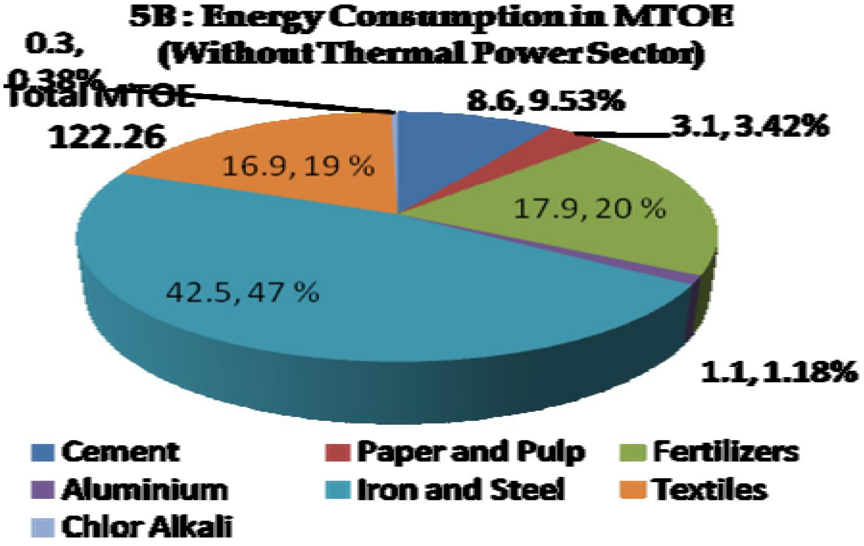
From Table 2, the sum of total energy consumption by all designated sectors excluding railways is 273.36 million tonnes of oil equivalent (Mtoe) and from Table 3, the sum of total energy consumption by all 714 designated consumers under proposed PAT scheme is 181 Mtoe. Also Total Primary Energy Consumption (TPES) in FY 2008 was 565.93 Mtoe[44].

However, it should be noted that in above analysis, 'Thermal Power Plant' is also considered as one of the designated sectors, which is also supplying electricity to the other designated sectors. As a result, there is double accounting of electricity generated by thermal power plants and consumed by the industries in designated sectors while estimating the 'Total Energy Consumption by Designated Sectors'. This can be clearly visualised through the pie charts provided in Figure 5 below.

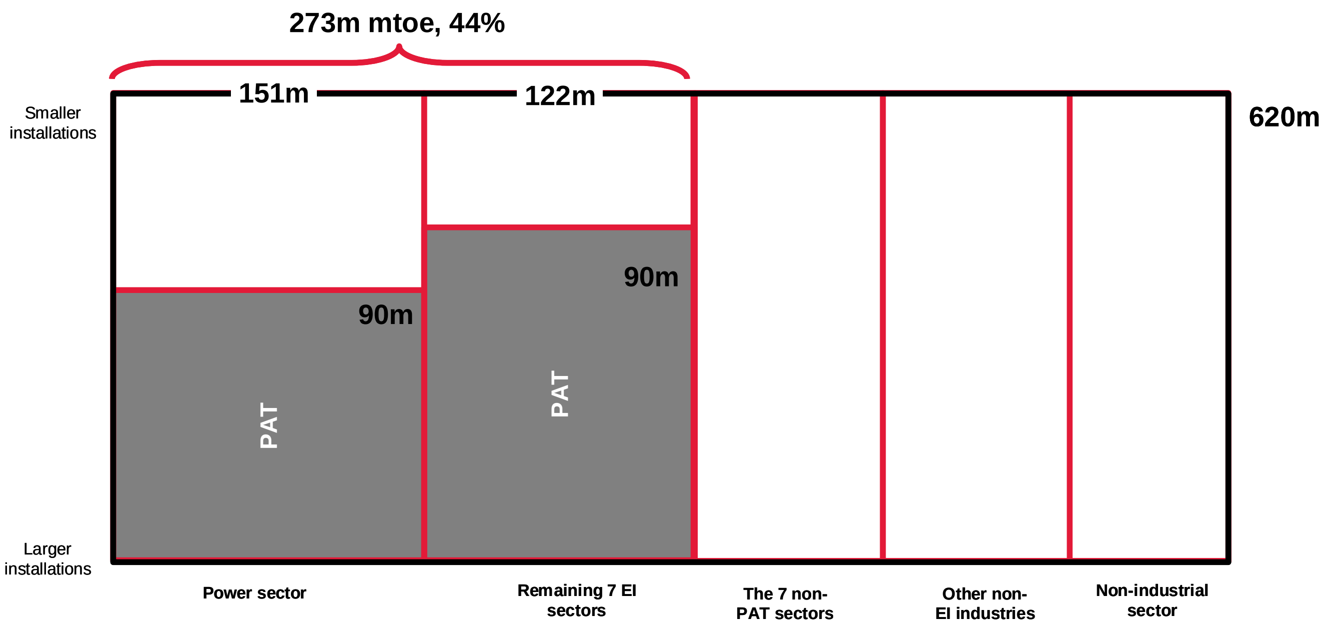
Figure 8.5: Total Consumption by Designated Consumers with & Without Power Sector



[44] *The Energy Data & Directory Year Book- 2009*



As indicated in Figure 5 above, the total energy consumption by designated sectors including thermal power plants and excluding thermal power plant is 273 Mtoe and 122 Mtoe. Hence to avoid the double accounting in total energy consumption by designated sectors it is important to exclude thermal power sector and to consider it separately. Thus the percentage of 'Total Energy Consumption by Designated Sectors Excluding Thermal Power Sector' (122.26 Mtoe) with respect to TPES (565.93 Mtoe) is 21.6%.



With reference to above discussions, while estimating the total energy consumption by designated consumers under proposed PAT scheme, it is also necessary to exclude thermal power plants to avoid double accounting.

The percentage energy saving potential for each designated sector is estimated by dividing the difference between the existing SEC and best practice SEC by the existing SEC of that sector. Estimated percentage energy saving potential for different sectors is indicated in Table 4 below.

Table 4: Estimated % Energy Saving Potential for Different Sectors

Sectors	Average Specific Consumption (TOE/tonne)		Energy Saving Potential (%)
	Existing	Best Practice	
Cement	0.084	0.0706	16%
Paper and Pulp	0.678	0.505	26%
Fertilizers	0.897	0.760	15%
Aluminium	1.440	1.10	23%
Iron and Steel	0.788	0.600	24%
Textiles*	0.0005	Not Available	
Chlor Alkali	0.257	0.213	17%
TPP**	2703.9	2432.20	10%

Average Specific Consumption is In - * TOE/Sq m & ** kCal/kWh

However best practice SEC is not available for textile sector where as for few others like aluminium source is not reliable, hence the Energy Saving potential for all designated consumers except thermal power plants is assumed to be around 15% of total energy consumption. For thermal power plants the current heat rate is 2703.90 kCal/kWh, with power plant efficiency improvement up to 35% to 36%, it can go down to 2432 kCal/kWh i.e. saving potential of 10%. The sector wise energy saving potential for designated consumers under proposed PAT scheme is provided in Table 5 below.

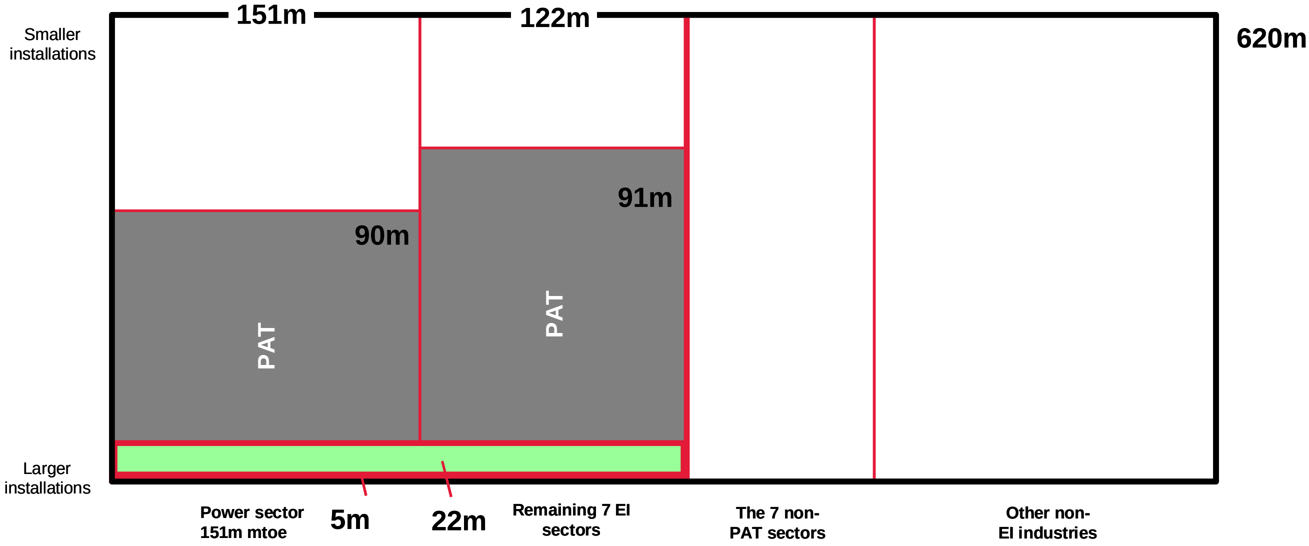
Table 5: Sector Wise Energy Saving Potential for Designated Consumers Under PAT

Sectors	Energy Consumption (Mtoe)	Energy Saving Potential	
		%	Mtoe
Cement	8.6	15%	1.29
Paper and Pulp	3.1	15%	0.46
Fertilizers	17.9	15%	2.68
Aluminium	1.1	15%	0.16
Iron and Steel	42.5	15%	6.37
Textiles	16.9	15%	2.53
Chlor Alkali	0.3	15%	0.05
TPP	90.7	10%	9.07
Total	**181.0**		**22.6**

As indicated in Table 5, the total energy saving potential under proposed PAT scheme is 22.6 Mtoe, i.e. 12.5% of existing total consumption of designated consumers to be covered under PAT scheme and 4 % of TPES in FY 2008.

We understand that the PAT scheme is targeted to save approximately 10m Mtoe in the first 3 years of the scheme. This would equate to an increasing c1.7m Mtoe per annum, cumulatively adding up to 10m Mtoe (1.7+3.4+5.1). An average 1% annual reduction target (cumulatively 1%, 2%, 3%) would correlate with our bottom-up estimation: 170m Mtoe (c29% of total energy consumption).

With reference to best practice benchmarks, we estimate that a 22.6m Mtoe energy saving potential (c15% reductions to move towards current best practice). It is not clear that this level of savings will be available from the top 714 installations however. As large energy users, they may be at a more efficient point than the industry average.



9 Broadening, Deepening and Tightening the PAT scheme

This section sets out actions that the Government of India could undertake in the future that could expand the scheme to cover a greater width and breadth of the Indian energy economy than the PAT scheme as currently planned.

These actions could be consistent with broadening, deepening and tightening of the scheme more quickly and more aggressively than previously targeted. Such "over-performance" could be structured as part of a NAMA (supported or credited). The Mandatory PAT scheme report by this consortium outlines how international finance could be structured to allow Indian industry to benefit from international carbon finance when tackling significant energy efficiency investments.

9.1 Broadening of the PAT scheme to additional energy intensive sectors

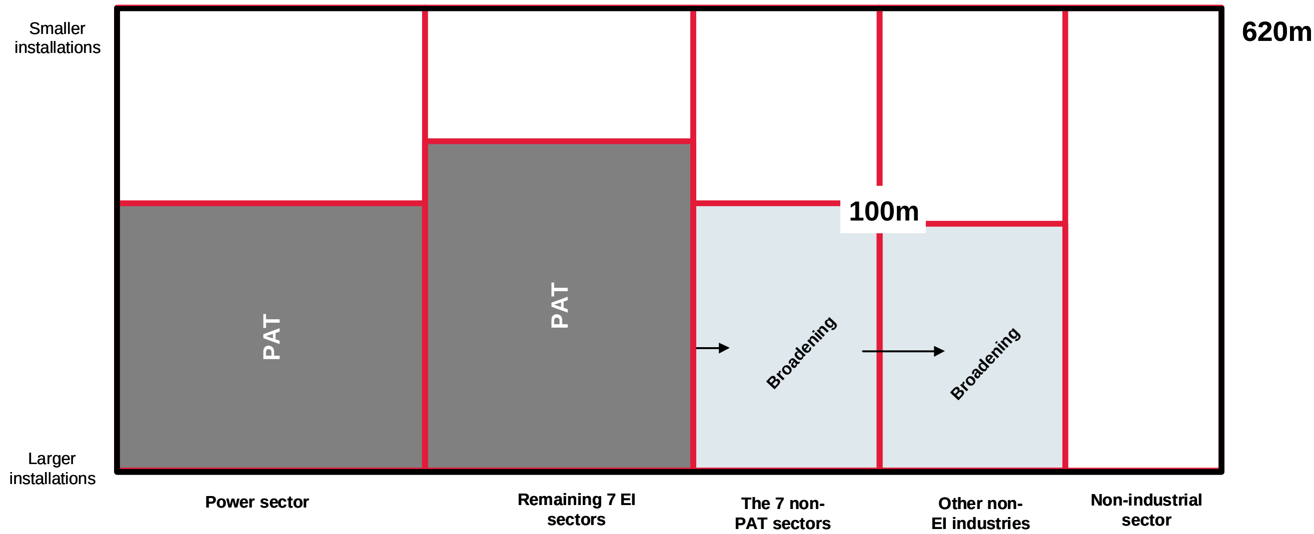
In the initial phases the Government of India has chosen to cover 9 energy intensive sectors. Several sectors with significant energy usage have not been covered by the scheme, but are

Designated Consumers within the Energy Conservation Act 2001[45]. It would be possible to broaden coverage to the both sectors within the ECA2001 or (in the longer term) other sectors:

- Sugar refining
- Commercial buildings
- Chemicals
- Petro-chemicals
- Ports
- Other power sector participants (transmission, distribution)
- Other transport systems
- Automobile manufacture
- Breweries
- Dairies
- Glass

The Consortium believes that there is significant potential outside the 9 covered sectors, and that broadening the scheme to other sectors is viable in Phase 2 or 3 of the scheme.

In order to broaden coverage, it is likely that BEE will need to consider engaging with Industry associations and other channels to manage the communication process, as well as assist in understanding the level of energy efficiency achievement that can be made in these sector. For case studies on 4 of the sectors mentioned above, please refer to the Appendices.



9.2 Deepening of the PAT scheme within the 9 covered sectors

In the initial phases the Government of India has chosen to cover only installations (within the 9 energy intensive sectors) that have annual energy usage over a certain threshold – for example

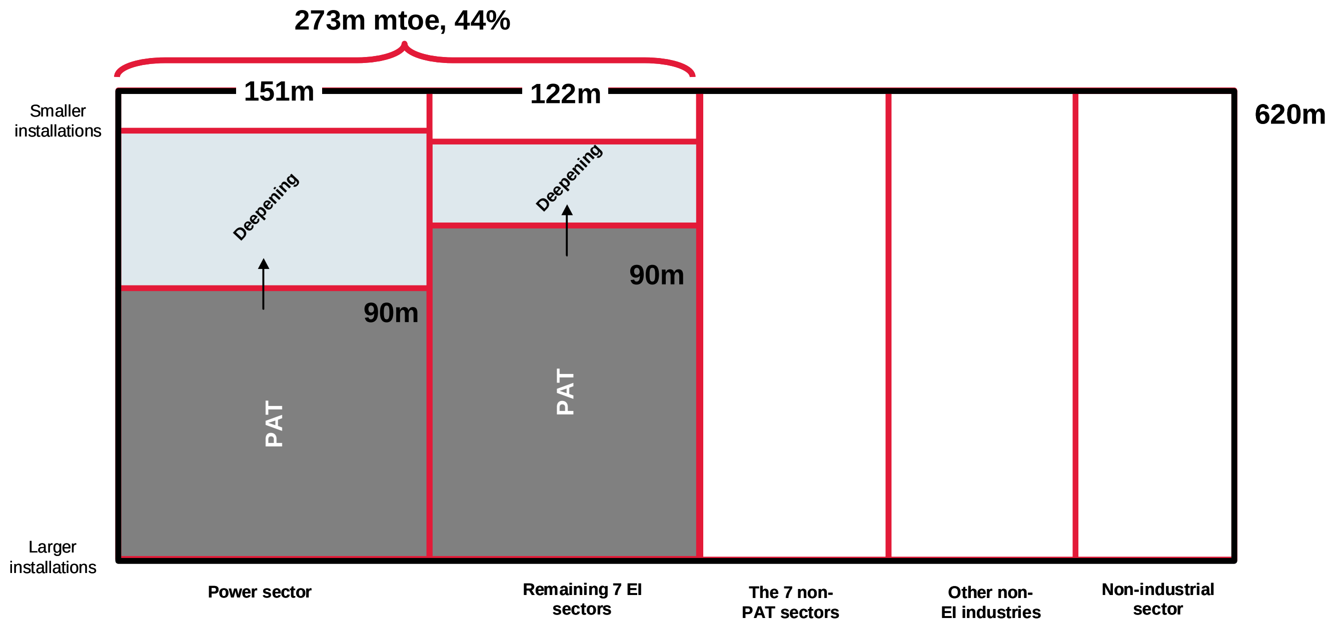
[45] *LIST OF ENERGY INTENSIVE INDUSTRIES AND OTHER ESTABLISHMENTS SPECIFIED AS DESIGNATED CONSUMERS 1. Aluminium; 2. Fertilizers; 3. Iron and Steel; 4. Cement; 5. Pulp and paper; 6. Chlor Alkali; 7. Sugar; 8. Textile; 9. Chemicals; 10. Railways; 11. Port Trust; 12. Transport Sector (industries and services); 13. Petrochemical, Gas Crackers, Naphtha Crackers and Petroleum Refineries; 14. Thermal power stations, hydel power stations, electricity transmission companies and distribution companies; 15. Commercial buildings or establishments.*

greater than 30,000 metric tonnes of oil equivalent. The PAT scheme could be deepened by lowering this threshold to 20,000 or 10,000 tonnes.

It has not been possible to estimate the additional numbers on installations that could be covered. We would recommend engaging with industry associations to assess the scale of additional installations that this would cover.

One approach would be to gradually reduce the threshold over time, with (for example) the second phase of the scheme deepened to cover sites with >20,000 tonnes, and then in Phase 3, >15,000 tonnes. There would be significantly many more business falling within the 10,000 to 15,000 range than in the 15,000 to 20,000 range.

At an estimated marginal administration cost of $10,000 -$20,000 per annum per site (inclusive of transaction costs such as energy audits), then this would indicate a lower level of 5,000 TOE per year if the scheme price was around $20-40 per TOE.



9.3 Tightening of the PAT scheme targets for the covered installations

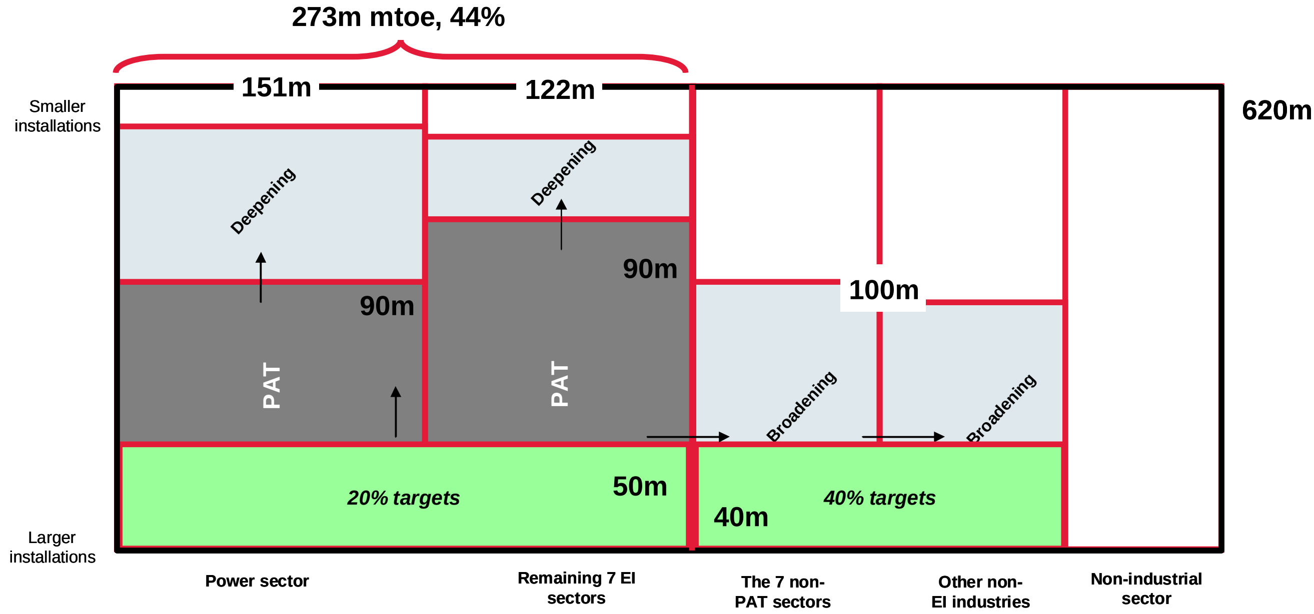
The tightening of the scheme represents the greatest opportunity to reduce energy usage. There are decreasing returns to expanding the scheme to cover smaller and smaller installations, but the tightening of targets for existing scheme participants does not suffer this disadvantage.

BEE estimates that economy-wide there are opportunities to reduce energy intensity by 23% with greatest opportunity in the industrial and agricultural sectors.

The UK experience across the sectors covered by the Climate Change agreements is that in many sectors achievements in excess of 30-40% can be achieved at little or no NPV cost. With significant GDP growth forecast in India there will be energy-efficiency economies of scale. More importantly, India has a higher capital investment ratio than in the UK, which has low economic growth and less investment in new facilities and production lines.

For example, by 2020 (and with only average 7% GDP growth) almost half of the industrial facilities in India will be (or have the opportunity to be) at “best available technology” standards as the investments in those facilities will have been made from 2010 onwards.

It is through the tightening of the scheme where the Government of India has the potential to secure international finance to ensure the investments made as the economy grows are at the very leading edge of the energy efficiency frontier.



10 Broadening of the Proposed PAT Scheme

The manufacturing industry in India accounts for 28% of the national Gross Domestic Product (GDP) and 44.8% of commercial energy use[46], with significant level of coal and oil in the energy mix (50% and 30% respectively). The energy intensity (energy use per unit GDP) of India's industrial output (6416 kCal /dollar) is more than three times that of the US (2400 kCal/dollar) and four times that of the UK (1574 kCal/dollar) but appreciably less than that of China (8360 kCal/dollar).[47]

The high energy intensity in the Indian industry may be attributed partly to investments made in basic and energy intensive industries, with emphasis on developmental plans and achieving self-reliance. These energy intensive sectors are therefore prime candidates for energy efficiency initiatives, and are the target of the Government of India's proposed trading scheme in energy saving certificates (Perform Achieve and Trade Scheme). The GOI has outlined a proposed Perform, Achieve and Trade 'PAT' scheme for Mandatory Trading in energy saving certificates for energy intensive industries from Iron & Steel, Paper & Pulp, Cement, Chlor-Alkali, Fertilizer, Aluminium, Thermal Power Plant, Railways & Textile sector. For proposed PAT scheme, BEE has identified 714 Designated Consumers as on February 2010[48] to enhance energy efficiency in above referred Designated Sectors.

As per analysis carried out by ABPS Infra, the 'Total Energy Consumption' by these Designated Sectors (excluding Thermal Power Sector to avoid double counting) is 122.26 Mtoe, which is 21.6% with respect to Total Primary Energy Supply (TPES) of 565.93 Mtoe and 29.9% of Total Primary Commercial Energy Supply (TPCES) of 408.49 Mtoe[49]. However, 60.74 Mtoe i.e. 14.8% of TPCES by other Manufacturing Industry sectors remains uncovered by proposed PAT

[46] *The Energy Data & Directory Yearbook 2009*
[47] *Rao 2006 & TEDDY 2009*
[48] *www.bee-india.nic.in, Accessed on 3rd March 2010*
[49] *ABPS Infra's Report & Analysis for Mandatory Sectors*

scheme. In addition, in view of very high Transmission and Distribution losses of 27% in Indian power sector[50], significant savings in commercial energy is possible by T&D loss reduction. Hence it is necessary to broaden the scope of the proposed PAT scheme by considering other manufacturing industry sectors like Dairy, Sugar, Automobiles and non-manufacturing sectors like Commercial Buildings, Road Transport and Transmission & Distribution Sectors etc.

10.1 Overview of Other Sectors

With overall objective to broaden the scope of proposed PAT Scheme and to estimate the energy saving potential for other energy intensive sectors, the sector specific Macro Analysis was carried out. The whole effort was to develop a simplified approach to estimate the energy saving potential in each sector and propose broadening of the PAT Scheme.

As a part of the analysis, all identified other sectors were reviewed for base year data i.e. FY 2008 and a sector specific analysis was carried out to study the specific energy consumption, production growth rates etc. The growth rates for different sectors as estimated by the respective Ministry/ Planning Commission, Industry Associations, etc. were used for the purpose of calculation of annual production during compliance period and its overall impact on energy consumption and saving potential. Overview of other sectors for broadening the scope of proposed PAT Scheme and detailed approach to estimate the saving potential is provided in the sections below.

10.1.1 Sugar Sector

India is one of the largest sugar producers in the world and the largest consumer of the commodity. The Indian sugar industry has a turnover of around Rs. 300 billion and is the second largest agro based industry, next only to the textile industry[51]. It is amongst the few industries that have successfully contributed to the rural economy. It has done so by commercially utilizing the rural resources to meet the large domestic demand for sugar and by generating surplus energy to meet the increasing energy needs of India through cogeneration. In addition to this, the industry has become the mainstay of the alcohol industry.

The Indian sugar production has grown at a CAGR of 4.9%[52]. According to CRISIL Research, sugar production in the year FY 2008 was 28.2 million MT. The sugar industry in India is highly fragmented. In FY 06 sugar season, out of 455 sugar factories 239 factories were from cooperative sectors. Also, there are number of players in the unorganised segment, who mainly produce gur and khandsari, which are less refined forms of sugar and act as substitutes.

Perishable nature of cane, small landholdings and the need to influence domestic prices; in India, sugar is highly regulated sector. Since 1993, the regulatory environment for agriculture based industries has considerably eased, but sugar still continues to be an essential commodity under the Essential Commodity Act. There are regulations across the entire value chain land demarcation, sugarcane price, sugarcane procurement, sugar production and sale of sugar by mills in domestic and international markets.

Sugar is produced in India primarily in nine states. In 2006, the six states i.e. Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Uttar Pradesh and Tamil Nadu produced more than 1 million MT of sugar per annum each, with the three states of Bihar, Punjab and Haryana producing less than 1 million MT of sugar. In 2006, these states accounted for 94% of the total sugar

[50] CEA General Review 2009
[51] CRISIL report on sugar Industry
[52] KPMG Sugar Industry Report

production in India with Maharashtra and Uttar Pradesh leading with 27% and 30% of the total production.

Sugarcane is the primary raw material for sugar production in India. The average energy consumption in an Indian sugar mill is about 38 units per tonne of cane crushed, whereas as per NECA 04 report of Rajashree Sugars & Chemicals, electrical SEC is 35 units & Thermal SEC is 405 kCal / tonne of sugarcane crushed (equivalent to 38 units). Total cane crushed was about 360 million tonnes in FY 2008[53]. The six years CAGR of sugarcane crushed is around 0.93% as per CRISIL report.

The Indian sugar consumption has steadily increased at 3.5% since 1996[54]. Typically, sugar consumption is driven by the increase in per capita income. The per capita consumption has seen a steady growth of 2.1% CAGR over the period from 1996 to 2006. The increase in per capita sugar consumption has been at the expense of Gur and Khandsari consumption, major alternate sweeteners consumed in India.

10.1.2 Dairy Sector

According to Dairy India estimates, the current size of the Indian dairy sector is US$ 62.67 billion and has been growing at a rate of 5% a year. India's present total milk production is estimated to 114 million tonnes and continues to be the largest producer of milk in the world since 1988[55]. India's modern dairy sector has expanded rapidly over last few years. From an insignificant 0.2 million lpd of milk being processed in the year 1951, the organized sector is presently handling some 20 million lpd in over 400 dairy plants.

In India milk processing industry is small (10-15%) compared to the huge amount of milk produced every year. A specific Indian phenomenon is the unorganised sector of milkmen, vendors who collect the milk from local producers and sell the milk in both, urban and non-urban areas, which handles around 65-70% of the national milk production. In the organised dairy industry, the cooperative milk processors have a 60% market share. The cooperative dairies process 90% of the collected milk as liquid milk and rest 10% as other dairy products whereas the private dairies process and sell only 20% of the milk collected as liquid milk and 80% as other dairy products with a focus on value-added products.

India's per capita milk consumption is 101 kg, which is 39% of US, 34% of EU and 44 % of Russia.[56] India, being a developing country, a vast market for dairy products is likely to get developed in near future with increase in disposable income.

Milk processing industry involves energy usage mainly for cooling of fresh milk and then to heat it (Pasteurizing) to destroy both contaminating micro-organisms and naturally occurring enzymes that change the flavour of milk. Energy cost contributes to 30-35% of the overall dairy product manufacturing cost. The current average specific energy consumption in the Indian dairy industry is approximately 65 MkCal/tonne where as best practice SEC is close to 46 MkCal/tonne.

10.1.3 Commercial Building Sector

Following rapid urbanization rates, in 2008 commercial buildings covered an area of 200 million sq. m. The expected area under the commercial stock in 2030 will be approximately 869 million

[53] *IREDA Investors Manual*
[54] *KPMG Sugar Sector Report*
[55] *www.ibef.org, accessed as on 2nd April, 2010*
[56] *www.ifcndairy.org, accessed on 15th April, 2010*

sq. m., 70% of which has not been built as yet[57]. Key factors supporting growth of commercial buildings sector in India are: increasing urbanization, rapid population growth, strong economic growth, expansion of organized retail sector, flourishing IT/ITES sector, government's reforms and policy initiatives and rising living standards.

Commercial buildings, which include offices, hotels, hospitals, IT Parks, shopping malls, retail shops etc, are one of the fastest growing sectors of the Indian economy reflecting the increasing share of the services sector in the economy. Services sector demonstrated the highest growth over the last 12-year period among the three components of Indian Economy, namely agriculture, industry and services[58].

Several studies have highlighted the fact that building design in India does not take into consideration energy efficiency aspects. As a result, in commercial buildings, the average annual energy consumption per sq. m. of the floor area or EPI is in excess of 200 kWh/sq. m./year. Efficient design based on well-documented scientific principles alone has the capability to reduce the same to 120-160 kWh/sq. m./year, a reduction to the tune of 20-40% from the existing level of energy consumption.

According to BEE, the national benchmark for EPI in Indian buildings is approximately 180 kWh/sq. m./year, where as an ECBC compliant building should have EPI of around 110 kWh/sq. m./year[59].

Energy efficiency factors in Indian Commercial buildings vary according to geography, climate, building type, location, demographics, economic development, lifestyle changes and technology and the spread of new equipment.

10.1.4 Automobile Sector

The automobile industry in India is the 9th largest in the World with an annual production of over 2.3 million units in 2008[60]. In 2009, India emerged as Asia's 4th largest exporter of automobiles, behind Japan, South Korea and Thailand.

The economic growth over the past few years and growth of middle class in India has attracted global auto majors to India. Moreover, India provides trained manpower at competitive costs making India a favoured destination for manufacturing. According to a study by Deloitte, at least one Indian company will be among the top six carmakers that would dominate the global auto industry by 2020. According to the study, the car industry would see a massive capacity building in low-cost locations like India and China as manufacturers shift base from developed regions.

Two-wheeler segment in India is dominated by motorcycles. The domestic two-wheeler industry has grown steadily at a CAGR of 8.5% from 4.2 million in 2001 to 7.43 million in FY 2008. Two-wheelers exports have grown at a CAGR of over 38% in the last seven years with majority of the exports to Bangladesh, Sri Lanka, Bhutan and Nepal. Two wheeler segment is dominated by local as well as foreign players such as Hero Honda, Bajaj Auto, Honda Motors, TVS Motors and Suzuki.

Three-wheelers segment growth has been driven by the need for a low-cost, last mile transportation system. Three-wheeler sales in India touched a new record of 0.4 million in FY 2007. The proportion of three-wheeler goods carriers in overall sales has doubled; indicating the increased need for a low-cost, last mile transportation system.

[57] *AEEE Roundtable, USAID ECO III Project, August 2009*
[58] *DLF Red Herring Prospectus, May 2007*
[59] *BEE, Roadmap for Energy Efficiency in Buildings, April 2010*
[60] *http://en.wikipedia.org/wiki/Automobile_industry_in_India Accesses on March 21, 2010*

Passenger vehicles segment in India is dominated by cars. The domestic Indian passenger vehicles market has grown at a CAGR of 12.6% over the last seven years to reach 1.55 million units in FY 2008. Exports of cars from India have grown at a CAGR of 30% in the last seven years to reach 331,000 units in FY 2008[61]. Exports of cars in FY 2008 increased 52% over FY 2007. This is the highest-ever, single-year jump in car export numbers in India. Maruti Suzuki India Ltd. and Tata Motors are among the largest passenger car manufacturers in the country.

Commercial vehicles segment picked up after slight drag in 2008. The domestic commercial vehicles industry clocked sales of more than 384,000 vehicles in FY 2008.

The share of LCVs is gradually increasing. In FY 2008, the LCV goods segment led growth with a share of 45%. Tata Motors, Ashok Leyland, Eicher Motors are among the largest commercial vehicle manufacturers in the country.

Energy in both forms, thermal as well as electricity is utilized by Automobile industry for manufacturing process. Production capacity, type and age of paint shop, compressed air system factors have got the profound impact on the plant energy consumption (electrical & thermal). The specific energy consumption per vehicle Eq for two wheeler segment, three wheeler segment, Passenger vehicles segment and commercial vehicles segment is 0.003, 0.003, 0.053 and 0.04 TOE/Vehicle Eq respectively where as best practice SEC is 0.0025, 0.0025,0.05 and 0.0324 TOE/Vehicle Eq respectively.

10.1.5 Road Transport Sector (Passenger)

Population and GDP are two fundamental drivers that influence person and freight mobility demand. Energy consumption in the transport sector currently represents a small share of the total energy consumption in India (15%). As indicated in Table 1, in terms of road transportation, travelling by bus is by far the most used means of passenger transport in India, accounting for 70% of total Passenger Kms (PKms) in FY 2008.

Table 6: Projections of Billion Passenger kilometers (Billion PKms) for Road Transport [62]

	Actual			Projections FY 2008
	FY 1991	FY 2001	CAGR (%)	
Cars	87.19	245.39	11%	506.33
Taxis	13.39	37.61	11%	77.49
Auto	36.40	110.91	12%	241.92
Jeeps	17.78	46.84	10%	92.28
Two Wheelers	134.19	391.97	11%	830.09
Bus	1216.80	2457.95	7%	4020.88
Total Road	**1505.75**	**3290.67**	**8.35%**	**5768.99**

Overall road transport is the fastest growing mode of transportation with ten year CAGR of 8.35%, followed by air and rail. Total energy consumption in the transport sector is evenly distributed between freight and passenger transportation.

In India, motorization is still low but car ownership is increasing fast with increasing GDP. In 2020, the transportation sector (Passenger & Freight) is projected to account for 21% of total

61 *www.siamindia.com/scripts/gross-turnover.aspx , accessed on March 22, 2010*
62 *LBNL Report*

final energy use and 14% of primary energy use, versus 16% of total final energy use and 12% of primary energy use in 2005.

For passenger road transport, energy intensity for Car, Taxis & Jeep is 0.94 MJ/Pkm with 676 projected billion Pkms, energy intensity for bus is 0.19 MJ/Pkm with 4021 projected billion pkms, energy intensity for auto-rickshaw is 0.58 MJ/Pkm with 242 projected billion Pkms and energy intensity for two wheelers is 0.53 MJ/Pkm with 830 projected billion Pkms. Thus the weighted average energy intensity for passenger road transport sector is 0.343 MJ/Pkm. It is assumed that with technology advances energy intensity will reduce by 15% to 0.292 MJ/Pkm.

10.1.6 Transmission and Distribution Sector

In view of Government's focus on providing electricity to rural areas, the power distribution system is being extended to reach remote villages. The total length of Transmission & Distribution (T&D) lines in the country increased from 6.57 million circuit kilo meter (ckm) in FY 2005 to 7.27 million ckm in FY 2008 with 3 year CAGR of 3.47%. Region wise addition of T&D lines is provided in Table 2 below,

Table 7: Region wise T&D lines in Circuit Kilometres

REGION	2005	2008	3 Yr CAGR
Northern Region	1679704	1856281	3.39%
Western Region	1905076	2197473	4.87%
Southern Region	2277975	2456336	2.54%
Eastern Region	537694	581205	2.63%
North Eastern Region	170374	187651	3.27%
All India	**6570823**	**7278946**	**3.47%**

As of February 28, 2008, a total of 4474 inhabited villages were electrified, while cumulatively 4,87,338 villages were electrified.[63] However, T&D losses in the country remain high, at around 27%, compared to an average 10-15%in developed countries. The difference in the amount of electricity supplied and amount actually metered is usually reported as T&D losses. High T&D losses are attributed to the transmission and distribution of a large amount of power at a low voltage and overloading of the existing T&D network. The rise in rural electrification has resulted in the proliferation of low voltage (less than 11 kv) transmission line. As per General Review carried out by CEA in 2009, region wise T&D losses in MU are provided in Table 3. As indicated in Table 3, region wise loss density in kWh/ckm is calculated by dividing regional loss with regional ckm. Thus the average loss density for India is 25761 kWh/ckm where as for southern region loss density is 15042 kWh/ckm.

Table 8: Region wise T&D losses and loss density for FY 2008

Region	T&D Loss		Loss Density (kWh /ckm)
	%	MU	

[63] *CRISIL report on Power Sector*

Northern Region	30.26%	61010	32867
Western Region	29.40%	63769	29019
Southern Region	19.77%	36949	15042
Eastern Region	29.31%	22285	38342
North Eastern Region	43.41%	3501	18657
All India	27.20%	**187513**	**25761**

10.2 Approach for Estimating Potential Savings

A simplified sector specific approach is followed to estimate the saving potential for selective other sectors. For the purpose of analysis, FY 2008 is considered as base year.

10.2.1 Sugar sector

Sugar sector energy saving potentials is estimated as the difference between the total energy consumption by the sector under business as usual scenario and total energy consumption by the sector under best practice scenario, details are as provided in Table 4 below,

Table 9: Energy Saving Potential Estimates for Sugar Sector

	Particulars	Unit	2008
A	Annual Sugarcane Crushed	000 Tons	360000
	Average Specific Energy Consumption (Electrical)	kWh/tonne	35.03
	Average Specific Energy Consumption (Thermal)	MkCal/tonne	0.000405
B	Overall Average SEC (BAU Scenario)	TOE/tonne	0.0031
C	Total Energy Consumption (BAU Scenario)	TOE	1099125
	Best Practice Specific Energy Consumption (Electrical)	kWh/tonne	22.38
	Best Practice Specific Energy Consumption (Thermal)	MkCal/tonne	0.000300
D	Overall Best Practice SEC	TOE/tonne	0.0020
E	Total Energy Consumption (Best Practice Scenario)	TOE	703684
F	Energy Saving Potential	TOE	395441
		%	36%

Total energy consumption under BAU scenario and best practice scenario is estimated as a product of annual sugarcane crushed (3,60,000,000 tonnes) with SEC in BAU scenario (0.0031 TOE/tonne) & SEC in best practice scenario (0.0020 TOE/tonne) respectively. Thus the energy saving potential for sugar sector is equivalent to 395441 TOE (36%) in base Year.

10.2.2 Dairy Sector

In dairy sector, Total energy consumption under BAU scenario and best practice scenario is estimated as a product of annual milk processed (7,468,000 tonnes) with SEC in BAU scenario (6.5 TOE/tonne) & SEC in the best practice scenario (4.66 TOE/tonne) respectively. As indicated in Table 5 below, energy saving potential for dairy sector is equivalent to 13,740,936 TOE (28%) in base Year.

Table 10: Energy Saving Potential Estimates for Dairy Sector

	Particulars	Unit	2008
A	Annual Milk Processing	000 Tons	7468
	Average Specific Energy Consumption (Thermal+ Electrical)	MkCal/tonne	65.00
B	Overall Average SEC (BAU Scenario)	TOE/tonne	6.500
C	Total Energy Consumption (BAU Scenario)	TOE	48541350
	Best Practice Specific Energy Consumption (Thermal+ Electrical)	MkCal/tonne	46.60
D	Overall Best Practice SEC	TOE/tonne	4.660
E	Total Energy Consumption (Best Practice Scenario)	TOE	34800414
F	Energy Saving Potential	TOE	13740936
		%	28%

10.2.3 Commercial Building Sector:

In commercial building sector, energy is consumed mainly for air conditioning and lighting purposes. Overall energy saving potential for this sector is estimated as a difference between total energy consumption under BAU scenario and best practice scenario calculated as a product of commercial built up area (2,00,000,000 Sq meter) with SEC in BAU scenario (200 kWh/Sq meter) & SEC in best practice scenario (110 kWh/Sq meter) respectively. As indicated in Table 6 below, energy saving potential for commercial building sector is 1,548,000 TOE (45%) in the base Year.

Table 11: Energy Saving Potential Estimates for Commercial Building Sector

	Particulars	Unit	2008
A	Commercial Built-up Area	000 Sq. Meter	200000
	Average Specific Energy Consumption (Electrical)	kWh/Sq mt.	200.00
B	Overall Average SEC	TOE/Sq mt.	0.0172
C	Total Energy Consumption (BAU Scenario)	TOE	3440000
	Best Practice Specific Energy Consumption (Electrical)	kWh/Sq mt.	110.00
D	Overall Best Practice SEC	TOE/Sq mt.	0.0095
E	Total Energy Consumption (Best Practice Scenario)	TOE	1892000
F	Energy Saving Potential	TOE	1548000
		%	45%

10.2.4 Automobile Sector:

For simplicity and computation of SEC, automobile sector is categorised as two wheeler segment, three wheeler segment, passenger vehicles segment and commercial vehicles segment. Energy saving potential is estimated for each segment by estimating the total energy consumption under business as usual scenario and total energy consumption under best practice scenario; details are provided in Table 7 below

Table 12: Energy Saving Potential Estimates for Automobile Sector for FY 2008

	Particulars	Unit	Two Wheelers	Three Wheelers	Passenger Vehicles	Commercial Vehicles
A	Number of Two Wheelers produced	000 Nos	7430	467	1550	400
B	Overall Average SEC (BAU Scenario)	TOE/Vehicle Eq	0.0030	0.0030	0.0530	0.0400
C	Total Energy Consumption (BAU Scenario)	TOE	22290	1400	82150	16000
D	Overall Best Practice SEC	TOE/Vehicle Eq	0.0025	0.0025	0.0500	0.0324
E	Total Energy Consumption (Best Practice Scenario)	TOE	18575	1166	77500	12960
F	Energy Saving Potential	TOE	3715	233	4650	3040
		%	17%	17%	6%	19%

As indicated in Table 7, energy saving potential for two wheeler segment is 3715 TOE, for three wheeler segment 233 TOE, for passenger vehicles 4650 TOE and for commercial vehicle segment 3040 TOE (19%) in base year.

10.2.5 Road Transport Sector (Passenger):

For road transport sector, total energy consumption under BAU scenario and best practice scenario is estimated by product of total passenger kilometres of road transport (5,737,000,000,000 Pkms) with specific energy intensity in BAU scenario (0.0000082 TOE/Pkm) and energy intensity in best practice scenario (0.0000070 TOE/Pkm) respectively, as indicated in Table 8.

Table 13:: Energy Saving Potential Estimates for Road Transport Sector

	Particulars	Unit	2008
A	Total Passenger Kilometers (Road Transport)	Million Pkms	5737000
	Weighted Average Energy Intensity Per Passenger Km	MJ / Pkm	0.34
B	Energy Intensity in TOE	TOE/Pkm	0.0000082
C	Total Energy Consumption (BAU Scenario)	TOE	47100
	Best Practice Energy Intensity Per Passenger km	MJ / Pkm	0.29

D	Best Practice Energy Intensity In TOE	TOE/Pkm	0.0000070
E	Total Energy Consumption (Best Practice Scenario)	TOE	40035
F	Energy Saving Potential	TOE	7065
		%	15%

Thus the energy saving potential for road transport sector is equivalent to 7065 TOE (15%) in base Year.

10.2.6 Transmission & Distribution Sector:

In India power transmission and distribution accounts suffers loss to the tune of 27%. T&D losses are also a function of voltage level at which power is transmitted and distributed. Overall T&D losses for BAU scenario and best practice scenario are estimated by product of total transmission and distribution line lengths in circuit kilometres (7,279,000 ckm) with T&D loss density in BAU scenario (2.215 TOE/ckm) and T&D loss density in best practice scenario (1.294 TOE/ckm) respectively. As indicated in Table 9, total energy saving potential by T&D loss reduction is estimated as 6,709,908 TOE (42%) in base year.

Table 14: Energy Saving Potential Estimates for T&D Sector

	Particulars	Unit	2008
A	Transmission & Distribution Line Lengths (Ckt Kms)	000 Ckt Kms	7279
	T&D Average Loss Density	kWh/ Ckt km	25761
B	Loss Density TOE Equivalent	TOE/Ckt km	2.215
C	Total Energy Consumption (BAU Scenario)	TOE	16126135
	BEST Practice T&D Loss Density	kWh/ Ckt km	15042.15
D	Best Practice Loss Density - TOE Equivalent	TOE/Ckt km	1.294
E	Total Energy Consumption (Best Practice Scenario)	TOE	9416227
F	Energy Saving Potential	TOE	6709908
		%	42%

10.3 Overall Energy Saving Potential

Overall energy consumption under business as usual scenario and best practice scenario with saving potential is provided in Table 10 below.

Table 15: Overall Energy Saving Potential for Other Sectors

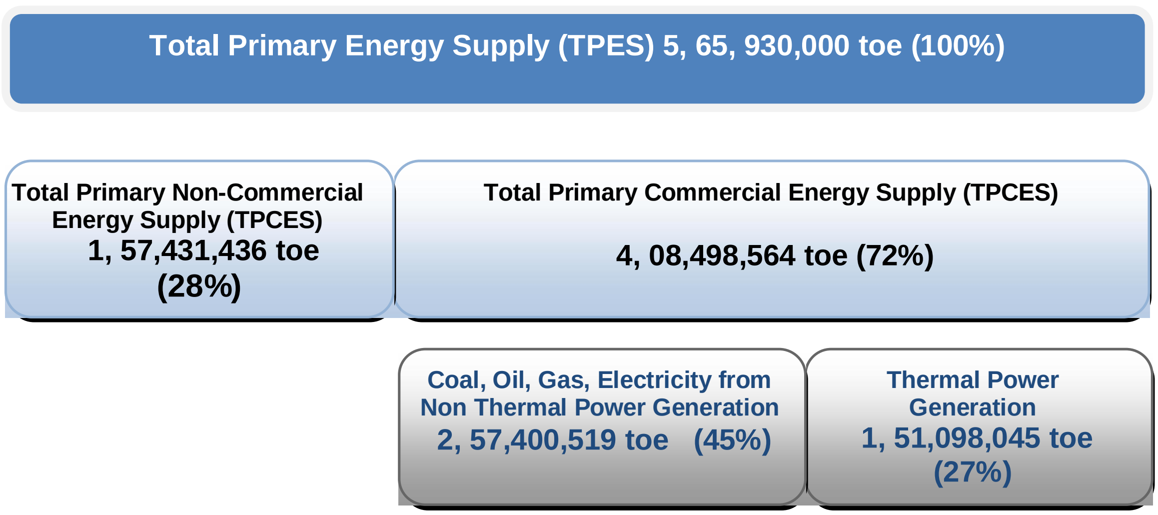
Sr No	Sectors Covered		BAU Scenario Energy Consumption (TOE)	Best Practice Scenario Energy Consumption (TOE)	Energy Saving Potential	
					TOE	% of Total
1	Sugar Sector		1099125	703684	395441	1.76%
2	Dairy Sector		48541350	34800414	13740936	61.31%
3	Commercial Building Sector		3440000	1892000	1548000	6.91%
4	Automobile Sector	Two Wheeler	22290	18575	3715	0.02%
		Three Wheeler	1400	1166	233	0.00%
		Passenger Vehicle	82150	77500	4650	0.02%
		Commercial Vehicle	16000	12960	3040	0.01%
5	Passenger Road Transport		47100	40035	7065	0.03%
6	Transmission & Distribution		16126135	9416227	6709908	29.94%
TOTAL			69375550	46962562	22412988	

From Table 10, the overall energy consumption by these six sectors under BAU scenario is 69.37 million tonnes of oil equivalent (Mtoe), whereas for best practice scenario overall energy consumption is 46.96 Mtoe with energy saving potential of 22.41 Mtoe in these six sectors. . With Total Primary Energy Consumption (TPES) of 565.93 Mtoe in FY 2008, the saving potential is 4 % of TPES.

10.4 Detailed Energy Balance

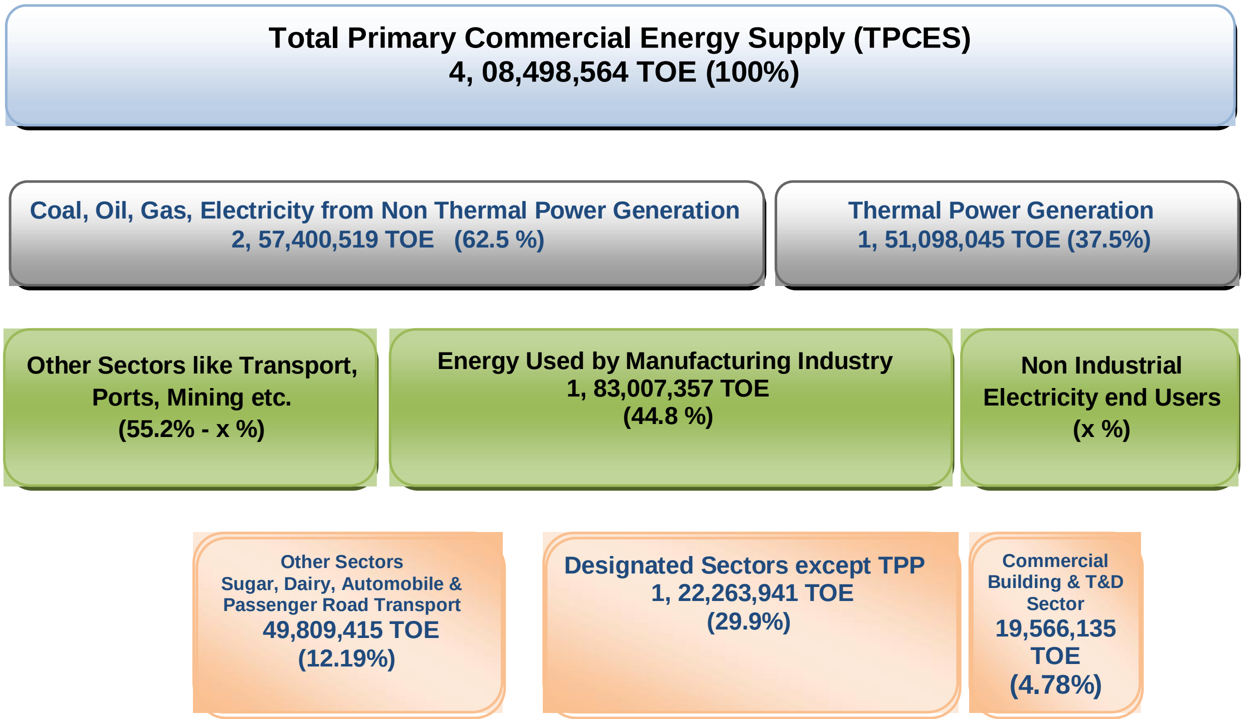
To get an overview of energy usage and sector specific saving potential, a detailed energy balance for mandatory as well as other sectors is carried out as provided in Figures below,

Figure 10.1: Energy Balance forTotal Primary Energy Supply



As shown in Figure 1, out of total primary energy, 72% is commercial energy and 28% is non-commercial energy. 45% of total primary energy is used in the form of coal, oil, gas, non thermal power generation etc, where as 27% is commercial energy used for thermal power generation. All mandatory and other sectors depend on commercial energy; detailed energy balance for total primary commercial energy is provided in Figure 2 below,

Figure 10.2: Energy Balance forTotal Primary Commercial Energy Supply



As indicated in Figure 2 above, out of total primary commercial energy supply of 408.49 Mtoe, 62.5%of total primary commercial energy is used in the form of coal, oil, gas and non thermal power generation etc, whereas 37.5% of total primary commercial energy is used for thermal power generation. As reported in “The Energy Data Directory & Year Book 2009”, 44.8% of total primary commercial energy (183 Mtoe) is used by manufacturing industries. Designated sectors (cement, iron & steel, paper & pulp, fertilizer, aluminium, textile and chlor-alkali) except TPP account for (122.26 Mtoe) 29.9% of total primary commercial energy consumption. Manufacturing industries like sugar, dairy and automobile and passenger road transport sector account for (49.8 Mtoe) 12.19% of total primary commercial energy consumption, whereas commercial building and T&D sectors consume (19.5 Mtoe) 4.78% of total primary commercial energy consumption in the form of electricity.

11 Stakeholder analysis

Energy intensive industries namely fertilizers, aluminum, textiles, cement, iron & steel, pulp & paper, and chlor- alkali consume around 65 per cent of total industrial energy. A CII study[64] on energy efficiency estimated that Indian Industry has the potential to save up to 15 to 25 per cent of total energy consumption.

Over the past decade, energy efficiency in Indian industry has increased steadily. In the major energy-consuming industrial sectors, such as cement, steel, aluminium, fertilizers, etc., average specific energy consumption has been declining because of energy conservation in existing units, and much more due to new capacity addition with state- of-art technology. The specific energy consumption of Indian cement plants and of Indian iron and steel plants has been declining rapidly. In the cement sector, the specific energy consumption of the most efficient plants is now comparable to that of the most efficient plants in the world.

CII conducted detailed interviews of stakeholders for the mandatory trading market covering aluminium, cement, chlor-alkali, fertilizers, power, pulp and paper, and railways sector. The interviews were conducted to gather industry perspective on the issues, opportunities, barriers, and way-forward to implement the Perform Achieve and Trade scheme.

All the sectors analyzed have distinct characteristics and operating dynamics; the cement sector for example is highly concentrated with 90% of the production capacity covered by few large companies. The chlor-alkali sector consists of 30-35 large companies which capture the majority of the market with limited number of small units. The power and fertilizer sector share some of the same characteristics as they are highly regulated by the government with government stake in many large companies. The textile sector on the other hand is largely decentralized with 75% of the mills being stand-alone mills in the sector.

During the interactions it was gathered that the industry is aware about energy efficiency and have been taking initiatives and have been implementing new processes or technology to reduce their carbon foot-print. The motivation for the existing activities in energy efficiency improvements across sectors is because of benefits reaped through improved competitiveness, reduction in input costs, and goodwill earned by being socially responsible. The level of awareness, however, regarding the PAT scheme is very low with many industry players having no awareness about the scheme.

In a general sense there exists energy efficiency opportunities across sectors by improving operations and maintenance systems, also there are various improved technologies and best practices that can be adopted to improve efficiency and reduce carbon emission. Some of the other avenues for energy efficiency are better heat recovery, use of variable frequency drives, use of improved catalyst, use of improved materials, optimization of electrolysis and better steam utilization. It was also observed that the deciding factors considered while choosing energy efficient technologies are investment cost, pay back periods, long term energy cost scenario, long term liability though legislative interventions.

During the stakeholder interaction it was observed that though the level of awareness of energy efficiency and strategies to be energy efficient are well understood by many players, there are certain barriers which should be overcome:

- The level of awareness across the management board is not equal more so in smaller units; this changes the level of priority given to fund allocation within the organization
- There is certain level of reluctance to undertake any energy efficient project due to lack of easy financing available in the market moreover the pay back time for such projects is more than 7 years

[64] *Building a Low Carbon Indian Economy*

- Energy efficient projects implementation is time consuming and often requires operators to shut plants for improvements, which is inconvenient to the operators
- In certain sectors there is limited experience or proven track record for energy efficient technologies
- The plants power saving through energy efficiency should be able to sell surplus power to third party. Although this is allowed theoretically, however the state utilities discourage power trade
- Constraints relating to plant's structural lay-out
- In certain sectors lack of data availability is a limiting factor
- Small size companies feel the need to hire consultants to carry out audits and energy efficiency consultancy, which is an expensive proposition

In addition to the barriers shared by the industry, some of the perceived risks are:

- Companies may be penalized for the energy efficiency improvement before the implementation of PAT, as there is no possibility of generating ESCerts (energy saving certificates) for the improvements, so called as penalty for early action
- Inadequate incentives from the government for adopting energy efficient technologies
- Companies would like to reduce their risk exposure by sharing risk with energy efficient technology suppliers, who currently are reluctant to share the risk of failure
- Limited experience of the energy efficient technology suppliers in relevant sector
- Apprehension of sudden increase in price of energy efficient equipment, because of demand created by PAT targets. This might lead to closing down of several plants.
- ESCerts prices may be too low which may not justify the company's investment
- In certain sectors availability of raw material is a constraint, as an energy efficient equipment / machinery will not be helpful unless the particular raw material is not available

Some of the suggestions shared which should be considered while developing the framework and implementing the PAT scheme are:

- PAT should not be implemented in isolation. An enabling framework should be first created which should include:
    - Provision of soft capital at 2-3% interest rate
    - Provision of tax depreciation for energy efficient technology
    - Zero custom duty on energy efficient product's import
- There should be system-wise benchmarks available within each sector
- A gestation period of 3-4 years is required before the PAT is implemented
- Targets should be different for different units and should not be a sectoral target
- Administrative cost under PAT and transaction cost of issuing ESCerts, trading etc should also be considered and it should be kept as low as possible
- Process level data should be gathered and used in defining the targets also all independent variables such as production volume, technology, type of fuels etc should be utilized to develop several scenarios to define targets

- Improvement targets should be given for each unit for a certain time period which should be modified in subsequent commitment periods
- A neutral body should be appointed to define and set PAT target
- The PAT system should be well-defined as manufacturers may outsource energy intensive activities thereby manipulating the system

11.1 Development of a PAT Scheme in India - The Way Forward

It is evident that there is a huge potential for energy efficiency saving across industries, however, it is imperative that a consolidated and well defined ESCerts trading market is developed in every respect for enabling Indian industry to tap the opportunities. Failing such consolidation, the Indian market will remain fragmented, more costly and less efficient for market players.

11.2 Set-up an Organised Domestic PAT Scheme in India

Clearly, there is a pressing need for setting-up an organized exchange in India that could lead to following benefits:

- Price discovery of various carbon products specifically ESCerts
- Transparency and benchmarking in Indian energy efficiency savings market
- Pooling of all local project developers at one place and providing matchmaking services
- Mitigation of risks such as credit risk, delivery risk, performance risk by organizing the market

The objective in India should be to set up an exchange, where price is determined by double side bidding. Along with the spot trading, the exchange can also facilitate futures and options trading based on energy efficiency savings. There could be a separate exchange for this or it could be linked to one or more of the existing exchanges in India. Thereafter, such trading can start in one of the existing national commodity exchanges in the country, after adequate capacity is built.

To enable development of such a trading market concerted efforts would be required on certain pre-requisites. Some of these are discussed as below:

a) Awareness Generation: It is critical that the industry and other stakeholders have a clear understanding of the PAT scheme and its implications. This would entail undertaking sector specific awareness generation exercises.

b) Financial sector: A real financial industry must be developed for ESCerts trading by establishing specialized institutions and developing a pool of specialized professions. Trading, guaranteeing and hedging products must be created and developed to cater to the industry's trading appetite.

c) Policy interventions: Clear-cut policy guidelines should be in place to encourage ESCerts trading. Consequently, all applicable tax benefits should be in public domain. It is also essential that a certifying body should be established to add credibility to the market.

d) Capacity Building: There is a need to build capacity especially of financial, legal, technical expertise for smooth implementation and operation of the Scheme.

e) Trading Exchange: Creation of a trading exchange would be a positive step in terms of the development of the trading Scheme. Exchanges could eventually establish markets in other environmental products likely to come up in the near future.

11.3 Risks and barriers

Sector	Risks & Barriers
Aluminum	• PAT scheme may not be of great benefit to the sector as the market is price competitive which can be achieved only though reduction in important raw materials like Energy
Cement	• Lay-out constraints (difficult to change lay-out of existing plants) • Pay-back period of some of the EE technology is very high. E.g. for ball mill to vertical mill, payback period is 8-12 years • Manufacturers should be able to sell surplus power to third parties. Though theoretically, it is allowed but practically it is very difficult as State utilities are unwilling to let it happen • CDM mechanism is not very helpful due to procedural complicacies • ESCerts prices may be too low • Limitation in technology • Sudden demand created by PAT targets may flare-up prices of energy efficiency equipment as there are limited numbers of suppliers internationally. This may lead to closing down of several plants
Chlor- Alkali	• Lack of awareness and lack of focus in certain cases of Energy Efficiency • Lack of easy financing for energy efficiency projects • PAT if implemented without wide-scale awareness and understanding may be counter-productive
Fertilizers	• Administrative cost under PAT and transaction cost of issuing ESCerts, trading etc should also be considered and should be as low as possible • Process level data should be gathered and used in defining the targets. Target setting is complex and all the independent variables such as production volume,

	technology, type of fuels etc should be considered to develop several scenarios by varying one variable each at a time
Power	• Fund are available with large power companies, however, allocation of the funds to energy efficiency projects is a problem, as there are often competing priorities • Implementation of energy efficiency projects sometimes is time consuming and operators do not want to shut plants for improvements
Pulp & Paper	• Small pulp and paper companies need to hire consultant to carry out audits and energy efficiency consultancy. This is very expensive for small companies • Financing is another barrier for small companies as there are issues in arranging financing for working capital • If systems are designed to operate on higher efficiency, they would require use of particular variety of raw material. It may not be possible to get suitable raw material which may result in no energy efficiency improvement
Railways	• Awareness is limited • Lack of data to measure energy efficiency benefits • No or limited financing for high value cost projects
Textiles	• Industry wants a pay-back period as low as 5 years for any project. However, in some of the energy efficiency projects in the sector pay-back period is around 7 years

Appendix 1: International trading and energy efficiency schemes

European Union Emission Trading Scheme (EU ETS)

The EU ETS is a mandatory emissions trading scheme covering over 10,000 energy intensive installations across the 25 Member States of the European Union. Phase 1 of the scheme operated from 2005 to 2007. Phase 2 started in 2008 and will last until 2012, and phase III will operate from 2013 to 2020.

- **Scheme Objective** - The Scheme is one of the EU's key measures for delivering its commitments under the Kyoto Protocol and for delivering its objective of demonstrating leadership in reducing emissions of greenhouse gases. The EU ETS covers electricity generation and the main energy-intensive industries – power stations, refineries and offshore, iron and steel, cement and lime, paper, food and drink, glass, ceramics, engineering and the manufacture of vehicles.
- **Ambition and target setting** - Phase 1 and 2 was based on straight line caps throughout the phase. Phase 3 has a decreasing cap, declining by 1.8% per year to 2020. Allocation for Phase 1 and 2 allocation was done through national governments (NAPs) based on a share for each sector. Phase 3 will involve centrally allocated EU targets. Phase 1 allowed for 95% of the allowances to be given away as opposed to being auctioned. Retrospectively the allowances were found to be excessive and as a result the carbon prices crashed. The over-allocation issue was addressed in Phase 2 of the EUETS. A lack of consistency in target-setting assumptions and methodologies has made it difficult to evaluate the adequacy of targets across nations.
- **Institutional set-up/ governance** - The European Commission plays a central role in administering the scheme, proposing policy for adoption through Directives, approving Member States' plans and monitoring the outcome from the scheme. The scheme is overseen by the central European Environment Agency but each member state has competent authority to manage the scheme in country.
- **Monitoring, Reporting and Verification** - Under the EU ETS Directive companies participating in the scheme are required to monitor their emissions, have their emissions verified by an accredited verifier, and report their emissions annually to the relevant Member State authority. Companies failing to surrender sufficient allowances to cover their verified emissions must pay a penalty, and buy the required number of allowances from the market.
- **Trading arrangements** - Computerised registries are key components of the scheme and wider international emissions trading under the United Nations Framework Convention on Climate Change's (UNFCCC's) Kyoto Protocol. All national registries are connected directly to the UNFCCC's International Transaction Log (ITL). This transaction log is responsible for checking all transactions to ensure they adhere to the rules of international emissions trading under the Kyoto Protocol. The ITL also has a link to the EC's Community Independent Transaction Log (CITL). This transaction log is responsible for checking all transactions to ensure that they adhere to the rules of the EU ETS.

References

Project Performance Corporation, Toward a US Emission Trading Scheme - Lessons learned and Linkage to other systems, May 2009

National Audit Office, European Union Emissions Trading Scheme: a review by the National audit office, March 2009

CRS report for congress, Climate Change and the EU Emissions Trading Scheme (ETS): Kyoto and Beyond, November 2008

Kruger J et al, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, February 2007

Sunderland J, Retrospective on Phase 1 of the European Union Emissions Trading Scheme (EU-ETS), 2008
DECC Website, 2009
http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/tackling_clima/emissions/eu_ets/eu_ets.aspx

Climate Change Agreements (CCAs)

CCAs are voluntary mechanisms that encourage energy efficiency in energy intensive industries in the UK. CCAs were introduced in 2001 and are set to expire in March 2013. However, the Government intends for the scheme to continue until 2017.

- **Scheme Objective** - Whilst implementing a climate change levy met increasing pressure on business to contribute to UK objectives to climate change, the Government recognised the need for special consideration to be given to the energy intensive industries given their energy usage and their exposure to international competition. Consequently, the Government has provided an 80% discount from the Climate Change Levy for those industry sectors that agree challenging targets for improving their energy efficiency or reducing carbon emissions.
- **Ambition and target setting** - The UK Government's aim when selecting the sectors and enterprises that would be eligible to join a Climate Change Agreement (CCA) was to target the largest industrial energy users. The UK used evidence available from national statistics to identify the top energy using industry sectors (measured in absolute terms). CCAs cover ten major energy intensive sectors (aluminium, cement, ceramics, chemicals, food & drink, foundries, glass, non-ferrous metals, paper, and steel) and there are over thirty smaller sectors with agreements. Targets are based on historical levels of energy use.
- **Institutional set-up/ governance** - The Department of Energy and Climate Change (DECC) oversee the scheme. At the outset of the programme, there were just 6 DECC staff working on the CCAs, not all full time. In addition to the 'core' staff, there was a small team of six consultants employed to give technical support on target setting and these people concentrated their initial efforts on the top ten sectors. By 2009, there was approximately 20 full time equivalent staff working on the CCA programme, including consultants.
- **Monitoring, Reporting and Verification** - Data on energy use and production is reported to DECC on a biannual basis. Provided participants have used fewer kWh per unit of production than their target sets out, they will meet the target. DECC will check the information through site audits. It is likely that if the CCAs are extended, a move to independent verification will be made.
- **Trading arrangements** - CCA holders are able to access the UK ETS, with target units that over-achieve against targets allowed to convert that over-achievement into allowances for sale in the UK ETS. Similarly, target units that fail to meet targets through direct means, may make up the shortfall by purchasing and retiring UK ETS allowances. The introduction of the European Union Emissions Trading Scheme on 1 January 2005 required DECC to undertake some minor amendments to the CCAs to ensure that operators could not benefit twice (or equally be penalised twice) for the same energy reduction.

References

DECC, UK Climate Change Levy and Climate Change Agreements, Sep 2009
Glachant, M & Muizon, G de, Climate Change Agreements in UK: A Successful Policy Experience?, 2006
Carbon Trust website, http://www.carbontrust.co.uk/climatechange/policy/cc_agreements.htm

DECC CCA website,
http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/tackling_clima/ccas/ccas.aspx

CRC Energy Efficiency Scheme (CRC)

The CRC is the UK's mandatory energy saving scheme aimed at improving energy efficiency and reducing carbon dioxide emissions, as set out in the Climate Change Act 2008. The scheme will affect approximately 20,000 organisations, with around 5,000 of these required to participate in the scheme. The scheme is due to start in April 2010, with a three-year introductory phase.

- **Scheme Objective** - The CRC scheme has been designed to raise awareness in large organisations and encourage changes in behaviour and infrastructure. It is the Government's intention that overall, CRC will deliver reductions of at least 4.4 million tonnes of UK CO_2 emissions per year by 2020. By driving energy efficiency, the CRC will also deliver emissions reductions cost-effectively, and enable sustainable growth.
- **Ambition and target setting** - An organisation will be included in CRC if, over the course of the qualification period, it has: one or more half hourly electricity meters (HHM) settled on the half hourly market; and responsibility for total half hourly metered electricity supplies of at least 6,000 MWh. Although qualification for CRC is based on half hourly electricity consumption only, CRC covers both direct and indirect emissions from all energy sources.
- **Institutional set-up/ governance** - The Environment Agency (EA), Scottish Environmental Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA) are appointed as joint scheme Administrators. The basic administrative functions will be carried out by the EA for the whole of the UK**.**
- **Monitoring, Reporting and Verification** - There are four reporting requirements for CRC participants: Registration Data; Evidence Pack; Annual Statements and Footprint Reports. The reporting of emissions will be done via the online Registry primarily through annual summary energy reports from metered energy where possible. This will be supported by self-reading or energy bills where necessary, and will be self-certified. Participants must also follow rules for measuring different types of energy use appropriately and keep adequate records to support the information that they must report to the Administrators.
- **Trading arrangements** - CRC will operate as a cap and trade scheme in which Participants are required to purchase and surrender allowances corresponding to their annual CRC emissions with one allowance equivalent to one tonne of carbon dioxide emitted. Participants can purchase allowances during the sale or auction of allowances, by trading with other Participants or third parties on the secondary market, or via the safety valve mechanism. Allowances may also be banked for use in future years, with the exception of the end of the Introductory Phase when all allowances that have not been surrendered will be cancelled to protect the integrity of the cap

References

DECC, Consultation on the Draft Order to Implement the Carbon Reduction Commitment, March 2009

Consultation on the Draft Order to Implement the Carbon Reduction Commitment, October 2009

DECC, Final Impact Assessment on the Order to implement the CRC Energy Efficiency Scheme, October 2009

DECC CRC Website, 2010

http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

Tradable White Certificates (TWCs)

Tradable White Certificates are part of mandatory schemes implemented in several EU countries, with varying scope. A white certificate also referred to as an Energy Savings Certificate (ESC) or Energy Efficiency Credit (EEC), is an instrument issued by an authorised body guaranteeing that a specified amount of energy savings has been achieved.

- **Scheme Objective** - Under this mechanism, producers, suppliers or distributors of electricity, gas and oil are required to undertake energy efficiency measures for the final user. Targets vary with countries, due to fragmented markets with different objectives and policy responses.
- **Ambition and target setting** - In the UK TWCs focuses on the residential sector. Eligible technologies include insulation, energy efficient appliances and boilers, and low energy lighting. In Italy TWCs cover all energy end-use sectors. In France the policy covers all fuels and sectors including transport (excluding installations covered by the EUETS).
- **Institutional set-up/ governance** - UK: Measures implemented by suppliers are assessed and approved by the regulator OFGEM. OFGEM has developed administrative procedures to monitor delivery and supervise supplier's progress. Italy: AEEG, the Italian Regulatory authority for Electricity and Gas, defines the methodologies for determining savings and manages the scheme. France: The French agency for Environment and Energy management and ATEE (Association Technique Energie Environment) are responsible for setting methodologies for calculating energy savings.
- **Monitoring, Reporting and Verification** - UK: DEFRA developed an ex-ante model for determining the energy savings attributed to measures under the scheme, depending upon the type of dwelling, its age and size. Italy: Energy savings may be determined ex-ante, based on field measurement or an energy monitoring plan. France: Verification is carried out by the Ministry of Industry.
- **Trading arrangements** - UK: Both energy savings and obligations can be traded but no certificate trades are allowed. Energy savings/ obligations traded have to be reported to monitoring authority, OFGEM. Informal trading is more common e.g. a technology provider or third party implementing measures in properties and selling the savings to the compliance buyer. Italy: White certificates can be bought in the market or via bilateral contracts.

References

Intelligent Energy, EuroWHiteCert Project: Stepwise towards effective European energy efficiency policy portfolios involving white certificates

UK Renewables Obligation (RO)

The RO places an obligation on UK suppliers of electricity to source an increasing proportion of their electricity from renewable sources. The RO was introduced in 2002.

- **Scheme Objective** - The Renewables Obligation (RO) is the Government’s main policy mechanism for incentivising renewable electricity in the UK. Since its introduction, the RO has been subject to a number of changes aimed at improving its efficiency and effectiveness.
- **Ambition and target setting** - Originally target set in terms of % of renewable electricity supplied. From April 09, this changed to number of ROCs (Renewable Obligation Certificates) - one ROC per MWh of renewable electricity generated by the supplier, in response to different ROC banding for different technologies.

- **Institutional set-up/ governance** - The RO is administered by Ofgem who issue renewable electricity generators with 1 ROC for each megawatt hour of eligible renewable electricity generated.
- **Monitoring, Reporting and Verification** - Where suppliers do not have sufficient ROCs to meet their obligations, they must pay an equivalent amount into a fund, the proceeds of which are paid back on a pro-rated basis to those suppliers that have presented ROCs. Non-compliance penalties are collected in a penalty fund and redistributed to those market actors that comply with their targets. This has resulted in the lifting the market price of the certificates higher than the penalty price.
- **Trading arrangements** - Suppliers can meet their obligation by: acquiring ROCs; paying a buy-out price (rising each year with the retail price index); or a combination of ROCs and paying a buy-out price. When a supplier chooses to pay the buy-out price, the money they pay is put into the buy-out fund. Following the end of an Obligation period, the buy-out fund is recycled to electricity suppliers presenting ROCs.

References

DECC, Impact Assessment of changes to the Renewables Obligation (RO) (to be implemented in 2010), URN:09D/700, July 2009

European Commission, Review and analysis of national and regional certificate of schemes, 2007

Regional Greenhouse Gas Initiative (RGGI)

The RGGI is a mandatory scheme in the United States aiming to reduce greenhouse gas emissions. Ten north-eastern and Mid-Atlantic States have agreed cap and will reduce emissions from the power sector by 10% by 2018. Approximately 225 fossil fuel-fired electric power plants (25 megawatts or greater) are covered by the scheme. Emission permit auctioning began in 2008, and the first three-year compliance period began in January, 2009.

- **Scheme Objective** - The cap on emissions of CO_2 from power plants in the RGGI region will be 10 percent lower by 2018 than at the start of the RGGI program in 2009. The ten states will use revenues from allowance auctions to boost investment for energy efficiency and renewables, while creating green jobs and accelerating the regional shift to a clean-energy economy. RGGI aims to demonstrate that a national program to reduce emissions can benefit both the environment and the economy.
- **Ambition and target setting** - RGGI covers fossil fuel-fired electric power plants 25 megawatts or greater in size. Power plants regulated under state RGGI programs account for approximately 95% of the region’s total electric generation sector CO_2 emissions.
- **Institutional set-up/ governance** - RGGI is an agreement among the Governors of ten Northeastern and Mid-Atlantic states. The RGGI States have retained a professional independent market monitor (Potomac Economics) to oversee auctions and subsequent market activity.
- **Monitoring, Reporting and Verification** - Participants need to install and certify monitoring systems and collect, record, quality assure and report data necessary to quantify CO_2 mass emissions from that unit.
- **Trading arrangements** - RGGI is composed of individual CO_2 Budget Trading Programs in each of the ten participating states. These ten programs are implemented through state regulations. Regulated power plants can use a CO_2 allowance issued by any of the ten participating states to demonstrate compliance with the state program governing their facility. Taken together, the ten individual state programs function as a single regional compliance market for carbon emissions. The RGGI States will distribute allowances primarily through

regional auctions. Allowances can also be traded on a secondary market. Proceeds from the sale of allowances will fund state programs that promote energy efficiency and projects for clean renewable energy

References

RGGI Inc, Regional Greenhouse Gas Initiative (RGGI) Fact Sheet, 2009

RGGI, Design Elements for Regional Allowance Auctions under the Regional Greenhouse Gas Initiative, 2008

RGGI, Overview of RGGI CO_2 Budget Trading Program, 2007

Climate Strategies, Linking Existing and Proposed Greenhouse Gas Emissions Trading Schemes in North America, 09

Summary Developed and Endorsed by: Environment Northeast et al., Lessons Learned From RGGI, A review of key components of the nation's first mandatory greenhouse gas cap & trade system, 2008.

PPI, Murrow D & Shattuck P, Essential Lessons from the Regional Greenhouse Gas Initiative, April 2009

RGGI website, http://www.rggi.org/about/documents

New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS)

The NSW GGAS is a mandatory scheme aiming to reduce greenhouse gas emissions associated with the production and use of electricity. The scheme imposes benchmark targets on all NSW electricity retail suppliers, certain generators and all market customers that take electricity supply in NSW directly from the National Electricity Market. The scheme commenced in January, 2003.

- **Scheme Objective** - Reduce greenhouse gas emissions associated with the production and use of electricity and to develop and encourage activities to offset the production of greenhouse gas emissions.
- **Ambition and target setting** - The Electricity Supply Amendment (Greenhouse Gas Emission Reduction) Act 2002 sets a State greenhouse gas benchmark expressed in tonnes of carbon dioxide equivalent (CO_2-e) per capita. The initial level was set at the commencement of GGAS in 2003 at 8.65 tonnes. The benchmark progressively drops to 7.27 tonnes in 2007 which represents a reduction of five per cent below the Kyoto Protocol baseline year of 1990.
- **Institutional set-up/ governance** - The Independent Pricing and Regulatory Tribunal of NSW (IPART) is the independent economic regulator for NSW. IPART oversees regulation of the electricity, gas, water and transport industries and undertakes other tasks referred to it by the NSW Government.
- **Monitoring, Reporting and Verification** - Benchmark participants must submit an annual greenhouse gas benchmark statement to IPART confirming their electricity sales, greenhouse gas benchmark, and the number and details of abatement certificates surrendered. If a benchmark participant fails to surrender enough abatement certificates to meet their mandatory benchmark, then a penalty is assigned.
- **Trading arrangements** - GGAS can be characterised as a "baseline and credit" form of emissions trading where certificates are issued for actions that reduce emissions compared to prior practice, business as usual or, in some cases, current industry practice. Each certificate represents a tonne of emissions reduction. Benchmark participants may purchase and surrender off-setting certificates to reduce the average emissions attributable to them. The scheme establishes a registry to evidence the creation, transfer and ultimate surrender of abatement certificates

References

GGAS, Introduction to GGAS, 2008

IPART, Compliance and Operation of the NSW Greenhouse Gas Reduction Scheme during 2008, July 2009

CEEMA discussion paper, The NSW Greenhouse Gas Reduction Scheme: An analysis of the NGAC Registry for the 2003, 2004 and 2005 Compliance Periods, 2007

NSW Liberals National Coalition, Response to the Carbon Pollution Reduction Scheme Green Paper, 2008

GGAS website, http://www.greenhousegas.nsw.gov.au/overview/scheme_documents.asp

Chicago Climate Exchange (CCX)

CCX is a voluntary, legally binding greenhouse gas reduction and trading system for emission sources and offset projects in North America. CCX has more than 350 members ranging from corporations, educational institutions and government organisations. The exchange was launched in 2003.

- **Scheme Objective** - CCX seeks to achieve environmental gains by gradually reducing program-wide and individual members' emissions limits. The scheme hopes to build the skills and institutions needed to cost-effectively manage GHGs. Another goal is to facilitate capacity-building in both public and private sectors to facilitate GHG mitigation.
- **Ambition and target setting** - The companies joining the exchange commit to reducing their aggregate emissions by 6% by 2010. CCX Members are leaders in greenhouse gas (GHG) management and represent all sectors of the global economy, as well as public sector innovators. Reductions achieved through CCX are the only reductions made in North America through a legally binding compliance regime.
- **Institutional set-up/ governance** - The founder and chairman of CCX is economist and financial innovator Dr. Richard L. Sandor. Members make a legally binding commitment to the CCX Emission Reduction Schedule and are subject to annual emissions verification. Indirect emissions are an opt-in. Compliance with the CCX Emission Reduction Schedule is enforced by the CCX Environmental Compliance Committee.
- **Monitoring, Reporting and Verification** - Independent, third party verification is undertaken by the Financial Industry Regulatory Authority (FINRA). FINRA also monitor CCX trading activity using market surveillance technologies and review all verifier's reports for offset projects.
- **Trading arrangements** - CCX is a cap and trade system and Members make a legally binding emission reduction commitment. Members are allocated annual emission allowances in accordance with their emissions Baseline and the CCX Emission Reduction Schedule. Members who reduce beyond their targets have surplus allowances to sell or bank; those who do not meet the targets comply by purchasing CCX Carbon Financial Instrument (CFI) contracts.

References

CCX, CCX Overview, 2008

Yang T, The Problem of Maintaining Emissions "Caps" in Carbon Trading Programs Without Federal Government Involvement: A Brief Examination of the Chicago Climate Exchange and the Northeast Regional Greenhouse Gas Initiative, 2006

CCX website, http://www.chicagoclimatex.com/content.jsf?id=821

China's Top-1000 Energy-Consuming Enterprises Program

The National Development Reform Commission (NDRC) in China launched the 'Top-1,000 Program,' which targets energy efficiency improvements in the 1,000 largest enterprises that together consume one-third of all China's primary energy. The scheme was launched in 2006.

- **Scheme Objective** - In 2005, the Chinese government announced an ambitious goal of reducing energy consumption per unit of GDP by 20% between 2005 and 2010. One of the key initiatives for realising this goal is the Top-1000 Energy-Consuming Enterprises program. The scheme aims to reduce unit energy consumption to domestic best practice level for all major products; and have some enterprises attain either international best practice levels or sector best practice levels.
- **Ambition and target setting** - In the Top-1000 Program, targets were set for each enterprise in order to support the provincial-level targets and to reach the overall savings target of 100 Mtce (2.9 EJ) for the Top-1000 Program. Preliminary targets for each enterprise were set taking into consideration their general situation rather than detailed assessments of energy-savings potential of each enterprise or each industrial sector.
- **Institutional set-up/ governance** - A number of national government departments and entities are involved in the Top-1000 program, including the Department of Resource Conservation and Environmental Protection of NDRC (China's macroeconomic management agency under the State Council which promotes energy saving), the National Bureau of Statistics (which collects and manages statistical information of enterprises), and the State-owned Assets Supervision and Administration Commission (which manages major state-owned enterprises).
- **Monitoring, Reporting and Verification** - The National Bureau of Statistics (NBS) is in charge of collecting data from the enterprises for the Top-1000 program. There is a generic spreadsheet that can be used for all Top-1000 plants to report their energy consumption by fuel quarterly on-line. The Top-1000 reporting is directly to NBS online via a website. There is no third party review or verification of the reported results at the enterprise, sector, provincial, or national level.
- **Trading arrangements** - The Top-1000 program was based on experience gained over three years through a pilot program with two steel mills in Shandong Province that relied heavily on European experiences with voluntary agreement programs.

References

Price, L, China's Top-1000 Energy-Consuming Enterprises Program:Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China, June 2008

US Acid Rain Programme (ARP)

The ARP is an initiative undertaken by the United States Environmental Protection Agency, aiming to reduce overall atmospheric levels of sulphur dioxide and nitrogen oxides, which cause acid rain. The program primarily targets coal-burning power plants. Phase 1 began in 1995 and Phase 2 began in 2000.

Appendix 2: Records of interviews

Meeting	:	CCA Interview with Marie Pender, DECC
Date	:	11th Jan, 2010
Time	:	10:30
Place	:	DECC Offices, 3 Whitehall Place, London
	:	
Attendees	:	Pratima Washan, Keith Regan, Marie Pender (NCM Division, Department of Energy and Climate Change, UK)

Questions and main points

1) Target setting approach for phase 1 of the CCAs (2000-2010)

- An 'Energy simulation model' was produced by BRE (Building Research Establishment) to facilitate negotiations. This was intended to be 'British industry specific' and modelled the range of technologies available plus cost-effectiveness of each of the options (assuming that availability of capital was not an issue)
- The approach was to set challenging targets for the industry (informed by the above analysis) and putting the onus on the sectors to present evidence on why they were not feasible.
- In general, the industry was very sceptical, which meant that a number of fall back scenarios were introduced in the initial years to give some level of comfort, which were than phased out. For instance, targets could be adjusted if a facility switched to a more energy intensive product. This flexibility was withdrawn in 2006.
- The targets were tightened in the subsequent reviews (2006, 2008) as virtually all sectors achieved their bi-annual targets by a considerable amount. These revised targets were not based on modelling, only negotiations.
- In some instances falling outputs has made achievement of relative targets difficult (as the plant is not operating at maximum capacity and therefore lower efficiency). However, in the 2008 reviews, no sector switched from a relative to an absolute target.
- Dialogue with industry sectors considered very important for determining the targets.

2) How effective have CCAs been as a policy in delivering energy/ emission reduction over and above BAU (business-as-usual)?

- It is difficult to determine what the BAU would have been. BAU keeps changing as it is a function of the energy prices
- Has delivered around 3MtCO_2 per year above BAU (current energy prices). This translates to around 4MtCO_2 per year compared to original BAU (as BAU has gone up).
- Has delivered £1.7 billion energy cost savings at today's price
- Has helped industry to be competitive

3) Changes being proposed for next phase of the CCAs (post 2010)

- Simplification of the administrative processes
- The initial consultation for phase 2 of the CCAs discussed the option to include absolute targets. As EUETS covers 80-85% of the CCA emissions, which are in effect capped, it was decided to allow relative targets under CCAs.
- CCA targets will include EUETS emissions but there will be separate negotiated targets for emissions covered exclusively under CCAs (electricity and direct combustion)

4) Role of UKETS within the overall CCA policy

- UKETS treated as a safety valve and not important to CCAs
- Industry not buying allowances even at £1/tCO_2 carbon price
- UKETS not proposed to be continued in future phases of CCAs. It is proposed to allow for purchase of EUAs or CERs to achieve compliance. In case of over-achievement against targets, the over-achievement can be ring-fenced by the company for their own use in the future but cannot be sold to other CCA participants.

5) Issues to be considered in the Indian context

- Over-performance is made available in time for under-performers
- Risk of not enough allowances available to trade (as this was a worry for the UKETS)
- Design mechanisms to take surplus allowances out of the system. This is of paramount importance to the success of the scheme. Options to manage oversupply discussed in March 09 consultation of CCAs
- A ‘buy-out’ fund as an option to manage oversupply not considered in the context of the CCAs
- Access to finance is perceived as an issue. In the context of the CCAs, no specific policies or incentives address this issue.
- For MRV, the focus should be to get it good enough (to balance costs and accuracy). Self-certification in case of the CCAs has worked well and audits have uncovered only minor errors that did not affect compliance against targets.

Meeting	:	CCA Interview with Mineral Products Association
Date	:	7th Jan, 2010
Time	:	11:00 to 12:00
Place	:	Camco London
	:	
Attendees	:	Pratima W (PW) Keith Regan (KR), Neal Mehta (NM), Dr Richard Leese (Manager, Legislative and Regulatory Programmes Mineral Products Association.

Questions and main points

1) Broad views on CCA:

- Policy works well with sector level target and distributing efforts equitably between participants working together.
- Relative targets allow growth and energy efficiency improvement
- Expensive way of achieving energy efficiency with CCL burden
- Myriad of overlapping polices adds complexity and MRV burden for participants (CCA, EU ETS, CRC)
- CCA good for fuel switching, but major step change in efficiency performance is dependent on investments cycle. Many investment decisions are made overseas by the multinational parent companies

2) Timelines

- Approximate time of two yrs from start to finish setting up CCA.
- Three main agreements need to be established: Participation, Underlying and Member agreements.
- Equitable target setting for participants is a difficult and time consuming process

3) Targets

- Targets have been demanding, and even though sector has never failed, individual companies have not met obligations
- Knowledge has been main factor that had improved target setting procedure over the years. History of data collection and sensitivity of data by participants and technical consultants (AEA on working for Govt) had greatly improved the reliability and accuracy of targets over the years.
- Sector Association in charge of all information from participants to set targets (what the unit can achieve and what barriers are) – requirement to keep this secret.
- Data transparency important part of negotiating targets, but this needs to be balanced with competitive regulations (i.e. avoid risk of collusion).

4) Trading

- Ability to buy and sell carbon credits to manage the risk of losing rebate is an important issue, especially in periods of uncertain and low demand (e.g. In 2008, Cement industry had low efficiency levels due to volatile operations).

5) Other

- Complaints over verification burden, but not as significant as CCL implication
- Sector associations are essential to manage CCA policy, and govt do not have resources to monitor each participant
- Sector is lobbying recent announcement that rebate will be cut to 65%, which will harm international competitiveness, and perceived to not improve energy efficiency levels.

Meeting	:	CCA Interview with Confederation of Paper Industries (CPI)
Date	:	8th Jan, 2010
Time	:	11:00 to 12:00
Place	:	Camco London
	:	
Attendees	:	Pratima W (PW), Neal Mehta (NM), David Morgan, Head of Regulatory Affairs and Steve Freeman, Energy & Environment Manager (CPI)

Questions and main points

1) Broad views on CCA:

- Paper is declining sector in UK and sector currently covers 50 mills = approx 20Twh
- Sector improved by 40% with SEC of approx 4 kWhp/t, achieving target
- Policy has worked extremely well at raising awareness and forcing mills to understand importance of energy efficiency, with insignificant regulatory burden.
- Policy allowed opportunity and motivation for participants/sector association to monitor and analyse energy performance.
- Rebate of CCL through CCA was key to ensuring additional energy efficiency savings
- Sector's success with policy is primarily due to effective energy data collection (goes beyond other sectors, recording monthly energy data on online system). The small number of installations with effective coordination with Energy managers meant policy operated effectively.
- Increased awareness on EU ETS
- Concerns over double trading issue (CCAs and EU ETS)

2) Timelines

- Approximate time of one year to set targets in 2000
- Sector spent significant time and effort gathering information on each participant

3) Targets

- Initial targets set with significant research and high quality data with consultancy support for each mill (may be an issue in Indian context). This essential information strengthened negotiating position to set targets.
- Association opted for agreement that did not punish individual units failing to meet targets, as long as sector as a whole met its overall target. This approach will be phased out because greater awareness and competition in the sector (free rider issue).
- Sector decided to have revised targets rebased on yr 2. This allowed initial 'theoretical' targets to be revised, after taking into account actual performance. This allowed a fairer operation of the policy.

4) Trading

- CPI in charge of ring fencing additional savings and converting to allowances to realise monetary value, which will be distributed equitably among participants.
- Clear that trading aspect of scheme is not significant driver for additional savings, and not as important as the CCL rebate, especially with low price and

5) Other

- A strong sector association is essential to manage CCA policy, with influence over units at board level and energy level.

Meeting	:	CCA Interview with Food and Drink Federation
Date	:	11th Jan, 2010
Time	:	11:00 to 12:00
Place	:	Camco London
	:	
Attendees	:	Pratima W (PW), Neal Mehta (NM), Steve Reeson, Head of Climate Change and Energy Policy- Food and Drink Federation (FDF)

Questions and main points

1) Broad views on CCA:

- Food and drink federation has 850 participants, covering half the sector
- Sector has experienced rationalisation over time.
- Majority of participants are not energy intensive (energy constitutes approx 5% of costs)
- 'Carrot and Stick,' policy approach has succeeded to deliver energy efficiency improvements in sector
- Balance of simplicity and pragmatism with comprehensive coverage and accurate targets.

2) Targets

- Ideally set targets using data on each participant with bottom up approach, and aggregate this to make sector target (prevalent approach for other sectors)
- FDF had to use top down approach due to the vast number of participants and historical lack of information. More comprehensive bottom up approach would have been too costly, time-consuming and onerous for the sector.
- The diversity of operations led to sub sector and sub-sub sector targets being set (commonality of operations), which tried to reflect cost effective energy efficiency savings for each sub sector. This research was conducted by Enviros, and used best practice information and international benchmarking information. Each unit was then assigned uniform sub (sub) sector target
- To overcome issue of using this approach and still rewarding early action, participants given the choice of the base year (from 1995 to 1999).
- Sector looking at ways to make targets more equitable, by using more information from participants, such as comprehensive bottom up approach for largest units. Knowledge over time has made targets more accurate and reliable.
- Extremely important to spend time initially to tray and get targets right (trail period) and then essential to have targets revised (at least every two years).
- Important to note political drivers in Govt negotiations and targets. More important in recent phases, leading to a more top down approach.

4) Trading

- Trading is integral part of policy. There have been cases where participants have not been driven to invest in efficiency improvements, but have simply bought their way to compliance. This failure can be attributed to weakness of UK ETS and over supply depressing the carbon credit price.
- Trading has been primarily one way, with few organisations verifying over achievement to sell in the market (majority ring fence over achievement and bank for future periods). A reason for this is high cost of verification.
- Purchasing of carbon credits is most important risk management tool. Other flexible options dealing with disruptions to fuel supply and unexpected regulatory constraints are not as important and require additional verification burden. These are proposed to be dropped in next CCA phase, despite disagreement from the majority of sectors.
- FDF not in charge of trading accounts, but supplied advice and contacts for organisations that will be able to help.

5) Role of Sector Association / Other

- Sector association role can be split into admin and other. Admin role (largely outsourced to Enviros) can be passed on to individual units. More important role is that of focussing targets in negotiations and a single point of contact for units. The commonality of purpose allows the sector association to provide energy efficiency advice (best practices guides and seminars), which leads to a more cooperative approach to realise energy savings.
- FDF moving from paper to Web based system, which should make process more efficient.
- Important to clearly define scope of policy. Numerous cases in food and drink sector where there is difficulty to assess which operations are eligible. Recommendation to lower existing 90/10 threshold will have simplification benefits, but may distort competitive behaviour.

Meeting	:	CCA Interview with EEF, Gareth Stace – experience with Dairy and Steel sector
Date	:	12th Jan, 2010
Time	:	15:00
Place	:	Camco London
	:	
Attendees	:	Pratima W (PW), Neal Mehta (NM), Gareth Stace, Head of Climate & Environment Policy EEF, the Manufacturers' Organisation (CCA experience with Dairy and Steel sector in former roles)

Questions and main points

1) Broad views on CCA:

- EEF is a federation of main manufacturing sectors and companies
- Steel is one of the biggest sector (energy) covered by CCA, and is dominated by one company- Corus (93%)
- Policy had been very successful in promoting energy management and efficiency improvements for majority of participants. Within EEF, non CCA members can be up to 5 yrs behind those covered by CCA.
- Discontent regarding new measures proposed, such as scrapping trading element and relative targets, and the revised rebate charge.
- Importance of simplification. UK climate policy landscape is over-complex, over-crowded and over-lapping.

2) Targets

- Initially steel sector targets set by Corus (dominant player), which was absolute energy based. However, this was revised in revision of targets, and three separate sub-sector targets were agreed (Corus, Electric Arc Furnace and other), which mean some facilities have a relative energy agreement.
- Lack of information in Dairy sector, meant target was initially set arbitrarily- negotiation without reasonable justification of figures.
- More equitable to share burden of arbitrary target down to participants to reflect their capacity to improve in future (i.e. lower targets for participants that had already taken early action, and harder targets, Dairy sector experiene). However, this can be a subjective approach requiring sufficient information on each participant. Easier to apply uniform target to all participants.
- Revision of targets is essential. And over time more comprehensive bottom up can be applied using historical emissions.
- Useful exercise to set recent Steel target was to allow independent consultants (Enviros) to complete in depth study of sector. This identified all cost effective energy efficiency

improvements in the sector, and extra knowledge made negotiations much more effective to set challenging but achievable targets.

- An approach could be to apply very tight targets to all participants, and put the onus on them to prove if they have failed.

4) Trading

- Trading is integral part of policy and robust price of credits is important, but market should function without intervention.
- Concern over closing UK ETS, and not rewarding efficiency gains. One way compliance through EU ETS credits perceived to be too costly for participants.
- Trading has been primarily one way, with few organisations verifying over achievement to sell in the market (majority ring fence over achievement and bank for future periods). A reason for this is high cost of verification.
- Purchasing of carbon credits is most important risk management tool. Other flexible options dealing with disruptions to fuel supply and unexpected regulatory constraints are not as important and require additional verification burden. These are proposed to be dropped in next CCA phase, despite disagreement from the majority of sectors.
- FDF not in charge of trading accounts, but supplied advice and contacts for organisations that will be able to help.

5) Role of Sector Association

- Sector association role is very important. In small country like UK, it is possible to make site visits, frequently if small number of units. May be difficult to coordinate in large country (India), where regional bodies may be more important.
- More important role for sectors and smaller participants that do not have their own energy teams. Diary sector required more handholding, but steel sector with specialised energy teams requires less support.
- Important role of admin and administration. Symbiotic relationship is key, and admin function allows better relationship with members and greater understanding on management issues for support and advice.

6) Other

- Importance of consultancy support for participants and sector associations.
- Important to clearly define scope of policy. Easier to select sites, and define scope of direct emissions relating to site (Scope 1 and 2 under WRI/WBCSD GHG Protocol).
- Dummy audits by sector associations is a useful exercise to ensure participants are on track to meet targets.

Appendix 3: Case study - Cement sector

Even though energy intensity per tonne of cement is less than that of other energy intensive materials such as aluminium and steel, the cement industry is by far the largest energy consumer amongst the all industry segments. This is mainly because of high volume of production. Globally cement production grew from 594 MT in 1970 to 2700 MT in 2007, i.e. more than four fold production increase between 1970 and 2007[65]. As s result, globally, the cement industry accounts for 85% of all energy use in the non metallic minerals sector.

Cement Industry Overview in India

Over the last few years, the Indian cement industry has witnessed strong growth, with demand reporting a compounded annual growth rate (CAGR) of 9.3% and capacity addition a CAGR of 5.6% between 2004-05 and 2008-09[66]. The major demand drivers for cement industry are real estate boom during 2004-08, increased investments in infrastructure by both the private sector and Government, and higher Governmental spending under various social programmes.

With 148 large cement plants and total installed capacity of around 231 million tonnes per annum (MTPA) as of September 2009, the Indian cement industry is the second largest[67] in the world, the largest being China. India's cement production is 6% of the global cement production after china which produces 47% of global cement production. Out of 147 large cement plants, there are 95 plants with installed capacity 1 MTPA and above. Additionally there are 365 mini and white cement plants with an installed capacity of 11.1 MTPA. Total cement production from these large and mini cement plants is 187.61 MTPA[68]. A few of the leading manufacturers are UltraTech/Grasim combine, Dalmia Cements, India Cements, Holcim etc.

The Indian cement industry has witnessed substantial reorganisation of capacities during the last couple of years. Some examples of the consolidation witnessed during the recent past include:

- Gujarat Ambuja taking a stake of 14% in ACC;
- Gujarat Ambuja taking over DLF Cements and Modi Cement;
- India Cement taking over Raasi Cement and Sri Vishnu Cement;
- Holcim strengthened its position in India by increasing its holding in Ambuja Cement from 22% to 56%. Moreover, it also increased its stake in ACC Cement.
- UltraTech Cement, a unit of conglomerate Aditya Birla Group, is absorbing sister unit Samruddhi Cement, to form India's biggest cement firm;
- Cimpor, the Portugese cement maker, acquired Grasim Industries' 53.63% stake in Shree Digvijay Cement;
- Vicat SA, a French cement maker acquired a 6.67% stake in Hyderabad-based Sagar Cement;
- Dalmia Cement has increased its stake in OCL India to 45.4% from 21.7% as part of its plan to expand its footprint in eastern India;
- Leading foreign funds like Fidelity, ABN Amro, HSBC, Nomura Asset Management Fund and Emerging Market Fund have together bought around 7.5% in India's third-largest cement firm, India Cements (ICL).

[65] *IEA Report on "Energy Technology Transition for Industries", strategies for next industrial revolution*
[66] *ICRA industry outlook for cement sector*
[67] *www.ibef.org, Accessed as on 2nd March, 2010*
[68] *www.cmaindia.org, Accessed as on 2nd March, 2010*

During 2008-09, total cement consumption in India stood at 178 MT while exports of cement and clinker amounted to around 3 MT. In spite of high growth rate, per capita cement consumption in India is only 120 kg against 264 kg in developed countries. In India, housing and infrastructure sectors consume 40% each, whereas 20% is consumed by industries and others.

The cement industry occupies an important place in the national economy because of its strong linkages to other sectors such as construction, transportation, coal and power. The Indian Cement industry is also characterized by continuous technological up-gradation and assimilation of the latest technology with more than 95% of the total capacity in the industry is based on modern and environment-friendly dry process technology and less than 5% of the capacity is based on old wet/semi-dry process technologies.

Over the last few decades, increased preference has been given to the energy efficient dry process technology so as to obtain a cost advantage in a competitive market. Moreover, many manufactures have switched over from the wet technology to the dry technology by making suitable modifications in their plants resulting in reducing Specific Energy Consumption (SEC) trend. Despite reduction in SEC, energy cost constitutes around 40-45% % of the total manufacturing cost of cement, stimulating the new, even more efficient technologies. It is expected that the plants using wet process technology will be completely phased out in the near future.

Drivers for the growth in Indian Cement Industry

Government initiatives in the infrastructure sector, coupled with the housing sector boom and urban development, are the main drivers for growth of the Indian cement industry. The increased infrastructure spending has been a key focus area for the Government over the last five years indicating positive market outlook for cement manufacturers. Apart from this, the Government has initiated several actions to promote Indian Cement Industry, which are described in the following paragraphs.

Proposed formation of coal regulator by Government is also looked upon as a positive move as it will facilitate timely and proper allocation of coal (a key raw material) blocks to the core sectors, cement being one of them.

Keeping in mind the global meltdown which is impacting the cement companies in India, the government has re-imposed the counter-veiling duty (CVD) and special CVD on imported cement in January 2010. This is likely to provide a level playing field to domestic companies.

According to a report by the ICRA Industry Monitor, the installed capacity is expected to increase to 241 MTPA by FY 2010-end. India's cement industry is likely to record an annual growth of 10% in the coming years with higher domestic demand resulting in increased capacity utilization.

Energy Conservation Act 2003 and Its Implications for the Cement Sector

Due to high primary energy consumption in the cement manufacturing, Government of India (GoI) has notified cement sector as one of the designated consumer under Energy Conservation Act 2001 (EC Act 2001). Post EC Act 2001, to control the energy intensity per capita of GDP, Government has also initiated several other activities listed below.

- Identification of the cement industries having TOE >30000 TPA, total of 104 installations have been identified and setting up of task force for cement sector
- E-filing of energy consumption for the designated consumers
- National Action Plan on Climate Change (NAPCC) on June 30, 2008
    - National Mission for Enhanced Energy Efficiency (NMEEE) under NAPCC
- A market based mechanism to enhance cost effective EE improvements in energy-intensive industries and facilities, through Tradable Energy Savings Certificates. (Perform Achieve and Trade (PAT))
- Accelerating the shift to energy efficient appliances through innovative measures to make the products more affordable. (Market Transformation for Energy Efficiency(MTEE))
- Creation of mechanisms that would help finance DSM programmes in all sectors by capturing future energy savings. (Energy Efficiency Financing Platform (EEFP))
- Developing fiscal instruments to promote energy efficiency namely Framework for Energy Efficient Economic Development (FEEED)

Regional Spread of Cement Sector Designated Consumers

For inclusion in the proposed PAT scheme, BEE has identified 714 designated consumers as on February 2009. These consumers are from nine industries, which are Aluminum, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Thermal Power Plant, Pulp and Paper and Textile sectors. Out of 714 designated consumers 104 designated consumers are from cement sector. To analyze the regional spread of cement sector designated consumers, mapping of these consumers has been carried out and presented in adjacent Figure 1. As indicated in figure, 76% of cement sector designated consumers are located in the seven states namely, Andhra Pradesh, Tamil Nadu, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh and Chhattisgarh.

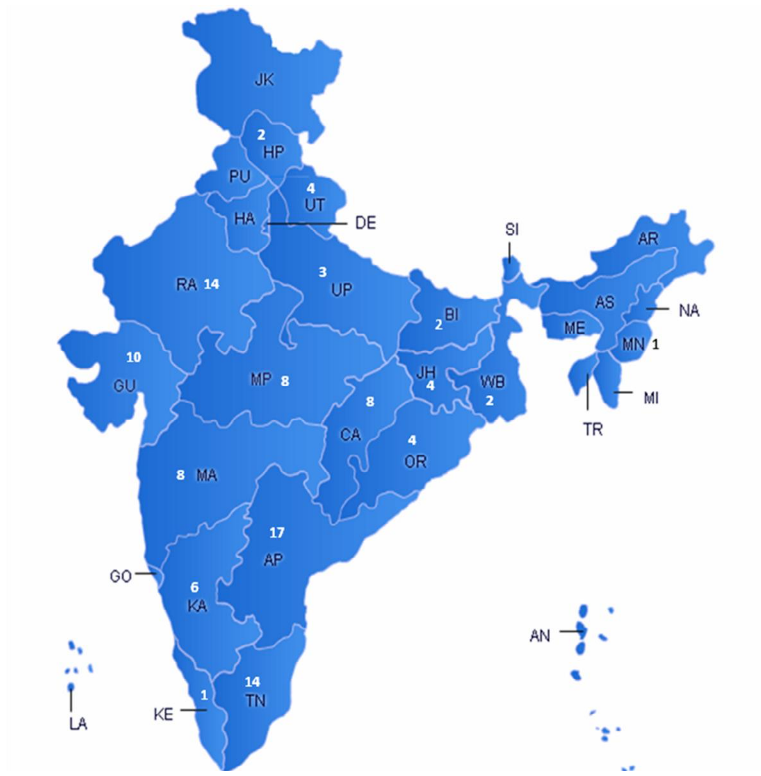


Figure 1: Mapping of Cement Industry Designated Consumers

Cement Production Process

Cement is a finely ground mixture of compounds, consisting mainly of silicates and aluminates of calcium, formed out of calcium oxide, silica, aluminum oxide and iron oxide. When mixed with water, cement acts as a glue to bind together the sand, gravel and crushed stone to form concrete, the most widely used construction material in the world. Cement is manufactured by burning a mixture of limestone and clay at high temperatures in a kiln, and then finely grinding the resulting clinker along with gypsum.

Broadly cement manufactured in the country can be categorized into three groups namely,

- Ordinary Portland Cement (OPC)
- Special Purpose Cement
- Portland Pozzolana Cement (PPC)

In India, OPC is manufactured in three grades, viz. 33 grade, 43 grade and 53 grade, the numbers indicating the compressive strength obtained after 28 days, when tested as per the stipulated procedure.

Apart from OPC, there are several other types of cement, most of them meant for special purposes, e.g. sulphate resistant cement, colored cement, oil well cement, etc. However, among general purpose cements, PPC is the most common. Typical composition of various types of cement is shown in Table 1 below;

Table1: Typical composition of different cement type

Cement type	Portland cement (%)	Portland fly-ash cement (%)	Blast-furnace cement (%)	Pozzolanic cement mixes (%)
Clinker	95-100	65-94	5-64	45-89
Fly-ash	-	6-35	-	-
Blast-furnace slag	-	-	36-95	-
Pozzolana	-	-	-	11-55
Additional constituents (clinker dust, mineral additives etc.)	0-5	0-5	0-5	0-5

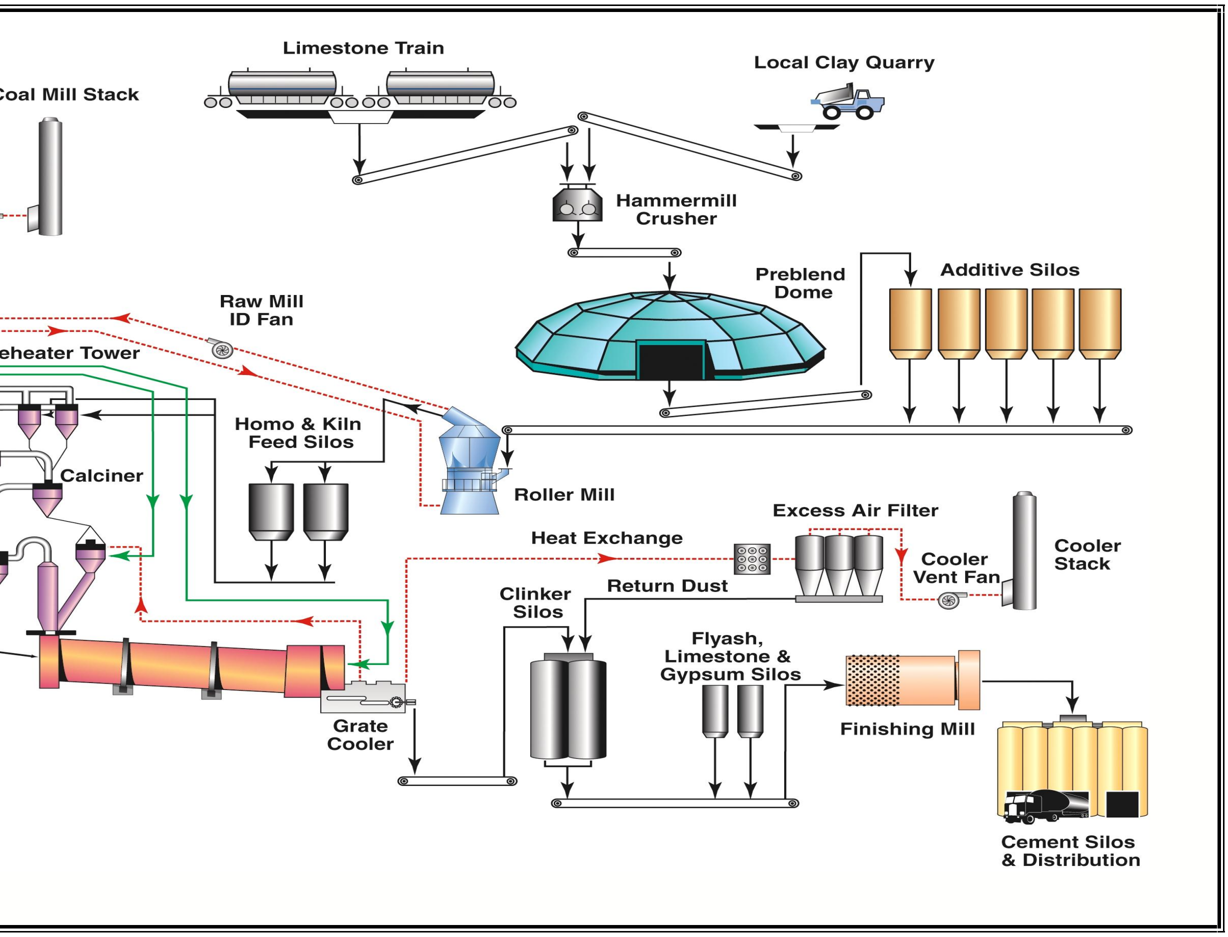
Note: Percentages excludes gypsum typically 5%
Source: IREDA-Investors' manual for energy efficiency

Briefly, cement manufacturing involves mining of limestone and mixing after primary size reduction, in proportion with other raw materials containing Silica, Alumina and Iron. This raw mix is than subjected to size reduction in the raw mills. The raw mix is subjected to pyro processing in a rotary kiln and cement clinker is formed by calcinations. This clinker coming out of the kiln is cooled in coolers and after considerable seasoning; clinker is ground with gypsum to form OPC. This is dry process of cement manufacturing.

Other old processes are (predominantly used in fifties and early sixties) wet process and semi-wet process depending upon the water content in the raw material and usage of vertical shaft kiln. Wet process consumes more energy to evaporate moisture before calcinations. The dry process is more efficient as it avoids water evaporation. In India more than 95% of the production is through dry process.

Process flow diagram for dry process cement manufacturing industry is provided in Figure 2 below:

ocess cement manufacturing industry



ssed as on 2nd March, 2010

Energy Use

Energy in the form of coal and electricity is utilized by cement industry for manufacturing process. Petroleum fuels are seldom used except in case of special cement production such as white cement. Following factors have got the profound impact on the plant energy consumption (electrical & thermal);

- Plant capacity:
- Raw material quality: grindability index (impact on electrical energy), moisture content (impact on thermal energy), total carbonates (impact on thermal energy), alumina and silica modulus (impact on thermal energy)
- Type and age of Machinery: type of mill, mill lines, air classifiers
- Coal quality: variation in the coal quality and deterioration over period of time
- Cement Grinding: blains number (cm^2/gm) has significant impact on cement mill power consumption

Thermal energy is utilized in the kiln for calcinations process (pyro processing) whereas major electrical energy guzzlers are raw mills, coal mills, kiln auxiliaries and cement mills.

A. **Raw Material Preparations:** It accounts for small fraction of overall primary energy consumption, and represents a large part of the electricity consumption.

B. **Clinker Production:** clinker production is the most energy intensive step, accounting for around 80% of the energy used in cement production.

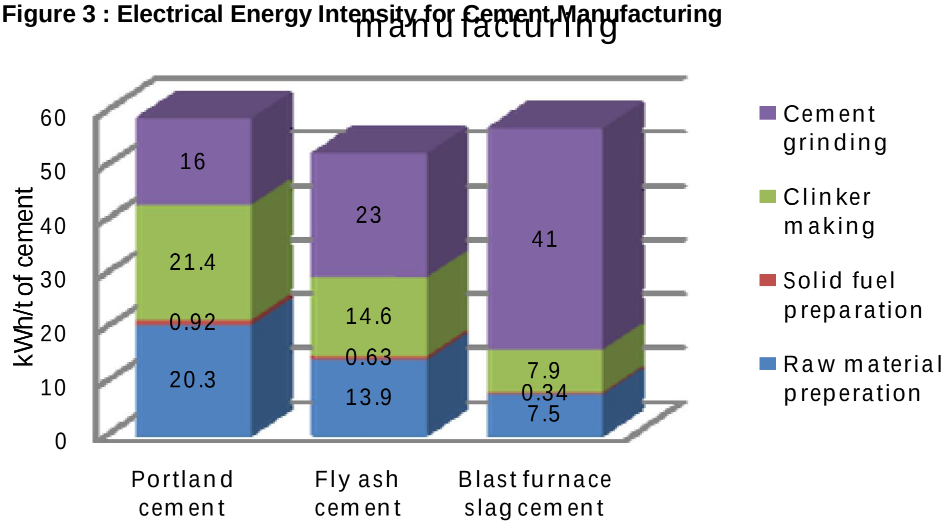
C. **Finish Grinding:** Clinker grinding accounts for large part of electricity consumption and power consumption depends upon the fineness or blains

Graph plotted in Figure 3 below shows the world best practice for final energy intensity values at each of the production steps for three types of cement, namely Portland cement, fly ash cement and blast furnace slag cement with assumptions provided in Table 2.

Table 2: Assumptions for various types of cement manufacturing

Component ratio	Portland cement	Fly ash cement	Blast furnace slag cement
Raw material to clinker	1.77	1.77	1.77
Coal to clinker	0.097	0.097	0.097
Additives to cement	0.05	0.35	0.65
Clinker to cement	0.95	0.65	0.35

Figure 3 : Electrical Energy Intensity for Cement Manufacturing



Note: Additional thermal energy is required for clinker making
Source: LBNL -62806 Rev.2 February 2008, World best practice energy intensity values for selected industrial sectors

Specific Energy Consumption

Energy efficiency improvements are the result of the combined effects of shifting away from inefficient wet process toward more efficient semi-dry and dry processes, as well as adoption of less energy-intensive equipment and practices. Implementation of advanced technology has reduced energy consumption in Indian cement plants. Graphs provided in Figure 4 & 5 below shows reduction in SEC over a period time due to technological advancement and energy conservation efforts.

Figure 4: Specific Electrical Energy Consumption Trend for Cement Industry

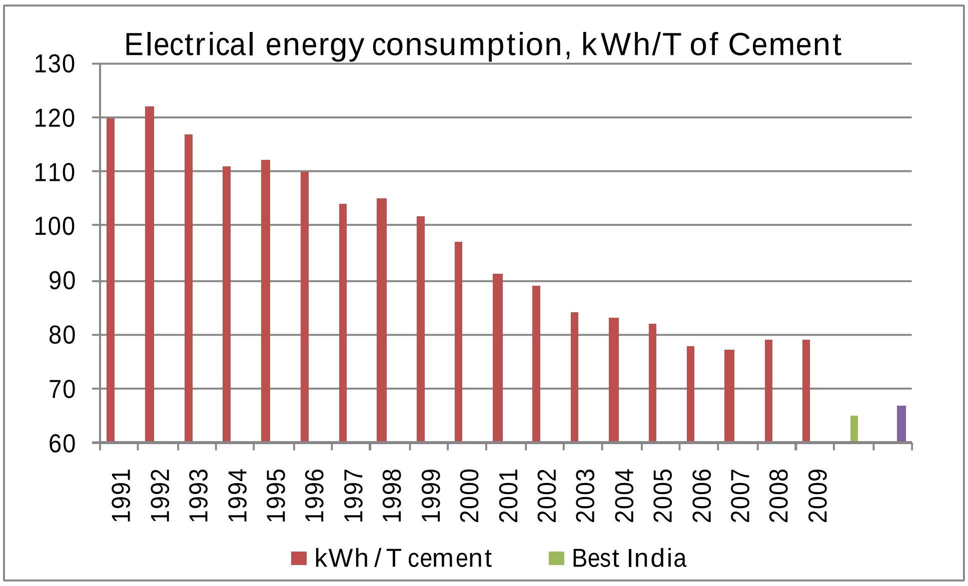
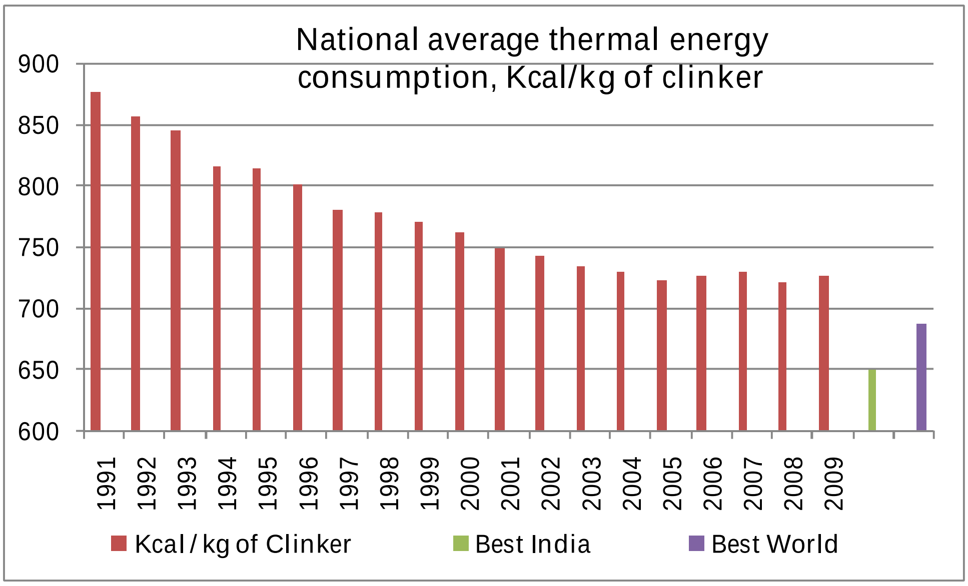


Figure 5: Specific Thermal Energy Consumption Trend for Cement



Although some Indian plants have the best energy consumption even when compared with the global best practice plants, there exists wide variation in the specific energy consumption across various installations in Cement Industry. There had been a steep decreasing trend for electrical and thermal specific energy till the year 2004 without any incentives or Governmental promotions of energy efficiency. Industries have reduced SEC on their own efforts due cutthroat global competition in WTO regime/open economy. Probably to drive further energy efficiency and to reduce SEC, promotional schemes like concessions for energy efficient equipment purchase, EScerts, low interest rates for capital expenditure towards energy efficient equipments etc. are required.

If the similar trend of reduction in SEC as observed since 2003 continues in Indian cement sector, electrical and thermal SEC will be as follows:

Figure 6 : Future Trends in Specific Electrical Energy Consumption

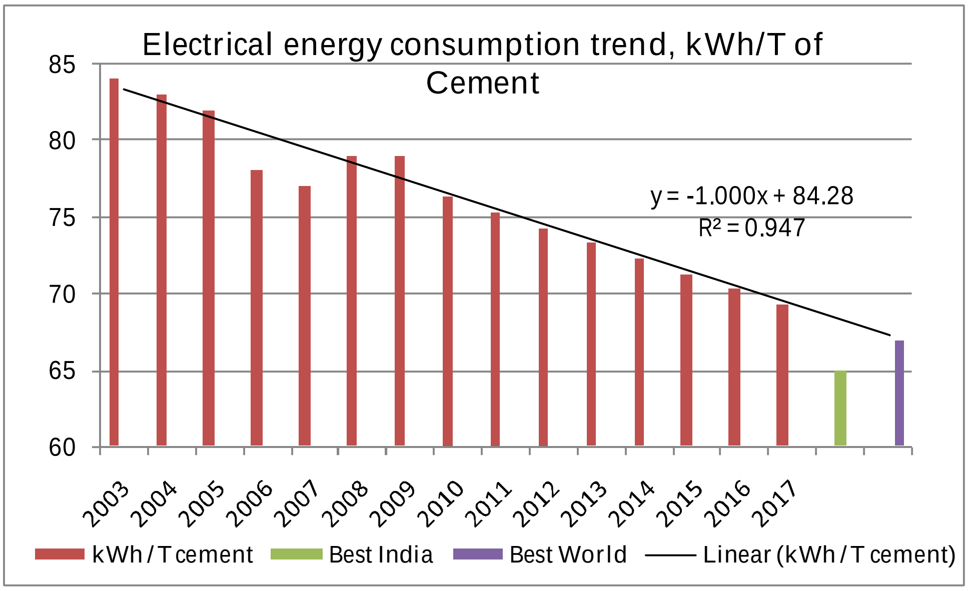
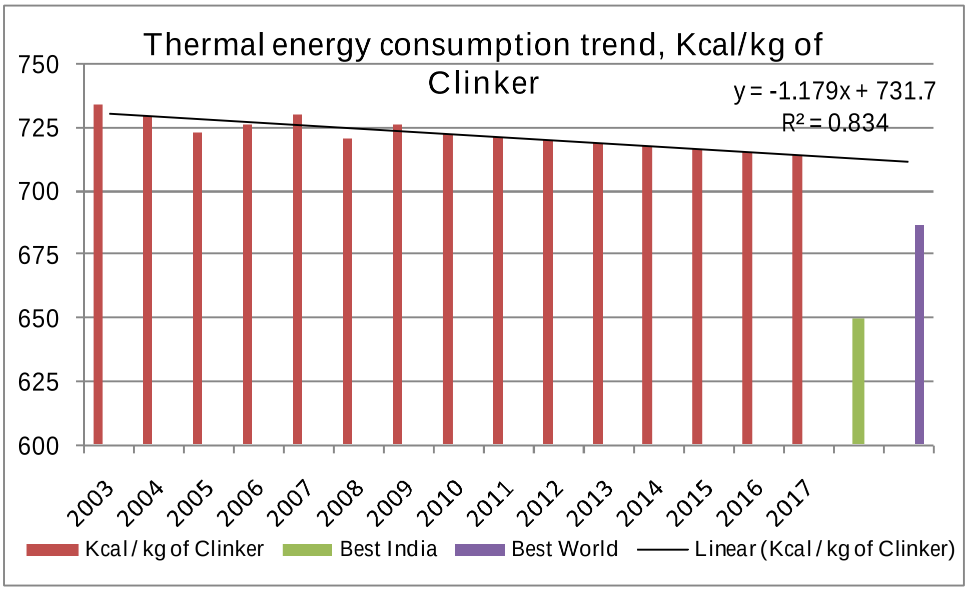


Figure 7 : Future Trends in Specific Thermal Energy Consumption



Analysis of sample companies in the Cement Sector

In this Section, analysis of companies operating in cement sector has been carried out. The data for these companies as available in the database of Centre for Monitoring Indian economy (CMIE) has been used. Data such as cement production by category, energy consumption by category of fuel, etc was collected for year 2009. Energy consumption (electrical as well as thermal) is converted to tonnes of oil equivalent (TOE). The companies for which either electricity consumption or fuel consumption or production numbers were missing are deleted. Minimum and maximum SEC, bandwidths and frequency distribution for SEC of the companies are identified and are presented in Table 3 below,

Table 3 : Specific Energy Consumption Bandwidth for Cement Industry

Parameters	Installed Capacity (MTPA)	Production (MTPA)	Specific Electrical Energy Consumption (kWh/T of Cement)			Specific Thermal Energy Consumption (Kcal/kg of Clinker)		
			2005-06	2006-07	2007-08	2005-06	2006-07	2007-08
Minimum	0.20	0.24	65.48	63.57	68.87	544.00	529.00	528.00
Maximum	4.50	3.62	95.50	96.75	94.50	847.00	852.00	848.00
Average	1.97	1.85	83.10	82.02	79.40	710.86	711.29	712.37

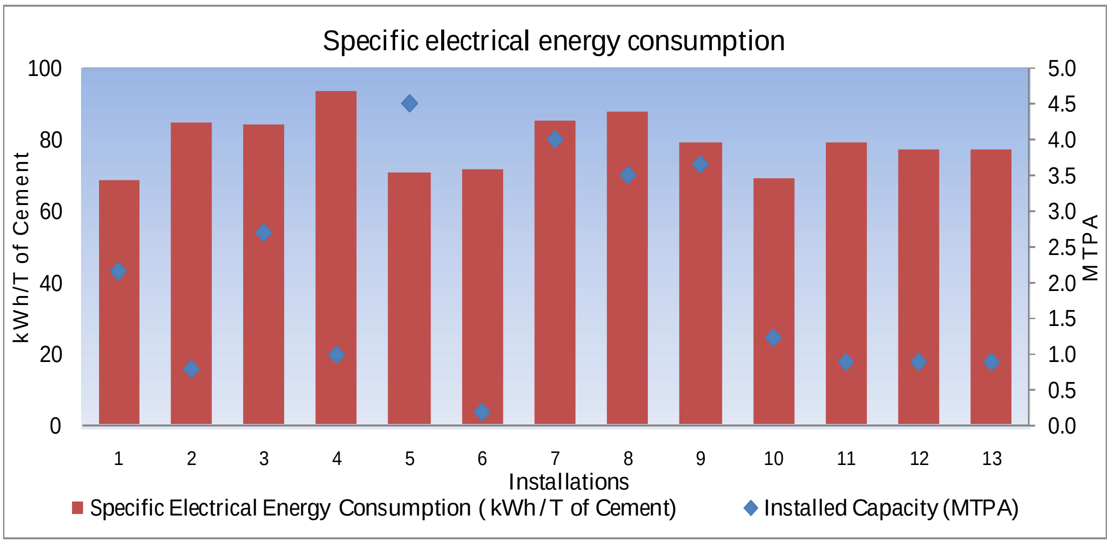
Following are some other observations, which emerge from the analysis of CMIE data:

- Total 25 installations identified for analysis, out of which 24 are DCs
- Products being manufactured are PPC, OPC & blended or combination
- Installed capacity varying from 0.2 MTPA to 4.5 MTPA
- These 25 industries contributes around 22% of the total installed capacity
- Production for year 2007-08 varying from 0.24 MTPA to 3.62 MTPA
- Specific electrical energy for 2007-08 is varying between 65.7 to 94.5 kWh/T cement

- Specific thermal energy for 2007-08 is varying between 528 to 848 Kcal/kg Clinker

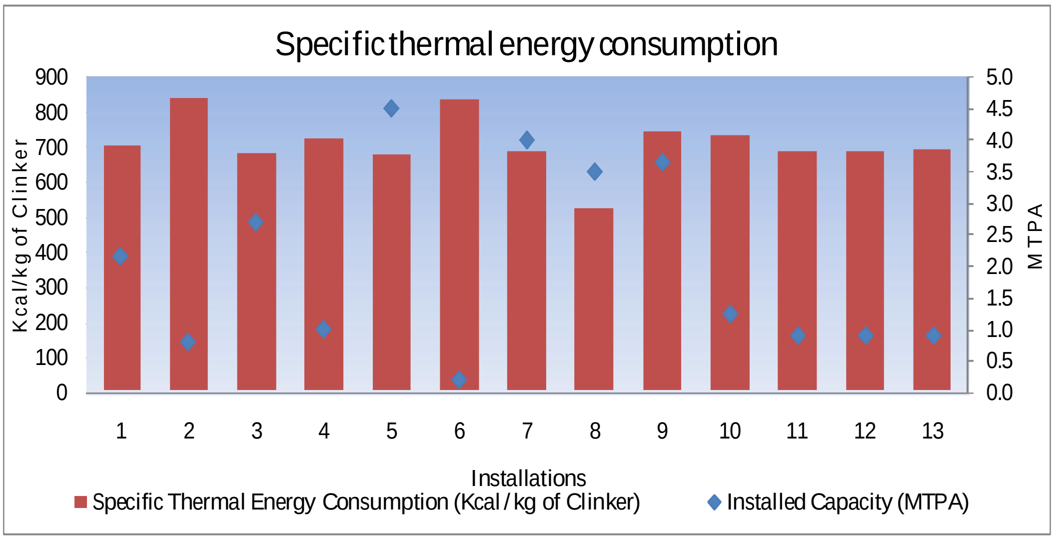
As expected, the companies are operating over a wide range of SEC for both clinker as well as cement manufacturing. While, some plants are operating very efficiently others have much higher SEC. There is a wide gap between the minimum and the maximum values of thermal and electrical SEC as indicated in Figure 8 & 9 below,

Figure 8: Variation in SEC (electrical) across Cement Industries



Note: SEC for PPC, OPC & blended or combination
** For some of the industries either production or SEC or both are not available*

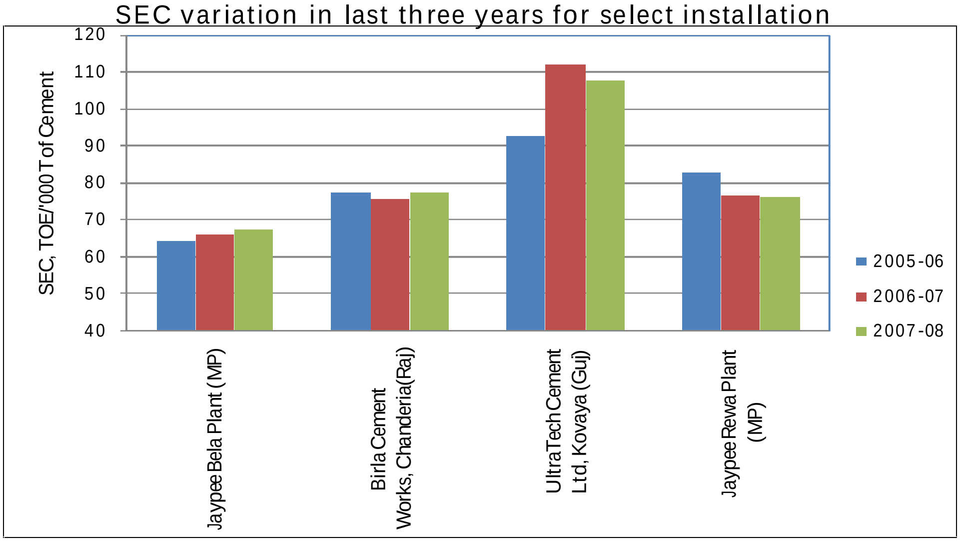
Figure 9: Variation in SEC (Thermal) across Cement Industries



Note: SEC for PPC, OPC & blended or combination
** For some of the industries either production or SEC or both are not available*

Since plants covered under PAT are integrated cement plants with clinker manufacturing to cement grinding, SEC trend in last three years is presented in terms of TOE/'000 T of cement production in Figure 10 below.

Figure 10: SEC Trend in Last Three Years for Select Installations



Note: SEC for PPC, OPC & blended or combination
Source: ABPS Analysis of NECA data

Further, the world best practice for energy intensity in the cement sector is presented in Table 4 below.

Table 4 : World Best Practice for Specific Energy Consumption

Product	SEC (GJ/tonne)	SEC(TOE/'000 tonne)
Portland Cement	2.9	69.4
Fly Ash Cement	2	47.8
Blast Furnace Slag Cement	1.7	40.7

Energy Efficiency in Cement Sector

As per the data available in CII Report "Building a Low Carbon Indian Economy", the energy saving potential in cement sector has been identified to be 15%, where as data collected through NECA Case Studies show that energy savings potential in excess of 24% . This potential varies between 5% and 40% from industry to industry depending on size, age, production technology, process, product combination etc. This potential could be tapped by adopting energy conservation measures like waste heat utilization, design modification, technology up-gradation, variable frequency drives (VFD), automation, renewable energy utilization, proper upkeep of the equipments etc.

Total 243 implementable energy conservation measures collected for twenty five installations from NECA, for last three year 2005-06, 2006-07 and 2007-08 are segregated into twelve categories like waste heat utilization, design modification, technology up-gradation, variable frequency drives (VFD), automation, renewable energy utilization, proper upkeep of the equipments, light energy savers, compressed air optimization etc. Investments and savings obtained thereby are then applied appropriate inflation factors to get average investment cost in 2009 for every unit of energy savings (Rs/TOE). Table 5 provides the details of energy conservation measures and payback periods for various energy conservation measures implemented in 25 Indian cement companies.

Table 5 : Energy Conservation Measures Implemented by Indian Cement Industries

Sr. No	Technology Utilization (Energy Conservation Measures)	Total Energy Savings, TOE	Investment Cost adjusted for 2009-10, Rs Lakh	Investment Cost, Rs. Lakh /TOE	Annual Savings adjusted for 2009-10, Rs. Lakh	Payback period, Years
1	Waste Heat Utilization	4032.68	4063.65	1.01	1575.60	2.6
2	Design Modification	5034.12	2242.77	0.45	5987.66	0.4
3	VFD	311.36	619.61	0.75	215.20	1.1
4	Proper upkeep of equipment	620.92	40.27	0.06	313.24	0.1
5	Technology Up-gradation	1255.57	1226.61	0.98	903.55	1.4
6	Light Energy Saver	4.82	11.84	2.46	7.12	1.7
7	Efficient Lights	7.57	6.91	0.91	3.72	1.9
8	Compressed air energy saver	52.03	22.47	0.43	28.25	0.8
9	Automation	182.66	0.00	0.00	57.06	Immediate
10	Renewable energy utilization	3.78	3.03	0.80	6.88	0.4
11	Resizing the components/equipment	87.48	1.92	0.02	45.79	Immediate
12	Soft Starter	3.35	13.84	4.13	12.86	1.1

It can be noted that some of the ECMs like automation, resizing of the equipments/components can be carried out with in-house efforts with minor investments.

While a number of cement plants in India approached world best practice levels in terms of energy efficiency, average Indian plants are relatively inefficient. Following table provides variation in SEC values for Indian cement plants during three years period for which NECA data is available and considered in this study. The table clearly indicates significant potential for energy efficiency improvement in cement sector.

Table 6 : Yearly Variation of SEC and savings potential by Indian Cement Industries

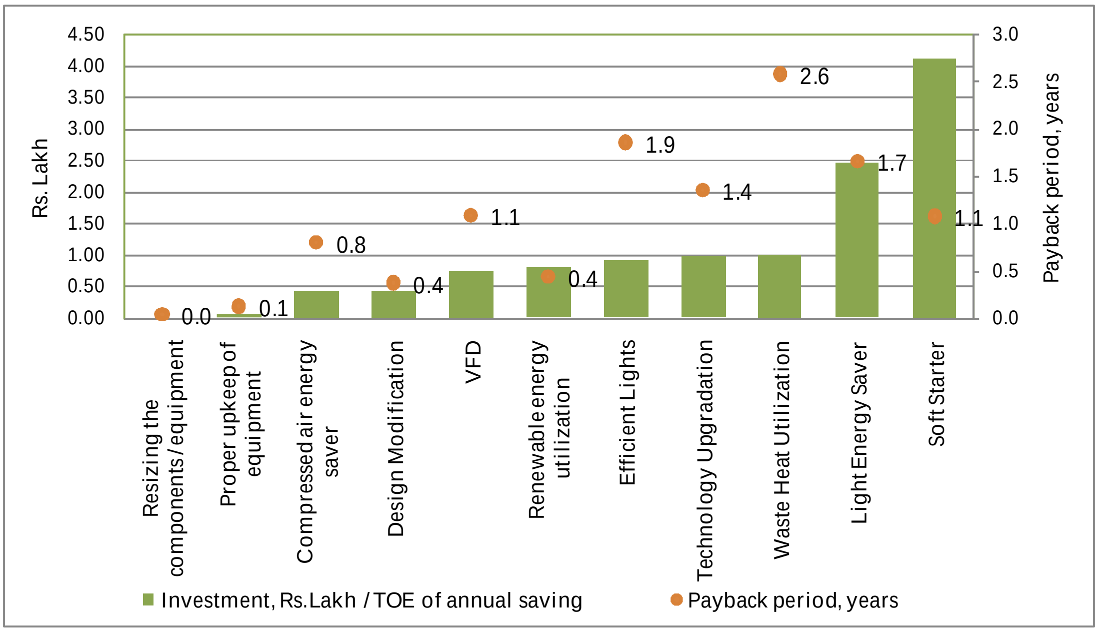
Installation	SEC (TOE/'000T)			Saving potential (%)		
	2005-06	2006-07	2007-08	2005-06	2006-07	2007-08
Installation-1	64.4	66.2	67.5	0%	3%	5%
Installation-2	77.4	75.8	77.3	17%	15%	17%
Installation-3	92.4	112.2	107.7	30%	43%	40%
Installation-4	82.8	76.8	76.1	22%	16%	15%

It can be noted from the above table that, even if any particular installation has performed well in a particular year and achieved the lowest possible/target SEC, it may not be able to retain the same SEC during subsequent years. Continuous efforts are required by the plant maintenance team to retain the 'once achieved' lowest SEC.

Cost of Energy Efficiency (Abatement cost)

Data analysed for 25 installations shows that there are vide variations in investment requirement to achieve one TOE savings. Figure 11 shows investment cost for one TOE annual savings for various energy conservation measures and payback period.

Figure 11: Cost Benefit for Energy Conservation Measures



The Energy Conservation Measures (ECM) can be categorised into short term, medium term and long term on the basis of payback periods for the ECM.

Short Term (Payback period of less than six months)

- Design modification to increase the capacity and resizing of the equipments, , close circuiting etc
- Proper upkeep of the equipments, avoiding idle running
- Automation and expert software to reduce wastages
- Renewable energy usage

Medium Term (Payback period of 6 to 18 months)

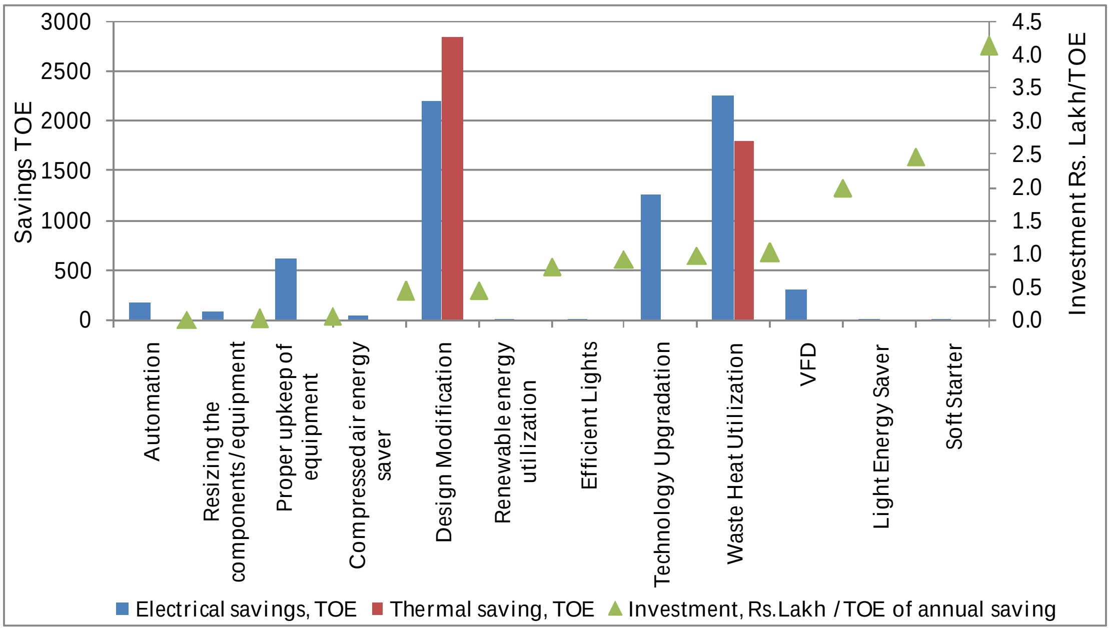
- Lighting efficiency improvement
- Installation of Variable speed drives and Soft starters
- Rationalization of compressed air

Long Term (Payback period of more than 18 months)

- Waste heat utilization
- Technological up-gradation

Figure 12 shows quantum of electricity as well as fuel savings (TOE) achieved by implementing 243 ECMs over three years period by 25 installations and investment required to achieve one TOE energy savings for various ECMs.

Figure 12: Quantum of energy savings by 25 installations



While some of the energy conservation measure lead to either electricity savings or fuel savings, measures like design modification and waste heat utilization lead to both electricity as well as fuel savings.

Analysis of ECMs implemented by Indian cement industries during 2005-06, 2006-07 and 2007-08 shows that one TOE energy savings can be achieved by investing Rs. 0.68 lakh per tonne of oil equivalent.

Appendix 4: Case study – Iron and Steel sector

World steel production amounted to 1250 MT in 2006 and 1344 MT in 2007. While production was nearly constant between 1975 and 2000, it grew by 58% between 2000 and 2007[69]. The main growth during this period occurred in China which produces around 36% of the world production followed by Japan. India ranks fourth in world steel production and first for the sponge iron production.

Iron & Steel Industry Overview in India

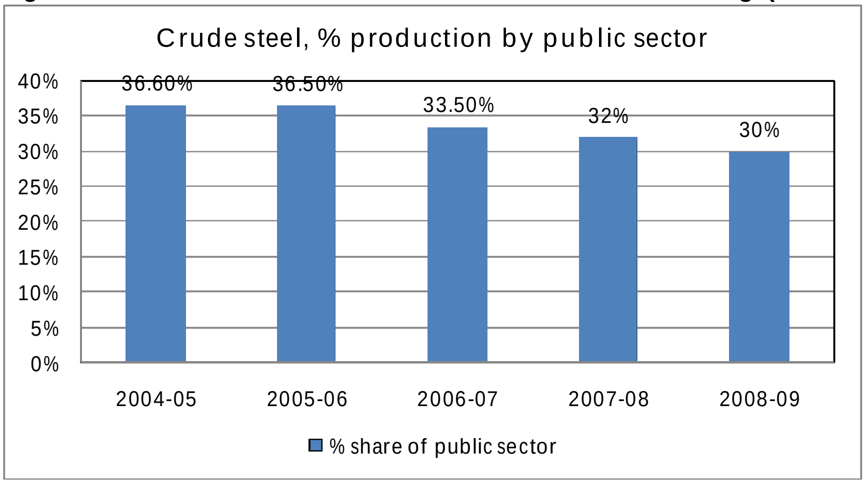
Over the past few years, the Indian Iron & Steel industry witnessed strong growth, with demand reporting a compounded annual growth rate (CAGR) of 7.3%.[70] The major demand drivers for Iron & Steel industry are ongoing real estate boom, increased investments in infrastructure by both the private sector and Government. As per official estimates, the Iron and Steel Industry contributes around 2% of the Gross Domestic Product (GDP) and its weight in the Index of Industrial Production (IPP) is 6.20%.

According to the year-end review by the Press Information Bureau, India has emerged as the fourth largest producer of steel in the world and the second largest producer of crude steel. State-owned steel maker, Steel Authority of India (SAIL), has become the most profitable steel company globally, beating steel majors such as ArcelorMittal, Posco, Bao Steel and Nippon in the half yearly profits (January-June 2009).

Nation's steel production recorded 28.49 MT in April-September 2009. The National Steel Policy-2005 has a target for taking steel production up to 110 MT by 2019–20. Nonetheless, with the current rate of ongoing greenfield and brownfield projects, the Ministry of Steel has projected India's steel capacity is expected to touch 124.06 MT by 2011–12. In fact, based on the status of memoranda of understanding (MoUs) signed by the private producers with the various state governments, India's steel capacity is likely to be 293 MT by 2020[71]. These investments are mostly in the states of Orissa, Jharkhand, Chhattisgarh and West Bengal.

In India state owned companies are still dominating in crude steel production with increasing contribution by the private owned companies. Share of public sector has reduced from 36.6% in 200-45 to 30% in 2008-09.

Figure 1: Public Sector Contribution in Iron & Steel Manufacturing (BF-BOF route)



Source: Annual Report 2008-09 of Ministry of Steel, GoI

[69] *IEA Report on "Energy Technology Transition for Industries", strategies for next industrial revolution*
[70] *ICRA industry outlook for Iron & Steel sector*
[71] *http://ibef.org/industry/steel.aspx access on March 2, 2010*

India accounts for around 5% of the global steel consumption. Almost 70% of the total steel used is for kitchenware. However, its use in railway coaches, wagons, airports, hotels and retail stores is growing immensely. India's steel consumption rose by 6.8% during April-November 2009 over the same period a year ago on account of improved demand from sectors like automobile and consumer durables and ongoing construction projects.

The scope for raising the total consumption of steel is huge, given that per capita steel consumption is only 35 kg compared to 150 kg across the world and 250 kg in China.

Steel players like JSW Steel and Essar Steel are increasing their focus on opening up more retail outlets pan India with growth in domestic demand. JSW Steel currently has 50 such steel retail outlets called JSW Shoppe and is targeting to increase it to 200 by March 2010. They expect at least 10% to 15% of their total production to be sold by their retail outlets.

Essar Steel which currently has over 300 retail outlets across the country plans to set up 5,000 outlets of various formats soon. It expects to sell 3 MT of steel through the retail route in two years.

A host of steel companies have lined up major investment proposals. Furthermore, with an expanding consumer market, the Indian steel industry is likely to receive huge domestic and foreign investments. According to the Investment Commission of India, investments of over US$ 30 billion in steel are in the pipeline over the next 5 years[72].

Following are some key developments in this sector:

- Tata Steel has raised US$ 500 million by issuing 'global depository receipts' (GDRs) aiming at expansion of its Jamshedpur plant and overseas mining projects.
- The state-owned Steel Authority of India Ltd (SAIL) will invest US$ 724.12 million to set up a 4-million tonne per annum steel mill at its Bhilai Steel Plant.
- SAIL is also planning to set up a 12-million tonne plant in Jharkhand.
- Stainless steel manufacturer and exporter, Varun Industries, is setting up a US$ 171.63 million stainless steel-cum-alloy steel plant at Rohat, Jodhpur.
- India’s largest engineering conglomerate Larsen & Toubro (L&T) and state-owned Nuclear Power Corporation of India Limited (NPCIL) have formed a US$ 370.09 million joint venture for specialized steel and forging products.

The Iron & Steel industry occupies an important place in the national economy because of its strong linkages to other sectors such as construction, transportation, iron ore, coal and power.

Being an energy intensive sector, new technologies, energy efficient equipments are being retrofitted to the existing furnaces and manufacturing equipments. Over the last decade, increased preference has been given to the energy intensive primary steel production (from iron ore) to meet rapid rise in demand and competition. Because primary steel production is much more energy-intensive than recycling of steel scrap, resulted in higher energy consumption per tone of steel product and offers more saving potential.

Drivers for the growth in Indian Iron & Steel Industry

Government initiatives in the infrastructure sector, coupled with the housing sector boom and urban development, continue being the main drivers of growth for the Indian Iron & Steel industry. Subsequent to the recent fall in international prices of commodities and to protect Indian producers, the Indian government has announced some changes in customs duty rates, which are effective from November 2008. The Indian government plans to invest in industries related to infrastructure and construction which will give stimulus to the steel sector.

[72] *www.ibef.org, Accessed as on 2nd March, 2010*

Moreover, in the Union Budget 2009-10, the government has made a 23% hike in allocation for highway development and US$ 1.034 billion increase in budgetary support to Railways which will further promote the steel industry.

Energy Conservation Act 2003 and its Implication to the Iron & Steel Sector

Due to high primary energy consumption by the Iron & Steel manufacturers, Government of India (GoI) notified Iron & Steel sector as one of the designated consumer under Energy Conservation Act 2001 (EC Act 2001). Post EC Act 2001, to control the energy intensity per capita of GDP, Government has also initiated several other activities listed below.

- **Identification of the Iron & Steel industries having TOE >30000 TPA, total of 98 installations have been identified**
- **E-filing of energy consumption for the designated consumers**
- **National Action Plan on Climate Change (NAPCC) on June 30, 2008**
- **National Mission for Enhanced Energy Efficiency (NMEEE) under NAPCC**
- **A market based mechanism to enhance cost effective EE improvements in energy-intensive industries and facilities, through Tradable Energy Savings Certificates. (Perform Achieve and Trade (PAT))**
- **Accelerating the shift to energy efficient appliances through innovative measures to make the products more affordable. (Market Transformation for Energy Efficiency (MTEE))**
- **Creation of mechanisms that would help finance DSM programmes in all sectors by capturing future energy savings. (Energy Efficiency Financing Platform (EEFP))**
- **Developing fiscal instruments to promote energy efficiency namely Framework for Energy Efficient Economic Development (FEEED)**

Regional Spread of Iron & Steel Sector Designated Consumers

For proposed PAT scheme, BEE has identified 714 designated consumers as on February 2009, and comprised of consumers from Alumunium, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Power Plant, Pulp and Paper and Textile sectors. Out of 714 designated consumers 98 designated consumers are from Iron & Steel sector. For the purpose to analyze the regional spread of Iron & Steel sector designated consumers, mapping of these consumers has been carried out and indicated in adjacent Figure 2. As indicated in figure, Most of

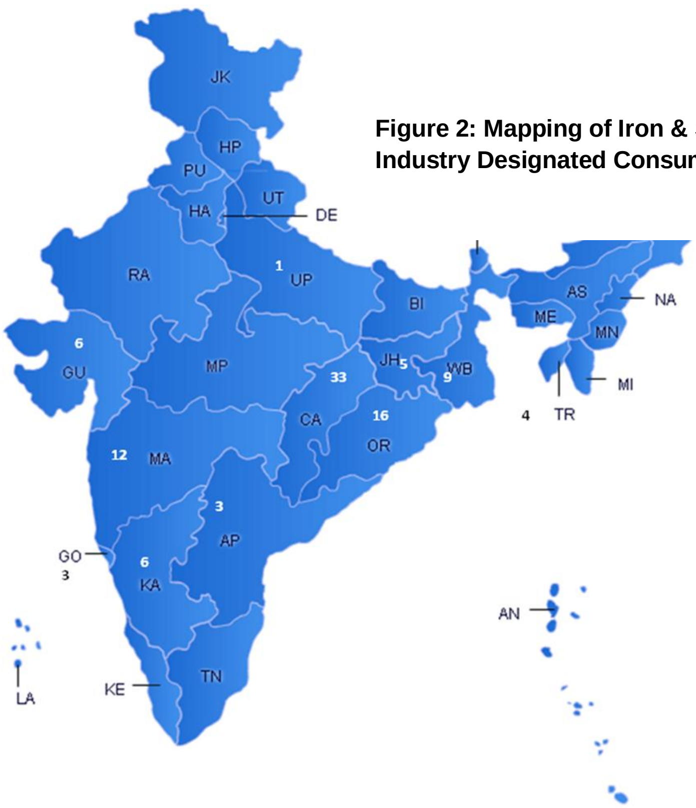


Figure 2: Mapping of Iron & Steel Industry Designated Consumers

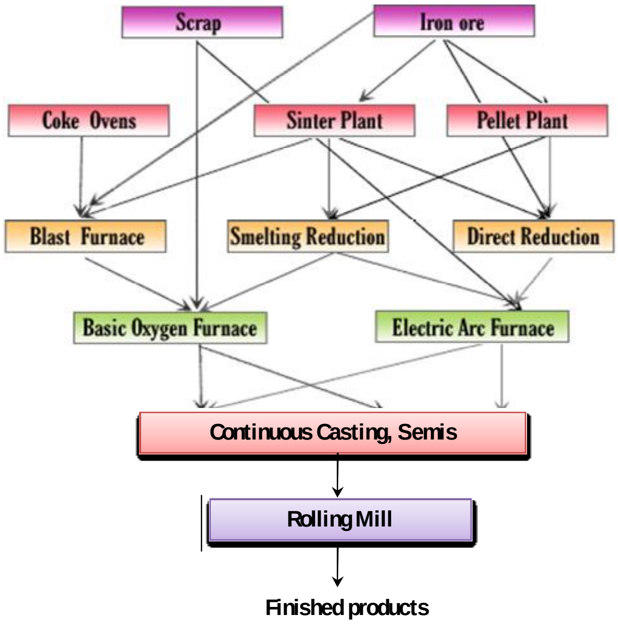
the iron & steel sector designated consumers are located in the Eastern States namely Jharkhand, Chhattisgarh, Orissa, West Bengal, Tripura, while others are in Uttar Pradesh, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, and Goa.

Iron & Steel Production Process

Steel is produced through many processing steps depending on product mix, raw materials available. There are four possible process configurations:

- **Blast Furnace (BF) – Basic Oxygen Furnace (BOF):** Sintered or palletized iron ore is reduced using coke to produce pig iron in blast furnace, further oxidising the carbon in the BOF by injecting oxygen.
- **Smelt Reduction – BOF:** It omits the coke production by combining the gasification of coal with melt reduction of iron ore (COREX), further oxidising the carbon in the BOF by injecting oxygen in the hot metal.
- **Direct Reduced Iron (DRI) - electrical Arc Furnace (EAF):** DRI or sponge iron produced by either natural gas or coal as reductant, further DRI is charged in the EAF with scrape to produce steel.
- **Scrap- EAF:** scrape is melted in the EAF to produce steel.

Figure 3: Block diagram for Iron & Steel manufacturing by different processes

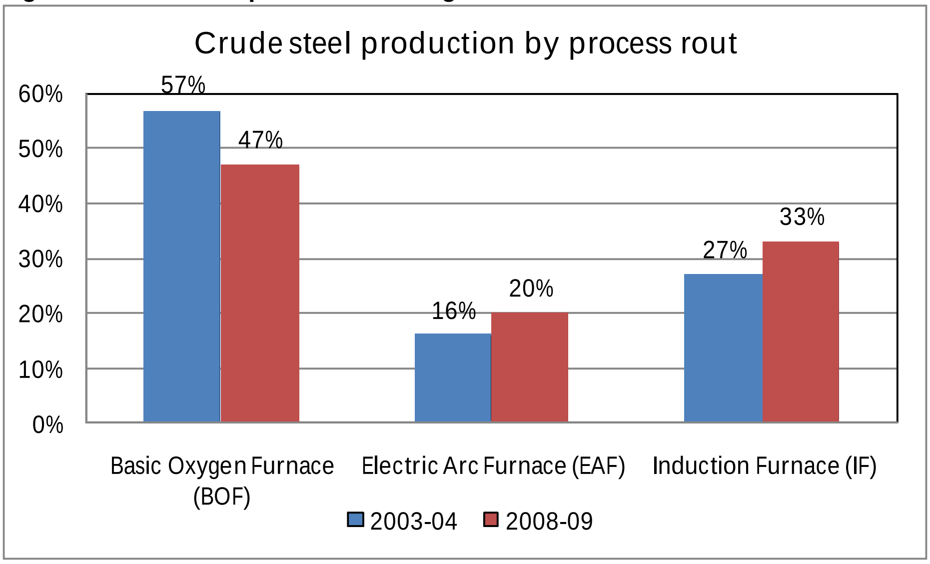


Broadly Iron & Steel industry in India can be categorized into three categories viz.

- **Main producers:** integrated steel making facility with capacity >0.5 MT utilizes iron ore and coal/gas like SAIL, TISCO and RINL.
- **Other major producers:** like ESSAR, ISPAT, JINDAL etc.
- **Secondary producers:** Sponge iron (providing feed stock for steel producers); mini blast furnaces, electric arc furnaces, induction furnaces that uses iron ore, sponge iron and scrap to produce steel; re-rollers (SMEs) producing merchant products.

In India steel production through DRI/scrape -EAF route has taken over the BF-BOF route due to lower energy intensity. Following graph shows shift is steel making from BF-BOF to DRI/scrape –EAF as compared to year 2003 -04.

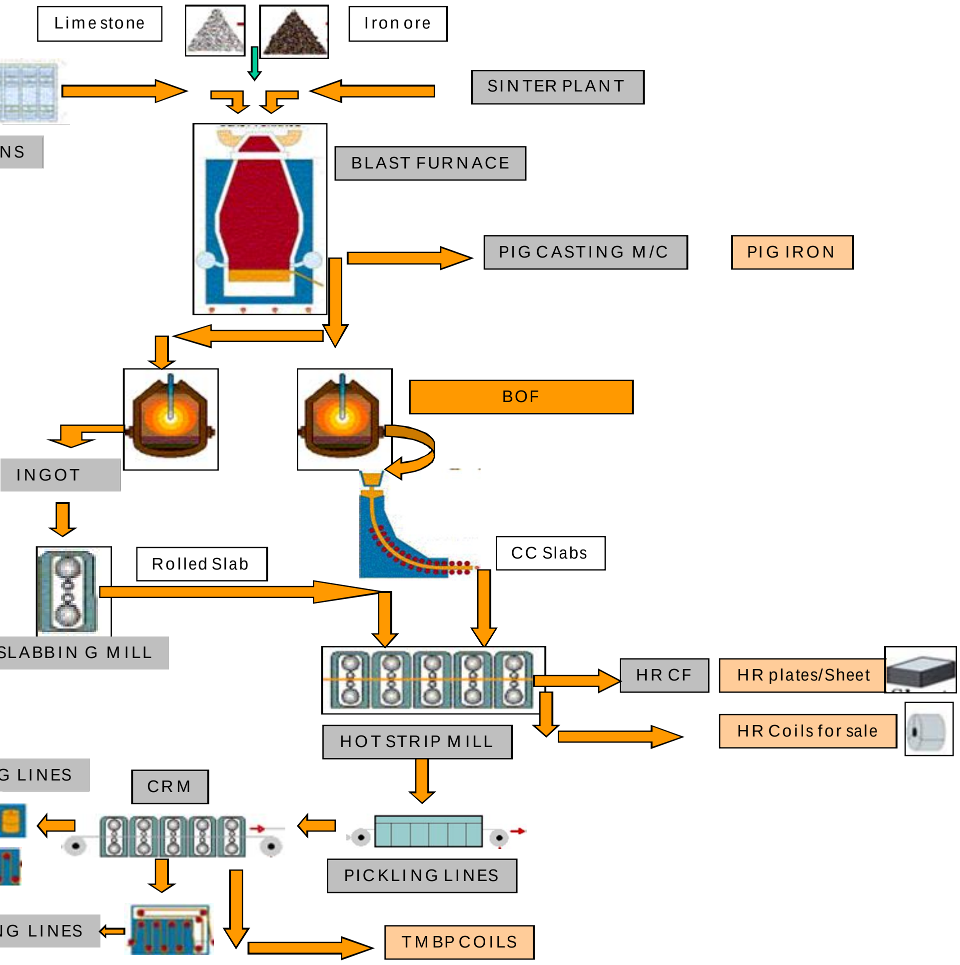
Figure 4: Crude Steel production through different route



Source: Annual Report 2008-09 of Ministry of Steel, GoI

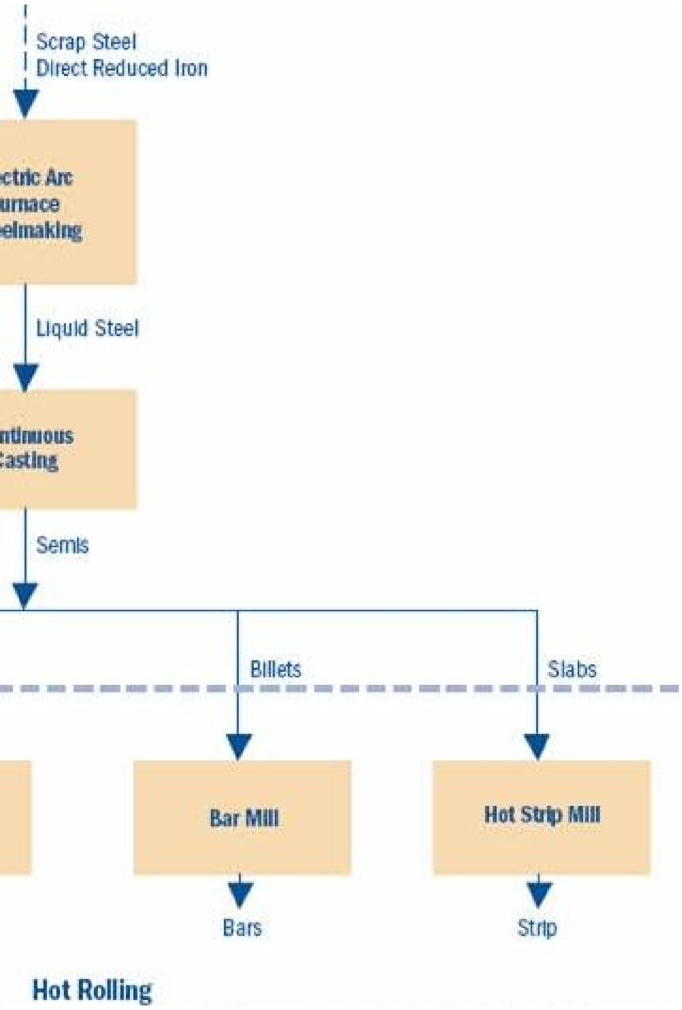
Process flow diagram for Iron & Steel manufacturing industry is provided in Figure 5 & 6 below,

Steel manufacturing (BF-BOF route)



h 05, 2010

Steel manufacturing (DRI/Scrape-EAF route)



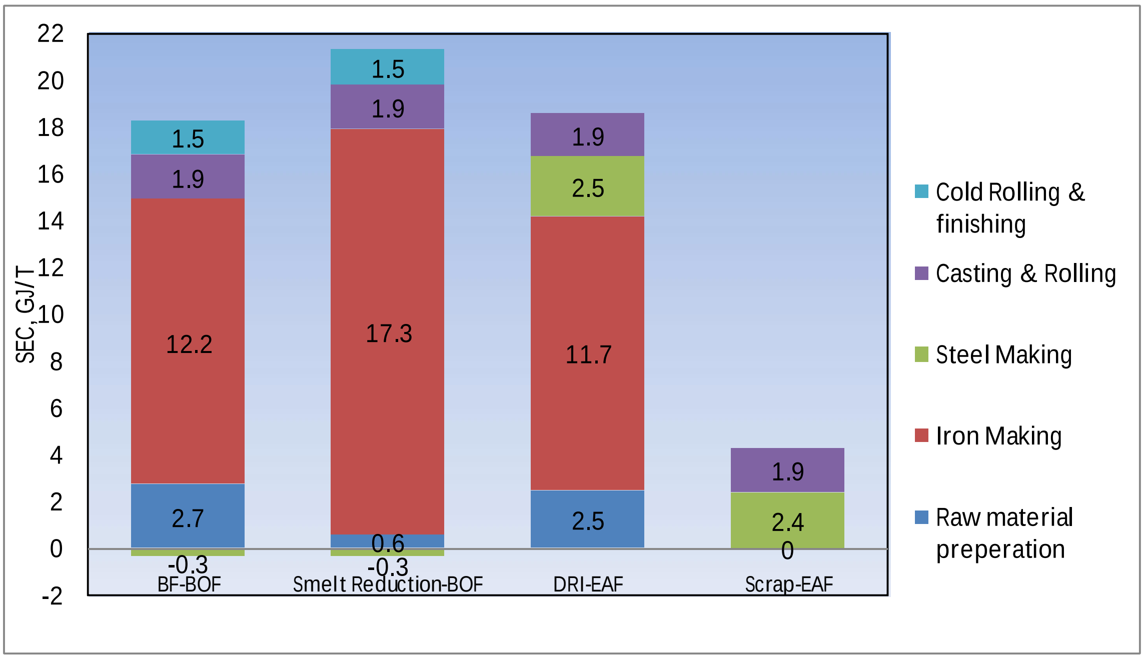
Energy Use

Energy in the form of coal (domestic and imported), gas and electricity is utilized by Iron & Steel industry for manufacturing process. Petroleum fuels are seldom used except for billet reheating, laddle preheating, heat treatment etc., in case of Steel and finished material production.

Thermal energy is utilized in the blast furnace for reduction process whereas major electricity guzzlers are EAF, driving motors, fans, pumps, compressors etc.

Graph plotted in Figure 7 below shows world best practice for final energy intensity values at each of the production step for four types of Iron & Steel namely BF-BOF, Smelt reduction-BOF, DRI-EAF and Scrap-EAF.

Figure 7: Final Energy Intensity for Iron & Steel Manufacturing (World Best Practice)



Source: LBNL -62806 Rev.2 February 2008, World best practice energy intensity values for selected industrial sectors

It should be noted that total energy intensity of the process route depends on the feed stock and material flow may differ from plant to plant, total should not be used to compare individual plants. Each of the steel production processes need to be treated separately.

Specific Energy Consumption

Energy efficiency improvements are the result of the combined effects of shifting away from inefficient BE-BOF to DRI-BOF as well as adoption of less energy-intensive equipment and practices. Waste heat recovery, quality of raw material and production of electricity from residual gases offers huge opportunity for the steel plants to maximise use of input fuels. Table 1 below shows SEC for different iron and steel manufacturing process in GJ/T as well as Gcal/T of steel.

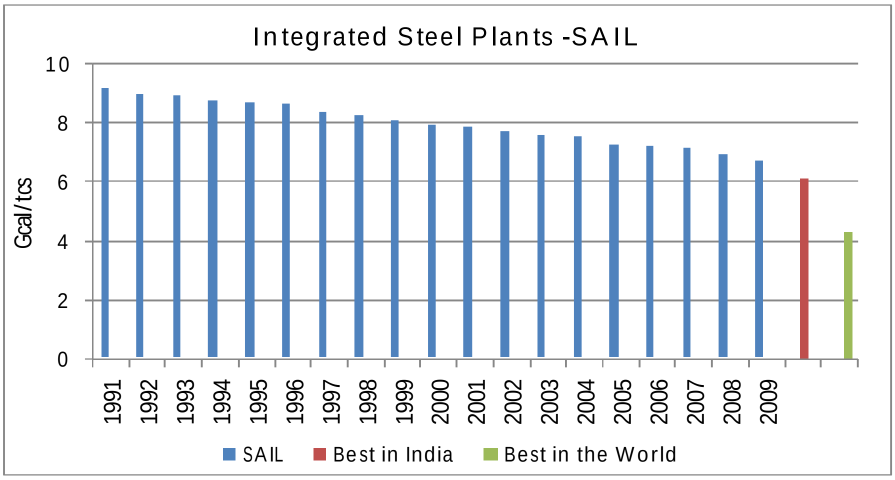
Table 1: Specific Energy Consumption (World best)

Steel manufacturing process	GJ/T	Gcal/T
BF-BOF	18.0	4.3
Smelt Reduction-BOF	21.0	5.0
DRI-EAF	18.6	4.4
Scrap-EAF	4.3	1.0

Source: LBNL -62806 Rev.2 February 2008, World best practice energy intensity values for selected industrial sectors

Specific energy consumption trend for Indian plants (SAIL) since 1991 is given in following Figure 8

Figure 8: Specific Energy Consumption Trend for Steel Industry



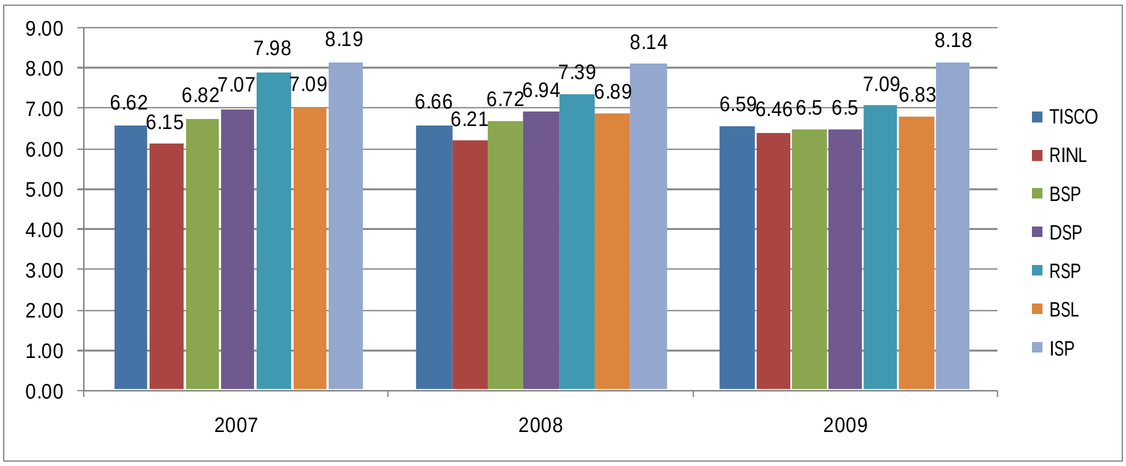
Source: Annual Report 2009, Ministry of Steel, GoI & NECA

The specific energy consumption for SAIL during 2008-09 is 6.74 Gcal/tcs as compared to the figure of 6.95 Gcal/tcs in 2007-08 registering an improvement of 2.7%.

Although Indian plants reduced SEC over period of time, still operating at much higher SEC than the best in world. There had been decreasing trend for SEC without any incentives or Government's significant promotions of energy efficiency. Industries have reduced SEC on their own efforts due cutthroat global competition in WTO regime/open economy. Probably to drive further energy efficiency and to reduce SEC, promotional schemes like concessions for energy efficient equipment purchase, Ecerts, low interest rates for capital expenditure towards energy efficient equipments etc. are required.

Also there is a wide band in the SEC across Indian integrated steel plants. Graph in the following Figure 9 shows the variation in SEC for some of the integrated steel plants during year 2007, 2008 and 2009.

Figure 9: Specific Energy Consumption Trend for Steel Industry



Source: Annual Report 2009, Ministry of Steel, GoI & NECA

Specific energy consumption at RINL is one of the lowest amongst the integrated steel plants in India. However, over the last few years, inspite of several energy consumption measures adopted by the RINL, its energy consumption is on an increase which is mainly because of use of relatively inferior grade of iron ore fines (with higher alumina content).

Data like iron and steel production, energy consumption, SEC, investments and savings achieved due to implementation of energy conservation measures (ECMs) implemented (for years 2005-06, 2006-07 & 2007-08) etc., have been collected from various sources like Center for Monitoring Indian economy (CMIE), Annual report 2008-9 of Ministry of Steel, National Energy Conservation Awards (NECA). Energy consumption (electricity as well as fuel) is converted to tonnes of oil equivalent (TOE). Savings achieved in electricity and fuels by implementing ECMs are tabulated and total energy savings is calculated in TOE. The companies for which either electricity consumption or fuel consumption or production numbers were missing are deleted.

For simplicity and computations of SEC total 98 DCs are categorised into following four categories

- Integrated steel plants
- Pig iron manufacturing plants
- Sponge iron manufacturing plants (DRI)
- Others steel/ steel billets manufacturing plants

Minimum and maximum SEC, bandwidths and frequency distribution for SEC for each of the categories of the companies are identified and are provided in the subsequent Tables in the subsequent paragraphs.

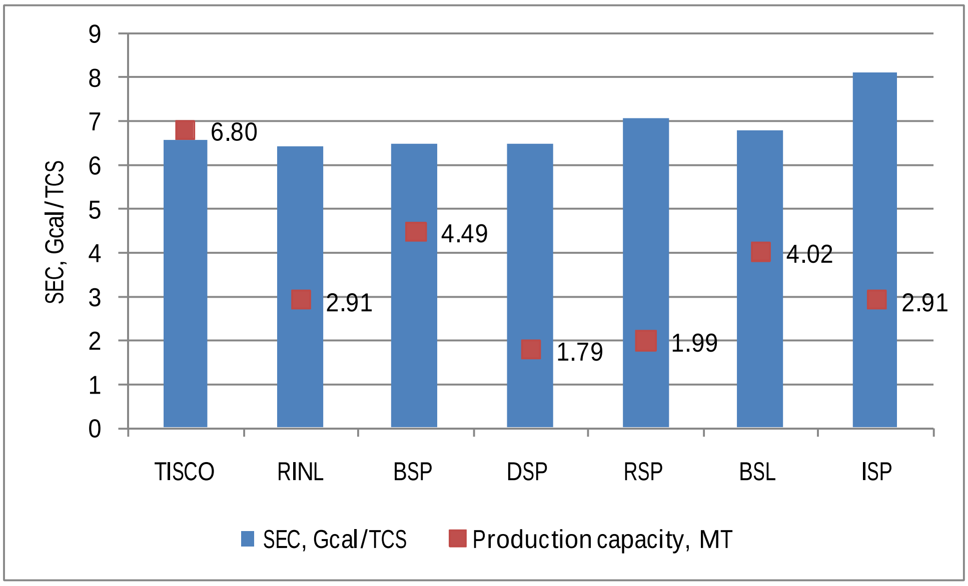
Integrated Steel Plants

Integrated steel plants in India are mostly State owned. Following Table 2 shows the band width for four integrated steel plants.

Table 2: Specific Energy Consumption Bandwidth for Integrated steel plants

Parameters	Installed Capacity (MTPA)	Production (MTPA)	Specific Energy Consumption (Gcal/TCS)				Energy Cost as % of total Manufacturing Cost		
			2005-06	2006-07	2007-08	2008-09	2005-06	2006-07	2007-08
Minimum	2.91	0.24	6.47	6.54	6.61	6.46	34.30	36.68	30.71
Maximum	6.80	3.62	7.10	7.09	6.89	6.83	47.00	42.00	40.00
Average	4.56	1.85	6.83	6.79	6.72	6.60	40.65	39.34	35.90

Figure 10: Variation in SEC among Integrated Steel Plant



Following are the observation noted from the data analysis

- Total no of installation identified and studied is 8 and all are designated consumers identified for PAT mechanism. Completed data set was available for only four plants.
- Products being manufactured are Crude steel, saleable steel
- Installed capacity varying from 1.79 MTPA to 6.8 MTPA
- Specific energy for year 2008-09 is varying from 6.46 Gcal/Tcs to 8.18 Gcal/Tcs
- Energy Cost as % of total Manufacturing Cost for year 2007-08 is varying from 31% to 40%

As expected, the companies are operating over a wide range of SEC for crude steel production. While, some plants are operating very efficiently others have much higher SEC. There is a wide gap between the minimum and the maximum values of SEC.

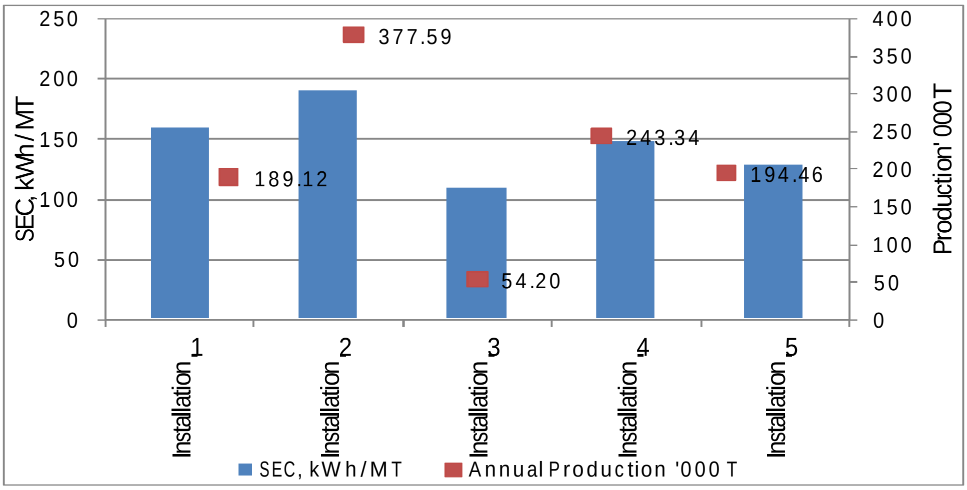
Pig Iron Plants

Pig Iron plants in India are mostly from private sector. Following Table 4 & Figure 11 shows the band width for five Pig Iron plants.

Table 3: Variation in SEC among Pig Iron Plants

Company Name	Annual Production, '000 T	SEC, kWh/MT
Installation-1	189.1	159.8
Installation-2	377.6	193.0
Installation-3	54.2	110.3
Installation-4	243.3	147.8
Installation-5	194.5	128.8
MIN	54.2	110.3
MAX	377.6	193.0
AVERAGE	212.9	149.0

Figure 11: Variation in SEC across Pig Iron plants



Following are the observation noted from the data analysis

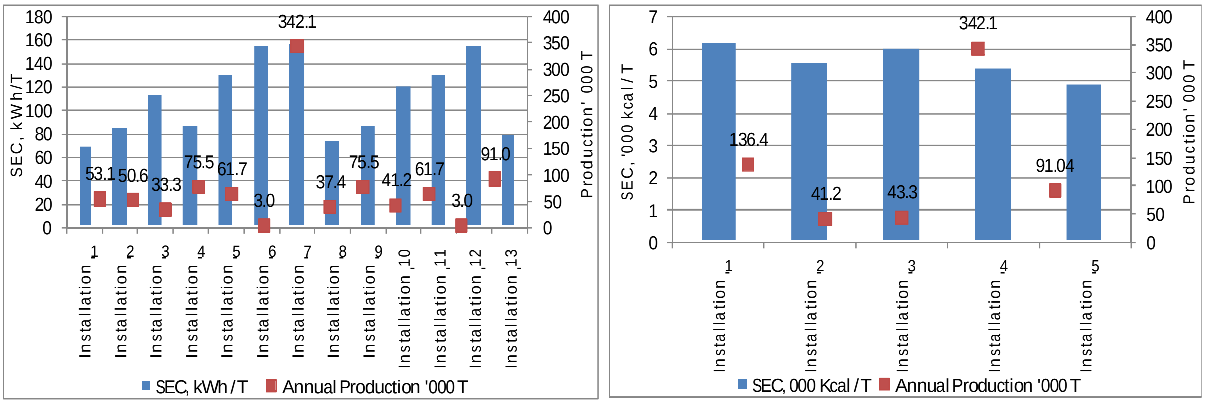
- Total no of installation identified and studied is 7 and all are designated consumers identified for PAT mechanism. Completed data set was available for only five plants.
- Products being manufactured are pig iron, saleable steel
- Installed capacity varying from 0.055MTPA to 0.4 MTPA
- Specific energy for year 2008-09 is varying from 110.3 kWh/T to 193 kWh/T

As expected, the companies are operating over a wide range of SEC for pig iron production. While, some plants are operating very efficiently others have much higher SEC. There is a wide gap between the minimum and the maximum values of SEC.

Sponge Iron Plants

Sponge Iron plants in India are mostly from private sector. Following Fig 12 shows the band width for thirteen Sponge Iron plants.

Figure 12: Variation in SEC Electrical and Thermal across Sponge Iron Plants



Following are the observation noted from the data analysis

- Total no of installation identified and studied is 13 and all are designated consumers identified for PAT mechanism.
- Products being manufactured are Sponge Iron by utilizing coal
- Production varying from .03 MTPA to 0.35 MTPA
- Specific electrical energy for year 2008-09 is varying from 68.9 kWh/T to 157.5 kWh/T and Specific thermal energy 4.9 to 6.2 '000Kcal/T.

Under PAT scheme, this gap in SEC is defined as the bandwidth. Under the scheme, it is proposed to divide this bandwidth into 3 to 4 ranges depending on the length of the bandwidth. Besides, for each of the range, separate achievement targets would be set. This is due to the fact that industries which have the lowest SEC are more efficient and would have less potential for improvement in energy efficiency as compared to those industries which have higher SEC and have larger potential for implementation of energy efficiency options. The industries lying in the more efficient range would have a much lower reduction target and the industries which have higher SEC would have a reduction target, whereas industries lying in the middle range would have targets in between.

Energy Efficiency in Iron and Steel Sector

As per the data available in CII report "Building a Low Carbon Indian Economy", the energy saving potential in cement sector is 10%, where as data collected through NECA shows that energy savings potential to the tune of 15% (with industry to industry saving potential variation of 5% to 25%, depending on size, age, production technology, process, product combination etc.) exist in iron and steel industries by adopting energy conservation measure like waste heat utilization, design modification, technology up-gradation, variable frequency drives (VFD), proper upkeep of the equipments etc.

Total 133 practically implementable energy conservation measures collected for seven installations (integrated steel plants as well as others) from NECA, CII and through secondary research for last three year 2005-06, 2006-07 and 2007-08 are segregated into twelve categories like waste heat utilization, design modification, technology up-gradation, variable frequency drives (VFD), automation, renewable energy utilization, proper upkeep of the equipments, light energy savers, compressed air optimization etc. Investments and savings obtained thereby are then adjusted for year 2009 by applying normalisation factor (50% weight of Wholesale Price Index & 50% weight of Consumer Price Index to arrive at mean inflation rate) to get average investment cost of per unit energy savings (Rs/TOE) and cost of energy saving. Table 4 shows the details of energy conservation measures implemented with payback periods for eight Indian iron & steel plants.

Table 4 : Energy Conservation Measures Implemented by Indian Iron & Steel Industries

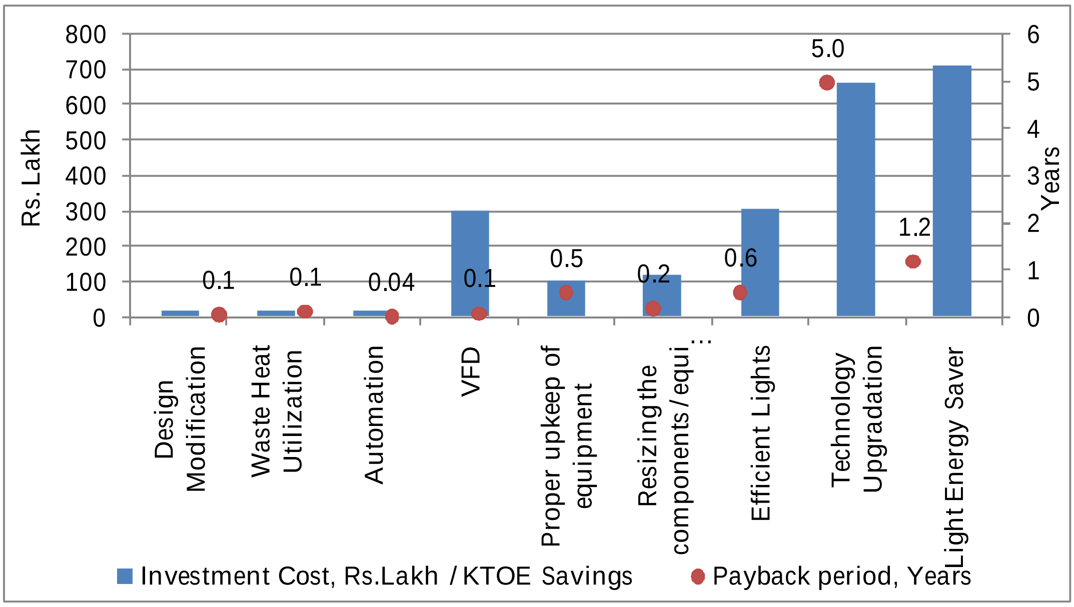
Sr. No	Technology Utilization (Energy Conservation Measures)	Total Energy Savings, TOE	Investment Cost adjusted for 2009-10, Rs Lakh	Investment Cost, Rs. Lakh /TOE	Annual Savings adjusted for 2009-10, Rs. Lakh	Payback period, Years
1	Waste Heat Utilization	92.44	1993.33	21.56	13172.67	0.15
2	Design Modification	28.38	599.77	21.13	7282.62	0.08
3	VFD	5.03	397.32	79.04	2705.28	0.15
4	Proper upkeep of equipment	17.11	1853.82	108.38	3398.19	0.55
5	Technology Up-gradation	10.96	7267.62	663.21	1455.03	4.99
6	Light Energy Saver	0.01	5.39	719.99	4.45	1.21
7	Efficient Lights	0.07	20.58	308.37	36.84	0.56
9	Automation	0.03	0.74	23.14	18.50	0.04
11	Resizing the components/equipment	0.11	13.93	123.05	64.34	0.22

It can be noted that some of the ECMs like automation, resizing of the equipments/components, design modification can be carried out with in-house efforts with minor investments.

Cost of Energy Efficiency (Abatement cost)

Data analysed for seven installations shows that there are vide variation in investment required to achieve one TOE savings depending on the type energy conservation measures. Figure 13 shows investment cost for one TOE annual savings for various energy conservation measures and payback period.

Figure 13: Cost Benefit for Energy Conservation Measures in Iron Steel Sector



All the implementable ECMs can be categorised into short term, medium term and long term payback period for prioritising implementation strategy.

Short terms (less than six months payback period)

- Design modification to increase the capacity and resizing of the equipments, waste heat utilization etc
- Proper upkeep of the equipments, avoiding idle running
- Automation and expert software to reduce wastages
- Variable frequency drives (VFD)

Medium terms (six months to 18 months payback period)

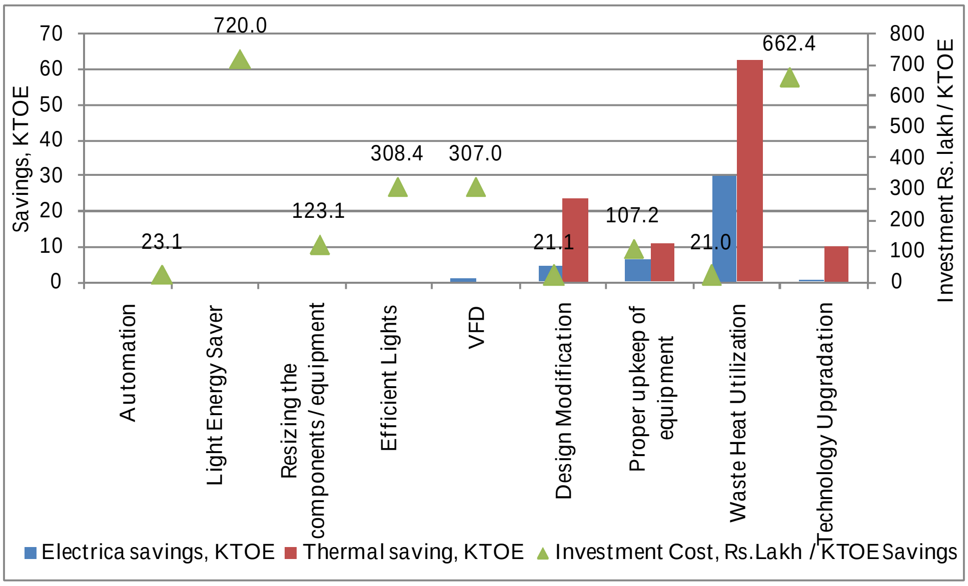
- Lighting efficiency improvement
- Rationalization of compressed air

Medium terms (more than 18 months payback period)

- Technological up-gradation

Figure 9 shows quantum of electricity as well as fuel savings (TOE) achieved by implementing 133 ECMs over three years period by seven installations and investment required to achieve one TOE energy savings for various ECMs.

Figure 14: Quantum of energy savings by seven installations



While some of the energy conservation measure only leads to electricity savings or fuel savings, measure like design modification and waste heat utilization leads to both electricity as well as fuel savings.

Analysis of ECMs implemented by Indian iron and steel industries during 2005-06, 2006-07 and 2007-08 shows that one TOE energy savings can be achieved by investing Rs. 0.08 lakh which is equivalent to Rs. 0.18 lakh in monitory terms (normalized for year 2009).

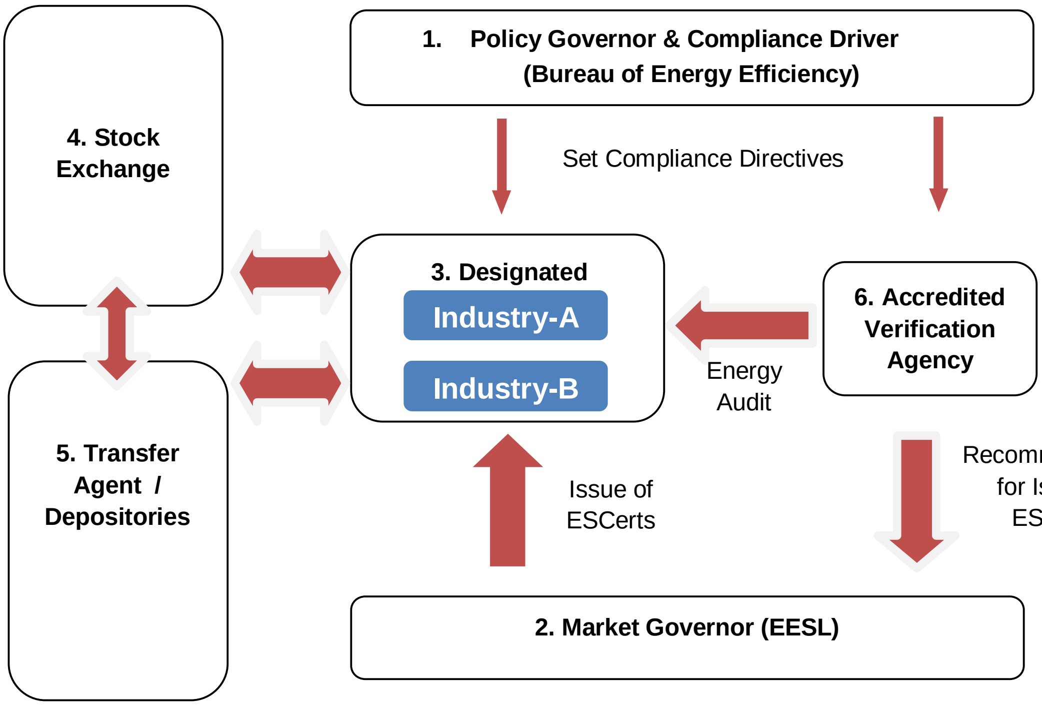
Appendix 5: Costs assessment of proposed PAT scheme

Similar to the European Union's Emission Trading Scheme (EU ETS), the proposed PAT scheme is expected to produce efficiency gains for designated consumers. Implementation of energy efficient measures involves certain costs to the firms/installation. However in addition to these costs there are many other major cost components involved in implementation of PAT scheme. Before we start with assessing the administrative and other costs to implement proposed PAT scheme it is necessary to understand the institutional framework to implement proposed PAT scheme

Institutional Framework for PAT Scheme

Institutional mechanism for proposed PAT scheme is provided in Figure 1 below. Under this mechanism BEE role is to ensure a compliance assurance through incentives and penalties to designated consumers. BEE will also accredit verification agencies. Accredited verification agencies verify the SEC target achievement for each designated consumer through detailed energy audit and recommend issuance of ESCerts to market governor i.e. Energy Efficiency Services Limited(EESL) . ESCerts issued by EESL could be traded by designated consumers to meet the compliance directives of BEE.

Figure 1: Institutional Mechanism for PAT



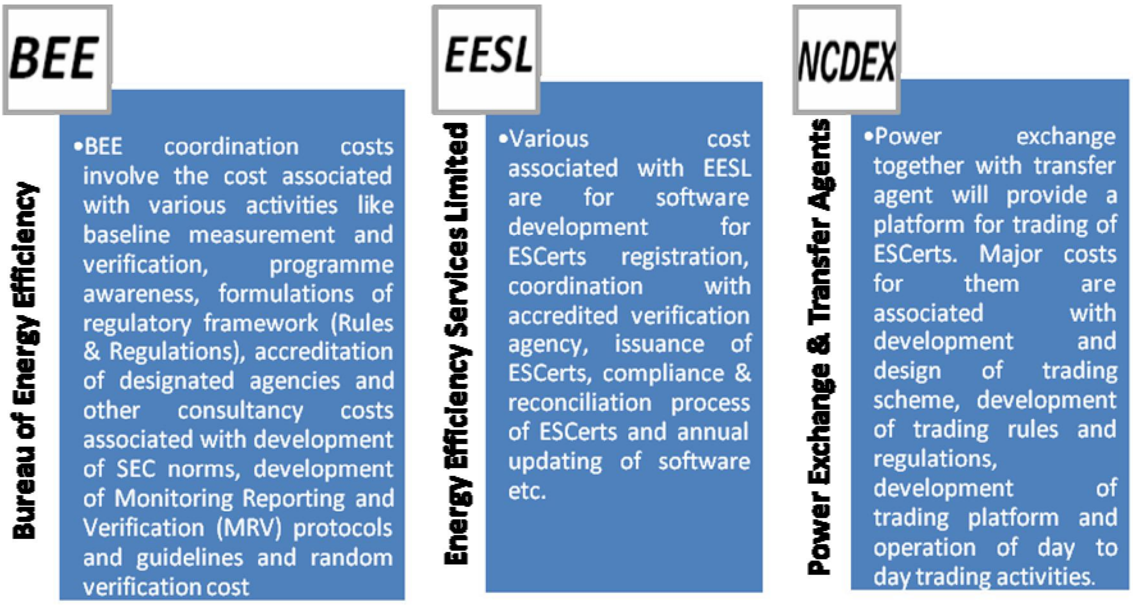
This study focuses on the coordination and transaction cost of different stakeholders involved for successful implementation of proposed PAT scheme and administrative costs of participating in the scheme incurred by firms including transaction and management costs. It is important to note that Bureau of Energy Efficiency (BEE) and Energy Efficiency Services Limited (EESL) also incurred coordination and transaction costs needed to establish complex organisations/regulations to facilitate PAT scheme implementation.

Coordination Cost for Different Stakeholders

For proposed framework of PAT scheme, BEE plays a major role as "Policy Governor and Compliance Driver", whereas EESL is a "Market Governor" looking after the issuance of

ESCerts and there reconciliation. The power exchange (NCDEX, MCX) together with transfer agent/depositor (e.g. CAMS) will provide trading platform. The various cost component for these stakeholders are highlighted in Figure 2 below.

Figure 2: Cost Components for Different Stakeholders



Administrative & Transaction Cost for Firms

As refers to firms, their transaction costs are associated with early implementation coasts, setting up a monitoring system, reporting their emissions, hiring a certified verifier every year and trading allowances if necessary. Some of these costs are incurred only once, in the initial stage of the policy implementation; however, other costs namely those associated with monitoring, reporting and verification (MRV) are continuing one. Finally, trading costs are variable, and depend on the number of transactions conducted and/or their volume.

Early preparatory / implementation costs are costs incurred by firms before the official start of the scheme. During this time, the familiarization with the rules and guidelines of the scheme had to be achieved, baseline consumption had to be calculated. These costs are comprised of costs incurred by the firms in terms of additional management and staff time and training and costs incurred in terms of consultancy services taken on.

Costs related to MRV activities were incurred annually since MRV procedures are mandatory on an annual basis for all participants in proposed PAT scheme. At the end of the year each firm had to prepare an annual energy consumption report which must then be verified. All annual energy consumption reports and monitoring will be verified by an independent accredited verifier.

Trading costs are depended on the number of transactions conducted; the volume of allowances traded; and any search or other fee costs incurred. Any installation could trade with any other installations within the same business group, or with other installations outside the business group and financial institutions.

Summary of Overall Cost Components Associated with PAT

Table 1: Summary of Overall Cost Components & yearly distribution

	Summary of Cost Components		Preparatory Phase		First Control Period			Second Control Period		
	Parameter Description	Unit	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
A	**Coordination costs for Stakeholders**	**Million Rs.**	**0**	**52**	**66**	**68**	**69**	**71**	**72**	**74**
	1. Policy Governor and Compliance Driver - BEE	Million Rs.	0.00	36.55	15.40	16.11	16.86	17.64	18.46	19.32
	2. Market Governor - EESL	Million Rs.	0.00	10.00	41.36	41.60	41.86	42.13	42.41	42.70
	3. Power Exchange - (e.g. NCDEX, MCX)	Million Rs.	0.00	5.67	5.82	6.11	6.42	6.74	7.08	7.43
	4. Transfer Agent / Depositor - (e.g. CAMS)	Million Rs.	0.00	0.00	3.57	3.75	3.94	4.13	4.34	4.56
B	**Administrative / transaction costs for Firms**	**Million Rs.**	**0**	**900**	**254**	**265**	**277**	**289**	**301**	**314**
	1. EarlyPrepratory / Implementation Cost	Million Rs.	0.00	185.93	37.78	39.67	41.66	43.74	45.93	48.22
	2. Monitoring Reporting & Verification Cost	Million Rs.	0.00	714.00	191.09	198.86	207.02	215.59	224.58	234.03
	3. Trading Cost	Million Rs.	0.00	0.00	25.26	26.52	27.85	29.24	30.71	32.24
	Number of Installations (Designated Consumers)	**No.**	714	714	714	714	714	714	714	714
	Average Administrative / transaction Cost for Firms	**Mn. Rs / Installation**	0.00	1.26	0.36	0.37	0.39	0.40	0.42	0.44

With overall objective to estimate the total cost involved associated with implementation of proposed PAT scheme are estimated based on various parameters discussed in sections above. The summary of all these cost components is provided in Table 1 above, where as details about all the activities, their cost and its occurrence time is provided in Annexure I & II below. Annexure I indicates the various cost components associated with associated with preparatory phase i.e. till end FY 2011, where as Annexure II indicates the Operating phase cost components i.e. from FY 2012 to FY 2017. The operating phase is further divided in two control periods of 3 years each (first control period is assumed from FY 12 to FY 14 and second from FY 15 to FY 17).

Preparatory Phase Cost Components - To ESCerts Programme

Parameter Description		Unit	Preparatory Phase FY 2010	Preparatory Phase FY 2011
A	**Coordination costs**	**Million Rs.**	**0**	**52**
	1. Policy Governor and Compliance Driver - BEE	**Million Rs.**	**0.00**	**36.55**
	Activity 1: Baseline Measurement and Verification	Million Rs.	0	17.85
	Activity 2: Programme Awareness	Million Rs.	0	11.00
	Activity 3: Formulations of Regulatory Framework (Rules and Regulations)	Million Rs.	0	2.10
	Activity 4: Accreditation Cost - Designated Agencies	Million Rs.	0	3.60
	Activity 5: Consultancy Cost	Million Rs.	0	2.00
	1. Development of SEC Norms For 9 Sectors	Million Rs.	0	1.00
	2. Development of MRV Protocols and Guidelines	Million Rs.	0	1.00
	2. Market Governor - EESL	**Million Rs.**	**0.00**	**10.00**
	Activity 1: Software Development Cost for ESCert Registration	Million Rs.	0	8.00
	Activity 2: ESCerts - Compliance & Reconciliation Process Protocols	Million Rs.	0	2.00
	3. Power Exchange - (e.g. NCDEX, MCX)	**Million Rs.**	**0.00**	**5.67**
	Activity 1: Development and Design of Trading Scheme	Million Rs.	0	2.00
	Activity 2: Development of Trading Rules and Regulations	Million Rs.	0	0.67
	Activity 3: Development of Trading Platform	Million Rs.	0	3.00
B	**Organization administrative / transaction costs**	**Million Rs.**	**0**	**900**
	1. Early Preparatory / Implementation Cost	**Million Rs.**	**0.00**	**185.93**
	Activity 1: Understanding scheme rules & Guidelines	Million Rs.	0	35.99
	Activity 2: Collection and analysis of energy data	Million Rs.	0	59.98
	Activity 3: Developing a compliance strategy	Million Rs.	0	89.96
	2. Monitoring Reporting & Verification Cost	**Million Rs.**	**0.00**	**714.00**
	Activity 1: Setting Up Monitoring System	Million Rs.	0	714.00

ents - To ESCerts Programme

scription	Unit	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
		Preparatory Phase		First Control Period			Second Control Period		
	Million Rs.	**0**	**0**	**66**	**68**	**69**	**71**	**72**	**74**
r - BEE	**Million Rs.**	**0**	**0**	**15.40**	**16.11**	**16.86**	**17.64**	**18.46**	**19.32**
ation Cost		0	0	1.00	1.00	1.00	1.00	1.00	1.00
	Million Rs.	0	0	14.4	15.1	15.9	16.6	17.5	18.3
ment of PAT Scheme	Million Rs.	0	0	0.20	0.20	0.20	0.20	0.20	0.20
Sample Size)	Million Rs.	0	0	14.20	14.91	15.66	16.44	17.26	18.12
	Million Rs.	**0**	**0**	**41.36**	**41.60**	**41.86**	**42.13**	**42.41**	**42.70**
redited Verification Agency	Million Rs.	0	0	4.23	4.45	4.67	4.90	5.15	5.40
	Million Rs.	0	0	35.70	35.70	35.70	35.70	35.70	35.70
as per Protocols	Million Rs.	0	0	0.63	0.66	0.69	0.72	0.76	0.80
ance of Software	Million Rs.	0	0	0.80	0.80	0.80	0.80	0.80	0.80
	Million Rs.	**0**	**0**	**5.82**	**6.11**	**6.42**	**6.74**	**7.08**	**7.43**
g Activities	Million Rs.	0	0	5.82	6.11	6.42	6.74	7.08	7.43
S)	**Million Rs.**	**0**	**0**	**3.57**	**3.75**	**3.94**	**4.13**	**4.34**	**4.56**
ation Cost	Million Rs.	0	0	3.57	3.75	3.94	4.13	4.34	4.56
on costs	**Million Rs.**	**0**	**0**	**254**	**265**	**277**	**289**	**301**	**314**
	Million Rs.	**0**	**0**	**37.78**	**39.67**	**41.66**	**43.74**	**45.93**	**48.22**
nergy data	Million Rs.	0	0	25.19	26.45	27.77	29.16	30.62	32.15
trategy	Million Rs.	0	0	12.59	13.22	13.89	14.58	15.31	16.07
st	**Million Rs.**	**0**	**0**	**191.09**	**198.86**	**207.02**	**215.59**	**224.58**	**234.03**
n of Monitoring System		0	0	35.7	35.7	35.7	35.7	35.7	35.7
tor	Million Rs.	0	0	12.59	13.22	13.89	14.58	15.31	16.07
Certified Verifier)	Million Rs.	0	0	143	149.94	157.44	165.31	173.57	182.25
	Million Rs.	**0**	**0**	**25.26**	**26.52**	**27.85**	**29.24**	**30.71**	**32.24**
ating in trading	Million Rs.	0	0	25.19	26.45	27.77	29.16	30.62	32.15
ker Fees)	Million Rs.	0	0	0.07	0.07	0.08	0.08	0.09	0.09