NORMALIZATION DOCUMENT AND MONITORING & VERIFICATION GUIDELINES

Cement Sector

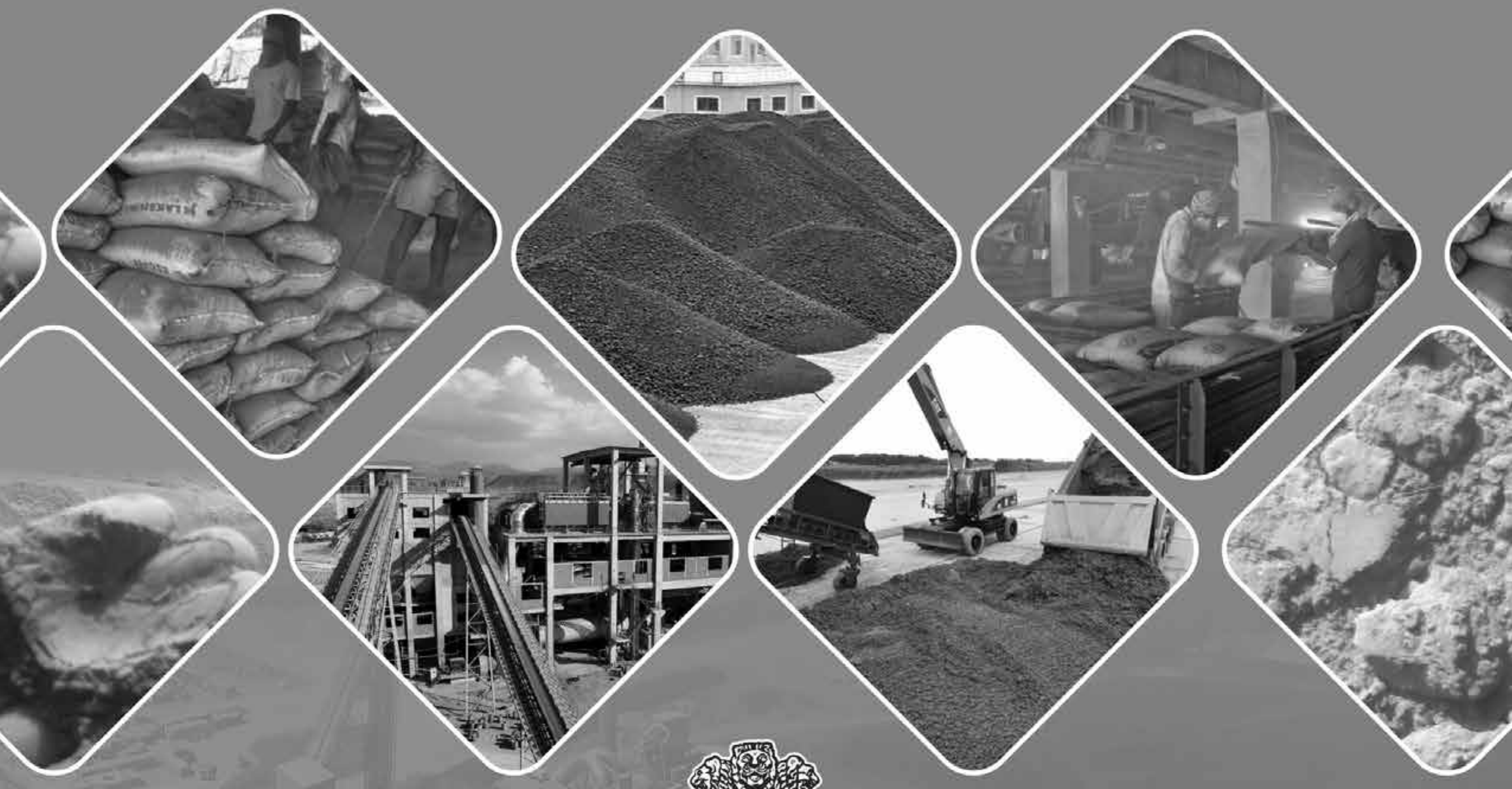
सत्यमेव जयते

MINISTRY OF POWER
GOVERNMENT OF INDIA

NORMALIZATION DOCUMENT AND MONITORING & VERIFICATION GUIDELINES

PAT SCHEME
PERFORM, ACHIEVE, TRADE

Cement Sector



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MINISTRY OF POWER
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BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

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Ajay Mathur, Ph.D.
Director General

Foreword

Perform Achieve and Trade (PAT), a flagship initiative under National Mission for Enhanced Energy Efficiency (NMEEE), is a regulatory intervention for reduction of specific energy consumption, with an associated market based mechanism through which additional energy savings can be quantified and traded as ECSerts.

Cement sector is one of the 8 notified energy intensive sectors under which a total of 85 plants are participating in this program. These plants have been mandated to reduce their Specific Energy Consumption (SEC) from baseline year of 2009-2010. It is expected that these plants may save 0.815 million tons of oil equivalent annually by the end of PAT cycle –I.

The publication of **"Normalization Document and M&V Guidelines" for Cement Sector** is an effort to facilitate the DCs to comply with notified PAT rules to participate with the PAT scheme and contribute towards achieving national target of energy savings. This document will also be helpful to all empanelled Accredited Energy Auditors (EmAEAs) and State Designated Agencies (SDAs) in the monitoring and verification process of PAT.

I want to record my appreciation for members of the Sectoral Expert Committee on Cement Sector, chaired by Shri A. Pahuja, Director-General, National Council for Cement and Building Material, Shri K. K. Chakarvarti, Energy Economist, BEE, Dr. K. N. Rao, Director (Energy & Environment) ACC Limited – Chairman, Technical Subcommittee, who worked tirelessly to put together the baseline data, normalization factors and M&V methodology for the sector. I especially want to record my appreciation for Shri S. Vikash Ranjan Technical Expert, GIZ who has put together the data and methodology associated with normalization.

I also compliment the efforts of all participating industrial units towards their endeavor in contributing to the national energy saving targets.

(Ajay Mathur)

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3.	Dr. K.N. Rao,	Director (Energy & Environment) ACC Limited	Member
4.	Shri K.C. Narang	Technical Advisor and Member Dalmia Cement (Bharat) Ltd.	Member
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NORMALIZATION METHODOLOGY

Cement

1. Introduction

In the journey towards inclusive growth of a country, the cement sector plays a vital role in its economic advancement and stays one of leading focal points for the construction sector and all infrastructure projects. The industry occupies an important place in the Indian economy because of its strong linkages to other sectors such as construction, transportation, coal and power.

The Indian cement industry is involved in production of several types of cement such as Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC), Portland Blast Furnace Slag Cement (PBFS), Oil Well Cement, Rapid Hardening Portland Cement, Sulphate Resisting Portland Cement, White Cement, etc. The Perform, Achieve and Trade (PAT) launched by the Bureau of Energy Efficiency under the Ministry of Power, Government of India, offers an opportunity to the industry to improve its energy efficiency and reduce energy consumption resulting in long term economic benefits in terms of reduced fuel expenditure with trading

2 Perform, Achieve and Trade (PAT)

The National Mission for Enhanced Energy Efficiency is one of the eight national missions under the National Action Plan on Climate Change.NMEEE is an integrated approach for climate change mitigation through energy efficiency measures.The mission was considered by the PM's council on Climate Change on 24 August, 2009 and has been approved by the Indian Cabinet in June, 2010.

In almost every sector in India, there is a large variation in energy intensities of different units, ranging from amongst the best in the world to extremely inefficient units. As a result, there is room to improve energy intensity in India with current commercially available technologies and best practices.

The key goal of the PAT scheme under NMEEE, is to mandate specific energy efficiency improvements for the most energy intensive industries, and further incentivise them to achieve better energy efficiency improvements that are superior to their specified SEC improvement targets.

To facilitate this, the scheme provides the option to industries that achieve superior savings to be rewarded with energy saving certificates for the excess savings, and to trade the additional certified energy savings certificates with other designated consumers who can utilise these certificates to comply with their reduction targets. The Energy Saving Certificates (ESCerts) so issued will be tradable on special trading platforms to be created in the power exchanges.

During the first cycle of PAT scheme, i.e. from 2012-13 to 2014-15, eight energy intensive sectors such as thermal power plants, aluminium, cement, chlor-alkali, fertiliser, iron & steel, pulp & paper, and textile have been included. There are 478 designated consumers in these 8 sectors and they account for about 165 million tonnes of oil equivalent of energy consumption annually. Upon implementation of the first cycle of PAT, it is expected that India would save energy to the tune of approximately 6.686 million tonnes of oil (mtoe) equivalent of energy, worth Rs6,800 crore by the end of 2014-15, equivalent to reduction of greenhouse gas emission by 24 million tonnes per year.

The Bureau of Energy Efficiency is at present focusing on development of normalisation factors so as to normalise the variation of operating parameters in the target year with respect to baseline operating parameters.

3. Indian Cement Industry and PAT

The threshold limit of 30,000 tonnes of oil equivalent (toe) has been defined as cut-off limit criterion for any unit in the cement sector to be identified as designated consumer and to be covered in PAT. The scheme has identified 85 designated consumers from the cement sector.

The cement sector has been categorised on the basis of products and process involved into seven sub-sectors—Portland Pozzolana Cement(PPC), Ordinary Portland Cement(OPC), Portland Slag Cement (PPC), Wet Plants, White Plants, Grinding Plants and Clinkerisation Plants. The total reported energy consumption of these designated consumers is about 15.01 mtoe. By the end of the first PAT cycle, the energy savings of 0.815 mtoe /year is expected to be achieved, which is around 12% of the total national energy saving target assessed under PAT.

Table 1: Sector-wise reduction target under PAT Cycle 1

S. No.	Sector	No. of Identified DCs	Annual Energy Consumption (Million toe)	Share Consumption (%)	Apportioned Energy Reduction For PAT Cycle-1 (Million toe)
1	Power (Thermal)	144	104.56	63.38%	3.211
2	Iron & Steel	67	25.32	15.35%	1.486
3	Cement	85	15.01	9.10%	0.815
4	Aluminium	10	7.71	4.67%	0.456
5	Fertilizer	29	8.20	4.97%	0.478
6	Paper & Pulp	31	2.09	1.27%	0.119
7	Textile	90	1.20	0.73%	0.066
8	Chlor- Alkali	22	0.88	0.53%	0.054
	Total	478	164.97	100.00%	6.686

The specific energy consumption patterns of most of the plants have a wide bandwidth. This happens mainly because of different product mix based on addition of Pozzolona, Slag and Fly Ash as blending additives. The Ordinary Portland Cement (OPC) has only Gypsum as an additive and consumes the highest energy per tonne. The clinker blends with additives to produce varieties of cement reduces the specific energy consumption per tonne.

4. Methodology for Baseline and Energy Performance Index (EPI)

Because of the complexities, it becomes extremely difficult to come to a common model to arrive at standardised SEC per tonne. Considering all these situations, conversion factors and best possible combination and categorisation have been worked out so that no designated consumer may have any grievance on the targets. While setting targets, the best unit in the group was set as reference and then the targets were worked out for others.

Dimensions of PAT mechanism:

- Methodology for establishing the baseline energy consumption
- Methodology for target setting for each sector

- The process of measurement and verification, in particular the verification agencies that need to be appointed by BEE for this purpose.
- The manner in which trading of the energy saving certificates can be encouraged, particularly instruments that could increase liquidity in the system.

4.1 General Rule for Establishing Baseline

Baseline Production (P_{base})	:	Avg. of 2007-8, 2008-9 & 2009-10
Baseline SEC (SEC_{base})	:	Avg. of 2007-8, 2008-9 & 2009-10
Baseline CU% (CU_{base})	:	Avg. of 2007-8, 2008-9 & 2009-10
Target SEC (SEC_{target})	:	SEC as estimated in 2014-15

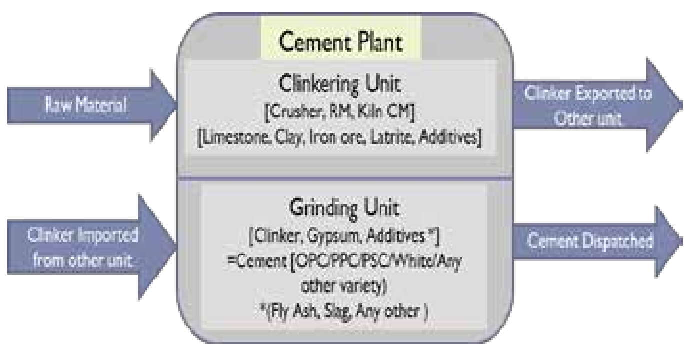
Estimation of Energy Saving (MTOE) : P_{base} (SEC_{base} – SEC_{target})

4.2 Methodology for Baseline and Energy Performance Index (EPI)

- For each plant, different types of cement products and exported clinker are converted into equivalent major product produced by that plant with the help of conversion factor, reported by the plantconcerned.
- Thermal Energy Input is arrived at by taking all types of fuels into account.
- Electricity Purchased is converted into equivalent thermal energy by multiplying it with 860. Whereas the electricity exported to the grid is calculated similarly by multiplying it with 2,717 (national average heat rate).
- Notional energy is also imposed on imported power
- Notional Equivalent Thermal Energy for Imported Power= Electricity purchased from Grid x (Weighted avg. heat rate of CPP of Cement plants-860).
- Total GtG Energy Consumption is calculated by adding the thermal inputs through all type of fuels, electricity purchased and subtracting the power exported to grid.
- Notional Energy (equivalent thermal energy) for Exported and Imported clinker are calculated based on thermal and electrical SEC reported by the concerned plant, wherein the Electrical kWh is converted into thermal kCal by multiplying the weighted average heat rate of the all form of electricity used in plant
- The notional energy required for exported/ imported clinker is added to the total thermal and electrical energy consumed by the plant only to arrive at the Gate to Gate Specific Energy Consumption.

4.3 Inbuilt Normalisation in EPI Calculation

4.3.1 Product Mix

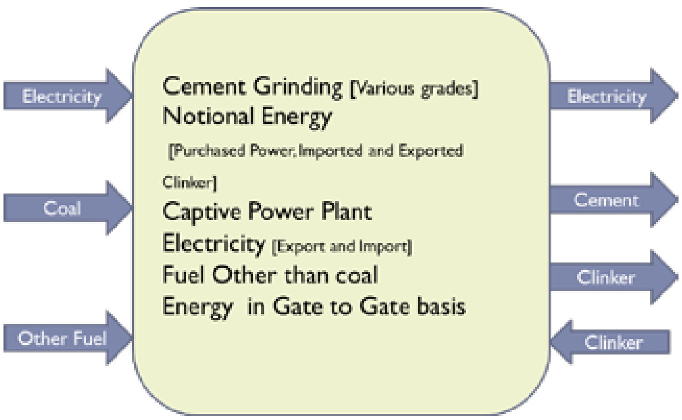


Conversion of Cement Equivalent to Major grade = (Cement production of a particular grade) X (CF* of Same grade)/(CF of Major grade) Total Cement Production Equivalent to major grade =Production of all grades of cement equivalent major grade + (exported clinker equivalent to major grade Cement)** *CF (Conversion Factor)= Clinker used for x grade/Cement Production of x grade

4.3.2 Energy Mix

In this model, all possibilities are considered

1. Cement Grinding of various grades
2. Notional energy required for Import and Export Clinker
3. Captive Power Plant
4. Electricity Import and export
5. Any Fuel other than Coal
6. Energy Accounted on Gate to Gate basis

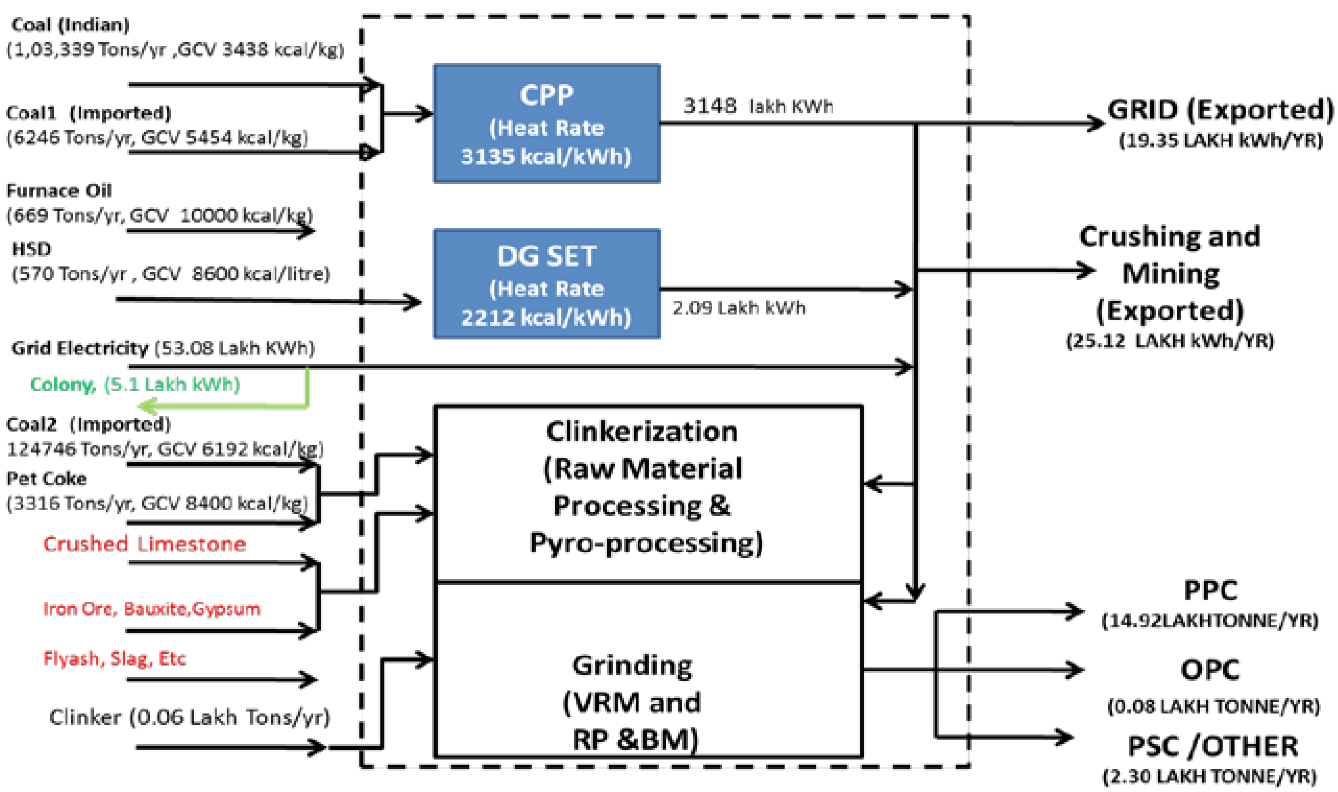


4.3.3 Input-Output for a typical Cement Plant

The typical boundary of a cement plant in the gate-to-gate concept under the PAT scheme ranges from input energy and raw material to output energy and product. The boundary depicts the specific energy consumption, which is energy consumed per unit of production. The SEC of an industry is calculated based on the gate-to-gate concept with the following formula:
Specific Energy Consumption (SEC) =

$$\frac{\text{Net energy input into the designated consumers' boundary}}{\text{Total quantity of output exported from the designated consumers' boundary}}$$

The theory of normalisation flows automatically with the input output concept, wherein change in the power source mix (Grid/CPP/DG/WHR/Co-Gen), product mix (OPC/PPC/PSC/Others) in the assessment year from baseline year could be worked out.



Note: All values presented in the above diagram are average of annual energy consumption of 2007-08, 2008-09, 2009-10

4.3.4 Normalisation Factors considered

The following normalisation factors have been considered

4.3.4.1 Equivalent major grade of cement production

The various product mixes are converted into equivalent major grade of cement product by the plant by using the following formulae:

(i) **Conversion of Ordinary Portland Cement (OPC) production equivalent to major product**

$$Equivalent\ Major\ Product\quad \frac{OPC\ Produced\ (Lakh\ Tonne) \times Conversion\ factor\ of\ OPC}{Conversion\ Factor\ of\ Major\ Product}$$

[Lakh Tonne]

(ii) **Conversion of Portland Pozolona (PPC) Production equivalent to major product**

$$Equivalent\ Major\ Product\quad \frac{PPC\ Produced\ (Lakh\ Tonne) \times Conversion\ factor\ of\ PPC}{Conversion\ Factor\ of\ Major\ Product}$$

[Lakh Tonne]

(iii) **Conversion of Portland Slag Cement (PSC)/any other variety of Cement Production equivalent to major product**

$$Equivalent\ Major\ Product\quad \frac{PSC\ or\ any\ other\ variety\ Cement\ Produced\ (Lakh\ Tonne) \times Conversion\ factor\ of\ PSC\ or\ any\ other\ variety\ Cement}{Conversion\ Factor\ of\ Major\ Product}$$

[Lakh Tonne]

(iv) **Conversion of Total Exported clinker to major product**

$$Equivalent\ Major\ Product\quad \frac{Total\ Exported\ Clinker\ (Lakh\ Tonne)}{Conversion\ Factor\ of\ Major\ Product}$$ [Lakh Tonne]

Where: Total Exported clinker= [Clinker Exported to other plants + clinker exported to clinker stock over and above the opening stock,]

(v) Conversion of Total Imported clinker to major product

$$Equivalent\ Major\ Product\quad \frac{Total\ Imported\ clinker\ (Lakh\ Tonne)}{Conversion\ Factor\ of\ Major\ Product}$$ Lakh Tonne]

Where: Total Imported clinker= [Clinker Imported from other plants + clinker Imported from clinker stock, equivalent to the quantity by which the clinker opening stock gets reduced]

(vi) **Total Equivalent major product of Cement**

It can be arrived at by summing up all the different grades of cements equivalent to major product calculated above:

Total Equivalent major product of Cement = a(i) +a(ii) +a(iii) + a(iv) [Lakh Tonne]

Note: S.No. a (v) is already accounted in major product

4.3.4.2. Calculation for Gate to Gate Specific Energy Consumption (SEC)

i. **Total Thermal Energy Consumption (Kiln + power Generation)**

Total Thermal Energy Consumptions to be calculated as:-

Total Thermal Energy Consumption= [{Fuel consumed (kiln+ power generation) (in Lakh Tonne) X Gross calorific value of respective fuel (kcal/kg) X100}-{(Electricity exported to grid (Lakh kWh) X 2717 (kcal/kWh))/10}]

[Million kcal]

Where: - 2717 kcal/kWh is the National Average Gross Heat Rate of Thermal Power Stations in the country in 2007.

ii. **Energy for Imported Electricity Consumption**

Total energy for imported Electricity Consumption is to be calculated as:-

Total energy for Imported Electricity= [{(Total Imported Electricity from grid (Lakh kWh) X 860(kcal/kWh)}/10]

[Million kcal]

iii. **Notional/ Normalisation energy for Imported electricity from Grid**

Notional Energy for imported electricity= [{Imported Electricity (Lakh kWh) x (3208 - 860) (kcal/kWh)} /10]

[Million kcal]

Where: 3208 kcal/kWh is the weighted average heat rate of captive power plants in all DCs in cement sector.

iv. **Notional/ Normalisation energy for grinding of exported Clinker**

It is calculated by using following formula:

Notional Energy =[{Total Exported clinker to major product (Lakh tonne) x Electrical SEC of cement grinding (kWh/tonne of cement) x Weighted Average Heat Rate (kcal/kWh)}/10]

[Million kcal]

Where:- Weighted Average Heat rate (kcal/kWh) = [{Imported Electricity (Lakh kWh)x

3208 (kcal/kWh)} + {DG generation (lakh kWh) x DG heat rate (kcal/kWh)} +

{Captive Power Plant Generation (lakh kWh) x Captive Power plant heat rate

(kcal/kWh)}] /[Imported Electricity (Lakh kWh) +DG generation (Lakh kWh)

+Captive power plant generation (Lakh kWh)]

v. Notional/ Normalisation energy for clinkerisation of imported Clinker

It is calculated by using following formula:

Notional Energy = Total Clinker imported (Lakh ton) x [(Thermal SEC of Clinkerisation, kcal/kg clinker x 1000)+{electrical SEC of clinkerisation (kWh/ton of clinker)x Weighted Average Heat Rate (kcal/kWh)}]/10

[Million kcal]

vi. Gate to Gate (GtG) Energy Consumption

GtG Energy Consumption=b(i)+b(ii)+b(iii) +b(iv)+b(v)

[Million kcal]

vii. Gate to Gate (GtG) Specific Energy Consumption

$$\textbf{GtG SEC} = \frac{GtG\ Energy\ Consumption\ (Million\ kCal)}{Total\ Equivalent\ Major\ Product\ of\ Cement\ (Lakh\ Tonne)\quad 100}$$

[kcal/kg of equivalent cement]

Note: - Notional/Normalisation Energy is not to be considered in Total Energy Consumption while deciding whether a plant falls under the designated consumer category or not. Normalisation energy is considered only in the calculation of Gate to Gate Specific Energy Consumption.

4.4. Methodology (Summary)

i. For each plant, different types of cement products and exported clinker are converted into equivalent major product produced by that plant with the help of clinker factors, reported by the plantconcerned.

ii. Thermal Energy Input is arrived at by taking all types of fuels into account (biomass or waste products energy is not considered if fired in a kiln).Electricity purchased is converted into equivalent thermal energy by multiplying it with 860 and loaded with notional energy (3,208-860 kcal/kWh). Whereas the electricity generated by the captive power plant exported to the grid is calculated similarly by multiplying it with 2,717 (national average of heat rate) and subtracted from the thermal energy used in generating the power.

iii. Total GtG Energy Consumption is calculated by adding the thermal inputs through all types of fuels, electricity purchased and subtracting the power exported to the grid.

iv. Notional Energy (equivalent thermal energy) for Exported and Imported clinker are calculated based on thermal and electrical SEC reported by the concerned plant, wherein the Electrical kWh is converted into thermal kcal by multiplying the weighted average heat rate of the plant, which takes into account imported electricity, DG set heat rate and captive power plant heat rate.

v. The notional energy required for imported power and exported/imported clinker is added to the total thermal and electrical energy consumed by the plant only to arrive at the GtG Specific Energy Consumption.

5. Target Setting in Cement Plants

5.1 Grouping of Cement plants

For the establishment of energy consumption norms and standards for designated consumers in the cement sector, the designated consumers have been grouped based on similar major product and process for benchmarking of their Specific Energy Consumption performance. The groupings are as under:

a. PPC Major product (This group contains cement plants producing PPC as a major product in overall production and all other products are converted to equivalent PPC)

b. OPC Major product (This group contains cement plants producing OPC as a major product in overall production and all other products are converted to equivalent OPC)

c. PSC Major product (This group contains cement plants producing PSC as a major product in overall production and all other products are converted to equivalent PSC)

d. White Cement Plant

e. Wet Cement Process Plant

f. Clinker Grinding Plant

g. Clinkerisation Plant

5.2 Energy Consumption Range

DRAFT

ENERGY CONSUMPTION RANGE IN INDIAN CEMENT PLANTS (85 DC's) (2007-10)

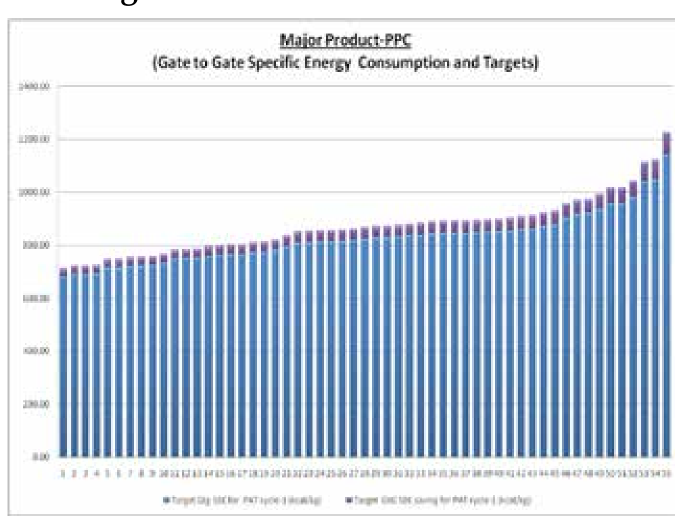
Products/Process (No. of Plants)	Thermal Energy Consumption (kcal/kg of clinker)		Electric Energy Consumption (kWh/Tonne equivalent cement)		Normalized Energy Consumption gtg (kcal/kg equivalent cement)		Total Energy Consumption of Sub-Sector	% Share of Sub-Sector
(Major Product)	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	(toe)	(%)
PPC (55 Plants)	658	1074.02	64.18	110.24	712.31	1227.1	10292843.975	68.57%
OPC (16 Plants)	727.33	1000.94	75.67	143.48	964.66	1368.43	3295349.387	21.95%
PSC (7 Plants)	701.02	1207.71	71.03	119.69	700.39	968.17	932008.497	6.21%
White Cement (2 Plants)	1093.72	1279.66	108.93	119.81	1452.23	1484.65	105566.281	0.70%
Wet Cement Plants (2 Plants)	1026.67	1415.07	79.75	113.86	1241.4	1244.56	152403.633	1.02%
Grinding Units (2 Plants)	—	—	38.78	40.38	138.73	201.05	88211.169	0.59%
Only Clinkerization (1 Plant)	869.33		87.47		1257.22		143790.367	0.96%
						Total	15010173.309	100.00%

The wide bandwidth of specific energy consumption (SEC) within an industrial sector is indicative of the large energy-savings potential in the sector. The wide bandwidth is also a reflection of the differences in the energysaving possibilities among plants because of their varying vintage, production capacity, raw material quality and product-mix. Such wide variation also makes it difficult to specify a single benchmark SEC for the sector as a whole — older plants will find the benchmark impossibly high if it is set at the level of newer plants; newer plants will find it trivial if it is set at the level of older plants.

The broad bandwidth of SEC within a sector, and the inability of all plants to achieve a sectoral benchmark SEC, suggests that SEC improvement norms need to be set for individual plants. These SEC improvement targets can be based on the trend of energy consumption and energysaving potential of the plants. In general, the higher the energy efficiency (or the lower the SEC), the lower the energysaving potential.

Thus, it is evident that it is not feasible to define a single norm/standard unless there is significant homogeneity among units in a sector. Therefore, the energy efficiency improvement targets fixed are "unit specific". Each DC is mandated to reduce its SEC by a certain value, based on its current SEC (or baseline SEC) within the sectoral bandwidth.

5.3 Example: Normalised Baseline Parameters and Target for PPC



85 cement plants covered under PAT have been grouped under 7 Categories; of these 55 cement plants produce Portland Pozzolana Cement (PPC) as a major product. The plants shown in the bar chart have normalised baseline operating parameters. The energy saving targets have been assigned based on their energy efficiency performance in the baseline year and increases as the inefficiency level increases. The exercise has helped in creating a benchmark for the plants covered in the cement sector. The plant can compare its performance with other plants as all of them have now normalised baseline parameters values.

5.4 Apportionment of Sub-Sector Target of Energy Saving in Cement Sector

S.No.	Sub Sector	NO. OF DCs	Avg. Energy Consumption			Target Energy Reduction for PAT Cycle-1	
			Mkcal	Million toe	%	Million toe	toe
1	PPC	55	102928440	10.293	68.57%	0.559	558865.489
2	OPC	16	32953494	3.295	21.95%	0.179	178925.965
3	PSC	7	9320085	0.932	6.21%	0.051	50604.807
4	White	2	1055663	0.106	0.70%	0.006	5731.880
5	Wet	2	1524036	0.152	1.02%	0.008	8274.985
6	Grinding	2	882112	0.088	0.59%	0.005	4789.558
7	Clinkerization	1	1437904	0.144	0.96%	0.008	7807.315
	Total	85	150101733	15.010	100.00%	0.815	815000.000

The energy saving targets in a group have been calculated on the basis of energy consumption of that particular group and is apportioned accordingly. The saving target of cement sector was calculated in the table as 0.815 mtoe and is distributed among the group as per the energy consumption.

5.4.1 Apportionment of Target of Energy Saving in individual Cement plant

S.No.	Name of Designated Consumer	Annual GtG Energy Consumption (Mkcal)	Annual GtG SEC (kcal/kg)	Reletive SEC	Reduction SEC Target (%)	Target SEC for PAT cycle-1 (kcal/kg)	Energy Saving With X factor (toe)	Target Energy Savings for PAT cycle-1 (toe)
MAJOR PRODUCT PPC								
1	Plant 1	2721475.76	712.31	1.00	3.9903	683.89	2721.48	10859.50
2	Plant 2	1777311.96	721.49	1.01	4.0418	692.33	1800.24	7183.54
3	Plant 3	1829132.15	721.98	1.01	4.0446	692.78	1854.01	7398.11
4	Plant 4	2740709.49	724.92	1.02	4.0609	695.48	2789.22	11129.75
5	Plant 5	1104943.57	746.17	1.05	4.1798	714.99	1157.43	4618.44
6	Plant 6	1746813.05	746.79	1.05	4.1834	715.55	1831.36	7307.62
7	Plant 7	1288276.78	753.44	1.06	4.2205	721.64	1362.61	5437.17
8	Plant 8	3729606.74	755.01	1.06	4.2297	723.08	3953.38	15775.12
9	Plant 9	1257253.99	756.35	1.06	4.2369	724.30	1334.95	5326.86
10	Plant 10	1557717.77	768.16	1.08	4.3031	735.11	1679.84	6703.02
11	Plant 11	2634424.58	783.29	1.10	4.3877	748.92	2896.81	11559.06

- Total Energy Consumption for the Sector does not include the notional energy required for exported/imported clinker as in case of GtG SEC calculation.
- The sectoral target for cement is is allocated on a pro-rata basis of total energy consumption among 7 sectors under PAT scheme;the targets for the thermal power sector have been fixed separately.
- Sub-Sectoral target is allocated on a pro-rata basis of total energy consumption in the grouping among the total cement sector.
- The DC level target is allocated based on a statistical analysis derived from relative SEC concept. This approach will be applicable to all the DCs of a sub-sector.

The individual plant's energy saving targets was calculated on the basis of the group's saving. The exampleshownis of aplant of the PPC group, wherein the target for this group was calculated as 558,865 tonnes of oil equivalent. This saving needs to be divided by 55 plantsin the PPC group by distributing the target as per their existing efficiency level. The same was distributed among the plants with a statistical approach and arrived at the saving target for an individual plant.

6. Normalisation

There are several factors that need to be taken into consideration in the assessment year such as change in the product mix, capacity utilisation, change in fuel quality, import/export of power, etc influenced by external factors, i.e., factors beyond the plant's control, in calculating the Specific Energy Consumption (SEC) of the plant within the boundary. This will ensure no undue advantage or disadvantage is imposed on a DC while assessing the performance in the assessment year as compared to the baseline year.

The operating parameters in the assessment year have to be normalised with reference to the baseline year so as to avoid any favourable or adverse impact on the specific energy consumption of the plant. This will also help to gauge accurately the energy efficiency projects implemented by the plant.

External Factors are:

- **Market Demand**
- **Grid Failure/Breakdown** (Grid not Sync with CPP)
- **Raw Material Unavailability**

- **Natural Disaster** (Flood, Earthquake etc)
- **Major change in Government policy** (Hampering plant's process system)
- **Unforeseen Circumstances** (Labour Strike/ Lockouts/Social Unrest/Riots etc)

Normalisation factors for the following areas have been developed in the cement sector, which will ultimately affect the gate to gate specific energy consumption in the assessment year. A broad categorisation of the factors are presented here:

- **Capacity Utilisation**
  - Availability of Fuel/Raw Material (Effect on Capacity Utilisation)
  - Natural Calamity/Rioting/Social Unrest/Labour Strike/Lockouts (Effect on Capacity Utilisation)
- **Product Mix & Intermediary Product**
- **Fuel Mix** (Pet Coke Utilisation in Kiln)
- **Power Mix** (Imported & Exported from/ to the grid and self-generation from the captive power plant)
- **Fuel Quality in CPP**
- **Low PLF in CPP**
- **Environmental Concern** (Additional Environmental Equipment requirement due to major change in government policy on Environment)

Normalisation will also takes place following some unavoidable circumstances in the assessment year as compared to the baseline year on furnishing authentic documents.

6.1 Capacity Utilisation

Variation in plant Capacity utilization in assessment year may take place from baseline year. This will have impact on gate to gate specific energy consumption

With the decrease in capacity utilisation due to any external reason not controlled by plant such as Market demand, Grid Power holiday etc. in the assessment year, the heat rate and specific energy consumption will also get upset and deteriorates the performance of the plant. Thus, this effect will attract the Normalization in assessment year w.r.t. the baseline year.

6.1.1 Need for Normalization

The normalization on capacity utilisation factor will be influenced by following external condition

- Market Demand
- Raw Material availability
- Grid Power holiday
- Natural Disaster
- Rioting/Social Unrest/Labour Problem
- Unforeseen Circumstances

The deterioration of Capacity Utilisation due to Internal Factor of plant such as Breakdown of Machine, Power breakdown, Poor maintenance practices, Plants management policy etc. will not be considered.

6.1.2 Normalization on Capacity Utilization

The capacity utilization normalization of the plant would be calculated for two different situations

1. Kiln capacity decrease due to external factor i.e., plant has to run at lower capacity as compared to the baseline operating capacity due to fuel, raw material non availability

2. Kiln capacity loss due to market demands/ power cuts/power holiday'setc leading to nos of Kiln Cold startupand Kiln Hot Shutdown due to outages not controlled by plant. The energy for cold startup and Hot stop will be used without significant or no production.

The Plant's kiln capacity and production rate has to be defined by taking hours of operation of kiln for the baseline and Assessment Year. So instead of taking TPD, the kiln capacity is taken as TPH.

6.1.2.1 Normalization on Capacity decrease due to external factor

- The deterioration of Kiln Heat rate with the kiln capacity could only be seen if the production has been decreased from the rated Kiln capacity, hence TPH comparison between baseline and assessment year is done to arrive at proper Normalization Factors.
- However, segregation is required between Internal and External factor, which has influence on Heat rate deterioration.
- The plant capacity in the assessment year will be compared from the baseline year in terms of Ton per Hour (TPH)
- Separate curve of Plant production rateVs Thermal Energy consumption and Plant production rate Vs Electrical Energy Consumption for nos of plant have been analysedwith curves were plotted and curve equation has been drawn. The equation is being used for defining various capacity utilisation factors.

6.1.2.2 Normalizationdue to kiln cold startup and Hot Stop caused due to external factor

Thermal Energy

- The Energy loss due to cold startup caused due to external factor defined above has been taken for kiln stabilization period during 24 hours achieving normal production level in 24th hour
- Based on different combination of kiln capacity an equation has been drawn to equate all capacities in mathematical form.
- Plant should maintain the records of the number of outages during the baseline and assessment year
- The Notional Energy due to loss in Productive hours due to external factor [In terms of Nos of Kiln Cold Startup] will be deducted from the assessment year Energy.

Electrical Energy

- The difference of Electrical Energy used during the Cold Startup from Baseline year to the Assessment year will be deducted from the Assessment year
- Plant needs to maintain proper Energy Meter Reading Records during Kiln Cold Startup due to external factors for baseline as well as assessment year

6.1.2.3 Definition of Cold Startup and Hot Stop of Kiln

Item	Record	Unit
Kiln Hot to Hot start	Annual	Hours
Kiln Hot to Cold stop due to external factor	Annual	Hours
Kiln Hot to Cold stop due to external factor	Annual	Nos
Kiln Hot to Cold stop due to external factor (Electrical Energy Consumption)	Annual	Lakh kWh
Kiln Cold to Hot start due to external factors	Annual	Hours
Kiln Cold to Hot start due to external factors	Annual	Nos
Kiln Cold to Hot start due to external factors (Electrical Energy Consumption)	Annual	Lakh kWh
Kiln Cold to Hot start due to internal factors	Annual	Nos

1. Hot to Hot Start in hours

Definition

A hot relight is required when a brief interruption of the electrical power supply causes the kiln to shut down. Even though the shut-down may have occurred unexpectedly due to Equipment Breakdown or O&M reasons, the plant should maintain the records in hours from Kiln Light-up to reach the pre-shutdown production level. The duration of such shut down could range from minutes to an hour.

Proforma - Data Entry

The DCs are required to fill the data in terms of total nos of hours per annum for Kiln small breakdowns/Shutdown due to internal or external factor in the modified data entry form. [∑ (nos of Kiln Hot to Hot Start x Nos of hours to reach Normal production level)]. The data entry is required for record purpose only.

Internal factor: Equipment Breakdown in Kiln Section having direct relation with mass, energy and air balancing equipment kiln, Operational Issues etc

External Factor: Factors, which cannot be controlled by Plant such as Grid Failure, Grid Shutdown, Flood, Earth-Quake etc

Normal Production: 70% of the Kiln Capacity is termed as Normal Production or the kiln production rates before the kiln stoppage due to external factor

Documentation:

The documents maintained by DCs clearly shows the direct reasons of the shutdown along with time and duration in hours and Energy consumed with quantity of Feed to reach the pre-shutdown production level for each such break-down or shutdown.

2. Hot to Cold Stop

Definition

Hot to cold Stop means the cessation of kiln operation. Shutdown begins when feed to the kiln is halted and ends when continuous kiln rotation ceases (Inching Stop). Planned shutdown caused due to internal and external factor of a kiln, consumes only electrical energy during Kiln slowing down. The shutting down of kiln, either occur due to internal factors like Operational issues, major break down of kiln section equipment etc or due to external factor like Unavailability of Grid Power, Raw material un-availability, Storage Full due to Market condition etc. These conditions are to be captured in-terms of Energy record (Electrical) with no of hrs, kiln takes until zero kiln rotation.
Proforma - Data Entry

The DCs are required to maintain the duration in hours of Kiln slowing down i.e., when the Feed in the kiln is halted and up to the zero rotation of kiln in a year with Energy consumption during the period caused due to internal and external factors separately. The data in nos are required to be filled up for external factor only. [∑ (Nos of Kiln Hot to Cold Stop x Nos of hours to reach zero rotation of kiln)].

The reading records for Energy meters are required to be maintained for such Hot to Cold stops. The difference of Electrical energy consumed during baseline as well as in assessment year will be deducted in the assessment year.

Internal factor: Equipment Breakdown in Kiln Section having direct relation with mass, energy and air balancing equipment kiln, Operational Issues, Planned Shutdown etc

External Factor: Factors, which cannot be controlled by Plant such as Grid Power Availability, Market Condition, Flood, Earth-Quake, Social Unrest, etc

Documentation:

The documents maintained by DCs clearly shows the direct reasons of the shutdown along with duration in hours and Energy consumed in each such shutdown.

3. Cold to Hot Start

Start-up as the time from when a shutdown Cold kiln first initiates firing fuel until it begins producing clinker at normal production level in a single run. Thus, Cold to Hot Start begins when a shutdown kiln turns on the induced draft fan and begins firing fuel in the main burner. The feed is being continuously introduced into the kiln up to kiln normal production level maintaining Kiln inlet temperature. The duration has been taken as 24 hours with part feed after the end of 16th hour.Thermal Energy will be used during the cold start-up of kiln to reach and maintain Kiln inlet temperature.The Cold start of kiln may take place due to Internal and external factors.

Proforma- Data Entry - Data Entry

The DCs are required to fill the data in Nos for Cold start caused due to both Internal and External Factors.

Thermal energy loss due to Cold to hot Start

The DCs are required to enter the data in Nos for cold start caused only due to External Factors. The data to be filled for both Assessment and Baseline year. The nos of cold start then be multiplied with Cold start up Thermal Energy

per cold start-up to get the Extra Energy consumption due to difference in start-up from Baseline and Assessment year. NCCBM has developed the relation between Energy and No of cold starts for all the kiln, which is integrated in one equation for normalization.

Electrical Energy loss due to Cold to hot Start

The Electrical Energy consumed during such starts should be maintained through proper Energy meter reading records during the Hot Start period for baseline as well as assessment year. The difference will then be normalized by deducting the same in assessment year

Internal factor: Equipment Breakdown in Kiln Section having direct relation with mass, energy and air balancing equipment kiln, Operational Issues, Planned Shutdown etc

External Factor: Factors, which cannot be controlled by Plant such as Grid Power Availability, Market Condition, Flood, Earth-Quake, Social Unrest, etc

Normal Production: 70% of the Kiln Capacity is termed as Normal Production or the kiln production rates before the kiln stoppage due to external factor

Documentation:

The documents maintained by DCs clearly shows the direct reasons of the shutdown for Cold Start-up along with other documents related to both internal and external factors.

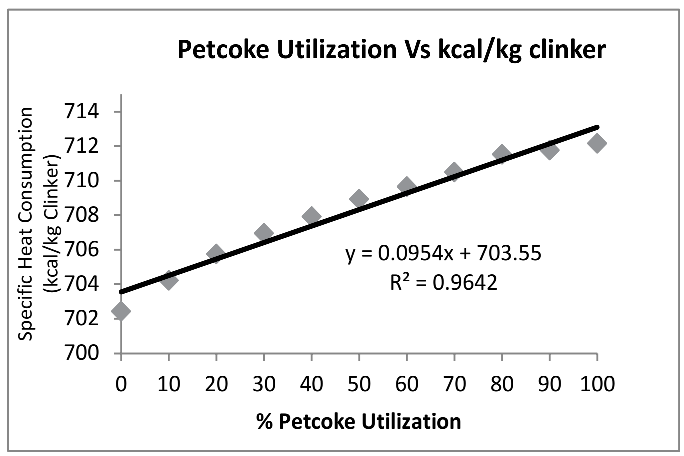
6.1.3 Normalization Calculation on Capacity decrease due to external factor

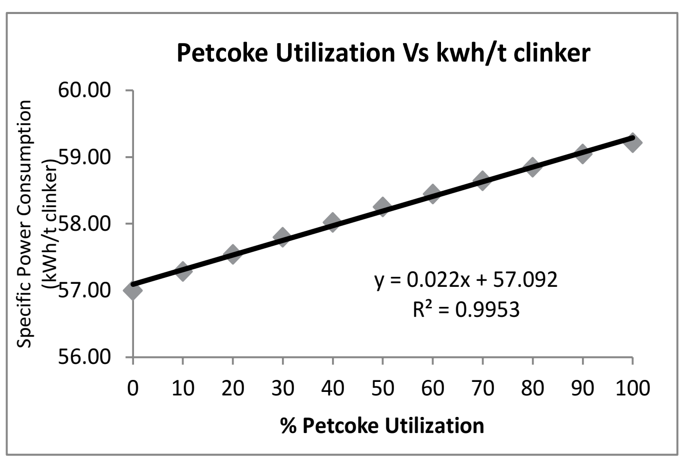
Variation in plant Capacity utilization in TPH in assessment year may take place from baseline year. The same could be normalised as per %age capacity utilisation equation w.r.t. thermal energy of kiln in terms of kiln heat rate and electrical SPC in terms of kwh/ton of Clinker. This will be applied for comparing the baseline and assessment year TPH derived from annual production and kiln running hours of individual kiln.

NCCBM study for Cement Sector indicates that there is 6 % increase in energy required by clinker when the capacity utilization falls to 55% of the rated value.

6.1.3.1 Pre-Requisites for Capacity Normalization

- The CU Normalization will be utilized if the plant shows deterioration in capacity in terms of Kiln TPH from the Baseline year, the vice versa is not applicable
- Any increase in TPH of Kiln w.r.t. baseline year is classified as efficiency improvement of kiln





6.1.4 Normalization Calculation on Capacity Utilsation

6.1.4.1 Normalization Calculation on capacity decrease for Kiln Heat Rate due to external factor

i) Normalization of Thermal SEC (Kiln Heat Rate) up to Clinkerisation

Thermal energy due to loss in kiln TPH, normalized in the assessment year for Kiln Heat Rate is to be calculated as:-

> Notional Thermal energy reduction due to loss in Kiln TPHw.r.t. Kiln Heat Rate [Million kcal] =[Kiln Heat Rate in AY (kcal/kg)-Kiln Heat Rate in BY (kcal/kg)] x Clinker Production in AY (Tons)/1000
>
> *Where:-* **[Kiln Heat rate in AY- Kiln Heat rate in BY]= 0.4673 x (TPH $_{BY}$- TPH $_{AY}$)**

AY = Assessment year

BY = Baseline Year

TPH_{BY}= Tons per hour of kiln in the baseline year

TPH_{AY}= Tons per hour of kiln in the assessment year

Kiln Heat Rate=Total Thermal Energy consumed in kiln (kcal)/Clinker Production (kg),in kcal/kg

ii) Normalization of Electrical SEC up to Clinkerisation

Thermal energy due to loss in kiln TPH, normalized in the assessment year for Kiln specific power consumption (SPC) is to be calculated as:-

> Notional thermal energy reduction due to loss in kiln TPH w.r.t. kiln SPC [Million kcal]=[Kiln SPC in AY (kwh/Ton)- Kiln SPC in BY(kwh/Ton)] x Clinker Production of Kiln in AY (Tons) X Weighted Heat Rate (kcal/kwh)/10^6
>
> *Where:-* **[KilnSPC in AY- Kiln SPC in BY]= 0.0943 x (TPH $_{BY}$- TPH $_{AY}$)**

AY = Assessment year

BY = Baseline Year

TPH= Tons per hour

SPC= Specific Power Consumption in kwh/Ton

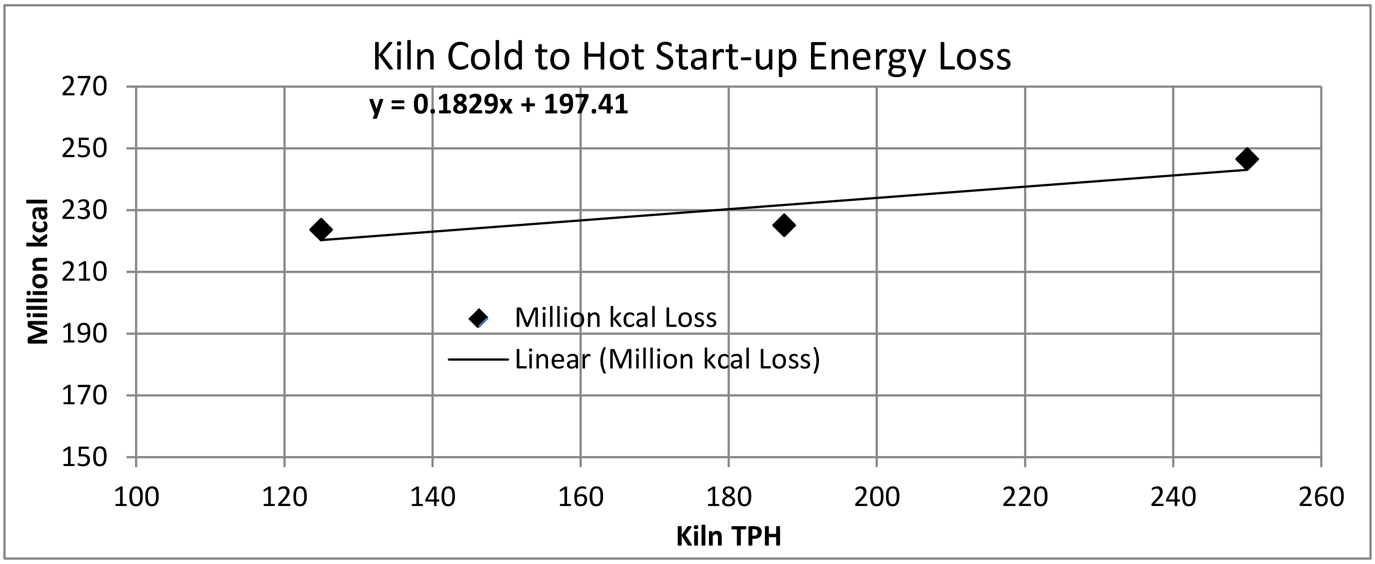
The above formulae stands for individual kiln. However, the notional thermal energy for normalization on Kiln Rate and Kiln SPC will be calculated for all the installed kiln of plant and added to get the Net notional thermal energy reduction figure.

6.1.4.2 Normalization Calculation on Kiln Start/Stopcaused due to external factor

(i) Normalization of Kiln Cold Start due to external factor for Thermal energy consumption

Energy is being utilized during kiln cold startup to reach normal production rate for any kiln outage. Due to external factor such as Market demand or Power breakdown, plant may use additional energy in assessment year for increase in kiln outages due to external factor not controlled by plant.

With different combination of Kiln production capacities and with the help of simulation, NCCBM has developed an equation to normalize the same in the assessment year as per following chart.



The graph is based on Energy used in kiln during kiln cold startup w.r.t. Kiln capacity in TPH and shows a linear equation Y= 0.1829X+197.41 in terms of Million kcal Energy loss.

Thermal energy due to additional Cold Start in assessment year of Kiln w.r.t. the baseline year, normalized in the assessment year for Kiln thermal energy consumption is to be calculated as:-

> Notional Energy to be subtracted w.r.t. additional Kiln Cold startup for Thermal Energy Consumption [Million kcal] = (0.1829 x Kiln TPH in AY + 197.41) x [Nos of Cold Startup in AY (Nos) -Nos of Cold Startup in BY (Nos)]

Where:-

AY = Assessment year

BY = Baseline Year

TPH= Tons per hour

(ii) Normalization of Kiln Cold Start due to external factor for Electrical energy consumption

Electrical energy due to additional Cold Start in assessment year of Kiln w.r.t. the baseline year, normalized in the assessment year for Kiln electrical energy consumption is to be calculated as:-

> Notional Energy to be subtracted w.r.t. additional Kiln Cold startup for Electrical Energy Consumption [Million kcal] = [Electrical Energy Consumption for Cold start in AY (Lakh kwh)- Electrical Energy Consumption for Cold start in BY (Lakh kwh)] x Weighted Heat Rate (kcal/kwh)/10

Where:-

AY = Assessment year

BY = Baseline Year

(iii) Normalization of Kiln Hot to Cold Stop due to external factor for Electrical energy consumption

Electrical energy due to additional Hot to Cold Stop in assessment year of Kiln w.r.t. the baseline year, normalized in the assessment year for Kiln electrical energy consumption is to be calculated as:-

> Notional Energy to be subtracted w.r.t. additional Kiln Cold to Cold Stop for Electrical Energy Consumption [Million kcal] = [Electrical Energy Consumption for Cold stop in AY (Lakh kwh)- Electrical Energy Consumption for Cold stop in BY (Lakh kwh)] x Weighted Heat Rate (kcal/kwh)/10

Where:-

AY = Assessment year

BY = Baseline Year

The above formulae stands for individual kiln. However, the notional thermal energy for normalization on Kiln Start/Stop will be calculated for all the installed kiln of plant and added to get the Net notional thermal energy reduction figure

6.1.4.3 Note on New Line /Production Unit installed after baseline year

In case a DC commissions a new line/production unit before or during the assessment/target year, the production and energy consumption of new unit will be considered in the total plant energy consumption and production volumes once the Capacity Utilisation of that line has touched / increased over 70%. However, the energy consumption and production volume will not be included till it attains 70% of Capacity Utilisation. Energy consumed and production made (if any) during any project activity during the assessment year, needs to be exclusively monitored and will be subtracted from the total energy and production in the Assessment year. Similarly, the same methodology is applied on a new unit installation for power generation (CPP)within the plant boundary.

The Capacity Utilisation will be evaluated based on the OEM document on Rated Capacity or Name plate rating on capacity of New Line/ Production Unit and the production of that line/ unit as per DPR/Logsheet.

6.1.5 Documentation

a. Documentary proof for unavailability or Raw Material and Fuel

b. Power Cut/ Power Holiday documents from respective Boards

c. Force Major condition documents: Flood, Earthquake, Labor Strike, Rioting or Social unrest, Change in Government policy

d. Baseline Vs Assessment year Kiln Stop hours (Hot-Hot) Analysis with supporting documents [Ex-Log sheets, DPR. MPR, Lab Report/register/ SAP Data]-For running kiln

e. Kiln Stop Hours for i) Cold-Hot and ii) Hot- Cold with supporting documents [Ex-Log sheets, DPR. MPR, Lab Report/ register/ SAP Data/CCR trends/Silo Full] with stoppage analysis

f. Production documents for Clinker and Cement [MPR/CCR Trend/Lab Report or Register or other supporting documents]

g. Clinker and cement (Import and Export) (Excise documents/Internal transfer details)

h. The individual kiln wise production, Thermal SEC and run hours data required for the baseline years with supporting documents

i. Energy Meter Reading records during Cold Startup and Hot shut down for individual kiln

6.2 Product Mix and Intermediary Product

6.2.1 Baseline Year Methodology:

In the Cement Sector each plant, having different product mix based on additives like Gypsum, Slag and Fly Ash with different blending ratio. Hence, different types of cement products and exported clinker are converted in to equivalent major product produced by that plant with the help of conversion factor, reported by the concerned plant. The Products are

OPC (Ordinary Portland Cement)

PPC (Portland Pazzolona Cement)

PSC (Portland Slag Cement)/ others

6.2.2 Need for Normalization

For all the Product mix change in assessment year with respect to Baseline year, there is a need to develop and impose proper Normalization factors, so that any change in the product mix could be nullified and the concerned plant should not suffer / or gain advantage due to this change only.

Partially processed product (Intermediary Product) import by the plant (for which part of the energy is not required to be used by the plant) and export from the plant for which energy has been used but it is not taken into account in the final product. For example, a cement plant can import or export clinker, which is an intermediately product but not the final product i.e., Cement, may alter in the assessment year.

6.2.3 Normalization Methodology

- The DC has to get a benefit for using high percentage of additives (Waste Product such as Fly Ash and Slag) in Cement in the assessment year as compared to the Baseline Year
- Higher additives ratio in Cement yield higher efficiency of the plant
- The difference of %age additives from baseline year in assessment year will be converted to Notional clinker produced due to additives
- The Energy consumed to produce the Notional Clinker will then be subtracted from the Total Energy in the Assessment year using year's Weighted Heat Rate of electricity consumed, Heat Rate of Kiln and Electrical SEC up to clinkerisation.

6.2.4 Product Mix Case

Product mix (some products consume higher energy whereas other consume comparatively less) may change in Assessment year w.r.t. baseline year

- If major product changed in Assessment Year from baseline year

  Case 1:- OPC to PPC/PSC or Vice-versa

- If clinker factor changed due to change in additives(Fly ash/Slag/others) percentage from the baseline year.

  Case 2:-PPC/PSC to PPC/PSC (Clinker Factor change of PPC/PSC)

  Case 3:- OPC to OPC (Clinker Factor change of PPC/PSC)

  Case 4:-OPC to PPC /PSC(Clinker Factor change of PPC/PSC)

  Case 5:-PPC /PSC to OPC (Clinker Factor change of PPC/PSC)

  Case 6:- PPC /PSC to PPC/PSC (PPC/PSC production increase)

- Difference in Grinding Energy for Equivalent Cement production (Excluding Exported clinker) and Actual Cement Production

6.2.5 Common Normalization formulae for all the above combinations

- Baseline Major Product shall be considered as major product of Assessment year.
- The difference of Energy between Actual Cement production Vs Equivalent Cement production from Baseline year will be added in total energy in the assessment year after negating Clinker Export
- Notional Energy for Clinker produced due to Additive Change or Change in Clinker Factor will be deducted from total energy
- Baseline Clinker Factor shall be considered as Clinker Factor of Assessment year for making equivalent Cement i.e. the baseline clinker factor is to be divided after getting the actual cement (Cement produced will be multiplied by assessment year clinker factor) for making equivalent cement produced

- Notional Energy for Clinker produced due to Additive Change or Change in Clinker Factor will be deducted from total energy. Considering the assessment year's Clinker factor in the same year for converting into the equivalent product is a repetition and leading to duel benefit in terms of additive use. The actual production of PPC/PSC is being used for converting the Notional clinker production. Hence, for Product Mix Normalization, the major product and clinker factor was maintained same as of baseline year in the assessment year.
- If the OPC Clinker factor =0 in the baseline year, then the OPC Clinker factor of assessment year will be used in the baseline year otherwise, baseline year OPC Clinker Factor exist. The vice-versa is applicable in the assessment year
- If the PPC/PSC/Others production in the baseline year or assessment year=0, then PPC/PSC/Others clinker factor will become zero otherwise the existing Clinker factor of respective type of cement persist.

6.2.6 Product Mix Calculation

6.2.6.1 Normalisation for Product Mix-Grinding energy

The difference of grinding Energy between Actual Production Vs Equivalent Cement Production of Baseline and Assessment year will be subtracted in total energy in the assessment year considering Clinker Export also as per following equation

1. Notional Energy for Grinding (Million kcal) = $\{[(ECP_{BY} - RCP_{BY} - ECPExC_{BY}) \times CSPC_{BY} \times WHR_{BY}] - [(ECP_{AY} - RCP_{AY} - CPExC_{AY}) \times CSPC_{AY} \times WHR_{AY}]\}/10$

Where

ECP_{AY}= Equivalent Major Cement production in assessment year in Tons

RCP_{AY}= Reported cement production in assessment year in Tons

$CSPC_{AY}$= Electrical SEC of cement grinding (kWh/Ton of cement) for assessment year

WHR_{AY}= Weighted average CPP Heat/Grid Heat Rate (kcal/kWh) in the assessment year

ECP_{BY}= Equivalent Major Cement production in baseline year in Tons

RCP_{BY}= Reported cement production in baseline year in Tons

$CSPC_{BY}$= Electrical SEC of cement grinding (kWh/Tone of cement) for baseline year

WHR_{BY}= Weighted average CPP/Grid Heat Rate (kcal/kWh) for baseline year

$ECPExC_{AY}$= Equivalent major Cement production from Exported Clinker in assessment year in Tons

$ECPExC_{BY}$= Equivalent major Cement production from Exported Clinker in baseline year in Tons

6.2.6.2 Normalisation for Product Mix-Additives

The following formulae will be applied for calculating the Notional Energy for Clinker Produced due to change in Additives/ Clinker Factor. The notional energy corrections calculated will be subtracted from the total energy in the assessment year

(i) Notional Thermal Energy for Clinker Produced due to change in Additives/ Clinker Factor [Million kcal]= ClPcf x [KTHRAY x 1000+KSPCAY x WHRAY +]/10

ClPcf= Clinker produced due to change in Additives / Clinker Factor (Lakh Ton)

$KSPC_{AY}$=Kiln Specific Power Consumption (Electrical SEC up to Clinkerisation) (kwh/ton of Clinker) in the assessment year

WHR_{AY}= Weighted average CPP/Grid/DG

Heat Rate (kcal/kWh) in the assessment year

$KTHR_{AY}$ *=Thermal SEC of Clinker in the assessment year (kcal/kg of clinker)*

Where- ClPcf=ClPcf1+ClPcf2

(ii) *ClPcf1: Clinker produced due to change in Additives/Clinker Factor (Lakh Ton) for PPC* $=PPCPr_{AY} \times \{(OPCCF_{AY}-PPCCF_{AY})-(OPCCF_{BY}-PPCCF_{BY})\}$

$\boldsymbol{PPCPr_{AY}}$ *= PPC Production in the assessment year (lakh Ton)*

$\boldsymbol{OPCCF_{AY}}$ *= OPC Clinker factor in the assessment year*

$\boldsymbol{PPCCF_{AY}}$ *= PPC Clinker Factor in the assessment year*

$\boldsymbol{OPCCF_{BY}}$ *= OPC Clinker factor in the baseline year*

$\boldsymbol{PPCCF_{BY}}$ *= PPC Clinker Factor in the baseline year*

(iii) *ClPcf2: Clinker produced due to change in Additives/Clinker Factor (Lakh Ton) for PSC/Others* $=PSCOPr_{AY} \times \{(OPCCF_{AY}-PSCOCF_{AY})-(OPCCF_{BY}-PSCOCF_{BY})\}$

$PSCOPr_{AY}$ *= PSC/Others Production in the assessment year (lakh Ton)*

$OPCCF_{AY}$ *= OPC Clinker factor in the assessment year*

$PSCOCF_{AY}$ *= PSC/Others Clinker Factor in the assessment year*

$OPCCF_{BY}$ *= OPC Clinker factor in the baseline year*

$PSCOCF_{BY}$ *= PSC/Others Clinker Factor in the baseline year*

6.2.7 Documentation

- Fly Ash/Slag/Additives other than Gypsum-Purchase document
- Additives Stock and consumption documents [DPR,MPR, SAP data. Store Receipt etc]
- Blended Cement Sale- Excise Documents
- Lab Report of Cement Quality [PPC /PSC/ Others] to prove % additive in Blended Cement
- Cement production documents of Cement Mill [Ex-Log sheets, DPR. MPR, Lab Report/register/ SAP Data]

6.3 Power Mix

6.3.1 Baseline Year Methodology:

In GtG methodology, the heat rate of power source considered as per following factors

- Electricity Imported from grid
  @ 3208 kcal/kWh in cement sector
  [@ 860 kcal/kWh in other sector]
- CPP generated Electricity
  @ Actual CPP Heat Rate
- DG generated Electricity
  @ Actual DG Heat Rate
- Electricity Exported to grid
  @ 2717 kcal/kWh

6.3.2 Need for Normalization

Power Sources and Import: The ratio of electricity import/export may change in the assessment year w.r.t. the baseline year. In specific energy consumption calculation, the Electricity import from Grid is taken @3208 kcal/ kWh, whereas heat rate of self- generation could be in the range of 2200-4000 kcal/kWh. Hence, the heat rate of self-generated electricity impact 3-4 times than the Grid Electricity in SEC calculation

There is a possibility that a plant, by increasing the import from grid to meet plant's electricity demand can show savings because of decrease in its own captive power consumption, which has a higher heat rate.

Power Export: The heat rate of power export from Plant having CPP as one of the power source has been taken as 2717 kcal/kwh (national average heat rate of all power plants) in the baseline year, while the heat rate of self-generation from CPP stands at 3200-4000 kcal/kwh. Hence, the plant exporting power higher or lower in the assessment year w.r.t. the baseline year will gain or loss in terms of Energy Consumption in the plant.

Therefore, this advantage/disadvantage attracts Normalization Factors

6.3.3 Power Mix Normalization methodology

Power Sources and Import

- The baseline year power mix ratio will be maintained for Assessment year for Power Source and import
- The Normalised weighted heat rate calculated from the baseline year Power mix ratio will be compared with the assessment year Weighted Heat Rate and the Notional energy will be deducted from the Total energy assessed
- The Thermal Energy difference of electricity consumed in plant in baseline year and electricity consumed in plant during assessment year shall be subtracted from the total energy, considering the same % of power sources consumed in the baseline year.
- However, any efficiency increase (i.e. reduction in Heat Rate) in Assessment year in any of the power sources will give benefit to the plant

Power Sources and Export

- In case of Power export, the plant will be given disadvantage of advantage by comparing the assessment year heat rate of CPP with the baseline year heat rate of CPP and deduct the same by taking the heat rate of 2717 kcal/kwh
- CPP Actual Net Heat Rate will be considered for the net increase in the export electricity from the baseline.

6.3.4 Power Mix Normalization Calculation

6.3.4.1 Power Mix Normalization for Power Sources

Notional Energy to be subtracted from the total Energy of Plant in the assessment year for Power Mix Normalisation is calculated as

i. *Energy Correction for all power source in the assessment year [Million kcal]=* $TECPS_{AY} \times (A\text{-}WHR_{AY} - N\text{-}WHR_{AY})$

Where:-

$TECPS_{AY}$: Total energy consumption from all the Power sources (Grid, CPP, DGetc) for AY in Million kwh

$A\text{-}WHR_{AY}$: Actual Weighted Heat Rate for the Assessment Year in kcal/kwh

$N\text{-}WHR_{AY}$: Normalised Weighted Heat Rate for the Assessment Year in kcal/kwh

ii. *Normalised Weighted Heat Rate for Assessment year (kcal/kwh):*

$N\text{-}WHR_{AY} = A \times (D/G) + B \times (E/G) + C \times (F/G)$

Where

A: Grid Heat Rate for Assessment year (AY) in kcal/kwh

B: CPP Heat Rate for AY in kcal/kwh

C: DG Heat Rate for AY in kcal/kwh

D: Grid Energy consumption for Base Line Year (BY) in Million kwh

E: CPP Energy consumption for BY in Million kwh

F: DG Energy consumption for BY in Million kwh

G: Energy Consumed from all Power sources (Grid, CPP, DG) for BY in Million kwh

(Note: Any addition in the power source will attract the same fraction to be included in the above equation as $\boldsymbol{PSiHR_{AY} \times (PSiEC_{BY}/TEC_{BY})}$

$PSiHR_{AY}$*= Power Source (ith) Heat rate for AY in kcal/kwh*

$PSiEC_{BY}$*= Power Source (ith) Energy Consumption for BY in Million kwh*

TEC_{BY}*=Total Energy consumption for BY in Million kwh*

The Electricity Consumption from WHR is not being considered for Power Mix Normalization

6.3.4.2 Power Mix Normalization for Power Export

Net Heat Rate of CPP to be considered for export of Power from CPP instead of 2717 kCal/kWh

The Export power normalization:

- Actual CPP heat rate would be considered for the net increase in the export of power from the baseline.
- The exported Energy will be normalized in the assessment year as following calculation

(i)	**Energy to be subtracted in the assessment year in Million kcal:** $\boldsymbol{=(EXP_{AY}-EXP_{BY})*((GHR_{AY}/(1-APC_{AY}/100))-2717)}$

GHR_{AY}*: CPP Gross Heat Rate for AY in kcal/kwh*

EXP_{AY}*: Exported Electrical Energy in AY in Million kwh*

EXP_{BY}*: Exported Electrical Energy in BY in Million kwh*

APC_{AY}*: Auxiliary Power Consumption for AY in %*

6.3.5 Documentation

a. Electricity Bills from Grid

b. Energy generation Report from CPP/DG/WHR/CoGen

c. Power Export Bills from Grid and ABT meter reading

d. Fuel consumption Report [DPR, MPR, Lab Report]

e. Fuel GCV test report- Internal and external [As received or As fired basis as per baseline methodology]

6.4 Coal Quality for CPP

Coals are extremely heterogeneous, varying widely in their content and properties from country to country, mine to mine and even from seam to seam. The principle impurities are ash-forming minerals and sulphur. Some are interspersed through the coal seam; some are introduced by the mining process, and some principally organic sulphur, nitrogen and some minerals salts.

These impurities affect the properties of the coal and the combustion process, therefore the plant's boiler efficiency & Turbine Efficiency. The generating companies have no control over the quality of coal supplied. The raw coal mainly being supplied to the power stations could have variation in coal quality. Further, imported coal is also being used and blended with Indian coal by large number of stations, which could also lead to variations in coal quality.

The methodology should have provisions to take care of the impact of variations in coal quality. Therefore, average "Ash, Moisture, Hydrogen and GCV" contents in the coal during the baseline period as well as for assessment year is considered

for Normalization and the correction factor has been worked out based on the following boiler efficiency formula:

$$\text{Boiler Efficiency} = 92.5 - \frac{[50 * A + 630\,(M + 9\,H)]}{G.C.V}$$

Where:

A= Ash percentage in coal

M= Moisture percentage in coal

H= Hydrogen percentage in coal

G.C.V= Gross calorific value in kcal/kg

Station Heat Rate (Kcal/kWh) = Turbine Heat Rate/Boiler efficiency

6.4.1 Fuel Quality Normalization

- Change in coal GCV, moisture%, Ash% affect the properties of the coal and the combustion process, resulting in loss/ gain in the plant's boiler efficiency. To compensate for the change in efficiency of boiler with change in coal quality, the energy loss to be subtracted from the Total Energy consumption
- The plant/generating companies have no control over the quality of coal supplied, with Coal Linkage agreements.
- Further, variation in mix of imported coal with Indian coal could also lead to variations in coal quality. The normalisation factor shall take care of the impact of variations in coal quality
- The Coal quality have impact on Boiler Efficiency of a captive Power Plant, with decrease in coal quality the efficiency of boiler will also decrease and hence the gross heat rate of CPP will also decease as per above formulae

6.4.2 Pre-Requisite

- The Proximate and Ultimate analysis of coal for baseline should be available to compare the same in assessment year
- In case of unavailability of Ultimate analysis of coal in baseline year, the %H will be taken constant for baseline year as per assessment year data

6.4.3 Coal Quality Normalization Methodology

- The Boiler Efficiency will be calculated for the baseline as well as assessment year with the help of Coal analysis constituents like GCV, %Ash, %Moisture, %H and Boiler Efficiency Equation provided to calculate the Boiler efficiency.
- Hence, by keeping the Turbine heat rate constant for both the years, the CPP heat hate will be calculated for the respective year

6.4.4 Coal Quality Normalization Calculation

The Thermal Energy for the difference in heat rate of CPP will be deducted from the total energy consumption of the plant in the Assessment Year is calculated as

(i) Notional Thermal Energy to be deducted in the assessment year [Million kcal] = [CPP Heat Rate in AY (kcal/kwh)-Actual CPP Heat Rate in BY (kcal/kwh)] x CPP Generation in AY (Lakh kwh)/10

(ii) CPP Heat Rate in AY= CPP Heat Rate in BY x *(Boiler Efficiency in BY/Boiler Efficiency in AY)*

(iii) Boiler Efficiency in BY= 92.5-[{50xA+630 (M+9H)} /GCV] (Values are for baseline Year)

(iv) Boiler Efficiency in AY= 92.5-[{50xA+630 (M+9H)} /GCV] (Values are for assessment Year)

Where:

A: Ash in %

M= Moisture in %

H= Hydrogen in %

GCV: Coal Gross Calorific Value in kcal/kwh

AY = Assessment year

BY = Baseline Year

CPP= Captive Power Plant

THR=Turbine Heat Rate

6.4.5 Documentation

- Fuel Linkage Agreement
- Operating Coal Quality- Monthly average of the lots (As Fired Basis),Test Certificate for Coal Analysis including Proximate and Ultimate analysis (Sample Test from Government Lab for cross verification)
- Performance Guarantee Test (PG Test) or Report from Original Equipment Manufacturer (OEM)

  Design /PG test Boiler Efficiency documents

  Design/PG Test Turbine Heat Rate documents

6.4.6 Note on Proximate and Ultimate Analysis of Coal

If the ultimate analysis has not been carried out in the baseline year for getting H% result, following conversion formulae from Proximate to Ultimate analysis of coal could be used for getting elemental chemical constituents like %H

Relationship between Ultimate and Proximate analysis

$\%C = 0.97C + 0.7(VM+0.1A) - M(0.6-0.01M)$

$\%H2 = 0.036C + 0.086\ (VM - 0.1xA) - 0.0035M2(1-0.02M)$

$\%N2 = 2.10 - 0.020\ VM$

Where

C= % of fixed carbon

A=% of ash

VM=% of volatile matter

M=% of moisture

6.5 Petcoke Utilisation in Kiln

Petcoke is a by-product obtained during refining of heavy crude oil. Petcoke is characterised as a high grade fuel with high calorific value of more than 8000 Kcal per kg, having low ash content and low volatile matter but high sulphur content, up to 7 per cent.

Petcoke provides scope for manufacturing higher grade of cement with the same raw material or same grade of cement using marginal and low grade limestone contributing to resource conservation. Due to higher calorific value compared to coal, less quantity of petcoke needs to be moved from source to plant site, which reduces the cost of transport. However, as the sulphur content in petcoke is high, its larger use increases the sulphur cycle and aggravates build-up formation in the kiln system.

6.5.1 Need for Normalization

1. Change from Petcoke to Coal or Coal to Petcoke
2. There is a need for changes in raw mix design, fineness of fuel, modifications in burner, calciner and cooler so that a trouble-free and cost effective operation is achieved. With several disadvantages of use of PetCoke in Cement kiln like
   - Difficult to burn
   - Hard to grind
   - High Sulphur Content
   - Can have high metal content

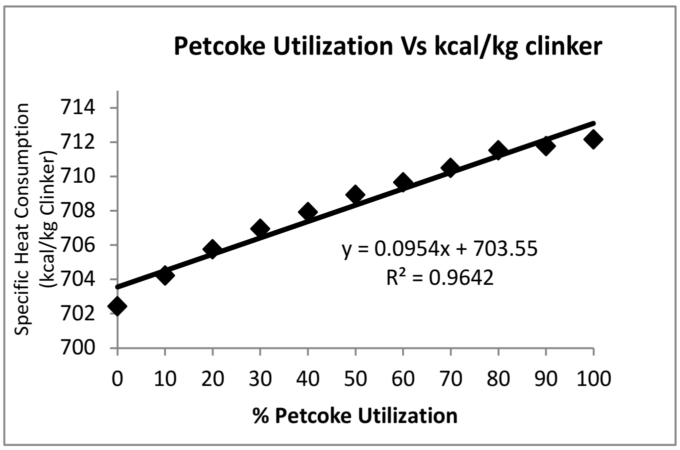
   The loss of heat rate and high specific power consumption has been observed with the increasing use of Petcoke after blending with coal. All the above disadvantages is being covered by low price, easy availability and resource conservation as compared to coal

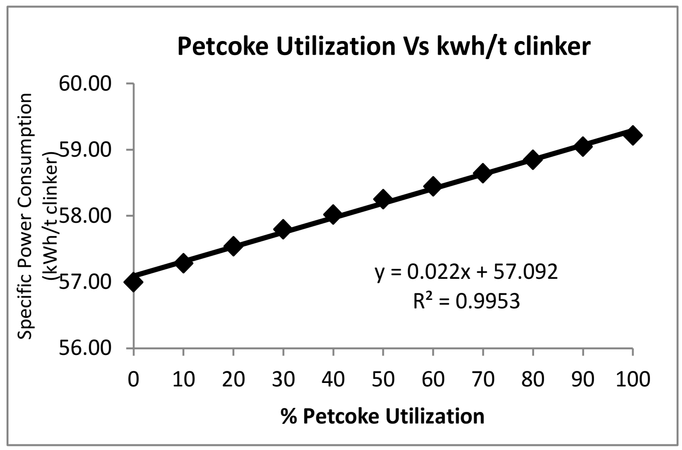
6.5.2 Normalization Methodology

1. Normalization factor for %age PETCOKE usage in cement kilns
2. To compensate for the change in heat rate due to variation in usage of Petcoke in the kiln from the baseline
3. Kiln Heat Rate Normalization for higher or Lower % of PetCoke Consumption in Assessment year w.r.t. Baseline Year
4. The normalisation will be used for Kiln heat rate and kiln Specific Power Consumption (SPC)

6.5.3 Normalization Calculation

1. A graph is plotted between heat rate of kiln, Specific Power Consumption and % use of Petcoke from different plant of different capacity to arrive a linear equation
2. The linear equation generated from the graph will then be computed for baseline as well as for assessment year in terms of Energy loss in Kiln heat rate and Specific Power Consumption





3. The output of curve is an equation and having following relationship w.r.t. kiln heat rate and Kiln SPC w.r.t. % use of Pet coke in kiln

   Normalization factor for %age PETCOKE usage in cement kilns is to compensate for the change in heat rate and Electrical SEC (specific power consumption) due to variation in usage of Petcoke in the kiln from the baseline.

   Kiln Heat Rate & Electrical SEC Normalization for higher or lower % of PetCoke Consumption will take place in Assessment year w.r.t. Baseline Year.

   The normalization will be used for Kiln heat rate and kiln Specific Power Consumption (SPC) is calculated as per following equation

i. Notional Thermal Energy to be deducted in the assessment year due to % use of Petcoke consumption in the kiln [Million kcal] = ($N\text{-}KHR_{AY}$ - KHR_{BY}) x Total Clinker Production in Lakh Tons x 100 + ($N\text{-}KSPC_{AY}$-$KSPC_{BY}$)) x Total Clinker Production in Lakh Tons x WHR_{AY} /10

6.5.3.1 Normalization Calculation for Kiln Heat Rate

i. Normalized Kiln Heat rate with Petcoke consumption in assessment year [kcal/kg of clinker] $N\text{-}KHR_{AY}=KHR_{BY} + 0.0954 \times (\%\ PC\ Cons_{AY} - \%\ PC\ Cons_{BY})$

$N\text{-}KHR_{AY}$=Normalized Kiln Heat rate with effect of Petcoke consumption in assessment year in kcal/kg of clinker

KHR_{BY}=Total Thermal Energy consumed in kiln/Clinker Production in kg, kcal/kg of clinker in the baseline year

PC $Cons_{AY}$=Petro-coke Consumption in assessment year in %

PC $Cons_{BY}$=Petro-coke Consumption in baseline year in %

AY = Assessment year

BY = Baseline Year

TPH= Tons per hour

WHR_{AY}= Weighted Heat Rate in assessment year

6.5.3.2 Normalization Calculation for Electrical SEC (Specific Power Consumption)

i. Normalized Electrical SEC upto clinkering in assessment year [kwh/ton of clinker] $N\text{-}KSPC_{AY} = KSPC_{BY} + 0.022 \times (\%\ PC\ Cons_{AY} - \%\ PC\ ConsBY)$

$N\text{-}KSPC_{AY}$ = Normalised Kiln Specific Power Consumption with effect of Petcoke consumption up to clinkerisation in the assessment year in kwh/ton of clinker

$KSPC_{BY}$=Kiln Specific Power Consumption up to clinkerisation in the baseline year in kwh/ton of clinker

PC $Cons_{AY}$=Petro-coke Consumption in assessment year in %

PC $Cons_{BY}$=Petro-coke Consumption in baseline year in %

AY = Assessment year

BY = Baseline Year

6.5.4 Documentation

- Production Report with documents [Ex: Log sheets / SAP /Lab Report DPR/MPR etc]
- Fuel Consumption (Pet Coke and Coal) Documents [Store receipt/DPR]

6.6 Low PLF compensation in CPP

6.6.1 Need for Normalization

Owing to fuel non- availability, Grid disturbance, Plant load unavailability due to external factor etc, plant forced to reduce the load on turbine leading to low efficiency of units and Station. Due to decreased loading, the Plant load Factor (PLF) will be worsened and affects the unit heat rate. The comparison between baseline year and assessment year will be carried out through characteristics curve of Load Vs Heat rate for correction factor. The increased PLF in the assessment year as compared to baseline year will not be normalized back to the baseline year PLF.

Hence, Normalization is required to compensate for the change in heat rate of CPP due to variation in PLF from the baseline.

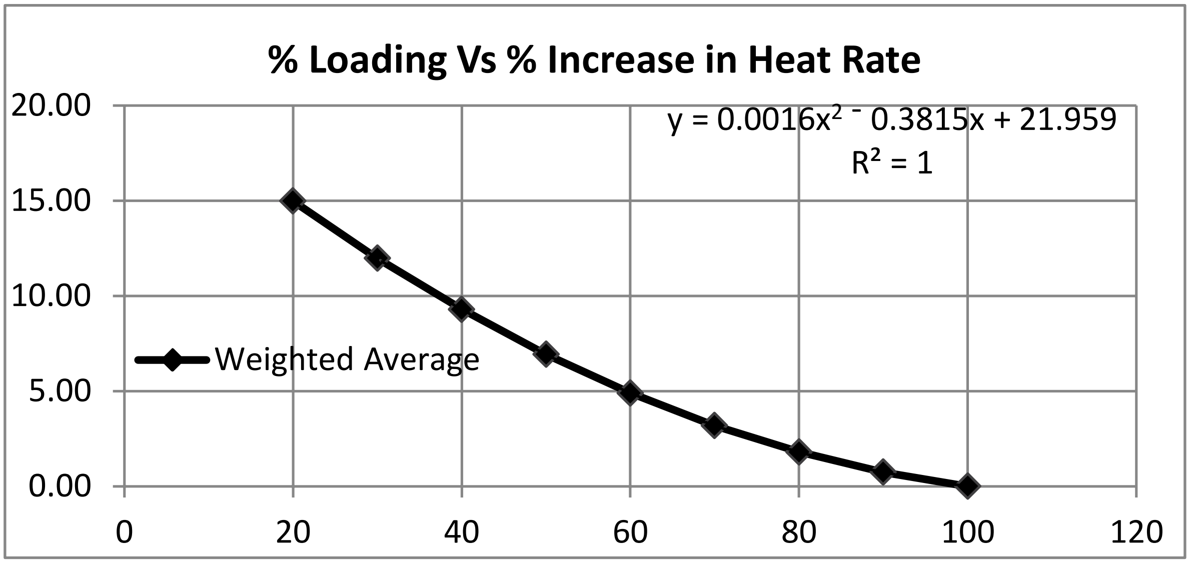
6.6.2 Normalization Methodology

The Heat Mass Balance Diagram (HMBD) of low capacity Power Plant in the range of 20-25 MW installed in Cement Sector have be analyzed at different load

The curve was put into the Ebsilon software and Plant model has been developed for nosof Power plants under study to verify the varying nature of Turbine Heat Rate w.r.t. Loading condition

The graph was plotted after getting the weighted average of % decrease in loading Vs % increase in heat rate

6.6.3 Normalization Calculation



Equation: % Increase in Heat Rate due to decrease in Loading=

=0.0016 x(%Loading)^2-0.3815 x %Loading +21.959

Normalization is required to compensate for the change in heat rate of CPP due to variation in PLF from the baseline.

The Thermal Energy reduction due to low PLF in CPP is calculated as below:-

(i)	Notional Thermal Energy deducted in the assessment year from the total energy consumption of the plant [Million kcal] = Gross Generation in Lakh kwh x [Actual Gross Heat Rate in AY (kcal/kwh)-Normalised Gross Heat Rate in AY (kcal/kwh)]

(ii)	Normalised Gross Heat Rate in AY [kcal/kwh]= Actual Gross Heat Rate in AY (kcal/kwh) x (1- % Decrease on % increase in Heat Rate from baseline in AY due to external factor)/100]

(iii)	% Decrease on % increase in Heat Rate from baseline in AY due to external factor [%]= [% Increase in Heat Rate in AY - % Increase in Heat Rate in BY] x % Decrease in PLF in Assessment Year due to external factor in %

(iv)	%Increase in Heat Rate at PLF of Baseline Year = =0.0016 x(%Loading BY)^2-0.3815 x %Loading $_{BY}$ +21.959

(v)	%Increase in the Heat Rate at PLF of Assessment Year = =0.0016 x(%Loading AY)^2-0.3815 x %Loading$_{AY}$+21.959

Where

AY: Assessment Year

BY= Baseline Year

%Loading $_{BY}$ = Percentage Loading (PLF) in Baseline Year

%Loading $_{AY}$ = Percentage Loading (PLF) in Assessment Year

6.7 Normalization others

6.7.1 Environmental concern (Additional Environmental Equipment requirement due to major change in government policy on Environment)

6.7.1.1 Need for Normalization

Change in Government policy on Environment Standard can take place after baseline year

leading to the installation of additional equipment by Designated Consumers. The factor is not controlled by plant and termed as external factor. The additional equipment consumes thermal as well as electrical energy and directly or indirectly not contributing to the energy efficiency of the plant.

Hence, the additional equipment installation will be a disadvantageous proposition for the plant and affect the GtG Energy consumption of the plant, which in-turn increases the SEC of the Plant. This needs to be normalized with respect to the baseline year.

6.7.1.2 Methodology

The Normalization takes place in the assessment year for additional Equipment's Energy Consumption only if there is major change in government policy on Environment Standard.

- The Energy will be recorded for additional installation through separate Energy meter for the assessment year of from the date of commissioning in the assessment year.
- If separate energy meter installation is not possible due to installation of the equipment such as Additional Field in the ESP or additional bags in the Bag House/ Dust Collector in the existing one, then 80% of rated capacity will be converted in to Energy for Normalization.
- Any additional equipment installed to come back within the Environmental standards as applicable in the baseline, will not qualify for this Normalization i.e., If any Plant after the baseline year has deviated from the Environmental Standards imposed in the baseline year and additional equipment are being installed after the baseline to come back within the Standards, then the plant is not liable to get the Normalization in this regard.
- The Energy will be normalised for additional Energy consumption details from Energy meters. This is to be excluded from the input energy.

6.7.1.3 Normalisation Calculation

The Energy is to be excluded from the input energy as calculated below

(i)	Notional Thermal Energy to be deducted in the assessment year due to Environmental Concern [Million kcal] = Additional Electrical Energy Consumed (Lakh kwh) x Weighted Heat Rate (kcal/kwh)/10+ Additional Thermal Energy Consumed (Million kcal)

6.7.1.4 Documentation

- Energy Meter Reading records for each additional equipment
- OEM document for Energy Capacity
- Equipment Rating plate
- DPR/MPR/Log Sheet/EMS record

6.7.2 Unavailability of Bio-mass/Alternate Fuel w.r.t baseline year

6.7.2.1 Need for Normalization

The Plant could have used high amount of Biomass or Alternate Fuel in the process to reduce the usage of fossil fuel in Kiln in the baseline year. By using Biomass or Alternate Fuel the Energy consumption of the plant has come down, since the energy for biomass or alternate fuel were not included as Input Energy to the Plant.

The Biomass availability in the assessment year may decrease and in turn the plant is compelled to use Fossil fuel. Hence, the energy consumption of the plant may go up in the assessment year resulted into higher SEC. Normalization will take place if unavailability

of Biomass or Alternate Fuel is influenced by the external factor not controlled by the Plant.

The external factor for unavailability of Biomass may be Flood, Draught in the region and external factor for Alternate Fuel may be Environmental concern in the region.

6.7.2.2 Methodology

The normalization for Unavailability for Biomass or Alternate Fuel takes place only if sufficient evidence in-terms of authentic document is produced

- Plant to furnish the data replacement of fossil fuel from Biomass/ Alternate Fuel (Solid/Liquid) in the assessment year w.r.t. baseline year.
- The energy contained by the fossil fuel replacement will be deducted in the assessment year

6.7.2.3 Normalisation Calculation

The normalization for Unavailability for Biomass or Alternate Fuel is applied in the baseline year. The energy contained by the fossil fuel replacement will be deducted in the assessment year

i. Notional Thermal Energy to be deducted in the assessment year due to Biomass/Alternate Fuel Unavailability [Million kcal]= FFB_{AY} $GCVB_{BY}$ /1000 + $FFSA_{AY}$ x $GCVSA_{BY}$ /1000 + $FFLA_{AY}$ x $GCVLA_{BY}$/1000

Where

FFB_{AY}= Biomass replacement with Fossil fuel due to un-availability used in the process in Assessment Year (Tons)

$GCVB_{BY}$: Gross Calorific Value of Biomass in Baseline Year (kcal/kg)

$FFSA_{AY}$= Solid Alternate Fuel replacement with Fossil fuel due to un-availability used in the process in Assessment Year (Tons)

$GCVSA_{BY}$: Gross Calorific Value of Solid Alternate Fuel in Baseline Year (kcal/kg)

$FFLA_{AY}$= Liquid Alternate Fuel replacement with Fossil fuel due to un-availability used in the process in Assessment Year (Tons)

$GCVLA_{BY}$: Gross Calorific Value of Biomass in Baseline Year (kcal/kg)

6.7.2.4 Documents

- Authentic Document in relation to Bio-Mass/Alternate Solid Fuel/Alternate Liquid Fuel availability in the region.
- Test Certificate of Bio-mass from Government Accredited Lab for GCV in Baseline and assessment year
- Test Certificate of replaced Fossil Fuel GCV

6.7.3 Construction Phase or Project Activities

6.7.3.1 Need for Normalization

The energy consumed during construction phase or project activities are non-productive energy and hence will be subtracted in the assessment year.

6.7.3.2 Methodology

- The list of equipment with Thermal and Electrical Energy Consumption details need to be maintained for Normalization in the assessment year.
- The energy consumed by the equipment till commissioning will also be deducted in the assessment year

6.7.3.3 Normalsiation Calculation

The energy consumed by the equipment during construction phase or project activities till commissioning will be deducted in the assessment year

i. **Notional Thermal Energy to be deducted in the assessment year due to Construction Phase or Project Activities [Million kcal]=** Electrical Energy Consumed due to commissioning of Equipment (Lakh kwh) x Weighted Heat Rate (kcal/kwh)/10+ Thermal Energy Consumed due to commissioning of Equipment (Million kcal)

6.7.3.4 Documents

- Energy Meter Readings of each project activity with list of equipment installed under each activity from 1st Apr to 31st March
- Solid/Liquid/Gaseous Fuel consumption of each project activity with list of equipment under each activity installed from 1st Apr to 31st March

6.7.4 Addition of New Line/Unit

6.7.4.1 Need for Normalization

Due to the gate to Gate concept for Specific Energy consumption, the input energy and production needs to be considered for new line/unit if it commissions in the same plant boundary. However, due to the stabilization period of a new line under commissioning, the energy consumption is very high with respect to the production/generation. Hence, following methodology will follow

In case a DC commissions a new line/production unit before or during the assessment/target year, the production and energy consumption of new unit will be considered in the total plant energy consumption and production volumes once the Capacity Utilisation of that line has touched / increased over 70%. However, the energy consumption and production volume will not be included till it attains 70% of Capacity Utilisation. Energy consumed and production made (if any) during any project activity during the assessment year, needs to be exclusively monitored and will be subtracted from the total energy and production in the Assessment year. Similarly, the same methodology is applied on a new unit installation for power generation (CPP) within the plant boundary.

6.7.4.2 Methodology

- The Capacity Utilisation will be evaluated based on the OEM document on Rated Capacity or Name plate rating on capacity of New Line/ Production Unit and the production of that line/unit as per DPR/ Logsheet.
- The Electrical and thermal energy will be recorded separately for the new line
- The production/generation will have to be recorded separately
- The date of reaching production or generation level at 70% of Capacity Utilisation will have to be monitored
- The Production/generation and Energy consumed will be deducted from the total energy of the assessment year

6.7.4.3 Normalisation Calculation

The Energy reduction will take place in the assessment year for addition of new line/unit normalization as per following calculation

i) Thermal Energy Consumed due to commissioning of New process Line/ Unit till it attains 70% of Capacity Utilization to be subtracted in assessment year (Million kcal) = (Electrical Energy Consumed due to commissioning of New process Line/Unit till it attains 70% of Capacity Utilization (Lakh kWh) x Weighted Average Heat rate in AY (kcal/ kwh)/10) + Thermal Energy Consumed due to commissioning of New Process Line/Unit till it attains 70% of Capacity Utilization (Million kcal)