NORMALIZATION DOCUMENT AND MONITORING & VERIFICATION GUIDELINES

PAT SCHEME
PERFORM, ACHIEVE, TRADE

Pulp and Paper Sector

सत्यमेव जयते

MINISTRY OF POWER
GOVERNMENT OF INDIA

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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 ESCerts.

Pulp & Paper sector is one of the 8 notified energy intensive sectors under which a total of 31 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 0.119 million tons of oil equivalent annually by the end of PAT cycle –I.

The publication of **"Normalization Document and M&V Guidelines" for Pulp & Paper 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 Pulp & Paper Sector, chaired by Director, Central Pulp & Paper Research Institute, Shri S.K Khandare, Energy Economist, BEE, Shri Arijit Sengupta, Asst. Energy Economist, BEE, Shri Ishan Jain, Project Engineer, BEE and Dr. B.P Thapliyal, Sector Expert, 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.	Shri Surajit Ray	Ex – Vice President JK Papers Ltd.	Member
4.	Shri R Narayana Moorthy	Secretary General Indian Paper Manufacturers Association	Member
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13.	Shri A K Asthana	Senior Technical Expert, GIZ
14.	Shri Vikas Ranjan	Technical Expert, GIZ

2.   Introduction

The Indian Paper Industry accounts for about 1.6% of the world's production of paper and paperboard. There are over 650 paper mills in the country producing different types of paper using various raw materials. The consumption of different grades of paper has been growing in line with the country's GDP growth. However, the raw material base has been changing significantly over the years. The input consumption in paper and pulp industry is high and the output low compared to other industries like cement, for example. The input-output ratio is 8:1. The quantum of these inputs varies from raw material to raw material and has a direct bearing on the overall efficiency of the paper industry. There is wide variation in the quantity of major inputs is in Indian mills. The power consumption varies between 1200kWh and 1700 kWh, steam from 10 tonne to 16 tonne, coal 1.5-3.0 tonne, water 60-125 m3, and cooking chemicals 60-400 kg/t paper.

Though the best raw material for pulp and paper manufacturing is derived from soft woods and some of the hard wood species, the Indian pulp and paper industry depends on bamboo and mixed hardwood. This helps conserve the dwindling forest resources. The industry also uses alternative raw material to a large extent along with the farm plantations. Fibrous raw material is the single largest component influencing the manufacturing cost of paper. Any perceptible increase in the cost of fibre from these raw materials has a considerable impact on the manufacturing cost.

For sustained supply of raw materials, the industry has to use renewable sources to the maximum extent. The fibre resources used by the Indian pulp and paper industry come from three sources:

Forests
Forests based raw materials include bamboo and mixed hardwoods from forest felling, and eucalyptus wood from plantations (both organised plantations and farmers' fields/agro forestry plots).

Agricultural residues
This includes bagasse, rice and wheat straws and cotton stalks.

Waste paper
This includes domestic and imported waste paper.

3. Overview of Manufacturing Process

Pulp and paper are manufactured from raw materials containing cellulose fibres, generally wood, recycled paper, and agricultural residues. The main steps in pulp and paper manufacturing are: Raw material preparation and handling, pulp manufacturing, pulp washing and screening, chemical recovery, bleaching, stock preparation, and papermaking. Pulp mills and paper mills may exist separately or as integrated operations.

An integrated mill is one that conducts pulp manufacturing on site. Non-integrated mills have no capacity for pulping but must bring pulp to the mill from an outside source. Integrated mills have the advantage of using common auxiliary systems for both pulping and papermaking such as steam, electric generation, and wastewater treatment. Transportation cost is also reduced.

A paper mill can house a single paper machine or several machines; each machine can make a single grade of paper or a variety of papers. A dedicated machine usually manufactures a commodity grade paper such as liner board or tissue. Machines designed to make specialty grades typically have more operating flexibility and will manufacture many types of paper. The basic process of paper making remains the same despite the type of paper manufactured or the size of the machine.

Step 1 - Wood preparation

The bark is removed from in-coming logs, and these are then chipped. Sometimes, the wood arrives at the plant already chipped, meaning that this step is unnecessary.

Step 2 - Cooking

The wood chips are heated in a solution of sodium hydroxide (NaOH) and sodium sulphide (Na2S) in a pressure cooker, during which time a lot of the lignin (the reinforcing susbstance that make tree cells wood hard and 'woody' rather than soft like those of other plants) is removed from the wood. The pressure is then released suddenly, causing the chips to fly apart into fibres.

Step 3 - Pulp washing

The pulp is washed with water to wash out the cooking chemicals and lignin from the fibre so that they will not interfere with later process steps.

Step 4 - Pulp screening

A sieve is used to remove from the pulp knots and uncooked fibres clumped together.

Step 5 - Bleaching

This is done in two stages. First, the pulp is treated with NaOH in the presence of oxygen (O2). The NaOH removes hydrogen ions from the lignin and then the O2 breaks down the polymer. The pulp is then treated with chlorine dioxide (ClO2), a mixture of NaOH, O2 and peroxide and finally with ClO2 again to remove the remaining lignin.

Step 6 - Paper making

The fibres are mechanically treated to make them bond well (strengthening the paper), chemicals added to provide special properties such as colour or water resistance, and then the water is squeezed out and the pulp rolled smooth and dried.

Various ancillary processes result in the recovery of calcium oxide (CaO), NaOH and Na2S, the major chemicals used in the process. Various utilities ensure that such conditions as sufficient reaction times and adequate mixing are met.

3.1 Process Flow Diagram
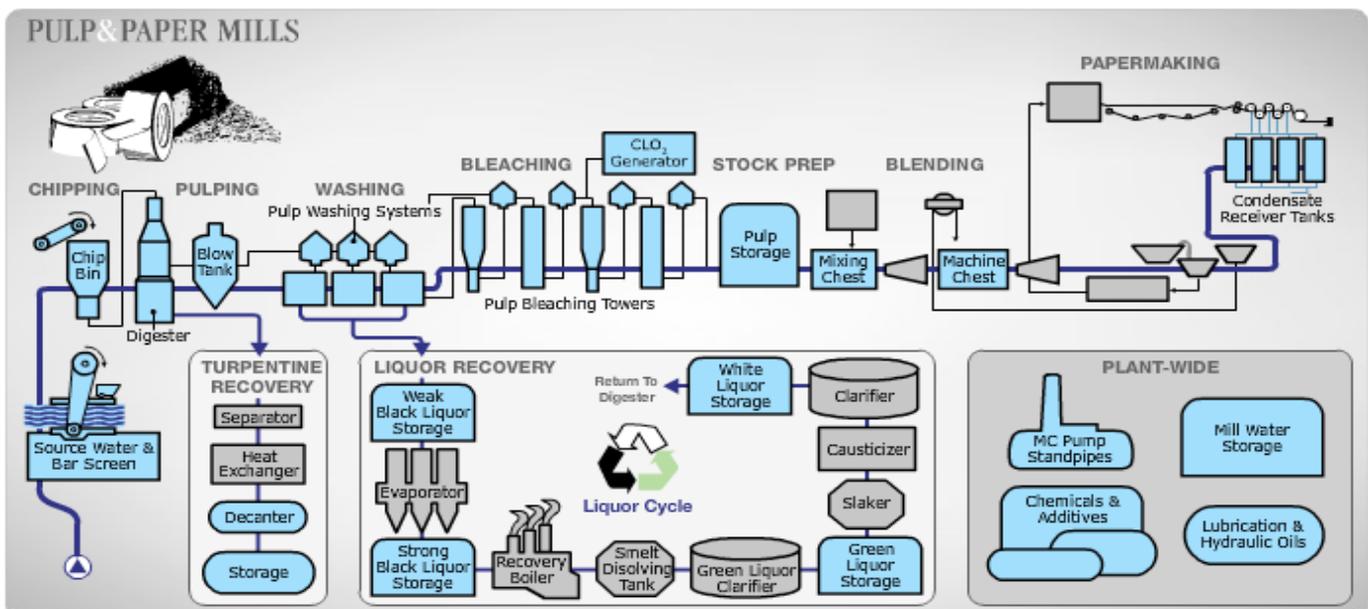
4. Perform, Achieve and Trade (PAT)

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 Rs 6,800 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.

5. Indian Paper Industry and PAT

The present PAT cycle has 31 of India's 653 paper and pulp units. The threshold limit of 30,000 tonnes of oil equivalent (toe) has been defined as the cut-off limit criterion for any unit to be identified as designated consumer (DC).

The pulp & paper sector has been categorised on the basis of raw material usage:

1. Wood based units (17 units)

2. Agro based units (6 units)

3. Recycled fibre based units (7 units)

4. 100% market based pulp (1 unit)

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                    ┌─────────────────────┐
                    │  Pulp & Paper Sector │
                    │     (31 DCs)         │
                    └─────────────────────┘
          ┌──────────────┬──────────────┴──────────┬──────────────┐
          ▼              ▼                          ▼              ▼
┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ Wood based   │ │ Agro based   │ │ Recycled     │ │ 100% market  │
│ units        │ │ units        │ │ fiber        │ │ based pulp   │
│ (17 units)   │ │ (6 units)    │ │ based units  │ │ (1 unit)     │
│              │ │              │ │ (7 units)    │ │              │
└──────────────┘ └──────────────┘ └──────────────┘ └──────────────┘
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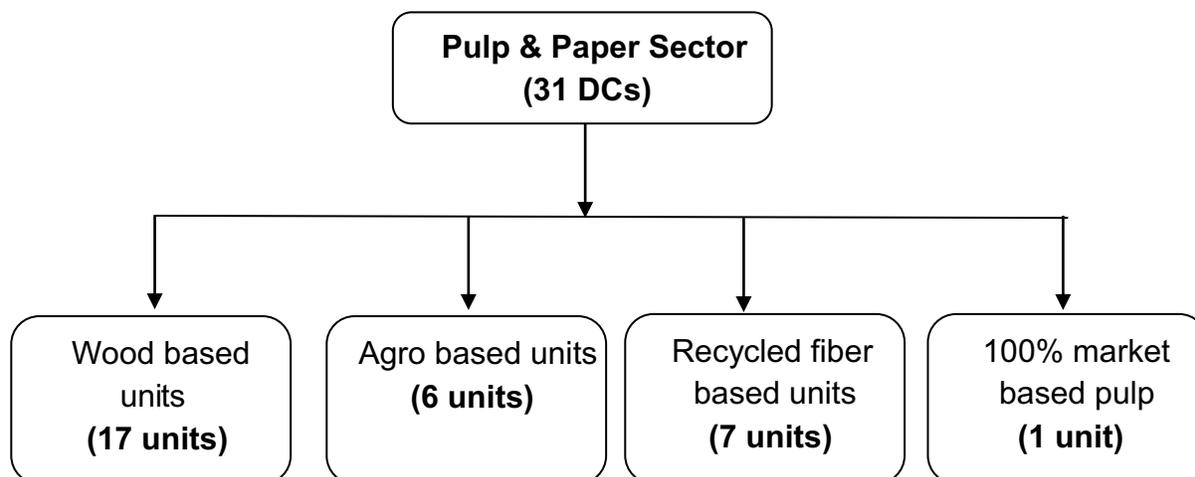
The total energy consumption of these designated consumers is about 2.09 million tonne of oil equivalent (mtoe). By the end of the first PAT cycle, the energy savings of 0.119 mtoe /year is expected to be achieved, which is around 1.77% of total national energy saving targets assessed under PAT.

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	Fertiliser	29	8.20	4.97%	0.478
6	Paper & Pulp	31	2.09	1.77%	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**

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

Owing to inherent 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.

6.1 General rule for establishing Baseline

Baseline Production (Pbase): Avg. of 2007-8, 2008-9 & 2009-10

Baseline SEC (SECbase): Avg. of 2007-8, 2008-9 & 2009-10

Baseline CU% (CUbase): Avg. of 2007-8, 2008-9 & 2009-10

Target SEC (SECtarget): SEC as estimated in 2014-15

Estimation of Energy Saving (mtoe): Pbase (SECbase – SECtarget)

Specific Energy Consumption and Targets- Pulp & Paper

6.2 Target Setting

- The sectoral target for pulp and paper 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 paper and pulp 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.
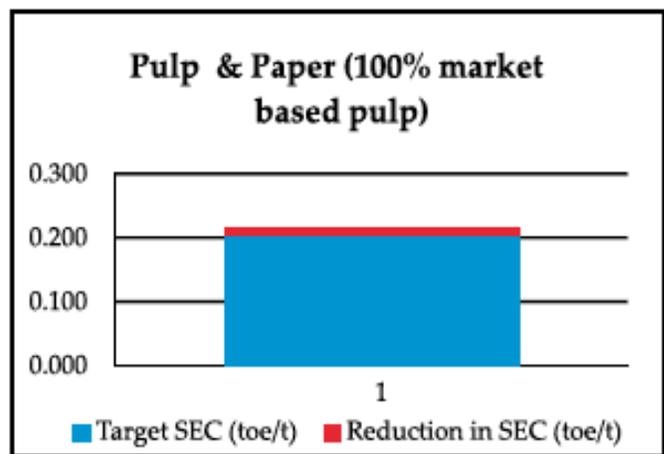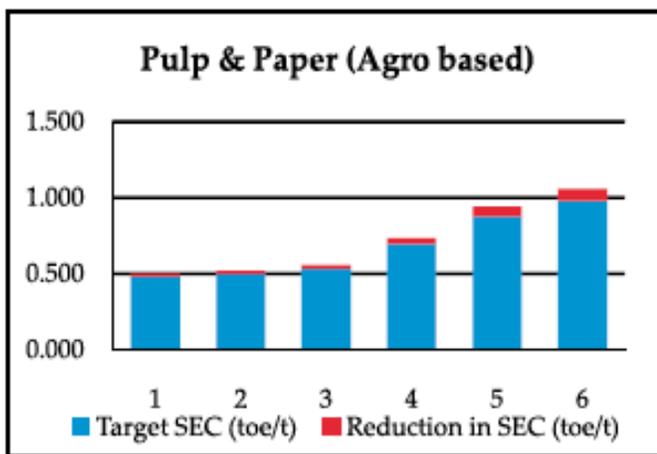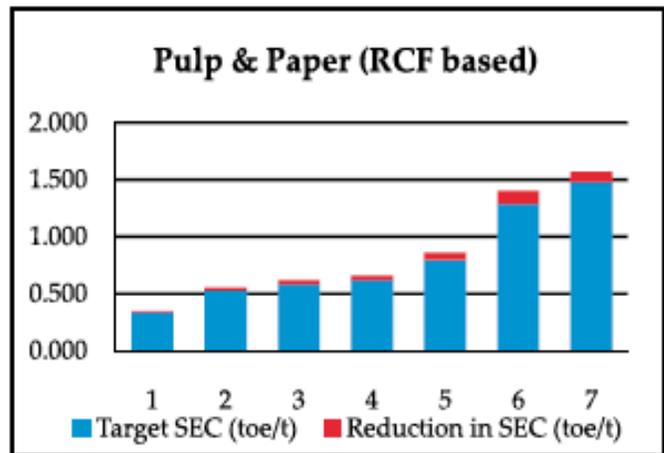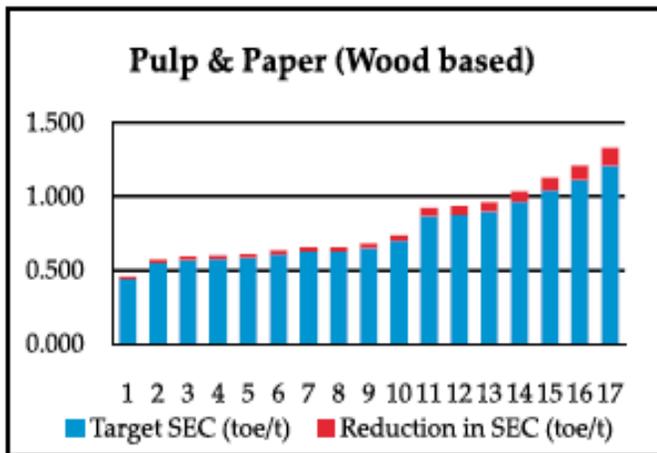
6.3 Methodology for Baseline and Energy Performance Index (EPI)

7. Normalisation

The Indian Paper industry produces diverse products using diverse raw materials and processes. Based on the process used for manufacture and their usage, paper products can be categorised into following broad categories.

Category	Purpose	Example
Cultural paper	information and literary purposes	writing Printing paper, fine paper (copier paper) etc
Packaging paper and paperboard	Commercial (packaging), industrial and constructional use	paperboard and cardboard, kraftliner, sack paper etc.
Speciality paper	Personal or sanitary purposes	tissue paper, cigarette paper, lables, glassine etc.
Newsprint	Communication	Newsprint

Normalization factors for the following factors have been developed in Pulp & Paper sector, which will ultimately affect the gate to gate specific energy consumption in the Assessment year. A broad categorization of the factors is as under:

1. **Equivalent Products.**

2. **Intermediary Products.**

3. **Fuel quality in CPP and Cogen.**

4. **Power Mix** (Imported & Exported from/ to the grid and self-generation from the captive power plant).

5. **Others**

   5.1 **Environmental concern** (Additional Environmental Equipment requirement due to major changes in government policy on Environment)

   5.2 **Biomass/Alternate Fuel Unavailability**

   5.3 **Construction Phase or Project Activity Phase**

   5.4 **Unforeseen circumstances**

   5.5 **Thermal Energy used in Waste heat recovery**

   5.6 **Renewable Energy Certificate Normalization**

The Normalization will also take place on some unavoidable circumstances in the Assessment year as compared to the Baseline year with proposed authentic base documents.

7.1 Normalisation of Equivalent Product (Pulp)

7.1.1 Need for Normalisation of Equivalent Product

The Pulp and paper mills produce different varieties of the paper and paper board by using the wood, agro and/or recycled fibre pulps as well as by using their different ratios. This results in variation of the products. However, another reason for the variation in the product furnish is due to addition of the fillers and some paper additives/chemicals, which increase the ash load in paper without affecting its quality parameters. It results in saving of expensive fiber resources. The pulp produced by some mills is also exported as saleable pulp after drying it in wet lap machine.

For change in the Products mix in Assessment year with respect to Baseline year, there is a need to develop and execute Normalization factors in a proper manner, 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.

Apart from the in-house production of pulp (for making paper and for export as saleable pulp),

mills also import softwood and hardwood pulps to impart certain properties in the paper products. Therefore in case of a pulp and paper mill, as the pulp can be either imported or exported, which is an intermediary product and not the final product, there may be variation in their quantities in the Assessment year to the Baseline years.

For different varieties of the paper, paper board, specialty paper and newsprint as well as the partially processed products (Intermediary Product), i.e., purchased pulp, imported by the plant (for which part of the manufacturing energy is not used by the plant) and exported pulp from the plant (for which energy has been used but it is not taken into account in the final product), different approaches are required to normalise the variations in their products mix during the Assessment year.

i. If major product changed in the Assessment year from baseline in Pulp making

Case 1:- Wood based pulp to Agro based pulp or Vice-versa

Case 2:-Wood based pulp to RCF based pulp or Vice-versa

Case 3:- Agro based pulp to RCF based pulp or Vice-versa ………………

ii. If major product changed in Assessment Year from baseline year in the Paper making

Case 1:- Writing printing to Specialty or Vice-versa

Case 2:-Writing Printing to Board and Kraft paper or Vice-versa

Case 3:- News print to Specialty or Vice-versa …………………………………

> **All the above changes with respect to the Baseline Year attracts Normalisation, hence the major product of the baseline year has to be kept same in the assessment year**

In case of the product mix it is necessary to convert different types of paper products and exported pulp to be converted in to equivalent major product produced by that plant in the baseline year. Where as in case of import and export of the pulp, as an intermediary product, proper energy accounting (addition or subtraction) is required to compensate the energy. The approach for normalisation of import and export of the pulp and the variation in product quality is discussed below.

7.1.2 Baseline Year Methodology:

The Pulp and Paper mills are different in terms of raw material use, process layouts and product mix based on furnish like pulps used in different blending ratios and the additives such as fillers etc. Some integrated paper mills having excess pulp production capacity, also export pulp as a product apart from the main product, paper, paper board, newsprint, specialty papers etc. Hence, different types of paper products and exported pulp are required to be converted in to equivalent major product produced by that plant with the help of conversion factors. The conversion factors should be based on the data reported by the concerned plant. The products therefore are;

- Exported pulp

- Cultural papers mainly defined as writing printing paper (WPP) and value added coated (chromo and art) papers.

- Packaging paper and paperboard covering the broad sub-categories like paperboard, cardboard, kraftliner, sack paper etc.

- Speciality papers defined as tissue paper, cigarette paper, lables, glassinepaper etc.

- Newsprint.

The mills also import pulp, as purchased softwood and hardwood pulps, and are mixed in a well-defined ratio for product quality. Since in case of imported pulp energy input is not

required for manufacture, therefore any change in its quantity can also affect the specific energy consumption in final paper products.

The baseline year methodology therefore needs to consider the energy inputs in all forms of intermediate and final products in the Baseline year and have relative comparison in the Assessment year, to compensate the effect of changes in the factors which may affect energy consumption.

7.1.3 Normalisation for Equivalent Pulp Product

To find out the Normalisation factor for saleable pulp, it is necessary to determine the specific energy consumption (SEC) for production of pulp from different raw materials, such as wood, agro residues and the recycled fiber. After determination of the SEC for pulp production, the equivalent pulp product may be calculated. Therefore the calculation of the equivalent pulp product is determined in two steps as below.

- Calculation of stocks of exported/ imported pulp
- Calculation of its quantities.
- Calculation of Specific Energy Consumption for production of pulp from wood, agro residues and RCF in the Baseline year and the Assessment year.
- Calculation for pulp as equivalent product in the Baseline and Assessment year.

7.1.3.1 Methodology for Out put Products

- The Specific Energy Consumption (SEC) should be known for each product
- The methodology will be used for Parallel and Series line production
- One major product to be chosen among the products for parallel line production, the product which is sold out will be included after conversion into the equivalent product
- For Series production major product is
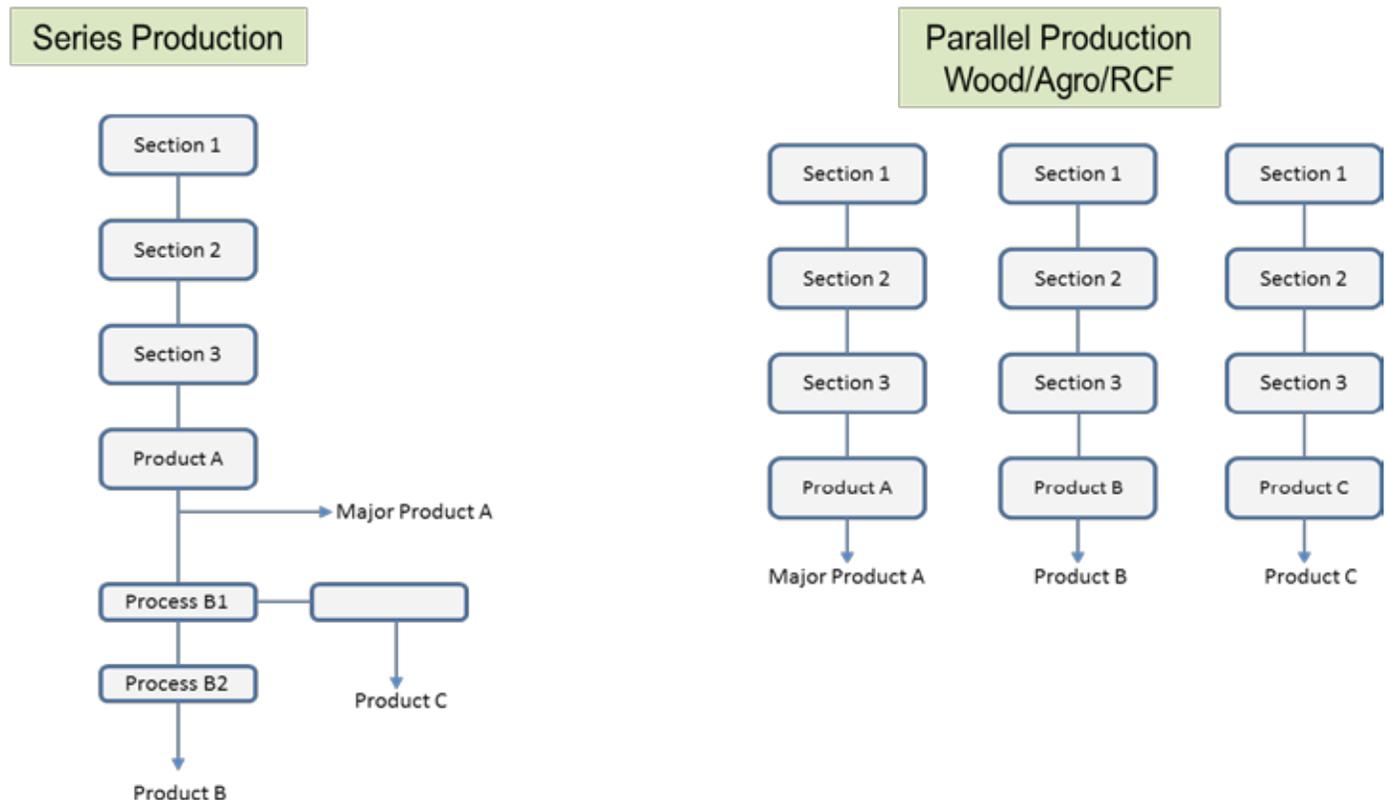
fixed, all the products or value added product will be converted to the major product with the help of specific energy consumption (SEC) factor

- The Energy factor of baseline will be used to convert other products to the major product in the Assessment Year

- The Major product will be kept same in the Assessment Year as of Baseline Year

- In the Pulp & Paper Sector each plant, having different product mix based on process like Writing Printing Paper, Paper Board and Kraft, Speciality paper or News Print.

- Hence, different types of Paper products are converted in to equivalent major product produced by that plant with the help of energy factor, based on the SEC of the product.

Pulp Making	Pulp Route	Paper Making
❏ Pulp making is a series process plant from the basic raw material three different parallel routes i.e., from wood, agro and RCF ❏ Unbleached or bleached Pulp can be exported or imported depending on the availability of raw material ❏ Energy requirement from different raw material is different, hence equivalent product system has been introduced for Pulp product sell or purchase ❏ Saleable pulp are being made after drying it in the Wet Lap or Drying M/c ❏ Import/Export of product will be covered as Intermediary product normalisation in pulp after	❏ Wood pulp Mill (chipper + digester+ WSC+ bleach plant + Recovery + utilities+ Others) ❏ Agro pulp Mill (Depither +cutter + digester + WSC+ bleach plant + Recovery+ utilities + Others) ❏ RCF Pulp Mill (Hydrapulper / Drumpupler+ de-inking+ bleach plant+ utilities+ Others)	❏ There are four main products out of many products in the plant. The highest produced product is being made as major product and accordingly other product needs to be converted to the main products ❏ Other parallel production will be made equivalent to the major product. value addition like Coating in Writing Printing, Paper board and Kraft is to be converted to the major product using the Baseline Energy Ratio in the Assessment Year ❏ Exclusion methods for plants having series system and inclusion method for plant running in parallel system for product mix normalization have been adopted

7.1.3.2 Methodology for Value added Products

i. If any plant in baseline year produces a product 'X', with SEC of the product 'S' and in assessment year if the same plant perform value addition on their product with same weight 'X' but the amount of energy consumption for value addition increases the SEC of the product. So with same amount of product in baseline and assessment year the SEC differs.

ii. This normalization factor accounts for the deviation of SEC from the baseline year due to the factors which are beyond the control of the plant management.

Product Mix-Value Addition Product

Series Production

Parallel Production

- Notional Energy for Import(Ei) = Pi x Si
- Notional Energy for Export(Ee)=Pe x Se
- Total Energy (E)= E1+Ei-Ee
- SEC for Major Product: S2=E2/P
- Equivalent Product(Peq) =P+P1 x (S3/S2)+P2*(S4/S2)
- SEC=**E/Peq**
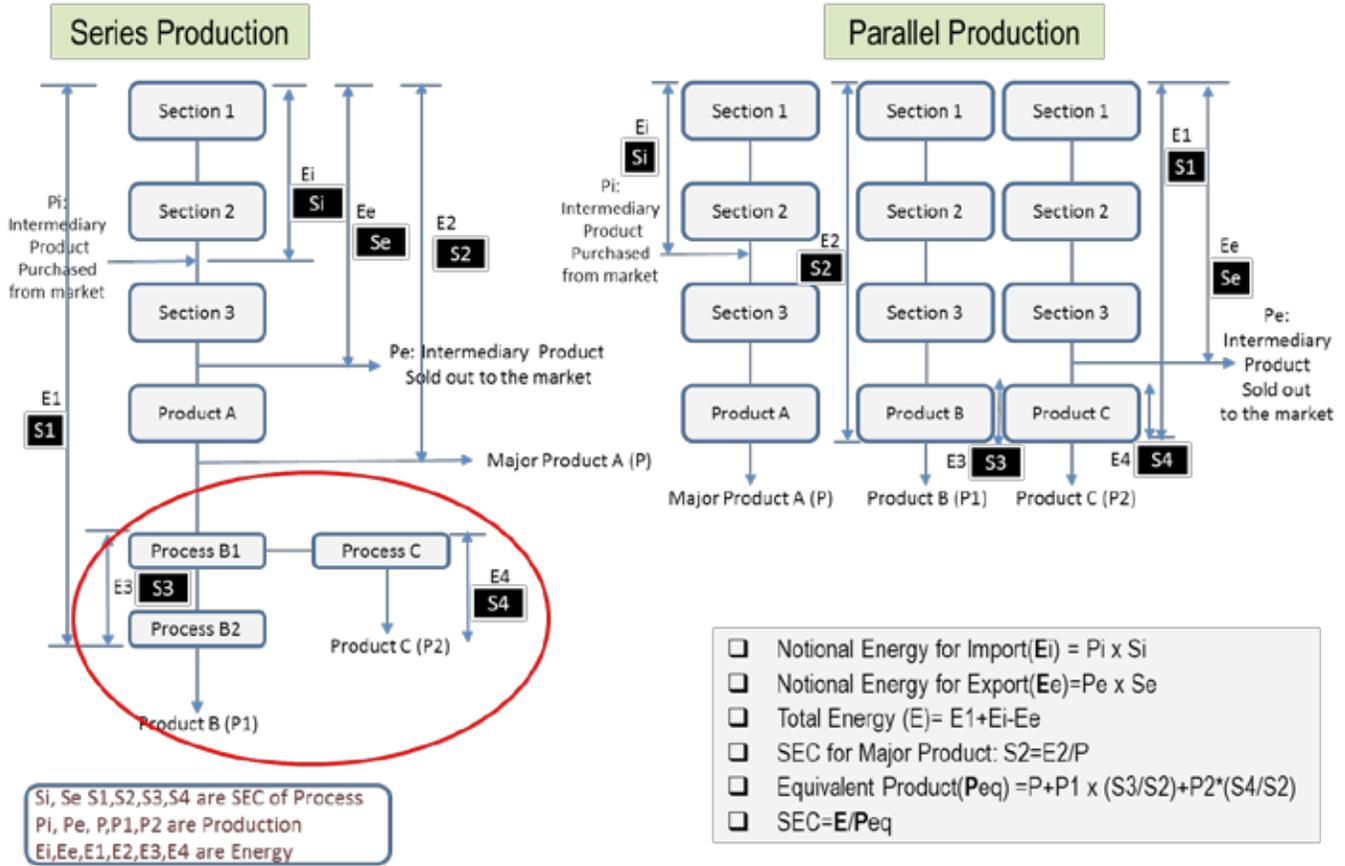
7.1.4 SEC Calculation for production of pulp from wood, agro residues and RCF in the Baseline year and the Assessment year.

The pulp is produced from wood, agro residues and recycled fiber, therefore separate SEC for production of pulp from these raw materials must be known.

Pulp mills based on the production process, will have different specific energy consumption to produce the pulp. For wood, agro and RCF pulp production the energy (thermal and electrical) used in following processes is taken into consideration.

- Wood (chipper + digester+WSC+ bleachplant + Chemical recovery + utilities +ETP)

- Agro (depither, cutter + digester+WSC+ bleach plant + Chemical recovery + utilities + ETP)

- RCF (hydrapulper+deinking+bleach plant + utilities + ETP)

Following formulae are used for calculation of the SEC for wood pulp (SECWP), SEC for agro pulp (SECAP) and SEC of recycled fiber pulp (SECRP).

a. SEC of Wood Pulp

SECWP= SEC of Wood Pulp (kcal/Tonne) = Specific Steam Consumption –MP for Wood Pulp (kcal/Tonne) + Specific Steam Consumption –LP for Wood Pulp (kcal/Tonne) + Specific Energy Consumption (Power) for Wood Pulp (kcal/Tonne)   ----(7.4.1 a)

Where,

Specific Steam Consumption –MP for Wood Pulp (kcal/Tonne) = [{MP-Steam Consumption for Wood Pulp (Tonne)/Wood Pulp Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Specific Steam Consumption –LP for Wood Pulp (kcal/Tonne) = [{LP-Steam Consumption for Wood Pulp (Tonne)/Wood Pulp Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Specific Energy Consumption (Power) for Wood Pulp (kcal/Tonne)= {Power Consumption for Wood Pulp (kwh)/ Wood Pulp Production (Tonnes)} x Heat Rate (kcal/kwh).

b. SEC of Agro Residue Pulp

SECAP=SEC of Agro (kcal/Tonne) = Specific Steam Consumption –MP for Agro (kcal/Tonne) + Specific Steam Consumption –LP for Agro(kcal/Tonne) + Specific Energy Consumption (Power) for Agro(kcal/Tonne)   ----(7.4.1 b)

Where,

Specific Steam Consumption –MP for Agro (kcal/Tonne) = [{MP-Steam Consumption for Agro (Tonne)/Agro Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Specific Steam Consumption –LP for Agro (kcal/Tonne) = [{LP-Steam Consumption for Agro (Tonne)/Agro Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Specific Energy Consumption (Power) for Agro (kcal/Tonne)= {Power Consumption for Agro (kwh)/ Agro Production (Tonnes)} x Heat Rate (kcal/kwh)

c. SEC of RCF Pulp

SECRP= SEC of RCF (kcal/Tonne) = Specific Steam Consumption –MP for RCF (kcal/Tonne) + Specific Steam Consumption –LP for RCF(kcal/Tonne) + Specific Energy Consumption (Power) for RCF(kcal/Tonne)   ----(7.4.1 c)

Where,

Specific Steam Consumption –MP for RCF (kcal/Tonne) = [{MP-Steam Consumption for RCF (Tonne)/RCF Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000.

Specific Steam Consumption –LP for RCF (kcal/Tonne) = [{LP-Steam Consumption for RCF (Tonne)/RCF Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000.

Specific Energy Consumption (Power) for RCF (kcal/Tonne)= {Power Consumption for RCF (kwh)/ Agro Production (Tonnes)} x Heat Rate (kcal/kwh).

7.1.5   Calculation for pulp as equivalent product in the Baseline and Assessment year

The calculations used for Normalisation of Pulp as Equivalent Product in the Baseline year and Assessment year is presented below.

A.   Calculation of the equivalent pulp product in baseline year.

Equivalent Product (Pulp) for BY [Tonnes]= WPm (CFWBY x PPWBY) + APm (CFABY x PPABY) + RCFm (CFRBY x PPRBY)

Where;

WP_m = *wood pulp to main product*

AP_m = *Agro pulp to main product*

RCF_m = *RCF pulp to main product*

CFW_{BY} = *Conversion factor for wood pulp in Baseline Year*

CFA_{BY} = *Conversion factor for Agro pulp in Baseline Year*

CFR_{BY} = *Conversion factor for RCF pulp in Baseline Year*

PPW_{BY} = *Pulp production of Wood Pulp (Tonne) in BY*

PPA_{BY} = *Pulp production of Agro Pulp (Tonne) in BY*

PPR_{BY}= *Pulp production of RCF Pulp (Tonne) in BY*

The conversion factors CFW, CFA and CFR for Baseline Year in Eq. 1.4 will be calculated as shown below.

$$CFW_{BY} = \frac{\text{SEC for Wood pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.2 A)}$$

$$CFA_{BY} = \frac{\text{SEC for Agro pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.2 B)}$$

$$CFR_{BY} = \frac{\text{SEC for RCF pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.2 C)}$$

B.   Calculation of the equivalent pulp product in Assessment year

Equivalent Product (Pulp) for AY[Tonnes]$= WP_m \, (CFW_{AY} \times PPW_{AY}) + AP_m \, (CFA_{AY} \times PPA_{AY}) + RCF_m \, (CFR_{AY} \times PPR_{AY})$ -----(7.5.3)

Where

CFWAY = Conversion factor for wood pulp in Assessment Year

CFAAY = Conversion factor for Agro pulp in Assessment Year

CFRAY = Conversion factor for RCF pulp in Assessment Year

PPWAY = Pulp production of Wood Pulp (Tonne) in Assessment Year

PPAAY = Pulp production of Agro Pulp (Tonne) in Assessment Year

PPRAY = Pulp production of RCF Pulp (Tonne) in Assessment Year

Condition#1– When baseline saleable pulp production is zero in the Baseline Year.

The Eq. No. 7.5.2.A, 7.5.2.B and 7.5.3.C for Assessment Year, given below, are applicable in case when baseline production = 0 for the concerned product (saleable pulp), otherwise the baseline conversion factor will be considered.

$$CFW_{BY} = \frac{\text{SEC for Wood pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.4.A)}$$

$$CFA_{BY} = \frac{\text{SEC for Agro pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.4.B)}$$

$$CFR_{BY} = \frac{\text{SEC for RCF pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{(7.5.4.C)}$$

Condition#2– When baseline saleable pulp production is not zero in the Baseline year.

In this case, the calculations in eq. 7.5.2 and 7.5.4are applicable when the baseline production ≠ 0 for a product i.e., wood, agro and RCF pulps. Thus following baseline conversion factor will be considered.

$$CFW_{BY} = \frac{\text{SEC for Wood pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad (7.5.2.A)$$

$$CFA_{BY} = \frac{\text{SEC for Agro pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad (7.5.2.B)$$

$$CFR_{BY} = \frac{\text{SEC for RCF pulp (BY)}}{\text{SEC of Major Product (BY)}} \quad (7.5.2.C)$$

7.1.6 Documentation

• Pulp sales Documents

• Pulp production documents [for e.g. Log sheets, DPR. MPR, Lab Report/register/ SAP Data]

7.2 Normalisation for Intermediary Product (Pulp)

7.2.1 Normalisation of Intermediary Products

In Indian Pulp & Paper Sector, pulp can be produced by using the following raw materials:

• From wood (Hardwoods) using chippers, digesters, washing, screening &centricleaning (WSC), and bleaching using different bleach chemicals.

• From agro residues (wheat straw, bagasse, reeds and other annual plants) using cutters, depithers, digesters, washing, screening &centricleaning (WSC), and bleaching using different bleach chemicals.

• From recycled fibers (RCF) and market pulp using hydrapulpers, cleaning and screening of the stock, deinking and bleaching of the pulp.

• Apart from the above pulp manufacturing from different raw materials, mills also import 100% market pulp which is used for paper production.

Since pulp mills based on the above raw materials have different unit operations to produce and process the pulp, hence, these are designated as distinct wood pulp street; agro pulp street and RCF pulp streets. Power and steam consumption in all above streets are different and thus there will be variation in the specific energy consumption for process specific pulp production. Many mills use variety of raw materials using wood, agro and RCF pulp streets and further the pulp production also varies according to the variation in product quality and market demand. The variation in pulp production in Assessment year with respect to Baseline year, therefore needs to develop and impose proper Normalization factors, so that any change in the process to prepare pulp and final product produced could be nullified and the concerned plant should not suffer / or gain advantage due to this change in pulp production.

For this the major product of baseline year would be considered for the assessment year for calculating Equivalent product in

the assessment year. Major product could be from Wood, Agro or RCF pulp depending on Maximum production. The terminologies used for calculation are;

> AY: Assessment Year
>
> BY: Baseline Year
>
> SEC: Specific Energy Consumption

7.2.1.1 Methodology for Intermediary Product

Import of intermediary product for production of final product can happen along with export of intermediary product also undertaken as per market demand. The change in the proportion of import or export during baseline year to target year may affect the SEC of the plant

For all the changes in the ratio of the Import & Export in assessment year with respect to Baseline year, there is a need to develop and formulate proper Normalization factors, so that any change in the ratio of imported and exported product could be nullified and the concerned plant should not suffer / or gain advantage due to this changes

Product Mix-Intermediary Product

Notional Energy for Import(Ei) = Pi x Si
Notional Energy for Export(Ee)=Pe x Se
Total Energy (E)= E1+Ei-Ee
SEC for Major Product: S2=E2/P
Equivalent Product(Peq) =P+P1 x (S3/S2)+P2*(S4/S2)
SEC=E/Peq

Si, Se S1,S2,S3,S4 are SEC of Process
Pi, Pe, P,P1,P2 are Production
Ei,Ee,E1,E2,E3,E4 are Energy

7.2.1.2 Pulp Stock (Assessment Year)

The calculation of the bleached pulp stock is shown below

BS_{WP}=**Wood bleached pulp stock** ----(8.1. a) **[Tonnes]** =Closing Stock of Total wood Bleached saleable Pulp (Tonnes)- Opening Stock of Total wood Bleached saleable Pulp (Tonnes)

BS_{AP}=**Agro bleached pulp stock** ----(8.1.b) **[Tonnes]** =Closing Stock of Total Agro Bleached saleable Pulp (Tonnes) - Opening Stock of Total Agro Bleached saleable Pulp (Tonnes)

BS_{RP}=**RCF bleached pulp stock** ----(8.1.c) **[Tonnes]** = Closing Stock of Total RCF Bleached saleable Pulp (Tonnes) - Opening Stock of Total RCF Bleached saleable Pulp (Tonnes)

7.2.1.3 Pulp Export Quantities (Assessment Year)

Calculations are made according to following conditions.

Condition#1 -If BSWP> 0, following calculation will be used for Total Wood bleached Export

P_{EWP}=**Total Wood bleached Export** ----(8.1.d) **[Tonnes]=** Export Wood Bleached Pulp (Tonnes) + Wood bleached pulp stock (Tonnes)

Condition#2- If BSWP< 0, following calculation will be used for Total Wood bleached Export

P_{EWP}=**Total Wood bleached Export** ----(8.1.e) **[Tonnes] =** Export Wood Bleached Pulp (Tonnes)

Condition#3 -If BSAP> 0, following calculation will be used for Total Agro bleached Export

P_{EAP} = Total Agro bleached Export ----(8.1.f) [Tonnes]= Export Agro Bleached Pulp (Tonnes)

Condition#4 -If BSAP< 0, following calculation will be used for Total Agro bleached Export

P_{EAP} = **Total Agro bleached Export** ----(8.1.g) **[Tonnes]=** Export Agro Bleached Pulp (Tonnes)

Condition#5 - If BSRP> 0, following calculation will be used for Total RCF bleached Export

P_{ERP}= **Total RCF bleached Export** ----(8.1.h) **[Tonnes]=** Export RCF Bleached Pulp (Tonnes) + RCF bleached pulp stock (Tonnes)

Condition#6 - If BSAP< 0, following calculation will be used for Total RCF bleached Export

P_{ERP}= **Total RCF bleached Export** ----(8.1.i) **[Tonnes]=** Export RCF Bleached Pulp

7.2.1.4 Pulp Import Quantities for Baseline Year (BY)

Condition#1 - If BSWP> 0, following calculation will be used for Total Wood bleached Import

P_{IWP} =**Total Wood bleached Import** ----(8.1.j) **[Tonnes]=** Import Wood Bleached Pulp (Tonnes)

Condition#2 - If BSWP< 0, following calculation will be used for Total Wood bleached Export

P_{IWP} =**Total Wood bleached Import** ----(8.1.k) **[Tonnes]=** Import Wood Bleached Pulp (Tonnes) - Wood bleached pulp stock (Tonnes)

Condition#3 - If BSAP> 0, following calculation will be used for Total Agro bleached Import

P_{IAP}= Total Agro bleached Import [Tonnes]= Import Agro Bleached Pulp (Tonnes)	----(8.1.l)

Condition#4 - If BSAP< 0, following calculation will be used for Total Agro bleached Export

P_{IAP} = Total Agro bleached Import [Tonnes]= Import Agro Bleached Pulp (Tonnes) - Agro bleached pulp stock (Tonnes)	----(8.1.m)

Condition#5 - If BSRP> 0, following calculation will be used for Total RCF bleached Import

P_{IRP} = Total RCF bleached Import [Tonnes]= Import RCF Bleached Pulp (Tonnes)	----(8.1.n)

Condition#6 - If BSRP< 0, following calculation will be used for Total RCF bleached Export

P_{IRP} Total RCF bleached Import [Tonnes]= Import RCF Bleached Pulp (Tonnes) - RCF bleached pulp stock (Tonnes)	----(8.1.o)

7.2.1.5 Pulp Import Quantities for Assessment Year (AY)

Condition#1 - If BSWP> 0, following calculation will be used for Total Wood bleached Import

P_{IWP} =Total Wood bleached Import [Tonnes]= Import Wood Bleached Pulp (Tonnes) + Wood Pulp Production till new line attains 70% of Capacity utilisation	----(8.1.p)

Condition#2 - If BSWP< 0, following calculation will be used for Total Wood bleached Export

P_{IWP} =Total Wood bleached Import [Tonnes]= Import Wood Bleached Pulp (Tonnes) + Wood Pulp Production till new line attains 70% of Capacity utilisation - Wood bleached pulp stock (Tonnes)	----(8.1.q)

Condition#3 - If BSAP> 0, following calculation will be used for Total Agro bleached Import

P_{IAP} Total Agro bleached Import [Tonnes]= Import Agro Bleached Pulp (Tonnes) + Agro Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)	----(8.1.r)

Condition#4 - If BSAP< 0, following calculation will be used for Total Agro bleached Export

P_{IAP} Total Agro bleached Import [Tonnes]= Import Agro Bleached Pulp (Tonnes) + Agro Pulp Production till new line attains 70% of Capacity utilisation (Tonnes) - Agro bleached pulp stock (Tonnes)	----(8.1.s)

Condition#5 - If BSRP> 0, following calculation will be used for Total RCF bleached Import

P_{IRP} = Total RCF bleached Import [Tonnes]= Import RCF Bleached Pulp (Tonnes) + RCF Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)	----(8.1.t)

Condition#6 - If BSRP< 0, following calculation will be used for Total Agro bleached Export

P_{IRP} Total RCF bleached Import [Tonnes]= Import RCF Bleached Pulp (Tonnes) + RCF Pulp Production till new line attains 70% of Capacity utilisation (Tonnes) - RCF bleached pulp stock (Tonnes)	----(8.1.u)

7.2.2 The Net Import Energy to be deducted in the Assessment Year

The net import energy to be deduced in the assessment year is calculated as shown in the below equation

Net Import/Export Energy for bleached pulp to be deducted in the assessment year [Million kcal]= $\{[(SEC_{WP} \times PE_{WP})/10^6 - (SEC_{WP} \times P_{IWP})/10^6] + [(SEC_{AP} \times P_{EAP})/10^6 - (SEC_{AP} \times P_{IAP})/10^6] + [(SEC_{RP} \times P_{ERP})/10^6 - (SEC_{RP} \times P_{IRP})/10^6]\}$

Where,

P_{EWP} is Total Export of the Wood Pulp (Tonne)

P_{IWP} is Total Import of the Wood Pulp (Tonne)

P_{EAP} is Total Export of the Agro Pulp (Tonne)

P_{IAP} is Total Import of the Agro Pulp (Tonne)

P_{ERP} is Total Export of the RCF Pulp (Tonne)

P_{IRP} is Total Import of the RCF Pulp (Tonne)

SEC_{WP} Total Specific Energy Consumption of saleable Wood Pulp in kcal/tonne

SEC_{AP} Total Specific Energy Consumption of saleable Agro Pulp in kcal/tonne

SEC_{RP} Total Specific Energy Consumption of saleable RCF Pulp in kcal/tonne

SECWP, SECAP &SECRP will be calculated as per Sr. No 7.4 for Assessment and Baseline year.

7.2.3 Documentation

• Pulp sales Documents

• Pulp production documents [for e.g. Log sheets, DPR. MPR, Lab Report/register/ SAP Data]

7.3 Normalisation of Equivalent Product (Paper)

The pulp is further processed to prepare the paper. Various types of paper can be manufactured using the pulp and the specific energy consumption varies with product specific. The products considered for normalisation are:

o Writing Printing Paper

o Paper Board &kraft Paper

o Speciality Paper

o Newsprint

o Writing Printing Coated Paper

o Coated Board

7.3.1 Normalization Methodology

Product mix, i.e., production of different grades of paper, where some products consume higher energy whereas other consume comparatively less, due to change in their quantities and ratios may change SEC in Assessment year with respect to Baseline year.

Normalisation will be done for all products mix manufactured by the DC in Assessment year. This will be based on the conversion of all products into the major product manufactured in the Baseline year.

The DC has to get a benefit for using high percentage of fillers and additives (precipitated calcium carbonate, PCC, or china clay etc.) in paper in the Assessment year as compared to the Baseline Year. Since increase in filler loading will result in higher production without addition of energy, therefore plant will get a benefit.

However in case of reduction in filler loading due to market demand for certain grades, and qualities, mill will have to bear and compensate the addition of energy itself.

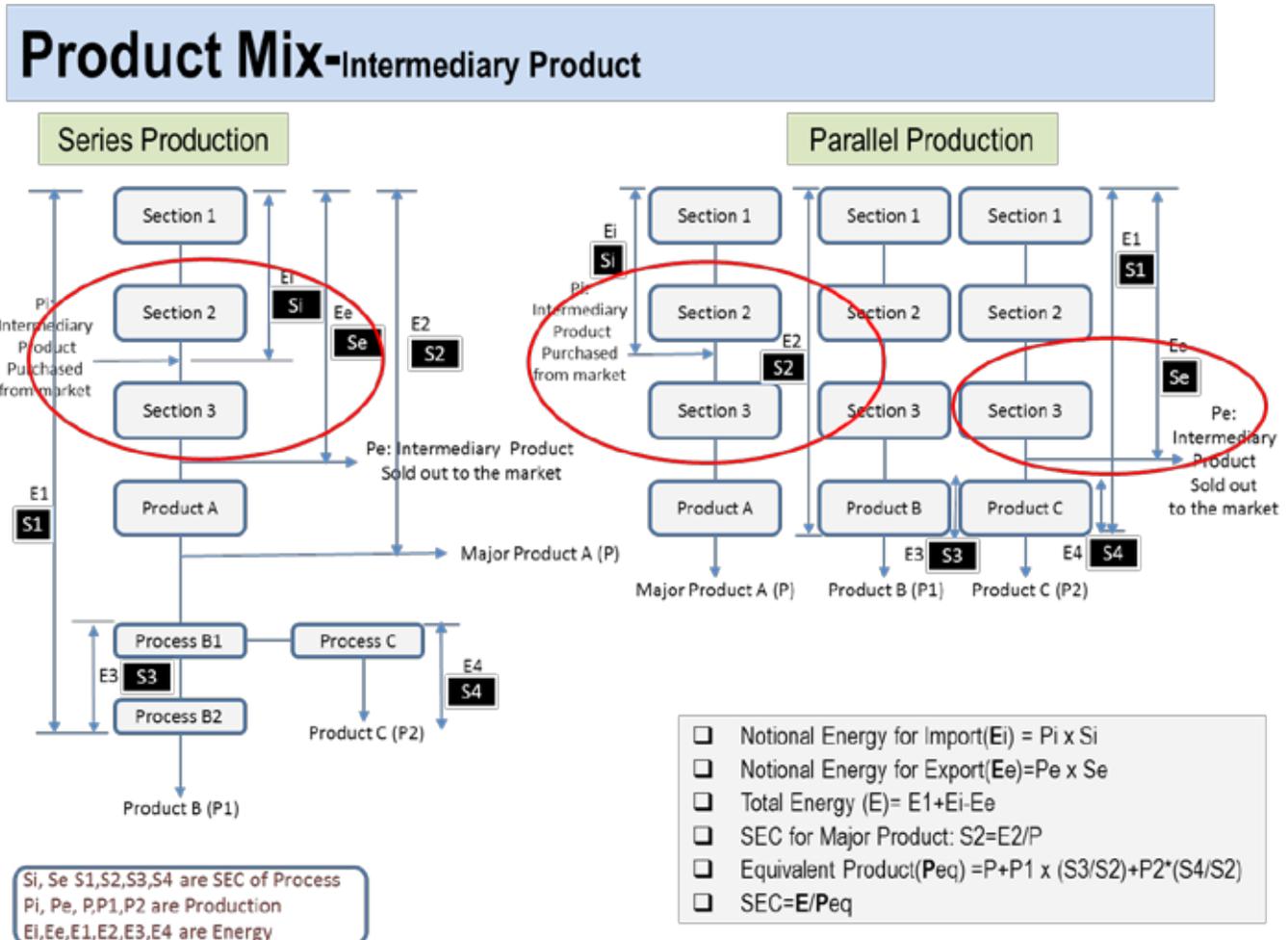i. Import of intermediary product for production of final product can happen along with export of intermediary product also undertaken as per market demand. The change in the proportion of import or export during baseline year to target year may affect the SEC of the plant

ii. For all the changes in the ratio of the Import & Export in assessment year with respect to Baseline year, there is a need to develop and formulate proper Normalization

factors, so that any change in the ratio of imported and exported product could be nullified and the concerned plant should not suffer / or gain advantage due to this changes

The details of the calculations for equivalent product in the Baseline and Assessment year are given below.

7.3.2 Common Normalization formulae for all the product mix case combinations

- Baseline Major Product shall be considered as major product of Assessment year.

- The calculation of SEC of different grades of paper produced by a mill will consider the power and steam consumption in stock preparation, additives, paper machine, finishing house, and utilities.

- It will be assumed that there is no variation in specific energy of paper production in above unit operations, by using different types of pulps or their blends in different ratios.

7.3.3 Product Mix Calculation

(a) SEC Calculation for Writing and Printing Paper Grades

To find out the Normalisation factor for product mix, it is necessary to determine the specific energy consumption (SEC) for production of different varieties of paper. After determination of the SEC for paper production, the equivalent paper product will be calculated. Therefore the calculation of the equivalent pulp product is determined in following steps as below.

o Calculation of Specific Energy Consumption for production of paper in the Baseline year and the Assessment year.

o Calculation product mix as equivalent major product in the Baseline and Assessment year.

7.3.4 SEC calculation for Baseline and Assessment Year
The calculation of SEC for WPP, paper board, specialty, newsprint, coated paper and board is presented in this section.

The SEC calculations for Writing Printing paper (WPP) (in terms of total kcal/tonne for steam–MP, LP and power consumption) will be calculated as below.

SEC for Writing and Printing Paper (kcal/Tonne) = Writing Printing Grade Paper Specific Steam Consumption-MP (kcal/Tonne) + Writing Printing Grade Paper Specific Steam Consumption-LP + Writing Printing Grade Paper Specific Energy Consumption for Power (kcal/Tonne)   ----(9.4.1 a)

Where,

Writing Printing Grade Paper Specific Steam Consumption-MP (kcal/Tonne) = [{MP-Steam Consumption for Writing Printing Grade (Tonne)/ Writing Printing Grade Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Writing Printing Grade Paper Specific Steam Consumption-LP (kcal/Tonne) = [{LP-Steam Consumption for Writing Printing Grade (Tonne)/ Writing Printing Grade Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Writing Printing Grade Paper Specific Energy Consumption for Power (kcal/Tonne)={Power Consumption for Writing Printing Grade (kwh)/Writing Printing Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

(b) SEC Calculation for Paper Board Grades

SEC for Paper Board Grade (kcal/Tonne) = Paper Board Grade Paper Specific Steam Consumption-MP (kcal/Tonne) + Paper Board Grade Paper Specific Steam Consumption-LP + Paper Board Grade Paper Specific Energy Consumption for Power (kcal/Tonne)   ---- (9.4.1 b)

Where,

Paper Board Grade Paper Specific Steam Consumption-MP (kcal/Tonne) = [{MP-Steam Consumption for Paper Board Grade (Tonne)/Paper Board Grade Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000)

Paper Board Grade Paper Specific Steam Consumption-LP (kcal/Tonne) = [{LP-Steam Consumption for Paper Board Grade (Tonne)/Paper Board Grade Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Paper Board Grade Paper Specific Energy Consumption for Power (kcal/Tonne)={Power Consumption for Paper Board Grade (kwh)/Paper Board Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

(c) SEC for Speciality Paper Grade

SEC for Speciality PaperGrade (kcal/Tonne) = Speciality Paper Grade Paper Specific Steam Consumption-MP (kcal/Tonne) + Speciality Paper Grade Paper Specific Steam Consumption-LP + Speciality Paper Grade Paper Specific Energy Consumption for Power (kcal/Tonne)   ---- (9.4.1 c)

Where,

Speciality Paper Grade Paper Specific Steam Consumption-MP (kcal/Tonne) = [{MP-Steam Consumption for Speciality Paper Grade (Tonne)/Speciality Paper Grade Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Speciality Paper Grade Paper Specific Steam Consumption-LP (kcal/Tonne) = [{LP-Steam Consumption for Speciality Paper Grade (Tonne)/Speciality Paper Grade Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Speciality Paper Grade Paper Specific Energy Consumption for Power (kcal/Tonne)={Power Consumption for Speciality Paper Grade (kwh)/Speciality Paper Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

(d) SEC for News Print Grade

SEC for News Print Grade (kcal/Tonne) = News Print Grade Paper Specific Steam Consumption-MP (kcal/Tonne) + News Print Grade Paper Specific Steam Consumption-LP + News Print Grade Paper Specific Energy Consumption for Power (kcal/Tonne) ---- (9.4.1 d)

Where,

News Print Grade Paper Specific Steam Consumption-MP (kcal/Tonne) = [{MP-Steam Consumption for News Print Grade (Tonne)/News Print Grade Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

News Print Grade Paper Specific Steam Consumption-LP (kcal/Tonne) = [{LP-Steam Consumption for News Print Grade (Tonne)/News Print Grade Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

News Print Grade Paper Specific Energy Consumption for Power (kcal/Tonne)={Power Consumption for News Print Grade (kwh)/Paper Board Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

(e) SEC for Writing printing Coated Grade

SEC for Writing Printing Coated Grade (kcal/Tonne) = Writing Printing Coated Grade Paper Specific Steam Consumption-MP (kcal/Tonne) + Writing Printing Coated Grade Paper Specific Steam Consumption-LP + Writing Printing Coated Grade Paper Specific Energy Consumption for Power (kcal/Tonne) ---- (9.4.1 e)

Where,

Writing Printing Coated Grade Paper Specific Steam Consumption-MP (kcal/Tonne) = [{MP-Steam Consumption for Writing Printing Coated Grade (Tonne)/Writing Printing Coated Grade Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Writing Printing Coated Grade Paper Specific Steam Consumption-LP (kcal/Tonne) = [{LP-Steam Consumption for Writing Printing Coated Grade (Tonne)/Writing Printing Coated Grade Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Writing Printing Coated Grade Paper Specific Energy Consumption for Power (kcal/Tonne)={Power Consumption for Writing Printing Coated Grade (kwh)/Writing Printing Coated Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

(f)   SEC for Coated Board Grade

SEC for Coated Board Grade (kcal/Tonne) = Coated Board Grade Paper Specific ---- (9.4.1 f)
Steam Consumption-MP (kcal/Tonne) + Coated Board Grade Paper Specific Steam
Consumption-LP + Coated Board Grade Paper Specific Energy Consumption for
Power (kcal/Tonne)

Where,

Coated Board Grade Paper Specific Steam Consumption-MP (kcal/Tonne) =
[{MP-Steam Consumption for Coated Board Grade (Tonne)/Coated Board Grade
Production (Tonnes)} x Enthalpy of MP-Steam (kcal/kg)] x 1000

Coated Board Grade Paper Specific Steam Consumption-LP (kcal/Tonne) =
[{LP-Steam Consumption for Coated Board Grade (Tonne)/Coated Board Grade
Production (Tonnes)} x Enthalpy of LP-Steam (kcal/kg)] x 1000

Coated Board Grade Paper Specific Energy Consumption for Power (kcal/
Tonne)={Power Consumption for Coated Board Grade (kwh)/Coated Board
Grade Production (Tonnes)} x Heat Rate (kcal/kwh)

7.3.5   Equivalent Product Calculations in Baseline Year

Calculations of the equivalent product in Baseline and Assessment year will be as below.

a)   Equivalent product (paper) for baseline year will be calculated as below.

Equivalent Product (Paper) for BY (Tonnes) = FPWP (CFWPBY x PWPBY) + ---- (9.5.1)
FPPB (CFPBBY x PPBBY) + FPSP (CFSPBY x PSPBY) + FPNP (CFNPBYx PNPBY)
+ FPWPC (CFWPCBY x PWPCBY) + FPBC (CFCBBY x PCBBY)

Where,

FP_{WP}= Writing Printing Paper to Final Product

FP_{PB}= Paper Board to Final Product

FP_{SP} = Speciality Paper to Final Product

FP_{NP} = Newsprint to Final Product

FP_{WPC} = Writing Printing Coated paper to Final Product

FP_{CB} = Coated Board to Final Product

$CFWP_{BY}$ = Conversion factor for writing printing paper in Baseline Year

$CFPB_{BY}$ = Conversion factor for Paper Board & Kraft Paper in Baseline Year

$CFSP_{BY}$ = Conversion factor for Speciality Paper in Baseline Year

$CFNP_{BY}$ = Conversion factor for News Print in Baseline Year

$CFWPC_{BY}$ = Conversion factor for Writing Printing Coated paper in Baseline Year

$CFCB_{BY}$ = Conversion factor for Coated Board in Baseline Year

PWP_{BY}=Total Writing Printing Paper production

in Baseline Year (Tonnes)

PPB_{BY} = Total Paper Board Paper production in Baseline Year (Tonnes)

PSP_{BY} = Total Speciality Paper production in Baseline Year (Tonnes)

PNP_{BY} = Total Newsprint paper production in Baseline Year (Tonnes)

$PWPC_{BY}$ = Total Writing Printing Coated Paper production in Baseline Year (Tonnes)

PCB_{BY} = Total Coated Board Paper production in Baseline Year (Tonnes)

7.3.5.1 Conversion Factors for Baseline Year will be calculated as below

$$\text{(i)} \quad CFWP_{BY} = \frac{\text{SEC for Writing Paper (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{-----(9.5.1 a)}$$

$$\text{(ii)} \quad CFPB_{BY} = \frac{\text{SEC for Paper Board (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{-----(9.5.1 b)}$$

$$\text{(iii)} \quad CFSP_{BY} = \frac{\text{SEC for Speciality Paper (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{-----(9.5.1 c)}$$

$$\text{(iv)} \quad CFNP_{BY} = \frac{\text{SEC for News Print (BY)}}{\text{SEC of Major Product (BY)}} \quad \text{-----(9.5.1 d)}$$

$$\text{(v)} \quad CFWPC_{BY} = \frac{\text{SEC for Writing Printing Coated Paper (BY)}}{\text{(SEC of Major Product (BY))}} \quad \text{-----(9.5.1 e)}$$

$$\text{(vi)} \quad CFCB_{BY} = \frac{\text{(SEC for Coated Board (BY))/}}{\text{(SEC of Major Product (BY))}} \quad \text{-----(9.5.1 f)}$$

7.3.6   Equivalent Product Calculations in Assessment Year (AY)

Equivalent Product (Paper) for AY (Tonnes) = FP_{WP} $(CFWP_{AY} \times PWP_{AY})$ + FP_{PB} $(CFPB_{AY} \times PPB_{AY})$ + FP_{SP} $(CFSP_{AY} \times PSP_{AY})$ + FP_{NP} $(CFNP_{AY} \times PNP_{AY})$ + FP_{WPC} $(CFWPC_{AY} \times PWPC_{AY})$ + FP_{BC} $(CFCB_{AY} \times PCB_{AY})$ -----(9.6. 1)

Where,

$CFWP_{AY}$ = Conversion factor for writing printing paper in Assessment Year

$CFPB_{AY}$ = Conversion factor for Paper Board & Kraft Paper in Assessment Year

$CFSP_{AY}$ = Conversion factor for Speciality Paper in Assessment Year

$CFNP_{AY}$ = Conversion factor for News Print in Assessment Year

$CFWPC_{AY}$ = Conversion factor for Writing Printing Coated paper inAssessment Year

$CFCB_{AY}$ = Conversion factor for Coated Board in Assessment Year

PWP_{AY} = Total Writing Printing Paper production in Assessment Year (Tonnes)

PPB_{AY} = Total Paper Board Paper production in Assessment Year (Tonnes)

PSP_{AY} = Total Speciality Paper production in Assessment Year (Tonnes)

PNP_{AY} = Total Newsprint paper production in Assessment Year (Tonnes)

$PWPC_{AY}$ = Total Writing Printing Coated Paper production in Assessment Year (Tonnes)

PCB_{AY} = Total Coated Board Paper production in Assessment Year (Tonnes)

7.3.6.1 Conversion Factors for Assessment Year

The conversion factors for writing & printing paper, paperboard, specialty grades and newsprint in Assessment Year in Eq. 9.6.a will be calculated as shown below. Based on the product mix variation, there are two conditions for the calculations. These are 1)when the baseline production of the concerned product is zero and 2)when it is not zero.

Condition#1– Applicable only in case concern production = 0, in this case the following conversion factors are considered. Otherwise the baseline conversion factor will be considered

$$\textbf{(i) } CFWP_{AY} = \frac{\text{SEC for Writing Paper (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ a)$$

$$\textbf{(ii) } CFPB_{AY} = \frac{\text{SEC for Paper Board (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ b)$$

$$\textbf{(iii) } CFSP_{AY} = \frac{\text{SEC for Speciality Paper (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ c)$$

$$\textbf{(iv) } CFNP_{AY} = \frac{\text{SEC for News Print (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ d)$$

$$\textbf{(v) } CFWPC_{AY} = \frac{\text{SEC for Writing Printing Coated Paper (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ e)$$

$$\textbf{(vi) } CFCB_{AY} = \frac{\text{SEC for Coated Board (AY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ f)$$

Condition#2– Applicable only in case baseline production of concern product $\neq$ 0. In this case baseline conversion factor will be considered.

$$\textbf{(i) } CFWP_{AY} = \frac{\text{SEC for Writing Paper (BY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ g)$$

$$\textbf{(ii) } CFPB_{AY} = \frac{\text{SEC for Paper Board (BY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ h)$$

$$\textbf{(iii) } CFSP_{AY} = \frac{\text{SEC for Speciality Paper (BY)}}{\text{SEC of Major Product (BY)}} \quad -----(9.6.1\ i)$$

(iv) $CFNP_{AY} = \dfrac{\text{SEC for News Print (BY)}}{\text{SEC of Major Product (BY)}}$ -----(9.6.1 j)

(v) $CFWPC_{AY} = \dfrac{\text{SEC for Writing Printing Coated Paper (BY)}}{\text{SEC of Major Product (BY)}}$ -----(9.6.1 k)

(vi) $CFCB_{AY} = \dfrac{\text{SEC for Coated Board (BY)}}{\text{SEC of Major Product (BY)}}$ -----(9.6.1 l)

Major Product of Baseline year would be considered in the Assessment year for calculating Equivalent product in the assessment year. Major product could be from Wood, Agro or RCF pulp depending on Maximum production

AY: Assessment Year

BY: Baseline Year

SEC: Specific Energy Consumption

7.3.7 Documentation

- PCC/China clay /Additives -Purchase documents

- Filler and Additives stock and consumption documents [DPR, MPR, SAP data. Store Receipt etc.]

- Paper and paper board, Newsprint and specialty papers sale- Excise Documents

- Lab Report of Paper Quality testing [Ash contents/ GSM /Other parameters] to prove % filler addition and GSM variation in paper qualities.

- Paper production documents [for e.g. Log sheets, DPR. MPR, Lab Report/register/ SAP Data]

7.4 Fuel Quality of Coal in CPP & Co-Gen

Coals are extremely heterogeneous, varying widely in their content and properties from country tocountry, 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.

7.4.1 Coal Quality for CPP

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. The Thermal Energy for the difference in heat rate of CPP will be deducted from the total energy consumption of the plant

(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	-----(10.1.1)
(ii)	*CPP Heat Rate in AY=* CPP Heat Rate in BY x (Boiler Efficiency in BY/Boiler Efficiency in AY)	----(10.1.1 a)
(iii)	*Boiler Efficiency in BY=* $92.5-[\{50xA+630 (M+9H)\}/GCV]$ (Values are for baseline Year)	----(10.1.1 b)
(iv)	*Boiler Efficiency in AY=* $92.5-[\{50xA+630 (M+9H)\}/GCV]$ (Values are for assessment Year)	----(10.1.1 c)

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

7.4.2 Coal Quality for Cogen

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.

(i)	**Boiler efficiency in baseline year (BY) =** $92.5-[\{50xA+630 (M+9H)\}/GCV]$	----(10.2.1)
(ii)	**Boiler efficiency in assessment year (AY)=** $92.5-[\{50xA+630 (M+9H)\}/GCV]$	----(10.2.2)
(iii)	**Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler) in BY (Factor)=** $\sum_{n=13}^{16}$ {Operating Capacity of Process Boilers used for Steam generation in TPH x Percentage of Coal Energy Used in steam Generation in all the boilers for Steam generation in %) / $\sum_{n=13}^{16}$ Operating Capacity of Process Boilers used for Steam generation (TPH)}	----(10.2.3 a)
(iv)	**Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler) in AY (Factor) =** $\sum_{n=13}^{16}$ {(Operating Capacity of Boilers used for Steam generation in TPH x Percentage of Coal Energy Used in steam Generation in all the boilers for Steam generation in %) / $\sum_{n=13}^{16}$ Operating Capacity of Boilers used for Steam generation (TPH)}	----(10.2.3 b)
(v)	**Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler) in BY =** $\sum_{n=1}^{12}$ {(Operating Capacity of Boilers used for Steam generation in TPH x Percentage of Coal Energy Used in steam Generation in all the boilers for Steam generation in %) / $\sum_{n=1}^{12}$ Operating Capacity of Boilers used for Steam generation (TPH)}	----(10.2.4 a)

(vi)	**Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler) in AY =** $\sum_{n=1}^{12}$ {(Operating Capacity of Boilers used for Steam generation in TPH x Percentage of Coal Energy Used in steam Generation in all the boilers for Steam generation in %) / $\sum_{n=1}^{12}$ Operating Capacity of Boilers used for Steam generation (TPH)}	----(10.2.4 b)
(vii)	**Weighted Average Specific Steam Consumption in BY & AY (kCal/kg of Steam)=** $\sum_{n=13}^{16}$ (Total Steam Generation in Process Boiler (Tonnes) x Specific Energy Consumption for Steam Generation in Process Boilers (kcal/kg of steam) $+\sum_{n=1}^{12}$ (Total Steam Generation in Co-Gen Boiler (Tonnes) x Specific Energy Consumption for Steam Generation in Co-Gen Boiler (kcal/kg of steam)} / $\sum_{n=1}^{16}$ Steam generation in Co-gen + process boilers	----(10.2.5)
(viii)	**Normalized Specific Energy Consumption for Steam Generation (kCal/kg of Steam) =** Weighted Average Specific Steam Consumption in BY x (Boiler efficiency in BY (%)/Boiler Efficiency in AY (%))	----(10.2.6)
(ix)	**Difference in Specific Steam from BY to AY (kCal/kg of Steam) =** Normalized Specific Energy Consumption for Steam Generation in AY(kcal/kg of steam) - Weighted Average Specific Steam Consumption in BY (kcal/kg of steam)	----(10.2.7)
(x)	**Energy to be subtracted w.r.t. Fuel Quality in Co-Gen (Million kCal)=** Difference in Specific Steam from BY to AY (kcal/kg of steam)x {(Total Steam Generation of all Process Boilers in AY (Tonnes) x Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler) in AY)+(Total Steam Generation at Co-Gen Boiler in AY (Tonnes) x Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler) in AY)}/1000	----(10.2.8)

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

TPH=Tonnes Per Hour

7.4.3 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

7.4.4 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)

%H$_2$= 0.036C + 0.086 (VM -0.1xA) - 0.0035M^2(1-0.02M)%N2= 2.10 -0.020 VM

Where

C= % of fixed carbon

A= % of ash

VM= % of volatile matter

M= % of moisture

7.5   Power Mix

7.5.1   Power Mix Normalization for Power Sources

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

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

(i) Energy Correction for all power source in the assessment year [Million kcal]= $TECPS_{AY}$ x (A-WHR$_{AY}$ - N-WHR$_{AY}$)	----(11.1.1)

Where:-

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

A-WHR$_{AY}$: Actual Weighted Heat Rate for the Assessment Year in kcal/kwh

N-WHR$_{AY}$: Normalised Weighted Heat Rate for the Assessment Year in kcal/kwh

(ii) Normalised Weighted Heat Rate for Assessment year (kcal/kwh) = N-WHR$_{AY}$= A x (D/G)+B x (E/G)+C x (F/G)	----(11.1.2)

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 PSiHR$_{AY}$ x (PSiEC$_{BY}$/TEC$_{BY}$)

(iii) $PSiHR_{AY}$= Power Source (ith) Heat rate for AY in kcal/kwh   ----(11.1.3)

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

(v) TEC_{BY}=Total Energy consumption for BY in Million kwh

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

7.5.2 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. Actual Generation Net 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 per following calculation.

(i)   Notional energy for Power export to be subtracted in the assessment year [Million kcal] =$(EXP_{AY} -EXP_{BY})*[\{(GnNHR_{AY})-2717)\}]/10$

Where:

$GnNHR_{AY}$: Generation Net Heat Rate for AY in kcal/kwh

EXP_{AY}: Exported Electrical Energy in AY in Lakh kwh

EXP_{BY}: Exported Electrical Energy in BY in Lakh kwh

7.5.3 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]

7.6 Normalisation Others

7.6.1 Environmental Concern ((Additional Environmental Equipment requirement due to major change in government policy on Environment)

7.6.1.1 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.

7.6.1.2 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.

7.6.1.3 Notional Energy to be deducted to Environmental Concern

Additional Environmental Equipment requirement due to major change in government policy on Environment

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 normalized for additional Energy consumption details from Energy meters. This 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) ----(12.1.3)

7.6.1.4 Documentation

- Energy Meter Reading records for each additional equipment

- OEM document for Energy Capacity

- Equipment Rating plate

- DPR/MPR/Log Sheet/EMS record

7.6.2 Biomass/ Alternate Fuel Unavailability w.r.t Baseline Year

7.6.2.1 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.

7.6.2.2 Methodology

The normalization for Unavailability for Biomass or Alternate Fuel takes place only if sufficient evidence in-terms of authentic documents are to be 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.

7.6.2.3 Notional Energy to be deducted to Biomass/Alternate Fuel

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

| (ii) | **Notional Thermal Energy to be deducted in the assessment year due to Biomass/Alternate Fuel Unavailability [Million kcal]=** $FFB_{AY} \, GCVB_{BY} /1000 + FFSA_{AY} \times GCVSA_{BY} /1000 + FFB_{AY} \times GCVLA_{BY}/1000$ | ----(12.2.3) |

Where

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

$GCVB_{BY}$: 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 (Tonnes)

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

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

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

7.6.2.4 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 assessment year.

- Test Certificate of replaced Fossil Fuel GCV.

7.6.3 Construction Phase or Project Activities

7.6.3.1 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.

7.6.3.2 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.

7.6.4 Notional Energy to be deducted for Construction Phase or Project Activities

The energy consumed during construction phase or project activities are non-productive energy and hence will be subtracted in the assessment year. The energy consumed by the equipment till commissioning will also be deducted in the assessment year

| (iii) | **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) | ----(12.3.3) |

7.6.4.1 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

7.6.5   Addition of New Line/Unit (In Process and Power Generation)

7.6.5.1 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.

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, 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.

7.6.5.2 Methodology

- The Capacity Utilization 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/ Log sheet

- 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.

7.6.5.3 Thermal Energy Consumed due to Commissioning of New Process

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%.

| (iv) | **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) | ----(12.4.3 a) |

The Production during commissioning of New Process Line/Unit will be subtracted from the total production of plant and added in the import of intermediary product (Wood Pulp, Agro Pulp and RCF Pulp as applicable).

(v) **Thermal Energy Consumed from external source due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation to be subtracted in the assessment year (Million kCal)=** (Electrical Energy Consumed from external source due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation (Lakh kWh) x Weighted Average Heat rate in AY (kcal/kwh)/10) + Thermal Energy Consumed due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation (Million kcal) ----(12.4.3 b)

(vi) **Steam Generation till New Line/Unit till it attains 70% of Capacity Utilisation (CPP/Co-Gen) to be added in the assessment year (Million kCal)=** {[Steam Generation From Co-gen till New Line/Unit till it attains 70% of Capacity Utilisation (Tonne) * Steam specific Energy Consumption (kcal/kg of Steam)]} / 1000 ----(12.4.3 c)

(vii) **Thermal Energy to be added in the assessment year for Power generation of a line /unit till it attains 70% of Capacity Utilisation (Million kcal)=** Net Electricity Generation till new Line/Unit attains 70% Capacity Utilisation (Lakh kWh) x Weighted Heat Rate (kcal/kwh)/10 ----(12.4.3 d)

Where

AY: Assessment Year

7.6.5.4 Documents

• Rated Capacity of new Process/line from OEM

• Energy Meter Readings and Power Consumption record of process/line with list of equipment installed from 1st Apr to 31st March

• Thermal Energy Consumption record with list of equipment from DPR/Log book/SAP Entry in PP module

• Production record from DPR/Log book/SAP Entry in PP module

• Energy Meter Readings and Power Consumption record of unit from external source with list of equipment installed from 1st Apr to 31st March

7.6.6 Unforeseen Circumstances

7.6.7 Need for Normalization

The Normalization is required for Energy system of a plant, if the situation influences the Energy Consumption, which cannot be controlled by Plant Management and is termed as Unforeseen Circumstances. However, Proper justification in terms of authentic document is required for taking any benefit out of it.

7.6.7.1 Methodology

Any such unforeseen circumstance should be properly analyzed by the plant management before placing for Normalization

• The list of such Unforeseen circumstances should be maintained with proper Energy records

• The plant needs to maintain the Energy Meter reading record to claim any Electrical Energy Normalization for Unforeseen Circumstances.

- For Claiming any normalization towards Thermal energy under this category, the Thermal Energy Consumption records are to maintained

7.6.7.2 Thermal Energy Consumed due to unforeseen circumstances

The Normalization is required for Energy system of a plant, if the situation influences the Energy Consumption, which cannot be controlled by Plant Management and is termed as Unforeseen Circumstances. The Energy consumed due to unforeseen circumstances to be deducted in the assessment year

> (viii) **Thermal Energy consumed due to unforeseen (Million kCal) =** (Electrical Energy to be Normalized in AY x Weighted Average Heat rate in AY (kcal/kWh)/10) + Thermal Energy to be Normalized (Million kcal)   ----(12.5.3)

7.6.7.3 Documents

- Relevant document on Unforeseen Circumstances beyond the control of plant

- Energy Meter Readings and Power Consumption during the said period of unforeseen circumstances

- Thermal Energy Consumption record during the said period of unforeseen circumstances from DPR/Log book/SAP Entry

7.6.8 Renewable Energy

Normalization of Export of Power from Renewable Energy Source on which REC Certificates or Preferential Tariff ("the tariff fixed by the Appropriate Commission for sale of energy, from a generating station using renewable energy sources, to a distribution licensee") partially or fully has been claimed by a DC.

7.6.8.1 Need for Normalization

As per Renewable Energy Certificate Mechanism, any plant after meeting Renewable Purchase Obligations (RPOs) can export renewable energy in the form of electrical energy and earn Renewable Energy Certificates (REC) and/ or can opt for preferential tariff for the exported electricity.

However, The DC should not claim duel benefit on same installation from two different Government's scheme i.e. PAT Scheme and REC Mechanism.

In view of the above, a DC covered under PAT scheme and exporting electricity generated from Renewable energy source and earning REC or taking preferential tariff, partially or fully will be treated as per following methodology.

7.6.8.2 Methodology

- The quantity of exported power (partially or fully) on which Renewable Energy Certificates have been earned by Designated Consumer in the assessment year under REC mechanism shall be treated as Exported power and normalization will apply. However, the normalized power export will not qualify for issue of Energy Saving Certificates under PAT Scheme.

- The quantity of exported power (partially or fully) from Renewable energy which has been sold at a preferential tariff by the Designated consumer in the assessment year under REC mechanism shall be treated as Exported power. However, the normalized power export will not qualify for issue of Energy Saving Certificates under PAT Scheme.

7.6.8.3 Thermal Energy Conversion for REC and Preferential Tariff

(ix) **Target Saving to be achieved (PAT obligation) (TOE) =** Equivalent Major Product Output as per PAT scheme Notification (Tonnes) in BY x Target Saving to be achieved (PAT obligation) (TOE/Te) ----(12.6.3 a)

(x) **Target Saving achieved in assessment year (TOE)=** [Gate to Gate Specific Energy Consumption in BY (TOE/Te)-Normalized Gate to Gate Specific Energy Consumption in AY (TOE/Te)] x Equivalent Major Product Output in tonnes as per PAT scheme Notification (Tonnes) ----(12.6.3 b)

(xi) **Additional Saving achieved (After PAT obligation) (TOE) =** Target Saving Achieved in AY (TOE) - Target Saving to be achieved (PAT obligation) in BY (TOE) ----(12.6.3 c)

A.   Thermal Energy Conversion for REC and Preferential Tariff, if Steam Turbine Heat Rate in assessment year = 0

(xii) **Thermal energy conversion for REC and Preferential tariff (TOE)=** [Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar & Non-Solar)(MWh) + Quantum of Energy sold under preferential tariff (MWh)] x 2717/10000 ----(12.6.3 d)

B.   Thermal Energy Conversion for REC and Preferential Tariff, if Steam Turbine Heat Rate in assessment year ≠ 0

(xii) **Thermal energy conversion for REC and Preferential tariff (TOE)=** [Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar & Non-Solar)(MWh) + Quantum of Energy sold under preferential tariff (MWh)] x Generation Net Heat Rate in AY (kcal/kwh)/10000 ----(12.6.3 e)

If, Additional Saving achieved (After PAT obligation) (TOE) <= 0,

- Thermal Energy to be normalized for REC and preferential tariff power sell under REC mechanism (TOE) = 0,

If, Additional Saving achieved (After PAT obligation) (TOE) > 0, and Thermal energy conversion for REC and Preferential tariff (TOE) > Additional Saving achieved (After PAT obligation) (TOE) then

- Thermal Energy to be normalized for REC and preferential tariff power sell under REC mechanism (TOE) = Additional Saving achieved (After PAT obligation) (TOE)

If, Additional Saving achieved (After PAT obligation) (TOE) > 0, and Thermal energy conversion for REC and Preferential tariff (TOE) < Additional Saving achieved (After PAT obligation) (TOE) then

- Thermal Energy to be normalized for REC and preferential tariff power sell under REC mechanism (TOE) =Thermal energy conversion for REC and Preferential tariff (TOE)

7.6.8.4 Documentation

- Renewable Energy Certificates
- Power Purchase Agreement (PPA)for the capacity related to such generation to sell electricity at preferential tariff determined by the Appropriate Commission.
- Renewal Purchase Obligation document

8. Gate to Gate Specific Energy Consumption

The gate to gate energy consumption

(i) **Total Energy with intermediary product normalization for AY and BY (Million kcal)=** Total Energy Consumed (Million kcal) + Notional Energy for Intermediary Product (Million kcal)   ----(13.1.1)

(ii) **GtG for Equivalent product for AY & BY (Million/Te) =** Total Energy with intermediary product normalization for AY and BY (Million kcal) / Total Equivalent Production (Tonne)   ----(13.1.2)

(iii) *GtG Specific Energy Consumption in Baseline year*

$$\frac{\text{Total Energy Consumption (Million kcal)}}{\text{Total Equivalent Production (Tonnes)}} = \frac{\text{Million kcal}}{\text{Tonne}}$$ ----(13.1.3)

(iv) *GtG Specific Energy Consumption in Baseline year*

$$\frac{\text{Total Energy Consumption (Million kcal)}}{\text{Total Equivalent Production (Tonnes)} \times 10} = \frac{\text{TOE}}{\text{Tonne}}$$ ----(13.1.3)

(v) **(v) Normalised Total Energy Consumption in the assessment year (Million kcal) =** Total Energy Consumption with intermediary product normalization in the assessment year (Million kcal) - Notional Energy Consumption for Power Mix (Million kcal)- Notional Energy Consumption for CPP and Cogen Coal Quality (Million kcal)- Notional Energy Consumption for Normalisation others (Environmental Concern+ Biomass/Alternate Fuel Availability+ Project Activities+ New Line/Unit Commissioning+ Unforeseen Circumstances) (Million kcal)   ----(13.1.5)

(vi) **Normalised Total Energy Consumption after REC compliance in the assessment year (Million kcal) =** Normalised Total Energy Consumption in the assessment year (Million kcal) +Renewable Energy Certificates Compliance under PAT Scheme (Million kcal)   ----(13.1.6)

(vii) **Normalised Gate to Gate Specific Energy Consumption after REC Compliance in assessment year (Million kacl/tonne) =** Normalised Total Energy Consumption after REC Compliance (Million kcal)/Total Equivalent production (tonnes)   ----(13.1.7)

(viii) **Normalised Gate to Gate Specific Energy Consumption after REC Compliance in assessment year (ToE/tonne) =** Normalised Total Energy Consumption after REC Compliance (Million kcal)/ [Total Equivalent production (tonnes) x 10]   ----(13.1.7)

9. Normalisation Example

Various examples showing calculation of the normalization factors are presented below.

9.1 Power Mix

Following case study examples for power mix in pulp and paper mills are presented to highlight the variation in power mix in assessment and baseline years.

Case 1:

This example illustrates the condition when production, SEC for pulp and paper, Grid heat rate, co-gen heat rate, DG heat rate, exported power heat rate are similar in assessment and the baseline years. However the Electricity imported from the grid and the co-generated power differs in assessment and baseline years. The production and performance indicators, heat rates of power sources in the assessment and baseline year are presented below.

Table: Production and Performance Indicators

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
1	Paper Production	Million Tonne	0.064	0.064
2	Thermal SEC for Equivalent Paper Production	kcal/kg	1250	1250
3	Electrical SEC up to Pulp	kWh/Tonne	550	550
4	Electrical SEC up to Paper	kWh/Tonne	400	400
5	Total Thermal energy used in Process	Million kcal	80000	80000

Table: Heat Rate of Power sources

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
6	Grid heat rate	kcal/kWh	860	860
7	Co-Gen heat rate	kcal/kWh	2200	2200
8	DG heat rate	kcal/kWh	2600	2600
9	Exported Power Heat rate	kcal/kWh	2717	2717

In the above table all the power sources in a plant are not considered, however for example purpose power sources like Grid import, Co-Gen and DG heat rate are considered, the same has been replicated in the original normalization factors.

The variation in power mix, i.e., electricity imported from grid and electricity exported to the grid is shown, below in energy data from power sources table.

Table: Energy Data from Power Sources

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
10	Total Electricity Consumption of Plant without WHR generation	Million kWh	60.00	60.00
11	Total Electricity availability without WHR	Million kWh	65.00	65.00
12a	Electricity imported from the grid	Million kWh	10.00	15.00
12b	Electricity generated from Co-Gen	Million kWh	50.00	50.00
12c	Electricity generated from DG	Million kWh	5.00	5.00
12d	Electricity generated from WHR	Million kWh	5.00	5.00
13	Electricity exported to the grid	Million kWh	5.00	10.00
14	Co-Gen generated Electricity Consumption within the plant	Million kWh	45.00	40.00

The table above shows the increase in grid imported power from 10 MILLION KWH to 15MILLION KWH. The plant in this case exports additional 5 MILLION KWH power to the grid, by increasing it from 5 to 10 MILLION KWH. Consumption of the co-gen power in the plant is lowered by 5MILLION KWH from grid due to increase of import from grid.

Since power is generated with heat rate @2200 kcal/kWh, while power export is being taking place @ 2717 kcal/kwh. This difference in heat rate i.e., @ 517 kcal/kWh will be a advantageous proposition for the exporting plant, since, the same is contributing in the plant Specific Energy Consumption. In this situation, the plant will consume less thermal energy [5Million kWh @ (2200-2717) kcal /kWh] for same electricity consumption with in plant. Therefore the SEC of plant will decrease. This situationneeds to be normalized so as the plant should not suffer with change in export power from the baseline year.

The table below shows the plant energy consumption.

Table: Plant Energy Consumption

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
15	Thermal Energy Equivalent of Electricity Consumed Within Plant	Million kcal	118015	108730
16	Grid Share of electricity consumption of plant	Factor	0.167	0.25
17	Co-Gen Share of electricity consumption of plant	Factor	0.75	0.667
18	DG Share of electricity consumption of plant	Factor	0.083	0.083
19	Weighted Average heat rate of plant	kcal/kWh	2010	1898.33

The share of grid power is calculated as the ratio of the total electricity consumption excluding WHR generation and Power export. For example- Grid share factor will be 10 MILLION KWH /60 MILLION KWH = 0.1667 or 16.67% of the total electricity consumption of the plant.

The weighted average heat rate is heat rate of different power sources in the baseline as well as in the assessment year. It is the summation of average of the Million kWhltiplication of heat rate and generation. Calculations of heat rate in above case of power mix are shown below.

Calculation for Heat Rate in the Baseline Year

❖ **Total Energy Consumed in Baseline year**

= Energy consumed in process + (Grid Imported electricity X 860 kcal/kWh) + (Co-Gen generated electricity X Co-Gen heat rate) + (DG generated electricity X DG heat rate) – (Grid exported electricity X 2717 kcal/kwh)

= 80000 + (10 *860) + (50*2200) + (5*2196) – (5*2717)

=198015 million kcal

❖ **Gate to Gate SEC in the baseline year**

= Total energy consumed in baseline year/ (Equivalent Paper production*1000)

= 198015/ (0.064 *1000)

= 3093.98 kcal/kg of eq. paper

The change in assessment year in the power has been observed as

• Grid import increased from 10 MILLION KWH to 15 MILLION KWH

• Grid export increased from 5 MILLION KWH to 10 MILLION KWH

• Plant electricity consumption from Co-Gen decreased from 45 MILLION KWH to 40 MILLION KWH

• Co-Gen Generation remains constant at 50MILLION KWH

If plant decreases the use of electricity from Co-Gen generation (5MILLION KWH @2200kcal/kWh) and increases the import power from grid (5MILLION KWH @ 860 kcal/kWh). In this condition, the plant will consume less thermal energy [5MILLION KWH @ (2200-860) kcal / kWh] for same electricity consumption with in plant. Therefore the SEC of plant will decrease.

Without normalization in the Assessment year, the plant will get advantage as per following calculation

❖ **Total Energy Consumed in Assessment year would have been without Normalization**

= Energy consumed in process + (Grid Imported electricity X 860 kcal/kWh) + (Co-Gen generated electricity X Co-Gen heat rate) + (DG generated electricity X DG heat rate) – (Grid exported electricity X 2717 kcal/kwh)

= 80000 + (15 x 860) + (50x2200) + (5x2600) – (10x2717)

= 188730 million kcal

❖ **Gate to Gate SEC in the baseline year**

= Total energy consumed in baseline year/ (Equivalent Paper production*1000)

= 186710/ (0.064 x1000)

=2948.90 kcal/kg of eq. paper

It may be concluded that the plant will be on the advantageous side and enjoy a gain of 3093.98-2948.90=145.073 kcal/kg of eq. paper only by increasing grid import and export power.

This affect will be nullified through normalization in Power source mix and Power exports as per following calculation

1. **For Power Source Mix:** The additional imported electricity in assessment year as compared to baseline year calculated with

the Co-Gen heat rate [5MILLION KWH @ (2200-860) kcal/kWh=6700 Million kcal] will also be added to total energy of the plant

2. **For Power Export:** The additional exported electricity in assessment year as compared to baseline year calculated with the actual Co-Gen heat rate [5MILLION KWH x (2200-2717) kcal/kWh=-2585 Million kcal] will also be subtracted from total energy of the plant

The above effect takes place for single power source and power export. There could be Million kWhltiple power sources in any plant, hence effective calculation could be evaluated through normalizing and maintaining the same share of source in the assessment year, maintained in the baseline year as per following equation

❖ **Normalized Weighted Average heat rate of plant in assessment year**

= Grid Share of electricity consumption in baseline year X Grid heat rate + Co-Gen Share of electricity consumption in baseline year X Co-Gen heat rate + DG Share of electricity Consumption in baseline year X DG heat rate

= 0.1667 *860 + 0.75* 2200 + 0.0833*2600 = 2010 kcal/kWh

The Normalised weighted heat rate is then subtracted from the weighted heat rate of the plant for assessment year to get the net increase or decrease in combined weighted heat rate. The same would be Million kWhltiplied with the plant electricity consumption for Normalistaion as per following equation

❖ **Notional energy added in total energy due change in power source mix**

= Total electricity consumed within plant X (Wt. Average heat rate of plant in assessment year - Normalized Wt. Average heat rate)

= 60*(1898.33 – 2010)

= -6700 million kcal

Similarly, for power export normalization, actual heat rate of the Co-Gen for calculating the exported electricity from the plant, since the same was calculated @2717 kcal/kwh in the baseline year, hence the equation has been derived by taking into the consideration of baseline export electricity also as per following for Million kWhlae

❖ Notional energy for exported electricity to grid subtracted from total energy

= (Exported electricity in Assessment year – Exported electricity in Baseline year) X (Co-Gen heat rate in Assessment year -2717 kcal/kWh)

= (10-5)* (2200-2717)

= -2585 million kcal

If exported power goes down in the assessment year w.r.t. baseline year: In the baseline year; the exported power is taken as 2717 kcal/kwh, which is greater than the Co-Gen heat rate. The difference in the heat rate is then Million kWhltiplied with the exported power automatically gets added in the total energy consumption of Plant in the base line year.

Now in the assessment year, if the exported power goes down in comparison to the baseline values, the same quantity of energy which was added in the baseline year shall be added in the total energy consumption of the Plant. By doing this, the SEC of Plant remains same for equal condition for all situations.

The situation in terms of SEC of the plant remains unchanged if the energy of exported power would have been subtracted in the baseline year so as in the assessment year. This situation is matched in the assessment year by Power normalizations.

❖ **Total Energy Consumed in Assessment year**

= Energy consumed in process + (Grid Imported electricity X 860 kcal/kWh) + (Co-Gen generated electricity X Co-Gen heat rate) + (DG generated electricity X DG heat rate) – (Grid exported electricity X 2717 kcal/kWh) + Notional Energy for Power mix - Notional Energy for exported electricity to grid

= 80000 + (15 *860) + (50*2200)+(5*2600) – (10*2717) – (-6700 – (-2585))

= 198015 million kcal

❖ **Gate to Gate SEC in the assessment year**

= Total energy consumed in assessment year/ (Equivalent Paper production*1000)

= 198015/ (0.064 *1000)

= 3093.98 kcal/kg of eq. Paper

Table: SEC in Baseline and Assessment year

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
20	Notional Energy for Power Mix	Mkcal	0.00	-6700.00
21	Notional Energy for Exported Electricity to Grid	Mkcal	0.00	-2585.00
22	Total Energy Consumed	Mkcal	198015	198015
23	SEC	kcal/kg	3093.98	3093.98

After Normalisation in assessment year with power source mix and power export, the Gate-to-Gate Energy stand at 3093.98 kcal/kg of eq.paper, which is equivalent to baseline SEC.

Case 2 :

Benefit of increasing efficiency in Co-Gen

If a plant increases its efficiency i.e., decreased its heat rate from 2200 kcal/kwh to 2100 kcal/kwh in the assessment year, the Specific Energy Consumption of the Plant will come down as per the equation discussed above.

Table: Heat Rate of Power sources- Co-Gen Heat Rate decreased

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
11	Grid heat rate	kcal/kWh	860	860
12	Co-Gen heat rate	kcal/kWh	2200	2100
13	DG heat rate	kcal/kWh	2600	2600
14	Exported Power Heat rate	kcal/kWh	2717	2717

Table: Plant energy Consumption

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
15	Thermal Energy Equivalent of Electricity Consumed Within Plant	Million kcal	118015	113015
16	Grid Share of electricity consumption of plant	Factor	0.167	0.167
17	Co-Gen Share of electricity consumption of plant	Factor	0.75	0.75
18	DG Share of electricity consumption of plant	Factor	0.083	0.083
19	Wt. Average heat rate of plant	Kcal/kWh	2010	1934.42

Table: SEC

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
20	Notional Energy for Power Mix	Million kcal	0.00	-10700
21	Notional Energy for Exported Electricity to Grid	Million kcal	0.00	-3085
22	Total Energy Consumed	Million kcal	198015	193015
23	SEC	kcal/kg	3098.98	3015.85

The SEC has been decreased with the decrease in Heat Rate of Co-Gen as stated in the above table.

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
1	CPP Generation	Lakh kWh	1721	1726
2	Actual CPP Heat Rate	kcal/kWh	3200	3250
3	Ash	%	42	39
4	Moisture	%	18	18
5	Hydrogen	%	5	5
6	GCV	kcal/kg	3500	3200

Accordingly the boiler efficiency is also changes and is calculated as shown below in baseline year and assessment year.

❖ **Boiler efficiency in baseline year**

=92.5-[{50xA+630 (M+9H)} /GCV]

=92.5 – [{50 x 42 + 630 x (18+9x5)} / 3500]

=80.56 %

❖ **Boiler efficiency in assessment year**

=92.5-[{50xA+630 (M+9H)} /GCV]

=92.5 – [{50 x 39 + 630 x (18+9x5)} / 3200]

=79.4875 %

Calculation of the CPP heat rate in assessment year is shown as below :

❖ **The CPP heat rate in assessment year due to fuel quality**

9.2 Normalization of Coal Quality in CPP

In this example due to chane in fuel calorfic value in the baseline and assessment year, following changes have been observed in generation of power, heat rate.

= CPP heat rate in baseline year x (Boiler Efficiency in baseline year / Boiler Efficiency in assessment year)

=3200 x (80.56/79.4875)

=3243.17 kcal/kWh

❖ **Increase in the CPP heat rate of assessment year due to fuel quality**

=3247.17 – 3200

=47.17 kcal/kWh

In this case, following energy needs to be substracted from total energy for normalization of coal quality in CPP.

❖ **Notional energy to be subtracted from total energy**

= (CPP generation in assessment year (Lakh kWh) * Increase in CPP heat rate)/10

= (1726x47.17)/10   Million kcal

=7452.2811 Million kcal

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 forMillion kWhlae 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)

%H_2= 0.036C + 0.086 (VM -0.1xA) - 0.0035M^2(1-0.02M)

%N_2=2.10 -0.020 VM

Where

C= % of fixed carbon

A=% of ash

VM=% of volatile matter

M=% of moisture

9.3   Normalization of Coal Quality in Co-Gen

In case the coal from example 3 is used for co-generation, following normalization will be referred.

❖   **Boiler efficiency in baseline year**

=92.5-[{50xA+630 (M+9H)} /GCV]

Details of Co-Gen Boiler – 1.

=92.5 – [{50 x 42 + 630 x (18+9x5)} / 3500]

=80.56 %

❖   **Boiler efficiency in assessment year**

=92.5-[{50xA+630 (M+9H)} /GCV]

=92.5 – [{50 x 39 + 630 x (18+9x5)} / 3200]

=79.48 %

The steam may be generated in the plant from Co-Gen Boilers and Process Boilers sources. However, for example purpose two Co-Gen boilers and two Process Boilers are considered. The calculation was done w.r.t. the weighted value of Cogen and Process boilers separately. The same will be reflected for all the Co-Gen and Process Boilers.

Due to degradation of coal quality in the assessment year the SEC will increase which is disadvantage to plant, as the quality of coal is not in control of plant therefore the difference in the SEC due to fuel quality is considered in Normalization.

As the boilers may use Million kWhlti – fuels as input for producing steam and it may be noted that the normalization is provided only for the coal used in the boiler. In this context, percentage of coal energy used is considered in the Normalization.

As the boilers may use Million kWhlti – fuels as input for producing steam, the provision is provided for 4 types of fuels. If the types of fuels are more than 4 the rest of the fuels should be converted to equivalent of fuel type-4.

For Co-Gen Boiler (1)					
S. No	Description	Units		Base Line Year (BY)	Assessment Year (AY)
(i)	Type				
(ii)	Rated Capacity	TPH		50.0	50.0
(iii)	Total Steam Generation	Tonne		321669.0	291836.0

(iv)	Running hours	Hrs	8411.0	7892.0
(v)	Coal Consumption	Tonne	37752.0	46701.0
(vi)	GCV of Coal	kcal/kg	4838.0	4649.0
(vii)	Type of Fuel - 2 Name : Consumption	Tonne	19801.0	16861.0
(viii)	GCV of any Fuel -2	kcal/kg	3200.0	3200.0
(ix)	Type of Fuel - 3 Name : Consumption	Tonne	18533.0	42130.0
(x)	GCV of any Fuel -3	kcal/kg	2000.0	2000.0
(xi)	Type of Fuel - 4 Name : Consumption	Tonne	3417.0	0.0
(xii)	GCV of any Fuel -4	kcal/kg	12064.0	
(xiii)	Operating Capacity	TPH	38.2	37
(xiv)	Specific Energy Consumption	kcal/kg of Steam	1008.2	1217.6
(xv)	Percentage of Coal Energy Used in steam Generation	%	0.56	0.61

❖ **Specific Energy Consumption for Steam Generation Boiler (Co-Gen Boiler -1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2(Tonne) * GCV of Fuel – 2(kcal/kg)) + (Type of Fuel – 3(Tonne) * GCV of Fuel – 3(kcal/kg)) + (Type of Fuel – 4(Tonne) * GCV of Fuel – 4(kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(37752*4838) + (19801*3200) + (18533*2000) + (3417*12064)]/321669

= 1008.2 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

= [(37752*4838)]/[(37752*4838) + (19801*3200) + (18533*2000) + (3417*12064)]

= 0.56

❖ **Specific Energy Consumption for Steam Generation Boiler (Co-Gen Boiler -1) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(46701*4649) + (16861*3200) + (42130*2000)]/ 291836

= 1217.6 kcal/kg of Steam

❖ Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 1) in AY

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

=[(46701*4649)]/[(46701*4649)+(16861*3200) + (42130*2000)]

= 0.61

Details of Co-Gen Boiler – 2.

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
	For Co-Gen Boiler (1)			
(i)	Type			
(ii)	Rated Capacity	TPH	60.0	60.0
(iii)	Total Steam Generation	Tonne	351689.0	331846.0
(iv)	Running hours	Hrs	8411.0	8416
(v)	Coal Consumption	Tonne	38752.0	38701.0
(vi)	GCV of Coal	kcal/kg	4838.0	4649.0
(vii)	Type of Fuel - 2 Name : Consumption	Tonne	18911.0	26891.0
(viii)	GCV of any Fuel -2	kcal/kg	3200.0	3200.0
(ix)	Type of Fuel - 3 Name : Consumption	Tonne	19533.0	33130.0
(x)	GCV of any Fuel -3	kcal/kg	2000.0	2000.0
(xi)	Type of Fuel - 4 Name : Consumption	Tonne	3417.0	936.0
(xii)	GCV of any Fuel -4	kcal/kg	12064.0	12064.0
(xiii)	Operating Capacity	TPH	41.812	46.55
(xiv)	Specific Energy Consumption	kcal/kg of Steam	933.45	1035.2
(xv)	Percentage of Coal Energy Used in steam Generation	%	0.571	0.523

❖ **Specific Energy Consumption for Steam Generation Boiler (Co-Gen Boiler -2) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(38752*4838) + (18911*3200) + (19533*2000) + (3417*12064)]/351689

= 933.45 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 2) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

=[(38752*4838)]/[(38752*4838) + (18911*3200) + (19533*2000) + (3417*12064)]

= 0.571

❖ **Specific Energy Consumption for Steam Generation Boiler (Co-Gen Boiler -2) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(38701*4649) + (26891*3200) + (33130*2000) + (936*12064)]/331846

= 1035.2 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 2) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

= [(38701*4649)]/[(38701*4649) + (26891*3200) + (33130*2000) + (936*12064)]

= 0.523

Details of Process Boiler – 1.

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
	For Process Boiler (3)			
(i)	Type			
(ii)	Rated Capacity	TPH	6.0	6.0
(iii)	Total Steam Generation	Tonne	15968.0	16274.0
(iv)	Running hours	Hrs	4990.0	5249.0
(v)	Coal Consumption	Tonne	2563.0	2579.0
(vi)	GCV of Coal	kcal/kg	5050.0	4935.0
(vii)	Type of Fuel - 2 Name : Consumption	Tonne	1368.0	1459.0
(viii)	GCV of any Fuel -2	kcal/kg	3200.0	3200.0
(ix)	Type of Fuel - 3 Name : Consumption	Tonne	934.0	972.0
(x)	GCV of any Fuel -3	kcal/kg	1100.0	1100.0
(xi)	Type of Fuel - 4 Name : Consumption	Tonne	132.0	152.0
(xii)	GCV of any Fuel -4	kcal/kg	2300.0	2300.0
(xiii)	Operating Capacity	TPH	3.2	3.1
(xiv)	Specific Energy Consumption	kcal/kg of Steam	1168.1	1156.1
(xv)	Percentage of Coal Energy Used in steam Generation	%	0.69	0.68

❖ **Specific Energy Consumption for Steam Generation Boiler (Process Boiler -1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(2563*5050) + (1368*3200) + (934*1100) + (132*2300)]/15968

= 1168.1 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Process Boiler – 1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/

kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

= [(2563*5050)]/[(2563*5050) + (1368*3200) + (934*1100) + (132*2300)]

= 0.69

❖ **Specific Energy Consumption for Steam Generation Boiler (Process Boiler -1) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(2579*4935) + (1459*3200) + (972*1100) + (152*1100)]/16274

= 1156.1 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 2) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(2579*4935)]/[(2579*4935) + (1459*3200) + (972*1100) + (152*1100)]

= 0.68

Details of Process Boiler - 2

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
	For Co-Gen Boiler (4)			
(i)	Type			
(ii)	Rated Capacity	TPH	12.0	12.0
(iii)	Total Steam Generation	Tonne	55655.0	57986.0
(iv)	Running hours	Hrs	6788.0	7343.0
(v)	Coal Consumption	Tonne	12707.0	13540.0
(vi)	GCV of Coal	kcal/kg	4520.0	4230.0
(vii)	Type of Fuel - 2 Name : Consumption	Tonne	435.0	487.0
(viii)	GCV of any Fuel -2	kcal/kg	2500.0	3200.0
(ix)	Type of Fuel - 3 Name : Consumption	Tonne	0	0
(x)	GCV of any Fuel -3	kcal/kg		
(xi)	Type of Fuel - 4 Name : Consumption	Tonne	0	0
(xii)	GCV of any Fuel -4	kcal/kg		
(xiii)	Operating Capacity	TPH	8.2	7.9
(xiv)	Specific Energy Consumption	kcal/kg of Steam	1051.5	1014.6
(xv)	Percentage of Coal Energy Used in steam Generation	%	0.981	0.974

❖ **Specific Energy Consumption for Steam Generation Boiler (Process Boiler -1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

= [(12707*4520) + (435*2500)]/55655

= 1051.5 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Process Boiler – 1) in BY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg))]/ [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))]

=[(12707*4520)]/[(12707*4520)+(435*2500)]

= 0.981

❖ **Specific Energy Consumption for Steam Generation Boiler (Process Boiler -1) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel (Tonne) – 2 * GCV of Fuel – 2(kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3(kcal/kg)) + (Type of Fuel – 4 (kcal/kg) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation(Tonne))]

= [(13540*4230) + (487*3200)]/57986

= 1014.6 kcal/kg of Steam

❖ **Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler – 2) in AY**

= [(Coal Consumption (Tonne) * GCV of Coal (kcal/kg)) + (Type of Fuel – 2 (Tonne) * GCV of Fuel – 2 (kcal/kg)) + (Type of Fuel – 3 (Tonne) * GCV of Fuel – 3 (kcal/kg)) + (Type of Fuel – 4 (Tonne) * GCV of Fuel – 4 (kcal/kg))] / [(Total Steam Generation (Tonne))]

=[(13540*4230)]/[(13540*4230)+(487*3200)]

= 0.974

Sr No	Description	Unit	Baseline Year [BY]	Assessment Year [AY]
1	Boiler Efficiency	%	80.56	79.48
2	Steam Generation at Boiler 1-2 (Co-Gen Boiler)*	Tonne	673358.0	623682.0
3	Steam Generation at Boiler 3-4 (Process Boiler)**	Tonne	71623.0	74260.0
4	Specific Energy Consumption for Steam Generation Boiler 1-2 (Co-Gen Boiler)	Kcal/ kg of Steam	969.137	1100.17
5	Specific Energy Consumption for Steam Generation Boiler 3-4 (Process Boiler)	Kcal/ kg of Steam	1084.22	1054.47
6	Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler)	Factor	0.565	0.561
7	Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler)	Factor	0.899	0.891

*: *The above example stands for 2 Cogen Boiler 1-2, the calculation could be repeated for 1-12 nos of boiler*

**: *The above example stands for 2 Process Boiler 1-2, the calculation could be repeated for 13-16 nos of boiler*

- ❖ **Steam Generation at Boiler (1-2) in BY**

  = Steam Generation by Co-Gen Boiler – 1 (Tonne) (BY) + Steam Generation by Co-Gen Boiler – 2 (Tonne) (BY)

  = 321669.0 + 351689.0

  = 673358.0 Tonne

- ❖ **Steam Generation at Boiler (1-2) in AY**

  = Steam Generation by Co-Gen Boiler – 1 (AY) (Tonne) + Steam Generation by Co-Gen Boiler – 2 (Tonne) (AY)

  = 291836.0+ 331846.0

  = 623682.0 Tonne

- ❖ **Steam Generation at Boiler (3-4) in BY**

  = Steam Generation by Co-Gen Boiler – 1 (BY) (Tonne) + Steam Generation by Co-Gen Boiler – 2 (Tonne) (BY)

  = 15968.0 + 55655.0

  = 71623 Tonne

- ❖ **Steam Generation at Boiler (1-2) in AY**

  = Steam Generation by Co-Gen Boiler – 1 (Tonne) (AY) + Steam Generation by Co-Gen Boiler – 2 (Tonne) (AY)

  = 16274.0 + 57986.0

  = 74260.0 Tonne

- ❖ **Specific Energy Consumption for Steam Generation Boiler 1-2 (Co-Gen Boiler) in BY**

  = (Specific Energy Consumption form Steam Generation Co-Gen Boiler-1 (kcal/kg steam) (BY)* Operating TPH of Co-Gen Boiler-1 (BY)) + (Specific Energy Consumption form Steam Generation Co-Gen Boiler-2 (kcal/kg steam) (BY) * Operating TPH of Co-Gen Boiler-2 (BY)) / [(Operating TPH of Co-Gen Boiler-1(BY)) + (Operating TPH of Co-Gen Boiler-2 (BY)]

  =[(1008.2*38.2+933.45*41.812)]/[(38.2+41.812)]

  = 969.137 kcal/ kg of Steam

- ❖ Specific Energy Consumption for Steam Generation Boiler 1-2 (Co-Gen Boiler) in AY

  = [(Specific Energy Consumption form Steam Generation Co-Gen Boiler-1 (kcal/kg steam) (AY) * Operating TPH of Co-Gen Boiler-1 (AY)) + (Specific Energy Consumption form Steam Generation Co-Gen Boiler-2 (kcal/kg steam) (AY) * Operating TPH of Co-Gen Boiler-2 (AY)) / [(Operating TPH of Co-Gen Boiler-1 (AY))] + (Operating TPH of Co-Gen Boiler-2 (AY)]

  =[(1217.6*37+1035.2*46.55)]/[(38.2+ 46.55)]

  = 1100.17 kcal/ kg of Steam

- ❖ **Specific Energy Consumption for Steam Generation Boiler 3-4 (Process Boiler) in BY**

  = [(Specific Energy Consumption form Steam Generation Process Boiler-1 (BY) (kcal/kg steam) * Operating TPH of Process Boiler-1 (BY)) + (Specific Energy Consumption form Steam Generation Process Boiler-2 (kcal/kg steam) (BY) * Operating TPH of Process Boiler-2 (BY))]/ [(Operating TPH of Process Boiler-1 (BY)) + (Operating TPH of Process Boiler-2 (BY)]

  = [(1168.1*3.2+8.2*1051.5)]/[(8.2+3.2)]

  = 1084.22 kcal/ kg of Steam

- ❖ **Specific Energy Consumption for Steam Generation Boiler 3-4 (Process Boiler) in AY**

  = (Specific Energy Consumption form Steam Generation Process Boiler-1 (kcal/kg steam) (AY) * Operating TPH of Process Boiler-1 (AY)) + (Specific Energy Consumption form Steam Generation Process Boiler-2 (kcal/kg steam) (AY) * Operating TPH of Process Boiler-2 (AY))/ [(Operating TPH of Process Boiler-1 (AY)) + (Operating TPH of Process Boiler-2 (AY)]

  = [(1156.1*3.1+ 1014.6 *7.9)]/[(3.1+7.9)]

  = 1054.47 kcal/ kg of Steam

- ❖ **Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler) BY**

  = [(Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler-1) (kcal/kg steam) (BY) * Operating TPH of Co-Gen Boiler-1 (BY)) + (Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler-2) (kcal/kg steam) (BY) * Operating TPH of Co-Gen Boiler-2 (BY)] / [(Operating TPH of Co-Gen Boiler-1 (BY) + Operating TPH of Co-Gen Boiler-2 (BY)]

  =[(0.56*38.2)+(0.571*41.812)]/[(38.2+ 41.812)]

  = 0.565

- ❖ **Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler) AY**

  = [(Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler-1) (kcal/kg steam) (AY) * Operating TPH of Co-Gen Boiler-1 (AY)) + (Weighted Percentage of Coal Energy Used in steam Generation (Co-Gen Boiler-2) (kcal/kg steam) (AY) * Operating TPH of Co-Gen Boiler-2 (AY)] / [(Operating TPH of Co-Gen Boiler-1 (AY) + Operating TPH of Co-Gen Boiler-2 (AY)]

  = [(0.61*37) + (0.523*46.55)]/ [(37+46.55)]

  = 0.561

- ❖ **Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler) BY**

  = [(Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler-1) (kcal/kg steam) (BY) * Operating TPH of Process Boiler-1 (BY)) + (Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler-2) (kcal/kg steam) (BY) * Operating TPH of Process Boiler-2 (BY)] / [(Operating TPH of Process Boiler-1 (BY) + Operating TPH of Process Boiler-2 (BY)]

  = [(0.69*3.2) + (0.981*8.2)]/ [(3.2+8.2)]

  = 0.899

- ❖ **Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler) AY**

  = [(Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler-1) (kcal/kg steam) (AY) * Operating TPH of Process Boiler-1 (AY)) + (Weighted Percentage of Coal Energy Used in steam Generation (Process Boiler-2) (kcal/kg steam) (AY) * Operating TPH of Process Boiler-2 (AY)] / [(Operating TPH of Process Boiler-1 (AY) + Operating TPH of Process Boiler-2 (AY)]

  = [(0.68*3.1) + (0.974*7.9)]/ [(3.1+7.9)]

  = 0.891

- ❖ **Weighted Specific Energy Consumption for Steam Generation (BY)**

  = [(Steam Generation at Boiler 1-2 (Tonne) (BY) x Specific Energy Consumption for Steam Generation in Cogen Boiler 1-2 (kcal/kg steam) (BY)) + (Steam Generation at Boiler 3-4 (Tonne)(BY) x Specific Energy Consumption for Steam Generation in Process Boiler 3-4 (kcal/kg steam) (BY))]/ (Steam Generation at Boiler 1-2 (Tonne) (BY) + Steam Generation at Boiler 3-4 (Tonne) (BY))

  = [(673358*969.137) + (71623.0*1084.22)]/ [(673358+71623.0)]

  = 980.20kcal/kg of Steam

- ❖ **Weighted Specific Energy Consumption for Steam Generation (AY)**

  =[(Steam Generation at Boiler 1-2 (Tonne) (AY) x Specific Energy Consumption for Steam Generation in Cogen Boiler 1-2 (kcal/kg steam) (AY)) + (Steam Generation at Boiler 3-4 (Tonne) (AY) x Specific Energy Consumption for Steam Generation in Process Boiler 3-4 (kcal/kg) (AY))]/ [(Steam Generation at Boiler 1-2 (Tonne) (AY) + Steam Generation at Boiler 3-4 (Tonne) (AY)]

  = [(623682*1100.17) + (74260*1054.47)]/ [(623682+74260)]

  = 1095.3kcal/kg of Steam

❖ **Normalized Specific Energy Consumption for Steam Generation (AY) (kcal/kg of Steam)**

= Specific Energy Consumption for Steam Generation Boiler 1-4 (BY)*(Boiler Efficiency (BY)/Boiler Efficiency (AY))

=980.20*(80.56/79.48)

=993.425 kcal/ kg of Steam

❖ **Difference Specific Steam from (BY) to (AY) (kcal/kg of Steam)=**

(Normalized Specific Energy Consumption for Steam Generation (kcal/kg steam) (AY) - Specific Energy Consumption for Steam Generation Boiler 1-4 (kcal/kg steam) (BY))

= (993.425 – 980.20)

=13.225kcal/kg of Steam

❖ **Notional energy to be subtracted w.r.t. Fuel Quality in Steam Generation Boiler (Million kcal)=**

((Difference Specific Steam from (BY) to (AY) (kcal/kg of Steam)*{Steam Generation at Boiler 1-2 (AY) (Tonne) * (Weighted Percentage of Coal Energy Used in steam Generation Boiler 1-2 (AY) (Co-Gen Boiler)+ Steam Generation at Boiler 3-4 (Tonne) (AY) * (Weighted Percentage

of Coal Energy Used in steam Generation Boiler 3-4(AY) (Process Boiler)}/1000

= {13.225*[(623682*0.561) + (74260* 0.891)]}/1000

= 5502.27 Million kcal

9.4 Intermediary Product (Pulp)

In the Pulp & Paper Sector pulp can be produced by following raw materials:

- Wood (chiper+digestor+WSC+bleach plant)

- Agro (depither,cutter+digestor+WSC+bleach plant)

- RCF (hydrapulper+deinking+bleach plant)

Pulp mills based on the above will have different process to produce the pulp. Hence, there will be variation in the specific energy consumption for process specific. 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 process to prepare pulp and final product produced could be nullified and the concerned plant should not suffer / or gain advantage due to this change only.

Production Details

S. No	Saleable Pulp Details	Units	Base Line Year (BY)	Assessment Year (AY)
1	Wood bleached Saleable Pulp Production	Tonne	10764.0	10782.0
2	Agro bleached Saleable Pulp Production	Tonne	26908.0	26774.0
3	RCF bleached Saleable Pulp Production	Tonne	13128.0	13189.0
4	Total Bleached Saleable Pulp	Tonne	50800	50745

Production Details

S. No	Closing and Opening Stock of Pulp	Units	Base Line Year (BY)	Assessment Year (AY)
1	Wood bleached Saleable Pulp Production	Tonne	10764.0	10782.0
2	Agro bleached Saleable Pulp Production	Tonne	26908.0	26774.0
3	RCF bleached Saleable Pulp Production	Tonne	13128.0	13189.0
4	Total Bleached Saleable Pulp	Tonne	50800	50745

Closing and Opening Stock of Pulp

S. No	Closing and Opening Stock of Pulp	Units	Base Line Year (BY)	Assessment Year (AY)
1	Opening Stock of Total wood Bleached saleable Pulp	Tonne	1530.0	1960.0
2	Opening Stock of Total Agro Bleached saleable Pulp	Tonne	1450.0	2580.0
3	Opening Stock of Total RCF Bleached saleable Pulp	Tonne	2480.0	1790.0
4	Closing Stock of Total wood Bleached saleable Pulp	Tonne	1530.0	1960.0
5	Closing Stock of Total Agro Bleached saleable Pulp	Tonne	2680.0	5690.0
6	Closing Stock of Total RCF Bleached saleable Pulp	Tonne	2480.0	1790.0

Import & Export Details

S. No	Closing and Opening Stock of Pulp	Units	Base Line Year (BY)	Assessment Year (AY)
1	Import Wood Bleached Pulp	Tonne	1250	4560
2	Import Agro Bleached Pulp	Tonne	0	0
3	Import RCF Bleached Pulp	Tonne	4250	8520
4	Export Wood Bleached Pulp	Tonne	0	0
5	Export Agro Bleached Pulp	Tonne	0	0
6	Export RCF Bleached Pulp	Tonne	0	0

Pulp Stock

S. No	Closing and Opening Stock of Pulp	Units	Base Line Year (BY)	Assessment Year (AY)
1	Wood bleached pulp stock	Tonne	0	0
2	Agro bleached pulp stock	Tonne	1230	3110
3	RCF bleached pulp stock	Tonne	0	0

Pulp Stock

Wood bleached pulp stock [Tonnes] (BY)
= Closing Stock of Total wood Bleached saleable Pulp (Tonnes)- Opening Stock of Total wood Bleached saleable Pulp (Tonnes)
= 1530 – 1530
= 0

Wood bleached pulp stock [Tonnes] (AY)
= Closing Stock of Total wood Bleached saleable Pulp (Tonnes)- Opening Stock of Total wood Bleached saleable Pulp (Tonnes)
= 1960 – 1960
= 0

Agro bleached pulp stock [Tonnes] (BY)
= Closing Stock of Total Agro Bleached saleable Pulp (Tonnes) - Opening Stock of Total Agro Bleached saleable Pulp (Tonnes)
= 2680 – 1450
= 1230

Agro bleached pulp stock [Tonnes] (AY)
= Closing Stock of Total Agro Bleached saleable Pulp (Tonnes) - Opening Stock of Total Agro Bleached saleable Pulp (Tonnes)
= 5690 – 2580
= 3110

RCF bleached pulp stock [Tonnes] (BY)
= Closing Stock of Total RCF Bleached saleable Pulp (Tonnes) - Opening Stock of Total RCF Bleached saleable Pulp (Tonnes)
= 2480-2480
= 0

RCF bleached pulp stock [Tonnes] (AY)
= Closing Stock of Total RCF Bleached saleable Pulp (Tonnes) - Opening Stock of Total RCF Bleached saleable Pulp (Tonnes)
= 1790 – 1790
= 0

Total Import/Export

S. No	Closing and Opening Stock of Pulp	Units	Base Line Year (BY)	Assessment Year (AY)
1	Total Wood bleached Export	Tonne	0.0	0
2	Total Agro bleached Export	Tonne	1230	3110
3	Total RCF bleached Export	Tonne	0	0
4	Total Wood bleached Import	Tonne	1250	4560
5	Total Agro bleached Import	Tonne	0	0
6	Total RCF bleached Import	Tonne	4250	8520

Pulp Export

Wood Pulp:

If Wood bleached pulp stock> 0, following calculation will be used for Total Wood bleached Export

❖ **Total Wood bleached Export [Tonnes] (BY) =** Export Wood Bleached Pulp (Tonnes) + Wood bleached pulp stock (Tonnes)
= 0 + 0 = 0

❖ **Total Wood bleached Export [Tonnes] (AY) =** Export Wood Bleached Pulp (Tonnes) + Wood bleached pulp stock (Tonnes)
= 0 + 0 = 0

Agro Pulp:

If Agro bleached pulp stock > 0, following calculation will be used for Total Agro bleached Export (BY)

❖ **Total Agro bleached Export [Tonnes] (BY) =** Export Agro Bleached Pulp (Tonnes) + Agro bleached pulp stock (Tonnes)
= 0 + 123
= 123

❖ **Total Agro bleached Export [Tonnes] (AY) =** Export Agro Bleached Pulp (Tonnes) + Agro bleached pulp stock (Tonnes)
= 0 + 3110
= 3110

RCF Pulp:

If RCF bleached pulp stock> 0, following calculation will be used for Total RCF bleached Export

❖ **Total RCF bleached Export [Tonnes] =** Export RCF Bleached Pulp (Tonnes) + RCF bleached pulp stock (Tonnes)
= 0 + 0
= 0

Pulp Import

Pulp produced till new line attains 70% of capacity utilisation will be subtracted from the total pulp production and added into the pulp import. So that the energy added for this amount of produced pulp will be equal to the normal energy consumption required to produce the same amount.

Wood Pulp:

If Wood Bleached Pulp Stock > 0, following calculation will be used for Total Wood bleached Import

❖ **Total Wood bleached Import [Tonnes] (BY) =** Import Wood Bleached Pulp (Tonnes) + Wood Pulp Production till new line attains 70% of Capacity utilization
= 1250 + 0
= 1250

❖ **Total Wood bleached Import [Tonnes] (AY) =** Import Wood Bleached Pulp (Tonnes) + Wood Pulp Production till new line attains 70% of Capacity utilization
= 4560 + 0
= 4560

Agro Pulp:

If Agro Bleached Pulp Stock > 0, following calculation will be used for Total Agro bleached Import

❖ **Total Agro bleached Import [Tonnes] (BY) =** Import Agro Bleached Pulp (Tonnes) + Agro Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)
= 0 + 0= 0

❖ **Total Agro bleached Import [Tonnes] (AY) =** Import Agro Bleached Pulp (Tonnes) + Agro Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)
= 0 + 0= 0

RCF Pulp:

If RCF Bleached Pulp Stock > 0, following calculation will be used for Total Agro bleached Import

❖ **PIRP = Total RCF bleached Import [Tonnes] (BY) =** Import RCF Bleached Pulp (Tonnes) + RCF Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)
= 4250 + 0
= 4250

❖ **PIRP = Total RCF bleached Import [Tonnes] (AY) =** Import RCF Bleached Pulp (Tonnes) + RCF Pulp Production till new line attains 70% of Capacity utilisation (Tonnes)
= 8520 + 0
= 8520

Specific Energy Consumption will be calculated as same equivalent product calculation. The detailed calculation is shown in the equivalent product calculation. However, the Specific Energy consumption of Wood-pulp, Agro-pulp and RCF-pulp are shown in below table

Specific Energy Consumption of Wood Pulp Mill

S. No	Wood pulp Mill (chiper+digestor+WSC+bleach Plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	631806	624946
2	Specific Steam Consumption -LP	kcal/Tonne	778050	771400
3	Specific Power Consumption	kcal/Tonne	385497	246172.2
4	Total Specific Energy Consumption (Wood Pulp)	kcal/Tonne	1795353	1642518.2
5	Total Agro bleached Import	Tonne	0	0
6	Total RCF bleached Import	Tonne	4250	8520

Specific Energy Consumption of Agro Pulp Mill

S. No	Agro Pulp Mill (depither,cutter+digestor+ WSC+bleach plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	1526350	1159340
2	Specific Steam Consumption -LP	kcal/Tonne	2969225	3003140
3	Specific Power Consumption	kcal/Tonne	1665749.80	1043215.916
4	Total Specific Energy Consumption (Agro Pulp)	kcal/Tonne	6161324.8	5205695.916

Specific Energy Consumption of RCF Pulp Mill

S. No	RCF Pulp Mill (hydrapulper+deinking+bleach plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	0	0
2	Specific Steam Consumption -LP	kcal/Tonne	841225	907725
3	Specific Power Consumption	kcal/Tonne	1166520.97	997679.085
4	Total Specific Energy Consumption (RCF Pulp)	kcal/Tonne	2007745.97	1905404.085

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. The net-energy consumption of the plant based on the Import & Export (Wood, Agro & RCF) is shown below.

Energy Consumption for Import and Export of Wood Bleached Pulp

S. No	Wood bleached pulp Energy	Units	Base Line Year (BY)	Assessment Year (AY)
1	Export Energy for wood bleached pulp	Million Kcal/ Annum	0.0	0.0
2	Import Energy for wood bleached pulp	Million Kcal/ Annum	696.241	2776.22
3	Net Energy for wood bleached pulp	Million Kcal/ Annum	696.241	2776.22
4	Total Specific Energy Consumption (RCF Pulp)	kcal/Tonne	2007745.97	1905404.085

❖ **Export Energy for wood bleached pulp (BY) =** (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (Wood Pulp) (kcal/kg))*10^6
= 0

❖ **Export Energy for wood bleached pulp (AY) =** (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (Wood Pulp) (kcal/kg))*10^6
= 0

❖ **Import Energy for wood bleached pulp (BY) =** (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (Wood Pulp) (kcal/kg))*10^6
= (1250/1795353) * 10^6
= 696.241 Million kcal

❖ **Import Energy for wood bleached pulp**

(AY) = (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (Wood Pulp) (kcal/kg))*10^6
= (4560/1642518.2) * 10^6
= 2776.22 Million kcal

❖ **Net Energy for wood bleached pulp (BY) =** Export Energy for wood bleached pulp (Million kcal) (BY) + Import Energy for wood bleached pulp (BY) (Million kcal)
= 0 + 696.241
= 696.241 Million kcal

❖ **Net Energy for wood bleached pulp (AY) =** Export Energy for wood bleached pulp (AY) (Million kcal) + Import Energy for wood bleached pulp (AY) (Million kcal)
= 0 + 2776.22
= 2776.22 Million kcal

Energy Consumption for Import and Export of Wood Bleached Pulp

S. No	Agro bleached pulp Energy	Units	Base Line Year (BY)	Assessment Year (AY)
1	Export Energy for Agro bleached pulp	Million Kcal/ Annum	0.0	0.0
2	Import Energy for Agro bleached pulp	Million Kcal/ Annum	0.0	0.0
3	Net Energy for Agro bleached pulp	Million Kcal/ Annum	0.0	0.0

❖ **Export Energy for Agro bleached pulp (BY) =** (Total Agro bleached Export (Tonne)/ Total Specific Energy Consumption (Agro Pulp) (kcal/kg))*10^6
= (1230/6161324.8) * 10^6
= 199.63 Million kcal

❖ **Export Energy for Agro bleached pulp (AY) =** (Total Agro bleached Export (Tonne)/ Total Specific Energy Consumption (Agro Pulp) (kcal/kg))*10^6
= (3110/5205695.916) * 10^6
= 597.422 Million kcal

❖ **Import Energy for Agro bleached pulp (BY) =** (Total Agro bleached Export (Tonne)/ Total Specific Energy Consumption (Agro Pulp) (kcal/kg))*10^6
= 0

❖ **Import Energy for wood bleached pulp (AY) =** (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (Wood Pulp) (kcal/kg))*10^6
= 0

❖ **Net Energy for Agro bleached pulp (BY) =** Export Energy for wood bleached pulp (Million kcal) (BY) + Import Energy for Agro bleached pulp (BY) (Million kcal)
= 199.63 + 0
= 199.63 Million kcal

❖ **Net Energy for Agro bleached pulp (AY) =** Export Energy for Agro bleached pulp (AY) (Million kcal) + Import Energy for Agro bleached pulp (AY) (Million kcal)
= 597.422 + 0
= 597.422 Million kcal

Energy Consumption for Import and Export of RCF Bleached Pulp

S. No	RCF bleached pulp Energy	Units	Base Line Year (BY)	Assessment Year (AY)
1	Export Energy for RCF bleached pulp	Million Kcal/ Annum	0.0	0.0
2	Import Energy for RCF bleached pulp	Million Kcal/ Annum	0.0	0.0
3	Net Energy for RCF bleached pulp	Million Kcal/ Annum	0.0	0.0

❖ **Export Energy for RCF bleached pulp (BY) =** (Total RCF bleached Export (Tonne)/ Total Specific Energy Consumption (RCF Pulp) (kcal/kg))*10^6
= 0

❖ **Export Energy for Agro bleached pulp (AY) =** (Total Agro bleached Export (Tonne)/ Total Specific Energy Consumption (RCF Pulp) (kcal/kg))*10^6
= 0

❖ **Import Energy for Agro bleached pulp (BY) =** (Total Agro bleached Export (Tonne)/

Total Specific Energy Consumption (RCF Pulp) (kcal/kg))*10^6
= (4250/2007745.97) * 10^6
= 2116.80 Million kcal

❖ **Import Energy for RCF bleached pulp (AY) =** (Total Wood bleached Export (Tonne)/ Total Specific Energy Consumption (RCF Pulp) (kcal/kg))*10^6
= (8520/1905404.085) * 10^6
= 4471.49 Million kcal

❖ **Net Energy for RCF bleached pulp (BY) =** Export Energy for wood bleached pulp

(Million kcal) (BY) + Import Energy for RCF bleached pulp (BY) (Million kcal)
= 0 + 2116.80
= 2116.80 Million kcal

❖ **Net Energy for RCF bleached pulp (AY)**

= Export Energy for RCF bleached pulp (AY) (Million kcal) + Import Energy for RCF bleached pulp (AY) (Million kcal)
= 0 + 4471.49
= 4471.49 Million kcal

S. No	Net Import/Export Energy for bleached pulp to be added	Units	Base Line Year (BY)	Assessment Year (AY)
1	Net Energy for Wood bleached pulp	Million kcal	696.241	2776.22
2	Net Energy for Agro bleached pulp	Million kcal	199.63	597.422
3	Net Energy for RCF bleached pulp	Million kcal	2116.80	4471.49
4	Total Net Import/Export Energy for bleached pulp to be added	Million kcal	3012.671	7845.132

The Notional Energy for the Import/Export for the bleached pulp will be added to the Total Energy Consumption of the plant.

9.5 Equivalent Product (Pulp)

Pulp mills based on the above will have different process to produce the pulp. Hence, there will be variation in the specific energy consumption for process specific.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 process to prepare pulp and final product produced could be nullified and the concerned plant should not suffer / or gain advantage due to this change only.

Energy Details

S. No	Particulars	Units	Base Line Year (BY)	Assessment Year (AY)
	Enthalpy and Heat Rate			
1	Enthalpy of MP steam	kcal/kg	686.00	686.00
2	Enthalpy of LP steam	kcal/kg	665.00	665.00
3	Heat Rate	kcal/kWh	2619.40	1734.34

The production details of the wood pulp are captured along with the steam consumption both (MP and LP) along with the Electrical Energy Consumption. Based on the Major product the conversion factors are applied.

Production Details of Wood Pulp

S. No	Wood pulp Mill(chiper+digestor+WSC+bleach plant+ Recovery+utilities+Others)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	10764.00	10782.00
2	Steam Consumption	Tonne- MP	9914.00	9832.00
3	Steam Consumption	Tonne- LP	12586.00	12497.00
4	Power Consumption	kWh	1530356.00	1530375.00
5	Steam-MP	T-MP/Tonne	0.92	0.91
6	Steam-LP	T-LP/Tonne	1.17	1.16
7	Power	kWh/Tonne	142.17	141.94

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (9914/10764)
= 0.921

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (9832/10782)
= 0.911

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (12586/10764)
= 1.17

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (12497/10782)
= 1.16

❖ Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (1530356/10764)
= 142.17

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (1530375/10782)
= 141.93

Specific Energy Consumption Calculation

S. No	Wood pulp Mill (chiper+digestor+WSC+bleach Plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	631806	624946
2	Specific Steam Consumption -LP	kcal/Tonne	778050	771400
3	Specific Power Consumption	kcal/Tonne	385497	246172.2
4	Total Specific Energy Consumption (Wood Pulp)	kcal/Tonne	1795353	1642518.2

❖ **Specific Steam Consumption – MP (kcal/Tonne) (BY)**
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.921 * 686 * 1000
= 631806 kcal/Tonne

❖ **Specific Steam Consumption – MP (kcal/Tonne) (AY)**
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.911 * 686 * 1000
= 624946 kcal/Tonne

❖ **Specific Steam Consumption – LP (kcal/Tonne) (BY)**
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 1.17 * 665 * 1000
= 777563 kcal/Tonne

❖ **Specific Steam Consumption – LP (kcal/Tonne) (AY)**
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 1.16 * 665 * 1000
= 771400 kcal/Tonne

❖ **Specific Power Consumption (kcal/Tonne) (BY)**
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 147.17 * 2619.40
= 385497

❖ **Specific Power Consumption (kcal/Tonne) (AY)**
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 141.94 * 1734.34
= 246172.21

❖ **Total Specific Energy Consumption – Wood Pulp (kcal/Tonne) (BY)**
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 631806+778050+985497
= 1795353

❖ **Total Specific Energy Consumption – Wood Pulp (kcal/Tonne) (AY)**
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 624946+771400+246172.2
= 1642518.2

Production Details of Agro Pulp

S. No	Agro Pulp Mill (depither,cutter+digestor+WSC+bleach plant +Recovery+ utilities+Others)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	26908.00	26774.00
2	Steam Consumption	Tonne - MP	59880.00	45437.00
3	Steam Consumption	Tonne- LP	120152.00	120923.00
4	Power Consumption	kWh	17111566.00	16104746.00
5	Steam-MP	T-MP/Tonne	2.225	1.69
6	Steam-LP	T-LP/Tonne	4.465	4.516
7	Power	kWh/Tonne	635.928	601.506

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (59880/26908)
= 2.225

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (45437/26774)
= 1.69

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (120152/26908)
= 4.465

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (120923/26774)
= 4.516

❖ Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (17111566/26908)
= 635.928

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (16104746/26774)
= 601.506

Specific Energy Consumption Calculation

S. No	Agro Pulp Mill (depither, cutter+digestor+WSC+bleach plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	1526350	1159340
2	Specific Steam Consumption -LP	kcal/Tonne	2969225	3003140
3	Specific Power Consumption	kcal/Tonne	1665749.80	1043215.916
4	Total Specific Energy Consumption (Agro Pulp)	kcal/Tonne	6161324.8	5205695.916

❖ Specific Steam Consumption – MP (kcal/Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 2.225 * 686 * 1000
= 1526350 kcal/Tonne

❖ Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 1.69 * 686 * 1000
= 1159340 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 4.465 * 665 * 1000
= 2969225 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 4.516 * 665 * 1000
= 3003140 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (BY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 635.928 * 2619.40
= 1665749.80

❖ Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 601.506 * 1734.34
= 1043215.916

❖ **Total Specific Energy Consumption – Agro Pulp (kcal/Tonne) (BY)**

= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 1526350+2969225+1665749.8
= 6161324.8

❖ **Total Specific Energy Consumption – Agro Pulp (kcal/Tonne) (AY)**
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 1159340+3003140+1043215.916
= 5205695.916

Production Details of RCF Pulp Mill

S. No	RCF Pulp Mill (hydrapulper/ Drumpulper+deinking+bleach plant+utilities+Others)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	13128.00	13189.00
2	Steam Consumption	Tonne-MP	0.00	0.00
3	Steam Consumption	Tonne-LP	16615.00	18012.00
4	Power Consumption	kWh	5846411.00	7586984.00
5	Steam-MP	T-MP/Tonne	0.00	0.00
6	Steam-LP	T-LP/Tonne	1.265	1.365
7	Power	kWh/Tonne	445.339	575.25

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/13128)
= 0

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (16615/13128)
= 1.265

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/13189)
= 0

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (18012/13189)
= 1.365

❖   Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (17111566/13128)
= 445.339

❖   Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (7586984/13189)
= 575.25

Specific Energy Consumption Calculation

S. No	RCF Pulp Mill (hydrapulper+deinking+bleach plant)	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	0	0
2	Specific Steam Consumption -LP	kcal/Tonne	841225	907725
3	Specific Power Consumption	kcal/Tonne	1166520.97	997679.085
4	Total Specific Energy Consumption (RCF Pulp)	kcal/Tonne	2007745.97	1905404.085

❖   Specific Steam Consumption – MP (kcal/Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖   Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖   Specific Steam Consumption – LP (kcal/Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 1.265 * 665 * 1000
= 841225 kcal/Tonne

❖   Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 1.365 * 665 * 1000
= 907725 kcal/Tonne

❖   Specific Power Consumption (kcal/Tonne) (BY)

= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 445.339 * 2619.40
= 1166520.97 kcal/Tonne

❖   Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 575.25 * 1734.34
= 997679.085 kcal/Tonne

❖   **Total Specific Energy Consumption – RCF Pulp (kcal/Tonne) (BY)**
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+841225+1166520.97
= 2007745.97 kcal/Tonne

❖   **Total Specific Energy Consumption – RCF Pulp (kcal/Tonne) (AY)**
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+907725+997679.085
= 1905404.085 kcal/Tonne

Production Details of RCF Pulp Mill

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Total Specific Energy Consumption (Wood Pulp)	kcal/Tonne	1795353	1642518.2
2	Total Specific Energy Consumption (Agro Pulp)	kcal/Tonne	6161324.8	5205695.916
3	Total Specific Energy Consumption (RCF Pulp)	kcal/Tonne	2007745.97	1905404.085

The major product is the product with highest production in the baseline year. There may be conditions when the major product remains the same in assessment year as that of the baseline year, but there is variation in the other products (i.e., production quantities change for all the products) due to market demand. In this case any change in the quantities of the other products will be converted into equivalent product w.r.t the baseline year production.

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Major Product	AGRO	Tonne	26908
2	SEC of Major Product	AGRO	kcal/T	6161324.8

Conversion Factors

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	wood pulp to main product	Factor	0.291	0.291
2	Agro Pulp to main product	Factor	1.0	1.0
3	RCF Pulp to main product	Factor	0.325	0.325

❖ Conversion Factor for Wood Pulp to Main Product (BY)

$$= \frac{\text{SEC for Wood pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= (1795353/6161324.8)
= 0.291

❖ Conversion Factor for Agro Pulp to Main Product (BY)

$$= \frac{\text{SEC for Agro pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= = (6161324.8/6161324.8)
= 1

❖ Conversion Factor for Wood Pulp to Main Product (AY)

$$= \frac{\text{SEC for Wood pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= (1795353/6161324.8)
= 0.291

❖ Conversion Factor for Agro Pulp to Main Product (AY)

$$= \frac{\text{SEC for Agro pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= (6161324.8/6161324.8)
= 1

❖ Conversion Factor for Agro Pulp to Main Product (BY)

$$= \frac{\text{SEC for RCF pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= (2007745.97/6161324.8)
= 0.325

❖ Conversion Factor for Agro Pulp to Main Product (BY)

$$= \frac{\text{SEC for RCF pulp (BY)}}{\text{SEC of Major Product (BY)}}$$

= (2007745.97/6161324.8)
= 0.325

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	wood	Tonne	10764	10782
2	Agro	Tonne	26908	26774
3	RCF	Tonne	13128	13189

❖ Wood Pulp to Main Product (Tonne) (BY)
= Conversion Factor for Wood Pulp to Main Product (BY) * Total production of Wood Pulp (BY) (Tonne)
= 0.291 * 10764
= 3132.329 Tonne

❖ Wood Pulp to Main Product (Tonne) (AY)
= Conversion Factor for Wood Pulp to Main Product (AY) * Total production of Wood Pulp (AY) (Tonne)
= 0.291 * 10782
= 3137.562 Tonne

❖ Agro Pulp to Main Product (Tonne) (BY)
= Conversion Factor for Agro Pulp to Main Product (BY) * Total production of Agro Pulp (BY) (Tonne)
= 1 * 26908.00
= 26908.00 Tonne

❖ Agro Pulp to Main Product (Tonne) (AY)
= Conversion Factor for Agro Pulp to Main Product (AY) *Total production of Agro Pulp (AY) (Tonne)
= 1 * 26774.00
= 26776.00 Tonne

❖ RCF Pulp to Main Product (Tonne) (BY)
= Conversion Factor for RCF Pulp to Main Product (BY) * Total production of RCF Pulp (BY) (Tonne)
= 0.325 * 13128
= 4266.6 Tonne

❖ RCF Pulp to Main Product (Tonne) (AY)
= Conversion Factor for RCF Pulp to Main Product (AY) * Total production of RCF Pulp (AY) (Tonne)
= 0.325 * 13189
= 4286.425 Tonne

❖ Total Equivalent Product Pulp (Tonne) (BY)
= Wood Pulp to main product (Tonne) + Agro Pulp to main product + RCF Pulp to main product
= 3132.329 + 26908.00 + 4266.66
= 34306.929

❖ Total Equivalent Product Pulp (Tonne) (AY)
= Wood Pulp to main product (Tonne) + Agro Pulp to main product + RCF Pulp to main product
= 3137.562 + 26774.00 + 4286.425
= 34197.987

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Wood Pulp to main product	Tonne	3132.329	3137.562
2	Agro Pulp to main product	Tonne	26908.00	26774.00
3	RCF Pulp to main product	Tonne	4266.6	4286.425
4	Total Equivalent Product Pulp	Tonne	34306.929	34197.987

9.6   Equivalent Product (Paper)

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Total Writing & Printing Paper Production	Tonne	42134.0	44233.0
2	Total Paper Board & Kraft paper Production	Tonne	12436.0	15698.0
3	Total Speciality paper Board Production	Tonne	0.0	9968.0
4	Total Newsprint Production	Tonne	9236.0	9528.0
5	Writing Printing Coated Paper	Tonne	0.0	0.0
6	Coated Board	Tonne	4587.0	4122.0

Energy Details

S. No	Particulars	Units	Base Line Year (BY)	Assessment Year (AY)
1	Enthalpy of MP steam	kcal/kg	686.00	686.00
2	Enthalpy of LP steam	kcal/kg	665.00	665.00
3	Heat Rate	kcal/kWh	2619.40	1734.34

Product mix (some products consume higher energy whereas other consume comparatively less) therefore change in their quantities and ratios may change SEC in Assessment year with respect to baseline year. Various possibilities of the product mix are discussed below.

Production and Energy Consumption Details of Writing Printing Grades

S. No	Writing Printing Grades	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	42134.0	44233.0
2	Steam Consumption-MP	Tonne-MP	0.0	0.0
3	Steam Consumption-LP	T onne-LP	159840.0	171342.0
4	Power Consumption	kWh	16276044.0	17489160.0
5	Steam-MP	T/Tonne	0.0	0.0
6	Steam-LP	T/Tonne	3.793	3.873
7	Power	kWh/Tonne	386.292	395.387

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/42134)
= 0

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/44233)
= 0

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (159840/42134)
= 3.793

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (171342/44233)
= 3.873

❖ *Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (16276044/42134)
= 386.292

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (17489160/44233)
= 395.3871

Specific Energy Consumption Calculation

S. No	Writing Printing Grades	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	0	0
2	Specific Steam Consumption -LP	kcal/Tonne	2522345	2575545
3	Specific Power Consumption	kcal/Tonne	1011853.265	685735.663
4	Total Specific Energy Consumption (Writing Printing)	kcal/Tonne	3534198.26	3261280.66

❖ Specific Steam Consumption – MP (kcal/ Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖ Specific Steam Consumption – MP (kcal/ Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/ Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.793 * 665 * 1000
= 2522345 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/ Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.873 * 665 * 1000
= 2575545 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (BY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 386.292 * 2619.40
= 1011853.265 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 395.3871 * 1734.34
= 685735.663 kcal/Tonne

❖ Total Specific Energy Consumption – Writing Printing Grades (kcal/Tonne) (BY)

= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+2522345+1011853.265
= 3534198.265 kcal/Tonne

❖ Total Specific Energy Consumption – Writing Printing Grades (kcal/Tonne) (AY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+2575545+685735.663
= 3261280.663 kcal/Tonne

Production and Energy Consumption DetailsPaper Board & Kraft paper Production

S. No	Paper Board & Kraft paper	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	12436	15698
2	Steam Consumption-MP	Tonne-MP	4964	6697
3	Steam Consumption-LP	Tonne-LP	34677	49678
4	Power Consumption	kWh	4276044	5489160
5	Steam-MP	T/Tonne	0.399	0.426
6	Steam-LP	T/Tonne	2.788	3.164
7	Power	kWh/Tonne	343.844	349.672

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (4964/12436)
= 0.399

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (6697/15698)
= 0.426

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (34677/12436)
= 2.788

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (49678/15698)
= 3.164

❖   Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (4276044/12436)
= 343.844

❖   Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (5489160/15698)
= 349.672

Specific Energy Consumption Calculation

S. No	Paper Board	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	273714	292236
2	Specific Steam Consumption -LP	kcal/Tonne	1854020	2104060
3	Specific Power Consumption	kcal/Tonne	900664.973	606450.136
4	Total Specific Energy Consumption (Paper Board)	kcal/Tonne	3028398.973	3002746.136

❖   Specific Steam Consumption – MP (kcal/Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.399 * 686 * 1000
= 273714 kcal/Tonne

❖   Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.426 * 686 * 1000
= 292236 kcal/Tonne

❖   Specific Steam Consumption – LP (kcal/Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 2.788 * 665 * 1000
= 1854020 kcal/Tonne

❖   Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.164 * 665 * 1000
= 2104060 kcal/Tonne

❖   Specific Power Consumption (kcal/Tonne) (BY)

= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 343.844 * 2619.40
= 900664.973 kcal/Tonne

❖   Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 349.672 * 1734.34
= 606450.136 kcal/Tonne

❖   Total Specific Energy Consumption – Paper Board (kcal/Tonne) (BY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 273714 + 1854020 + 900664.973
= 3028398.973

❖   Total Specific Energy Consumption – Paper Board (kcal/Tonne) (AY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 292236 + 2104060 + 606450.136
= 3002746.136 kcal/Tonne

Production and Energy Consumption Details of Specialty Paper

S. No	Newsprint	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	0.0	9968.0
2	Steam Consumption-MP	Tonne-MP	0.0	3569
3	Steam Consumption-LP	Tonne-LP	0.0	39668
4	Power Consumption	kWh	0.0	6252987
5	Steam-MP	T/Tonne	0.0	0.358
6	Steam-LP	T/Tonne	0.0	3.979
7	Power	kWh/Tonne	0.0	627.306

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (3569/9968)
= 0.358

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (39668/9968)
= 3.979

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (6252987/9968)
= 627.306

Newsprint

S. No	Newsprint	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	0.0	245588
2	Specific Steam Consumption -LP	kcal/Tonne	0.0	2646035
3	Specific Power Consumption	kcal/Tonne	0.0	1087961.888
4	Total Specific Energy Consumption (Speciality)	kcal/Tonne	0.0	6189884.888

❖ Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.358 * 686 * 1000
= 245588 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.979 * 665 * 1000
= 2646035 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 627.306 * 1734.34
= 1087961.888 kcal/Tonne

❖ Total Specific Energy Consumption – Newsprint (kcal/Tonne) (AY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 2455888+2646035+1087961.888
= 6189884.888 kcal/Tonne

Production and Energy Consumption Details of Newsprint

S. No	Newsprint	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	9236.0	9528.0
2	Steam Consumption-MP	Tonne-MP	0	0
3	Steam Consumption-LP	T onne-LP	26698	28667
4	Power Consumption	kWh	5018683.44	5652771.84
5	Steam-MP	T/Tonne	0	0
6	Steam-LP	T/Tonne	2.890	3
7	Power	kWh/Tonne	543.38	593.28

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/9236)
= 0

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (28667/9528)
= 3.0

❖ Steam – MP (T-MP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (0/9528)
= 0

❖ Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (5018683.44/9236)
= 543.38

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (26698/9236)
= 2.89

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (5652771.84/9528)
= 593.28

Specific Energy Consumption Calculation

S. No	Newsprint	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	0	0
2	Specific Steam Consumption -LP	kcal/Tonne	1921850	1995000
3	Specific Power Consumption	kcal/Tonne	1423329.57	1028949.235
4	Total Specific Energy Consumption (Newsprint)	kcal/Tonne	3345179.57	3023949.235

❖ Specific Steam Consumption – MP (kcal/Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖ Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0 * 686 * 1000
= 0 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 2.89 * 665 * 1000
= 1921850 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.0 * 665 * 1000
= 1995000 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (BY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 543.38 * 2619.40
= 1423329.57 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 593.28 * 1734.34
= 1028949.235 kcal/Tonne

❖ Total Specific Energy Consumption – Newsprint (kcal/Tonne) (BY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+1921850+1423329.57
= 3345179.57 kcal/Tonne

❖ Total Specific Energy Consumption – Newsprint (kcal/Tonne) (AY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 0+1995000+1028949.235
= 3023949.235 kcal/Tonne

Production and Energy Consumption Details of Coated Board

S. No	Writing Printing Grades	Units	Base Line Year (BY)	Assessment Year (AY)
1	Production	Tonne	4587.0	4122.0
2	Steam Consumption-MP	Tonne-MP	926	1145
3	Steam Consumption-LP	Tonne-LP	17847	16598
4	Power Consumption	kWh	1689756	1688972
5	Steam-MP	T/Tonne	0.201	0.277
6	Steam-LP	T/Tonne	3.890	4.026
7	Power	kWh/Tonne	368.379	409.745

❖ Steam – MP (T-MP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (926/4587)
= 0.201

❖ Steam – LP (T-LP/Tonne) (AY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (16598/4122)
= 4.026

❖ Steam Consumption (Tonne-MP)

$$= \frac{\text{Steam Consumption (Tonne-MP)}}{\text{Production (Tonne)}}$$

= (1145/4122)
= 0.277

❖ Power (kWh/Tonne) (BY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (1689756/4587)
= 368.379

❖ Steam – LP (T-LP/Tonne) (BY)

$$= \frac{\text{Steam Consumption (Tonne-LP)}}{\text{Production (Tonne)}}$$

= (17847/4587)
= 3.89

❖ Power (kWh/Tonne) (AY)

$$= \frac{\text{Electrical Energy Consumption (kWh)}}{\text{Production (Tonne)}}$$

= (1688972/4122)
= 409.745

Specific Energy Consumption Calculation

S. No	Coated Board	Units	Base Line Year (BY)	Assessment Year (AY)
1	Specific Steam Consumption -MP	kcal/Tonne	137886	190022
2	Specific Steam Consumption -LP	kcal/Tonne	2586850	2677290
3	Specific Power Consumption	kcal/Tonne	964931.952	710637.143
4	Total Specific Energy Consumption (Coated Board)	kcal/Tonne	3689667.953	3577949.143

❖ Specific Steam Consumption – MP (kcal/Tonne) (BY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.201 * 686 * 1000
= 137886 kcal/Tonne

❖ Specific Steam Consumption – MP (kcal/Tonne) (AY)
= Steam – MP (kcal/Tonne) * Enthalpy of MP steam (kcal/kg) * 1000
= 0.277 * 686 * 1000
= 190022 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (BY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 3.89 * 665 * 1000
= 2586850 kcal/Tonne

❖ Specific Steam Consumption – LP (kcal/Tonne) (AY)
= Steam – LP (kcal/Tonne) * Enthalpy of LP steam (kcal/kg) * 1000
= 4.026 * 665 * 1000
= 2677290 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (BY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 368.379 * 2619.40
= 964931.9526 kcal/Tonne

❖ Specific Power Consumption (kcal/Tonne) (AY)
= Electrical Energy Consumption (kWh/Tonne) * Heat Rate (kcal/kWh)
= 409.745 * 1734.34
= 710637.1433 kcal/Tonne

❖ Total Specific Energy Consumption – Coated Board (kcal/Tonne) (BY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 137886 + 2586850 + 964931.952
= 3689667.953 kcal/Tonne

❖ Total Specific Energy Consumption – Coated Board (kcal/Tonne) (AY)
= Specific Steam Consumption –MP (kcal/Tonne) + Specific Steam Consumption –LP (kcal/Tonne) + Specific Power Consumption (kcal/Tonne)
= 190022 + 2677290 + 710637.143
= 3577949.143 kcal/Tonne

The major product is the product with highest production in the baseline year. There may be conditions when the major product remains the same in assessment year as that of the baseline year, but there is variation in the other products (i.e., production quantities change for all the products) due to market demand. In this case any change in the quantities of the other products will be converted into equivalent product w.r.t the baseline year production.

Specific Energy Consumption Calculation

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Major Product	Writing Printing	Tonne	42134.0
2	SEC of Major Product	Writing Printing	kcal/T	3534198.26

Specific Energy Consumption

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Total Specific Energy Consumption (Writing Printing)	kcal/Tonne	3534198.26	3261280.66
2	Total Specific Energy Consumption (Paper Board)	kcal/Tonne	3028398.973	3002746.136
4	Total Specific Energy Consumption (Speciality)	kcal/Tonne	0.0	6189884.888
4	Total Specific Energy Consumption (Newsprint)	kcal/Tonne	3345179.57	3023949.235
5	Total Specific Energy Consumption (Writing Printing Coated Paper)	kcal/Tonne	0	0
6	Total Specific Energy Consumption (Coated Board)	kcal/Tonne	3689667.953	3577949.143

The conversion factors for writing & printing paper, paperboard, specialty grades and newsprint in Baseline and Assessment Year will be calculated based on the product mix variation.

Conversion Factors

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Writing Paper to Final Product	Factor	1	1
2	Paper Board to Final Product	Factor	0.8568	0.8568
3	Speciality Paper to Final Product	Factor	0	1.751
4	Newsprint to Final Product	Factor	0.946	0.946
5	Writing Printing Coating to Final Product	Factor	0	0
6	Board Coating and Converting to Final Product	Factor	1.043	1.043

Writing Paper to Final Product

❖ Conversion Factor for Writing Paper to Final Product (BY)

$$= \frac{\text{SEC for Writing Paper (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3534198.26/3534198.26)
= 1

❖ Conversion Factor for Writing Paper to Final Product (AY)

$$= \frac{\text{SEC for Writing Paper (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3534198.26/3534198.26)
= 1

Paper Board to Final Product

❖ Conversion Factor for Paper Board to Final Product (BY)

$$= \frac{\text{SEC for Paper Board (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3028398.973/3534198.26)
= 0.8568

❖ Conversion Factor for Paper Board to Final Product (AY)

$$= \frac{\text{SEC for Paper Board (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3028398.973/3534198.26)
= 0.8568

Speciality Paper to Final Product

❖ Conversion Factor for Speciality Paper to Final Product (BY)

$$= \frac{\text{SEC for Speciality Paper (BY)}}{\text{SEC of Major Product (BY)}}$$

= (0/3534198.26)
= 0

As the production in the base line year is 0.The conversion factor for specialty paper is as under

❖ Conversion Factor for Speciality Paper to Final Product (AY)

$$= \frac{\text{SEC for Speciality Paper (AY)}}{\text{SEC of Major Product (BY)}}$$

= (6189884.888/3534198.26)
= 1.751

Newsprint to Final Product

❖ Conversion Factor for Newsprint to Final Product (BY)

$$= \frac{\text{SEC for Newsprint Paper (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3345179.57/3534198.26)
= 0.9465

❖ Conversion Factor for Newsprint to Final Product (BY)

$$= \frac{\text{SEC for Newsprint Paper (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3345179.57/3534198.26)
= 0.9465

Coated Board to Final Product

❖ Conversion Factor for Newsprint to Final Product (BY)

$$= \frac{\text{SEC for Coated Board (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3689667.953/3534198.26)
= 1.043

❖ Conversion Factor for Newsprint to Final Product (BY)

$$= \frac{\text{SEC for Coated Board (BY)}}{\text{SEC of Major Product (BY)}}$$

= (3689667.953/3534198.26)
= 1.043

Equivalent Product Calculation

Production Details

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Total Writing & Printing Paper Production	Tonne	42134.0	44233.0
2	Total Paper Board & Kraft paper Production	Tonne	12436.0	15698.0
3	Total Speciality paper Board Production	Tonne	0.0	9968.0
4	Total Newsprint Production	Tonne	9236.0	9528.0
5	Writing Printing Coated Paper	Tonne	0.0	0.0
6	Coated Board	Tonne	4587.0	4122.0

❖ Writing Paper to Final Product (Tonne) (BY)
= Conversion Factor for Writing paper to Final Product (BY) * Production of Writing Paper (BY)
= 1 * 42134.0
= 42134.0 Tonne

❖ Writing Paper to Final Product (Tonne) (AY)
= Conversion Factor for Writing paper to Final Product (BY) * Production of Writing Paper (AY)
= 1 * 44233.0
= 44233.0 Tonne

❖ Paper Board to Final Product (Tonne) (BY)
= Conversion Factor for Paper Board to Final Product (BY) * Production of Paper Board (AY)
= 0.8568 * 12436.0
= 10655.1648 Tonne

❖ Paper Board to Main Product (Tonne) (AY)
= Conversion Factor for Paper Board to Final Product (BY) * Production of Paper Board (AY)
= 0.8568 * 15698.0
= 13450.046 Tonne

❖ Speciality Paper Board to Final Product (Tonne) (BY)
= Conversion Factor for Specialty Paper Board to Main Product (BY) * Production of Specialty Paper in (BY) (Tonne)
= 0 * 0
= 0 Tonne

❖ Speciality Paper Board to Final Product (Tonne) (AY)
= Conversion Factor for Specialty Paper Board to Main Product (BY) * Production of Specialty Paper in (AY) (Tonne)
= 1.751 * 9968
= 17453.968Tonne

❖ Newsprint to Final Product (Tonne) (BY)
= Conversion Factor for Newsprint to Main Product (BY) * Production of Newsprint in (BY) (Tonne)
= 0.946 * 9236
= 8737.256 Tonne

❖ Newsprint to Final Product (Tonne) (AY)
= Conversion Factor for Newsprint to Main Product (BY) * Production of Newsprint in (AY) (Tonne)

= 0.946 * 9528
= 9013.488Tonne

❖ Writing Printing Coated to Final Product (Tonne) (BY)
= Conversion Factor for Writing Printing Coated to Main Product (BY) * Production of Writing Printing Coated in (BY) (Tonne)
= 0 * 0
= 0Tonne

❖ Writing Printing Coated to Final Product (Tonne) (BY)
= Conversion Factor for Writing Printing Coated to Main Product (BY) * Production of Writing Printing Coated in (AY) (Tonne)
= 0 * 0
= 0Tonne

❖ Coated board to Final Product (Tonne) (BY)
= Conversion Factor for Coated board to Main Product (BY) * Production of Coated board in (BY) (Tonne)
= 1.043 * 4587.0
= 4784.241Tonne

❖ Coated board to Final Product (Tonne) (BY)
= Conversion Factor for Coated board to Main Product (BY) * Production of Coated board in (AY) (Tonne)
= 1.043 * 4122.0
= 4299.246Tonne

❖ Total Equivalent Product Paper (Tonne) (BY)
= Writing Paper to Final Product (BY) + Paper Board to Final Product (BY) + Specialty Paper to Final Product (BY) + Newsprint to Final Product (BY) + Writing Printing Coating to Final Product (BY) + Board Coating and Converting to Final Product (BY)
= 42134 + 10655.164 + 0 + 8737.256 + 0 + 4784.241
= 66310.66 Tonne

❖ Total Equivalent Product Paper (Tonne) (AY)
= Writing Paper to Final Product (AY) + Paper Board to Final Product (AY) + Specialty Paper to Final Product (AY) + Newsprint to Final Product (AY) + Writing Printing Coating to Final Product (AY) + Board Coating and Converting to Final Product (AY)
= 44233 + 13450.046 + 17453.968 + 9013.488 + 0 + 4299.246
= 88449.748 Tonne

S. No	Description	Units	Base Line Year (BY)	Assessment Year (AY)
1	Writing Paper to Final Product	Tonne	42134.0	44233.0
2	Paper Board to Final Product	Tonne	10655.164	13450.046
3	Specialty Paper to Final Product	Tonne	0	17453.968
4	Newsprint to Final Product	Tonne	8737.256	9013.488
5	Writing Printing Coating to Final Product	Tonne	0	0
6	Board Coating and Converting to Final Product	Tonne	4784.241	4299.246
7	Total Equivalent Product Paper	Tonne	66310.661	88449.748

9.7 Normalization Others

9.7.1 Environmental Concern

Table: Additional Electrical Energy requirement for Environmental Equipment

Sr No	Item	Date of Installation	Unit	Baseline Year	Assessment Year
1	Eqp 1	15-May-14	Lakh Unit	NA	20
2	Eqp 2	05-Oct-14	Lakh Unit	NA	5
3	Eqp 3	10-Nov-14	Lakh Unit	NA	10
4	Energy Consumed		Lakh Unit		35
5	Weighted Heat Rate		kcal/kwh	3200	3100

❖ **Additional Electrical Energy Consumed due to installation of Environmental Equipment**

=Total Electrical Energy Consumed for additional Equipment Installed due to Environmental concern in Lakh kWH x Weighted Heat Rate of the Power Sources in kcal/kWh/10

=35 x 3100/10

=10850 million kcal

Table: Additional Thermal Energy requirement for Environmental Equipment

Sr No	Item	Date of Installation	Unit	Baseline Year	Assessment Year
1	Eqp 4	15-Apr-14	Million kcal	NA	1200
2	Eqp 5	12-Sep-14	Million kcal	NA	5000
3	Eqp 6	15-Jan-15	Million kcal	NA	3500
4	Energy Consumed		Million kcal		9700
5	Weighted Heat Rate		kcal/kwh	3200	3100

❖ **Additional Thermal Energy Consumed due to installation of Environmental Equipment**

=Total Thermal Energy Consumed for additional Equipment Installed due to Environmental concern in Million kcal

=9700 Million kcal

❖ **Additional Total Energy Consumed due to installation of Environmental Equipment to be subtracted in the Assessment Year**

= Additional Electrical Energy Consumed due to installation of Environmental Equipment + Additional Thermal Energy Consumed due to installation of Environmental Equipment

=10850 Million kcal +9700 Million kcal

=20550 Million kcal

9.7.2 Biomass /Alternate Fuel Unavailability w.r.t. Baseline year (Replacement due to external factor)

Table: Fossil Fuel Replacement

Sr No	Item	Unit	Baseline Year	Assessment Year
1	Biomass replacement with Fossil fuel due to Biomass un-availability (used in the process)	Tonne	NA	20
2	Alternate Solid Fuel replacement with Fossil fuel due to Alternate Solid Fuel un-availability (used in the process)	Tonne	NA	15
3	Alternate Liquid Fuel replacement with Fossil fuel due to Alternate Liquid Fuel un-availability (used in the process)	Tonne	NA	5
4	Biomass Goss Calorific Value	kcal/kg		2100
6	Alternate Solid Fuel Goss Calorific Value	kcal/kg		2800
7	Alternate Liquid Fuel Goss Calorific Value	kcal/kg		6000

❖ **Thermal Energy used due to Biomass replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**

= Biomass replacement with Fossil fuel due to Biomass un-availability (used in the process) in Tonne x Biomass Gross Heat Rate (kcal/kg)/10^3

=20 x 2100/1000

=42 Million kcal

❖ **Thermal Energy used due to Alternate Solid Fuel replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**

= Alternate Solid Fuel replacement with Fossil fuel due to Biomass un-availability (used in the process) in Tonne x Alternate Solid Fuel Gross Heat Rate (kcal/kg)/10^3

=15 x 2800/1000

=42 Million kcal

❖ **Thermal Energy used due to Alternate Liquid Fuel replacement by Fossil Fuel in** the assessment year due to unavailability (Replacement due to external factor)

= Alternate Liquid Fuel replacement with Fossil fuel due to Biomass un-availability (used in the process) in Tonne x Alternate Liquid Fuel Gross Heat Rate (kcal/kg)/10^3

=5 x 6000/1000

=30 Million kcal

❖ **Total Thermal Energy to be deducted for Biomass/ Alternate Solid or Liquid Fuel replacement by Fossil Fuel in the assessment year due to unavailability**

= Thermal Energy used due to Biomass + Alternate Solid Fuel +Alternate Liquid Fuel replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)

=42 + 42 +30 Million kcal

=112 Million kcal

9.7.3 Construction Phase or Project Activities

Table: Additional Electrical Energy requirement during Construction Phase or Project Activities

Sr No	Item	Date of Installation	Unit	Baseline Year	Assessment Year
1	Eqp No 7	5-May-14	Lakh Unit	NA	2
2	Eqp No 8	18-Aug-14	Lakh Unit	NA	5
3	Eqp No 9	10-Feb-15	Lakh Unit	NA	1
4	Electrical Energy Consumed		Lakh Unit		8
5	Weighted Heat Rate		kcal/kwh	3200	3100

❖ **Additional Electrical Energy Consumed during Construction Phase or Project Activities**

= Total Electrical Energy Consumed for additional Equipment Installed during Construction Phase or Project Activities in Lakh kWH x Weighted Heat Rate of the Power Sources in kcal/kWh/10

= 8 x 3100/10

= 2480 Million kcal

Table: Additional Thermal Energy requirement during Construction Phase or Project Activities

Sr No	Item	Date of Installation	Unit	Baseline Year	Assessment Year
1	Eqp No 10	15-June-14	Million kcal	NA	1000
2	Eqp No 11	12-Oct-14	Million kcal	NA	1400
3	Eqp No 12	15-Jan-15	Million kcal	NA	900
4	Energy Consumed		Million kcal		3200

❖ **Additional Thermal Energy Consumed during Construction Phase or Project Activities**

= Total Thermal Energy Consumed for additional Equipment Installed during Construction Phase or Project Activities in Million kcal

= 3200 Million kcal

❖ **Additional Total Energy Consumed during Construction Phase or Project Activities to be subtracted in the Assessment Year**

= Additional Electrical Energy Consumed during Construction Phase or Project Activities + Additional Thermal Energy Consumed during Construction Phase or Project Activities

= 2480 Million kcal + 3200 Million kcal

= 5680 Million kcal

9.7.4 Addition of New Unit/Line (In Process and Power generation)

Table: Energy consumption due to commissioning of new line up to 70% Capacity Utilisation in Process

Sr No	Item	Unit	Baseline Year	Assessment Year
1	Electrical Energy Consumed due to commissioning of New process Line/Unit till it attains 70% of Capacity Utilisation	Lakh kWh	NA	50
2	Thermal Energy Consumed due to commissioning of New Process Line/Unit till it attains 70% of Capacity Utilisation	Million kcal	NA	1400
3	Pulp Production till new line attains 70% of Capacity utilisatiion	Tonne	NA	15000
4	Date of Commissioning (70% Capacity Utilisation)	Date		16-Aug-14
5	Weighted Heat Rate	kcal/kwh	3200	3100

❖ **Electrical Energy Consumed due to commissioning of new line**

=Total Electrical Energy Consumed Lakh kWh x Weighted Heat Rate of the Power Sources in kcal/kWh/10

=50 x 3100/10

=15500 Million kcal

❖ **Thermal Energy Consumed due to commissioning of new line**

=Total Thermal Energy Consumed due to commissioning of new line

=1400 Million kcal

❖ **Total Energy to be deducted in the assessment year for Electrical and Thermal**

Energy consumed due to commissioning of new line in Process

=Electrical Energy Consumed due to commissioning of new line + Thermal Energy Consumed due to commissioning of new line

=15500 Million kcal + 1400 Million kcal

=16900 Million kcal

Pulp Produced (15000 Tonne) till new line attains 70% of capacity utilization will be subtracted from the total Pulp production and added in the Pulp import; so that the energy added for this amount of produced Pulp will be equal to the normal energy consumption required to produce the same amount.

Table: Energy consumption due to commissioning of new line up to 70% Capacity Utilisation in Process

Sr No	Item	Unit	Baseline Year	Assessment Year
1	Electrical Energy Consumed from external source due to commissioning of New Line/ Unit till it attains 70% of Capacity Utilization in Power generation	Lakh kWh	NA	5

2	Thermal Energy Consumed due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation	Million kcal	NA	15000
3	Net Electricity Generation till new Line/Unit attains 70% Capacity Utilization	Lakh kWh	NA	40
4	Date of Commissioning (70% Capacity Utilization) Power Generation	Date		
5	Weighted Heat Rate	Kcal/kWh	3200	3100

❖ **Electrical Energy Consumed due to commissioning of new unit from external source**

=Total Electrical Energy Consumed Lakh kWh x Weighted Heat Rate of the Power Sources in kcal/kWh/10

=5 x 3100/10

=1550 Million kcal

❖ **Thermal Energy Consumed due to commissioning of new unit (for generation at higher heat rate of electricity)**

=Total Thermal Energy Consumed due to commissioning of new unit

=15000 Million kcal

❖ **Total Energy to be deducted in the assessment year for Electrical and Thermal Energy consumed due to commissioning of new line in Process**

=Electrical Energy Consumed due to commissioning of new line + Thermal Energy Consumed due to commissioning of new line

=1550 Million kcal + 15000 Million kcal

=16550 Million kcal

Electricity generated (40 Lakh kWh @ higher heat rate than Plant's power source heat rate) till new unit attains 70% of capacity utilization will be added in the total energy consumption of the plant at weighted heat rate of the plant 's power sources.

❖ **Electrical Energy to be added for the generated Electricity at Power sources heat rate**

=Total Electrical generated by new unit till it attain 70 of CU in Lakh kWh x Weighted Heat Rate of the Power Sources in kcal/kWh/10

=40 x 3100/10

=12400 Million kcal

Since the unit is generating electricity at higher heat rate due to initial commissioning phase, thus, higher amount of Energy is deducted than the addition in the total energy consumption of the plant.

9.7.5 Unforeseen Circumstances (External Factor)

Table: Additional Electrical Energy requirement due to Unforeseen Circumstances (External Factor)

Sr No	Item	Unit	Baseline Year	Assessment Year
1	Condition 1	Lakh Unit	NA	5
2	Condition 2	Lakh Unit	NA	5

3	Condition 3	Lakh Unit	NA	10
4	Energy Consumed	Lakh Unit		20
5	Weighted Heat Rate	kcal/kwh	3200	3100

❖ **Additional Electrical Energy Consumed due to Unforeseen Circumstance (External Factor)**

=Total Electrical Energy Consumed due to Unforeseen Circumstances in Lakh kWH x Weighted Heat Rate of the Power Sources in kcal/kWh/10

=20 x 3100/10

=6200 million kcal

Table: Additional Thermal Energy requirement due to Unforeseen Circumstances (External Factor)

Sr No	Item	Unit	Baseline Year	Assessment Year
1	Condition 1	Million kcal	NA	2000
2	Condition 4	Million kcal	NA	800
3	Condition 5	Million kcal	NA	3000
4	Energy Consumed	Million kcal		5800

❖ **Additional Thermal Energy Consumed due to Unforeseen Circumstances (External Factor)**

=Total Thermal Energy Consumed due to Unforeseen Circumstances in Million kcal

=5800 Million kcal

❖ **Additional Total Energy Consumed due to installation of Environmental Equipment to be subtracted in the Assessment Year**

= Additional Electrical Energy Consumed due to Unforeseen Circumstances + Additional Thermal Energy Consumed due to Unforeseen Circumstances

=6200 Million kcal +5800 Million kcal

=12000 Million kcal

9.7.6 Renewable Energy

Case I: Under Achievement of PAT Obligation with REC gain

Case II: Equal Achievement of PAT Obligation with REC gain

Case III: Over Achievement of PAT Obligation with REC gain

Table: REC and PAT obligation

Sr No	Descriptions	Basis/ Calculations	Unit	Baseline Year [BY]	Assessment Year [AY]
1	Steam Turbine Net Heat Rate	Form I	kcal/kwh	3900	3800

2	Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar & Non-Solar)	Annual	MWh		1000
3	Quantum of Energy sold under preferential tariff	Annual	MWh		500
4	Saving Target in TOE/ Tonne of product as per PAT scheme Notification		Toe/Tonne	0.040	
5	Equivalent Major Product Output in Tonne as per PAT scheme Notification		Tonne	50000	
6	Baseline Specific Energy Consumption as Per PAT Notification		Toe/Tonne	0.861	
7	SEC Target to be achieved	0.861-0.040	Toe/Tonne		0.821

Case I: Under Achievement of PAT Obligation with REC gain

The target SEC for a DC is 0.821 Toe/Tonne of equivalent Paperagainst the baseline SEC of 0.861Toe/Tonne of equivalent Paper.

- The DC achieves 0.822 Toe/Tonne in the assessment year and also obtained REC and Energy sold under preferential tariff to the tune of 1500 MWh.

- The thermal Energy conversion of REC and Energy sold under preferential tariff stands at 5700 Million kcal. The plant has already taken the benefit of exported power in power mix normalization by subtracting 5700 Million kcal from the total energy consumption of plant

Sr. No	Descriptions	Basis/ Calculations	Unit	Baseline Year [BY]	Current Year 2013-14
1	Normalized Gate to Gate Specific Energy Consumption	Annual	Toe/Tonne	0.861	0.822

In this case, the Energy shall not be normalized w.r.t. REC mechanism, since the DC is not being benefited in duel terms for Renewable Power generated as per following calculation table

Sr No	Descriptions	Basis	Unit	Baseline Year [BY]	Assessment Year [AY]
Renewable Energy Certificate Normalisation				
1	Target Saving to be achieved (PAT obligation)		Toe/Tonne equivalent Paper	0.04	
2	Target Saving to be achieved (PAT obligation)		Toe	2000	
3	Target Saving Achieved		Toe/Tonne equivalent Paper		0.039
4	Target Saving Achieved		Toe		1950
5	Additional Saving achieved (After PAT obligation)		Toe/Tonne equivalent Paper		-0.001
6	Additional Saving achieved (After PAT obligation)		Toe		-50.00
7	Thermal energy conversion for REC and Preferential tariff		Toe		570.0
8	Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism	Annual	Million kcal		0.00

Case II: Equal Achievement of PAT Obligation with REC gain

The target SEC for a DC is 0.821Toe/Tonne of equivalent Paper against the baseline SEC of 0.861Toe/Tonne of equivalent Paper.

- The DC achieves 0.821Toe/Tonne in the assessment year and also obtained REC and Energy sold under preferential tariff to the tune of 1500 MWh.

- The thermal Energy conversion of REC and Energy sold under preferential tariff stands at 5700 Million kcal.

Sr No	Descriptions	Basis/ Calculations	Unit	Baseline Year [BY]	Current Year 2013-14
1	Normalized Gate to Gate Specific Energy Consumption	Annual	Toe/Tonne	0.861	0.821

The plant has already taken the benefit of exported power in power mix normalization by subtracting 5700 Million kcal from the total energy consumption of plant

In this case also, the Energy shall not be normalized w.r.t. REC mechanism, since the DC is not being benefited in duel terms for Renewable Power generated as per following calculation table

Sr No	Descriptions	Basis	Unit	Baseline Year [BY]	Assessment Year [AY]
	Renewable Energy Certificate Normalisation				
1	Target Saving to be achieved (PAT obligation)		Toe/Tonne equivalent Paper	0.04	
2	Tiiiarget Saving to be achieved (PAT obligation)		Toe	2000	
3	Target Saving Achieved		Toe/Tonne equivalent Paper		0.04
4	Target Saving Achieved		Toe		2000
5	Additional Saving achieved (After PAT obligation)		Toe/Tonne equivalent Paper		0.0
6	Additional Saving achieved (After PAT obligation)		Toe		0.0
7	Thermal energy conversion for REC and Preferential tariff		Toe		570.0
8	Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism	Annual	Toe		0.00

Case III: Over Achievement of PAT Obligation with REC gain

The target SEC for a DC is 0.821Toe/Tonne of equivalent Paper against the baseline SEC of 0.861Toe/Tonne of equivalent Paper.

• The DC achieves 0.820Toe/Tonne in the assessment year and also obtained REC and Energy sold under preferential tariff to the tune of 1500 MWh.

• The Thermal Energy conversion of REC and Energy sold under preferential tariff stands at 5700 Million kcal.

Sr No	Descriptions	Basis/ Calculations	Unit	Baseline Year [BY]	Current Year 2013-14
1	Normalized Gate to Gate Specific Energy Consumption	Annual	Toe/Tonne	0.861	0.82

In this case, the DC is getting benefit of Renewable Power exported in duel terms i.e., by gaining REC or selling it @ preferential tariff and also overachieved PAT obligation to earn ESCerts. The Energy shall be normalized w.r.t. REC mechanism gain, since, the plant has already taken the benefit of exported power in power mix normalization by subtracting 5700

Million kcal from the total energy consumption of plant, hence the additional gain after PAT obligation in terms of energy to be added in the total energy consumption of the plant. Here, the additional gain after PAT obligation stands at 500 Million kcal, thus only the said thermal energy will be normalized as per concluding calculation table. The DC still gains from Renewable Power generated i.e., 5200 Million kcal (5700-500 Million kcal) to achieve PAT obligation apart from getting gain from REC mechanism.

Sr No	Descriptions	Basis	Unit	Baseline Year [BY]	Assessment Year [AY]
	Renewable Energy Certificate Normalisation				
1	Target Saving to be achieved (PAT obligation)		Toe/Tonne equivalent Paper	0.04	
2	Target Saving to be achieved (PAT obligation)		Toe	2000	
3	Target Saving Achieved		Toe/Tonne equivalent Paper		0.041
4	Target Saving Achieved		Toe		2050
5	Additional Saving achieved (After PAT obligation)		Toe/Tonne equivalent Paper		0.001
6	Additional Saving achieved (After PAT obligation)		Toe		50
7	Thermal energy conversion for REC and Preferential tariff		Toe		570.0
8	Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism	Annual	Toe		50.00

As per Renewable Energy Certificate Mechanism, any plant after meeting Renewable Purchase Obligations (RPOs) can export (Injection to the grid or deemed injection) renewable energy in the form of electrical energy and earn Renewable Energy Certificates (REC) and/ or can opt for preferential tariff for the exported electricity, as the case may be.

However, double benefit being accrued or claimed by a DC from PAT as well as REC mechanism could not be allowed. Keeping the above in view, the proposed normalization clauses are proposed below:

The quantity of exported (Deemed Injection or injection to the grid) power (partially or fully) on which Renewable Energy Certificates have been earned by Designated Consumer in the assessment year under REC mechanism shall be treated as Exported power and normalization will apply. However, the normalized power export will not qualify for issue of Energy Saving Certificates under PAT Scheme.

Thus keeping the above normalisation in view, the DCs were asked in the Form I to submit the data pertaining to gain of REC in the baseline as well as for the current year.

To avoid duel benefit from REC and PAT, a normalisation is proposed

Elaborate Example for REC Compliance-

For the year 2014-15,
REC received by DC: 10000 REC = 2717 toe (EScerts)
PAT Target (SEC): 0.0810 toe/Te
Baseline Production: 4591973 Te

► Case I: SEC achieved: 0.0811 toe/Te
The DC can avail the benefit of REC since it has not achieved the PAT target

► Case II: SEC achieved: 0.0810 toe/Te
The DC can avail the benefit of REC since it has equaled the PAT target

► Case III: SEC achieved: 0.0809 toe/Te
Gain of 0.0810-0.0809 = 0.0001 x 4591973 = 459 Escerts

The DC has achieved the target and about to gain 459 EScerts, the normalisation will take place and the SEC will be made to 0.0810. Hence there is no gain of ESCerts

The DC will not gain any ESCerts but can avail the benefit of REC

► Case IV: SEC achieved: 0.0800 toe/Te
Gain of 0.0810-0.0800 = 0.0010 x 4591973 = 4591 Escerts

The DC has achieved the target and about to gain 4591 EScerts, the normalisation will take place.

Here the DC stands to gain 4591-2717 =1874 ESCerts

The DC will gain 1874 ESCerts and also can avail the benefit of 10000 REC

Part-II
MONITORING & VERIFICATION GUIDELINES

1. Introduction

1.1. Background

Ministry of Power and Bureau of Energy Efficiency (BEE) have been implementing several programs for efficient use of energy and its conservation. This is further supplemented by the National Mission for Enhanced Energy Efficiency (NMEEE), which is one of the missions under the National Action Plan on Climate Change (NAPCC), launched by Hon'ble Prime Minister on 30th June 2008 to ensure increase in the living standards of the vast majority of people while addressing climate change concerns.

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

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

Ministry of Power, in consultation with Bureau of Energy Efficiency has prescribed the energy consumption norms and standards, in exercise of the power conferred under clause (g) and (n) of section 14 of the Energy conservation Act 2001 (Amended in 2010) for the Designated Consumers vide S.O. 687 (E) [Energy Conservation (Energy Consumption Norms and Standards for Designated Consumers, Form, Time within which, and Manner of Preparation and Implementation of Scheme, Procedure for Issue of Energy Savings Certificates and Value of per Metric Ton of Oil Equivalent of Energy Consumed) Rules, 2012] dated 30/03/2012 (Containing Baseline Specific Energy Consumption, Product Output and Target Specific Energy consumption for the Designated Consumers). The said S.O. Notification is based on the Rules notified under G.S.R. 269 (E) [Energy Conservation (Energy Consumption Norms and Standards for Designated Consumers, Form, Time within which, and Manner of Preparation and Implementation of Scheme, Procedure for Issue of Energy Savings Certificates and Value of per Metric Ton of Oil Equivalent of Energy Consumed) Rules, 2012] dated 30th March, 2012, herein referred as PAT Rules, 2012

The scheme covers 478 Units, known as Designated Consumer (DC) in 8 sectors (Thermal Power Stations, Iron and Steel Plants, Cement, Fertiliser, Textile, Pulp and Paper, Chlor Alkali & Aluminium sector) in the cycle I. Together these designated consumers used about 36% of the fossil fuel consumed in India in 2010. Each designated consumer has been mandated to achieve a specific reduction in its specific energy consumption. Percentage reduction targets were notified in March, 2012, and the percentage reduction target is less for a designated consumer that is already efficient, and more for one that is less efficient. Overall, all the plants together are to achieve a 4.05% reduction in the average energy consumption by the year 2014-15. This would imply a reduction of about 6.686 million tons-of-oil-equivalent in their annual energy consumption, and a reduction of about 23 million tons of carbon dioxide annually.

A robust monitoring, reporting and verification process will ensure effective and credible assessment of energy performance, achieved by industries covered under PAT.

1.2. Purpose

A reliable monitoring, reporting and verification (M&V) system forms the backbone of assessment process of the PAT scheme. The objective of the M&V system is to streamline the activities to be carried out for verifying the energy performanceachieved by the Designated Consumer in the target year.

> The documents sets out the requisite guidelines forM&V in the Monitoring and Verification phase under thePAT Rules. It provides practical guidance and proceduresto Designated Consumers (DCs) and Empanelled Accredited Energy Auditors (EmAEA) on verification requirements, and aims to establisha verification process consistent with relevant rules and regulation.

The Assessment of performance verification involves an independent evaluation of each activity undertaken by the DCs for compliance under PAT rules. Verification plays a crucial role in maintaining the integrity of the scheme and ensuring transparent validation.

The verification process will ensure that the information and data in Form 1and Pro-forma are free from material omissions, misrepresentations and errors.

The process requires EmAEA to verify the monitoring and verification of energy performance of DCsin accordance with PAT rules while taking into the consideration,Normalization factors and any other relevant conditions as defined PAT Rules

The verification must be completed between 1st April to 30th June of the year, following the assessment year.Submission of final verification report,verified annual Form 1,Sector SpecificPro-forma, EmAEA's verification report along with authentic supporting documents shall be done by the DC to the concern State Designated Agency (SDA) and Bureau of Energy Efficiency before 30th June.

The document:
➤ Provides Designated Consumers and EmAEAaset of guidelines to establish methods for assessment ofspecific energy consumption.
➤ Defines broad techniques for assessing/ determining factors that effects the performance of establishment.
➤ Provides general terms, which are applicable to all sectors and also includes specific sector term.
➤ Will be guided as per the provisions conferred under Rule 3 of PAT Rules 2012.
➤ Provides support to the Designated Consumer to meet its obligation specified in Rule 7 and Rule 15 of the PAT Rules.

1.3. Definition of M&V

M&V is the process to verify the Specific Energy Consumption through verifiable means of each Designated Consumer in the baseline year and in the assessment year by an empanelled accredited energy auditor.

The underlying principles for Monitoring and Verification include:
► **Consistency:** By applying uniform criteria to meet the requirements of the sector specific methodology throughout the assessment period.
► **Transparency:** Information in the verification reports shall be presented in an open, clear, factual, neutral and coherent manner based on documentary evidence
► **Acceptability:** The Empanelled Accredited Energy Auditors shall base their findings and conclusions upon objective evidence,

conduct all activities in connection with the validation and verification processes in accordance with the rules and procedures laid down by BEE, and state their validation or verification activities, findings, and conclusions in their reports truthfully and accurately.

► **Measurability:** Measurement is a fundamental starting point for any kind of data captured for Energy Performance Index.

    i. Measurement in energy saving projects: The energy saving from any project is determined by comparing measured parameters before and after implementation of a project, making appropriate adjustments for changes in conditions.

    ii. Measurement of parameters for data captured in Pro-forma: The parameters entered in the pro-forma shall be taken from the measured logs with supporting documentation through

    iii. Computational documentation from basic measurement at field

    iv. Measurement activities in the baseline and assessment year consist of the following:

- meter installation, calibration and maintenance
- data gathering and screening,
- development of a computation method and acceptable estimates from the basic measurement at field,
- computations with measured data, and
- reporting, quality assurance

A measurement boundary is a notional border drawn around equipment and/or systems that are relevant for determining the savings achieved through implementation of Energy saving projects.

► **Traceability:** The documents presented for substantiating the reduction in specific energy consumption or savings from ECM should be verifiable and visible.

► **Verifiability:** The validation of filled in data in the Pro-formaand savings from Energy Conservation Measures through proper authentic documentation are to be carried out by the EmAEA.

1.4. Empanelled Accredited Energy Auditor or Verifier

Accredited Energy Auditor firm empanelled with BEE under PAT rules will be the verifier of PAT M&V process

"verification" means a thorough and independent evaluation by the accredited energy auditor of the activities undertaken by the designated consumer for compliance with the energy consumption norms and standards in the target year compared to the energy consumption norms and standards in the baseline year and consequent entitlement or requirement of energy savings certificate.

"certification" means the process of certifying the verification report or check-verification report by the accredited energy auditor to the effect that the entitlement or requirement of energy savings certificateis quantified accurately in relation to compliance of energy consumption norms and standards by the designated consumer during the target year;

"check-verification" means an independent review and ex-post determination by the Bureau through the accredited energy auditor, of the energy consumption norms and standards achieved in any year of the three year cycle which have resulted from activities undertaken by the designated consumer with regard to compliance of the energy consumption norms and standards;

1.4.1. Qualification of Empanelled Accredited Energy Auditor (EmAEA)for Verification and Check-Verification

A firm registered under the Indian Partnership Act, 1932 (9 of 1932) or a company incorporated under the Companies Act, 1956 (1 of 1956) or any other legal entity competent to sue or to be sued or enter into contracts shall be entitled to undertake verification and check-verification regarding compliance with the energy consumption norms and standards and issue or purchase of energy savings certificate if it,-

(a) has at least one accredited energy auditor whose name is included in the list of the accredited energy auditors maintained by the Bureau under regulation 7 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010;

(b) has at least three energy auditors;

(c) has adequate expertise of field studies including observations, probing skills, collection and generation of data, depth of technical knowledge and analytical abilities for undertaking verification and check-verification;

(d) has a minimum turnover of ten lakhs rupees per annum in at least one of the previous three years or in case of a newly formed organisation, a net worth of ten lakhs rupees.

The application shall be accompanied by a certificate of registration or incorporationas the case may be.

1.4.2. Obligation of Empanelled Accreditor Energy Auditor

For the work of verification or check verification, the accredited energy auditor shall constitute a team comprising of a team head and other members including Process Experts:

Provided that a person who was in the employment of a designated consumer within the previous four years,shall not be eligible to perform the work of verification or check-verification for such designated consumer;

(1) Provided further that any person or firm or company or other legal entity, who was involved in undertaking energy audit in any of the designated consumer within the previous four years,shall not be eligible to perform the work of verification or check-verification for such designated consumer.

(2) The accredited energy auditor shall ensure that persons selected as team head and team members must be independent, impartial and free of potential conflict of interest in relation to activities likely to be assigned to them for verification or check-verification.

(3) The accredited energy auditor shall have formal contractual conditions to ensure that each team member of verification and check-verification teams and technical experts act in an impartial and independent manner and free of potential conflict of interest.

(4) The accredited energy auditor shall ensure that the team head, team members and experts prior to accepting the assignment inform him about any known, existing, former or envisaged link to the activities likely to be undertaken by them regarding verification and check verification.

(5) The accredited energy auditor must have documented system for determining the technical or financial competence needed to carry out the functions of verification and check –verification and in determining the capability of the persons, the accredited energy auditor shall consider and record among other things the following aspects,namely:-

(a) complexity of the activities likely to be undertaken;

(b) risks associated with each project activity;

(c) technological and regulatory aspects;

(d) size and location of the designated consumer;

(e) type and amount of field work necessary for the verification or check-verification.

(6) The accredited energy auditor shall have documented system for preparing the plan for verification or check-verification functions and the said plan shall contain all the tasks required to be carried out in each type of activity, in terms of man days in respect of designated consumers for the purpose of verification and check – verification.

(7) The names of the verification or check-verification team members and their bio-data shall be provided by the accredited energy auditor to the concerned designated consumer in advance.

(8) The verification or check-verification team shall be provided by the accredited energy auditor with the concerned working documents indicating their full responsibilities with intimation to the concerned designated consumer.

(9) The accredited energy auditor shall have documented procedure-

(i) to integrate all aspects of verification or check-verification functions;

(ii) for dealing with the situations in which an activity undertaken for the purpose of compliance with the energy consumption norms and standards or issue of energy savings certificate shall not be acceptable as an activity for the said purposes.

(10) The accredited energy auditor shall conduct independent review of the opinion of verification or check-verification team

and shall form an independent opinion and give necessary directions to the said team if required.

(11) In preparing the verification and check-verification reports, the accredited energy auditor shall ensure transparency, independence and safeguard against conflict of interest.

(12) The accredited energy auditor shall ensure the confidentiality of all information and data obtained or created during the verification or check verification report.

(13) In assessing the compliance with the energy consumption norms and standards and issue of energy savings certificates, the accredited energy auditor shall follow the provisions of the Act, rules and regulations made thereunder.

(14) After completion of the verification or check-verification, the accredited energy auditor shall submit the verification (in Form- "B") or check-verification report, together with the certificate in Form-'C', to the Bureau.

1.5. Important Documents required for M&V process

I. Accepted Baseline Audit Report (Available with BEE and DC)[1]
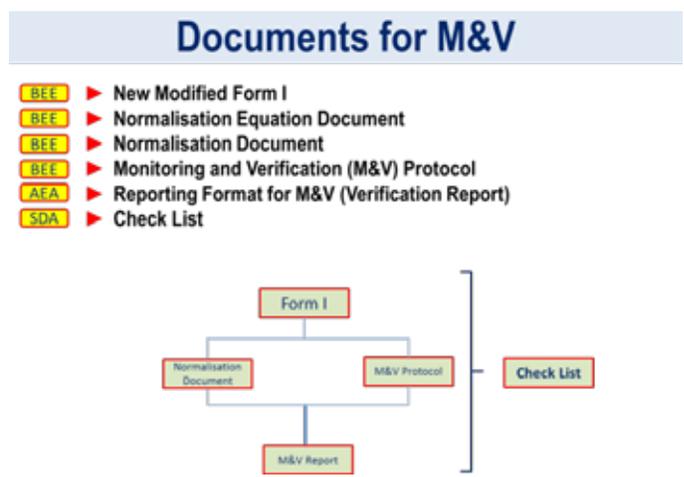
Figure 1: M&V Documents

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[1]Baseline Report: Available with BEE and respective DCs. EmAEA to verify the consistency of Report

II. Form 1& Sector Specific Pro-forma

III. Form A,B,C,D as covered in PAT rules

IV. Normalisation Factors Document available with BEE

V. Normalisation Guidelines Document

available with BEE

VI. Check List to be used by all stakeholders

VII. Reporting Format for EmAEA

VIII. ESCerts Management Registry

Figure 2: Stakeholders

Regulator	Administrator	Implementer	State Nodal Agency / Adjudicator	Verifier	Trading Regulator, Registry
MoP	Bureau of Energy Efficiency	Designated Consumer	State Designated Agency/ SERC	Empanelled Accredited Energy Auditor	CERC/ POSOCO
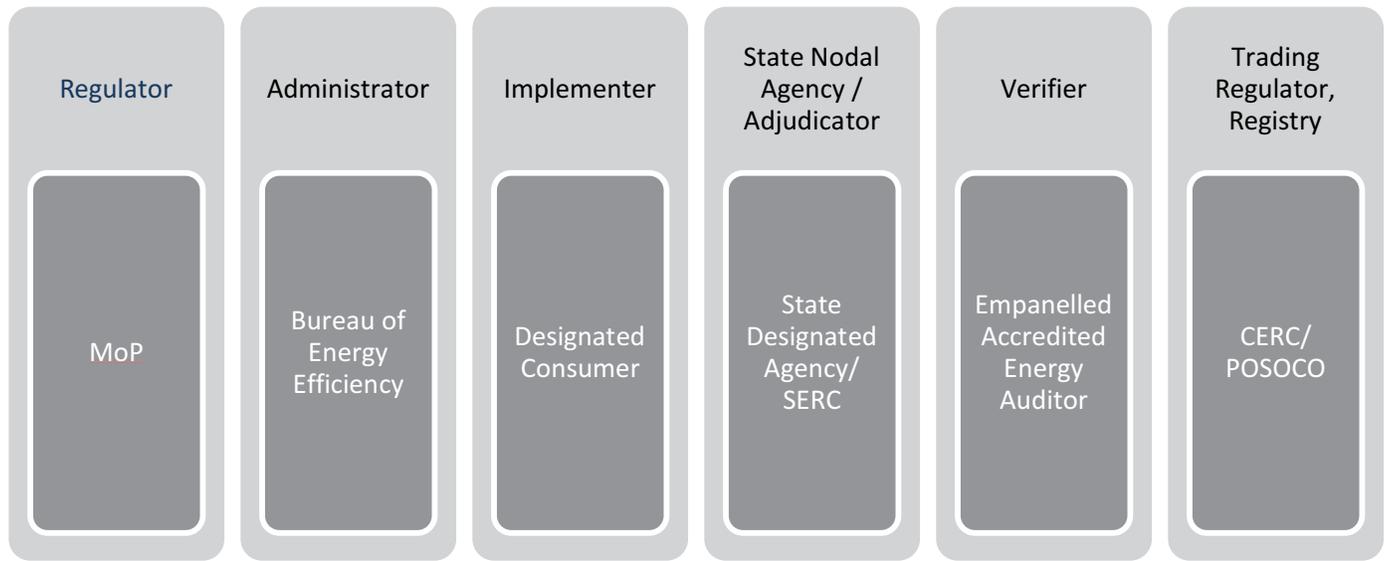
2. Broad Roles and Responsibilities

The various roles assessed to be performed in the verification process include administration, regulation and services delivery. The key stakeholders are Ministry of Power, Bureau of Energy Efficiency, State Designated Agencies, Adjudicator, Designated Consumers and Empanelled Accredited Energy Auditor.

2.1. General

The roles and responsibilities of individuals and designated consumer are set out in Energy Conservation Rules 2012 [2]

The roles and responsibilities of the Designated Consumer (DC), Empanelled Accredited Energy Auditor (EmAEA), Bureau of Energy Efficiency (BEE), State Designated Agencies (SDA),

Adjudicator and Ministry of Power (MoP) can be summed up as under

The Designated Consumer shall fill the data in the Sector Specific Pro-formaand Form 1 stating source of data in the Form, of its installation as per GtG boundary concept manually in Excel Sheet Pro-forma and in PATNET. The filled in Forms with the authentic source of data in terms of hard copy document shall have to be kept ready by Designated Consumer for verification. The designated consumer in consultation with the EmAEA, shall put in place transparent, independent and credible monitoring and verification arrangement. The verifier shall ensure transparency, independence and safeguard against conflict of interest.

As part of verification process, the EmAEA shall

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[2] Energy Conservation Rules 2012: Energy Consumption Norms and Standards for Designated Consumers, Form, Time within which, and Manner of Preparation and Implementation of Scheme,Procedure for Issue of Energy Savings Certificate and Value of Per Metric Ton of Oil Equivalent of Energy Consumed) as per Notification G.S.R.269 (E) dated 30th march 2012

carry out a strategic and statistical Analysis, checking of relevant and authentic document, Quarterly, Yearly and End of Cycle internal data audit reports, Performance Assessment Documents (Form A), Form I and sector specific pro-forma from DCs, the actual verification produce an internal verification report, Form B from EmAEA. These verified Forms, documents and reports will then be submitted to the SDA with a copy to the Bureau. The SDA, in turn after proper verification of Form A sent by DC may send comment to BEE for final verification based on the SDA Check List.

If the accredited energy auditor records a positive opinion in his verification report, the Bureau shall consider that all the requirements with regard to the compliance with energy consumption norms and standards, entitlement about issue or liability to purchase energy savings certificate have been met.

BEE on satisfying itself about the correctness of verification report, and check-verification report,wherever sought by it, send its recommendation under clause (aa) of sub-section (2) of section 13 to the Central Government, based on the claim raised by the designated consumer in Form `A', within ten working days from the last date of submission of said Form `A' by the concerned state designated agency, for issuance of energy savings certificates under section 14A Guidance on these responsibilities are presented in the Energy Conservation Rules 2012.

2.2. Designated Consumer

The Designated Consumers have the following responsibilities with respect to EOC or mid cycle verification as per guidelines in Energy Conservation Rules 2012:

1. To monitor and report in accordance with the monitoring plan approved by the BEE.

2. Establish data and information management system as per Sector Specific Supporting Pro-forma for Form 1, Normalization formulae

3. M&V arrangements for energy consumption and production by Designated Consumer

4. Without prejudice to the monitoring plan approved by the BEE, DC must comply with on-going obligations imposed under PAT Rules 2012

5. The monitoring methodology or the Input Data Entry with Normalisation factors shall be changed if this improves the accuracy of the reported data and for taking out any errors reported by DC in the Sector Specific Pro-forma (Linking formulae, error formulae or wrong data entry)

6. The designated consumer in consultation with the accredited energy auditor, shall put in place transparent,independent and credible monitoring and verification arrangements for energy consumption and production based on the Bureau of Energy Efficiency (Manner and Intervals of Time for Conduct of Energy Audit) Regulations, 2010 for compliance with the energy consumption norms and standard, and the said arrangements shall include,-

i) Preparation and Maintenance of Quarterly Data Reports to be prepared by DCs from 2012 onwards up to assessment year

   a. On the performance of plant and production process

   b. Internal Field Audit Report on Energy and Process

ii) Preparation and Maintenance of Yearly Data Reports to be prepared by DCs from 2012 onwards up to assessment year

   a. On the performance of plant and production process

b. Outcome of Internal Field Audit

c. Measures to reduce energy consumption and improve energy efficiency

d. Measures taken to improve the efficiency of the production processes during each year

iii) Preparation and Maintenance of Yearly Data Reports to be prepared by DCs from 2012 onwards up to assessment year

a. Report on production achieved, energy consumed

b. specific energy consumption achieved, specific energy consumption

c. reduction achieved, measures adopted for energy conservation and quantity of energy saved;

iv) Preparation and Maintenance of Consolidated End of Cycle (EOC) Data Reports to be prepared by DCs from 2012 onwards up to assessment year

a. Report on production achieved, energy consumed

b. specific energy consumption achieved, specific energy consumption

c. reduction achieved, measures adopted for energy conservation and quantity of energy saved;

7. The DC has to maintain in set tabulated format and set reports template as per above guidelines for submission to EmAEA

8. The DC has to fill the data in the Sector Specific Pro-forma for the Normalisationfactors including M&V protocol for its facility in conformity with the Sectoral Normalisation factor guidelines prepared by BEE

9. The data to be filled in the latest version of MS Office Excel sheet and PATNET

10. Designated Consumers shall facilitate verification and check-verification work by the EmAEA and SDA.

11. The designated consumers shall,-

(a) for assessment of their performance for compliance with the energy consumption norms and standards, get the work of verification done through accredited energy auditors;

(b) take all measures including implementation of energy efficiency projects recommended by the accredited energy auditor and good practices prevalent or in use in the concerned industrial sector so as to achieve the optimum use of energy in their plant :

I furnish the full and complete data, provide necessary documents and other facilities required by the accredited energy auditor for the purpose of performing the function of verification and check-verification.

12. The designated consumer for the purpose of achieving the compliance with the energy consumption norms and standards during the target year, in the relevant cycle shall take the following action and after completing the said action, furnish the status of compliance to the concerned state designated agency with a copy to the Bureau in Form D' by the end of five months from the last date of submission of Form `A'-

(a) by implementation of energy conservation and energy efficiency improvement measures or;

(b) where the measures implemented in terms of clause (a) are found

inadequate for achieving compliance with the energy consumption norms and standards, the designated consumer shall purchase the energy savings certificates equivalent in full satisfaction of the shortfall in the energy consumption norms and standards worked out in terms of metric ton of oil equivalent.

2.3. Empanelled Accredited Energy Auditor (EmAEA)

The EmAEA is responsible for verification of Energy Consumption Norms and Standards for Designated Consumers, Gate to Gate Specific Energy Consumption of baseline and assessment year as per guidelines of PAT Rules 2012 with subsequent attributes:

13. To ensure that the verification is carried out by properly trained and competent staff as per Section 1.4.2

14. The EmAEA is responsible for ensuring that the systems and processes adopted by the DC for determination of GtG SEC from the data in Sector Specific Pro-forma along with Normalisation sheets and information protocol have been maintained in conformity with the various notifications and information provided by BEE/SDA from time to time

15. EmAEA is required to perform different roles such as technical review of manufacturing processes & energy consumption patterns, system variabilities and their impact on energy consumption, and on issues including application of statistical methods and finally performance of verifications including integrity of data

16. The accredited energy auditor shall independently evaluate each activity undertaken by the designated consumer for compliance with the energy consumption norms and standards and entitlement or

requirement of energy savings certificate, to ensure that they meet with the requirements of these rules.

(A) The accredited energy auditor, in order to assess the correctness of the information provided by the designated consumer regarding the compliance with energy consumption norms and standards shall-

    (a) Apply standard auditing techniques;

    (b) Follow the rules and regulation framed under the Act;

    (c) Integrate all aspects of verification, and certification functions;

    (d) Make independent technical review of the opinion and decision of the verification team; also take into consideration, a situation where a particular activity may or may not form part of the activities related to the compliance with the energy consumption norms and standards, and the procedure for the assessment shall include,-

(B) Document review, involving

    (i) Review of data and its source, and information to verify the correctness, credibility and interpretation of presented information;

    (ii) Cross checks between information provided in the audit report and, if comparable information is available from sources other than those used in the audit report, the information from those other sources and independent background investigation;

(C) Follow up action, involving-

    (iii) Site visits, interviews with personnel responsible in the designated consumers' plant;

(iv) Cross-check of information provided by interviewed personnel to ensure that no relevant information has been omitted or, over or under valued;

(v) Review of the application of formulae and calculations, and reporting of the findings in the verification report.

(D) The accredited energy auditor shall report the results of his assessment in a verification report and the said report shall contain,

(a) The summary of the verification process, results of assessment and his opinion along with the supporting documents;

(b) The details of verification activities carried out in order to arrive at the conclusion and opinion, including the details captured during the verification process and conclusion relating to compliance with energy consumption norms and standards, increase or decrease in specific energy consumption with reference to the specific energy consumption in the baseline year;

(c) the record of interaction, if any, between the accredited energy auditor and the designated consumer as well as any change made in his assessment because of the clarifications, if any, given by the designated consumer.

17. EmAEA to prepare a verification report as per Reporting template to be provided by BEE

18. EmAEA to resolve errors, omissions or misrepresentations in the data/records/calculations in consultation with the DCs prior to completing the verification report

19. EmAEA to resolve calculation errors in the Sector Specific Pro-forma in consultation with the BEE prior to completing the verification

2.4. State Designated Agencies (SDA)

All the documents like verified Sector Specific Pro-forma, Form 1, Verification report of EmAEA and related documents will be routed to BEE via SDA.

20. The technical role of SDA are

i. Inspection & enforcement for M&V related systems

ii. Assist BEE in information management process

iii. Review and validation of Sector Specific Pro-forma, Form 1, Verification report of EmAEA and related documents before sending it to BEE

iv. After submission of duly verified Form 'A' by designated consumer, SDA may convey its comments, if any, on Form 'A' to the Bureau within fifteen days of the last date of submission of Form 'A'.

v. BEE, in consultation with SDA may decide to undertake review on Check verification

vi. The EmAEA in-charge of check-verification shall submit the report with due certification Form C to the BEE and the concerned SDA

vii. The State designated agency may furnish its comments on the report within ten days from the receipt of the report from the said EmAEA. In case no comments are received from the concerned state designed agency, it shall be presumed that they have no comments to offer in the matter

viii. The State designated agency within two months from the date of the receipt of the report referred to in sub-rule (9) shall initiate-

(a) action to recover from the designated consumer the loss to the Central Government by way of unfair gain to the designated consumer;

(b) penalty proceedings against the persons mentioned in the said report,under intimation to the Bureau;

(c) register complaint for such fraudulent unfair gain if designated consumer does not pay penalty and loss to the exchequer in the specified time mentioned in the penalty proceedings.

21. The administrative role of SDA are

The designated agency may appoint, after the expiry of five years from the date of commencement of this Act, as many inspecting officers as may be necessary for the purpose of ensuring compliance with energy consumption standard specified under clause (a) of section 14 or ensure display of particulars on label on equipment or appliances specified under clause (b) of section 14 or for the purpose of performing such other functions as may be assigned to them.

Subject to any rules made under this Act, an inspecting officer shall have power to –

(a) inspect any operation carried on or in connection with the equipment or appliance specified under clause (b) of section 14 or in respect of which energy standards under clause (a) of section 14 have been specified;

(b) enter any place of designated consumer at which the energy is used for any activity and may require any proprietor, employee, director, manager or secretary or any other person who may be attending in any manner to or helping in, carrying on any activity with the help of energy to afford him necessary facility to inspect–

(A) any equipment or appliance as he may require and which may be available at such place;

(B) any production process to ascertain the energy consumption norms and standards

2.5. Adjudicator

Section 17 and Section 28 of EC Act 2001 shall be referred for power to adjudicate

2.6. Bureau of Energy Efficiency

BEE shall co-ordinate with the Designated Consumers, SDA, Sectoral technical committee and other agencies to administer and monitor the Scheme as per PAT Rules and EC Act 2001.

22. BEE recommend to the Central Government the norms for processes and energy consumption standards required to be notified under clause (a) of section 14 of Energy Conservation Act 2001

23. Preparation and Finalization of Sector Specific Pro-forma for annual data entry in consultation with the Technical Committee set up by BEE

24. Preparation and finalization of Sector Specific Normalization Factors applicable in Assessment year in consultation with Technical Committee set up by BEE

25. Empanelment of Accredited Energy Auditor Firm as Verifier for M&V

26. Capacity building of SDA, EmAEA, Energy Manager of DCs

27. The Bureau on satisfying itself about the correctness of verification report, and check-verification report, wherever sought by it, send its recommendation under clause (aa) of sub-section (2) of section 13 to the Central Government, based on the claim raised by the designated consumer in Form `A', within ten working days from the last date of submission of said Form `A' by the concerned state designated agency, for issuance of energy savings certificates under section 14A

2.7. Ministry of Power

28. Roles and Responsibilities of Central Government have been covered under Energy Conservation Act 2001 and notified PAT Rules 2012

2.8. Institutional Framework for PAT

Transparency, flexibility and Industry engagement in program design help ensure effective industrial energy efficiency policy with adequate buy-in from the covered facilities. PAT's design phase involved extensive consultations with the DCs. Consultations ensured the design phase was transparent and allowed industry to engage in the process.

Since, PAT being largely a federal government scheme, hence involvement of State Designated Agencies as an extended arm of enforcement agency ushers outcome in the right direction.

An institutional frame work consisting of State Designated Agencies, Designated Consumers, Accredited Energy Auditors, Trading Exchanges[3] and Financing facilities has been established to implement the scheme. Bureau of Energy Efficiency is leading the process with state level capacity supported by AEA and Sectoral Technical committee constituted for rationalizing the process.

Figure 3: Institutional Framework
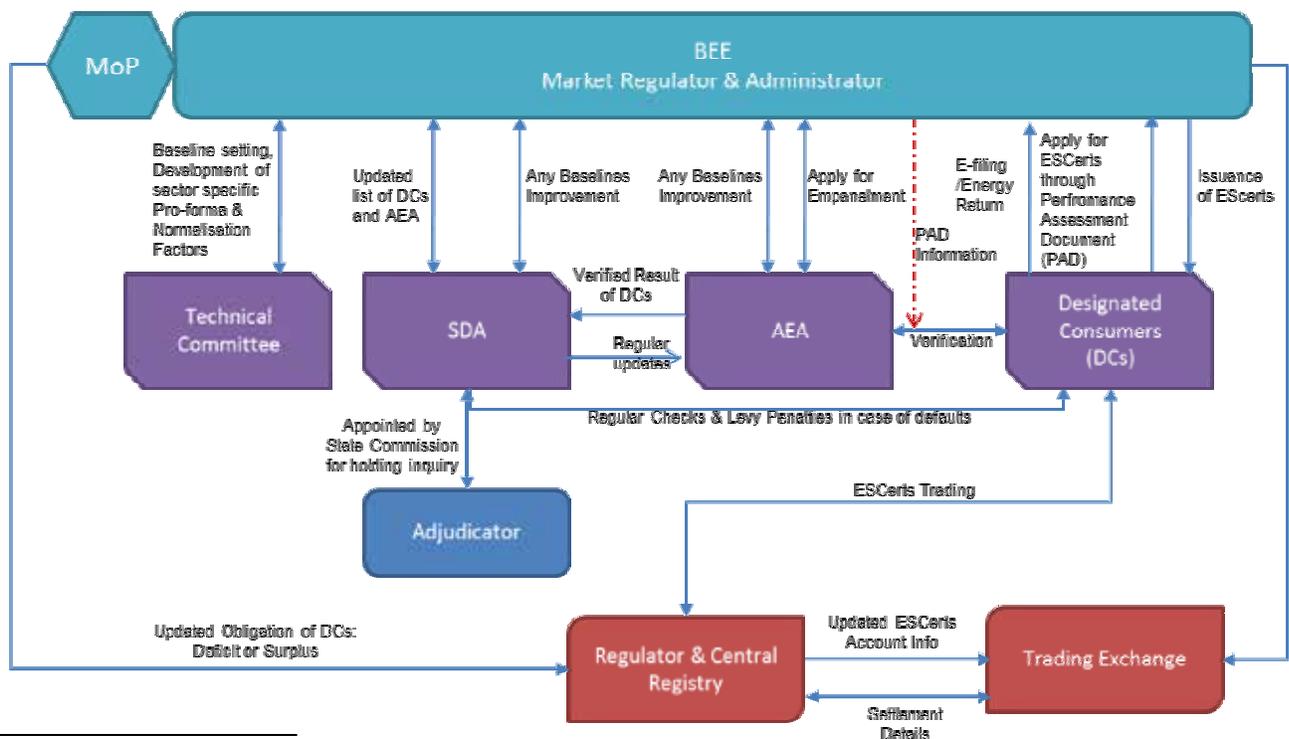
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[3] Trading Exchanges: IEX & PXIL

3.   Process & Timelines

3.1.   Activities and Responsibilities

The Energy Conservation Rules, 2012 clearly defines the timelines of activities and responsibilities to be carried out for accomplishment of PAT scheme. Timely submission of action plan from DC to trading of ESCerts needs to be done in a definite time zone. Constant performance monitoring of the program by the Administrator, through parameters like total ESCerts issued & traded, complying sectors or participants, market liquidity etc., will be carried out. Delays at any point of the process-chain will be identified and timely action be taken by the Administrator/ Regulator.

Automation of processes wherever feasible will be carried out for seamless implementation of the PAT scheme.

Table 1: Activities and Responsibilities for PAT Cycle I

S. No	Name of Form	Submitted by	Time of Submission	Submission authorities
1.	Form A	DCs	Three months from conclusion of target year (end of first, second or third year of relevant cycle) **30th June, 2015**	SDA & BEE
2.	Form B (Certificate of verification by AEE)	DCs	Three months from conclusion of target year (end of first, second or third year of relevant cycle) **30th June, 2015**	SDA & BEE
3.	BEE's Recommendation to MoP for issuance of ESCerts	BEE	10 working days from receipt of forms A & B	Ministry of Power
4.	Issuance of ESCerts	Central Government (MoP)	Within 15 days from receipt of recommendations by BEE	BEE
5.	Form D (status of Compliance)	DC	End of 5 months from the last date of submission of Form A	SDA & BEE
6.	Form C (check verification report and certificate)	AEA (Accredited Energy Auditor)	Within 6 months after issuance of ESCerts or within 1 year of submission of compliance report	BEE

3.2.   Process Interlinking

The complete process from notifying the targets to issuing Escerts are interlinked among different stakeholders complying a definite time frame as defined below

Figure 4: Stakeholders Interlinking
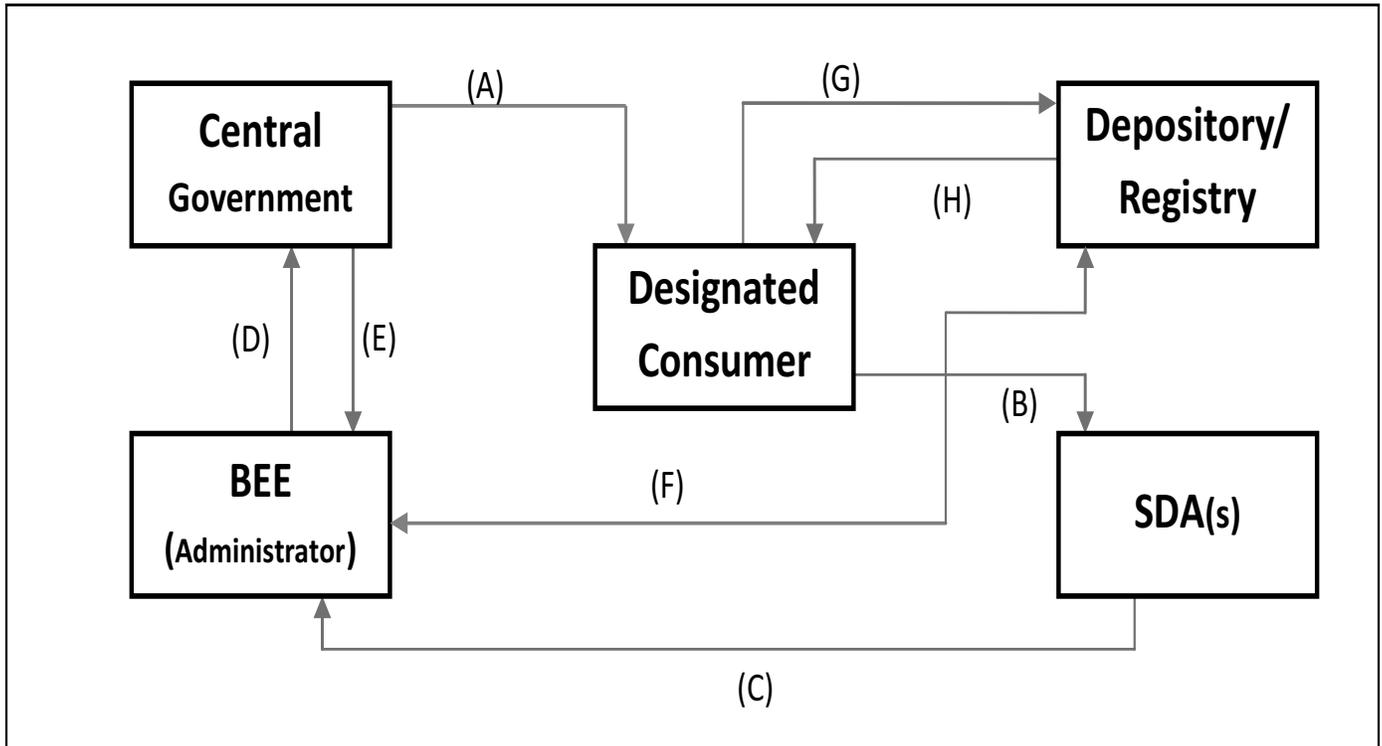
(A)   Targets from Central Government to DCs

(B)   Performance Assessment Document (Form A) from DC to SDA

(C)   PAD (Form-A) with recommendation for issuance, if overachieved   from SDA to BEE

(D)   Recommendation of ESCerts Issuance by BEE to Central Government

(E)   ESCerts Issuance Instruction from Central Government to BEE

(F)   Electronic ESCerts Issuance Instruction from BEE to Depository

(G)   DC Interaction with Depository A/c

(H)   ESCerts credit to DC's A/c

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┌─────────────────────────────────┐        ┌──────────────────────┐
│ Forms and Document [Form I,      │        │ FORM 1 filling in    │
│ Proforma, Form A, Form B] duly   │────────│ PATNET by DC on      │
│ verified by EmAEA                │        │ achieved SEC in AY   │
│ Submission by DC to SDA with a   │        └──────────────────────┘
│ copy to BEE                      │
└─────────────────────────────────┘
                │
                ▼
┌─────────────────────────────────┐
│ Forms and Document submission    │
│ by SDA to BEE                    │
└─────────────────────────────────┘
                │
                ▼
┌─────────────────────────────────┐
│ Verification of Forms and        │
│ Documents submitted by DC & SDA  │
│ by BEE                           │
└─────────────────────────────────┘
```

Change in SEC value after assessment

SEC after Check-Verification

Yes → SEC value to be rectified in PATNET by BEE with information to DC

No

Final SEC of BY/ AY — Under achiever — Final SEC of AY

Over achiever / Under Achiever / Over achiever

DC to purchase the EScerts from Exchange - up to November

Recommendation of EScerts by BEE to the Central Government if a DC overachieves the target

ISSUANCE OF ESCERTS BY CENTRAL GOVERNMENT (For Over Achievers)

Trading of ESCerts at Trading Platform

Submission of Form D by Designated Consumer

Penalty Proceedings to start by SDA on recommendation of BEE for the DCs not complying the Norms and Standards as per Notification

Figure 5: Flow Chart of ESCerts issuance

29. Penalty for Non-Achievement of Target

i. Compliance as per Form D of Energy Conservation Rules 2012

(a) Energy savings certificates: Enter +ve value if energy savings certificates issued to designated consumer or enter –ve value in case recommended for purchase of energy savings certificates

(b) Energy savings certificates

submitted for compliance: If designated consumer is recommended for purchase of energy savings certificates, then enter value of energy savings certificates submitted by designated consumer for compliance of energy consumption norms and standards- saving target of designated consumer.

(c) Balance energy savings certificates:- Numbers of energy savings certificates balance. If balance is ZERO than DC is in accordance for compliance of energy saving target and if balance is –ve than DC will be recommended for penalty.

ii. For Penalty and Power to adjudicate, refer section 26 and 27 of the EC Act 2001

iii. As per EC Act, 2001, section 26, Fixed penalty is maximum 10 Lakh and variable penalty is price of 1 TOE as specified in Energy Conservation Rules 2012. Any amount payable under this section, if not paid, will be recovered as if it were an arrear of land revenue.

3.3. Flow Chart showing verification process (Rules and Act required dates in **bold Italics**)

Responsibility	Date	Action and Stages of verification process
DC	*By June 30 each Year*	Submission of Energy Return Form I and Sector Specific Supporting Pro-forma for Form 1
DC	*By June 30 [First Year of PAT Cycle]*	Submission of Action Plan
DC	*Before M&V phase of PAT Cycle*	Hiring of Empanelled Accredited energy Auditor
DC/EmAEA	*April 1-June 30 [After completion of relevant PAT cycle]*	Monitoring and Verification
DC	*By June 30 [M&V phase of PAT Cycle]*	Submission of Verified Form I and Sector Specific Pro-forma, Form A, Form B and Other Document to SDA & BEE
DC	*By June 30 [After end of 1ˢᵗ and 2ⁿᵈ Year PAT Cycle]For Advance ESCerts*	Submission of Verified Form I and Sector Specific Pro-forma, Form A, Form B and Other Document to SDA & BEE
SDA	[15 days of the last date of sub. of Form A]	Submission of Comments on Verified Form I and Sector Specific Pro-forma, Form A, Form B and Other Document to BEE
BEE	**[10 working days from last date of submission of Form A by SDA]**[M&V phase of PAT Cycle]	Recommendation of Energy Saving Certificates to Central Government **[10 working days from last date of submission of Form A by SDA]**
Central Government	**[15 working days from date of receipt of recommendation by BEE]**[M&V phase of PAT Cycle]	Issue of Energy Saving Certificates**[15 working days from date of receipt of recommendation by BEE]**
DC	**[5 months from date of submission of Form A by DC to SDA]**[M&V phase of PAT Cycle]	Submission of Form D to SDA and BEE**[5 months from date of submission of Form A by DC to SDA]**
BEE/Power Exchange	[M&V phase of PAT Cycle]	ESCerts Trading period

Figure 6: Time Line Flow Chart

Monitoring & Verification Guidelines

4. Verification requirement

4.1. Guidelines for Selection Criteria of EmAEA by Designated Consumer

30. The EmAEA will be selected only from the List of EmAEA as available in the BEE official website

31. The procedure for selection of EmAEA should be followed from guidelines of PAT Rules 2012

32. The Designated Consumer may select EmAEA based on their experience in Energy Auditing Field and in the related sector as per information in Form III and Form IV (REGISTER CONTAINING LIST OF ACCREDITED ENERGY AUDITORS) Submitted by the Accredited Energy Auditor (www.bee-india.nic.in)

33. The EmAEA preferably have attended at least one Training Programs organized by Bureau of Energy Efficiency on Monitoring and Verification Guidelines.

34. The Designated Consumer needs to verify following during selection of AEA

    (a) Provided that a person who was in the employment of a designated consumer within the previous four years, shall not be eligible to perform the work of verification or check-verification for such designated consumer;

    (b) Provided further that any person or firm or company or other legal entity, who was involved in undertaking energy audit in any of the designated consumer within the previous four years, shall not be eligible to perform the work of verification or check

verification for such designated consumer.

35. EmAEA is required to submit the documentation on determining the capability of the team on Technical and financial competence after getting the formal order from Designated Consumer

36. EmAEA is required to submit the Name and detailed Bio-data on Energy Audit or Verification experiences of the team head, team members and experts to the DC prior to selection

37. The Designated Consumer to ensure that the EmAEA must have documented system on preparing plan for verification or check-verification along with activities chart defining task in man-days for the DC.

38. The selection process of EmAEA needs to be completed before 31st March of the end of PAT Cycle

39. The scope of workmay cover the time period till the check verification.

4.2. Guidelines for Empanelled Accredited Energy Auditor

40. For the Work of verification, EmAEA shall constitute a team in accordance to section 10 of Energy Conservation Rules, 2012; comprising following team members

41. Where ever necessary, EmAEA must state any discrepancies in their final verification reports. Potential improvements to achieve more accurate reporting in line with the PAT Rules and EC Act.

Table 2: Team Details (Minimum Team Composition)

Sr No	Designation	Qualification	Experience
1	Team Head	Accredited Energy Auditor	In the Field of Energy Auditing of PAT Sectors [4]
2	Team Member [Expert]	Graduate Engineer	Process or Technical Expert related to the specific sector, where verification will take place having experience of more than 10 years
3	Team Member	Certified Energy Auditor	In the Field of Energy Auditing
4	Team Member	Graduate/ Diploma Engineer	

42. The EmAEA may constitute any nos of team for verification or check-verification purpose to carry out the verification process for nos of Designated Consumer.

43. The EmAEA shall ensure that it has formal contractual conditions of team members including technical experts for verification and check-verification so as to act in an impartial and independent manner and free of potential conflict of interest.

44. The EmAEA, has the sole responsibility and signing authority on Form B, Form C

45. The verification by EmAEA should be completed for onward submission to SDA and BEE before 30th June in the year following the assessment year.

46. The EmAEA should furnish a time plan and activities chart to DC after receiving valid order from the respective designated Consumer

47. The Designated Consumer shall inform Bureau of Energy Efficiency about the date of start of verification by EmAEA.

48. The verification shall not be carried out by two different EmAEA for the particular DC in a single PAT cycle.

49. The audit report shall be certified by the EmAEA and shall be counter signed by the DCs Energy Manager and Competent Authority

50. EmAEA to submit an undertaking along with Form B indicating that there is no conflict of interest in the team assigned and PAT Rules 2012 and its amendments have been complied.

4.3. Guidelines for Verification process

4.3.1. Sector Specific Pro-forma

The Sector Specific Pro-forma is made with the purpose of capturing the data for Production, Energy and Normalization factors under equivalent condition for the baseline and assessment year. The filled in Pro-forma is used to calculate the Notional Energy for Normalization. Once complete data is filled in the Pro-forma, the SEC after Normalization automatically comes out in the summary sheet enabling the DC to see the actual performance of the plant

51. The Energy Conservation (Form and Manner for submission of Report on the Status of Energy Consumption by the Designated Consumers) Rules, 2007 directs every designated consumers to submit the status of energy consumption in electronic form as well as hard copy, within three

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[4] PAT Sectors: Thermal Power Stations, Steel, Cement, Aluminium, Fertiliser, Pulp & Paper, Textile, Chlor-Alkali

months, to the designated agency with a copy to Bureau of Energy Efficiency at the end of the previous financial year in Form-1.

52. The Sector Specific Pro-forma have many sections to cover all the aspects of GtG[5] methodology as follows:

    ► Instruction for Form 1 filling

    ► General Information Sheet

    ► Form 1

    ► Sector Specific Pro-forma

        o Production and Capacity Utilization Details

        o Section wise details of different products

        o Electricity and Renewable Energy Consumption

        o Power Generation (DG/GG/GT/ STG/Co-Gen/WHR)

        o Fuel Consumption (Solid/ Liquid/Gas/Biomass & Others)

        o Heat Rate of different power sources and Coal Quality

        o Miscellaneous Data for Normalisation

    ► Additional Equipment installation due to Environmental Concern

    ► Project Activities details

    ► Summary Sheet

    ► Normalization calculation sheets

53. The Form 1 will be automatically generated after filling the Pro-forma, which is required to be filled in the PATNET as input for final assessment of GtG SEC for the baseline and assessment year.

54. Formulae cells in Pro-forma, Summary sheet and Normalisation calculation sheets are locked to ensure data security, reliability etc.

55. There are five columns in the Sector Specific Pro-forma. Three columns are used for Baseline years i.e., Year 1, Year 2 and Year 3, the fourth column will be used for computing the average data of the baseline years and the fifth one for entering the data in Year 4 i.e. Assessment year/Target year/Current year.

56. The Sector Specific Pro-forma will be used for mandatory submission of annual Energy return. The data will be filled in the year 3 column as previous year and year 4 as current year after making the others column cells empty.

57. Average of the three baseline years is taken as baseline data for Normalisation

58. For the purpose of taking average of baseline year, other columns are not to be kept blank. However, if plant's data contains only one or two year operation, then the third year column should be kept as blank.

59. Cells have been Colour coded and locked for data security purpose in the Pro-forma.

4.3.2. Reporting in Sector Specific Pro-forma

60. Baseline parameter and Plant boundary in Gate to Gate Concept means

    ► **Plant Boundary for Energy and Product**

        ▪ Input Raw material

        ▪ Output product

        ▪ CPP installed within premises or outside the plant demographic boundary

        ▪ Energy inputs and Outputs (Electricity/Gas/Steam etc)

[5] GtG: Gate to Gate

► **Defining Input Energy in Sector Specific Pro-forma**

- Fuel Input to the Captive Power Plants
- Fuel Input to the Process
- Bifurcation of Input Energy for Renewables/Alternate source/ Biomass etc in Captive Power Plants
- Not connected with Grid- The energy used from the Renewables/Alternate source/ Biomass will not be added in the total input energy
- Connected with Grid-The energy used from the Renewables/ Alternate source/Biomass will be added in the total input energy
- Waste Heat Recovery
- Co-generation
- Accounting of Energy generation and Energy used inside the plant boundary

► **Raw material input and Product output**

- Intermediary semi-finished Product output for market sale- the energy for making the intermediary product to be deducted from the total energy consumption
- Intermediary semi-finished Product input as raw material in between the process- the energy for making up to the semi-finished intermediate product to be added in the total energy consumption.

61. The baseline Production and Energy related data to be entered in Sector Specific Pro-forma as per Baseline Report by individual DCs. The same will be verified by EmAEA.

62. The DCs are required to fill the data as per instruction sheets in all the relevant baseline and assessment year data field with source of data

63. The entered baseline data in the Excel Sheets will be locked for data security by BEE. The DC can enter data in all the fields other than locked Cells.

64. The Locked-in Sector Specific Pro-forma is to be sent to DCs for data entry.

65. The primary and secondary source of data should be kept ready in hard copies for verification by EmAEA as per guidelines in the instruction sheet.

66. The DCs are advised to fill the data in Excel Sheets only and return the same in Excel form to SDAs with a copy to BEE along with hard copies of Form 1, Sector Specific Pro-forma, Summary and all Normalisation sheets duly signed.

4.3.3. Verification Process

As part of the verification process, the EmAEA shall carry out the following steps:

67. The EmAEA after receiving the work order is advised to get the final Baseline report (Accepted by BEE) from the DC.

68. The EmAEAshall conduct a site visit on mutually agreed dates with Designated Consumer, to inspect the monitoring systems, conduct interviews, and collect sufficient information and supporting documentary evidencevide Sector Specific Pro-forma.

69. Prior to visiting the site, the EmAEA is advised to study the Baseline reports, Sector Specific Pro-forma and Sector specific Normalisation document

70. For computing SEC in Gate-to-Gate concept,the plant boundary was established such that the total energy input and the defined product output is fully captured. Typically, it is the entire plant

excluding colony,residential complex and transportation system. Similarly, mining operations in the case of Iron & Steel,Aluminium and Cement sector do not fall under plant boundary.

The same boundary should be considered for entire PATcycle as finalised for the baseline year in the final Baseline Energy Audit Report. Ideally, plant boundary should not change during the entire cycle. Any change in plant boundary limit or merger of two plants, division of operation should be duly reported. The definition of Plant boundary should be considered same as established in the baseline year

71. The EmAEA will assign the activities among team members for verifying the data through the Pro-forma, Documented Primary and secondary sources, Field reports, conducting interviews, site visits etc.

72. The filled in Baseline data for Production and Energy shall be verified through Baseline Report by EmAEA.

73. The additional Baseline data filled by DC needs to be verified based on authentic documentary evidence.

74. The baseline verified data shall be considered as final data to be filled in the sector specific pro-forma. In case of any typographical or factual error, the same shall be taken into account after taking into account corrected during verification process subject to all factual and authentic data source is available by DC. The EmAEA may take into account while preparing the verification form B.

75. The SEC calculation methodology as devised in the pro-forma shall be considered.

76. In case of any discrepancies observed in baseline data w.r.t. the Baseline reported data, the same should be reported to BEE with proper justification from EmAEA or DC for rectification in the existing Sector Specific Pro-forma. The rectified Pro-forma from BEE will be sent to the DC through e-mail.

77. Officials from Bureau of Energy Efficiency may visit Designated Consumers' Plant during the course of verification by EmAEA.

Figure 7: Stakeholders Output

BEE	Designated Consumer	Empanelled AEA [EmAEA]
▣ Verification of entered Baseline data in Pro-forma for Production and Energy as per Baseline Report ▣ Locked-in Pro-forma to be sent to DCs for data entry in assessment year ▣ Preparation of Document ► Normalisation Document ► M&V Guidelines	▣ Data entry in Pro-forma for Assessment year and Baseline years as per instruction sheet ▣ Source of Data from Primary and secondary source to be kept ready for verification as per guidelines ▣ Performance Assessment Form (Form A) ▣ Selection and hiring of Empaneled AEA as per guidelines of PAT Rules ▣ Submission of Form A and Form B along with Form I and Pro-forma to SDA and BEE	▣ Team Building by Empaneled AEA including experts ▣ Documents to carry ► Baseline report ► Sector specific Pro-forma ► Normalisation Document ► M&V Guidelines ▣ Work distribution among Team members at site ▣ Cross verification of Baseline data in the Pro-forma from the baseline report ▣ Review of Form I,Pro-forma data and its source ▣ Review of application of formulae and calculation ▣ Preparation of verification report ▣ Form B signing
OUTPUT **Form I & Sector Specific Pro-forma** **Normalisation Document** **M&V Guidelines**	**OUTPUT** **Filled-in Form I & Pro-forma** **Filled-in Form A,B** **Source of Data as Document**	**OUTPUT** **Verified Form I & Pro-forma** **EmAEA Signed Form B**

78. Review of assessment year data and its authentic sources:

   i.   The verifier shall ask the filled in Sector Specific Pro-forma with Form 1 from the Designated Consumer along with authentic documentary evidence

   ii. Incase DC reports some error; Interlinking or calculation error, these are to be reported back to BEE by the EmAEA with proper justification. BEE will send the rectified Pro-forma to DC through e-mail.

   iii. EmAEA shall start the verification of Pro-formareferringto the documents provided by DC

   iv. The guidelines as relevant to the data source are tabulated for different sections in Table 3 to 13 for Designated Consumers of sectors other than Thermal Power Plants. The instruction sheet of Thermal Power Plant sectormay be referred for detailed documentation requirement.

   v.   EmAEA may seek other documents relevant to the process of M&V as well apart from the documents mentioned in the guidelines for his satisfaction.

   vi. EmAEA should include a writeup on Fuel Analysis report, internally or externally, in the Verification Report

   vii. Data sampling method could be performed on sources of data, so that Operator's Log book/Log Sheet data/ Shift Report (Basic data Entry Point particularly for Lab test/Production/ External reasons etc) could be verified in a loop of verifying the source document. EmAEA is advised to verify random sampling of data up to the primary source for some of the

major parameters, affecting SEC of the Plant, which will be included in the Verification Report

   viii. In case of discrepancies between authentic document provided by DC and the Pro-forma, the same to be recorded in the EmAEA's verification report with justification if any from DC's and EmAEA.

79. Review of Energy Savings Projects

   i.   In terms of Rule 7 of PAT Rules 2012 on Quarterly, Yearly and EOC[6] internal data reports prepared by the Designated Consumer

   ii. In terms of Internal Audit reports prepared and maintained by the Designated Consumer

   iii. In terms of measures adopted for energy conservation and quantity of energy saved and investment made by the Designated Consumer covering the relevant cycle

   iv. Through Photographs, Screenshots in support of measures implemented in each year, if feasible

   v.   Through Percentage improvement in energy savings achieved in every year following the baseline year until the target year

   vi. Verification & validation based on evaluation of implemented EE projects through commissioning and procurement documents

   vii. Site visit to some of the implemented EE projects for verification and validation

   viii. Establish linkage of expected results of projects on reduction of GtG SEC

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[6] EOC: End of Cycle

ix. Identify SEC reduction reasons in the Verification Report

80. Review of Formulae and its application

i. EmAEA to review the formulae used in the Pro-forma with Normalisation factor sheets and its applications; Errors are to be reported immediately to BEE.

ii. EmAEA to review the formulae and calculation used to arrive certain data filled in the Pro-forma by Designated Consumer and documented properly in the Verification Report

81. Verification through Personnel Interviews, site visits and cross checking the same with the filled in data in Sector Specific Pro-forma

4.3.4. Primary and Secondary source of Documentation

82. For verification process, the DC shall provide all necessary information, supporting documents and access to the Plant site to EmAEA. It will be the responsibility of the EmAEA to maintain the confidentiality of the data collected and not to use for any other purpose except for the PAT scheme.

83. The data submitted for verification and other figure for SEC calculation of any unit has to be in line with the units declared production and consumption figures as per the statutory financial audit and declaration in their annual report.

84. EmAEA, while verifying the SEC calculation should also cross verify the input figures based on the procurement plans and physical receipts.

85. The transit and handling losses have to be within the standard norms allowable under financial audit.

86. Guidelines on sources of data for Designated Consumer and EmAEA:

a. The general guidelines for the sectors other than Thermal Power Plants sector are tabulated in Table 3 to 13 in subsequent pages.

b. For Thermal Power Plant sector, sector specific pro-forma shall be referred

c. Designated Consumer and EmAEA may also refer the guidelines provided in the Instruction sheet attached with the Sector Specific Pro-forma.

87. The general guidelines on sources of data are mentioned below. In case of any discrepancies, EmAEA may seek further field document or Equipment/ Section Log sheets for particular data verification

Table 3: Production and Capacity Utilisation details

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Production and capacity utilization details					
1	Production Capacity of a Plant/section/line/unit	Tonne	Annual	1) OEM Document of line/ unit/equipment capacity 2) Enviromental Consent to establish/operate document 3) DoF Communication	1) Equipment/Section wise capacity document from OEM 2) Capacity calculation document submitted for Enviromental Consent

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
2	Production of a Plant/ section/line/unit	Tonne	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) DCS/CCR/ SCADA Report/ Trends 3) DPR 4) MPR 5) SAP Entry in PP/SD module 6) Excise record (ER1) 7) Annual Report 8) TOP	1)Storage Level 2) Feeding Weigh feeders 3) Belt Weigher 4) Solid flow meter 5) Counters
3	Production of Intermediate/ Semifinished Product/Other product	Tonne	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) DCS/CCR/ SCADA Report/ Trends 3) DPR 4) MPR 5) SAP Entry in PP/SD module 6) Excise record (ER1) 7) Annual Report 8) TOP	1)Storage Level 2) Feeding Weighfeeders 3) Belt Weigher 4) Solid flow meter 5) Counters
4	Opening stock of Intermediary product	Tonne	Daily, Monthly	1) Inventory Report 2) Excise Document (ER1)3) Stores Entry 4) SAP Entry in MM/ PP/SD module 5) Annual Financial report 6) TOP	1) Field Inventory 2) Storage Level
5	Closing Stock of intermediary product	Tonne	Daily, Monthly	1) Inventory Report 2) Excise Document (ER1)3) Stores Entry 4) SAP Entry in MM/ PP/SD module 5) TOP	1) Field Inventory
6	Export of Intermediary Product	Tonne	Daily, Monthly	1) Excise Document 2) Stores receipt 3) SAP Entry in FI/ SD Module 4) Annual Report 5) TOP	1) Internal material Transfer Records
7	Import of Intermediary Product	Tonne	Daily, Monthly	1) Excise Document 2) Stores receipt 3) SAP Entry in FI/ SD Module 4) Annual Report 5) TOP	1) Internal material Transfer Records
8	Raw material consumption if any	Tonne	Daily, Monthly	1)Lab Product Test Report 2) DPR 3) MPR 4) SAP Entry in MM/PP module 5) Raw material stock entry (Stores) 6) TOP	1) Lab Testing Register 2) Closing and opening stock
9	Thermal Energy Consumption of section/Unit/Product	Tonne	Daily, Monthly	1)Fuel Weighfeeder 2) Fuel Flow Meter 3) DPR 4) MPR 5) SAP Entry in MM/PP module 6) TOP	1)Storage Level 2) Feeding Weigh feeders 3) Belt Weigher 4) Solid flow meter
10	Electrical Energy Consumption of section/Unit/Product	Tonne	Daily, Monthly	1) Energy Management System 2) Equipment List Major Eqp section 3) DPR 4) SAP Entry in MM/PP module 6) TOP	1)Storage Level 2) Feeding Weigh feeders 3) Belt Weigher 4) Solid flow meter

Table 4: Major Equipment capacity and Operating SEC

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Major Eqp Capacity and Operating SEC
1	Major Eqp wise production in Tonne.	Tonne	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) CCR SCADA Report/ Trends 3) DPR 4) MPR 5) SAP Entry in MM/ PP module	1)Storage Level 2) Feeding Weigh feeders 3) Belt Weigher 4) Solid flow meter
2	Operating Major Eqp thermal SEC (Total thermal energy consumed in Major Eqp/ total Major Eqp production) in kcal/ kg Intermediary Product.	Kcal/ kg or kcal/ Tonne	Continuous, Hourly, Daily, Monthly	1)Fuel Weighfeeder 2) Fuel Flow Meter 3) DPR 4) MPR 5) SAP Entry in MM/PP module	1)Storage Level 2) Feeding Weigh feeders 3) Belt Weigher 4) Solid flow meter
3	Operating Major Eqp electrical SEC (Total electricity consumed in Major Eqp/ total Major Eqp production) in kWh/ kg Intermediary Product.	Kwh/ Tonne	Continuous, Hourly, Daily, Monthly	1) Energy Management System 2) Equipment List Major Eqp section 3) DPR 4) SAP Entry in MM/PP module	1)Electrical Meter Record for Major Eqp section
4	Major Eqp wise annual running hours.	Hrs	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) DPR 3) MPR 4) DCS/CCR/ DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
5	Annual Hot-Hot start in Nos	Nos	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) DPR 3) MPR 4) DCS/CCR/ DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
6	Total annual Hot-Cold Stoppage Hours for Major Eqp due to **external factor** [7]	Hrs	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) DPR 3) MPR 4) DCS/CCR/ DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
7	Total annual Hot-Cold Stoppage Nos for Major Eqp due to external factor	Nos	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) DPR 3) MPR 4) DCS/CCR/ DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report

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[7] External Factor: Market Demand, Grid Failure (Where CPP is not Sync with Grid), Raw material unavailability, Natural Disaster, Rioting or Social unrest, Major change in government policy hampering plant's process system, Any unforeseen circumstances not controlled by plant management

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
8	Total annual Electrical Energy Consumption for Hot-Cold Stoppage for Major Eqp due to external factor in Lakh kWh	Lakh kWh	Continuous, Hourly, Daily, Monthly	1) Energy Meter Reading for Major Eqp Section 2) Major Eqp Log sheet 3) DPR 4) MPR 5) CCR SCADA Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
9	Total annual Cold-Hot Start Hours for Major Eqp due to external factor	Hrs	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) Major Eqp Shift operator's Log Register 3) DPR 4) MPR 5) CCR SADA Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
10	Total annual Cold-Hot Start Nos for Major Eqp due to external factor	Nos	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) Major Eqp Shift operator's Log Register 3) DPR 4) MPR 5) DCS/CCR/DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
11	Total annual Electrical Energy Consumption for Cold-Hot Start for Major Eqp due to external factor in Lakh kWh	Lakh kWh	Continuous, Hourly, Daily, Monthly	1) Energy Meter Reading for Major Eqp Section 2) Major Eqp Log sheet 3) DPR 4) MPR 5) DCS/CCR/DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report
12	Annual Cold-Hot Start in Nos due to internal factors	Nos	Continuous, Hourly, Daily, Monthly	1) Major Eqp Log sheet 2) Major Eqp Shift operator's Log Register 3) DPR 4) MPR 5) DCS/CCR/DCS Trends	1)Major Eqp Shift operator's Log Register 2) Breakdown report

Table 5: Boiler Details (Process and Co-Generation)

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
	Boiler Details (Process/Co-Gen)				
1	Type			1) OEM Document	
2	Rated Capacity	TPH	Annual	1) OEM document on Boiler Capacity 2) Predicted performance Data (PPD) for Boiler 3) Environmental Consent to Operate	1) Capacity calculation submitted for Environmental Consent
3	Total Steam Generation	Ton	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) DCS/ SCADA Trend 3) DGR 4)MGR 5) SAP Entry in PP/PM Module	1) Steam Flow Meter 2) Process steam Consumption report 3) Log Book

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
4	Running hours	Hrs	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) DCS/ SCADA Trend 3) DGR 4)MGR 5) SAP Entry in PP/PM Module	1) Hour Meter 2) Log book
5	Coal Consumption	Tonne	Continuous, Hourly, Daily, Monthly	1) Log Sheet 2) DCS/ SCADA Trend 3) DGR 4)MGR 5) SAP Entry in PP/PM Module	1) Weigh Feeder 2) Solid flow Meter 3) Coal Storage register 4) Storage Level
6	GCV of Coal	kcal/ kg	Daily, Monthly, Yearly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Test Certificate from Government Accredited lab. (Plant to maintain minimum 1 sample test in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel in case of CPP/Cogen Fuel, for Process Fuel 1 sample test in a quarter for Proximate Analysis) 3) Purchase Order, where guaranteed GCV range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
7	Type of Fuel – 2 Name : Consumption	Tonne	Continuous, Hourly, Daily, Monthly	1) DGR 2) MGR 3) CPP/ Cogen Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1)Belt Weigher before Fuel Bunker
8	GCV of any Fuel -2	kcal/ kg	Daily, Monthly, Yearly	1) DGR 2) MGR 3) Lab Test Report	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
9	Type of Fuel – 3 Name : Consumption	Tonne	Continuous, Hourly, Daily, Monthly	1) DGR 2) MGR 3) CPP/ Cogen Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1)Belt Weigher before Fuel Bunker
10	GCV of any Fuel -3	kcal/ kg	Daily, Monthly, Yearly	1) DGR 2) MGR 3) Lab Test Report	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
11	Type of Fuel – 4 Name : Consumption	Tonne	Continuous, Hourly, Daily, Monthly	1) DGR 2) MGR 3) CPP/ Cogen Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1) Belt Weigher before Fuel Bunker

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
12	GCV of any Fuel -4	kcal/kg	Daily, Monthly, Yearly	1) DGR 2) MGR 3) Lab Test Report	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
13	Feed water Temperature	°C	Continuous, Hourly, Daily, Monthly	1) DGR 2) DCS/SCADA Trends	
14	Operating Efficiency	%	Continuous, Hourly, Daily, Monthly	1) Indirect Method or Direct method calculation	
15	SH Steam outlet Pressure (Operating)	kg/cm2	Continuous, Hourly, Daily, Monthly	1) DGR 2) DCS/SCADA Trends	1) Field Pressure Meter
16	SH Steam outlet Temperature (Operating)	°C	Continuous, Hourly, Daily, Monthly	1) DGR 2) DCS/SCADA Trends	1) Field Temperature Meter
17	SH Steam Enthalpy (Operating)	kcal/kg	Continuous, Hourly, Daily, Monthly	1) Steam Table	
18	Design Efficiency	%	Yearly	1) OEM document on Boiler Efficiency 2) Predicted performance Data (PPD) for Boiler	1) Design Calculation

Table 6: Electricity from Grid/Others, Renewable Purchase Obligation, Notified Figures

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Electricity from Grid / Other (Including Colony and Others) / Renewable Purchase obligation/Notified Figures					
1	Annual electricity purchase from the grid	Lakh kWh	Daily, Monthly	1) Monthly Electricity Bills from Grid 2) Internal Meter reading records for grid incomer	Energy Management System

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
2	Renewable electricity consumption through wheeling	Lakh kWh	Daily, Monthly	1) Open Access records 2) Electricity Bills for Renewable energy 3) Renewable Purchase Obligation document	Energy Management System
3	Electricity consumption from CPP located outside of the plant boundary though wheeling	Lakh kWh	Daily, Monthly	1) Open Access records 2) Electricity Bills (for Wheeling)	Energy Management System
4	Renewable Purchase obligation of plant for the current year in % (Solar and Non-Solar).	%	Yearly	1) Renewable Purchase Obligation document	
5	Renewable Purchase obligation of plant for the current year in Lakh kWh (Solar and Non-Solar).	Lakh kWh	Yearly	1) Renewable Purchase Obligation document	
6	Renewable Purchase obligation of plant for the current year in MW (Solar and Non-Solar).	MW	Yearly	1) Renewable Purchase Obligation document	
7	Renewable Energy Generator Capacity in MW as approved by MNRE	MW	Yearly	1)'Certificate for Registration' to the concerned Applicant as 'Eligible Entity' confirming its entitlement to receive Renewable Energy Certificates for the proposed RE Generation project	
8	Quantum of Renewable Energy Certificates (REC) obtained as a Renewable Energy Generator (Solar & Non-Solar) in terms of REC equivalent to 1 MWh	Nos	Yearly	1) Renewable Energy Certificates	
9	Quantum of Energy sold interms of preferential tariff under REC Mechanism in MWh	Nos	Lot, Yearly	1)Power Purchase Agreement (PPA) for the capacity related to such generation to sell electricity at preferential tariff determined by the Appropriate Commission	

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
10	Plant connected load	kW	Monthly	1) L-Form document 2) Electrical Inspectorate record	1) Total connected Load (TCL) of Plant 2) Equipment List
11	Plant contract demand with utility i	kVA	Monthly	1) Monthly Electricity Bills from Utility	
12	DCs Notified Specific Energy Consumption in TOE/T for Baseline Year	TOE/T		1) Notification S.O.687 dated 31/03/2012	
13	DCs Target Specific Energy Consumption in TOE/T for Target year	TOE/T		1) Notification S.O.687 dated 31/03/2012	
14	Equivalent Major Product Output in tonne as per PAT scheme Notification	Tonne		1) Notification S.O.687 dated 31/03/2012	

Table 7: Own generation through Captive Power Plants

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Own Generation through CPP (STG/GG/GT/WHRB/DG)					
1	Selection is required from the drop down list for grid connectivity with grid (Yes/No)	Yes/ No			
2	Installed capacity of all the Units in MW.	MW	Annual	1) OEM document for capacity 2) Rating plate of Generator	1) Capacity Enhancement document 2) R&M document
3	Gross unit generation of all the Units in Lakh kWh.	Lakh kWh	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP main energy meter reading record 4) Energy Management System data	1) Energy Meter
4	Auxiliary power consumption (APC) in %.	%	Continuous, Hourly, daily, Monthly	1) Daily Power Report 2) Monthly Power Report 3) CPP main energy meter reading record 4) Energy Management System data	1) Energy Meter 2) Equipment List

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
5	Design Heat Rate of all the Units in kcal/ kWh.	Kcal/ kWh	Annual	1) OEM document on designed heat rate	1) PG test document
6	Annual running hours of all the units.	Hrs	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3)Energy Management System data	1) Break down report 3) Operators Shift Register
7	Annual available hours of respective unit. Ex. If a unit commissions on 1st Oct, then available hour for the year will be 4380 hours	Hrs	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) Energy Management System data	1) Break down report 3) Operators Shift Register
8	Break down hrs due to internal, Planned and external factor for calculating Plant Availability Factor	Hrs	Hourly, daily, Monthly	1) CPP Log Sheet 2) Operators log Register 3) Daily generation Report 4) Monthly Generation Report 5) Energy Management System data 6)Refer Sr. No: N	1) Operator's Shift Register 2) CPP Break down analysis Report
9	No of hrs per annum during which Plant run on low load due to Internal Factors/ Breakdown in Plant (Average weighted hours of all the units)	Hrs	Hourly, daily, Monthly	1) CPP Log Sheet 2) Operators log Register 3) Daily generation Report 4) Monthly Generation Report 5) Energy Management System data 6)Refer Sr. No: N	1) Operator's Shift Register 2) CPP Break down analysis Report
10	No of hrs per annum during which Plant runs on low load due to Fuel Unavailability/ Market demand/ External Condition (Average weighted hours of all the units)	Hrs	Hourly, daily, Monthly	1) CPP Log Sheet 2) Operators log Register 3) Daily generation Report 4) Monthly Generation Report 5) Energy Management System data 6)Refer Sr. No: N	1) Operator's Shift Register 2) CPP Break down analysis Report
Through Co-Generation					
1	Grid Connected	Yes/ No			
2	Installed Capacity	MW	Annual	1) OEM document for capacity 2) Rating plate of Generator	1) Capacity Enhancement document 2) R&M document
3	Annual Gross Unit generation	Lakh kWh	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP main energy meter reading record 4) Energy Management System data	1) Energy Meter

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
4	Auxiliary Power Consumption	Lakh kWh	Continuous, Hourly, daily, Monthly	1) Daily Power Report 2) Monthly Power Report 3) CPP main energy meter reading record 4) Energy Management System data	1) Energy Meter 2) Equipment List
5	Design Heat Rate	kcal/ kWh	Annual	1) OEM document on designed heat rate	1) PG test document
6	Running Hours	Hrs	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) Energy Management System data Inlet Steam	1) Break down report 3) Operators Shift Register
7	Total Steam Flow	Ton	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Makeup water Reading 2) Field Steam Flow meter reading
8	Avg. Steam Pressure	Kg/ cm2	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Pressure Meter
9	Avg. Steam Temperature	°C	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Temperature Meter
10	Avg. Steam Enthalpy	kcal/ kg	Continuous, Hourly, daily, Monthly	1) Steam Table	
				Steam Extraction 1 (MP)	
11	Total Steam Flow (at the Header)	Ton	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Makeup water Reading 2) Field Steam Flow meter reading
12	Avg. Steam Pressure (at the Header)	Kg/ cm2	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Pressure Meter
13	Avg.Steam Temperature (at the Header)	°C	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Temperature Meter
14	Avg. Steam Enthalpy (at the Header)	kcal/ kg	Continuous, Hourly, daily, Monthly	1) Steam Table	

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Steam Extraction 2 (LP)					
15	Total Steam Flow (at the Header)	Ton	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Makeup water Reading 2) Field Steam Flow meter reading
16	Avg. Steam Pressure (at the Header)	Kg/cm2	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Pressure Meter
17	Avg. Steam Temperature (at the Header)	°C	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Temperature Meter
18	Avg. Steam Enthalpy (at the Header)	kcal/kg	Continuous, Hourly, daily, Monthly	1) Steam Table	
Steam Condensing					
18	Total Exhaust Steam Flow	Ton	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Makeup water Reading 2) Field Steam Flow meter reading
20	Exhaust Steam Vacuum	Kg/cm2 (a)	Continuous, Hourly, daily, Monthly	1) Daily Generation Report 2) Monthly Generation Report 3) DCS/SCADA Records	1) Field Pressure Meter
Power from dedicated line					
1	Power wheeled through dedicated line in MW (average for the year)	MW	Hourly, daily, monthly	1) Energy Meter reading for nos of hours, 2) Daily Power Report	Energy Meter
2	Electricity wheeled in a year in lakh kWh	Lakh kWh		1) Separate Energy Meter Reading 2) Daily and Monthly Power Report	
3	Heat Rate of wheeled imported Electricity in kcal/kWh	kcal/kWh	daily, Monthly	1) Power Purchase Agreement 2) DGR of Sister concerned from where the power is wheeled 3)	1) Primary document from the sister concern 2) Excise document of purchase electricity
Power Export and Colony/Others consumption					

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
1	Quantity of electricity sold to the grid in Lakh kWh.	Lakh kWh	Continuous, Hourly, daily, Monthly	1) Daily Power Report 2) Monthly Power Report 3) Export main energy meter reading record 4) Energy Management System data 5) Monthly Export bill receipt sent to utility	Export Energy Meter
2	Quantity of electricity consumed in colony / other in Lakh kWh.	Lakh kWh	Continuous, Hourly, daily, Monthly	1) Daily Power Report 2) Monthly Power Report 3) Colony/other main energy meter reading record 4) Energy Management System data	1) colony/Others meter

Table 8: Solid Fuel Consumption

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Solid Fuel Consumption					
A. Coal (Indian) / Petcoke/ Coal (Imported) / Coal (Lignite)/Coal 1/Coal 2/Coal 3/ Coal 4 (Other Solid Fuel)/ Dolachar/Coal fines/Met Coke/Coke Breeze /Nut coke/Lump Coke (Imported)					
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs./ MT	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value (As Fired Basis [8]) of solid fuel consumed for power generation	kcal/ kg	Lot, Daily, Monthly, Quarterly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Test Certificate from Government Accredited lab. (Plant to maintain minimum 1 sample test in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel in case of CPP/Cogen/WHRB Fuel, for Process Fuel 1 sample test in a quarter for Proximate Analysis) 3) Purchase Order, where guaranteed GCV range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing

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[8] Location of sampling: As fired Fuel after the Grinding Mill

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
3	Gross calorific value (As Fired Basis [9]) of solid fuel consumed in the process	kcal/kg	Lot, Daily, Monthly, Quarterly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Test Certificate from Government Accredited lab. (Plant to maintain minimum 1 sample test in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel in case of CPP/Cogen/WHRB Fuel, for Process Fuel 1 sample test in a quarter for Proximate Analysis) 3) Purchase Order, where guaranteed GCV range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
4	Annual solid fuel quantity purchased	Tonne	Lot, Daily, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/PP/FI module 4) Annual Report	1) Stores Receipt Register
5	Annual solid fuel moisture % (As Received Basis)	%	Lot, Daily, Monthly, Yearly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Purchase Order, where guaranteed % moisture range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
6	Annual solid fuel quantity consumed in power generation	Tonne	Hourly, Daily and Monthly	1) DPR 2) MPR 3) CPP/Cogen/WHRB Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1)Belt Weigher before Coal Bunker
7	Annual solid fuel quantity consumed in process	Tonne	Hourly, Daily and Monthly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1) Belt Weigh Feeder 2) Solid Flow Meter
B. Biomass and other renewable solid fuel / Solid waste					
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs./Tonne	Yearly	1) Purchase Order for basic rates and taxes 2) Freight document for rates	

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[9] Location of sampling: As fired Fuel after the Grinding Mill

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Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
2	Gross calorific value of biomass / solid waste	kcal/kg	Lot, Daily, Monthly, Quarterly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Test Certificate from Government Accredited lab (NABL). (Plant to maintain minimum 1 sample test in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel in case of CPP Fuel, for Process Fuel 1 sample test in a quarter for Proximate Analysis) 3) Purchase Order, where guaranteed GCV range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
3	Annual biomass/solid waste quantity purchased	Tonne	Lot, Daily, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/PP/FI module 4) Annual Report	1) Stores Receipt Register
4	Annual solid fuel moisture % (As Received Basis)	%	Lot, Daily, Monthly, Yearly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Purchase Order, where guaranteed % moisture range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
5	Annual biomass/solid waste Consumed in power generation	Tonne	Hourly, Daily and Monthly	1) DPR 2) MPR 3) CPP Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1)Belt Weigher before Coal Bunker
6	Annual biomass/solid waste consumed in processing	Tonne	Hourly, Daily and Monthly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	1) Belt Weigh Feeder 2) Solid Flow Meter

Table 9: Liquid Fuel Consumption

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
Liquid Fuel Consumption					
A	**Furnace Oil**				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs/ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value of furnace oil	kcal/ kg	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited (NABL) Lab[10] 4) Standard Value as per Notification	Lab Register
3	Annual furnace oil quantity purchase	kL	Lot, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/ PP/FI module 4) Annual Report	Stores Receipt
4	Density of furnace oil	kg/Ltr	Lot, Montly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited (NABL) Lab 4) Standard Value as per Notification	Lab Register
5	Furnace oil quantity consumed in DG set for power generation	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) DG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
6	Furnace oil quantity consumed in CPP for power generation in kilo liters.	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
7	Furnace oil quantity used in process heating (including Pyro-processing and Product mill Hot Air Generator) in kilo litres.	kL	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Flow Meter, Dip measurement in day tank

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10 Government Accredited Lab: National Accreditation Board for Testing and Calibration Laboratories(NABL Labs)

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
B	**LSHS/HSHS**				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs/ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value of LSHS/HSHS	kcal/ kg	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited Lab 4) Standard Value as per Notification	Lab Register
3	Annual LSHS/HSHS quantity purchase	Tonne	Lot, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/ PP/FI module 4) Annual Report	Stores Receipt
4	LSHS/HSHS quantity consumed in DG set for power generation	Tonne	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) DG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
5	LSHS/HSHS quantity consumed in CPP for power generation	Tonne	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
6	LSHS/HSHS quantity consumed in process heating.	Tonne	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Flow Meter, Dip measurement in day tank
C	**HSD/LDO**				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs./ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	the gross calorific value of HSD/LDO	kcal/ kg	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited Lab 4) Standard Value as per Notification	Lab Register

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
3	Annual HSD/LDO quantity purchase	kL	Lot, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/PP/FI module 4) Annual Report	Stores Receipt
4	Density of HSD/LDO	kg/Ltr	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited Lab 4) Standard Value as per Notification	Lab Register
5	HSD/LDO quantity used in DG set for power generation	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) DG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
6	HSD/LDO quantity used in CPP for power generation	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
7	HSD/LDO quantity used in Transportation, if any	kL	Daily, Monthly, Yearly	1)Vehicle Log book 2) Stores Receipt 3) Fuel Dispenser meter reading 3) Work Order for Internal Transportation	
8	HSD/LDO quantity used in process heating	kL	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Flow Meter, Dip measurement in day tank
D	**Liquid Waste**				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs/ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value of liquid waste	kcal/ kg	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited Lab 4) Standard Value as per Notification	Lab Register
3	Annual liquid waste quantity purchase	kL	Lot, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/PP/FI module 4) Annual Report	Stores Receipt

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
4	Density of liquid waste	kg/Ltr	Lot, Monthly, Yearly	1) Test report from Supplier 2) Internal Test Report from lab 3) Test report from Government Accredited Lab 4) Standard Value as per Notification	Lab Register
5	Liquid waste quantity consumed in DG set for power generation	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) DG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
6	Liquid waste quantity consumed in CPP for power generation	kL	Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) CPP Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Flow Meter, Dip measurement in day tank
7	Liquid waste quantity consumed in process heating	kL	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Flow Meter, Dip measurement in day tank

Table 10: Gaseous Fuel Consumption

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
	Gaseous Fuel Consumption				
A	Natural Gas (CNG/NG/PNG/LNG)				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs./ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value of NG	kcal/ SCM	Lot, Monthly, Yearly	1) Test report from Supplier 2) Test report from Government Accredited Lab 3) Standard Value as per Notification	
3	Annual NG quantity purchase	Million SCM	Lot, Daily, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/ PP/FI module 4) Annual Report	Gas Meter Reading, Bullet Pressure Reading

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
4	NG quantity consumed in power generation	Million SCM	Continuous, Daily, Monthly, Yearly	1) Daily Generation Report 2) Monthly Generation Report 3) GG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Gas Meter Reading, Bullet Pressure Reading
5	NG quantity consumed in transportation	Million SCM	Daily, Monthly, Yearly	1)Vehicle Log book 2) Stores Receipt 3) Fuel Dispenser meter reading 3) Work Order for Internal Transportation	Gas Meter Reading, Bullet Pressure Reading
6	NG quantity consumed in process heating	Million SCM	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Gas Meter Reading, Bullet Pressure Reading
B	**Liquefied Petroleum Gas (LPG)**				
1	Landed cost of Solid Fuel i.e. Basic Cost+All Taxes + Freight. The landed cost of last purchase order in the financial year	Rs./ Tonne	Annual	1) Purchase Order for basic rates and taxes 2) Freight document for rates	
2	Gross calorific value of LPG in kcal/kg.	kcal/ kg	Lot, Daily, Monthly, Yearly	1) Test report from Supplier 2) Test report from Government Accredited Lab 3) Standard Value as per Notification	
3	Annual LPG quantity purchase	Million kg	Lot, Daily, Monthly, Yearly	1) Purchase Order 2) Stores Receipt 3) SAP Entry in MM/PP/FI module 4) Annual Report	Gas Meter Reading, Bullet Pressure Reading
4	LPG quantity consumed in power generation	Million kg	Daily, Monthly, Yearly	1) DPR 2) MPR 3) GG Log Sheet 4) SAP Entry in MM/PP/FI module 5) Annual Report	Gas Meter Reading, Bullet Pressure Reading
5	LPG quantity consumed in process heating	Million kg	Daily, Monthly, Yearly	1) DPR 2) MPR 3) Major Eqp Log Sheet 4) Product Mill Log Sheet 5) SAP Entry in MM/PP/FI module 6) Annual Report	Gas Meter Reading, Bullet Pressure Reading

Table 11: Documents for Quality Parameter

Sr No	Details	Unit	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
6 Quality Parameters						
A	**Raw Material Quality**				
1	Raw Material Quality (Sector Specific Raw Material Quality testing)	%	Lot, Monthly	1) Internal Test Certificate 2) External Test Certificate from related Sector Govt Accredited Lab	1) Lab Test Report Register
B	**Coal Quality in CPP (As Fired Basis)**				
1	the Ash % in coal used in CPP/Cogen/ WHRB	%	Lot, Daily, Monthly, Quarterly	1) Daily Internal Report from Lab on Fuel Proximate Analysis performed on each lot. 2) Test Certificate from Government Accredited lab. (Plant to maintain minimum 1 sample test in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel in case of CPP/Cogen/WHRB Fuel, for Process Fuel 1 sample test in a quarter for Proximate Analysis) 3) Purchase Order, where guaranteed GCV range is mentioned	1) Lab Register on Fuel Testing for Proximate Analysis 2) Calibration Record of instrument used for testing
2	the Moisture % in coal used in CPP/Cogen/ WHRB				
3	the Hydrogen % in coal used in CPP/ Cogen/WHRB				
4	the GCV value of coal used in CPP/Cogen/ WHRB				

Table 12: Documents related to Environmental Concern, Biomass/Alternate Fuel availability, Project Activities, New Line commissioning, Unforeseen Circumstances

Sr No	Details	Unit	Requirement	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
	Miscellaneous Data					
A	Additional Equipment installation after baseline year due to Environmental Concern					
(i)	Electrical Energy Consumption with list of additional Equipment installed due to Environmental Concern after baseline year in Sheet! Addl Eqp List-Env.	Lakh kWH	List of Equipment to be filled up	Daily, Monthly, Annual	Energy Meter Readings and Power consumption details of each additional equipment installed from 1st Apr to 31st March	1) EMS 2) Energy Meter 3) Addition Equipment List with capacity and running load 4) Purchase Order document 5) SAP Data in MM module
(ii)	Thermal Energy Consumption with list of additional Equipment installed due to Environmental Concern after baseline year in Sheet! Addl Eqp List-Env.	Million kcal	List of Equipment to be filled up	Daily, Monthly, Annual	Solid/Liquid/Gaseous Fuel consumption of each additional equipment installed from 1st Apr to 31st March	1) Fuel Flow Meter 2) Weigh Feeder 3) Purchase Order document 4) SAP Data in MM module
B	**Biomass/ Alternate Fuel availability**					
(i)	Details of replacement of Bio-mass with fossil fuel due to un-availability. This is required in fossil fuel tonnage in terms of equivalent GCV of Bio-mass (Used in Process)	Tonne	Fossil Fuel: Coal/ Lignite/Fuel Oil	Monthly	1) Authentic Document in relation to Bio-Mass/Alternate Solid Fuel/Alternate Liquid Fuel availability in the region. 2) Test Certificate of Bio-mass from Government Accredited Lab for GCV in Baseline and assessment year 3) Test Certificate of replaced Fossil Fuel GCV	

Sr No	Details	Unit	Requirement	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
(ii)	Details of replacement of Alternate Solid Fuel with fossil fuel due to un-availability. This is required in fossil fuel tonnage in terms of equivalent GCV of Alternate Solid Fuel (Used in Process)	Tonne		Monthly		
(iii)	Details of replacement of Alternate Liquid Fuel with fossil fuel due to un-availability. This is required in fossil fuel tonnage in terms of equivalent GCV of Alternate Liquid Fuel (Used in Process)	Tonne		Monthly		
C	**Project Activities (Construction Phase)**					
(i)	Electrical Energy Consumption with list of Project Activities and energy consumed during project activities treated as Construction phase in Lakh kwh Ref: Sheet!Project Activity List	Lakh kWH	List of Equipment to be filled up	Daily, Monthly	Energy Meter Readings of each project activity with list of equipment installed under each activity from 1st Apr to 31st March	1) EMS 2) Energy Meter 3) Addition Equipment List with capacity and running load 3) Purchase Order document 4) SAP Data in MM module
(ii)	Thermal Energy Consumption with list of Project Activities and energy consumed during project activities treated as Construction phase in Million kcal converted from different fuel Ref: Sheet!Project Activity List	Million kcal	List of Equipment to be filled up	Daily, Monthly	Solid/Liquid/Gaseous Fuel consumption of each project activity with list of equipment under each activity installed from 1st Apr to 31st March	1) Fuel Flow Meter 2) Weigh Feeder 3) Purchase Order document 4) SAP Data in MM module
D	**New Line/Unit Commissioning**					

Sr No	Details	Unit	Requirement	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
(i)	Electrical energy consumed in Lakh kWh during its commissioning till it attains 70% of the new line capacity utilisation	Lakh kWH		Daily, Monthly	1) Rated Capacity of new Process/line from OEM 2) Energy Meter Readings and Power Consumption record of process/line with list of equipment installed from 1st Apr to 31st March	1) EMS 2) Energy Meter 3) Addition Equipment List with capacity and running load
(ii)	Thermal energy consumed in Million kcal during its commissioning till it attains 70% of the new line capacity utilisation. The energy is calculated after converting from the different fuel GCV used in the new process/line	Million kcal		Daily, Monthly	1) Rated Capacity of new Process/line from OEM 2) Thermal Energy Consumption record with list of equipment from DPR/ Log book/SAP Entry in PP module	1) Fuel Flow Meter 2) Weigh Feeder
(iii)	Final/Intermediary Product production during its commissioning up to 70% of new line/process capacity utilisation in Tonne	Tonne		Daily, Monthly	1) Rated Capacity of new Process/line from OEM 2) Production record from DPR/Log book/SAP Entry in PP module	1) Weigh Feeder
(iv)	Date of achieving 70% capacity utilisation of new process/line	Dates			1) Record/Document from SAP Entry/Log Book Entry/DPR/ MPR	Operator's Shift Register
(v)	Electrical Energy consumed in Lakh kWh from external source during its commissioning till it attains 70% of the new unit capacity utilisation in Power generation	Lakh kWH		Daily, Monthly	1) Rated Capacity of new unit from OEM 2) Energy Meter Readings and Power Consumption record of unit from external source with list of equipment installed from 1st Apr to 31st March	1) EMS 2) Energy Meter 3) Addition Equipment List with capacity and running load

Sr No	Details	Unit	Requirement	Frequency of record	Primary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor	Secondary Documents from where the information can be sourced and to be kept ready for verification by Accredited Energy Auditor
(vi)	Thermal energy consumed in Million kcal during its commissioning till it attains 70% of the new unit capacity utilisation. The energy is calculated after converting from the different fuel GCV used in the new unit in Power generation	Million kcal		Daily, Monthly	1) Rated Capacity of new unit from OEM 2) Thermal Energy Consumption record with list of equipment from DPR/Log book/ SAP Entry	1) Fuel Flow Meter 2) Weigh Feeder
(vii)	Net generation in Lakh kwh from the new unit in power generation, used in the Product Plant till the new unit achieved 70% of Capacity Utilisation	Lakh kWH		Daily, Monthly	1) Record/Document from SAP Entry/Log Book Entry/DPR/ MPR	1) EMS 2) Energy Meter
(viii)	Date of achieving 70% capacity utilisation of new unit in Power generation	Dates			1) Record/Document from SAP Entry/Log Book Entry/DPR/ MPR	
E	**Unforeseen Circumstances**					
(i)	Electrical Energy Consumption with list of unforeseen circumstances consumed in Lakh kWh claimed for Normalisation	Lakh kWH	Unforeseen Circumstances: Situation not under direct or in-direct control of plant management		1) Relevant document on Unforeseen Circumstances beyond the control of plant 2) Energy Meter Readings and Power Consumption during the said period of unforeseen circumstances	1) EMS 2) Energy Meter 3) Addition Equipment List with capacity and running load
(ii)	Thermal Energy Consumption with list of unforeseen circumstances consumed in Million kcal claimed for Normalisation	Million kcal			1) Relevant document on Unforeseen Circumstances beyond the control of plant 2) Thermal Energy Consumption record during the said period of unforeseen circumstances from DPR/Log book/SAP Entry	1) Fuel Flow Meter 2) Weigh Feeder

Table 13: Documents related to External Factor

Sr No	Details
	Document related to external factor
(i)	**Market Demand**
	1)Product Storage Full record from Product Mill Log book 2)SAP entry in SD and FI module 3) SAP entry in PP module 4) Document related to sales impact of market
(ii)	**Grid Failure**
	1) SLDC Reference No. for planned Stoppages from respective Substation 2) Log book record of Main Electrical Substation of Plant 3) DPR 4) MPR 5) SAP entry in PM module of Electrical department
(iii)	**Raw Material un-availability**
	1) Material Order copy and denial document from Mines owner 2) SAP entry in MM/FI module on raw material order 3) DPR 4) MPR
(iv)	**Natural Disaster**
	1) Supporting Authentic document from Local district Administration 2) Major Eqp Log Sheet 3) Major Eqp operators Report book 4) DPR 5) MPR
(v)	**Major change in government policy hampering plant's process system**
	1)Government Notification or Statutory order 2) Authentic document from plant on effect of Major Eqp production due to policy change 3) DPR 4) MPR 5) SAP Entry on production change
(vi)	**Unforeseen circumstances/Labour Strike/Lockouts/Social Unrest/Riots**
	1) Relevant document on Unforeseen Circumstances beyond the control of plant 2) Energy Meter Readings and Power Consumption during the said period of unforeseen circumstances 3) Thermal Energy Consumption record during the said period of unforeseen circumstances from DPR/Log book/SAP Entry
B	**Note**
(i)	The hard copy/Printouts is to be signed by Authorised signatory, if SAP data is used as documents

5. Understanding Conditions

"Normalisation" means a process of rationalization of Energy and Production data of Designated Consumer to take into account changes in quantifiable terms that impact energy performance under equivalent conditions.

There are several factors that need to be taken into consideration in the assessment year such as change in product mix, capacity utilization, change in fuel quality, import/export of power etc **influenced by externalities i.e., factors beyond the control of Plant,** while assessing the Specific Energy Consumption (SEC) of the plant.

In order to incorporate and address the changes happening in the DCs from Baseline Year to Assessment year, Bureau has formulated Sub-Technical Committees under the Technical Committee for each sector. The sub-Technical committees include representatives from DCs, research associations, Concerned Ministries, expert bodies from government and private sector etc. The Sub-committee identified and prepared the normalization factors with consensus from the DCs.

The operating parameters in the Assessment year have to be normalized w.r.t Baseline year so as to avoid any favorable or adverse impact on the specific energy consumption of the plant. This will also assist inquantifying and establishing the benefits of the energy efficiency projects implemented by the plant

5.1. Specific Issues

88. The complete Normalisation Process with equations and calculations have been dealt separately in sector specific Normalisation documents. EmAEA needs to study the document to carry out the verification process.

89. The details of data furnished in Form 1 shall be drawn from the sector-specific Pro-forma, referred to in the guidelines, relevant to every designated consumer and the said sector-specific Pro-forma, duly filled in, shall also be annexed to Form 1

90. The Sector Specific Pro-forma have built-in calculations of Normalisation with specific Energy Calculation in the summary sheet. The notified Form 1 will be generated automatically from the Pro-forma, once filled in all respect.

91. The normalization will be given to DCs only upon submission of valid/authentic supporting documents. Failing which, the DC will not be eligible for normalizations.

92. The operating parameters for which normalization has been provided but not being claimed, the DC should submit the valid reason for the same.

93. For the new DCs, which are not covered under PAT scheme shall also fill up the Sector Specific Pro-forma for the verification of their total energy consumption.

94. Notional/Normalized Energy will not to be considered in Total Energy Consumption,

while deciding whether a plant falls under the designated consumer category or not. Normalization energy is considered only in the calculation of Gate to Gate Specific Energy Consumption.

95. **External factors definition:** The factors over which an individual DC does not have any control but that can impact the SEC are classified as uncontrollable factors.

   i. External Factors should be scrutinized carefully for Normalisation applicability

   ii. The defined external factors in the document are to be supported by external authentic documentary evidences

   iii. Any other undefined external factor, which may affect production or energy of a DC should be brought in the Verification Report by EmAEA with authentic documentary evidences

   iv. The external factors identified are as follows:

      a. Market Demand

      b. Grid Failure/Breakdown (Grid not Synchronized with CPP)

      c. Raw Material Unavailability

      d. Natural Disaster (Flood, Earthquake etc)

      e. Major change in Government policy (affect plant's process system)

      f. Unforeseen Circumstances (Labour Strike/Lockouts/Social Unrest/Riots/Others etc)

96. Boundary Limit:

   a. Establishment of plant GtG boundary is required with clear understanding of raw material input, Energy input, Power Import/Export, Intermediary

product Import/Export, Colony Power, Construction/Others Power, Power supplied to other Ancillary unit outside the plant boundary

b. Inclusion and exclusion from the plant boundary is maintained as established in the baseline year

c. Section wise Screen shot of SCADA from CCR/DCS is to be included in the verification report

d. Raw material input in the Plant boundary to be recorded for inclusion in the verification report

5.2. Fuel

97. Fuel Testing

a. Validation of Fuel quality testing from external and internal lab for same sample for each solid fuel used

b. Test Certificate from Government Accredited Lab (NABL):

   i. **CPP Fuel:** Plant to maintain minimum 1 sample test certificate in a quarter for Proximate and Ultimate Analysis i.e. 4 test certificates in a year for each fuel

   ii. **Process Fuel:** 1 sample test certificate in a quarter for Proximate Analysisi.e. 4 test certificates in a year for each fuel

c. Liquid /Gaseous Fuel Testing: As per Table 9

d. Reproducibility Limit of same sample

   i. The means of the result of duplicate determinations carried out in each of two laboratories on representative portions taken from the same sample at the last stage of sample preparation, should not differ by more than 71.7 kcal/kg as per ISO 1928: 1995 (E)

ii. If the difference is greater than 71.7 kcal/kg, the difference will be added to the GCV value of the test result obtained in DC's Lab for that particular quarter

e. Daily Proximate analysis record of all types of Coal to be maintained at Lab for ongoing submission as document related to fuel analysis

98. 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*

99. The basis of Fuel sample testing i.e., As Received Basis (ARB), As Fired Basis (AFB), As Dried Basis (ADB) for calculating or measuring GCV in assessment year will be same as made during baseline year. However, the location of Fuel sample testing and weight measurement should remain identical. This will be identified in the Pro-forma under Remarks column, if the basis is other than As Fired.

100. The status quo to be maintained in the assessment year for the basis of measuring GCV of Fuel (For Ex. As Received Basis, As Fired Basis, As Dried Basis etc.) as

followed in the baseline year i.e., if DC has submitted GCV value on "as received basis", the basis will be same in the assessment year as well. The DC has to write in the remarks/source of data field on basis of GCV taken in the assessment year. However, the EmAEA is requested to report the Fuel GCV "As fired basis" in the verification report, which may become baseline for subsequent PAT cycles.

101. Standard applicable IS Norms should be followed for Fuel (Solid, Liquid, Gas) sampling for internal or external labfrom different location

102. Internal Coal Testing method to be elaborated as per IS Norms and to be included as document in the EmAEA report.

103. Gross Calorific Value or High Heat Value:

    a. It is advised to measure the GCV of coal with the help of Bomb Calorimeter only in the assessment year and record the value daily in the LAB register for ongoing submission as document related to Fuel analysis.

    b. The calculation method for calculating GCV/NCV from Proximate and Ultimate Analysis in the assessment year will remain same as made during baseline year.

    c. In the absence of formulae for calculating GCV, the following Dulong's formulae may be used for Gross Calorific Value (GCV) or High Heat Value (HHV) calculation

        Dulong's Formulae (Value from Ultimate Analysis) for GCV covers basic principle, that there are only 3 components in a fuel which generate heat i.e., Carbon, Hydrogen and Sulphur as per following expression

$$Q = 81 \times C + 342.5 \times [H - O/8] + 22.5 \times S$$

Where
Q is GCV in kcal/kg
C = % of Carbon by weight
H=% of Hydrogen by weight
O=% of Oxygen by weight
S=% of Sulphur by weight

104. Net Calorific Value (NCV) or Low Heat Value (LHV):

    a. The NCV includes the Steam-condensing latent heat, the NCV is defined as the gross calorific value minus the latent heat of condensation of water (at the initial temperature of the fuel), formed by the combustion of hydrogen in the fuel. The latent heat of steam at ordinary temperature may be taken as 587kcal/kg. The NCV could be calculated by the following expression

$$NCV = GCV - 5.87 \times (9 \times H + M)$$

Where
NCV = Net Calorific Value (kcal/kg)
GCV = Gross Calorific Value (kcal/kg)
H= % of Hydrogen by weight
M= % of Moisture by weight

5.3. Normalization Condition and calculation

105. Plant should maintain the records of the number of outages during the baseline and assessment year.

106. Plant needs to maintain proper Energy Meter Reading/Records due to external factors for baseline as well as for assessment year.

107. Section wise Energy metering (Electrical and Thermal) is required for making Equivalent Product in Textile sub-sectors. Proper calculation document should be maintained, if energy figures are arrived by calculation method.

108. Plant to maintain Frequency of calibration and records of Energy monitoring equipment.

109. Calibration records of all weighing and measurement system with frequency of calibration to be included in the verification report.

110. The documents maintained by DCs should clearly show 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.

111. Additional Nos of Equipment details in Pro-forma:

   a. Additional Product/Section detail: The Designated Consumer may furnish additional Product/Section details as per sectional format in a separate Excel Sheet for insertion in the existing Pro-forma if sectional input data format is full. Otherwise, Total energy of additional section or product could be converted into the last product or section through SEC of both the product/section and feed the same in the last product/section format for baseline as well as for assessment year.

   b. Additional Line for Start/Stop Normalization: If the nos of line/unit exceeds from the existing nos, the DCs are advised to insert separate excel sheet of same format for finalization and insertion of additional line with normalization calculation by BEE.

   c. Additional Boiler detail (Process/ Cogen): Additional Nos of Process or Co-gen boiler will be annexed in a separate Excel sheet as per the format provided in the Pro-forma for Boilers.

112. Lump CPPs: Information for all parameters of CPP [12] to be provided for all CPPs in Weighted Average terms w.r.t Gross Unit Generation in the CPP section, except for Design Heat Rate DHR (1,2…)=DHR1 x C1+DHR2 x C2+…./(C1+C2….).

113. Lump Co-Gen (Extraction cum Condensing): The total nos of Co-Gen should be treated as lump power source and accordingly details to be filled in the Pro-forma as per following example in Table No #14 separately for Extraction cum Condensing Turbine

114. Lump Co-Gen (Back Pressure): The total nos of Co-Gen should be treated as lump power source and accordingly details to be filled in the Pro-forma as per following example in Table No #14 separately for Back Pressure Turbine.

Table 14: Lump Co-Generation treatment

Sr No	Description	Formulae	Unit	Remarks
(i)	Install Capacity (C1…..Cn)[13]	C1+C2+…Cn	MW	Sum of capacity
(ii)	Annual Gross Unit generation (AGG1…AGGn)	AGG1+AGG2+…AGGn	Lakh kWh	Sum of Generation
(iii)	Auxiliary Power Consumption (APC1….APCn)	APC1 +APC2…APCn	Lakh kWh	Sum of APC
(iv)	Design Heat Rate	DHR (1,2…n)= DHR1 x C1+DHR2 x C2+…./(C1+C2….Cn)	kcal/ kWh	Weighted Average of Design Heat Rate w.r.t to Installed Capacity

[12] CPP: Steam Turbine Generator (STG)/ Gas Turbine (GT)/Gas Generator(GG)/Diesel Generator (DG)
[13] 1,2,3….n: No of Cogen Sources

Sr No	Description	Formulae	Unit	Remarks
(v)	Running Hours	(RH1xAGG1+RH2xAGG2+ .... RHnx AGGn)/ (AGG1+AGG2+... AGGn)	Hrs	Weighted Average of Running Hours w.r.t to Annual Generation
(vi)	Auxiliary Power Consumption	(ii) x 100/(iii)	%	APC%
(vii)	Total Thermal energy used in Process	TEPr1+TEPr2+...TEPrn	Million kcal	Sum of Total Thermal Energy used in Process
(viii)	Total Thermal energy used in Power	TEPo1+TEPo2+...TEPon	Million kcal	Sum of Total Thermal Energy used in Power
(ix)	Heat Rate of Co-Gen	HR1xAGG1+.....+HRn x AGGn/ (AGG1+...+AGGn)	kcal/kwh	Weighted Average of Heat Rate

115. 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 will be 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/ Log sheet.

5.4. Normalisation General Issue

116. Normalisation Environmental Concern: Any additional equipment installed to comply with 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 have been installed after the baseline year to comply with these Standards, the plant is not eligible for Normalization.

117. Unavailability of biomass/Alternate fuel in assessment year as compared to the baseline year due to external factor. 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

118. If a captive power plant or cogeneration plant caters to two or more DCs for the electricity and/or steam requirements. In such scenario, each DC shall consider such captive power plant or cogeneration plant in its boundary and energy consumed by such captive power plant or cogeneration plant shall be included in the total energy consumption. However, electricity in terms of calorific value (as per actual heat

rate) and steam in terms of calorific value (as per steam enthalpy) exported to other plants shall be subtracted from the total energy consumption.

119. Normalisation for Start Stop: The Designated Consumer has to furnish the Electrical and Thermal Energy Consumption by taking into account the saleable or intermediate production made during Hot-Cold Stop and Cold-Hot Start.

    a. Hot to Cold Stop: The Plant ceases to halt after abrupt tripping of main equipment due to external factor.

    b. Cold to Hot Start: The Plant is restarted after a brief halt/stoppages to reach the normal production

120. For the Start/Stop Normalization following factor may be considered:

    a. At the time of Hot to Cold stop, due to external factors, electric energy consumed in the major section/plant to maintain essential loads of the plant shall be deducted from the total energy consumption.

    b. At the time of Cold to Hot start after Hot to Cold stop due to external factors, specific energy consumption of the major section/major equipment shall be multiplied with the actual production during this time and added to the total energy consumption.

    c. The actual equivalent production shall also be added to the total production.

For the purpose of clarity, equivalent production means the amount of production of that major section/equipment converted into the major product output.

121. For Normalization factors, which became applicable due to external factors, authentic documents to be produced by DC for the baseline as well for the assessment year. In absence of these authentic documents, no Normalization Factor will be applied/Considered.

122. For Investment for year 2010-11,2012-13, 2013-14 and 2014-15 will be included in the assessment year of sector specific pro-forma

123. Any factor, which has not been considered in the document and Form 1, the Empanelled Accredited Energy Auditor will report it separately with possible solution for the same and Annexed to the Form B (Verification Form)

124. Sector specific Pro-forma, Normalization document and aforementioned guidelines are the major elements of the M&V process, and additional Sector Specific M&V guidelines are provided in Annexure I-VIII.

125. Some of the information sought under this annexure could be considered as supporting information/documents, which may help EmAEA in submitting the Form B.

6. Abbreviations

NAPCC	National Action Plan for Climate Change
NMEEE	National Mission on Enhanced Energy Efficiency
PAT	Perform Achieve and Trade
M&V	Monitoring and Verification
MoP	Ministry of Power
BEE	Bureau of Energy Efficiency
SDA	State Designated Agency
EOC	End Of PAT Cycle
DCs	Designated Consumer
EmAEA	Empanelled Accredited Energy Auditor Firm
SEC	Specific Energy Consumption
Pro-forma	Sector Specific Pro-forma for Form 1
ECM	Energy Conservation Measures
GtG	Gate- to- Gate
PAD	Performance Assessment Document
ESCerts	Energy Saving Certificates
AEA	Accredited Energy Auditor
CPP	Captive Power Plant
AY	Assessment Year
BY	Baseline Year
DCS	Distributed Control System
CCR	Central Control Room
SCADA	Supervisory Control and Data Acquisition
SAP	System Application and Product Software
DPR	Daily Production Report
MPR	Monthly Production Report
DGR	Daily Generation Report
MGR	Monthly Generation Report
IEX	Indian Energy Exchange
PXIL	Power Exchange of India Limited
OEM	Original Equipment Manufacturer
GCV	Gross Calorific Value
NCV	Net Calorific Value
NABL	National Accreditation Board for Testing and Calibration Laboratories
TPP	Thermal Power Plant

7. Annexure

(i)   Annexure I: Thermal Power Station

(ii)   Annexure II: Steel

(iii)   Annexure III: Cement

(iv)   Annexure IV: Fertilizer

(v)   Annexure V: Aluminium

(vi)   Annexure VI: Pulp & Paper

(vii)   Annexure VII: Textile

(viii) Annexure VIII: Chlor-Alkali

7.1. Annexure I: Thermal Power Station

1. Auxiliary Power Consumption (APC)

EmAEA may verify the section/ equipment wise motor ratings. The sections/ equipment shall include

Table 15: Auxiliary Power Consumption Details (a,b,c)

a. Boiler and Auxiliaries

S. No.	Equipment	Power Rating (kW)	Current Rating (Amperes)
1.	Coal Grinding Mills		
2.	Coal Feeders		
3.	Boiler Re-Circulation Pump		
4.	Primary Air(PA) Fans		
5.	Secondary Air(SA) Fans		
6.	Induced Draught (ID) Fans		
7.	Seal Air fans		
8.	Scanner air fans		
9.	Air Pre-Heater (APH)		
10.	Miscellaneous/ Missed out equipment		

b. **Turbine and auxiliaries**

S.No.	Equipment	Power Rating (kW)	Current Rating (Amperes)
1.	Condensate Extraction Pump (CEP		
2.	Boiler Feed Pump (BFP)		
3.	Boiler Feed-booster Pump (BFBP)		
4.	Closed Circuit Cooling Water (CCCW) Pump/ De-Mineralised Cooling Water (DMCW) Pump		
5.	Auxiliary Cooling Water (ACW) Pumps		
6.	Condensate Polishing Unit (CPU)		
7.	Lube Oil Pumps		
8.	Seal Oil Pumps		
9.	Stator Water Cooling Pumps		
10.	Miscellaneous equipment		

c.   Balance of Plant

S.No.	Equipment	Power Rating (kW)	Current Rating (Amperes)
1.	Compressed Air System		
a)	Instrument Air Compressor		
b)	Service Air Compressors		
2.	Cooling Water (CW) Pumps		
3.	Cooling Tower (CT) Fans		
4.	Water Treatment Plant (WTP)		
a)	Clarifiers		
b)	Filters		
c)	Pumps		
d)	Ion Exchangers		
e)	Miscellaneous/ Missed out equipment		
5.	Coal Handling Plant		
a)	Wagon Unloading System		
b)	Crushers		
c)	Belts Conveyors		
d)	Stacker Reclaimer		
e)	Miscellaneous/ Missed out equipment		
6.	Ash handling System		
a)	Pumps		
b)	Dry Ash Handling System		
c)	Wet Ash Handling System		
d)	Miscellaneous/ Missed out equipment		
7.	Fire Fighting System		
8.	Air Conditioning System		
9.	Lighting		
10.	Transmission System		
11.	Miscellaneousequipment		

This data shall be produced by the DCs for verification of section wise APC. If any item has been missed out in the table above, it shall be inserted by the DC.

The DC shall submit all design documents, manufacturers data sheet, etc. in support of the equipment ratings if required.

2.   Coal Handling Plant

a.   Coal Input

The DC shall submit a copy of Fuel Supply Agreement (FSA) in which the coal quality shall appear. Also, the DC shall submit the transportation agreement/ contract indicating the amount and quality of coal procured.

b. Scheme

A schematic representation of the coal handling plant shall be provided by the DC indicating the flow of coal from wagons to boilers. The description shall include hours of operation and number of equipment in running and standby condition.

c. Coal Quality

The ultimate and proximate analysis of coal shall be submitted by the DC. The coal sample shall be taken at coal unloading, stacking and bunker feeding. The lab report in this regard shall be accepted.

3. Heat Rate

The DC shall give the fully traceable calculation for turbine Heat Rate, Gross Heat Rate and Net Heat Rate. The values taken for heat rate calculation shall be backed by evidences, which can be screen shot of DCS for the particular parameter.

4. Parameter verification

The DCs shall make the log books and Daily Generation Report (DGR) available as and when needed.

5. Fuel Oil

The DCs shall submit the liquid oil supply contract mentioning the properties of oil. Also, the consumption shall be backed by calculation and pictures/ screen shot of level indicators/ flow counter, etc.

6. Balance diagrams

a. The DCs shall submit the Heat Mass Balance Diagrams showing the complete cycle.

b. Water Balance Diagram shall also be submitted.

7. Fuel Mix Normalisation in Gas based Thermal Power Plant

Due to change in fuel mix i.e., % of consumption of Gas and Oil/other fuel in the assessment year w.r.t. baseline year, the variation in Boiler efficiency is evident. The same needs to be normalized as per total generation from Gas and Oil/other fuel and design boiler efficiency at 100% for gas and Oil/other fuel.

8. General

a. The scheme/ layout diagram of all sub-systems, e.g., CHP, AHP, WTP, etc. shall be submitted by the DCs. This shall facilitate in identifying the boundary condition of systems/ plant.

b. The DCs shall submit the maintenance history of systems/ equipment.

9. Plant Boundary

a. The plant boundary shall consist of the BTG island, Water Treatment plant (WTP), Effluent Treatment Plant (ETP), Coal Handling Plant (CHP), Ash Handling Plant, CW System, Compressed Air System, Fire Fighting system, Transmission System, etc. A typical sample of Plant boundary condition is represented below

Figure 8: Ex-GtG Boundary for Thermal Power Plant
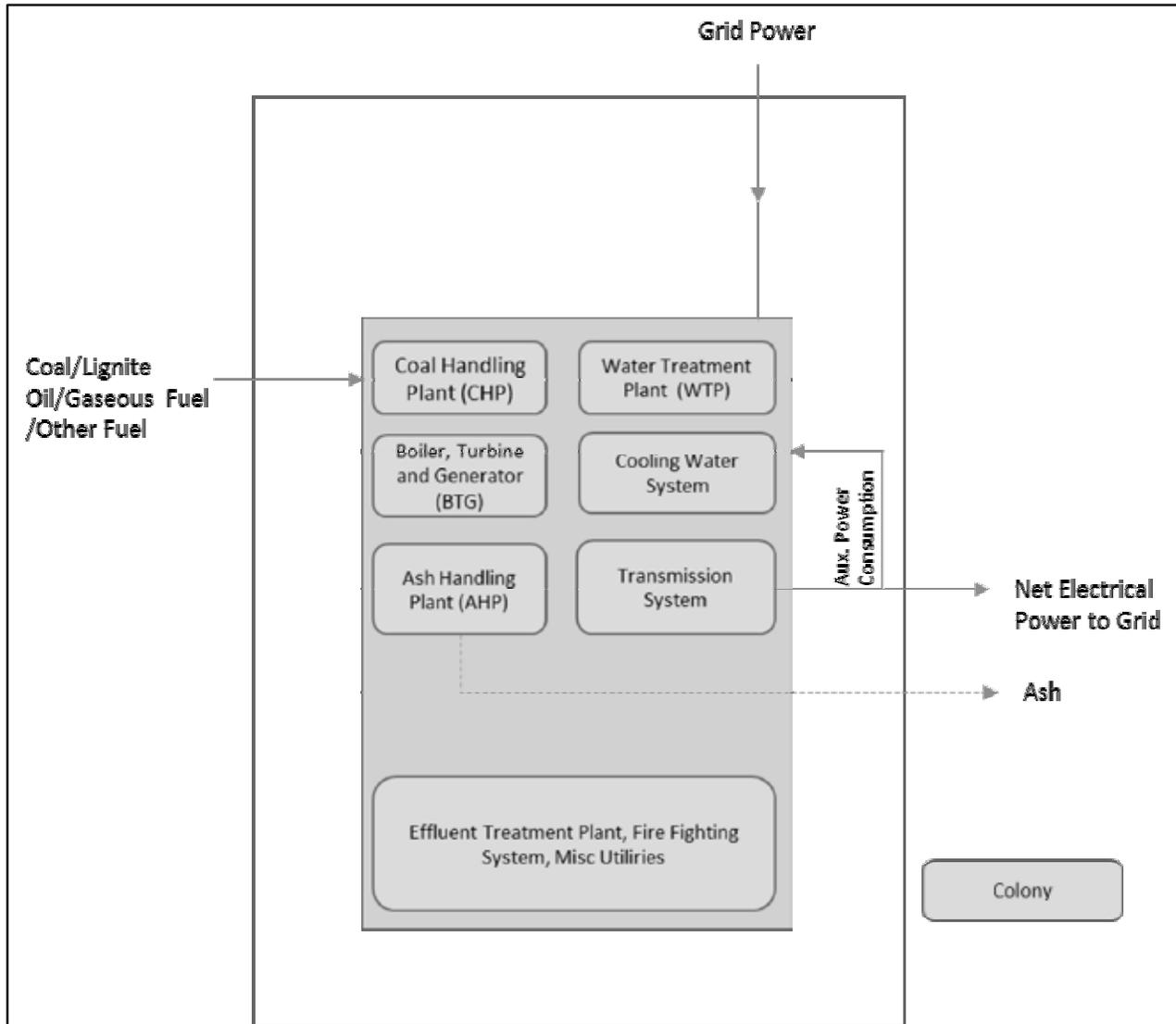
The colony does not form a part of the plant boundary and hence it is kept outside. In the figure above. The DC shall submit a latest Plot Plan of the station indicating all the systems/ sub-systems.

b.   The station energy balance diagram to be included in the Verification report. A typical sample of the diagram is shown below for Coal/Lignite/Oil/Gas based Power Plant and Combined Cycle Gas Turbine

Figure 9: Ex-Coal/Lignite/Oil/Gas based Thermal Power Plant Energy balance diagram
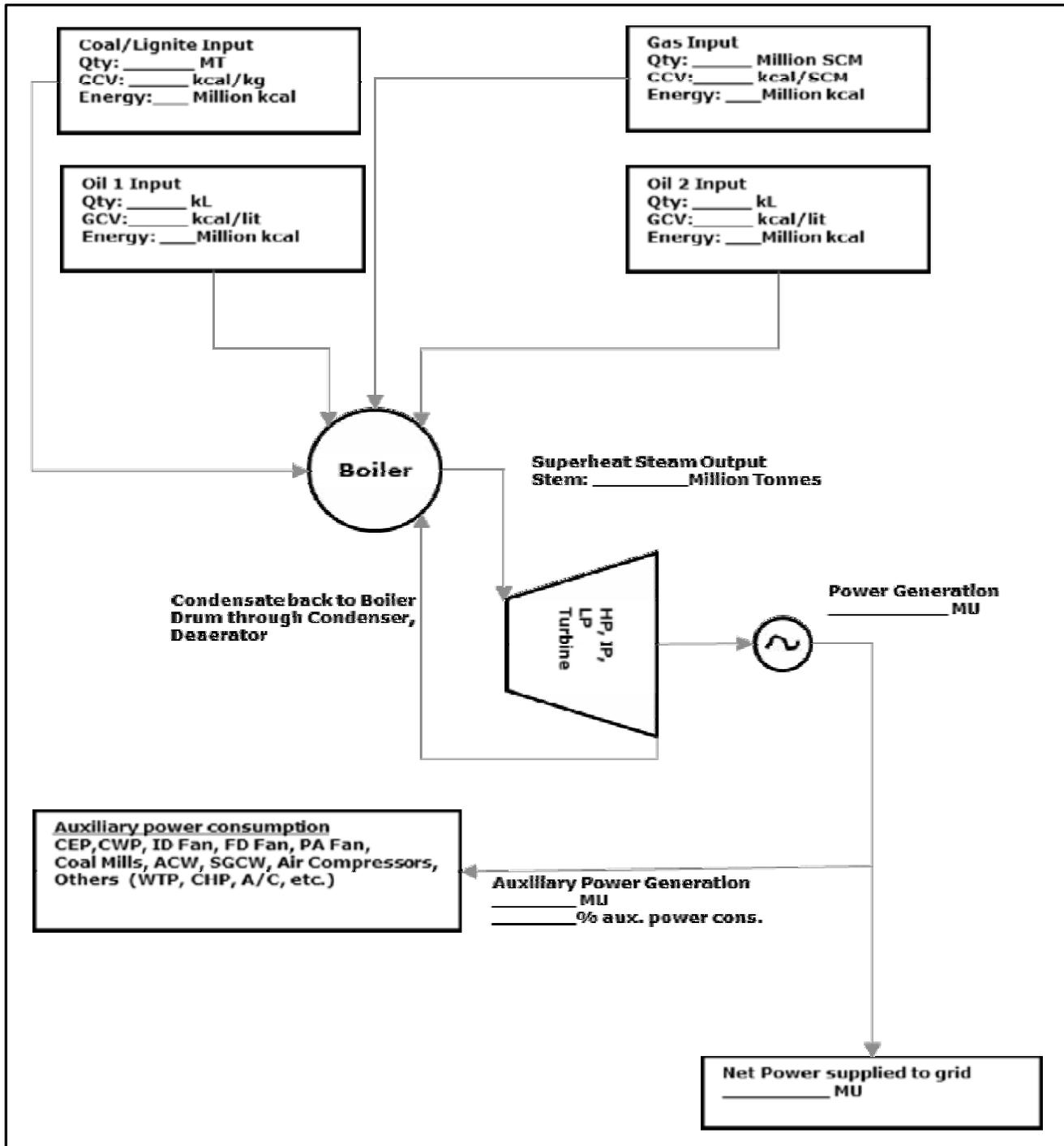
Figure 10: Ex-CCGT Energy balance diagram
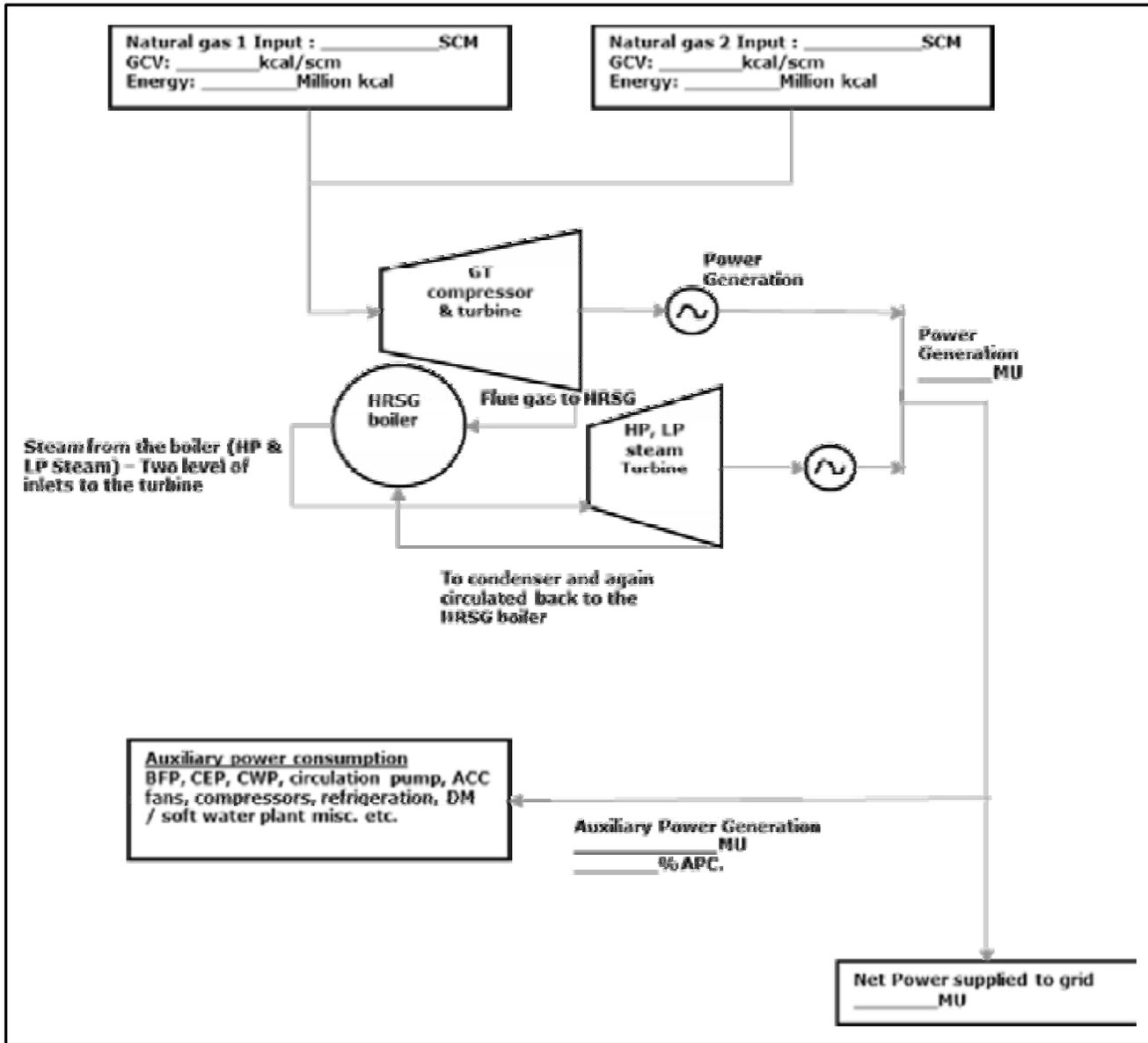
7.2. Annexure II: Steel

A: Integrated Steel Plant

1. The data submitted for verification and other figure for SEC calculation of any unit has to be in line with the units declared production and consumption figures as per the statutory financial audit and declaration in their annual report.

2. EmAEA, while verifying the SEC calculation should also cross verify the input figures based on the procurement plans and physical receipts.

3. The transit and handling losses have to be within the standard norms allowable under financial audit.

4. Crude steel is the product output of an Integrated Steel Plant (ISP). The term is internationally used to mean the 1st solid steel product upon solidification of liquid steel. In other words, it includes Ingots (in conventional

mills) and Semis (in modern mills with continuous casting facility). In PAT Scheme, for ISP, Crude steel is considered as the major product output.

5. The energy impact of any basic input such as Pellet, Sinter, DRI, Oxygen, Nitrogen, Argon, which has been either imported and/ or discontinued during assessment or baseline years, the upstream/notional energy impacts have to be apportioned in SEC as the case may be.

6. Import of any finished or semi-finished fuel input say coking coal vs coke,which has been either imported and/ or discontinued during assessment or baseline years, the upstream/notional energy impacts have to be apportioned in SEC as the case may be

7. For verification process, the DC shall provide all necessary information, supporting documents and access to the Plant site to EmAEA. It will be the responsibility of the EmAEA to maintain the confidentiality of the data collected and not to use for any other purpose except for the PAT scheme.

8. Quality of raw material for the purpose of normalisation needs to be maintained as per the frequency of monitoring of the particular raw material and has to be maintained and submit to EmAEA by the plant, duly signed by the authorized signatory of the Designated Consumer.

9. In case of normalisation benefit, unit has to provide metering and measurement of energy inputs for all the energy parameters, for which normalisation is claimed.

10. All the energy input calorific values for purchased energy and inputs that impact energy performance of unit shall be submitted based on suppliers documented analysis and contractually agreed and signed documents by competent authority. All these documents are mandatory to be counter signed by auditor. A third party determination of calorific Value of each fuel used in plant to be submitted for each quarter carried out by Government Accredited Laboratory (NABL).

B:Sponge Iron Sub-Sector

11. The entire sub-sector is divided into 7 group on similarity of product

12. The major product in 7 group is as per table below

Table 16: Sponge Iron Subsector- Major Product details

Sr No	Sub-Sector Group	Major Product	Remarks
1	Sponge Iron	Sponge Iron	
2	Sponge Iron with Steel Melting Shop	Sponge Iron	
3	Sponge Iron with Steel Melting Shop and Others (Ferro Chrome, FeMn, SiMn, Pig Iron, Ferro Silicon, Rolling Mills etc)	Sponge Iron	
4	Ferro Alloy	SiMn	
5	Ferro Chrome	Ferro Chrome	
6	Mini Blast Furnace (MBF)	Pig Iron	
7	Steel Processing Unit (SPU)	Steel	

13. The Energy consumption of Pellet Plant shall not be included in the assessment year as well as in the baseline year. The calculation for the same is included in the summary sheet of Pro-forma.

14. For Inclusion of Pellet Plant in GtG Specific Energy Consumption, The DC needs to specify the same so that the Summary sheet needs to be modified.

15. The Electrical and Thermal energy of Pellet Plant should be verified through proper measurement and Energy meters

16. Calibration records of all weighing and measurement system with frequency of calibration to be included in the verification report

17. Section wise SCADA Screen shot if required to be included in the verification report by EmAEA

18. The Energy and Mass balance calculation is required to be included in the verification report.

19. Section wise energy consumption needs to be recorded and included in the verification report.

20. The equivalent product is calculated based on the Product Mix calculation in the pro-forma. A typical process flow along with the location of major product is shown in the diagram. The same shall be included in the verification report for different section of Sponge Iron sub-sector.

Figure 11: Product Mix diagram

- Notional Energy for Import(Ei) = Pi x Si
- Notional Energy for Export(Ee)=Pe x Se
- Total Energy (E)= E1+Ei-Ee
- SEC for Major Product: S2=E2/P
- Equivalent Product(Peq) =P+P1 x (S3/S2)+P2 x (S4/S2)+P3 x (S5/S2) + P4 x(S6/S2)
- SEC=E/Peq
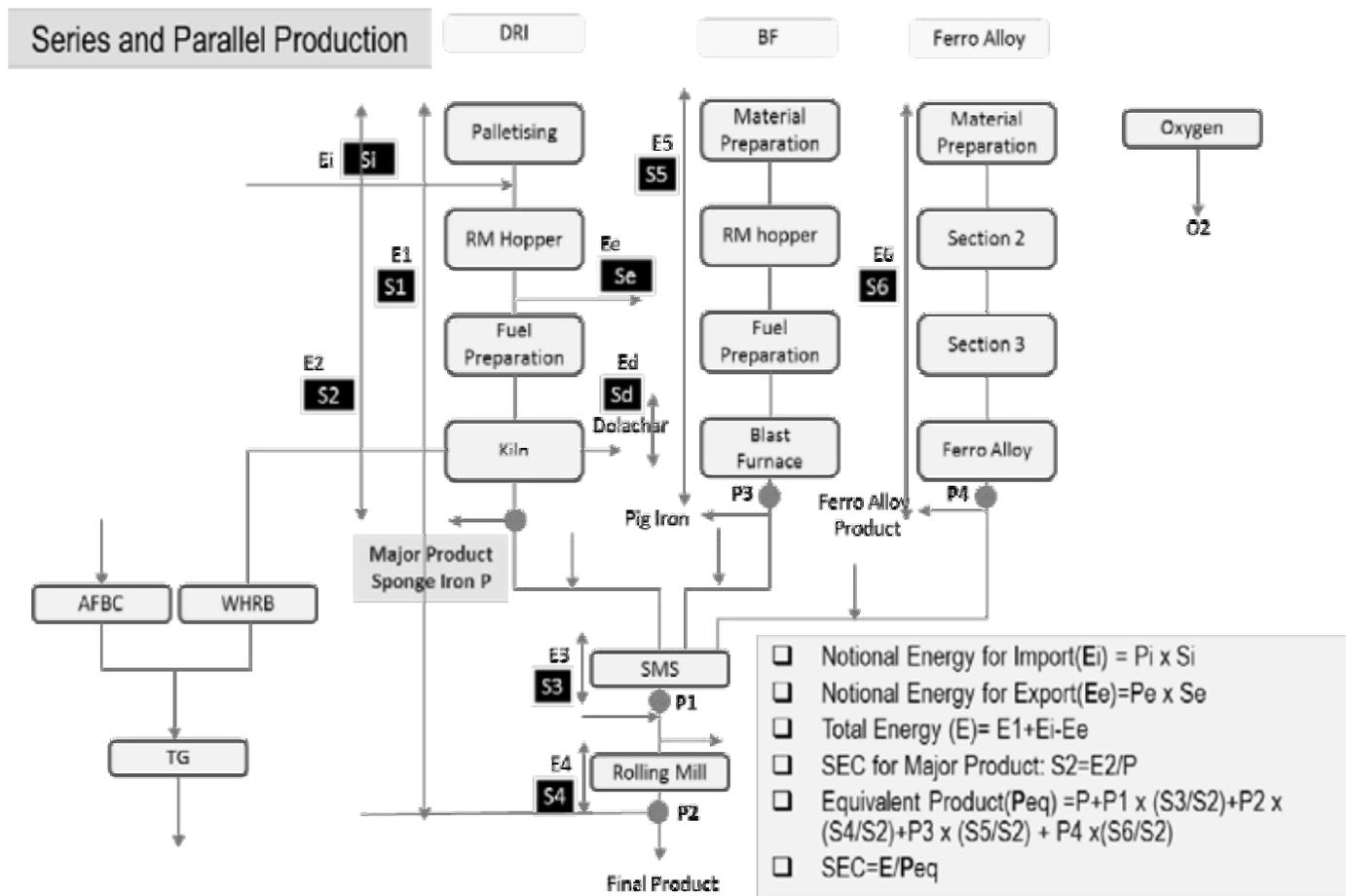
21. Demarcation of plant boundary is required with clear understanding of raw material input, Energy input, Power Import/ Export, Intermediary product Import/Export, Colony Power, Construction/Others Power, Power supplied to other Ancillary unit outside the plant boundary. A typical sample of Plant boundary condition is represented below

Figure 12: Ex-GtG Boundary boundary for Sponge Iron Sub-sector
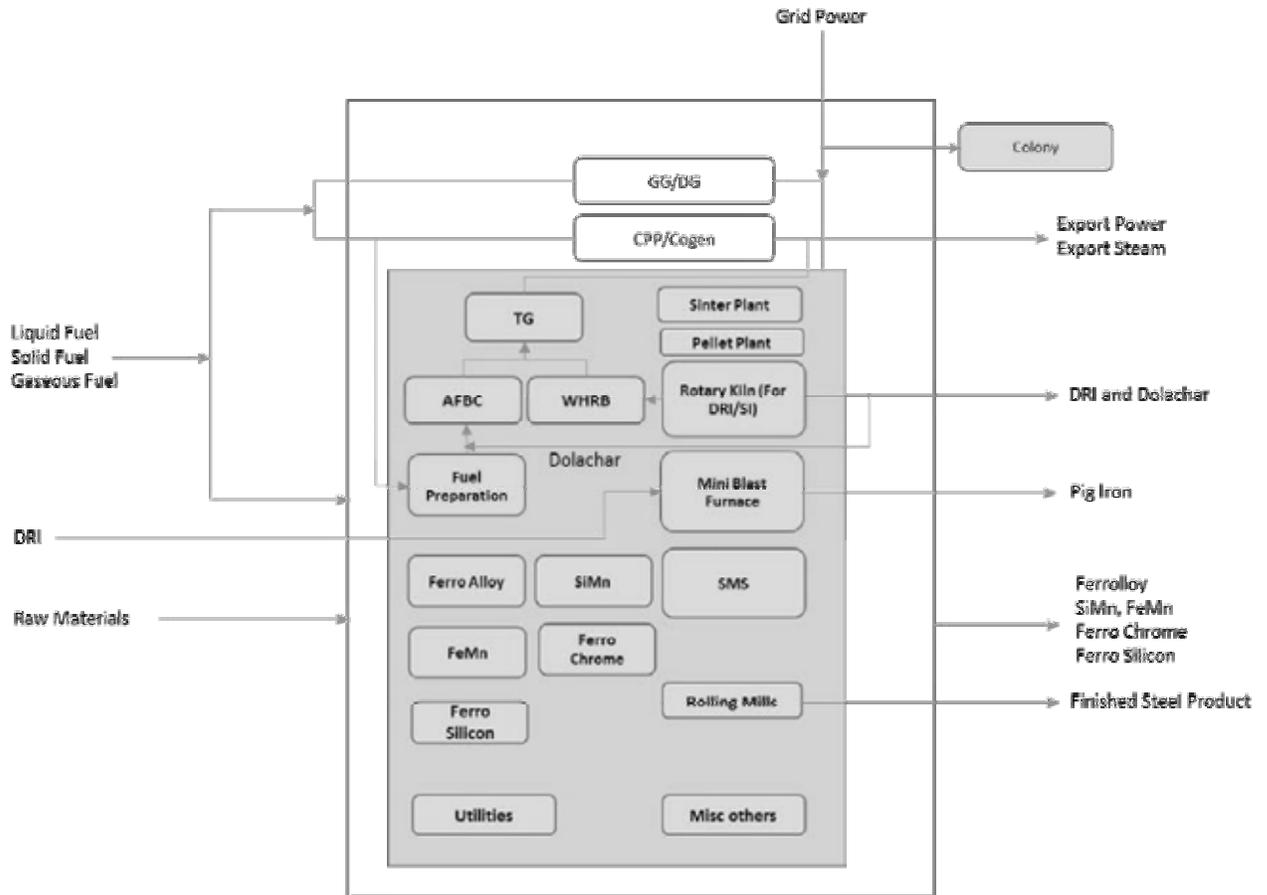
7.3. Annexure III: Cement

1. Preservation Power for Stopped Kiln: For kiln which goes under stoppages due to external factors, a certain quantity of power is required for safety and certain operations which needs to be maintained. The normalization for this power will be considered provided the DC has the baseline and assessment year data. Thisdifference of preservation power in the baseline as well as the assessment year shall be subtracted from the total energy consumed.

2. Frequency of Lab Analysis from NABL accredited Laboratories for providing normalization for Raw material Quality in the subsequent cycles:

2.1. Burnability analysis for raw mix – Once in each quarter

2.2. Limestone Bond index – Once in a year

3. Normalisation due to Non availability of fly ash due to external factor: DC to submitin support of claim on unavailability of fly ash during Assessment year to the EmAEA with sufficient data and documentation.

EmAEA to establish the facts whether in the vicinity of the particular DC, other Plants/DCs are getting Fly ash or not.

4. The status quo to be maintained in the assessment year for the basis of measuring GCV of Fuel (For Ex. As Received Basis, As Fired Basis, As Dried Basis etc.) as followed in the baseline year i.e., if DC has submitted GCV value on "as received basis", the basis will be same in the assessment year as well. The DC has to write in the remarks/source of data field on basis of GCV taken in the assessment year. However, The EmAEA is requested to report the Fuel GCV "As fired basis" in the verification report, which may become baseline for subsequent PAT cycles.

5. Plant Stoppages and Start due to high Clinker stock or Silo Full to be considered as external factor: Necessary

documentation to be provided by DC as per the instructionsgiven in Cement sector Pro-forma.

6. Normalisation on Use of Wet Fly Ash due to non-availability of dry Fly Ash: DC has to submit proper authentic documents to establish the increase in energy during AY due to usage of wet fly ash due to external reason. EmAEA to establish the facts whether in the vicinity of the particular DC, other Plants/DCs are getting dry Fly ash or not

7. Some of the information sought under this annexure could be considered as supporting information/documents, which may help EmAEA in submitting the Form B.

8. Review of Section wise specific power consumption (Line wise)

Table 17: Section wise Specific Power Consumption Details

Sr No	Section	kWh/tonne of Material	Conversion Factor to Clinker	kWh/tonne of Clinker	kWh/tonne of Cement	Remarks
1	Crusher					
2	Raw Mill					
3	Kiln					
4	Coal/Petcoke Mill					
5	Cement Mill					
6	Packing					
7	Utilities					
8	Misc					
	Sum					

9. Demarcation of plant boundary is required with clear understanding of raw material input, Energy input, Power Import/ Export, Intermediary product Import/ Export, Colony Power, Construction/ Others Power, Power supplied to other Ancillary unit outside the plant boundary. A typical sample of Plant boundary condition is represented below

Figure 13: Figure 14: Ex-GtG boundary for Cement Sector
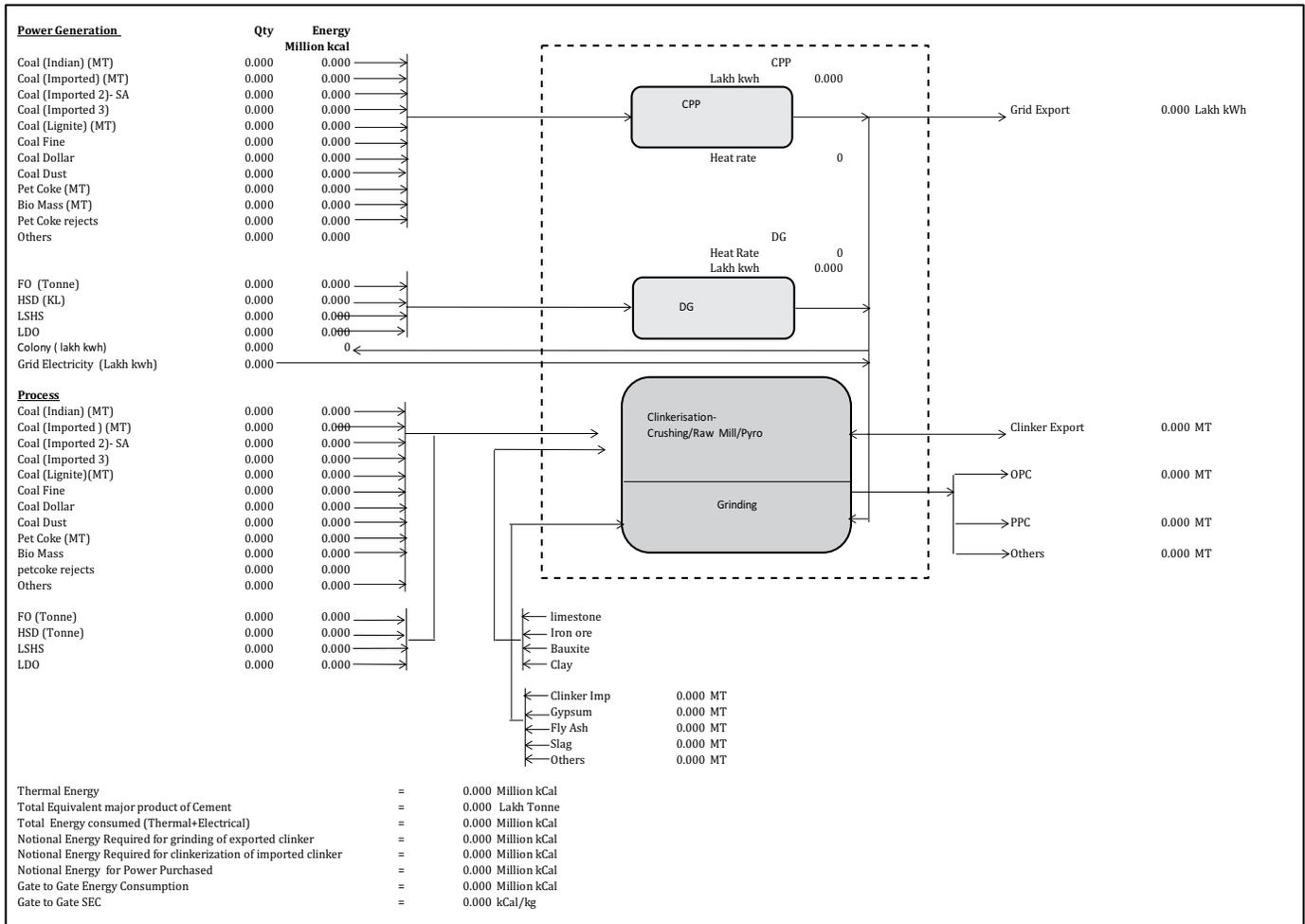
10. Mass and Energy balance verification

The clinker balance verification is required from Cement produced and Clinker factor with actual clinker produced by taking into account the Clinker stock difference and Clinker Import export. Similarly Energy balance up to clinkerisation could be verified as per the tabulated formulae

Table 18: Mass and Energy balance

Mass Balance Verification (A=B) Clinker Balance							
Sr No	Description	Unit	Year 1, 2007-08	Year 2, 2008-09	Year 3, 2009-10	Year 4, 2014-15	Remarks
A	Equivalent Clinker from total cement produced: [OPC x CFOPC]+[PPC x CFPPC)]+[PSC x CFPSC)]	Lakh tonnes					
B	Clinker Produced: Total Clinker Produced + (Clinker Imported- Clinker Exported)+(Opening Clinker Stock-Closing Clinker Stock)	Lakh tonnes					

Sr No	Description	Unit	Year 1, 2007-08	Year 2, 2008-09	Year 3, 2009-10	Year 4, 2014-15	Remarks
	% Variation	(A-B) x 100/A					
	Energy Balance Verification(C=D)						
C	FinalSEC (Before Normalisation)	kcal/kg equivalent cement					
D	(Thermal SEC for Clinkerization * PPC Clinker Factor) + (Electrical SEC for Clinkerization in thermal equivalent * PPC Clinker Factor) + (Electrical SEC for Cement grinding in thermal equivalent)	kcal/kg equivalent cement					
	% Variation	(C-D) x 100/C					

11. Section wise Screen shot of SCADA from CCR/DCS is to be included in the verification report

12. Raw material input in the Plant boundary to be recorded for inclusion in the verification report

13. Heat balance of Kilns (Kiln wise)for the assessment year is required to be included in the verification report with boundary and understanding on CV basis i.e., NCV or GCV of fuel

14. Calibration records of all weighing and measurement system with frequency of calibration to be included in the verification report

15. Clinker Factor Verification

The Clinker factor calculation is to be documented and produced in the verification report, the verification could be done by taking following factor into account from the pro-forma A1-A20

Table 19: Clinker Factor calculation

Item	Unit	Year1	Year2	Year3	Year 4	Remarks
Gypsum % in Cement	%					
Clinker used for PPC	tonne					
Clinker used for OPC	tonne					
Clinker used for PSC	tonne					
Clinker Used for Cement	tonne					
Gypsum used in OPC	tonne					
Gypsum used in PPC	tonne					
Gypsum used in PSC	tonne					
Clinker factor for PPC	factor					
Clinker Factor for OPC	factor					
Clinker Factor for PSC	factor					

16. Establishment of clear inclusion and exclusion from the plant boundary is maintained as in the baseline year.

17. Some of the factors, which are not covered in the cement sector pro-forma, the EmAEA is required to report it separately

7.4. Annexure IV: Fertilizer

Fertilizer industry is maintaining an elaborate system of measurement and reporting of production and energy data in the form of "Technical Operating Data (TOP)", as per the guidelines of Fertilizer Industry Coordination Committee (FICC), Department of Fertilizers. The TOP data is also audited by cost accountant. TOP data can be accepted as such. In case of multi-product plants, distribution of raw materials, power, steam and other utilities to be segregated and quantities allocated for urea production are to be brought out distinctly.

1.0 Measurement & recording

In the following table, items have been identified, which are required for calculating material & energy balance at battery limit of the complex. Against each item, following information is to be furnished :-

a) Measuring device: Name, tag number, model, location

b) Accuracy level of measurement or date of last calibration. Correction factors (if any)

c) Type of record: Data logger/ digital recorder, charts, direct reading/log book/ log sheet etc.

d) Frequency of reading: Hourly, shift wise, daily, periodically

e) Whether the quantities are ascertained by material balance?

f) Stock verification

Table 20: Material and Energy balance of Fertilizer sector

Sr. No.	Item	Unit	Measuring device Name/ tag no/model/ location	Accuracy level / correction factors (if any)	Records Type/ Location	Frequency of reading	Remarks
1.0	**Final/ intermediate products**						
1.1	**Urea production**	MT					
1.2	**Ammonia**						
1.2.1	Production	MT					
1.2.2	Consumption for urea	MT					
1.2.3	Consumption for other products	MT					
1.2.4	Sent to storage	MT					
1.2.5	Received from storage	MT					
1.2.6	Export	MT					
2.0	**Input raw materials**						
2.1	Natural gas						
2.1.1	Properties						
a	GCV	Kcal/ SCM					
b	NCV	Kcal/ SCM					
2.1.2	Total receipt						
a	Main receiving station	MMSCMD					

Sr. No.	Item	Unit	Measuring device Name/ tag no/model/ location	Accuracy level / correction factors (if any)	Records Type/ Location	Frequency of reading	Remarks
2.1.3	Distribution						
a	Reformer feed	MMSCMD					
b	Reformer fuel	MMSCMD					
c	Gas turbine	MMSCMD					
d	HRU	MMSCMD					
e	Boilers	MMSCMD					
f	Others	MMSCMD					
2.2	**Naphtha**						
2.2.1	**Properties**						
a	Sp. Gravity	gm/cc					
b	GCV	Kcal/kg					
c	NCV	Kcal/kg					
2.2.2	**Total receipt**						
a	Volume	kl					
b	Weight	MT					
2.2.3	**Distribution**						
a	Reformer feed	MT					
b	Reformer fuel	MT					
c	Others	MT					
2.3	**Diesel**						
2.3.1	**Properties**						
a	Sp. Gravity	gm/cc					
b	GCV	Kcal/kg					
c	NCV	Kcal/kg					
2.3.2	**Total receipt**						
a	Volume	kl					
b	Weight	MT					
3.3	**Distribution**						
a	DG Sets	kl					
b	Others						
2.4	**Furnace oil /LSHS etc.**						
2.4.1	**Properties**						
a	Sp. Gravity	gm/cc					
b	GCV	Kcal/kg					

Sr. No.	Item	Unit	Measuring device Name/ tag no/model/ location	Accuracy level / correction factors (if any)	Records Type/ Location	Frequency of reading	Remarks
c	NCV	Kcal/kg					
2.4.2	**Total receipt**						
	Volume	kl					
	Weight	MT					
2.4.3	**Distribution**						
a	Boiler	MT					
b	Other furnaces (specify)	MT					
c	Misc (if any)						
2.5	**Coal**						
2.5.1	**Properties**						
a	GCV	Kcal/kg					
b	NCV	Kcal/kg					
2.5.2	**Total receipt**						
a	Weight	MT					
2.5.3	**Distribution**						
a	Boilers(1+2+3)	MT					
b	Others (specify)	MT					
c	Stock variation						
2.6	**Any other fuel**						
3.0	**Steam**						
3.1	**Production**						
3.1.1	Boiler (Individual)						
3.1.2	GTG/HRU						
3.1.3	Service/auxiliary boiler						
3.1.4	Others						
3.2	**Consumption**						
3.2.1	Steam turbo generator						
3.2.2	Ammonia plant						
3.3.3	Urea plant						
3.3.4	Others						

2. Material balance of all inputs at battery limit of entire complex

Following information is to be filled-in as follows:-

(i) One month having best operation as per TOP.

(ii) For financial year, as per TOP.

Table 21: Material balance of all inputs in Fertilzer sector

Sr. No.		Item	Unit	Received at plant battery limit	Allocated for urea production	Allocated for other products	Difference if any	Remarks
1.0		**Purchased items**						
1.1		Purchased power	MWh					
1.2		Natural gas	MMSCMD					
1.3		Naphtha						
	a	Volume	Kl					
	b	Weight	MT					
1.4		Diesel	Kl					
1.5		Furnace oil /LSHS etc.						
	a	Volume	Kl					
	b	Weight	MT					
1.6		Coal	MT					
1.7		Any other fuel						
2.0		Steam						
2.1		Production						
2.1.1		Boiler (Individual)	MT					
2.1.2		GTG/HRU	MT					
2.1.3		Service/auxiliary boiler	MT					
2.1.4		Others	MT					
2.2		Consumption	MT					
2.2.1		Steam turbo generator	MT					
2.2.2		Ammonia plant	MT					
2.2.3		Urea plant	MT					
2.2.4		Others	MT					
3.0		**Power**						
3.1		**Generation**	MWh					
3.1.1		GTG	MWh					
3.1.2		Others	MWh					
3.2		**Consumption**						
3.2.1		Ammonia plant	MWh					
3.2.2		Urea plant	MWh					
3.2.3		Others	MWh					

3.   Pro-forma

a.   Pro-forma

Under the PAT scheme, all DCs are required to fill-in and submit to BEE, Pro-forma, which is mandatory, with following salient features:

i.   Plant capacity, production & capacity utilization

- Installed capacity
- Production
- Capacity utilization

ii. Purchased electricity – Purchased quantity, cost, consumption

iii. Generated electricity through DG/turbo gen/gas turbine/co-generation

iv. Fuels – Gaseous (NG, LNG), Liquid (Naphtha, fuel oil, diesel) solid (coal, coke) – Purchased quantity, calorific value (GCV).

v. Consumption of energy input for

- Power generation

- Process raw material

- Process heating

vi. Using waste as fuel

vii. Use of non-conventional energy (Solar, wind, etc)

ix. Total energy input at BL

b. **Sector Specific Pro-forma**

Keeping in view the special requirements in fertilizer sector, the Pro-forma has been modified with following changes:-

i. Plant capacity is reported in following formats:-

1. **Name plate capacity:** The original name plate capacity at the time of installation of plant.

2. **Re-assessed capacity:** As revised by "Fertilizer Industry Coordination Committee (FICC) " in the year 2002.

3. **Baseline production:** As worked out (for urea product only) under PAT scheme. It is an average of production for three baseline years viz 2007-08, 08-09, 09-10.

4. **Re-vamp capacity:** Subsequent to baseline period i.e. 2007-10, some plants carried out major revamp to enhance capacity further. The capacity is as reported by DCs to Department of Fertilizers.

ii. **Calorific value of fuel**

In fertilizer sector, all the energy calculations are based on net calorific value (NCV) of fuel. NCV will also be furnished along with GCV.

iii. **Total inputs at plant battery limit**

In the existing Pro-forma, only the inputs, which are allocated for urea production, are furnished. Modified Pro-forma, provides for furnishing total inputs at plant battery limit in addition to the inputs allocated for urea product.

iv. **Quantity of natural gas**

Presently, natural gas is being received from a number of sources. Instead of giving quantity of natural gas received from different sources separately, total quantity shall be furnished at one place only. However break up of this quantity may be furnished for Feed and fuel along with respective NCV. Other fuels which are not in use in fertilizer sector have been removed.

4. **Annexure to Pro-forma**

The Pro-forma being of generic nature does not contain information specific to fertilizer sector. Therefore, additional technical information is furnished through "Annexure to Pro-forma. Information furnished in Annexure to Pro-forma is as following:

A. Installed capacity, production, CU, on-steam days for ammonia / urea for base 5 years.

B. Installed capacity has been substituted with re-assessed capacity.

C. Inputs to Ammonia Plant

- NG/RLNG/LNG/PMT (Feed, fuel) – Quantity, NCV

- Naphtha (Feed, fuel) – Quantity, NCV

- Steam / power – Quantity, conversion factor

- Credits / debits – DM Water heating, LP steam export etc.

- Ammonia production

D. **Inputs to Urea Plant**

- Ammonia consumption for urea

- Power/steam

- Credits/debits– DM Water heating, LP steam export etc.

E. Conversion factor for power generated.

F. Heat value of steam generated.

G. Information available in log sheets, log books, data logger print outs and other plant documents need to be verified with appropriate references.

5. **Plant battery limit block diagram**

Block diagram showing total energy input at Plant BL as well as credit / debit of energy at intermediate stages for establishment of " Base Line SEC" To be filled-in by Designated Consumers (DC's)
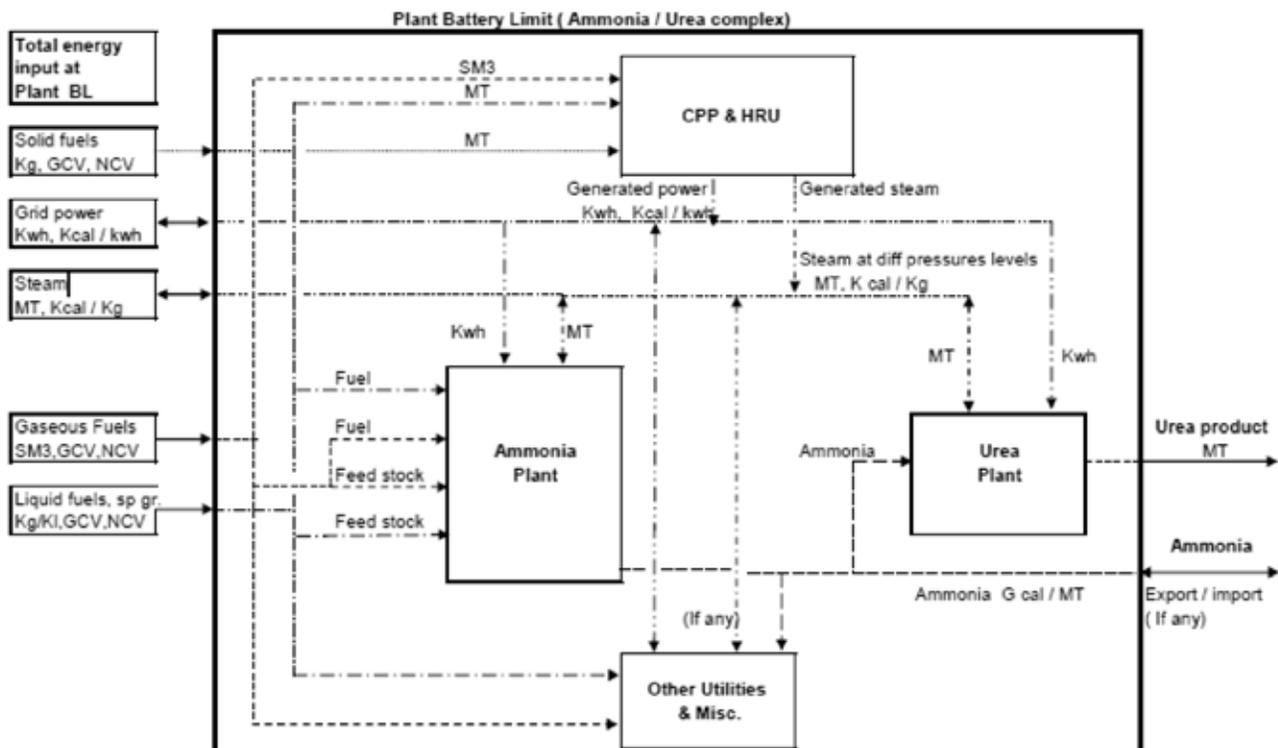
6. **Data not available in Pro-forma and Annexure – 1**

- Fuel input to boilers

- Waste gases available from ammonia/ urea plants and fed to boilers.

- Quantity of steam produced.

- Other energy inputs like pre-heated DM water

- Calculations for conversion factors of steam/power.

a. Additional information in Block diagram

The illustrative block diagram in sections - 5 above, when, filled adequately, incorporates missing information.

i. It depicts all inputs at plant battery limit, which may be

consumed for production of urea as well as other products.

ii. It also depicts all inputs allocated for urea production.

iii. Gives details on various imports/ exports, debit/credit etc.

iv. One set of sample calculations of gate-to-gate energy balance to be furnished by DC.

v. Basis of calculations, conversion factors, assumptions, import/export, credit/debit etc; to be mentioned specifically.

7. Procedure for calculation of specific energy consumption (SEC)

In general specific energy consumption (SEC) is calculated by dividing total energy input at battery limit by final product. However, in case of ammonia / urea complex, part of the input energy is utilized for manufacturing ammonia wherein Carbon-di-oxide (CO_2) is also produced as by-product. Ammonia and CO_2 are then reacted to produce urea. Part of the steam/power energy is consumed in urea plant. Further, full quantity of ammonia produced is not necessarily consumed for urea manufacture. Part of ammonia may go to storage or export. Similarly, part of steam / power may be either exported or imported. Therefore, in fertilizer sector, SEC of urea cannot be calculated directly by dividing total energy input by urea product. Following procedure is to be adopted for calculating SEC:-

a. Allocation of fuel for production of ammonia, power/steam and other products/facilities (wherever applicable).

b. Calculation of conversion factor for power generated (Kcal/Kwh) and its distribution.

c. Conversion factor for purchased power (taken as 2860 Kcal/Kwh).

d. Calculation of heat value of steam produced (Kcal/Kg) and its distribution.

e. Calculation of SEC for ammonia by considering the following:-

i. Feed & fuel energy input to ammonia plant directly

ii. Allocation of steam/power to ammonia plant along with conversion factors.

iii. Credit/debit of energy at ammonia plant battery limit like pre-heating of DM water, burning 'Off gases" in boiler furnace etc.

f. Calculation of SEC for urea by considering the following:-

i. Allocation of ammonia, separately as manufactured or purchased, for urea production.

ii. Allocation of steam/power to ammonia plant along with conversion factors.

iii. Credit/debit of energy by way of export of steam, burning vent gases etc.

Sr. No.	Description	Unit	Illustrative figures	Actual for 2014-15	Remarks
1.0	**Overall plant battery limit**				
1.1	**Inputs**				
1.1.1	Natural gas (NG)				
a	Quantity	MMSCM			
b	NCV of NG	Kcal/SCM			
1.1.2	Naphtha				
a	Quantity	kl			

Sr. No.	Description	Unit	Illustrative figures	Actual for 2014-15	Remarks
b	NCV of naphtha	Kcal/lit Kcal/kg			
c	Density of naphtha	gm/cc			
1.1.3	Grid power	MWh			
1.1.4	Steam	MT			
1.1.5	Ammonia	MT			
1.2	Output				
	Urea	MT			
	Power export	kWh			
2.0	**CPP/HRU**				
2.1	**Input**				
2.1.1	Natural gas	MMSCM			
2.2	Output				
2.2.1	Power	MkWh			
	Heat rate	Kcal/kWh			
2.2.2	Steam	MT			
	Heat content	Kcal/kg			
3.0	**Ammonia Plant**				
3.1	**Input**				
3.1.1	NG feed	MMSCM			
3.1.2	NG fuel	MMSCM			
3.1.3	Naphtha feed	kl			
3.1.4	Naphtha fuel	kl			
3.1.5	Steam	MT			
3.1.6	Power	MkWh			
3.2	**Output**				
3.2.1	Ammonia product	MT			
4.0	**Urea Plant**				
4.1	**Input**				
4.1.1	Ammonia	MT			
4.1.2	Steam	MT			
4.1.3	Power	MkWh			
4.2	**Output**				
4.2.1	Urea product	MT			
5.0	**Service boiler / Utilities**				
5.1	**Input**				
5.1.1	NG Fuel	MMSCM			
5.1.2	Naphtha fuel	kl			

8. Gate to Gate specific energy consumption (SEC)

i. Overall material & energy balance

An illustrative material & energy flow diagram of an ammonia/urea fertilizer complex is given below
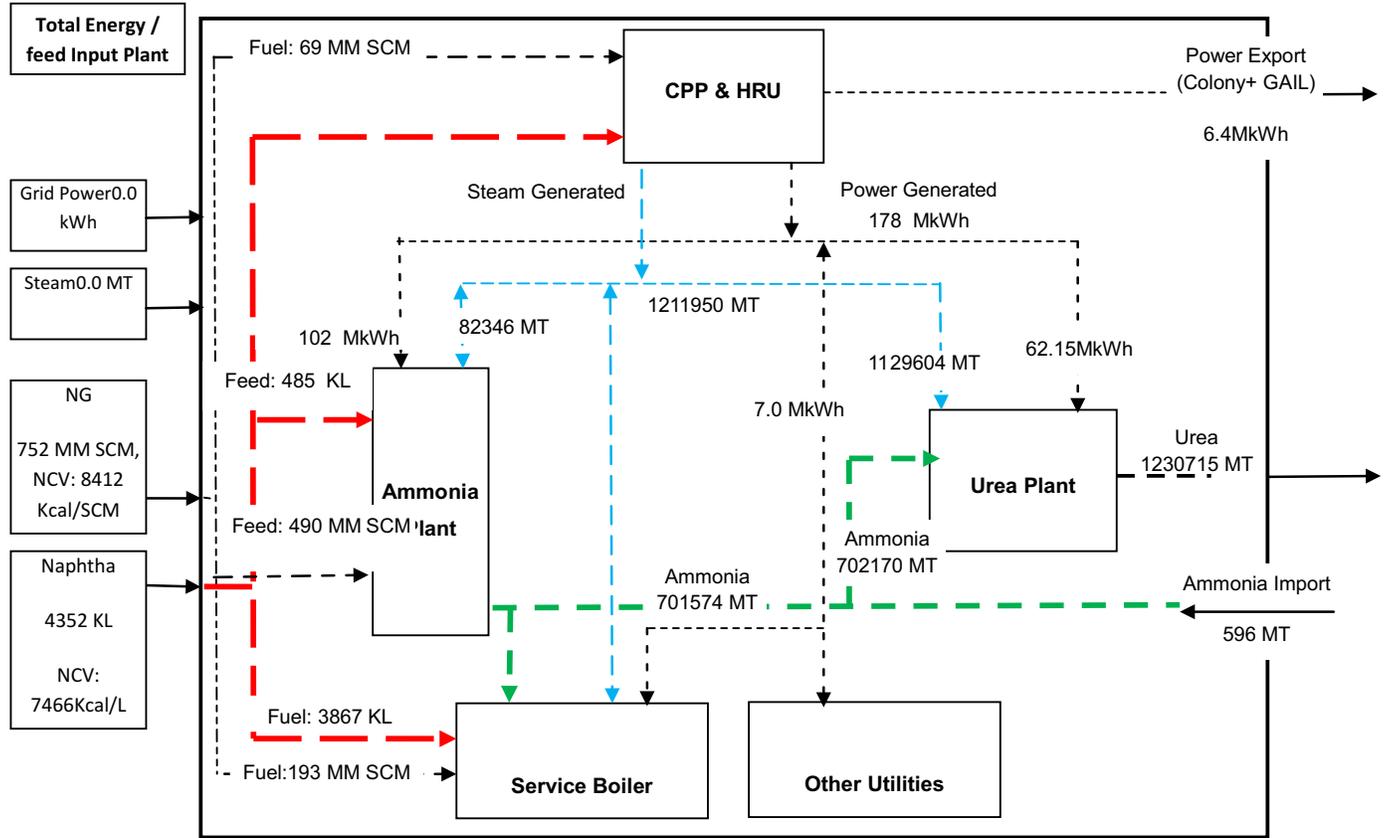
Figure 16: Overall Material and Energy balance. Figures mentioned above are indicative and used for representational purpose only . The actual data will vary from unit to unit .

II. CALCULATION OF SPECIFIC ENERGY CONSUMPTION (SEC) OF AMMONIA

(a)   Material balance of Natural Gas

Description	Quantity (MM SCM)	NCV (Kcal/SCM)	Heat content (Gcal) 2 x 3	Remarks
1	2	3	4	
Total input				
	752	8412	6325824	
Distribution				
CPP/HRU	69	8412	580428	
Reformer feed	490	8412	4121880	
Reformer fuel	193	8412	1623516	

(b)   Material balance of Naphtha

Description	Quantity (KL)	NCV (Kcal/ L)	Heat content (Gcal) 2 x 3	Remarks
1	3	2	4	5
Total input				
	4352	7466	32492	
Distribution				
Reformer feed	485	7466	3621	
Service boiler	3867	7466	28871	

c)   Energy balance in Ammonia Plant

Item	Unit	Quantity	NCV/ Heat value	Heat content Gcal	Specific energy consumption
Ammonia production	MT				
NG feed	MM SCM				
NG fuel	MM SCM				
Naphtha feed	MT				
Naphtha fuel	MT				
Steam	MT				
Power	MkWh				
Total feed energy	Gcal				
Total fuel energy	Gcal				
Power + steam	Gcal				
Total SEC	Gcal/MT				
Non plant energy	Gcal/MT				
SEC including non-plant energy	Gcal/MT				

(d)   Energy balance in Urea Plant

Item	Unit	Quantity	NCV/ Heat value	Heat content Gcal	Specific energy consumption
Urea production	MT	1230715			
Ammonia feed	MT	701574	7.691	5395806	4.384
Steam	MT	1129604	743	839295	0.682
Power	MkWh	62150	511	31759	0.026
Total energy	Gcal			6266860	
Total SEC	Gcal/MT				5.092
Non plant energy	Gcal/MT				0.079
SEC including non plant energy	Gcal/MT				5.171

9. Computing Baseline data

Under first cycle of PAT scheme, the baseline period constitutes the years 2007-08, 08-09 and 2009-10. Urea product has been taken as basis for calculating Specific energy consumption "SEC".

a. Production

Baseline production of urea is obtained by averaging urea production for three baseline years i.e. 2007-08, 08-09, 09-10. Production during target year (2014-15) is reported in the following table.

Sr. No.	Description	Unit	Baseline data				Assessment year
			2007-08	2008-09	2009-10	Average	2014-15
1.0	Urea product						
1.1	Installed capacity	MT				n.a.	
1.2	Actual production	MT					
1.3	Capacity Utilization	%				n.a.	

b. Specific energy consumption (SEC)

Baseline specific energy consumption (SEC) of urea is obtained by weighted average for three baseline years i.e. 2007-08, 08-09, 09-10. Specific energy consumption (SEC) during target year (2014-15) is reported in the following table.

Sr. No.	Description	Unit	Baseline data				Assessment year
			2007-08	2008-09	2009-10	Total	2014-15
1.0	Urea production	Tonnes				n.a.	
1.1	SEC	Gcal/ MT				n.a.	
1.2	Total energy	Gcal					
1.3	Weighted average	Gcal/MT	n.a	n.a	n.a		

10. Normalization factors

PAT procedure provides for "Normalization" of reported data based on capacity utilization factor, when plant load factor (PLF) has a deviation of more than 30%. The PAT procedure also provides for normalization by statistical analysis methods. In fertilizer sector, apart from capacity utilization, there are some other important factors viz. number of forced shut down of the plant, use of naphtha due to unavailability of natural gas, quality of coal and commissioning period after major revamp of the plant, which also affect specific energy consumption of product. Identified causes of un-productive energy consumption on account of factors, which are beyond the control of the plant are as follows:

(i)   Forced shut down of the plant and subsequent Cold start up

(ii) List of critical equipment, which on failure, cause forced shut down.

(iii) Plant operation at low load

(iv) Reduction of ammonia synthesis and CO shift catalyst

(vi) Use of naphtha due to non-availability of gas

(vi) Deterioration in quality of coal

For calculating the unproductive energy consumption against individual factor, formats were developed showing illustrative calculations.

a. Low capacity utilization

In addition to the reasons for lower capacity as given in PAT document, lower capacity utilization due to following reasons has also been considered for normalization(i) shortage of raw material including feed, fuel, water, electricity etc. (ii) high cost of inputs leading to unviable urea production beyond certain capacity (iii) major equipment failure (iv) force majeure.

Factors like shortage of raw materials (mainly the gas), decline in market demand, change in Govt. policy etc. are beyond the control of DCs. These factors may force the plant to be operated at lower capacity, thus causing adverse effect on energy consumption. In such cases, normalization shall be allowed as follows.

i. Pre-requisites for Normalization

1. A DC shall furnish detailed and convincing reasons with supporting documents for reduction in capacity utilization, due to factors, beyond their control.

2. Following criteria shall be adopted:-

   a) No compensation shall be allowed if the capacity utilization of urea plant on annual basis is 95% or above.

   b) Compensation shall be allowed for capacity utilization between 70-95%.

   c) Below 70%, the data shall be discarded.

3. The claim will be based on Technical operating data (TOP), which is being reported to Fertilizer Industry Coordination Committee (FICC) of Department of Fertilizers, Govt. of India.

4. Normalization due to low capacity utilization will be considered only in one of the plants i.e. either ammonia or urea.

5. Subsequent to the baseline year i.e.2007-10, some DCs have carried out major revamp of their plant for capacity enhancement in line with New Investment Policy for urea notified by the Govt. in 2008. Govt. recognized enhanced capacity, while reimbursing cost of production under the pricing policy. The enhanced capacity shall be considered, while calculating capacity utilization for normalization, subject to confirmation from DoF, Government of India and also verification certificate issued by an Accredited Energy Auditor to DC which seek to declare their enhanced installed capacities, production and energy use. Cost of this audit will be borne by the DC. Check tests of such verification could be carried out by BEE, if needed.

6. Some plants are having ammonia plant capacity higher than the quantity of ammonia required for urea production and thus, diverting surplus ammonia for production of other products or direct sales. In such cases, due to Govt. policy and/or market conditions, consumption of surplus ammonia for production of other products becomes unviable and under these circumstances, ammonia plant is operated at lower capacity, thus resulting in higher energy consumption per MT of ammonia, which also get transferred to urea, even if the urea plant is operated at full load; Normalization shall be allowed.

7. In case of ammonia / urea complex having ammonia capacity matching with urea production, capacity utilization of urea plant shall be considered.

ii. Calculation of normalization factor

1. Based on the operating data collected from plants at 100%, 85% and 70% plant load, average normalization

factor works out to be 0.02 Gcal per MT of urea per percentage reduction in plant load below 95% up to 70%.

2. Impact of Lower Capacity utilization shall be worked out as follows:-

   a. Maximum permissible value (Gcal/ MT urea) = (95 - % Capacity utilization) * 0.02.

   b. Actual unproductive energy (Gcal/ MT urea) = Annual Energy, Gcal/MT of Urea - Weighted Average of Monthly Energy Consumptions for the months with Capacity Utilization of 100% or more

   c. Lowest of the either (a) or (c) shall be considered for allowing the impact of lower capacity utilization.

3. Impact of Lower Capacity utilization of plants where ammonia is surplus than required for urea production, shall be worked out as follows:

   a. Maximum permissible value (Gcal/ MT ammonia) = (95 - % Capacity utilization of ammonia plant) * 0.02 Gcal.

   b. Actual unproductive energy (Gcal/ MT urea) = Annual Energy, Gcal/ MT of ammonia - Weighted Average of Monthly Energy Consumptions for the months with ammonia plant Capacity Utilization of 100% or more

   c. Lowest of the above two shall be considered for allowing the impact of lower capacity utilization. In such cases, normalization due to low capacity utilization (i.e. <95%) will be allowed only in one of the plants i.e. either ammonia or urea.

4. Capacity utilization for urea plant will be calculated based on "Baseline urea Production".

   iii. Supporting data / documentation Data shall be maintained in the following formats:-

A. Month-wise production & energy consumption during the year

Sr. No.	Month	Ammonia				Urea			
		On stream	production	CU	SEC	On stream	production	CU	SEC
		days	MT	%	Gcal/MT	days	MT	%	Gcal/MT
1	April								
2	May								
3	June								
4	July								
5	August								
6	September								
7	October								
8	November								
9	December								
10	January								
11	February								
12	March								

B.   Data for best operating months

Sr. No.	Best operating month	Ammonia production	CU	Urea production	CU	SEC Ammonia	SEC Urea	Reference
		MT	%	MT	%	Gcal/ MT	Gcal/ MT	

(i)   Take the month in which , plants have run for all the calendar days.

(ii) Capacity utilization during the month should be equal to or above 100%.

b.   Cold startup of the plant after forced shut down

In case of sudden failure of a critical equipment as per the list below, or external factors (as notified), ammonia plant undergoes a forced shut down. Restarting the plant from cold conditions (Cold start up) , consumes unproductive energy and shall be normalized.

i.   Pre-requisites for Normalization

A. The list of critical equipment failure of which leads to complete shutdown of plant and consequent cold start up, allowed under this normalization factor is   given below :-

1. Primary Reformer

2. Secondary Reformer

3. Heat Exchange Reformer

4. Reformed Gas Boiler

5. Carbon dioxide absorber and stripper

6. Air, Refrigeration and synthesis compressors

7. Synthesis converters

8. Synthesis Gas Waste Heat Boilers

9. High pressure urea reactor, stripper and carbamate condenser

10. Carbon dioxide compressor

11. Utility boiler furnace

12. Gas turbine/HRSG

13. Cooling Tower

14. Major Fire leading to complete shutdown of plant and cold startup

15. Turbo generator along with GTG

16. Purifier

17. CO Shift Converter

B. The Designated Consumer (DC) shall furnished a detailed report on failure of such equipment and its impact on energy consumption.

C. The Designated Consumer shall declare with back up documentation, what portion of such unproductive consumption during the month is due to cold shutdown and startup activity.

D. This actual energy loss due to shut down and cold startup in Gcal/MT of Urea shall be compensated, subject to maximum of 0.03 Gcal/MT of Urea.

ii. Calculation of normalization factor

A. Energy loss during the month(s) for which additional cold startup is being claimed shall be calculated as follows:-

(i) (Monthly Energy per MT of Ammonia during the month– Weighted Average Monthly Energy Consumption for the months with 100% on-stream days) X Monthly Ammonia production for the month of Startup.

(ii) This Energy Loss shall be divided by Annual Urea Production to identify total unproductive loss in a month.

(iii) The Designated Consumer shall declare what portion of such unproductive consumption during the month is due to cold shutdown and startup activity.

(iv) This actual energy loss due to shut down and cold startup in Gcal/ MT of Urea shall be compensated, subject to maximum of 0.03 Gcal/ MT of Urea.

(v) The failure of critical equipment leading to complete shutdown of plant and consequent cold start up, allowed under this normalization factor is given at Annexure -

iii. Documentation

Sr. No.	Description	Unit	2007-08	2008-09	2009-10	2014-15
1	Ammonia production	MT				
2	Urea production	MT				
3	Total no of cold start up	Nos				
4	Cold start up due to failure of major equipment	Nos				
5	For each start up					
a	Duration	hours				
b	Energy consumed	Gcal				

Note: For each shut down / cold start up, information to be filled-in separately.

c. Use of naphtha

A. Using part naphtha involves additional energy consumption as follows:-

    a) For each startup of facilities to use naphtha as feed including pre-reformer

    b) For the period of use of naphtha as feed

    c) For the period of use of naphtha as fuel

B. DCs shall furnish detailed and convincing reasons with supporting documents for use of naphtha due to non-availability of gas on account of factors, beyond their control.

i. Pre-requisites for Normalization

A. As per directives from Department of Fertilizers, Govt. of India, use of naphtha is to be discontinued in phased manner. As such, use of naphtha is not foreseen. However, provision is being made, in case naphtha has to be used due to shortage of natural gas in future, with permission from DoF.

B. In case of use of naphtha, DC will furnish details regarding non-availability of gas, leading to use of naphtha.

ii. Calculation of normalization factor

A. Following formula shall be used

Energy loss (Gcal/MT Urea) = (185*S + 0.625 * Nfeed + 0.443 * Nfuel) / urea production in MT

S=   1   if naphtha is used as feed in startup

S=   0   if naphta is not used as feed in startup

N_{Feedc}=   quantity of naphtha used as feed in MT.

N_{Fuelc}=   quanity of naphtha/LSHS/FO used as fuel in MT.

iii. Documentation

Sr. No.	Description	Unit	2007-08	2008-09	2009-10	2014-15
1	Ammonia production	MT				
2	Urea production	MT				
3	NG consumption	MMSCMD				
4	Shortfall in NG	MMSCMD				
5	Equivalent naphtha	kl				
6	Actual naphtha used	kl				

d. Catalyst reduction

Fresh catalyst is in oxidized form and needs to be reduced with synthesis gas, wherein hydrogen reacts with oxygen and gets converted into water. Whole plant is operated at 60-80% load for around 48 to 120 hours, depending upon type and quantity of catalyst. Thus, replacement / reduction of **ammonia synthesis and CO shift catalysts** consumes large amount of unproductive energy. Therefore, normalization due to replacement / reduction of these catalysts will be allowed.

i. Pre-requisites for Normalization

A. In case of ammonia synthesis catalyst, in the older plants, oxidized form of the catalyst is used which takes around 4-5 days for reduction, causing corresponding un-productive energy consumption. Presently, " Pre-reduced catalyst" is also available, which is expansive but takes around 48 hours for reduction, thus consuming lesser un-productive energy. This aspect will be taken care , while calculating normalization factor.

B. This will be considered subject to certification by DCs and furnishing to BEE information as follows:

(i) Year in which the catalyst were last changed along with copies of purchase order, last placed with the vendor , time taken in commissioning of catalyst , facts and figures clearly indicating and quantifying rise in the energy consumption of plant due to the replacement of this catalyst.

(ii) Copies of purchase orders placed by units with the vendors for supply of fresh catalysts.

ii. Calculation of normalization factor

Adjustment shall be allowed on the basis of actual plant data, subject to a maximum of 0.04 Gcal/MT of Urea.

e. Deterioration in quality of coal

The quality of indigenous coal has been deteriorating gradually, thus affecting boiler efficiency adversely. The reduction in boiler efficiency due to poor quality of coal shall be compensated.

i. Pre-Requisites for Normalization

Weighted average of three years data shall be worked out. In case there is significant variation, then normalization factor shall be applied based on the actual impact due to the variation.

ii. Calculation of normalization factor

A. Quality of coal affects boiler efficiency, which shall be calculated by following empirical formula:-

Boiler Efficiency = 92.5 – ((50*A+630 (M+9H))/GCV.

Where

A = Ash content of coal (%)

M = Moisture (%)

H = Hydrogen (%)

GCV = Kcal/Kg

B. Boiler efficiency shall be converted into specific energy consumption, as follows:

Additional Energy Consumption, Gcal/MT of Urea = Energy of Coal per MT of Urea in Target Year, Gcal/MT of Urea * (Boiler Efficiency in Base Year – Boiler Efficiency in Target Year)/Boiler Efficiency in Target Year.

iii. Documentation

A. Coal consumption and analysis

Sr. No.		Parameters	Unit	2007-08	2008-09	2009-10	2014-15
1		Quantity of coal used	MT				
2		GCV (Weighted average)	Kcal/kg				
3		NCV (Weighted average)	Kcal/kg				
4		**Proximate analysis**					
	A	Fixed carbon	%				
	B	Volatile matter	%				
	C	Moisture	%				
	D	Ash	%				
5		**Ultimate analysis**					
	A	Carbon	%				
	B	Hydrogen	%				
	C	Sulphur	%				
	D	Nitrogen	%				
	E	Oxygen	%				

f. Additional provisions

i. Normalization factors to be applied during assessment year, shall also be applied on baseline data for 2007-10.

B. Provision of normalization factors is intended solely to save plants from penalties for non-achieving the saving targets, for reasons which are beyond the control of DCs. However, availing of any of the normalization factors shall render the DC ineligible for issuance of E-certificates under PAT scheme. Therefore DC should seek normalization only when specified energy saving target is not met due to reasons beyond control of DCs.

C. DC's claim will be examined based on Technical operating data (TOP), which is being reported to Fertilizer Industry Coordination Committee (FICC) of Department of Fertilizers, Govt. of India as well as by auditors designated by Bureau of Energy Efficiency (BEE).

7.5. Annexure V: Aluminium

1. The energy required to transport mined bauxite to refining operations with inthe plant boundary, alumina to smelting operations, ingots to metal processors, and scrap from collection to melting is accounted as inside transportation and consider as energy used in plant.

2. Plant stoppages and start due to external factor: Necessary documents has to be provided by DC

3. Proper documents on Bauxite Quality for the purpose of normalization have to be maintained and submitted to EmAEA.

4. Refinery Mass Balance (Bauxite to alumina ratio): The DC has to provide necessary calculation document to EmAEA during M&V for verification of alumina product ratio.

5. Smelter Mass Balance (Alumina to Molten Aluminium ratio): The DC has to provide necessary calculation document to EmAEA during M & V for verification of Molten Aluminium product ratio

6. In Smelter Plant EmAEA has to verify BusBar Voltage drop and Anode-Cathode Distance in reduction cell.

7. DC needs to submit HMBD of Turbine system or characteristics curve between Load and Turbine Heat Rate PLF normalization. Equivalent capacity HMBD or characteristics curve shall be used, if OEM data is not available with the DC

8. In case of addition of new Potline, a DC shall submit all relevant design data of new Pot line to EmAEA for inclusion in the verification report

9. The baseline SEC factor used for product equivalent will be used for assessment year product equivalent. The major product of the baseline period will be considered in the assessment year. In case if any new product is introduced in the assessment year the SEC factor of assessment year will be used for converting to equivalent major product for the assessment period.

10. For Import or Export of Carbon Anode, DC shall be required to fill the Pro-forma the type of anode (i.e., Green Anode, Baked Anode or Rodded Anode) exported or imported in the Remarks Column. The SEC shall be for the type of Carbone Anode i.e., SEC up to the type of Carbon Anode produced. Generally for importing or exporting anodes, the energy shall be booked till the energy of baked anodes

1. Refinery

11. Review of Section wise Specific Energy Consumption

Table 22: Section wise Energy Consumption details

S. No	Section	Thermal energy Consumption	Electrical Energy Consumption	kWh/tone of Alumina	kWh/tone of Aluminium	Remarks
1	Grinding					
2	Digestion					
3	Clarification					
4	Precipitation					
5	Calcination					

12. Plant Boundary

Demarcation of plant boundary is required with clear understanding of raw material input, energy input, power import/export, Intermediary product import/export, Colony power, Construction power, power supplied to other ancillary unit outside of the plant boundary. Typical plant boundary conditions are produced below.

Figure 17: Ex- GtG boundary for Aluminium (Refinery sub sector)

B. Smelter

13. Carbon Anode to Molten Aluminium ratio: The DC has to provide necessary document to EmAEA during M & V. Approximately 0.45 kilograms of carbon anode were needed to produce one kilogram of aluminum

14. The smelter Energy consumption shall be taken up to Molten Alumina in the pro-forma

15. The additional cast house product shall be converted into one product and inserted in the Product "other" details in pro-forma

16. The energy used in smelter for imported scrap/ cold metal for production of finished products shall be considered for product equivalent hot metal SEC calculation

Table 23: Section wise Energy Consumption details

S.No	Section	Thermal Energy Consumption	Electrical Energy Consumption	kWh/tone of Anode	kWh/tone of Aluminium	Remarks
1	Pitch					
2	Coke					
3	Baking					

17. Electrolytic reduction energy consumption:

Table 24: Voltage Distribution

S.No	Reduction Cell (Section wise)	Voltage Distribution
1	External	
2	Anode	
3	Polarization	
4	Bath	
5	Reaction	
6	Cathode	
7	Other	

18. Plant Boundary

Demarcation of plant boundary is required with clear understanding of raw material input, energy input, power import/ export, Intermediary product import/ export, Colony power, Construction power, power supplied to other ancillary unit outside of the plant boundary. Typical plant boundary conditions are produced below
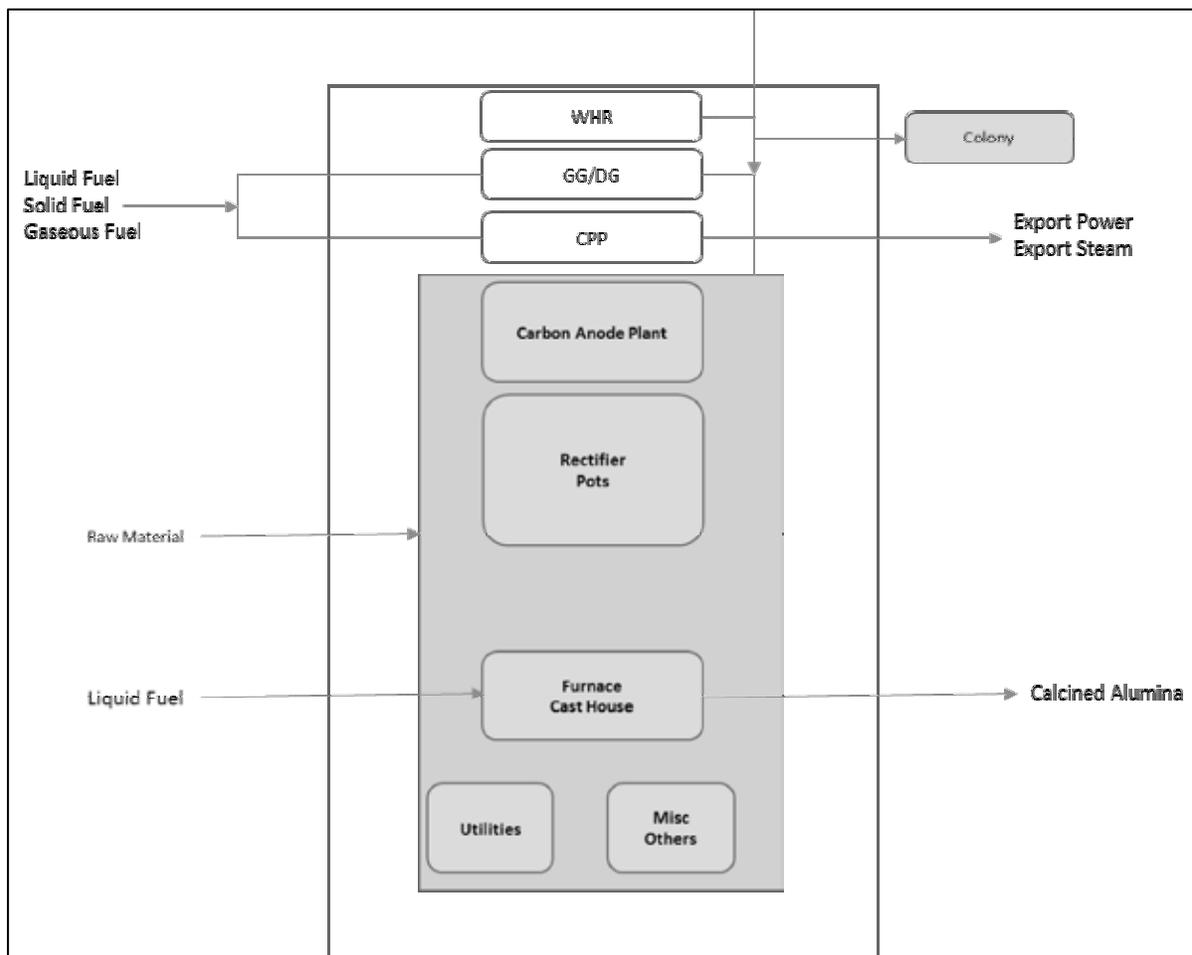
Figure 18: Ex- GtG boundary for Aluminium (Smelter sub sector)

C. Cold Sheet

19. Necessary documents as per the instruction in Form 1 need to be provided by DC to EmAEA for verification of section wise energy consumption and Specific Energy Consumption.

20. Product equivalent of other cold rolled products shall be calculated offline to to single cold rolled product through conversion from SEC of different cold rolled product.

21. Plant Boundary

Demarcation of plant boundary is required with clear understanding of raw material input, energy input, power import/export, Intermediary product import/export, Colony power, Construction power, power supplied to other ancillary unit outside of the plant boundary. Typical plant boundary conditions are produced below
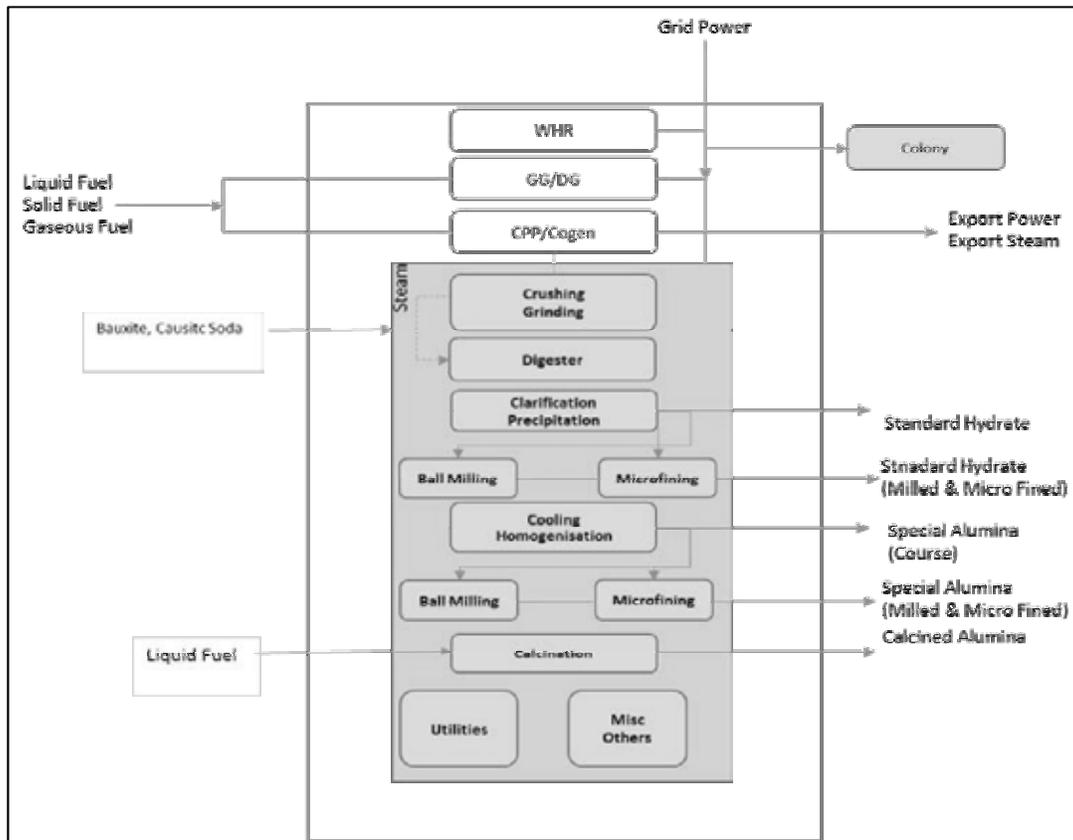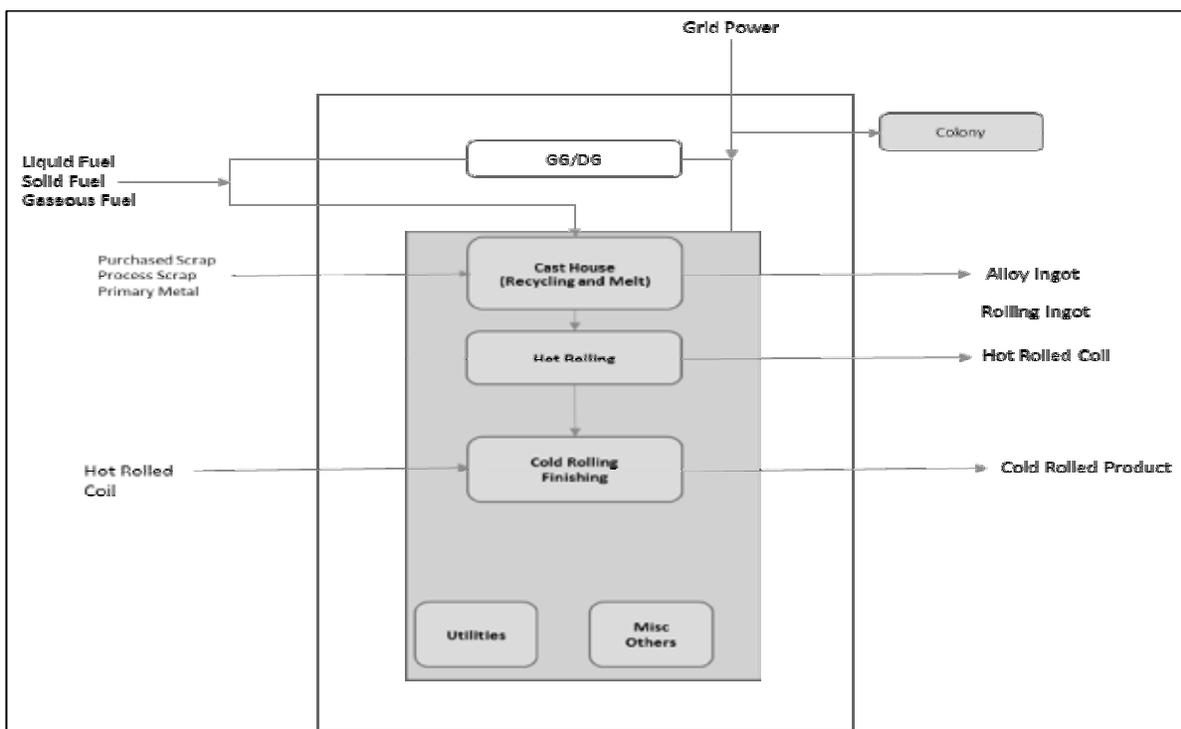

Figure 19: Ex- GtG boundary for Aluminium (Cold Sheet sub sector)

7.6. Annexure VI: Pulp & Paper

1. The boundary can be drawn virtually by including CPP or Cogen in the boundary limit of DCs, if nos DCs exist in a same boundary limit.

2. The captive power plant (CPP) or cogen will be taken into the virtual boundary of each DCs and accordingly import and export of power and steam will be treated as per Pro-forma data entry system.

3. If a captive power plant or cogeneration plant caters to two or more DCs for the electricity and/or steam requirements. In such scenario, each DC shall consider such captive power plant or cogeneration plant in its boundary and energy consumed by such captive power plant or cogeneration plant shall be included in the total energy consumption. However, electricity in terms of calorific value (as per actual heat rate) and steam in terms of calorific value (as per steam enthalpy) exported to other plants shall be subtracted from the total energy consumption.

4. It is to be noted that the same fuel input needs to be considered in case CPP is being taken into the boundary limit. By import and export of energy, the energy consumption from the CPP is automatically left out for the particular DC for SEC calculation.

5. Mill wise verification data are required to be included in the verification report

A. Wood Based Mills:-

a. The auditors may collect details required in M&V format by mentioning the source and document from where data is collected. Subsequently the data may be verified from the, data provided by the DC in sector specific Pro-forma for normalization.

b. The information required is shown in the flow chart for wood based pulp and paper mill

c. List of documents required for monitoring and verification

Table 25: General details required in wood based Pulp and Paper Mills

A.1 Raw Material Details

Type of Wood:-

Sr No	Name of the raw material	Moisture, %	Quantity, tonne/annum	Source/ document
1				
2				
3				
4				
5				

A.2 Wood Pulp Mill (Including Raw material, Chipper , Digester , WSC, ODL , Bleach Plant, Recovery , WTP, and ETP)

i) Pulping Processes Used

Sr No	Type of pulping	Capacity tonne/annum	Production tonne/annum	Total Yield (Including screening losses)	Source / Document
1	Chemical				
2	Semi Chemical				
3	Chemi Thermo Mechanical				
4	Other				

ii) Extended Delignification (ODL)

Sr No	Item	Unit	Value	Source / Document
1	Capacity	tonne/ annum		
2	Date of Installation of ODL Plant	Date		

iii) Bleaching

Sr No	Item	Chemical Pulp	Semi Chemical	Chemical Thermo Mechanical Pulp
1	Type of Bleaching	ECF/conv.	ECF/conv.	ECF/conv.
2	Sequence Used			
3	Bleaching Losses %			
4	Bleached Pulp Yield %			
5	Brightness of pulp, %			

Sr No	Item	Unit	Value	Source / Document
1	Capacity	Tonne/ annum		
2	Date of Installation of ECL Plant	Date		

iv) Energy Consumption in Pulp Mill

Sr No	Item	Qty	Source/ Document
1	Steam Consumption, LP/a		
2	Steam Consumption, MP/a		
3	Power Consumption, kWh/a		

v) Pulp Dryer

Sr No	Item	Unit	Qty	Source / Document
1	Capacity	Tonne/annum		
2	Production of salable pulp, t/a	Tonne/annum		
3	Energy Consumption in pulp dryer	kcal		
4	LP Steam Consumption	Tonne/annum		
5	MP Steam Consumption	Tonne/annum		
6	Power Consumption	kWh/annum		

vi) Chemical Recovery

Sr No	Item	Unit	Data	Source / Document
1	Type of chemical recovery	Conventional/Non-Conventional		
2	Total Black liquor Solids generated	Tonnes		
3	In Lime Kiln Installed	Yes/No		
4	Date of Installation of Lime Kiln I	Date		
5	Date of Installation of Lime Kiln II	Date		
6	Date of Installation of Lime Kiln III	Date		

vii)   Over-all Energy consumption in pulp mill

Sr No	Item	Qty	Source / Document
1	LP Steam consumption, t/a		
2	MP Steam consumption, t/a		
3	Power consumption, kWh/a		

A.3 Paper Machine (including stock preparation, chemical preparation / addition plant, finishing house)

(i)   Paper Machine Details

Number of Paper Machines

Item	PM-1	PM-2	PM-3	PM-4	PM-5	Source/ document
Type of paper machine						
Capacity,t/a						
Type of paper produced						
Production, t/a						
Annual weight average GSM						
Energy Consumption in paper machine (including Stock Preparation, chemical addition and finishing house)						
LP Steam consumption t/a						
MP Steam consumption, t/a						
Power consumption, kWh/a						

(ii)   Coating / Value addition

Coating If any   Yes /No

Type of coating   online / offline

Item	Qty	Source/ document
Capacity of offline coating plant, t/a		
Production of coated paper/board, t/a		
LP Steam consumption,t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

(iii) Over-all Energy consumption in paper machine,stock preparation, chemical preparation and addition plant , finishing house and offline coating plant add (i+ii)

	Qty	Source/ document
LP Steam consumption,t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

A.3 The Information required is shown in the Flow Chart for Wood Based Pulp and Paper Mill
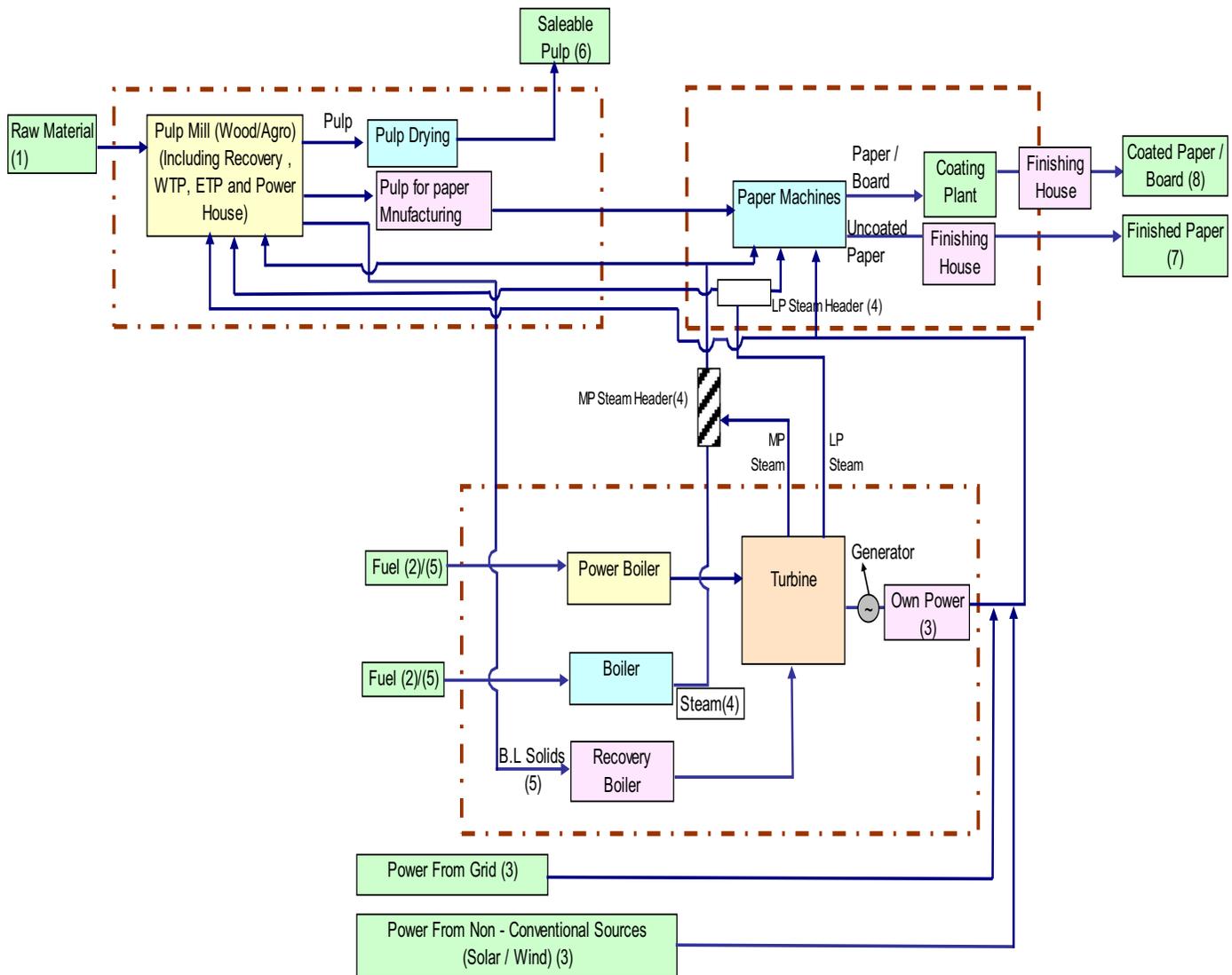

Figure 20: Ex- GtG boundary and metering details for Wood based Pulp and Paper Mill

Table 26: Documents required wood based Pulp and Paper Mills

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
1	Raw Materials	Lab Report	Report on moisture(%), Ash (%) and other analysis of the raw materials used by the mill
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of raw materials used by the mills.
		Purchase Document From Purchase Department	Purchase documents providing details of raw material purchased by the mill
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of raw materials used by the mills
		Raw Material Consumption Reports	Consumption reports giving details of raw material consumed by the mill. The report may be for raw material chip production, digester loading etc. from the concerned department.
			Frequency: Daily/ weekly/ monthly/ annual consumption documents may be produced for different types of raw materials used by the mill in chipper / digesters house..
		Annual Report	Annual report showing details of raw materials consumed on annual basis by the mill.
			Frequency: Annual consumption of raw materials by the mill.
2	Purchased Fuels	Fuel Purchase report/ documents	Purchase documents providing details of fuel purchased by the mill.
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of fuels used by the mills.
		Lab report for GCV moisture and Ash	Lab report on GCV, moisture(%), Ash (%) and other analysis (proximate and ultimate) density etc, of the fuel used by mill.
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of fuels used by the mills.
		Fuel Consumption Report	Consumption reports giving details of fuel consumed by the mill in boilers, DG sets etc. The consumption report may be from the concerned department showing details of fuel consumption.
			Frequency: Daily/ weekly/ monthly/ annual fuel consumption documents may be produced for different types of fuels used by the mill in boiler/DG sets etc.
		Annual Report	Annual report showing details of fuels consumed on annual basis by the mill.
			Frequency: Annual consumption of fuels by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
3	Power	Electricity Purchased from Grid	Purchased electricity bill from state electricity board providing details of the electricity purchased by the mill.
			Frequency: monthly/ annual purchased electricity bills may be produced by the mills.
		Own power generation	Details of own power generation from different sources such as turbines(gas, steam etc), DG sets.
			Frequency: Daily/ weekly/ monthly/ annual own generation reports may be produced by the mills. These reports may be the log sheets/ production reports from power house.
		Production of power from Non Conventional sources, e.g. Solar / wind power	Details of power generation from different Non-conventional sources such as Solar / wind turbines, bio gas etc.
			Frequency: Daily/ weekly/ monthly/ annual Power generation reports may be produced by the mills. These reports may be the log sheets/ production reports from concerned power houses / departments
		Annual Report	Annual report showing details of Power purchased from grid, own power generation, power from non-conventional sources etc.
			Frequency: Annual report of power purchased , own generation, generation from non- conventional sources etc.by the mill.
4	Steam	Steam generation by the mill	Details of Steam generation from different boilers, extraction of steam from turbines, steam generation from waste heat recovery and non-conventional sources(Solar steam generators)
			Frequency: Daily/ weekly/ monthly/ annual steam generation reports may be produced by the mills. These reports may be the log sheets/ production reports for steam generation from boiler house etc.
		Steam consumption by the mill	Details of Steam consumption in different sections of the mill such as pulp mill, chemical recovery, paper machine, power house and other plants of the mill.
			Frequency: Daily/ weekly/ monthly/ annual steam consumption reports may be produced by the mills. These reports may be the log sheets/ consumption reports for steam consumption by individual section of the mill or power boiler house.
		Annual Reports	Annual report showing details of Steam Generation and consumption from various sources. The generation and consumption of steam may be in individual departments as well as for the whole mill, boilers, extraction steam, steam from non-conventional sources etc.
			Frequency: Annual report of steam generation and consumption by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
5	Internally Generated Fuels (Black liquor solids, pith, chipper dust)	Generation report of Black liquor, pith, chipper dust, etc	Details of generation of black liquor, pith, chipper dust or any other combustible waste by the mill from different sections such as chipper house, pulp mill, other plants.
			Frequency: Daily/ weekly/ monthly/ annual Black liquor, dust etc generation reports may be produced by the mills. These reports may be the log sheets/ production reports for Black liquor and pith generation from boiler house etc.
		Lab reports for GCV, solids, moisture, ash etc.	Lab report on GCV, solids (%) moisture(%), Ash (%) and other analysis (proximate) of the Black liquor, pith, dust etc. used by the mill.
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of Black liquor, pith, dust etc. used by the mill.
		Annual Report	Annual report showing details of Black liquor generation, dust and pith generation, from various sources such as pulp mill, chippers, etc.
			Frequency: Annual report of Black liquor, pith and dust generation by the mill.
6	Saleable Pulp	Opening and closing stock of saleable pulp	Documents providing details of opening and closing of saleable pulp records by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of the saleable pulp stock may be produced for different types of pulps produced by the mill.
		Saleable pulp production	Documents providing details of production of saleable pulp from different raw materials by the mill.
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of saleable pulp from different types of raw materials produced by the mill.
		Annual Report	Annual report showing details of saleable pulp production from different raw materials and its consumption etc. Also the annual stock closing and opening of the saleable pulp from annual report may be produced
			Frequency: Annual report of saleable pulp production, consumption and stock (opening/ closing) by the mill.
7	Uncoated paper/ board, Newsprint, Specialty grade	Opening and closing stock reports	Documents/ records providing details of opening and closing of Uncoated paper / board, Newsprint, Specialty grade paper products by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
		Paper production report / documents	Documents providing details of production of Uncoated paper/board, Newsprint, Specialty grade paper products, produced by the mill
			Frequency: Daily/weekly/ monthly/ annual production records/documents providing details of Uncoated paper/board, Newsprint, Specialty grade paper products, produced by the mill.
		Annual Report	Annual report showing details of Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill.
			Also the annual stock closing and opening of the Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Uncoated paper / board, Newsprint , Specialty grade paper products, produced and stock (opening/ closing) by the mill.
8	Coated Paper / board	Opening and closing stock reports	Documents/ records providing details of opening and closing of Coated Paper / board by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Coated Paper / board, produced by the mill.
		Paper production report / documents	Documents providing details of production of Coated Paper / board produced by the mill
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of Coated Paper / board produced by the mill.
		Annual Report	Annual report showing details of Coated Paper / board, produced by the mill.
			Also the annual stock closing and opening of the Coated Paper / board, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Coated Paper / board, produced and stock (opening/ closing) by the mill.

B.   Agro Based Mills:-

a.   The auditor may collect details required in M&V by mentioning the source and document from where data is collected. Subsequently the data may be verified from the data provided by the DC in pro-forma for normalization.

b.   The information required is shown in the flow chart for Agro based pulp and paper mill.

c.   List of documents required for various monitoring and verification

Table 27: General details required in Agro based Pulp and Paper Mills

B.1Raw Material Details

Type of Agro Paper

Name of the raw material	Moisture, %	Quantity, t/a	Source/ document

Whether Depithing at Mill Site   Yes / No

B.2 Depither Details

Item	Unit	Qty	Source/ document
No. of Depithers	Nos		
Capacity	Tonne/annum		
Type of depithing,	Wet/dry		
Moisture	%		
Pith removal	%		

B.3 AgroPulp Mill (Including Raw material, Pulper, Digester , WSC, ODL , Recovery, Bleach Plant, WTP, and ETP)

i) Pulping Process Used

Type of pulping	Capacity t/a	Production t/a	Total Yield (Including screening losses)	Source / Document
Chemical				
Semi Chemical				
Chemi Thermo Mechanical				
Other				

ii) Refining Details

Items	Unit	Qty	Source / Document
Type of refiners			
Capacity of Refiner, t/a	Tonne/annum		
Pulp Yield, %	%		

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iii) Extended Delignification (ODL)

Item	Unit	Qty.	Source / Document
Extended Delignification (ODL)	Yes/No		
Capacity	Tonne/annum		
Date of Installation of ODL Plant	Date		

v) Bleaching

Item	Chemical Pulp	Semi Chemical	Chemical Thermo Mechanical Pulp
Type of Bleaching	ECF/conv.	ECF/conv.	ECF/conv.
Sequence Used			
Bleaching Losses %			
Bleached Pulp Yield %			
Brightness of pulp, %			

Item	Date	Source / Document
Date of Installation of ECF Bleach Plant		

vi) Energy Consumption in Pulp Mill

Item	Qty	Source/ Document
LP Steam Consumption, t/a		
MP Steam Consumption, t/a		
Power Consumption, kWh/a		

v) Pulp Dryer

Sr No	Item	Unit	Qty	Source / Document
1	Capacity	Tonne/annum		
2	Production of salable pulp	Tonne/annum		
3	Energy Consumption in pulp dryer	kcal		
4	LP Steam Consumption	Tonne/annum		
5	MP Steam Consumption	Tonne/annum		
6	Power Consumption	kWh/annum		

vi) Chemical Recovery

Sr No	Item	Unit	Data	Source / Document
1	Type of chemical recovery	Conventional/ Non-Conventional		
2	Total Black liquor Solids generated	Tonnes		
3	In Lime Kiln Installed	Yes/No		
4	Date of Installation of Lime Kiln I	Date		
5	Date of Installation of Lime Kiln II	Date		
6	Date of Installation of Lime Kiln III	Date		

vii) Over-all Energy consumption in pulp mill

Item	Qty	Source / Document
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

B.4 Paper Machine (including stock preparation, chemical preparation/addition plant, finishing house)

(i) Paper Machine Details

Number of Paper Machines

Item	PM-1	PM-2	PM-3	PM-4	PM-5	Source/ document
Type of paper machine						
Capacity, t/a						
Type of paper produced						
Production, t/a						
Annual weight average GSM						
Energy Consumption in paper machine (including Stock Preparation , chemical addition and finishing house)						
LP Steam consumption t/a						
MP Steam consumption, t/a						
Power consumption, kWh/a						

(ii)   Coating / Value addition

Coating If any   Yes /No

Type of coating   online / offline

Item	Qty	Source/ document
Capacity of offline coating plant, t/a		
Production of coated paper/board, t/a		
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

(iii)   Over-all Energy consumption in paper machine,stock preparation, chemical preparation and addition plant , finishing house and offline coating plant add (i+ii)

	Qty	Source/ document
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

B.5 The Information required is shown in the Flow Chart for Agro Based Pulp and Paper Mill

Figure 21: Ex- GtG boundary and metering details for Agro based Pulp and Paper Mill
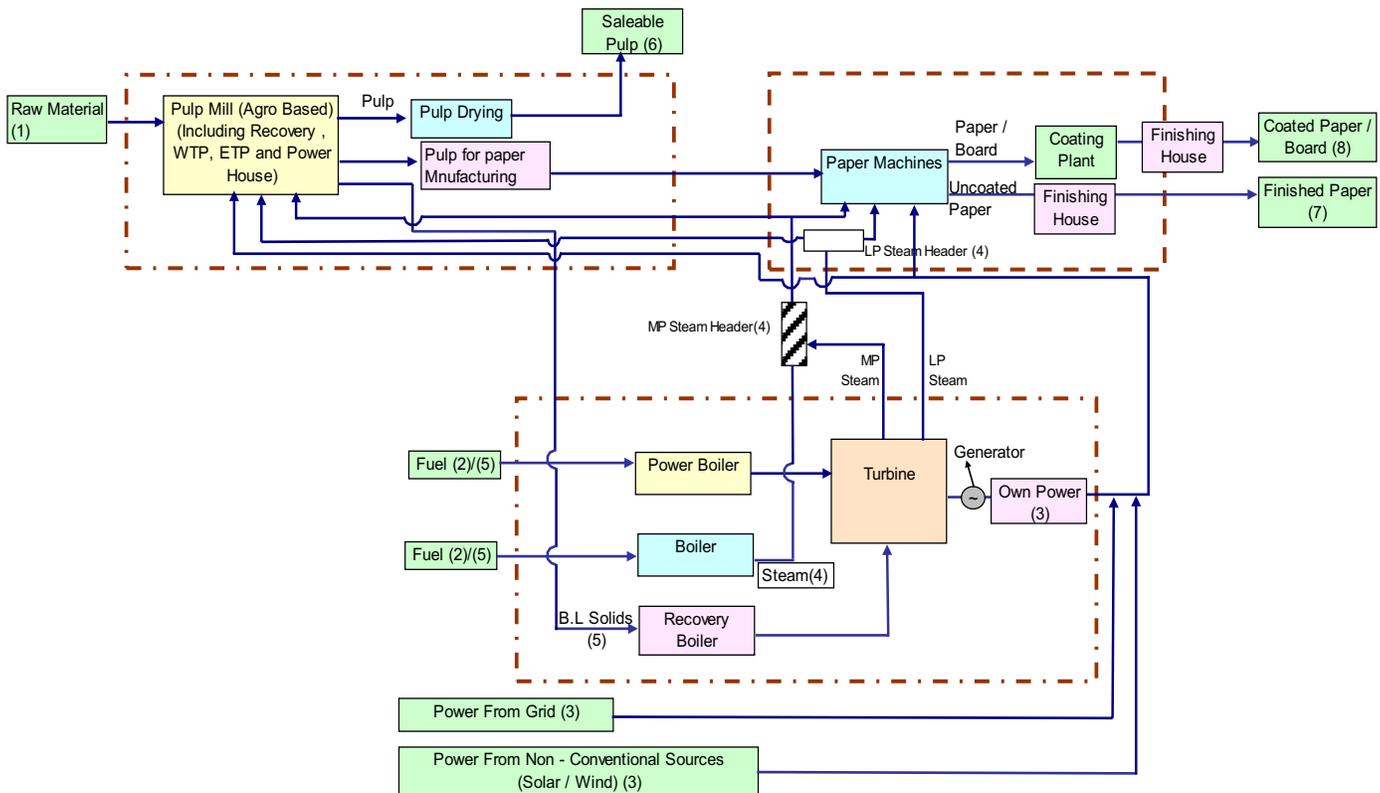
Table 28: Document required for Agro based Pulp and Paper Mills

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
1	Raw Materials	Lab Report	Report on moisture(%), Ash (%) and other analysis of the raw materials used by the mill
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of raw materials used by the mills.
		Purchase Document From Purchase Department	Purchase documents providing details of raw material purchased by the mill
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of raw materials used by the mills
		Raw Material Consumption Reports	Consumption reports giving details of raw material consumed by the mill. The report may be for raw material chip production, digester loading etc. from the concerned department.
			Frequency: Daily/ weekly/ monthly/ annual consumption documents may be produced for different types of raw materials used by the mill in chipper / digesters house..
		Annual Report	Annual report showing details of raw materials consumed on annual basis by the mill.
			Frequency: Annual consumption of raw materials by the mill.
2	Purchased Fuels	Fuel Purchase report / documents	Purchase documents providing details of fuel purchased by the mill.
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of fuels used by the mills.
		Lab report for GCV moisture and Ash	Lab report on GCV, moisture(%), Ash (%) and other analysis (proximate and ultimate) density etc, of the fuel used by mill.
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of fuels used by the mills.
		Fuel Consumption Report	Consumption reports giving details of fuel consumed by the mill in boilers, DG sets etc. The consumption report may be from the concerned department showing details of fuel consumption.
			Frequency: Daily/ weekly/ monthly/ annual fuel consumption documents may be produced for different types of fuels used by the mill in boiler/DG sets etc.
		Annual Report	Annual report showing details of fuels consumed on annual basis by the mill.
			Frequency: Annual consumption of fuels by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
3	Power	Electricity Purchased from Grid	Purchased electricity bill from state electricity board providing details of the electricity purchased by the mill. Frequency: monthly/ annual purchased electricity bills may be produced by the mills.
		Own power generation	Details of own power generation from different sources such as turbines(gas, steam etc), DG sets. Frequency: Daily/ weekly/ monthly/ annual own generation reports may be produced by the mills. These reports may be the log sheets/ production reports from power house.
		Production of power from Non Conventional sources, e.g. Solar / wind power	Details of power generation from different Non-conventional sources such as Solar / wind turbines, bio gas etc. Frequency: Daily/ weekly/ monthly/ annual Power generation reports may be produced by the mills. These reports may be the log sheets/ production reports from concerned power houses / departments
		Annual Report	Annual report showing details of Power purchased from grid, own power generation, power from non-conventional sources etc. Frequency: Annual report of power purchased , own generation, generation from non- conventional sources etc.by the mill.
4	Steam	Steam generation by the mill	Details of Steam generation from different boilers, extraction of steam from turbines, steam generation from waste heat recovery and non-conventional sources(Solar steam generators) Frequency: Daily/ weekly/ monthly/ annual steam generation reports may be produced by the mills. These reports may be the log sheets/ production reports for steam generation from boiler house etc.
		Steam consumption by the mill	Details of Steam consumption in different sections of the mill such as pulp mill, chemical recovery, paper machine, power house and other plants of the mill. Frequency: Daily/ weekly/ monthly/ annual steam consumption reports may be produced by the mills. These reports may be the log sheets/consumption reports for steam consumption by individual section of the mill or power boiler house.
		Annual Reports	Annual report showing details of Steam Generation and consumption from various sources. The generation and consumption of steam may be in individual departments as well as for the whole mill, boilers, extraction steam, steam from non-conventional sources etc. Frequency: Annual report of steam generation and consumption by the mill

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
5	Internally Generated Fuels (Black liquor solids, pith , chipper dust)	Generation report of Black liquor, pith, chipper dust, etc	Details of generation of black liquor , pith , chipper dust or any other combustible waste by the mill from different sections such as chipper house, pulp mill, other plants. Frequency: Daily/ weekly/ monthly/ annual Black liquor, dust etc generation reports may be produced by the mills. These reports may be the log sheets/ production reports for Black liquor and pith generation from boiler house etc.
		Lab reports for GCV, solids, moisture, ash etc.	Lab report on GCV, solids (%) moisture(%), Ash (%) and other analysis (proximate) of the Black liquor, pith, dust etc. used by the mill. Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of Black liquor, pith, dust etc. used by the mill.
		Annual Report	Annual report showing details of Black liquor generation, dust and pith generation, from various sources such as pulp mill, chippers, etc. Frequency: Annual report of Black liquor, pith and dust generation by the mill.
6	Saleable Pulp	Opening and closing stock of saleable pulp	Documents providing details of opening and closing of saleable pulp records by the mill. Frequency: Daily/ weekly/ monthly/ annual opening and closing records of the saleable pulp stock may be produced for different types of pulps produced by the mill.
		Saleable pulp production	Documents providing details of production of saleable pulp from different raw materials by the mill. Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of saleable pulp from different types of raw materials produced by the mill.
		Annual Report	Annual report showing details of saleable pulp production from different raw materials and its consumption etc. Also the annual stock closing and opening of the saleable pulp from annual report may be produced Frequency: Annual report of saleable pulp production, consumption and stock (opening/ closing) by the mill.
7	Uncoated paper / board, Newsprint , Specialty grade	Opening and closing stock reports	Documents/ records providing details of opening and closing of Uncoated paper / board, Newsprint , Specialty grade paper products by the mill. Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Uncoated paper / board, Newsprint , Specialty grade paper products, produced by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
		Paper production report / documents	Documents providing details of production of Uncoated paper/board, Newsprint, Specialty grade paper products, produced by the mill
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of Uncoated paper / board, Newsprint , Specialty grade paper products, produced by the mill.
		Annual Report	Annual report showing details of Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill.
			Also the annual stock closing and opening of the Uncoated paper/board, Newsprint, Specialty grade paper products, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Uncoated paper / board, Newsprint , Specialty grade paper products, produced and stock (opening/ closing) by the mill.
8	Coated Paper / board	Opening and closing stock reports	Documents/ records providing details of opening and closing of Coated Paper / board by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Coated Paper / board, produced by the mill.
		Paper production report / documents	Documents providing details of production of Coated Paper / board produced by the mill
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of Coated Paper / board produced by the mill.
		Annual Report	Annual report showing details of Coated Paper / board, produced by the mill.
			Also the annual stock closing and opening of the Coated Paper / board, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Coated Paper / board, produced and stock (opening/ closing) by the mill.

C. RCF Based Mills:-

a. The auditor may collect details required in M&V format) by mentioning the source and document from where data is collected. Subsequently the data may be verified from the, data provided by the DC in pro-froma for normalization.

b. The information required is shown in the flow chart for RCF based pulp and paper mill.

c. List of documents required for various monitoring and verification

Table 29: General details required in RCF based Pulp and Paper Mills

A.1 Material Details

Type of Waste Paper

Name of the raw material	Moisture, %	Quantity, t/a	Source/ document

A.2 RCF Pulp Mill (Including Pulper, Pulp Cleaning and Screening, Deinking, Bleaching, WTP, and ETP)

i) Pulper / Pulp Cleaning and Screening Process Used

No. of Unit	Capacity t/a	Production t/a	Source / Document
Pulper			
HD Cleaner			
Screening			
Cleaning and screening rejects, t/a			
No. of Deinking loops			

ii) Deinking / Bleach Process

Item	Qty.	Source / Document
Capacity, t/a		
Pulp yield, %		
Fibre Loss, %		
Ink removal Efficiency, %		
Bleaching Stages Yes/No		
Bleaching losses, t/a		

iii) Refining

Item	1	2	3	Source / Document
Type of Refiners				
No. of Refiners				
Initial Pulp Freeness oSR /CSF				
Final Freeness oSR /CSF				

iv) Energy Consumption in Pulp Mill

Item	Qty	Source / Document
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

v) Pulp Dryer

Sr No	Item	Unit	Qty	Source / Document
1	Capacity	Tonne/annum		
2	Production of salable pulp, t/a	Tonne/annum		
3	Energy Consumption in pulp dryer	kcal		
4	LP Steam Consumption	Tonne/annum		
5	MP Steam Consumption	Tonne/annum		
6	Power Consumption	kWh/annum		

vi) Over-all Energy consumption in pulp mill

Item	Qty	Source / Document
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

A.3 Paper Machine (including stock preparation, chemical preparation/addition plant, finishing house)

(i) Paper Machine Details

Number of Paper Machines

Item	PM-1	PM-2	PM-3	PM-4	PM-5	Source/ document
Type of paper machine						
Capacity, t/a						
Type of paper produced						
Production, t/a						
Annual weight average GSM						
Energy Consumption in paper machine (including Stock Preparation , chemical addition and finishing house)						
LP Steam consumption t/a						
MP Steam consumption, t/a						
Power consumption, kWh/a						

(ii) Coating / Value addition

Coating If any   Yes /No
Type of coating   online / offline

Item	Qty	Source/ document
Capacity of offline coating plant, t/a		
Production of coated paper/board, t/a		
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

(iii)   Over-all Energy consumption in paper machine,stock preparation, chemical preparation and addition plant, finishing house and offline coating plant add (i+ii)

	Qty	Source/ document
LP Steam consumption, t/a		
MP Steam consumption, t/a		
Power consumption, kWh/a		

A.4 The Information required is shown in the Flow Chart for RCF Based Pulp and Paper Mill
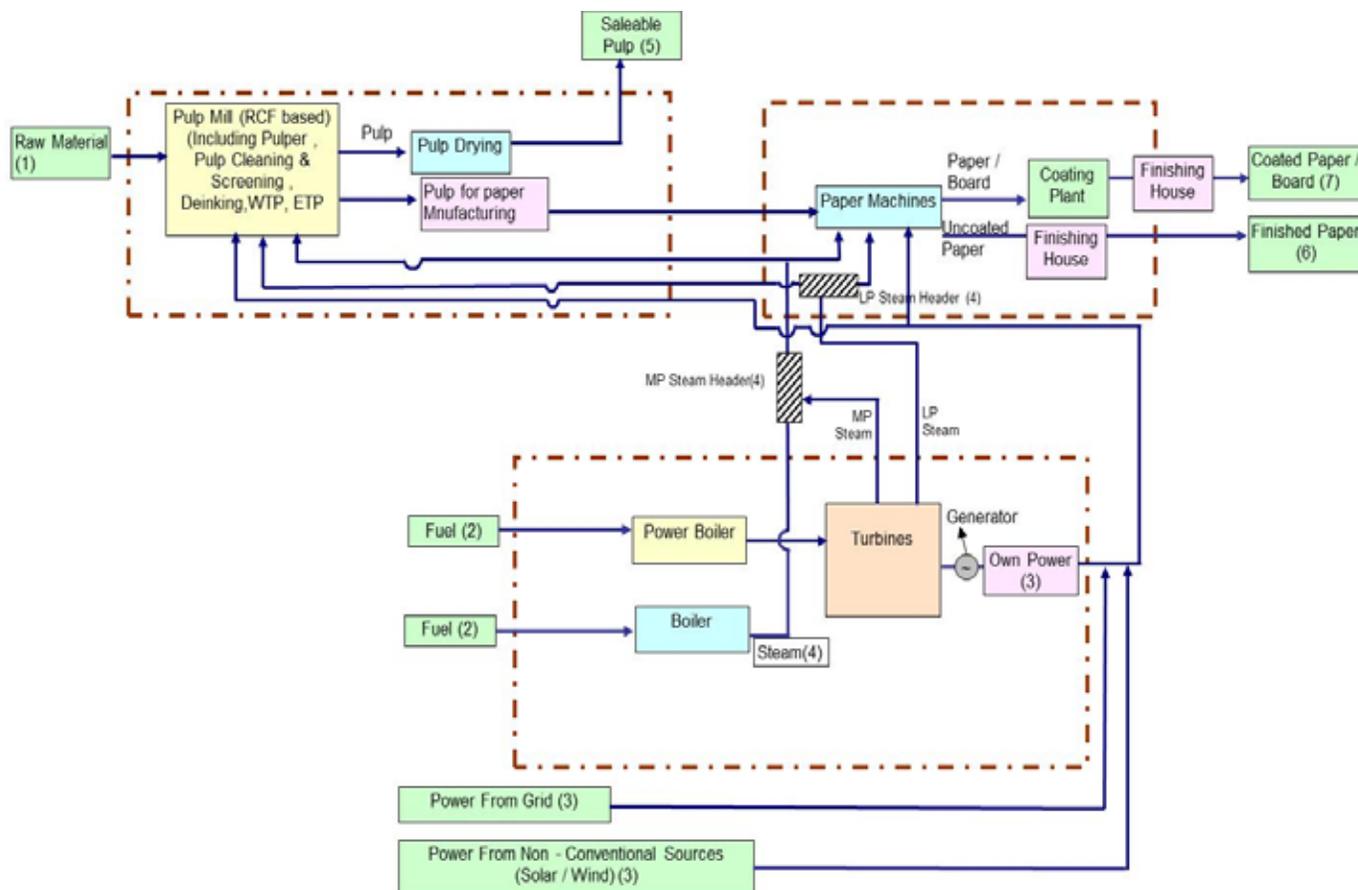
Table 30: Documents required in RCF based Pulp and Paper

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
1	Raw Materials	Lab Report	Report on moisture(%), Ash (%) and other analysis of the raw materials used by the mill
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of raw materials used by the mills.
		Purchase Document From Purchase Department	Purchase documents providing details of raw material purchased by the mill
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of raw materials used by the mills
		Raw Material Consumption Reports	Consumption reports giving details of raw material consumed by the mill. The report may be for raw material chip production, digester loading etc. from the concerned department.
			Frequency: Daily/ weekly/ monthly/ annual consumption documents may be produced for different types of raw materials used by the mill in chipper / digesters house..
		Annual Report	Annual report showing details of raw materials consumed on annual basis by the mill.
			Frequency: Annual consumption of raw materials by the mill.
2	Purchased Fuels	Fuel Purchase report / documents	Purchase documents providing details of fuel purchased by the mill.
			Frequency: Daily/ weekly/ monthly/ annual purchase documents may be produced for purchase of different types of fuels used by the mills.
		Lab report for GCV moisture and Ash	Lab report on GCV, moisture(%), Ash (%) and other analysis (proximate and ultimate) density etc, of the fuel used by mill.
			Frequency: Daily/ weekly/ monthly/ annual lab reports may be produced for different types of fuels used by the mills.
		Fuel Consumption Report	Consumption reports giving details of fuel consumed by the mill in boilers, DG sets etc. The consumption report may be from the concerned department showing details of fuel consumption.
			Frequency: Daily/ weekly/ monthly/ annual fuel consumption documents may be produced for different types of fuels used by the mill in boiler/DG sets etc.
		Annual Report	Annual report showing details of fuels consumed on annual basis by the mill.
			Frequency: Annual consumption of fuels by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
3	Power	Electricity Purchased from Grid	Purchased electricity bill from state electricity board providing details of the electricity purchased by the mill. Frequency: monthly/ annual purchased electricity bills may be produced by the mills.
		Own power generation	Details of own power generation from different sources such as turbines(gas, steam etc), DG sets. Frequency: Daily/ weekly/ monthly/ annual own generation reports may be produced by the mills. These reports may be the log sheets/ production reports from power house.
		Production of power from Non Conventional sources, e.g. Solar / wind power	Details of power generation from different Non-conventional sources such as Solar / wind turbines, bio gas etc. Frequency: Daily/ weekly/ monthly/ annual Power generation reports may be produced by the mills. These reports may be the log sheets/ production reports from concerned power houses / departments
		Annual Report	Annual report showing details of Power purchased from grid, own power generation, power from non-conventional sources etc. Frequency: Annual report of power purchased , own generation, generation from non- conventional sources etc.by the mill.
4	Steam	Steam generation by the mill	Details of Steam generation from different boilers, extraction of steam from turbines, steam generation from waste heat recovery and non-conventional sources(Solar steam generators) Frequency: Daily/ weekly/ monthly/ annual steam generation reports may be produced by the mills. These reports may be the log sheets/ production reports for steam generation from boiler house etc.
		Steam consumption by the mill	Details of Steam consumption in different sections of the mill such as pulp mill, chemical recovery , paper machine, power house and other plants of the mill. Frequency: Daily/ weekly/ monthly/ annual steam consumption reports may be produced by the mills. These reports may be the log sheets/ consumption reports for steam consumption by individual section of the mill or power boiler house.
		Annual Reports	Annual report showing details of Steam Generation and consumption from various sources. The generation and consumption of steam may be in individual departments as well as for the whole mill, boilers, extraction steam, steam from non-conventional sources etc. Frequency: Annual report of steam generation and consumption by the mill

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
5	Saleable Pulp	Opening and closing stock of saleable pulp	Documents providing details of opening and closing of saleable pulp records by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of the saleable pulp stock may be produced for different types of pulps produced by the mill.
		Saleable pulp production	Documents providing details of production of saleable pulp from different raw materials by the mill.
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of saleable pulp from different types of raw materials produced by the mill.
		Annual Report	Annual report showing details of saleable pulp production from different raw materials and its consumption etc. Also the annual stock closing and opening of the saleable pulp from annual report may be produced
			Frequency: Annual report of saleable pulp production, consumption and stock (opening/ closing) by the mill.
6	Uncoated paper / board, Newsprint, Specialty grade	Opening and closing stock reports	Documents/ records providing details of opening and closing of Uncoated paper / board, Newsprint , Specialty grade paper products by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill.
		Paper production report / documents	Documents providing details of production of Uncoated paper/board, Newsprint, Specialty grade paper products, produced by the mill
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of Uncoated paper / board, Newsprint , Specialty grade paper products, produced by the mill.
		Annual Report	Annual report showing details of Uncoated paper / board, Newsprint, Specialty grade paper products, produced by the mill.
			Also the annual stock closing and opening of the Uncoated paper / board, Newsprint , Specialty grade paper products, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Uncoated paper / board, Newsprint , Specialty grade paper products, produced and stock (opening/ closing) by the mill.

S.No.	Details of input and output	Source / Type of document required	Details of the Source / document and frequency
7	Coated Paper / board	Opening and closing stock reports	Documents/ records providing details of opening and closing of Coated Paper / board by the mill.
			Frequency: Daily/ weekly/ monthly/ annual opening and closing records of Coated Paper / board, produced by the mill.
		Paper production report / documents	Documents providing details of production of Coated Paper / board produced by the mill
			Frequency: Daily/ weekly/ monthly/ annual production records/ documents providing details of Coated Paper / board produced by the mill.
		Annual Report	Annual report showing details of Coated Paper / board, produced by the mill.
			Also the annual stock closing and opening of the Coated Paper / board, produced by the mill
			from annual report may be produced
			Frequency: Annual report of Coated Paper / board, produced and stock (opening/ closing) by the mill.

7.7. Annexure VII: Textile

1. Section wise Energy metering (Electrical and Thermal) is required for making Equivalent Product in Textile sub-sectors. Proper calculation document should be maintained, if energy figures are arrived by calculation method.

2. SCADA Screen shot is required for Major and Auxilliary systems.

3. Inclusions and Exclusion should be clearly marked in the Gate to Gate Boundary Diagram.

4. It is essential to express quantities of different product types in a single unit for calculation of specific energy consumption from Gram per Linear Meter (GLM) or Gram per Square Meter (GSM). DC to furnish back up calculation of conversion to EmAEA.

5. Mass balance is required to be furnished in the verification report.

6. EmAEA is advised to convert other special product or value added product in to the major equivalent product through Energy Consumption and the calculation is to be included in the verification report

7. Spinning Sub-Sector

   a. Count of Yarn is one of the important parameter. Change in the count of the yarn may result in the change in the UKG of the plant. So normalization for count of yarn is important. Hence, all the product needs to be converted to 40s count s per SITRA guidelines for UKG calculation at TFO - AutoConer output. The calculation for conversion shall be an integral part of the verification report.

   b. The open end yarn to be converted to 10s count for UKG calculation.

   c. Section wise energy consumption to be provided for backup calculation as per sample table. EmAEA is required to insert or delete the section as per the requirement

Table 31: Section wise Energy Consumption

Sr No	Item	Electrical SEC (kwh/kg)	Thermal SEC (kcal/kg)	Remarks
1	Blow Room			
2	Carding			
3	Combing			
4	Draw Frame			
5	Speed Frame			
6	Ring Frame			
7	Winding			
8	TFO			
9	AutoConer			
10	Doubling			
11	Singing and Sizing			
12	Humidification			
13	Lighting			
14	Utilities			
15	Misc Others			

d. The calculation used to convert other type of yarn (Like PV, Worsted etc) into the singular yarn in the baseline year will remain same in the assessment year. EmAEA is advised to use the same formulae as per Baseline Year Report.

e. All special product yarn (Melange/ Fibre dyed Yarns, High value blended yarns mixed with Wool, Silk, Modal, Nylon, etc ,Slub Yarns, Compact yarns, TFO doubled yarns, Jaspe yarns, Jaspe slub yarns, Nep effect yarns) needs to be converted in to single major product. The conversion formulae for baseline and assessment year will be same.

f. Production and capacity to be equated w.r.t. the Nos, speed, weight and running hours of Ring Frame and Autoconer.

g. Mention clear bifurcation of energy in Major Product (GtG boundary as per PAT) and other products as per Boundary Limit Example.
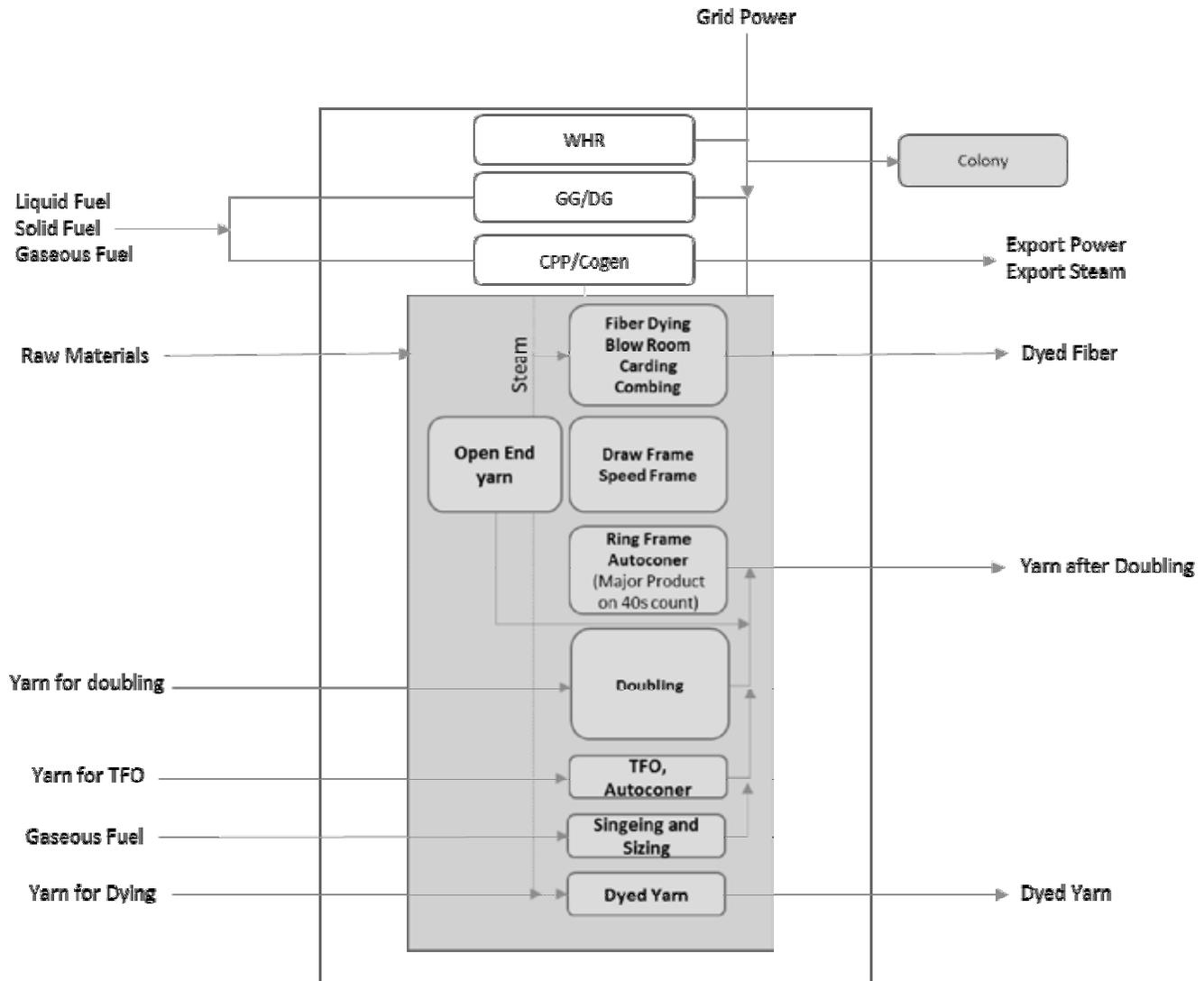
Figure 22: Ex- GtG boundary for Textile (Spinning sub sector)

8. Composite and Processing Sub sector

   a. There are five finished product defined in the Composite sub-group, all other special or value added product shall be converted into either of these five major products through energy consumption of making those special or value added product. The calculation of conversion is to be included in the verification report of EmAEA.

   The final five finished products in the Composite sub group are:

   i. Cotton

   ii. Polyster Cotton

   iii. Lycra

   iv. Non Cellulosic Product (100% Synthetic)

   v. Wool based product

   b. Picks as standard for taking production in case of Weaving. In case of weaving, in order to streamline products of all the DCs 60 PPI (Picks per Inch) as standard value and DCs should

convert their weaving production at different picks to production at 60 PPI. EmAEA to include the conversion calculation in the verification report.

c. Similarly for Knitting, conversion factors shall be in terms of Wales on weight basis.

d. Mass and Energy balance calculation is required to be included in the verification report by EmAEA

e. Steam balance diagram is required to be included in the verification report by EmAEA

f. Section wise Specific Energy Consumption is required to be specified as per table below

Table 32: Section wise Energy Consumption

Sr No	Item	Electrical SEC (kwh/kg)	Thermal SEC (kcal/kg)	Remarks
Spinning				
1	Blow Room			
2	Carding			
3	Combing			
4	Draw Frame			
5	Speed Frame			
6	Ring Frame			
7	Winding			
8	TFO			
9	AutoConer			
10	Doubling			
11	Singing and Sizing			
Knitting/Weaving				
1	Wraping			
2	Sizing			
3	Knotting			
4	Weaving			
Processing				
1	Singeing			
2	Desizing			
3	Mercerizing			
4	Bleaching			
5	Sueding			
6	Dying			
7	Printing			
Misc and Others				
1	Humidification			
2	Lighting			
3	Utilities			
4	Others			

EmAEA is required to add the section as per the requirement and need

g. Demarcation of plant boundary is required with clear understanding of raw material input, Energy input, Power Import/Export, Intermediary product Import/Export, Colony Power, Construction/Others Power, Power supplied to other Ancillary unit outside the plant boundary. A typical sample of Plant boundary condition is represented below
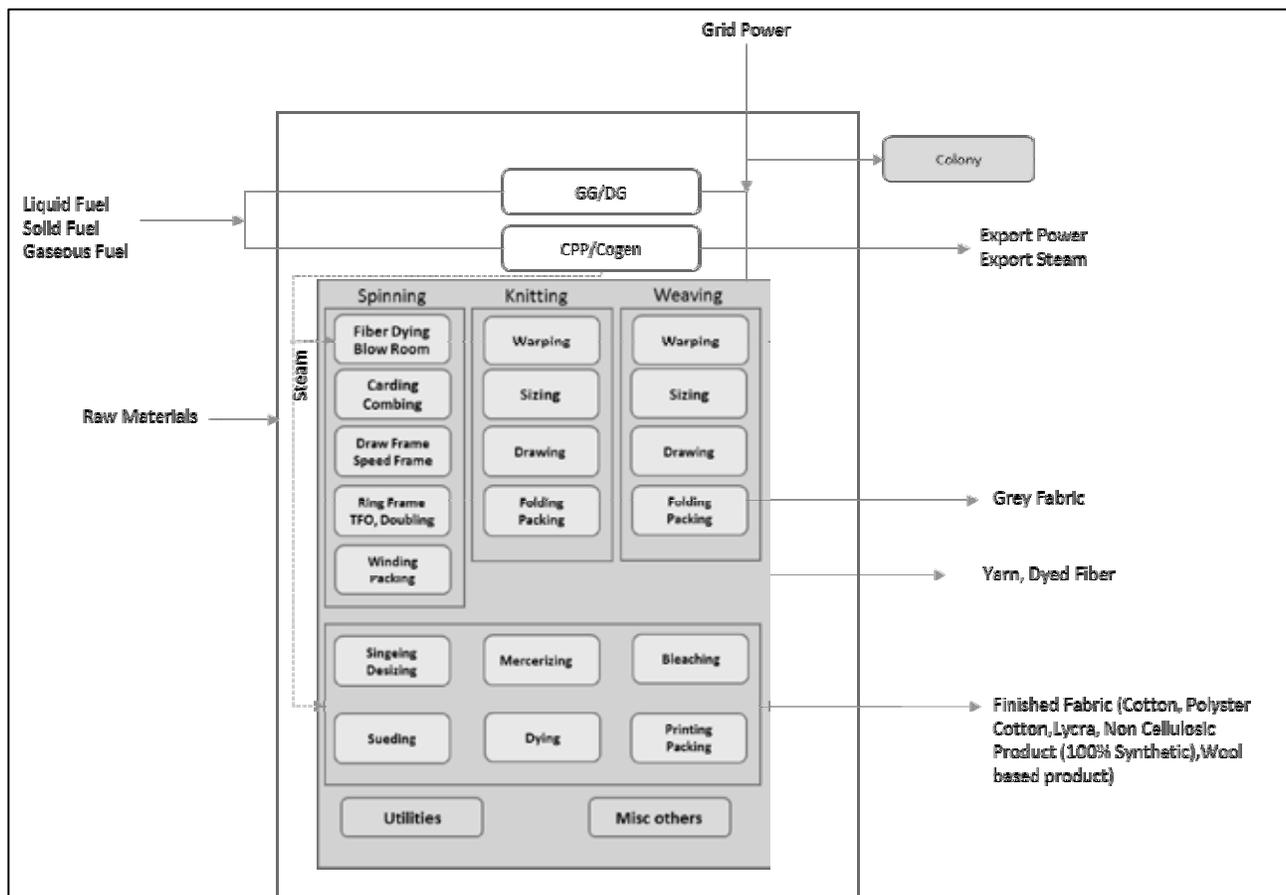

Figure 23: Ex- GtG boundary for Textile (Composite/ Processing sub sector)

9. Fiber Sub-Sector

a. Section wise production and Energy performance is required for each Fiber Product

b. The Products and sections are different in Fiber sub-sector, hence the Pro-forma of the subsector specify the major product and other Products from 1-5.

c. EmAEA to specify the product details with sectional Process Flow Diagram in the verification report.

d. Mass balance calculation w.r.t. input raw material and output product with conversion factor is required to be produced

e. Fuel used as raw material should not be considered from the input energy and reported in the verification report by EmAEA

f. DC has to submit weighted average denier value for their products. Plant has to submit production value in single denier by converting all the denier value

g. DCs have to convert all of their products in single major product equivalent by taking ratio of the SEC of the other products to the main product

h. EmAEA to include the details of major products and other products as mentioned in Pro-forma as per following table

Table 33: Product Name in Fiber Sun-sector

Sr No	Item	Name	Unit	Remarks
1	Raw Material			
2	Major Product			
3	Product 1			
4	Product 2			
5	Product 3			
6	Product 4			
7	Product 5			
8	Denier			

i. Steam Balance Diagram of the Plant from Steam generation to Steam consumption is required to be included in the verification report

j. Product wise, sectional (Sub Process) yearlyThermal and Electrical Energy details is required as per following sample table for Product 1

Table 34: Section wise Energy Consumption

Sr No	Item	Electrical SEC (kwh/kg)	Thermal SEC (kcal/kg)	Remarks
1	Polymerisation Process			
2	Spinning Process			
3	Draw line Process			
4	Utilities			
5	Misc Others			

k. Boundary Condition

Mention clear bifurcation of energy in Major Product (GtG boundary as per PAT) and other products as per Boundary Limit Example
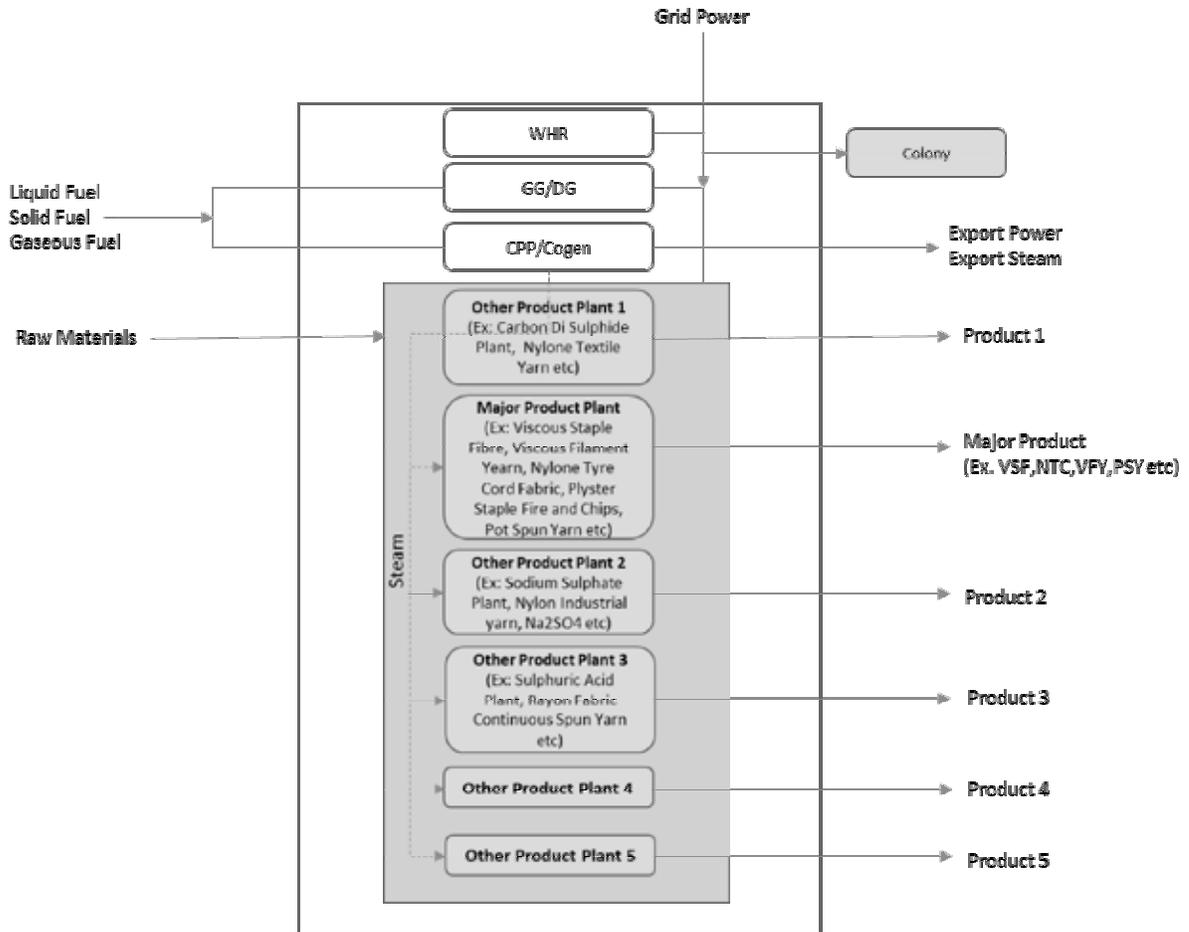
Figure 24: Ex- GtG boundary for Textile (Fiber) Sub- sector

7.8. Annexure VIII: Chlor Alkali

1. Section wise Details

   Section wise Specific Power consumption and Specific Thermal consumption shall be specified and provided to EmAEA as per following format. EmAEA can add section if required

Table 35: Section wise Energy details

| Sr No	Section	SPC kwh/tonne	SEC kcal/kg	Remarks
1	Primary Brine Plant.			
2	Secondary Brine Plant.			
3	Membrane Cell Plant.			
4	Chlorine / Hydrogen Treatment Plant			
5	HCl / Sodium Hypo Plants.			
6	Caustic Concentration and evaporation units.			
7	Utilities Plant.			
8	Waste Water Treatment Plant.			

2. Membrane Change verification: Details regarding membrane change for each cell shall be provided along with the membrane configuration

3. Maximum allowable capacity of chlorine storage in the DC shall be specified and provided to the EmAEA

4. Cathode- Anode coating verification: Details regarding Cathode- Anode coating shall be provided along with the membrane configuration

5. EmAEA shall ensure and verify production of Caustic Soda lye (49% concentration) and Hydrogen as per quantity of Chlorine produced during the electrolysis process. EmAEA shall also ensure that these productions should not exceed the stoichiometric limit

6. If a captive power plant or cogeneration plant caters to two or more DCs for the electricity and/or steam requirements. In such scenario, each DC shall consider such captive power plant or cogeneration plant in its boundary and energy consumed by such captive power plant or cogeneration plant shall be included in the total energy consumption. However, electricity in terms of calorific value (as per actual heat rate) and steam in terms of calorific value (as per steam enthalpy) exported to other plants shall be subtracted from the total energy consumption.

7. Boundary Condition

Mention clear bifurcation of energy in Caustic Soda plant (GtG boundary as per PAT) and other products as per Boundary Limit Example

Figure 25: Ex- GtG boundary for Chlor-Alkali sector
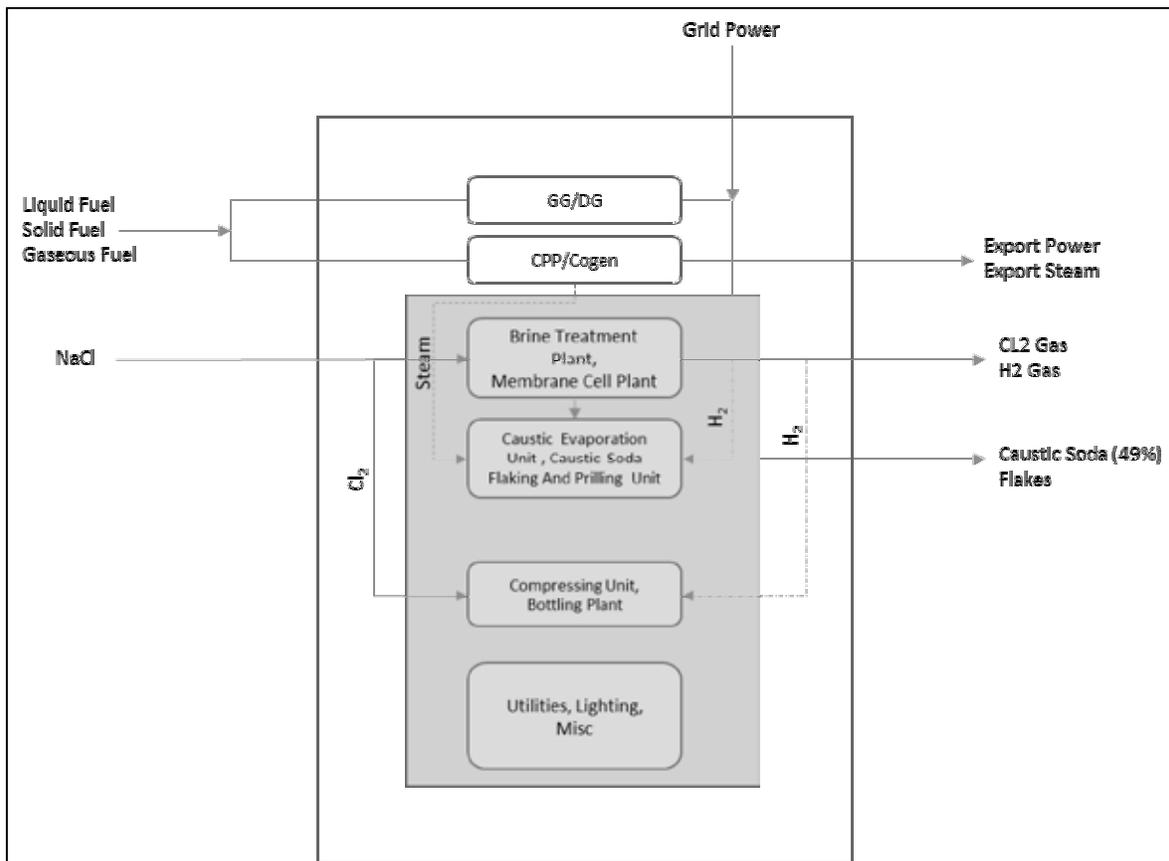
For all practical and legal purposes in connection with M&V guidelines, the English version of the notified PAT rules 2012 and EC Act 2001 will be considered as final.

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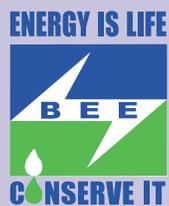
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