Specific Energy Consumption for Steam Generation Boiler 1-4 (BY) = (80.56 / 79.48) 
= 993.425 kcal/ kg of Steam

\[ \text{Difference Specific Steam from (BY) to (AY) (kcal/kg of Steam)} = (993.425 - 980.20) \]
\[ = 13.225 \text{ kcal/kg of Steam} \]

\[ \text{Notional energy to be subtracted w.r.t. Fuel Quality in Steam Generation Boiler (Million kcal)} = (13.225 * [(623682 * 0.561) + (74260 * 0.891)]) / 1000 \]
\[ = 5502.27 \text{ Million kcal} \]

### 4.3 Hydrogen Mix

#### Need for Normalisation

**Normalization for Hydrogen mix (consideration of reducing venting of Hydrogen)**

Normalization factor is developed to reduce wastage of hydrogen which can be further used as a fuel or in making of other products in the plant. But while using Hydrogen as fuel the SEC of the plant will increase so to nullify the effect so caused. The favor will be provided by reducing the extra energy used in fuel which may have vented. Here under are the examples to discussed for Hydrogen normalization:

Points should be noted that:

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Description</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Caustic Soda Lye Production</td>
<td>Ton</td>
<td>50000</td>
<td>60000</td>
</tr>
<tr>
<td>2</td>
<td>Stoichiometric Hydrogen Generation</td>
<td>Lakh NM3</td>
<td>140</td>
<td>168</td>
</tr>
<tr>
<td>3</td>
<td>Hydrogen Bottled (as product)</td>
<td>Lakh NM3</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>4</td>
<td>Hydrogen used as Fuel</td>
<td>Lakh NM3</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>Hydrogen used in other products (as product)</td>
<td>Lakh NM3</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>Hydrogen Vented</td>
<td>Lakh NM3</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>
Normalisation Calculation

1. The normalisation will trigger, if and only if, the percentage of Hydrogen vented in the assessment year is lesser than the minimum value of the percentage of Hydrogen vented in baseline year.

2. Total hydrogen generation will be calculated by considering the stoichiometric ratio of hydrogen generation @ 280 Lakh NM3 per tonne of Caustic Soda lye.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Description</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>% Hydrogen Vent</td>
<td>%</td>
<td>14.3</td>
<td>4.8</td>
</tr>
<tr>
<td>8</td>
<td>% Hydrogen Used as Fuel</td>
<td>%</td>
<td>14.3</td>
<td>29.8</td>
</tr>
<tr>
<td>9</td>
<td>% Hydrogen Used as Product + others</td>
<td>%</td>
<td>71.4</td>
<td>65.5</td>
</tr>
<tr>
<td>10</td>
<td>Difference of % Hydrogen Vent in AY wrt BY</td>
<td>%</td>
<td>-</td>
<td>9.5</td>
</tr>
<tr>
<td>11</td>
<td>Difference of % Hydrogen Used as fuel in AY wrt BY</td>
<td>%</td>
<td>-</td>
<td>-15.5</td>
</tr>
<tr>
<td>12</td>
<td>Difference of % Hydrogen Used in Product + other product</td>
<td>%</td>
<td>-</td>
<td>-6.0</td>
</tr>
<tr>
<td>14</td>
<td>Notional Energy to be subtracted</td>
<td>Million kCal</td>
<td>-</td>
<td>6608.33</td>
</tr>
</tbody>
</table>

Case-I: Considering venting reduces, consumption in fuel increases.

- **% Hydrogen vented (BY)**
  
  \[
  \text{HY} = \frac{\text{Hydrogen vented}}{\text{Stoichiometric Hydrogen Generated}} \\
  = \frac{20}{140} \\
  = 14.3 \%
  \]

- **% Hydrogen Used as Fuel (BY)**
  
  \[
  \text{HY} = \frac{\text{Hydrogen used for Fuel}}{\text{Stoichiometric Hydrogen Generated}} \\
  = \frac{20}{140} \\
  = 14.3 \%
  \]

Stoichiometric Hydrogen Generation (Lakhs NM3) (BY)

\[
\text{BY} = \frac{\text{Caustic Soda Production} \times 280}{10^5} \\
= \frac{50000 \times 280}{10^5} \\
= 140 \text{ Lakhs NM3}
\]

Stoichiometric Hydrogen Generation (Lakhs NM3) (AY)

\[
\text{AY} = \frac{\text{Caustic Soda Production} \times 280}{10^5} \\
= \frac{60000 \times 280}{10^5} \\
= 168 \text{ Lakhs NM3}
\]

- **% Hydrogen Used as Product + others (BY)**
  
  \[
  \text{HY} = \frac{\text{Hydrogen used for Product + others}}{\text{Stoichiometric Hydrogen Generated}} \\
  = \frac{(80+20)}{140} \\
  = 71.4 \%
  \]

- **% Hydrogen vented (AY)**
  
  \[
  \text{HY} = \frac{\text{Hydrogen vented}}{\text{Stoichiometric Hydrogen Generated}} \\
  = \frac{8}{140} \\
  = 4.8 \%
  \]
% Hydrogen Used as Fuel (AY) = Hydrogen used for Fuel / Stoichiometric Hydrogen Generated
= 50/140
= 29.8%

% Hydrogen Used as Product + others (AY) = Hydrogen used for Product + others / Stoichiometric Hydrogen Generated
= (85+25)/140
= 65.5%

As seen above % hydrogen vented in assessment year is less than % hydrogen vented in baseline year, it will trigger the following normalization formula.

Energy to be subtracted from total Energy Consumption (MkCal) (AY)
= [(% of Hydrogen vented (BY) - % of Hydrogen vented (AY)) - (% of Hydrogen used for production/others (BY) - (% of Hydrogen used for production/others (AY))] x Stoichiometric Hydrogen Generation (BY) x 3050/10
= {9.5 - (-6.0)}*140*3050 /10
= 6608.33 Mkcal

4.4. Low PLF in CPP

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

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

Normalization Methodology

The Heat Mass Balance Diagram (HMBD) of low capacity Power Plant in the range of 20-25 MW installed in Cement Sector have been analyzed at different load
The curve was put into the Ebsilon software and Plant model has been developed for nos of Power plants under study to verify the varying nature of Turbine Heat Rate w.r.t. Loading condition

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

Normalization Equation

Equation: % Increase in Heat Rate due to decrease in Loading =
=0.0016 x( %Loading)^2-0.3815 x %Loading +21.959

Normalization is required to compensate for the change in heat rate of CPP due to variation in PLF from the baseline.
The Thermal Energy reduction due to low PLF in CPP is calculated as below:

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

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

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

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

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

Where
AY: Assessment Year
BY= Baseline Year
\% \text{Loading}_{BY} = \text{Percentage Loading (PLF) in Baseline Year}
\% \text{Loading}_{AY} = \text{Percentage Loading (PLF) in Assessment Year}

Normalisation calculation

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Description</th>
<th>Unit</th>
<th>Baseline Year (BY)</th>
<th>Assessment Year (AY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Installed capacity</td>
<td>MW</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>Gross generation of CPP</td>
<td>Lakh kwh</td>
<td>3750</td>
<td>3600</td>
</tr>
<tr>
<td>3</td>
<td>Break down hrs due to internal, Planned and external factor</td>
<td>Hrs</td>
<td>1125</td>
<td>625</td>
</tr>
<tr>
<td>4</td>
<td>Plant low load hrs due to Internal Factors/ Breakdown in Plant</td>
<td>Hrs</td>
<td>700</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>Plant low load hrs due to External Factors like Fuel Unavailability/ Market demand/External Condition</td>
<td>Hrs</td>
<td>900</td>
<td>700</td>
</tr>
<tr>
<td>6</td>
<td>Plant Availability Factor (PAF)</td>
<td>Factor</td>
<td>0.87</td>
<td>0.93</td>
</tr>
<tr>
<td>7</td>
<td>Plant Load Factor (PLF)</td>
<td>%</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>8</td>
<td>% of loss due to external Factors</td>
<td>%</td>
<td>56.25</td>
<td>70</td>
</tr>
</tbody>
</table>

There are five nos of STG from STG1 to STG 5 are considered in the Form I and consolidated input is taken for PLF calculation. The calculation STG 1-5 was done on weighted basis w.r.t the CPP gross unit generation. Increased no of STG will be filled in the separate Excel Sheet as per format provided for STG data filling in Form I.

Calculation of PAF, PLF and % of loss due to External factor

- **Plant Availability Factor (PAF) in Base line year**
  
  \(=\) (Total Available hours in a year in BY-
Internal Planned Shutdown, Breakdown/Outages hrs in BY-External Planned Shutdown, Breakdown/Outages hrs in BY)/ Total Available hours in a year in BY
=(8760-1125)/8760
=0.87

- **Plant Availability Factor (PAF) in Assessment year**
  =(Total Available hours in a year in AY-Internal Planned Shutdown, Breakdown/Outages hrs in AY-External Planned Shutdown, Breakdown/Outages hrs in AY)/ Total Available hours in a year in AY
  =(8760-625)/8760
  =0.93

- **Plant Load Factor (PLF) in Baseline Year**
  =(Gross Generation in Lakh kwh in BY)/(Installed capacity in MW in BY x Total available hours in a year in BY x PAF in BY)
  =(3750 x 10^5 x100/70 x10^3 x 8760 x0.87)
  =70.2%

- **% loss of PLF due to external factor in Baseline Year**
  =(( Plant low load hrs due to External Factors in BY)/( Plant low load hrs due to External Factors in BY + Plant low load hrs due to Internal Factors/ Breakdown in Plant in BY)
  =(900 x 100/700+900)
  =56.25%

- **% loss of PLF due to external factor in Assessment Year**
  =(( Plant low load hrs due to External Factors in AY)/( Plant low load hrs due to External Factors in AY + Plant low load hrs due to Internal Factors/ Breakdown in Plant in AY)
  =(700 x 100/300+700)
  =70%

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Description</th>
<th>Unit</th>
<th>Baseline Year (BY)</th>
<th>Assessment Year (AY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gross generation of CPPs</td>
<td>Lakh kWh</td>
<td>3750</td>
<td>3600</td>
</tr>
<tr>
<td>2</td>
<td>Actual Gross Heat Rate</td>
<td>Kcal/kWh</td>
<td>2600</td>
<td>2800</td>
</tr>
<tr>
<td>3</td>
<td>Plant Load Factor</td>
<td>%</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>% of loss due to external Factors</td>
<td>%</td>
<td>56.25</td>
<td>70</td>
</tr>
</tbody>
</table>

- **Percentage increase in the Heat Rate from Design Heat Rate in Baseline Year**
  = 0.0016 x ( % PLF)^2 - 0.3815 x ( % PLF) +21.959
  = (0.0016 x (70)^2) – (0.3815 x 70) +21.959
  =3.094%

- **Percentage increase in the Heat Rate from Design Heat Rate in Assessment Year**
  = 0.0016 x ( % PLF)^2 - 0.3815 x ( % PLF) +21.959
  = (0.0016 x (63)^2) – (0.3815 x 63) +21.959
  =4.275%
- Difference of % increase in Heat Rate of Assessment Year and Baseline Year
  \[= \% \text{ increase in Heat Rate of Assessment Year} - \% \text{ increase in Heat Rate of Baseline Year}\]
  \[= 4.275 - 3.094 = 1.181 \%\]

- % loss in PLF from Assessment Year due to external factor is 70 %

- Percentage increase in Heat Rate from Design Heat Rate in Assessment Year due to external factor
  \[= 1.181 \times \left( \frac{70}{100} \right) = 0.8267 \%\]

- The Normalized Gross Heat of Assessment Year
  \[= \text{Actual Gross Heat Rate} \times \left(1 - \frac{0.0.8267\%}{100}\right)\]
  \[= 2776.8 \text{kcal/kWh}\]

- Total notional energy subtracted from the total energy due to loss of PLF
  \[= \text{Gross generation of CPP X (Actual gross Heat Rate} - \text{Normalized gross Heat Rate})/10\]
  \[= 3600 \times (2800 - 2776.8)/10\]
  \[= 8352 \text{ Million kcal}\]

### Table: Calculation for PLF Normalization

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year (BY)</th>
<th>Assessment Year (AY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loading</td>
<td>%</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>2</td>
<td>Actual Gross Heat Rate</td>
<td>kcal/kwh</td>
<td>2600</td>
<td>2800</td>
</tr>
<tr>
<td>3</td>
<td>% Increase in Heat rate from Design Heat Rate</td>
<td>%</td>
<td>3.094 (=0.0016 x (70) ^ 2-0.3815 x 70 +21.959)</td>
<td>4.2749 (=0.0016 x (63)^2-0.3815 x 63 +21.959)</td>
</tr>
<tr>
<td>4</td>
<td>Difference</td>
<td>%</td>
<td>1.1809 (=4.2749-3.094)</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>Loss in loading due to external factor</td>
<td>%</td>
<td></td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>% Decrease from baseline</td>
<td>%</td>
<td>0.8267 (=1.1809*70/100)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Normalised Gross Heat Rate</td>
<td>kcal/kwh</td>
<td></td>
<td>2776.8 (=2800*(1-0.8287/100))</td>
</tr>
<tr>
<td>8</td>
<td>Gross generation</td>
<td>Lakh kWh</td>
<td></td>
<td>3600</td>
</tr>
<tr>
<td>9</td>
<td>Energy to be subtracted</td>
<td>Million kcal</td>
<td></td>
<td>8352 (=3600*(2800-2776.8)/10)</td>
</tr>
</tbody>
</table>
4.5. Normalization Others

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

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.

Normalization 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 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 normalized for additional Energy consumption details from Energy meters. This is to be excluded from the input energy.

Normalization Formula

1. **Installation due to Environmental concern:**
   
   Additional Electrical & Thermal Energy Consumed due to Environmental Concern \( (\text{Million kcal}) \) =
   
   \((\text{Additional Electrical Energy Consumed (Lakh kWh)} \times \text{Weighted Average heat rate in AY/10}) + \text{Additional Thermal Energy Consumed}\)

2. **Biomass replacement with Fossil fuel due to un-availability:**

   \( (\text{Million kcal}) = \frac{\text{Biomass replacement with Fossil fuel due to Biomass un-availability (used in the process)} \times \text{Biomass Gross Calorific Value}}{10^3} \)
### Documentation

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Sub-Group</th>
<th>Elements</th>
<th>Reason/ Requirement</th>
<th>Impact</th>
<th>Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Additional Equipment Installation due to Environmental law</td>
<td>Auxiliary Power Consumption</td>
<td>The Energy will be normalized for additional Energy consumption. This is to be excluded from APC</td>
<td>APC</td>
<td>The DC has to maintain the documents for additional installation of Environmental Equipment</td>
</tr>
<tr>
<td>5</td>
<td>Flood, Earthquake etc</td>
<td>Proper weightage could be given in SEC in terms of capacity utilization, energy used for re-establishment</td>
<td>Plant Load Factor</td>
<td></td>
<td>The DC has to maintain the authentic documents for natural disaster</td>
</tr>
</tbody>
</table>

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

**Fuel replacements (Unavailability of Bio-mass/ Alternate Fuel w.r.t baseline year)**

**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 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.

**Normalization Methodology**

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

**Normalization Formula**

\[
\text{Alternate Solid Fuel replacement with Fossil fuel due to un-availability (Million kcal)} = \text{Alternate Solid Fuel replacement with Fossil fuel due to Alternate Solid Fuel un-availability (used in the process) (in Tonne)} \times \text{Solid Alternate Fuel Gross Calorific Value} / 10^3
\]
2. \[ \text{Alternate Liquid Fuel replacement with Fossil fuel due to un-availability (Million kcal)} = \] 
\[ \text{Alternate Liquid Fuel replacement with Fossil fuel due to Alternate Liquid Fuel un-availability (used in the process) (in Tonne) x Liquid Alternate Fuel Gross Calorific Value /10^3} \]

**Documents**

- Test Certificate of Bio-mass from Government Accredited Lab for GCV in Baseline and assessment year.
- Test Certificate of replaced Fossil Fuel GCV.

**Construction Phase or Project Activity Phase**

**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.

**Normalization 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.

**Normalization Formula**

1. \[ \text{Additional Electrical & Thermal Energy Consumed due to commissioning of Equipment (Construction Phase) (Million kcal)} = \] 
\[ \text{(Electrical Energy Consumed due to commissioning of Equipment x Weighted Average Heat rate in AY/10)} \] 
\[ + \text{Thermal Energy Consumed due to commissioning of Equipment} \]

**Documents**

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

**Addition of New Line/Unit**

**Need for Normalization**

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

- In case a DC commissions a new line/production unit before or during the assessment/target year, the production and energy consumption of new unit will be considered in the total plant energy consumption and production volumes once the Capacity Utilization 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 Utilization. Energy consumed and production made (if any) during any project activity...
during the assessment year, needs to be exclusively monitored and will be subtracted from the total energy and production in the Assessment year. Similarly, the same methodology is applied on a new unit installation for power generation (CPP) within the plant boundary.

**Normalization 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 Utilization will have to be monitored
- The Production/generation and energy consumed will be deducted from the total energy of the assessment year

**Normalization Formula**

1. **Electrical & Thermal Energy Consumed due to commissioning of New process Line/Unit till it attains 70% of Capacity Utilization (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/10) + Thermal Energy Consumed due to commissioning of New Process Line/Unit till it attains 70% of Capacity Utilization in Power generation

2. **Electrical & Thermal Energy Consumed from external source due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation (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/10) + Thermal Energy Consumed due to commissioning of New Line/Unit till it attains 70% of Capacity Utilization in Power generation

3. **Energy to be added for Power generation of a line/unit till it attains 70% of Capacity Utilization (Million kcal)** = (Net Electricity Generation till new line/unit attains 70% Capacity Utilization (Lakh kWh) x Generation Net Heat Rate in AY/10)

4. **Energy to be added for Steam generation of a line/unit till it attains 70% of Capacity Utilization (Million kcal)** = (Steam Generation from Co-Gen till new line/Unit attains 70% of Capacity Utilization (Lakh kWh) x Steam Specific Energy Consumption in AY/1000)

**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 April 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

Unforeseen Circumstances

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.

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

Normalization Formula

\[ \text{Electrical & Thermal Energy to be Normalized (Million kcal)} = (\text{Electrical Energy to be Normalized in AY} \times \text{Weighted Average Heat rate in AY}/10) + \text{Thermal Energy to be Normalized} \]

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.

Thermal Energy used in Waste heat recovery

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.

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, as the case may be.

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.

**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.

**Normalization Formula**

1. Additional Saving achieved (After PAT obligation) \( \text{(TOE/Ton)} \) = Target Saving Achieved in AY \( \text{(TOE/Ton)} \) - Target Saving to be achieved (PAT obligation) in BY \( \text{(TOE/Ton)} \)

2. Additional Saving achieved (After PAT obligation) \( \text{(TOE)} \) = Target Saving Achieved in AY \( \text{(TOE)} \) - Target Saving to be achieved (PAT obligation) in BY \( \text{(TOE)} \)

3. Thermal energy conversion for REC and Preferential tariff \( \text{(TOE)} \) = If Steam Turbine Net Heat Rate in AY =0, then Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar & Non-Solar) \( \text{(MWh)} \) + Quantum of Energy sold under preferential tariff \( \text{(MWh)} \) x 2.717, otherwise Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar & Non-Solar) \( \text{(MWh)} \) + Quantum of Energy sold under preferential tariff \( \text{(MWh)} \) x Generation Net Heat Rate in AY/ \( 10^4 \)

4. Thermal Energy to be normalized for REC and preferential tariff power sell under REC mechanism \( \text{(TOE)} \) = If 14.6.1 <= 0 then 0, Else if, Thermal energy conversion for REC and Preferential tariff \( \text{(TOE)} \) is greater than Additional Saving achieved (After PAT obligation) \( \text{(TOE)} \) than Additional Saving achieved (After PAT obligation) \( \text{(TOE)} \) else Thermal energy conversion for REC and Preferential tariff \( \text{(TOE)} \)

**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

**Total Normalized energy consumption of the DC \( (E) \text{ (TOE)} \)**

Total normalized energy consumption of the DC \( (E) \text{ (TOE)} \) = [(Total Electricity purchased from Grid \( \text{(Lakh kWh)} \) x 860/10) + (Fuel Consumed \( \text{(Tonne)} \) X GCV of Fuel \( \text{(Kcal/Kg)} \) X 1000) – (Electricity Exported to Grid/Others \( \text{(Million kWh)} \) x 2717) + Notional Energy

4.5.1. Environmental concern Calculation

Table: Additional Electrical Energy requirement for Environmental Equipment

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Date of Installation</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eqp 1</td>
<td>15-May-14</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Eqp 2</td>
<td>05-Oct-14</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Eqp 3</td>
<td>10-Nov-14</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Energy Consumed</td>
<td></td>
<td>Lakh Unit</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>5</td>
<td>Weighted Heat Rate</td>
<td></td>
<td>kcal/kwh</td>
<td>3200</td>
<td>3100</td>
</tr>
</tbody>
</table>

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

= 35 x 3100 / 10

= 10850 million kcal

Table: Additional Thermal Energy requirement for Environmental Equipment

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Date of Installation</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eqp 4</td>
<td>15-Apr-14</td>
<td>Million kcal</td>
<td>NA</td>
<td>1200</td>
</tr>
<tr>
<td>2</td>
<td>Eqp 5</td>
<td>12-Sep-14</td>
<td>Million kcal</td>
<td>NA</td>
<td>5000</td>
</tr>
<tr>
<td>3</td>
<td>Eqp 6</td>
<td>15-Jan-15</td>
<td>Million kcal</td>
<td>NA</td>
<td>3500</td>
</tr>
<tr>
<td>4</td>
<td>Energy Consumed</td>
<td></td>
<td>Million kcal</td>
<td></td>
<td>9700</td>
</tr>
</tbody>
</table>

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
4.5.2. Biomass /Alternate Fuel Unavailability w.r.t. Baseline year (Replacement due to external factor)

Table: Fossil Fuel Replacement

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biomass replacement with Fossil fuel due to Biomass unavailability (used in the process)</td>
<td>Tonnes</td>
<td>NA</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Alternate Solid Fuel replacement with Fossil fuel due to Alternate Solid Fuel un-availability (used in the process)</td>
<td>Tonnes</td>
<td>NA</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Alternate Liquid Fuel replacement with Fossil fuel due to Alternate Liquid Fuel un-availability (used in the process)</td>
<td>Tonnes</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Biomass Goss Calorific Value</td>
<td>kcal/kg</td>
<td></td>
<td>2100</td>
</tr>
<tr>
<td>5</td>
<td>Alternate Solid Fuel Goss Calorific Value</td>
<td>kcal/kg</td>
<td></td>
<td>2800</td>
</tr>
<tr>
<td>6</td>
<td>Alternate Liquid Fuel Goss Calorific Value</td>
<td>kcal/kg</td>
<td></td>
<td>6000</td>
</tr>
</tbody>
</table>

- **Thermal Energy used due to Biomass replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**
  - $\text{Thermal Energy} = \text{Biomass replacement with Fossil fuel due to Biomass unavailability (used in the process)} \times \text{Biomass Gross Heat Rate (kcal/kg)/10^3}$
  - $=20 \times 2100/1000$
  - $=42 \text{ Million kcal}$

- **Thermal Energy used due to Alternate Solid Fuel replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**
  - $\text{Thermal Energy} = \text{Alternate Solid Fuel replacement with Fossil fuel due to Biomass un-availability (used in the process)} \times \text{Alternate Solid Fuel Gross Heat Rate (kcal/kg)/10^3}$
  - $=15 \times 2800/1000$
  - $=42 \text{ Million kcal}$

- **Thermal Energy used due to Alternate Liquid Fuel replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**
  - $\text{Thermal Energy} = \text{Alternate Liquid Fuel replacement with Fossil fuel due to Biomass un-availability (used in the process)} \times \text{Alternate Liquid Fuel Gross Heat Rate (kcal/kg)/10^3}$
  - $=5 \times 6000/1000$
  - $=30 \text{ Million kcal}$

- **Total Thermal Energy to be deducted for Biomass/ Alternate Solid or Liquid Fuel replacement by Fossil Fuel in the assessment year due to unavailability (Replacement due to external factor)**
  - $\text{Total Thermal Energy} = 42 + 42 + 30 \text{ Million kcal}$
  - $=114 \text{ Million kcal}$
4.5.3. Construction Phase or Project Activities

Table: Additional Electrical Energy requirement during Construction Phase or Project Activities

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Date of Installation</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eqp No 7</td>
<td>5-May-14</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Eqp No 8</td>
<td>18-Aug-14</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Eqp No 9</td>
<td>10-Feb-15</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Energy Consumed</td>
<td></td>
<td>Lakh Unit</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Weighted Heat Rate</td>
<td></td>
<td>kcal/kwh</td>
<td>3200</td>
<td>3100</td>
</tr>
</tbody>
</table>

- **Additional Electrical Energy Consumed during Construction Phase or Project Activities**
  - Construction Phase or Project Activities in Lakh kWh x Weighted Heat Rate of the Power Sources in kcal/kWh/10
  - $=8 \times 3100/10$
  - $=2480$ Million kcal

Table: Additional Thermal Energy requirement during Construction Phase or Project Activities

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Date of Installation</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eqp No 10</td>
<td>15-June-14</td>
<td>Million kcal</td>
<td>NA</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>Eqp No 11</td>
<td>12-Oct-14</td>
<td>Million kcal</td>
<td>NA</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>Eqp No 12</td>
<td>15-Jan-15</td>
<td>Million kcal</td>
<td>NA</td>
<td>900</td>
</tr>
<tr>
<td>4</td>
<td>Energy Consumed</td>
<td></td>
<td>Million kcal</td>
<td></td>
<td>3200</td>
</tr>
</tbody>
</table>

- **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
4.5.4. 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

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrical Energy Consumed due to commissioning of New process Line/Unit till it attains 70% of Capacity Utilisation</td>
<td>Lakh kWh</td>
<td>NA</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Thermal Energy Consumed due to commissioning of New Process Line/Unit till it attains 70% of Capacity Utilisation</td>
<td>Million kcal</td>
<td>NA</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>Caustic Soda Lye Production till new line attains 70% of Capacity utilisation</td>
<td>Tonnes</td>
<td>NA</td>
<td>15000</td>
</tr>
<tr>
<td>4</td>
<td>Caustic Soda Flakes Production till new line attains 70% of Capacity utilisation</td>
<td>Tonnes</td>
<td>NA</td>
<td>5000</td>
</tr>
<tr>
<td>5</td>
<td>Date of Commissioning (70% Capacity Utilisation)</td>
<td>Date</td>
<td></td>
<td>16-Aug-14</td>
</tr>
<tr>
<td>6</td>
<td>Weighted Heat Rate</td>
<td>kcal/kwh</td>
<td>3200</td>
<td>3100</td>
</tr>
</tbody>
</table>

- **Electrical Energy Consumed due to commissioning of new line**
  \[
  \text{Electrical Energy Consumed due to commissioning of new line} = \text{Total Electrical Energy Consumed Lakh kWh} \times \text{Weighted Heat Rate of the Power Sources in kcal/kWh/10}
  \]
  \[
  = 50 \times 3100/10 \\
  = 15500 \text{ Million kcal}
  \]

- **Thermal Energy Consumed due to commissioning of new line**
  \[
  \text{Thermal Energy Consumed due to commissioning of new line} = \text{Total Thermal Energy Consumed due to commissioning of new line}
  \]
  \[
  = 1400 \text{ Million kcal}
  \]

- **Total Energy to be deducted in the assessment year for Electrical and Thermal Energy consumed due to commissioning of new line in Process**
  \[
  \text{Total Energy to be deducted in the assessment year for Electrical and Thermal Energy consumed due to commissioning of new line in Process} = \text{Electrical Energy Consumed due to commissioning of new line} + \text{Thermal Energy Consumed due to commissioning of new line}
  \]
  \[
  = 15500 \text{ Million kcal} + 1400 \text{ Million kcal}
  \]
  \[
  = 16900 \text{ Million kcal}
  \]

Caustic Soda Lye Produced (15000 Tonnes) & Caustic Soda Flakes Produced (5000 Tonnes) till new line attains 70% of capacity utilization will be subtracted from the total Caustic Soda Lye production & Caustic Soda Flakes Produced respectively and the total energy consumption for producing these particular amount of product will also be subtracted.
**Table: Energy consumption due to commissioning of new line up to 70% Capacity Utilisation in Power Generation**

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrical Energy Consumed from external source due to commissioning of New Line/Unit till it attains 70% of Capacity Utilisation in Power generation</td>
<td>Lakh kWh</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Thermal Energy Consumed due to commissioning of New Line/Unit till it attains 70% of Capacity Utilisation in Power generation</td>
<td>Million kcal</td>
<td>NA</td>
<td>15000</td>
</tr>
<tr>
<td>3</td>
<td>Net Electricity Generation till new Line/Unit attains 70% Capacity Utilisation</td>
<td>Lakh kWh</td>
<td>NA</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Date of Commissioning (70% Capacity Utilisation) Power Generation</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Weighted Heat Rate</td>
<td>Kcal/kWh</td>
<td>3200</td>
<td>3100</td>
</tr>
</tbody>
</table>

- **Electrical Energy Consumed due to commissioning of new unit from external source**
  
  \[ \text{Total Electrical Energy Consumed Lakh kWh} \times \text{Weighted Heat Rate of the Power Sources in kcal/kWh/10} \]
  
  \[ = 5 \times 3100/10 \]
  
  \[ = 1550 \text{ Million kcal} \]

- **Thermal Energy Consumed due to commissioning of new unit (for generation at higher heat rate of electricity)**
  
  \[ \text{Total Thermal Energy Consumed due to commissioning of new unit} \]
  
  \[ = 15000 \text{ Million kcal} \]

- **Total Energy to be deducted in the assessment year for Electrical and Thermal Energy consumed due to commissioning of new line in Process**
  
  \[ \text{Electrical Energy Consumed due to commissioning of new line} + \text{Thermal Energy Consumed due to commissioning of new line} \]
  
  \[ = 1550 \text{ Million kcal} + 15000 \text{ Million kcal} \]
  
  \[ = 16550 \text{ Million kcal} \]

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**
  
  \[ \text{Total Electrical generated by new unit till it attain 70 of CU in Lakh kWh} \times \text{Weighted Heat Rate of the Power Sources in kcal/kWh/10} \]
  
  \[ = 40 \times 3100/10 \]
  
  \[ = 12400 \text{ Million kcal} \]

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.
4.5.5. Unforeseen Circumstances (External Factor)

Table: Additional Electrical Energy requirement due to Unforeseen Circumstances (External Factor)

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Condition 1</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Condition 2</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Condition 3</td>
<td>Lakh Unit</td>
<td>NA</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Energy Consumed</td>
<td>Lakh Unit</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Weighted Heat Rate</td>
<td>kcal/kwh</td>
<td>3200</td>
<td>3100</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Item</th>
<th>Unit</th>
<th>Baseline Year</th>
<th>Assessment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Condition 1</td>
<td>Million kcal</td>
<td>NA</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>Condition 4</td>
<td>Million kcal</td>
<td>NA</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>Condition 5</td>
<td>Million kcal</td>
<td>NA</td>
<td>3000</td>
</tr>
<tr>
<td>4</td>
<td>Energy Consumed</td>
<td>Million kcal</td>
<td></td>
<td>5800</td>
</tr>
</tbody>
</table>

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
4.5.6. 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

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis/Calculations</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steam Turbine Net Heat Rate</td>
<td>Form I</td>
<td>kcal/kwh</td>
<td>3900</td>
<td>3800</td>
</tr>
<tr>
<td>2</td>
<td>Quantum of Renewable Energy Certificates (REC) obtained as a Renewal Energy Generator (Solar &amp; Non-Solar)</td>
<td>Annual</td>
<td>MWh</td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>Quantum of Energy sold under preferential tariff</td>
<td>Annual</td>
<td>MWh</td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>4</td>
<td>Saving Target in TOE/ton of product as per PAT scheme Notification</td>
<td>Toe/Tonne</td>
<td></td>
<td>0.040</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Equivalent Major Product Output in Tons as per PAT scheme Notification</td>
<td></td>
<td>Tons</td>
<td>50000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Baseline Specific Energy Consumption as Per PAT Notification</td>
<td></td>
<td>Toe/Tonne</td>
<td>0.861</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>SEC Target to be achieved</td>
<td>0.861-0.040</td>
<td>Toe/Tonne</td>
<td>0.821</td>
<td></td>
</tr>
</tbody>
</table>

Case I: Under Achievement of PAT Obligation with REC gain

The target SEC for a DC is 0.821 Toe/Ton of equivalent Chlor-Alkali against the baseline SEC of 0.861 toe/Ton of equivalent Chlor-Alkali.

The DC achieves 0.822 toe/Ton 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.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis/Calculations</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Current Year 2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normalized Gate to Gate Specific Energy Consumption</td>
<td>Annual</td>
<td>Toe/Tonne</td>
<td>0.861</td>
<td>0.822</td>
</tr>
</tbody>
</table>
In this case, the Energy shall not be normalized w.r.t. REC mechanism, since the DC is not being benefited in dual terms for Renewable Power generated as per following calculation table

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis / Calculations</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td></td>
<td>Million kcal</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Target Saving Achieved</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>0.039</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Target Saving Achieved</td>
<td></td>
<td>Million kcal</td>
<td>1950.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>-0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td></td>
<td>Million kcal</td>
<td>-500.00</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Thermal energy conversion for REC and Preferential tariff</td>
<td></td>
<td>Million kcal</td>
<td>570.0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism</td>
<td>Annual</td>
<td>Million kcal</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

**Case II: Equal Achievement of PAT Obligation with REC gain**

The target SEC for a DC is 0.821 toe/Ton of equivalent Chlor-Alkali against the baseline SEC of 0.861 toe/Tons of equivalent Chlor-Alkali.

- The DC achieves 0.821 toe/Ton 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.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis / Calculations</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Current Year 2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normalized Gate to Gate Specific Energy Consumption</td>
<td>Annual</td>
<td>Toe/Tonne</td>
<td>0.861</td>
<td>0.821</td>
</tr>
</tbody>
</table>

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 dual terms for Renewable Power generated as per following calculation table

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td>Million kcal</td>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Target Saving Achieved</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>0.04</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Target Saving Achieved</td>
<td>Million kcal</td>
<td>2000</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td>Million kcal</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Thermal energy conversion for REC and Preferential tariff</td>
<td>Million kcal</td>
<td>570.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism</td>
<td>Annual</td>
<td>Million kcal</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

**Case III: Over Achievement of PAT Obligation with REC gain**
The target SEC for a DC is 0.821 toe/Tonne of equivalent Chlor-Alkali against the baseline SEC of 0.861 toe/Tonne of equivalent Chlor-Alkali.

- The DC achieves 0.820 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.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis/Calculations</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Current Year 2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normalized Gate to Gate Specific Energy Consumption</td>
<td>Annual</td>
<td>Toe/Tonne</td>
<td>0.861</td>
<td>0.820</td>
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</tbody>
</table>

In this case, the DC is getting benefit of Renewable Power exported in dual 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.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Descriptions</th>
<th>Basis</th>
<th>Unit</th>
<th>Baseline Year [BY]</th>
<th>Assessment Year [AY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td></td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Target Saving to be achieved (PAT obligation)</td>
<td>Million kcal</td>
<td></td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Target Saving Achieved</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td></td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Target Saving Achieved</td>
<td>Million kcal</td>
<td></td>
<td>2050</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td>Toe/Tonne equivalent Chlor-Alkali</td>
<td></td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Additional Saving achieved (After PAT obligation)</td>
<td>Million kcal</td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Thermal energy conversion for REC and Preferential tariff</td>
<td>Million kcal</td>
<td></td>
<td>570.0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thermal Energy to be Normalised for REC and preferential tariff power sell under REC mechanism</td>
<td>Annual</td>
<td>Million kcal</td>
<td>50.00</td>
<td></td>
</tr>
</tbody>
</table>

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 dual 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**
## 5. Abbreviations

<table>
<thead>
<tr>
<th>Item</th>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAT</td>
<td>Perform, Achieve and Trade</td>
</tr>
<tr>
<td>NMEEE</td>
<td>National Mission for Enhanced Energy efficiency</td>
</tr>
<tr>
<td>SEC</td>
<td>Specific Energy Consumption</td>
</tr>
<tr>
<td>SPC</td>
<td>Specific Power consumption</td>
</tr>
<tr>
<td>ESCerts</td>
<td>Energy Saving Certificates</td>
</tr>
<tr>
<td>GtG</td>
<td>Gate-to-Gate</td>
</tr>
<tr>
<td>CPP</td>
<td>Captive Power Plant</td>
</tr>
<tr>
<td>PLF</td>
<td>Plat Load Factor</td>
</tr>
<tr>
<td>PAF</td>
<td>Plant Availability Factor</td>
</tr>
<tr>
<td>TPH</td>
<td>Tons Per Hour</td>
</tr>
<tr>
<td>DC</td>
<td>Designated Consumer</td>
</tr>
<tr>
<td>CU</td>
<td>Capacity Utilisation</td>
</tr>
<tr>
<td>BY</td>
<td>Baseline Year</td>
</tr>
<tr>
<td>AY</td>
<td>Assessment Year</td>
</tr>
<tr>
<td>Wt.</td>
<td>Weighted</td>
</tr>
<tr>
<td>DPR</td>
<td>Daily Production Report</td>
</tr>
<tr>
<td>MPR</td>
<td>Monthly Production Report</td>
</tr>
<tr>
<td>CCR</td>
<td>Central Control Room</td>
</tr>
<tr>
<td>SAP</td>
<td>Systems, Applications, Products in Data Processing</td>
</tr>
<tr>
<td>ABT</td>
<td>Availability Base Tariff</td>
</tr>
<tr>
<td>WHR</td>
<td>Waste Heat Recovery</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>DG</td>
<td>Diesel Generator</td>
</tr>
<tr>
<td>CoGen</td>
<td>Co-Generation</td>
</tr>
<tr>
<td>GCV</td>
<td>Gross Calorific Value</td>
</tr>
<tr>
<td>THR</td>
<td>Turbine Heat Rate</td>
</tr>
<tr>
<td>Eff</td>
<td>Efficiency</td>
</tr>
<tr>
<td>PG</td>
<td>Performance Guarantee</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment manufacturer</td>
</tr>
<tr>
<td>MM</td>
<td>Materials Management (SAP Module)</td>
</tr>
<tr>
<td>PP</td>
<td>Production and Planning (SAP Module)</td>
</tr>
<tr>
<td>SD</td>
<td>Sales and Distribution (SAP Module)</td>
</tr>
<tr>
<td>FI</td>
<td>Financial Accounting (SAP Module)</td>
</tr>
<tr>
<td>PM</td>
<td>Plant Maintenance (SAP Module)</td>
</tr>
<tr>
<td>EMS</td>
<td>Energy Management System (SAP Module)</td>
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<tr>
<td>RPO</td>
<td>Renewable Purchase Obligation</td>
</tr>
<tr>
<td>REC</td>
<td>Renewable Energy Certificates</td>
</tr>
</tbody>
</table>
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. Their effort are 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 India’s vast majority of people while addressing concerns regarding climate change.

The Perform Achieve and Trade (PAT) Scheme is one of the initiatives under NMEEE program, which was notified on 30th March 2012. PAT scheme is a market assisted compliance mechanism, designed to accelerate implementation of cost effective improvements in energy efficiency in large energy-intensive industries, through certification of energy savings that could be traded. PAT flows out 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. The energy intensity reduction target, mandated for each unit, depend on its current efficiency: more efficient units have a lower reduction target less efficient units have a higher target.

The Ministry of Power, in consultation with Bureau of Energy Efficiency has prescribed the energy consumption norms and standards, in the 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 March, 2012 (Containing Baseline Specific Energy Consumption, Product Output and Target Specific Energy consumption for the Designated Consumers).


The scheme covers 478 designated consumers (DC) in 8 sectors (thermal power stations, iron and steel plants, cement, fertiliser, textile, pulp and paper, chlor alkali and aluminium) in the first phase. 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 prescribed reduction in its specific energy consumption. The reduction targets were notified in March, 2012. Overall, all the plants together are to achieve a 4.05% reduction in the average energy consumption by 2014-15. This implies a reduction of about 6.686 million tonnes of oil equivalent (mtoe) in their annual energy consumption and a reduction of about 23 million tonnes of carbon dioxide emission, 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 performance achieved by the Designated Consumer in the target year.

The documents sets out the requisite guidelines for M&V in the Monitoring and Verification phase under the PAT Rules. It provides practical guidance and procedures to Designated Consumers (DCs) and Empanelled Accredited Energy Auditors (EmAEA) on verification requirements, and aims to establish a 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 1 and Pro-forma are free from material omissions, misrepresentations and errors.

The process requires EmAEA to verify the monitoring and verification of energy performance of DCs in 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 Specific Pro-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.

This document helps develop clarity on the verification process as it:

- Provides Designated Consumers and EmAEA set of guidelines to establish methods for assessment of specific 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 Computational documentation from basic measurement at field

iii. 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-forma and 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**

The accredited energy auditor firm empanelled with BEE will be the verifier of PAT. Given below are key exercises the verifier will carry out and their meaning.

**Verification:** 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 to energy saving certificates.

**Certification:** It is the process of certifying the verification report or check-verification report by the accredited energy auditor to the effect that the entitlement of energy saving certificate is quantified accurately in relation to compliance of energy consumption norms and standards by the designated consumer during the target year.

**Check-verification:** This is 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 incorporation as the case may be.

1.4.2. Obligation of Empanelled Accréditeur Energy Auditor

(1) 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;

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.

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.

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.

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.

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 accredited energy auditor shall provide in advance the names of the verification or check-verification team members and their biodata to the designated consumer concerned.

(8) The accredited energy auditor shall provide the verification or check-verification team with the relevant working documents indicating their full responsibilities with intimation to the designated consumer.

(9) The accredited energy auditor shall have documented procedures for the following:
(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)

![Figure 1: M&V Documents](image)

1Baseline 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

Figure 2: Stakeholders

2. Broad Roles and Responsibilities

The various roles to be assessed 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 manually in Excel Sheet Pro-forma and in PATNET in the sector specific Pro-forma and Form 1 stating source of data, of its installation as per gate to gate boundary concept. 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 the verification process, the EmAEA shall carry out a strategic and statistical analysis, checking of relevant and authentic documents, quarterly, yearly and end of cycle internal data audit reports, performance assessment documents (Form A), Form I and sector specific pro-forma from designated consumers; the EmAEA will also carry out the actual verification and produce an internal verification report, Form B. 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 its comments 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 the verification and check-verification reports, wherever sought by it, will send its recommendations 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 10 working days from the last date of its submission, for issuance of energy saving certificates under section 14A.

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)

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 Normalization factors 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) get their compliance with the energy consumption norms and standards assessed by 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;

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 compliance with the energy consumption norms and standards during the target year, in the relevant cycle shall take the following actions and furnish the status of compliance to the 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) practise energy conservation and carry out energy efficiency measures to comply with energy consumption norms, or

(b) where the energy efficiency measures implemented are found inadequate for achieving compliance with the energy consumption norms and standards,
the designated consumer shall purchase energy saving certificates to meet the compliance norms in terms of metric tonne of oil equivalent.

2.3. Empanelled Accredited Energy Auditor (EmAEA)

The EmAEA is responsible for verification of compliance with 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 are essential

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 various roles such as technical review of manufacturing processes and energy consumption patterns, system variability and its impact on energy consumption; the EmAEA is also required to apply statistical methods of verification and also ensure integrity and authenticity of data.

16. The accredited energy auditor shall independently evaluate each activity undertaken by the designated consumer towards compliance with the energy consumption norms and standards, and entitlement to or requirement of energy saving certificates.

(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:

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;

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.

(B) 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/her 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/her 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 Designated Consumers (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 report

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 EmAEA. In case no comments are received from the concerned state designed agency concerned, 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 is given below

The designated agency may appoint, after 5 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 the label of 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

(c) inspect any equipment or appliance as may be required and which may be available at such places where energy is used for any activity;

(d) inspect any production process to ascertain the energy consumption norms and standards

2.5. Adjudicator

Section 27 and Section 28 of the Energy Conservation (EC) Act, 2001 shall be referred to 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 shall 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. It will prepare and finalise sector specific Pro-forma for annual data entry in consultation with the technical committee set up by BEE.

24. BEE will prepare and finalise sector specific normalisation factors applicable in assessment year in consultation with the technical committee set up by BEE.

25. The Bureau will carry out empanelment of the accredited energy auditor firm as verifier

26. It will carry out capacity building of SDA, EmAEA, energy managers of designated consumers

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. The roles and responsibilities of the Central Government have been covered under clause 14(chapter V) of EC Act, 2001 and notified under PAT Rules, 2012.

2.8. Institutional Framework for PAT

Transparency, flexibility and engagement with industry players in programme design help ensure effective industrial energy efficiency policy, which even the facilities covered are likely to buy into. PAT’s design phase involved extensive consultations with designated consumers; the consultations ensured the design phase was transparent and allowed industry to engage in the process.

Since PAT is largely a federal scheme, involvement of state designated agencies as an extended arm of enforcement ushers outcome in the right direction.

An institutional framework 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

\(^3\)Trading Exchanges: IEX & PXIL
3. **Process & Timelines**

3.1. **Activities and Responsibilities**

The Energy Conservation Rules, 2012 clearly define the timeline of activities and responsibilities to be carried out for accomplishment of PAT scheme. From submitting the action plan to trading of ESCerts by designated consumers, the various steps under PAT need to be executed in a definite time frame.

Constant monitoring of the scheme, through parameters like total ESCerts issued and 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 taken by the administrator/regulator.

Automation of processes, wherever feasible, will be carried out for seamless implementation of PAT.

### Table 1: Activities and Responsibilities for PAT Cycle I

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of Form</th>
<th>Submitted by</th>
<th>Time of Submission</th>
<th>Submission authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Form A</td>
<td>DCs</td>
<td>Three months from conclusion of target year (end of first, second or third year of relevant cycle) <strong>30th June, 2015</strong></td>
<td>SDA &amp; BEE</td>
</tr>
<tr>
<td>2.</td>
<td>Form B (Certificate of verification by AEE)</td>
<td>DCs</td>
<td>Three months from conclusion of target year (end of first, second or third year of relevant cycle) <strong>30th June, 2015</strong></td>
<td>SDA &amp; BEE</td>
</tr>
<tr>
<td>3.</td>
<td>BEE’s Recommendation to MoP for issuance of ESCerts</td>
<td>BEE</td>
<td>10 working days from receipt of forms A &amp; B</td>
<td>Ministry of Power</td>
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<td>4.</td>
<td>Issuance of ESCerts</td>
<td>Central Government (MoP)</td>
<td>Within 15 days from receipt of recommendations by BEE</td>
<td>BEE</td>
</tr>
<tr>
<td>5.</td>
<td>Form D (status of Compliance)</td>
<td>DC</td>
<td>End of 5 months from the last date of submission of Form A</td>
<td>SDA &amp; BEE</td>
</tr>
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<td>6.</td>
<td>Form C (check verification report and certificate)</td>
<td>AEA (Accredited Energy Auditor)</td>
<td>Within 6 months after issuance of ESCerts or within 1 year of submission of compliance report</td>
<td>BEE</td>
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