MONITORING REPORT

AAC BLOCK/PANEL MANUFACTURING UNIT AT KRISHNA, ANDHRA PRADESH

Document Prepared By EnvironmentFirst Energy Services (P) Limited

Contact Information: Abhishek Kumar I EnvironmentFirst Energy Services (P) Limited
+91 9584594493 I abhishekmazumdar@environmentfirst.in

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Prepared By	*EnvironmentFirst Energy Services (P) Limited*
Contact	*Abhishek Kumar* *EnvironmentFirst Energy Services (P) Limited* *405-A, Prakrati Corporate; 18/2 Y N Road, Indorew-452001 (M.P.)* *+91 9584594493, abhishekmazumdar@environmentfirst.in* *www.environmentfirst.in*

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Greenway Building Materials India Pvt. Ltd. (hereinafter referred to as GBMIPL) has installed an autoclaved aerated concrete (AAC) blocks manufacturing unit of capacity 1, 50,000 m3/annum with an expansion plan to reach at 2, 40,000 m3/annum in Andhra Pradesh State India. The plant has started its operation on 01/08/2013, and till date the capacity has been 1, 50,000 m3/annum. In near future, the expansion will be planned.

The AAC blocks manufactured at the project plant is using waste material fly ash generated from thermal power plants as the primary raw material. The AAC blocks produced is replacing conventional fired (baked) clay bricks as construction material.

The specific energy demand for manufacturing AAC blocks is lower as compared to conventional clay bricks. The energy requirement for fired clay bricks manufactured in India is supplied predominantly by high carbon intensive fossil fuel sources. AAC blocks are being manufactured by the autoclaving process, which is less energy intensive as compared to the thermal baking process used for manufacturing of fired clay bricks. Thus, the project activity results in lower greenhouse gas emission as compared to the conventional clay bricks manufacturing process.

The project would result in average greenhouse gas emission reduction of around 56,233 tCO2e in the specified monitoring period.

1.2 Sectoral Scope and Project Type

The project is a non AFOLU project, developed in line with UNFCCC approved CDM methodology. With reference to Appendix B to the simplified modalities and procedures for small scale CDM project activities.

The project activity falls under the following category:

Sectoral Scope: 04 -Manufacturing Industries

Type (III): Other project activities

Category Z: Fuel switch, process improvement and energy efficiency in brick manufacture.

Methodology: AMS III.Z. - *"Fuel switch, process improvement and energy efficiency in brick manufacture" Version 5.0*[1]

The project is not a grouped project.

[1] https://cdm.unfccc.int/filestorage/H/W/F/HWF609IQJBMOA38Y47PEL1ZXVSDNCK/EB79_repan18_AMS-III%20Z_ver05.0.pdf?t=bXV8bnA5ZTM1fDB3X2nPwAYLzi5HQWLxmZlh

1.3 Project Proponent

Organization name	Greenway Building Materials India Pvt. Ltd.
Contact person	Mr. Sunkara Balaguru Prasad
Title	MD
Address	Paritala (V),Kanchikacherla,Krishna District Andhra Pradesh- 521180
Telephone	+91 8886677515
Email	info2@greenwayinfra.com

Organization name	Environmentfirst Energy Services (P) Limited
Contact person	Abhishek Kumar
Title	Director
Address	405-A, Prakrati Corporate; 18/2 Y N Road, Indorew-452001 (M.P.)
Telephone	+91 9584594493 / 0731-6007860
Email	abhishekmazumdar@environmentfirst.in

1.4 Other Entities Involved in the Project

Not Applicable.

1.5 Project Start Date

01/08/2013

1.6 Project Crediting Period

Crediting Period Start Date: 01/08/2013
Crediting Period End Date: 31/07/2023
Length: 10Years 00Months (Renewal Crediting Period opted)

1.7 Project Location

Country: India
Region: Southern India
State: Andhra Pradesh
District: Krishna
Village: Paritala

Geographical Location of the project activity: Latitude: 16.659°N
Longitude: 80.409°E

Nearest Railway Station: Vijayawada
Nearest Airport: Vijayawada

1.8 Title and Reference of Methodology

The project has been developed using the following baseline and monitoring methodology approved under CDM program of UNFCCC:

Type III: Other Project Types

Methodology Applied: AMSIIIZ. "Fuel Switch, process improvement and energy efficiency in brick manufacture" Sectoral Scope: 04 EB 79,
https://cdm.unfccc.int/methodologies/DB/6HUGOIMHJ1JJZMGZ3YQT094S6XU4IO

Version 5.0; Valid from 01st June 2014 onwards.

Applied Methodological Tool:

1. ."Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" Version 02, Annex 11, EB 41.
   http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

2. "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", Version 01, Annex 7, EB 39.
   http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf

3. "Project and leakage emissions from road transportation of freight" Version 01.0.0, Annex 10 of EB63
   http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.pdf

4. "Tool for the demonstration and assessment of additionality", Version (06.1.0), (EB 69)
   http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.1.0.pdf.

1.9 Other Programs

Not Applicable. The project has not applied for registration under any other GHG program..

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The total installed capacity of the project is 1,50,000 CUM. The technology used for the project activity is AAC Brick-Manufaturing. The commissioning date is 01/08/2013.

The plant have run successfully during the reported monitoring period. All the physical and technical features as stated in the registered PD are in place and project has been operated as described in the registered PD.

No events or situations happened during the reported monitoring period which can alter the applicability of the applied methodology.

2.2 Deviations

2.2.1 Methodology Deviations

Not Applicable, as no deviation has been admitted.

2.2.2 Project Description Deviations

Not Applicable, as no deviation has been admitted.

2.3 Grouped Project

Not Applicable. This is not a Grouped Project Activity.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	EF_{BL}
Data unit	tCO2/m³
Description	The parameter is Annual production specific emission factor for manufacturing the product derived in the baseline scenario to project activity product.
Source of data	Calculated based on data taken from: 1. “Brick and ceramic sectors” report by Asian Institute of Technology[2] 2. "Energy Conservation and Pollution Control in brick kilns” report by Sameer Maithel, N Vasudevan, Lt. Col. Rakesh Joshi (Retrd.)[3] 3. Density of bricks taken from www.reade.com[4]
Value applied:	0.39936
Justification of choice of data or description of measurement methods and procedures applied	The value is a calculated value. It has been derived based on CO_2 emission per brick data taken from “Brick and ceramic sector report”, which has been converted to CO_2 emission per unit volume of baseline brick with weight of each brick taken from “Energy conservation and Pollution Control in brick kilns” report and density of each brick from the engineering tool box. Values used are such that conservativeness of baseline emission factor is ensured.
Purpose of Data	For calculating the baseline emission
Comments	This value is fixed ex-ante.

Data / Parameter	EF_{cement}
Data unit	tCO2/ ton of cement

2 http://www.faculty.ait.ac.th/visu/Prof%20Visu's%20CV/Books%20and%20research%20reports/BRICK%20AND%20CERAMIC.pdf

3 http://www.cosmile.org/papers/brick_statuspaperVSBKsindia2003.pdf

4 http://www.reade.com/Particle_Briefings/spec_gra2.html

Description	Carbon emission factor o Cement production
Source of data	CSI Protocol default emission factor of cement production for India and China(Figure5.8:Regional average net CO2 emissions per tonne cement in page 23/43 of the report) Link: http://wbcsdcement.org/pdf/csi-gnr-report-with%20label.pdf
Value applied:	0.638
Justification of choice of data or description of measurement methods and procedures applied	CSI Protocol is an authentic source of data.
Purpose of Data	For calculating the leakage emission
Comments	This value is fixed ex-ante.

Data / Parameter	$EF_{Aluminium}$
Data unit	tCO2/ ton of Aluminium
Description	Carbon emission factor of Aluminium Power production
Source of data	**Table 17: Industrial processes-emission factors and activity data**
Value applied:	1.89
Justification of choice of data or description of measurement methods and procedures applied	CSI Protocol is an authentic source of data.
Purpose of Data	For calculating the leakage emission
Comments	This value is fixed ex-ante.

Data / Parameter	EF_{Lime}
Data unit	tCO2/ ton of $CaCO_3$
Description	Carbon emission factor of Lime
Source of data	Chapter 2 of "Mineral Industry Emissions" of 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Link: http://www.ipccnggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_2_Ch2_Mineral_Industry.pdf
Value applied:	0.4397 tCO2/ ton of CaO.
Justification of choice of data or description of measurement methods and procedures applied	In the general practice lime from mineral source is available with a purity of 30-45% in terms of CaO that results in lesser emissions. However the project activity requires 85% purity in terms of CaO. The emission factor is computed using the stoichio-metric ratio of 0.43 tones CO2/ ton of lime.
Purpose of Data	For calculating the leakage emission

Comments	This value is fixed ex-ante.

Data / Parameter	**$EF_{CO2,f}$**
Data unit	gCO2/t km
Description	Default carbon di-oxide emission factor for freight transport activity f.
Source of data	Based on the methodological tool "Project and leakage emissions from road transportation of freight."(Version 01.0.0)
Value applied:	Vehicle Class: Heavy Vehicles; Emission factor (gCO2/tKm): 129 For raw material (Fly ash, Gypsum, Cement, Lime, Aluminium Powder) transportation generally heavy vehicles are being used. So PP has considered the values for emission factor of Heavy vehicles.
Justification of choice of data or description of measurement methods and procedures applied	Based on the default values specified and calculated as per the methodological tool "Project and leakage emissions from road transportation of freight."(Version 01.0.0).
Purpose of Data	For calculating the leakage emission
Comments	For heavy vehicles, the emission factor has been derived based on custom design transient speed-time-gradient drive cycle (adapted from the international FIGE cycle), vehicle dimensional data, mathematical analysis of loading scenarios, and dynamic modelling based on engine power profiles, which, in turn, are a function of gross vehicle mass (GVM), load factor, speed/acceleration profiles and road gradient.

Data / Parameter	**TDL**
Data unit	No unit
Description	Technical Transmission and distribution losses
Source of data	Based on the methodological tool to calculate baseline, project and/or leakage emissions from electricity consumption Version 1.0
Value applied:	10%
Justification of choice of data or description of measurement methods and procedures applied	Based on the default values specified and calculated as per the methodological tool "Project and leakage emissions from road transportation of freight."(Version 01.0.0).
Purpose of Data	For calculating the leakage emission
Comments	-

3.2 Data and Parameters Monitored

Data/ Parameter	**Production-**$P_{PJ,y}$
Data unit	m3
Description	The annual production of the facility in year y
Source of data	Plant Records – production log book data
Description of measurement methods and procedures to be applied	Number of standard sized cakes being manufactured is being monitored manually. Number of cakes manufactured can be converted to volume units using the standard volume for each cake.
Frequency of monitoring/recording	Monitoring frequency: Continuously Recording frequency: Daily
Value applied:	1,97,132.23
Monitoring equipment	Number of blocks produced is manually counted.
QA/QC procedures to be applied	The personnel of PP will make periodical visits to the plant to check the digital & manual record keeping, and Blocks selling data and blocks stocks data can be used for verification of figures.
Purpose of data	For calculating the baseline & project emissions.
Calculation method	Production = (Number of cakes) x (standard volume per cake)
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**QCement**
Data unit	Tonnes
Description	Tons of cement used over a year y of project activity production
Source of data	Purchase bill of cement
Description of measurement methods and procedures to be applied	Primary recording by raw material /pour which is recorded digitally through load cell located at mixer tower.
Frequency of monitoring/recording	Monitoring frequency: Every purchase of raw material Recording frequency: Monthly
Value applied:	19,162.57
Monitoring equipment	No monitoring equipment is required
QA/QC procedures to be applied	Since cement is procured in cement bags of known quantity, QA/QC is ensured.

Purpose of data	For calculating the leakage emissions.
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**QLime**
Data unit	Tonnes
Description	Tons of Lime used over a year y of project activity production
Source of data	Purchase bill of Lime
Description of measurement methods and procedures to be applied	Primary recording by raw material /pour which is recorded digitally through load cell located at mixer tower.
Frequency of monitoring/recording	Monitoring frequency: Every purchase of raw material Recording frequency: Monthly
Value applied:	7,762.61
Monitoring equipment	No monitoring equipment is required
QA/QC procedures to be applied	Since lime is procured in bags of known quantity, QA/QC is ensured.
Purpose of data	For calculating the leakage emissions.
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**QGypsum**
Data unit	Tonnes
Description	Tons of Gypsum used over a year y of project activity production
Source of data	Purchase bill of Gypsum
Description of measurement methods and procedures to be applied	Primary recording by raw material /pour which is recorded digitally through load cell located at mixer tower.
Frequency of monitoring/recording	Monitoring frequency: Every purchase of raw material Recording frequency: Monthly

Value applied:	923.50
Monitoring equipment	No monitoring equipment is required
QA/QC procedures to be applied	Since Gypsum is procured in bags of known quantity, QA/QC is ensured.
Purpose of data	For calculating the leakage emissions.
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**QAluminium**
Data unit	Tonnes
Description	Tons of Aluminium used over a year y of project activity production
Source of data	Purchase bill of Aluminium
Description of measurement methods and procedures to be applied	Primary recording by raw material /pour which is recorded digitally through load cell located at mixer tower.
Frequency of monitoring/recording	Monitoring frequency: Every purchase of raw material Recording frequency: Monthly
Value applied:	99.39
Monitoring equipment	No monitoring equipment will be used.
QA/QC procedures to be applied	Since Aluminium is procured in bags of known quantity, QA/QC is ensured.
Purpose of data	For calculating the leakage emissions.
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**QFly Ash**
Data unit	Tonnes
Description	Tons of Fly Ash used over a year y of project activity production
Source of data	Purchase bill of Fly Ash
Description of measurement methods	Primary recording by raw material /pour which is recorded digitally through load cell located at mixer tower.

and procedures to be applied	
Frequency of monitoring/recording	Monitoring frequency: Every purchase of raw material Recording frequency: Monthly
Value applied:	69,536.04
Monitoring equipment	No monitoring equipment is used
QA/QC procedures to be applied	Since Aluminium is procured in bags of known quantity, QA/QC is ensured.
Purpose of data	For calculating the leakage emissions.
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	**Compressive strength of AAC blocks**
Data unit	MPa
Description	The project activity output - AAC blocks/panels are tested in a compressive strength testing machines (CTM) in any of the laboratories of polytechnics, engineering colleges, building centres, national laboratories etc, and the test certificate are provided during verification.
Source of data	Lab reports
Description of measurement methods and procedures to be applied	Sampling Approach will be adopted. Please refer Annex -1. Dry compressive strength of the project block would be tested in nationally approved laboratory. Compressive strength test would be carried in line with IS code: 6441 Part V.
Frequency of monitoring/recording	Monitoring frequency: Once in every 6 months Recording frequency: Once in every 6 months
Value applied:	4 to 5.4 N/mm^2
Monitoring equipment	Compressive strength was carried out in a laboratory.
QA/QC procedures to be applied	The laboratory would comply with relevant national standards.
Purpose of data	Methodology Justification
Calculation method	Not Applicable
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

Data / Parameter	$EC_{PJ,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project plant in year y
Source of data	Electricity Bills.
Description of measurement methods and procedures to be applied	Separate electricity meter would be installed for monitoring of electricity imported from state grid and electricity generated by captive diesel generator sets. Electricity consumption of the plant would be calculated as summation of the electricity imports from state grid and electricity generated by captive diesel generator sets.
Frequency of monitoring/recording	Monitoring frequency: Continuously Recording frequency: Daily
Value applied:	1971.32 MWh/year
Monitoring equipment	No equipment is used.
QA/QC procedures to be applied	The meter is used for the electricity is not in our control. So QA/QC is not required.
Purpose of data	For calculating the project emission
Calculation method	Not Applicable
Comments	Archived data will be kept during the crediting period plus 2 years or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	$D_{f,y}$
Data unit	Km
Description	Return trip road distance between the origin and destination of freight transportation activity f in monitoring period m
Source of data	Records by project participants
Description of measurement methods and procedures to be applied	Determined once ex-ante for each freight transportation activity f for a reference trip (actual purchase invoices) and using online map sources.
Frequency of monitoring/recording	Monitoring frequency: Whenever road trip distance changes Recording frequency: Whenever road trip distance changes
Value applied:	Fly Ash: 25

	Cement: 176 Lime: 3934 Gypsum: 744 Aluminium Powder: 1998
Monitoring equipment	Purchase invoices and online maps are 3rd party applications
QA/QC procedures to be applied	The data is a 3rd party data.
Purpose of data	For calculating the leakage emission
Calculation method	Roundtrip road travel distances calculated from online maps.
Comments	All data would be stored for a minimum of 2 years after the end of the crediting period or last verification, whichever occurs later

3.3 Monitoring Plan

The monitoring plan would involve structure for:

- Monitoring, recording and archiving of all data required for calculation of *ex-post* emissionreduction from the project.
- Storing documents required for emission reduction calculations.
- Conducting/arranging calibration tests for monitoring equipment
- Ensuring quality of recorded data
- Co-ordinating with consultants and auditors to submit monitored data to VCS Board.

The monitoring team will be structured as follows:

Position	Report to:
Operators	Plant head
Supervisor managers(technical/maintenance)	
VCS monitoring project manager	

Detailed responsibility of each member in the monitoring team is provided below:

Sr. No	Tasks description	Operator(s)	Supervisor	Plant	CDM monitoring project manager
Monitoring activity					

1	Recording of	√	√		
Quality Assurance & Quality Control					
2	Verification of data monitored (consistency and completeness)		√	√	
3	Ensuring adequate			√	√
4	Ensuring adequate maintenance		√	√	√
	Ensuring calibrationof		√	√	√
5	Data archiving: ensuring adequate storage of data monitored			√	√
6.	Identification of non-conformance and corrective/preventive actions and monitoring plan			√	√
7	Emergency		√	√	
Calculation of GHG emission reductions and reporting					
8	Processing of data and calculation of				√
9	Monitoring report: management review of monitoring report			√	√

All data is being collected in paper log books and/or online data collection system and would be converted to spread sheet form on an annual basis.

The quality of data has been sourced by periodic verification of data by VCS monitoring project manager. All data would be stored for a minimum of 2years after the end of the crediting period or last verification whichever occurs later. In case there is an inconsistency on monitored data, the period will be removed from emission reduction crediting period unless sufficiently reliable alternative methods are available and validated by external agencies appointed to verify monitoring report submitted to VCS Board.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per Section B.4 of the registered PD, the baseline to the project activity is – Installation of similar capacity baked clay bricks manufacturing unit. The corresponding energy baseline has been calculated taking into account the different technologies with different levels of energy consumption associated with the baked clay brick production.

Baseline emissions are quantified in line with paragraph 21 of the methodology as follows:

$$BE_y = EF_{BL} \times P_{PJ,y}$$

Where,

BE_y	tCO_2e	The annual baseline emissions from fossil fuels displaced by the project activity in the year y
EF_{BL}	tCO_2/m^3	The annual production specific baseline emission factor
$P_{PJ,y}$	m^3	The annual net production of the facility in year y

As per the methodology, paragraph 23, "*Annual production specific emission factor (EFBL) for installation of systems in a new facility or for capacity addition in an existing system shall be determined using one of the options below:*

(a) Using manufacturers" specifications such as for brick production rate, energy consumption in the process;
(b) Using specifications of comparable units having similar techno-economic parameters;
(c) Using reference plant approach"

The project activity uses paragraph 23 (c) to determine the baseline emission factor.

Using the reference plants approach, as detailed in paragraph 23 of the methodology AMS-III.Z Version 05,(Fuel Switch, process improvement and energy efficiency in brick manufacture), the baseline emission factor shall be calculated from emissions data of other brick manufacturing plant of capacity 300.000 m^3/yr and using the common practice technology. As established in section 2.4 of the registered PD, the common practice technology in this sector is red clay fired clay bricks, across all plant capacities in India. Publicly available documents[5] released by independent party provides weighted average emission factor for brick manufacturing sector in India. The document calculates the average emission factor for the different technologies and fuel types (represented by $EF_{CO2, brick}$ in the Equation below)

For this project activity, the lower range of the emission factor of 780 $kgCO_2$/1000 for baseline bricks, has been directly sourced from the document and used. The public document from which it is extracted provides emission factor in terms of CO_2/1000 baseline bricks, however the size and density of AAC blocks produced in the project plant is different from that of baseline bricks.

[5] Asian Institute of Technology Report Page 25 available at: http://www.faculty.ait.ac.th/visu/Prof%20Visu's%20CV/Books%20and%20research%20reports/BRICK%20AND%20CERAMIC.pdf

So, the emission factor of 780 $kgCO_2$/1000 baseline bricks has been converted into a volumetric emission factor as follows:

The annual production specific baseline emission factor is thus estimated ex-ante as follows:

$EF_{BL} = (EF_{CO2,\ Brick} / W_{Brick}) * (D_{Brick} / 1000)$

Where,

EF_{BL} = The annual production specific emission factor for year y in tCO_2/m^3

$EF_{CO2,\ Brick}$ = CO_2 emission per baseline brick produced in $KgCO_2$/brick (as obtained from third party documents)

W_{Brick} = Weight of each baseline brick produced

D_{Brick} = Density of each baseline brick produced

4.2 Project Emissions

Project emissions have been calculated using paragraph 24 of the methodology AMS-III.Z Fuel Switch, process improvement and energy efficiency in brick manufacture (Version 05). Project emission sources relevant for this project are:

As per approved methodology project activity emissions (PEy) consist of those emissions associated with the use of electricity from grid and fossil fuel (and Fuel oil).The emission during the project activity can be calculated in accordance with the "Tool to calculate baseline, project and /or leakage emissions from electricity consumption", "Tool to calculate the emission factor for an electricity system"[6], version 2.2.

The project activity will consume

— **Electricity for its operations**, which will primarily be sourced from grid with a standby option from Diesel Generator Set; and the associated project emissions, will be computed in line with the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" and

Therefore as per eq.24 of applied methodology;

The project emissions should be calculated as follows:

$$\mathrm{PE_y} = PE_{elec,y} + PE_{fossilfuel,y} + PE_{transport,y} + PE_{cultivation,y} + PE_{CH4,y}$$

Where:

PE_y Project emissions in year *y* (tCO_2)

$PE_{elec,y}$ Project emissions due to electricity consumption in year *y* (tCO_2)

[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

$PE_{fossilfuel,y}$	Project emissions due to fossil fuel consumption in year *y* (tCO_2)
$PE_{transport,y}$	Project emissions from transportation of the renewable biomass from the places of their origin to the manufacturing facility site in year *y* (tCO_2)
$PE_{cultivation,y}$	Project emissions from renewable biomass cultivation in year *y* (tCO_2e)
$PE_{CH4,y}$	Project emissions due to the production of charcoal in kilns not equipped with a methane recovery and destruction facility in year *y* (tCO_2e)

Calculation of $PE_{elec,y}$

"The emissions include electricity consumption (including auxiliary use) $PE_{elec,y}$ *associated with the biomass treatment and processing, calculated as per the tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".*

The project emission from the consumption of electricity can be calculated from the methodological tool "Tool to calculate baseline, project and/or leakage emission from electricity consumption", Version 01, EB 39, Annex 7[7] are as follows: Electricity is used for the operation of the manufacturing process.

In the generic approach, project emissions from consumption of electricity is calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{EC,y} = \Sigma\ EC_{PJ,j,y} \times EF_{EL,j,y} \times (1+ TDL_{j,y})$$

$PE_{EC,y}$	Project emissions from electricity consumption in year *y* (tCO2/yr)
$EC_{BL,k,y}$	Quantity of electricity that would be consumed by the baseline electricity consumption source *k* in year *y* (MWh/yr)
$EF_{EL,j,y}$	Emission factor for electricity generation for source *j* in year *y* (tCO2/MWh)
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
j	Sources of electricity consumption in the project

As per the tool, the following three scenarios apply to the sources of electricity consumption:

Scenario A: Electricity consumption from grid.

Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plants(s).

[7] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf

Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plants.

Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)

Under this scenario, the consumption of electricity in the project, the baseline or as a source of leakage may result in different emission levels, depending on the situation of the project activity. The following three cases can be differentiated:

Case C.I: Grid electricity. The implementation of the project activity only affects the quantity of electricity that is supplied from the grid and not the operation of the captive power plant. This applies, for example,

- If at all times during the monitored period the total electricity demand at the site of the captive power plant(s) is, both with the project activity and in the absence of the project activity, larger than the electricity generation capacity of the captive power plant(s); or
- If the captive power plant is operated continuously (apart from maintenance) and feeds any excess electricity into the grid, because the revenues for feeding electricity into the grid are above the plant operation costs; or
- If the captive power plant is centrally dispatched and the dispatch of the captive power plant is thus outside the control of the project participants.

Case C.II: Electricity from captive power plant(s). The implementation of the project activity is clearly demonstrated to only affect the quantity of electricity that is generated in the captive power plant(s) and does not affect the quantity of electricity supplied from the grid. This applies, for example, in the following situation: A fixed quantity of electricity is purchased from the grid due to physical transmission constraints, such as a limited capacity of the transformer that provides electricity to the relevant source. In this situation, case C.II would apply if the total electricity demand at the site of the captive power plant(s) is at all times during the monitored period, both with the project activity and in the absence of the project activity, larger than the quantity of the electricity that can physically be supplied by the grid.

Case C.III: Electricity from both the grid and captive power plant(s). The implementation of the project activity may affect both the quantity of electricity that is generated in the captive power plant(s) and the quantity of electricity supplied from the grid. This applies, for example: If the captive power plant(s) is/are not operating continuously; or If grid electricity is purchased during a part of the monitored period; or

- If electricity from the captive power plant is fed into the grid during a part of the monitored period.

The project plant would consume the electricity from grid and Diesel Generator Set in absence of grid connectivity *i.e.* "the captive power plant(s) is/are not operating continuously", thus the applicable criteria is Scenario C.

Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively.

Scenario A: Electricity consumption from the grid: *In this case, project participants may choose among the following options: Option A1: Calculate the combined margin emission factor* *of the applied electricity system, using the procedures in the latest approval version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).*

Option A2: Use the following conservative default values:

— *A value of 1.3 tCO2 /MWh if*

(a) Scenario A applied only to project and/or leakage electricity consumption sources but not to baseline electricity consumption sources; or

(b) *Scenario A applied to: both baseline and project (and /or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources.*

— *A value of 0.4 tCO2/MWh for electricity grids where hydro power plants constitute less than 50% of total grid generation in 1) average of the five most recent years ,or 2) based on long-term averages for hydroelectricity production, and a value of 0.25 tCO2/MWh for other electricity grids. These values can be used if*

a) *Scenario A applied only to baseline electricity consumption sources but not to project or leakage electricity consumption sources; or*

b) *Scenario A applied to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and leakage sources.*

The project emissions from electricity consumption can be calculated based on the quantity of electricity consumed from grid by the use of Option A1 of the Scenario A.

To calculate the combined margin emission factor of the applicability system the PP have used the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" (Version 04.0, Annex 15, EB 75)[8].

The following steps are applied for calculating the combined margin emission factor:

Step 1: Identify the relevant electricity systems

Central Electricity Authority of India (CEA), Ministry of Power, Government of India (Host Country) has given the delineations of the project electricity system and the connected electricity system in India. As per CEA, the Indian power system is divided into two independent regional grids, namely NEWNE & Southern. Each grid covers several States.

Geographical Scope of two regional grids:

[8] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

NEWNE				Southern
Northern	**Eastern**	**Western**	**North-Eastern**	**Southern**
Chandigarh	Bihar	Chhattisgarh	Arunachal Pradesh	Andhra Pradesh
Delhi	Jharkhand	Gujarat	Assam	Karnataka
Haryana	Orissa	Daman & Diu	Manipur	Kerala
Himachal Pradesh	West Bengal	Dadra & Nagar Haveli	Meghalaya	Tamil Nadu
Jammu & Kashmir	Sikkim	Madhya Pradesh	Mizoram	Pondicherry
Punjab	Andaman-Nicobar	**Maharashtra**	Nagaland	Lakshadweep
Rajasthan		Goa	Tripura	
Utter Pradesh				
Uttaranchal				

For the purpose of calculating the emission reductions achieved by any CDM project, the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1, Annex 19, EB 63) requires that the "project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints". This implies that the grid emission factors could be most appropriately calculated at the level of the two regional grids. As per the delineation given by CEA, Andhra Pradesh state falls into the SOUTHERN Regional Grid.

As the Project Investor has proposed to establish their project activity of the manufacturing facility of the AAC block/panel manufacturing unit at Krishna Dist., Andhra Pradesh,therefore PP has chosen SOUTHERN Regional Grid as the relevant electricity system.

Step 2: Choose whether to include off grid power plants in the project electricity system (optional)

PP may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation

Option II: Both grid power plants and off grid power plants are included in the calculation.

PP has chosen option I to calculate operating margin and build margin emission factor.

Step 3: Select a method to determine the operating margin (OM)

(a) Simple operating margin;

(b) Simple adjusted operating margin;

(c) Dispatch data analysis operating margin;

(d) Average operating margin

"CO_2 Baseline Database for Indian Power Sector" Version 9, published by Central Electricity Authority (hereafter CEA Database) has been referred for the values of OM. As per the *"Tool to calculate the emission factor for an electricity system"* (Version 04.0, Annex 15, EB 75), any of the four methods can be used, however, the simple OM method can be used only if the low-cost/must run resources constitute less than 50% of the total grid generation in: 1) average of the five most recent years, or 2) based on long term averages for hydroelectricity production. Operating Margin has been calculated using the Simple OM method as the low-cost/must run resources constitute less than 50% of the total grid generation of the Southern Grid in average of the five most recent years (average value being 20.1%),as clearly depicted from the below table:

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

Year	2008-09	2009-10	2010-11	2011-12	2012-13
Southern Grid	22.8%	20.6%	21.0%	21.0%	15.2%

For the simple OM method, emission factors can be calculated using either of the two following data vintages:

Ex ante option - If the *ex ante*option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

Ex post option - If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

PP has chosen ex ante option and emission factor determined at validation stage will be the same throughout the crediting period.

Step 4: Calculate the operating margin emission factor according to the selected method

Simple OM has been calculated using "Tool to calculate the emission factor for an electricity system" (Version 04.0, Annex 15, EB 75). PP has opted for option A and used data provided by CEA, Version 9. Net electricity generation and absolute CO_2 emission of all generating power plants serving the system, not including low-cost/ must–run power plants, calculated from CEA database and CO_2 emission per unit net electricity generation (tCO_2/ MWh) estimated for year 2010-11, 2011-12 and 2012-13. The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system.

Please refer Baseline emission sheet for detail simple OM emission factor calculation.

Net Generation in Operating Margin (GWH) (incl. Imports)[9]

2010-11	4,76,986.7213

[9] *Data Source: Central Electricity Authority (CEA) database Version 9,January'2014*

2011-12	5,02,300.3809
2012-13	5,39,385.3723

Simple Operating Margin (t CO_2/MWh) (incl. Imports)[10]

2010-11	0.971
2011-12	0.969
2012-13	0.991

Operating Margin Emission Factor is being calculated as:

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} * EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh),sourced from CO_2 Baseline Database for the Indian Power Sector, CEA, Version 9.0.

m = All power units serving the grid in year *y* except low-cost/must-run power units

y = the relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor of each power unit *m* should be determined as follows:

- **Option A1.** If for a power unit m data on fuel consumption and electricity generation is available, the emission factor($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_{i} FC_{i,m,y} x NCV_{i,y} \text{ x } EF_{CO2,i,y}}{EG_{m,y}}$$

[10] *Data Source: Central Electricity Authority (CEA) database Version 9,January'2014*

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year y (tco_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit m in year *y*(Mass or volume unit)

$NCV_{i,y}$ = Net calorific value(energy content) of fossil fuel type *i* in year *y*(GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tco_2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh)

m = All power units serving the grid in year *y* except low-cost/must-run power units

i = All fossil fuel types combusted in power unit *m* in year *y*.

y = The relevant year as per the data vintage chosen in Step 3

The Central Electricity Authority (CEA) of India has published the official database on emission factors for all regional grids in India, in order to facilitate CDM project and offer consistent data for all project developers. Application of this officially published database represents the most accurate approach, hence has been applied for the project activity. In line with this, the simple OM emission factor is calculated based on the generation power plants serving the system, not including low-cost/must run power plants/units, as sourced from CO_2 Baseline Database for the Indian Power Sector, Version 9, CEA.

The Generation Weighted Simple Operating Margin (tCO2/ MWh) has been calculated to 0.9677[11]

Step 5: Calculate the build margin (BM) emission factor

Vintage of data is based on option 1 of step 4. (Refer *"Tool to calculate the emission factor for an electricity system".* BM Emission Factor calculation has been done *ex-ante* and hence BM Emission Factor value will remain fixed and need not be monitored during the crediting period.

The Build Margin emission factor is the generation weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

[11]Refer the Emission Reduction sheet for detailed calculations

$EF_{grid,BM,y}$	= Build margin CO_2 emission factor in year *y*(tCO_2/MWh).
$EG_{m,y}$ unit *m*	= Net quantity of electricity generated and delivered to the grid by power in year *y* (MWh)
$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh),sourced from CO_2 Baseline Database for the Indian Power Sector, CEA, Version 9.0.
m	= All power units serving the grid in year *y* except low-cost/must-run power units
y	= The relevant year as per the data vintage chosen in Step 3

YEAR	2012-13
Build Margin NWENE (tCO_2/MWh)	0.9593

BM values have been taken from CO_2 Baseline Database for the Indian Power Sector, Version 9. CO_2 Baseline Database for the Indian Power Sector is published by Central Electricity Authority, Ministry of Power; Govt. of India.

Step 6: Calculate the combined margin emissions factor

The emission factor for grid electricity or Grid Emission Coefficient (also referred as CO_2 Emission factor) is calculated as the weighted average of the operating margin emission factor ($EF_{grid,OM,y}$) and the build margin emission factor ($EF_{grid, BM,y}$), where the weights W_{OM} and W_{BM} for wind projects, by default, are W_{OM} = 0.5 & W_{BM} = 0.5 $EF_{grid,CMy}$ is calculated as below and are expressed in tCO_2/MWh.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CMy} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

Where:

$EF_{grid,BM,y}$	= Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	= Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
W_{OM}	= Weighting of operating margin emissions factor (%)
W_{BM}	= Weighting of build margin emissions factor (%)

Emission Factor SOUTHERN Grid (Combined Margin) calculations are as below:-

Particulars	Details	Source
Operating Margin (tCO_2/MWh)	0.9677	CEA[12]
Built Margin (tCO_2/MWh)	0.9509	CEA
Combined Margin (tCO_2/MWh)	=(0.5*0.9677)+(0.5*0.9509) = 0.9593	

Hence, the combined margin emission factor for the SOUTHERN Grid is 0.9593 tCO2e/ MWh.

Scenario B: Electricity consumption from an off-grid captive power plant In this case, project participants may choose among the following options: Option B1: The emission factor for electricity generation is determined based on the CO2 emissions from fuel combustion and the electricity generation in the captive power plant (s) installed at the site of the electricity consumption source.
The emission factor of the captive power plant(s) is calculated as follows:

$$EF_{EL,j/k/l,y} = (\Sigma\Sigma FC_{n,i,t} \times NCV_{i,t} \times EF_{CO2,i,t}) / \Sigma EG_{n,t}$$

$EF_{EL,j/k/l,y}$	Emission factor for electricity generation for source *j*, *k* or *l* in year *y* (tCO2/MWh)
$FC_{n,i,t}$	Quantity of fossil fuel type *i* fired in the captive power plant *n* in the time period *t* (mass or volume unit)
$NCV_{i,t}$	Average net calorific value of fossil fuel type *i* used in the period *t* (GJ / mass or volume unit)
$EF_{CO2,i,t}$	Average CO2 emission factor of fossil fuel type *i* used in the period *t* (tCO2 / GJ)
$EG_{n,t}$	Quantity of electricity generated in captive power plant *n* in the time period *t* (MWh)
i	are the fossil fuel types fired in captive power plant *n* in the time period *t*
j	Sources of electricity consumption in the project
k	Sources of electricity consumption in the baseline
l	Leakage sources of electricity consumption
n	Fossil fuel fired captive power plants installed at the site of the electricity consumption source *j*, *k* or *l*
t	Time period for which the emission factor for electricity generation is determined (see further guidance below)

[12] Source: CO_2 Baseline Database for the Indian Power Sector, CEA, Version 9.0

Option B2: Use the following conservative default values:

- A value of 1.3 tCO_2/MWh if

(a) The electricity consumption source is a project or leakage electricity consumption source; or

(b) The electricity consumption source is a baseline electricity consumption source; and the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is less than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s).

- A value of 0.4 tCO_2/MWh if

(a) The electricity consumption source is a baseline electricity consumption source; or

(b) The electricity consumption source is a project electricity consumption source and the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is **greater** than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s). Option B1 was adopted to determine the Emission Factor of electricity under Scenario B;

The emission factor for SOUTHERN Grid is 0.9593 $tCO_2/MWh$where as the calculated value of emission factor for the DG set (750 kVA) is 0.5984 tCO_2/MWh, which has been computed & derived as below;

DG Set Emission Factor		
NCV of Diesel (TJ/ton)	0.04	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.2- Default Net Calorific Values (NCVs) and Upper limit of the 95% confidence intervals.
CO2 emission factor (TCO2/TJ)	74.8	2006 IPCC Guidelines for National Greenhouse Gas Inventories Table 1.4 – Default CO2 emission factors for combustion, Upper value of 95% confidence interval
Specific fuel consumption(kg/kWh)	0.2	Manufacturers data input
Emission factor of DG Set	0.5984	tCO2/MWh

So emission factor for electricity generation determined as per guidance for scenario A: Electricity consumption from the grid was found to higher and therefore more conservative than emission factor for electricity generation determined as per guidance for scenario B: Electricity consumption from an off-grid captive power plant.

Calculation of $PE_{fossilfuel\ y}$

"The emissions include fossil fuel consumption (including auxiliary use) $PE_{fossilfuel\ y}$ *associated with the operation of the manufacturing process and the biomass treatment and processing, calculated as per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".*

PP does not opt for any use of fossil fuel for their AAC Block/Panel manufacturing process. Electricity &Rice-husk are the only sources of the energy for their production process. So there is no scope of consumption of the fossil fuel to the manufacturing plant and the parameter $PE_{fossilfuel\ y}$, is zero for the project activity.

Calculation of $PE_{transport\ y}$,

"Project emissions from the transportation of the renewable biomass from its source to the manufacturing production site shall be accounted for following the procedures in AMS-III.AK "Biodiesel production and use for transport applications" if the transportation distance is more than 200 km, otherwise they can be neglected."

PP opt for Rice-husk for their AAC Block/Panel manufacturing process, and the transportation distance is less than 200Kms,so has been neglected as per the guideline.

Calculation of $PE_{cultivation,y}$

"In cases where the project activity utilizes biomass sourced from dedicated plantations, the project emissions from renewable biomass cultivation shall be calculated as per the relevant provisions of AMS-III.AK "Biodiesel production and use for transport applications".

The emission from renewable biomass cultivation is considered as zero.

Calculation of $PE_{CH4,y}$

"The project methane emissions from the charcoal produced in kilns not equipped with a methane recovery and destruction facility and methane emissions from the production of charcoal shall be accounted for as per the relevant procedures of AMS-III.K "Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process". Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable, e.g. the source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln and operating conditions such as ambient temperature."

PP does not involve any use of charcoal in the project activity. Basically it is an Autoclaved curing process. The AAC blocks are to be processed through Autoclaved curing method. So there is no scope of generation of methane emission from the project activity.

4.3 Leakage

As per the paragraph 30 & 31 of the methodology,

"Leakage emissions on account of the diversion of biomass from other uses (competing uses) shall be calculated as per "General guidance on leakage in biomass project activities". "*In the case of project activities involving change in production process or a change in type and quantity or raw and /or additive materials as compared with the baseline, the incremental emissions associated with the production/ consumption and transport of those raw materials consumed as compared to baseline, shall be calculated as leakage."*

As per the methodology, the project activity entails two types of leakage due to change in production process which leads to change in type and quantity of raw and/or additive materials as compared to baseline

— Emissions associated with consumption of raw and/or additive materials
— Emissions associated with transportation of raw and/or additive materials

The applicable equation is as below for calculating the leakage emission:

$LE_y = LE_{rm,prod,y} + LE_{TR,m}$

Where:

LE_y	Leakage emissions associated with consumption and transport of raw and/or additive materials in the year y.
$LE_{rm,prod,y}$	Leakage emissions associated with consumption of raw and/or additive materials in the year y
$LE_{TR,m}$	Leakage emission associated with transportation of raw and/or additive materials in the year y

Leakage emission associated with consumption of raw and/or additive materials: Aluminium Powder & Gypsum are used for the production of AAC block at very lower amount. In this project cement and lime are two major inputs with significant emissions during their production; the fraction of the contribution of Aluminium Powder & Gypsum in per Cum AAC Block production is very lower. However the Leakage due to the Alluminium Powder production has been considered as a conservative approach. On the other hand, the Gypsum is a byproduct from hydrofluoric acid and fertilizer industries which is available commercially in the market..Thus it needs not to be considered in the leakage computation.

$LE_{rm,prod,y} = Q_{cement,y} \times EF_{cement} + Q_{lime,y} \times EF_{lime} + Q_{Aluminium,,y} \times EF_{Aluminium}$

Where:

$LE_{rm,prod,y}$	Leakage emissions associated with consumption of raw and/or additive materials in the year y
$Q_{cement,y}$	Quantity of cement consumed for the production of AAC blocks/panels in the year y.
EF_{cement}	CO2 emission factor of the cement production.
$Q_{lime,y}$	Quantity of lime consumed for the production of AAC blocks/panels in the year y.
EF_{lime}	CO2 emission factor of the lime production.
$Q_{Aluminium,,y}$	Quantity of Aluminium Powder consumed for the production of AAC blocks/panels in the year y.

$EF_{Aluminium}$	CO2 emission factor of the Aluminium production.

Leakage emission due to raw material transportation: As per the methodological tool "Project and leakage emissions from road transportation of freight" Version 01 the emissions due to the raw material transportation can be calculated as below:

$LE_{TR,m} = \Sigma D_{fm} \times F_{Rf,m} \times EF_{CO2,f} \times 10^{-6}$

Where,

$LE_{TR,m}$	Leakage emission from road transportation of freight monitoring period m (tC02).
D_{fm}	Return trip road distance between the origin and destination of freight transportation activity f in monitoring period m (km).
$F_{Rf,m}$	Total mass of freight transported in freight transportation activity f in monitoring period m (t).
$EF_{CO2,f}$	Default CO2 emission factor for freight transportation activity f (g CO2 / t km).
f	Freight transportation activities conducted in the project activity in monitoring period m

4.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01/08/13 to 31/03/14	9063.11	224.66	2622.66	6215
01/04/14 to 31/03/15	40359.46	1000.45	10473.13	28885
01/04/15 to 31/12/15	29304.16	726.41	7443.99	21133
Total	78726.73	1951.52	20539.78	56233

Note: Final ER value is rounded to zero decimal point.