AAC BLOCK/PANEL MANUFACTURING UNIT AT KRISHNA, ANDHRA PRADESH

nucon blocks
for a sustainable future

Document Prepared By EnvironmentFirst Energy Services (P) Limited

Project Title	*AAC Block/Panel Manufacturing unit at Krishna, Andhra Pradesh*
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1 PROJECT DETAILS

1.1 Summary Description 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 m^3/annum with an expansion plan to reach at 2, 40,000 m^3/annum in Andhra Pradesh, India. The project activity involves setting up a new facility and is accordingly classified as a Greenfield project. The AAC blocks manufactured at the project plant would use waste material fly ash generated from thermal power plants as the primary raw material. The AAC blocks technology would replace fossil fuel (coal) used in the conventional fired (baked) clay bricks technology. The AAC blocks and conventional clay brick is used as construction materials.

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 (coal) sources. AAC blocks are 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.

In terms of performance standard of AAC blocks, the AAC blocks are being manufactured in compliance with the requirements of the relevant national standard. Compressive strength test would be carried in line with IS code: 6441 Part V.The project would result in average greenhouse gas emission reduction of around 56,107 tCO2e/ annum.

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:

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]

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

The project is not a grouped project.

1.3 Project Proponent

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Greenway Building Materials India Pvt. Ltd. (Private Entity) Environmentfirst Energy Services (P) Limited (Private Entity)	No

Organization name	Greenway Building Materials India Pvt. Ltd.
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Organization name	Environmentfirst Energy Services (P) Limited
Contact person	Abhishek Kumar
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Telephone	+91 9584594493 / 0731-6007860
Email	abhishekmazumdar@environmentfirst.in

1.4 Other Entities Involved in the Project

Not Applicable

1.5 Project Start Date

Based on the project start date definition available in Program Definitions, Requirement Document v3.5[2], project start date is 01/8/2013, which corresponds to the first production start date of the Autoclaved Aerated Concrete Block.

1.6 Project Crediting Period

Crediting Period Start Date: 01/8/2013

Crediting Period End Date: 31/07/2023

Length: 10Years 00Months (Renewal Crediting Period opted)

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	Yes
Large project	NA

Year	Estimated GHG emission reductions or removals (tCO_2e)
2013-2014	35067
2014-2015	56107
2015-2016	56107
2016-2017	56107
2017-2018	56107
2018-2019	56107
2019-2020	56107
2020-2021	56107
2021-2022	56107
2022-2023	56107
Total estimated ERs	540030
Total number of crediting years	10
Average annual ERs	56,107 (leaving first year for calculating annual ERs)

[2] http://www.v-c-s.org/sites/v-c-s.org/files/VCS%20Program%20Guide%2C%20v3.5.pdf

1.8 Description of the Project Activity

The prime objective of the project activity is to produce a high-quality, load-bearing and well insulating building or construction material by adopting an efficient low energy intensive brick production process instead of a high energy intensive brick production process like Clay Brick Bull‟s trench kilns (BTKs) and positively impact the energy consumption pattern both at the brick production level and at the building operation level.

While attaining the prime objective the project activity will also

1) Reduce GHG emissions associated to energy consumption (both fossil fuel and electricity) in the high energy intensive BTKs by an energy efficient brick making technology.

2) Reduce air pollution by introducing robust air treatment facilities in the project activity; the clay brick kiln technology is adopted by an unorganized sector with very poor air treatment facilities; and,

3) Enhance the use of fly ash, an industrial -waste, as an ingredient of building material.

The project activity entails production of AAC blocks, which is a steam-cured mix of pulverized fuel ash (PFA), cement, lime, anhydrite (gypsum) and an aeration agent. The high-pressure steam-curing in autoclaves achieves a physically and chemically stable and light weight product, comprising myriads of tiny non-connecting air bubbles which give AAC its diverse qualities and makes it such an excellent insulating material.

Production process of AAC blocks does not involve sintering or kiln heating for blocks consolidation and thus completely eliminates the burning of fossil fuels as required in the clay brick production by adopting the green waste mixing technology in PFA slurry process, ultimately contributing to the reduction of greenhouse gas emissions. The core of this technology is the AAC blocks composition and its chemistry, with fly ash from thermal plants (coal power plants) mixed with lime and gypsum, which enable the blocks to acquire the mechanical properties required during the hydration and curing process without being sintered.

The production process consists of the following steps:

1) Dosing and mixing of fly ash with lime, Ordinary Portland Cement (OPC), stabilisers and gypsum at a high dosing speed at very high accuracy.

2) Casting and rising/pre curing of the mixture to enable the fresh mix to rise and harden to a firm green cake with the volume of the mould.

3) Tilting mould cakes with the tilt manipulator on to a cutter machine and oiling to prevent the sticking of the green cakes for reuse.

4) Horizontal and cross cutting the cakes by cutter which are equipped with broken-wire-detection system.

5) Milling and back tilting onto a cooking frame.

6) Green separation of cut cakes by passing through the green separator to avoid sticking of cut layers during autoclaving and eliminating further mechanical separation in white state.

7) Curing with a steam at pressure of approximately 12 Bar in autoclave system for 12 hrs period. The steam is generated from a boiler which is using rice husk as fuel.

8) A post autoclaving, after buffering and de-stacking of hardened cakes from the cooking frames to the packaging line for final packaging.

The major components of equipment installed as part of project activity are as follows:

- Raw materials storage silos
- Raw material mixer
- Hydraulically operated moulding section
- Autoclave section
- Steam boilers
- Compressed air network
- Internal transportation system

Specifications of AAC blocks manufactured under the project activity are as follows:

S. No.	Particulars	Unit	Value	Remarks (if any)
Physical Characteristics				
1	Dimension of AAC blocks	Mm	600X200X100	As per Actual Production
2	Density	Kg/m3	551-600	
3	Dry Shrinkage (max)	%	0.1	As per Indian Standard – IS 2185
4	Thermal Conductivity	W/m-K	0.24	
5	Compressive Strength	N/mm2	>3.75	
Raw Material Composition				
1	Fly Ash	%	65	Lab test report & Actual Monitoring Data at the plant.
2	Cement	%	18.5	
3	Lime	%	6	
4	Gypsum	%	1	
5	Aluminium Powder	%	0.1	

Energy/ Fuel used: Rice husk in boiler and electricity for Autoclave process.

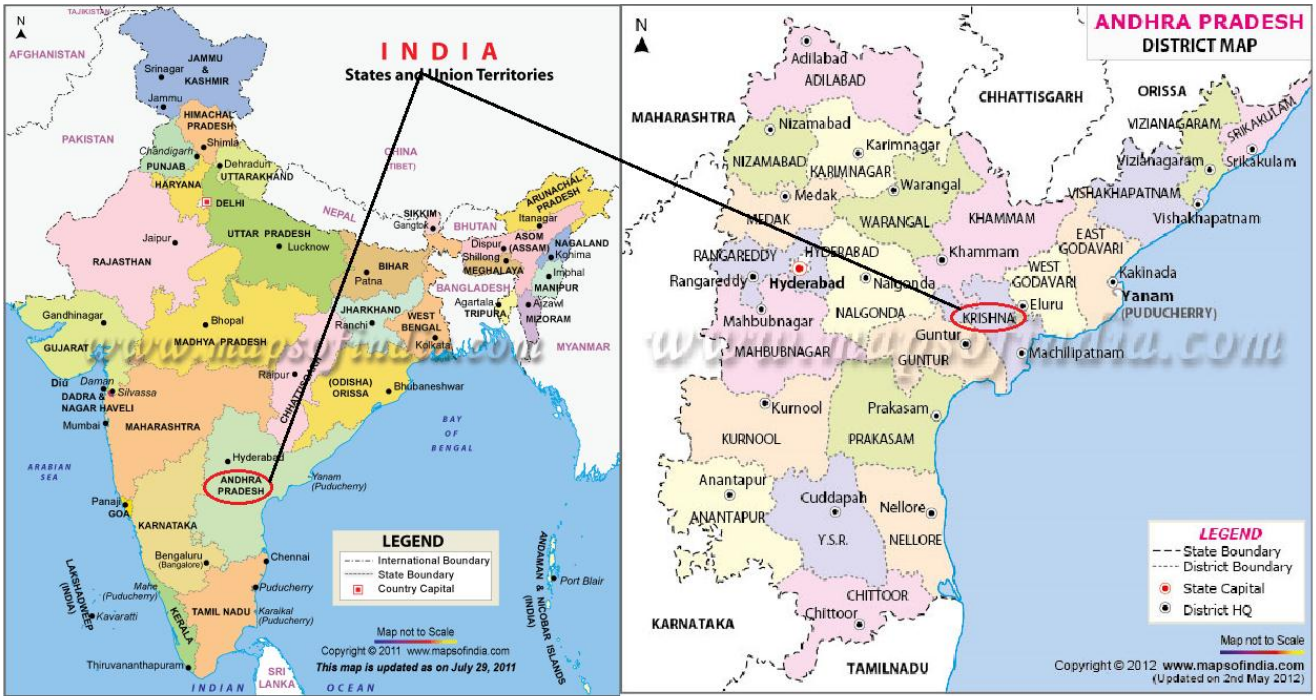
The estimated life-time of the project activity is 15 years.

1.9 Project Location

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

Geographical Location of the project activity: Latitude: 20.217°N

Longitude: 72.794°E



Nearest Railway Station: Vijayawada
Nearest Airport: Vijayawada

Indicative Map:

1.10 Conditions Prior to Project Initiation

This is a green field project. Presently there is no AAC block/brick manufacturing facility in the project location.

Clay brick manufacturing, an alternative brick manufacturing technology and the baseline scenario as identified in section 2.4 below involves two key processes: (a) producing green bricks and (b) sintering/firing the green bricks in a kiln. The sintering process requires huge amount of thermal energy inputs which is sourced majorly from the fossil fuel (coal) combustion with a small quantum from combustion of biomass in the form of fuel wood.

Production of AAC blocks and panels does not require any sintering process as the project activity eliminates the burning of fossil fuel as required in the clay brick production.So the amount of such energy, which is required in the project activity scenario, is much lower than the thermal energy required in clay brick manufacturing process. Therefore, the project activity enables total energy reduction and its associated GHG reduction due to change in brick production process. It may be worthwhile to note that there will be some emissions associated to production and consumption and transportation (to site) of raw materials (flyash, cement, Gyspum, Aluminium and lime) used in the project activity, which will be considered for as leakages to project activity. The details are given in below and ER sheet.

1.11 Compliance with Laws, Statutes and OtherRegulatory Frameworks

The project obtained all statutory clearances from relevant Indian authorities such as license by Inspector of Factories, NOC provided by Pollution Board.

1.12 Ownership and Other Programs

1.12.1 Right of Use

Purchase order of equipment, clearances and land document in name of GBMIPL, helps in establishing GBMIPL as owner of credits generated from this project. But GBMIPL will only claim VCS credit.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project is hosted by India where there is no national level binding limit in brick manufacturing units.

1.12.3 Other Forms of Environmental Credit

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

1.12.4 Participation under Other GHG Programs

The project has not applied for any other credits registration program.

1.12.5 Projects Rejected by Other GHG Programs

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

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project is taken up as a stand-alone project.

Leakage Management

Leakage emissions, as identified under the applied methodologies and tools, are being deducted from gross emission reduction generated by the project. Further, the monitoring plan of the project activity includes detailed description of monitoring plan required to collect all leakage related data.

Commercially Sensitive Information

No portion of the information contained in this document is considered to be publicly sensitive by GBMIPL.

Further Information

No additional consideration required.

2 APPLICATION OF METHODOLOGY

2.1 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. “Demonstration of additionality of smallscale project activities” , Version (10), (EB 83)

   http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.1.0.pdf

2.2 Applicability of Methodology

Compliance of project activity with applicability criteria 2 to 13 has been demonstrated below:

Applicability Criteria	***Compliance by project***

1. *The methodology comprises one or more technology/measures listed below in brick production facilities:* a) *Shift to an alternative brick production technology/process; or* b) *Complete/Partial substitution of fossil fuels with renewable biomass (including solid biomass residues such as sawdust and food industry organic liquid residues); or* c) *Complete/partial substitution of high carbon fossil fuels with low carbon fossil fuels*	The project activity is a New facility (Greenfield project activity) which entails shift from baseline scenario brick production technology Fixed chimney BTK (a high energy intensive process) to project scenario - an alternative brick production technology AAC Technology (low energy intensive process) – therefore the project activity meets the applicability criterion. The term shift has been used in context of the baseline scenario or the common practice scenario for brick manufacture in host country.
2. *The measures may replace, modify, retrofit or add capacity to systems in existing facilities or be installed in a new facility.*	The project activity measure itself is a whole new facility. Thus, the project activity meets the applicability criterion.
3. *Complete or partial fuel substitution and associated activities may also result in improved energy efficiency of existing facility; however project activities primarily aimed at emission reductions from energy efficiency measures shall apply AMS-II.D "Energy efficiency and fuel switching measures for industrial facilities". Thus, the methodology is applicable for the production of:* a) *Bricks that are the same in the project and baseline cases; or* b) *Bricks that are different in the project case versus the baseline case due to a change(s) in raw materials, use of different additives, and/or production process changes resulting in reduced use or avoidance of fossil fuels for forming, sintering (firing) or drying or other applications in the facility as long as it can be demonstrated that the service level of the project brick is comparable to that of the baseline brick (as per paragraph 11) Examples include pressed mud blocks (soil blocks) with cement or lime stabilization and other „unburned" bricks that attain strength due to fly ash, lime/cement and gypsum chemistry.*	Not Applicable. The project was not implemented at an existing facility.
4. *New facilities (Greenfield projects) and project activities involving capacity*	The project falls under the Type III Greenfield projects (new facilities) and the most plausible

additions are only eligible if they comply with the requirements for Greenfield projects and capacity increase projects specified in the "General Guidelines for SSC CDM methodologies".	baseline scenario for this project activity is "the burnt clay brick manufacturing using conventional technologies". This project activity baseline is in line with the baseline requirements of the Type III small-scale methodology. Thus, the project activity meets the applicability criterion. Emission reductions per year is less than 60 kt every year in the crediting period.
5. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the General Guidance for SSC methodologies. If the remaining life time of the affected systems increases due to the project activity, the crediting period shall be limited to the estimated remaining lifetime, i.e, the time when the affected systems would have replaced in the absence of the project activity.	The project activity is not a replacement or retrofit to an existing facility. The project activity is being implemented as a New facility (Greenfield project). Thus the criterion under discussion is not applicable.
6. For existing facilities, it shall be demonstrated, with historical data, that for at least three years immediately prior to the start date of the project implementation, only fossil fuels (no renewable biomass) were used in the brick production systems that are being modified or retrofitted. In cases where small quantities of biomass were used for experimental purposes this can be excluded.	The project activity is not a replacement or retrofit to an existing facility. The project activity is being implemented as a New facility (Greenfield project). Thus the criterion under discussion is not applicable.
7. The biomass utilized by the project activity shall not be chemically processed (e.g. esterification to produce biodiesel, degumming and/or neutralization by chemical reagents) prior to the combustion but it may be processed mechanically (e.g. pressing, filtering)/thermally (e.g. gasification to produce syngas)	In the proposed project activity there is no use of biomass. So there is no scope of any mechanical or chemical treatment of the renewable biomass through the project activity. Thus the criterion under discussion is not applicable.
8. In cases where the project activity utilizes charcoal produced from biomass as fuel, the methodology is applicable provided	In the proposed project activity there is no use of charcoal produced from renewable biomass as fuel. Thus the criterion under discussion is

that: a) *Charcoal is produced in kilns equipped with a methane recovery and destruction facility; or* b) *If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered.*	not applicable.
9. In the case of project activities involving changes in raw materials (including additives), it shall be demonstrated that additive materials are abundant in the country/region according to the following procedures: *Step 1: Using relevant literature and/or interviews with experts, a list of raw materials to be utilized is prepared based on the historic and/or present consumption of such raw materials.* *Step 2: The current supply situation for each type of raw material to be utilized is assessed and their surplus availability is demonstrated using one of the approaches below:* i. *Approach 1: Demonstrate that the raw materials to be utilized, in the region of the project activity, are not fully utilized. For this purpose, demonstrate that the quantity of material is at least 25% greater than the demand for such materials or the availability of alternative materials for at least one year prior to the project implementation.* ii. *Approach 2: Demonstrate that suppliers of raw materials to be utilized, in the region of the project activity, are not able to sell all of their supply of these materials. For this purpose, project participants shall demonstrate that a representative sample of suppliers of the raw materials to be utilized, in the region, had a surplus of material (e.g., at the*	Applicable and fulfilled. As per clarification number SSC_518, surplus availability is not required to be demonstrated for raw materials which are industrial products having commercial value. However, surplus availability of waste materials used as raw material in the project activity should be demonstrated. For the proposed project activity, only fly ash is a waste product and surplus availability of fly ash has been demonstrated in line with Approach 1 provided by the methodology. As per annual report of Central Electricity Authority, Government of India [3] , the utilisation of fly ash was 57%, resulting in a surplus availability of 43%.

[3] Page 82 of the report available at: http://www.cea.nic.in/reports/yearly/annual_rep/2009-10/ar_09_10.pdf

<table>
<tr>
<td>end of the period during which the raw material is sold),which they could not sell and which is not utilized.</td>
<td></td>
</tr>
<tr>
<td>10. This methodology is applicable under the following conditions:
a) The service level of project brick shall be comparable to or better than the baseline brick, i.e., the bricks produced in the brick production facility during the crediting period shall meet or exceed the performance level of the baseline bricks (in terms of for example dry compressive strength, wet compressive strength, density). An appropriate national standard shall be used to identify the strength class of the bricks, bricks that have compressive strengths lower than the lowest class bricks in the standard are not eligible under this methodology. Project bricks are tested in nationally approved laboratories at 6 months interval (at a minimum) and test certificates on compressive strength are made available for verification;</td>
<td>The applied methodology satisfies the following applicable conditions to the project case:
(a) The service level of the project brick is higher than the baseline bricks. The comparative data of the project bricks & baseline bricks are provided below:

Table B.2.2: Comparison of Service level of the project bricks with baseline bricks:
<table>
<tr><td>Parameters</td><td>Baseline Bricks</td><td>Project Bricks</td></tr>
<tr><td>Minimum Compressive Strength(N/mm^2)</td><td>2.5-3</td><td>3.5-4</td></tr>
<tr><td>Dry density (kg/m^3)</td><td>1800</td><td>550-700</td></tr>
</table>
Source: http://aac-india.com/aac-blocks-vs-clay-bricks/

In the context of testing of bricks/blocks, the SSC WG, at its 22nd meeting clarified as follows:

“The testing can be undertaken based on the national/regional standards or guidelines applicable to the type of project activity bricks. Testing can also be undertaken as per the procedures provided by the technology provider as long as the testing methods can be substantiated with reference to peer reviewed literature i.e. relevant international journal, publications, publications of national/international building research centres etc.
As long as the testing procedures in the guidelines/standards are met, the testing itself can be undertaken in polytechnics, engineering colleges, building centers, national laboratories etc.”

Further the service level of the project brick will be tested as per above ruling of SSC WG at 6 months interval and test certificates on compressive strength will be made available for verification through the crediting period in line with the methodology requirements to evidence</td>
</tr>
</table>

	that service level of the project brick is higher than the service level of the baseline brick.
10b) The existing facilities involving modification and/or replacement shall not influence the production capacity beyond ±10% of the baseline capacity unless it is demonstrated that the baseline for the added capacity is the same as that for the existing capacity in accordance with paragraph 4 of the methodology	The project activity is not a replacement or retrofit to an existing facility. The project activity is being implemented as a New facility (Greenfield project). Thus the criterion under discussion is not applicable.
10c) Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually.	Emission reductions from the project activity are estimated to be around 56107 tCO2 /annum, which is less than the methodology limit of 60 ktCO2e annually. Thus the criterion under discussion is applicable.
11. This methodology is not applicable if local regulations require the use of proposed technologies or raw materials for the manufacturing of bricks unless widespread non compliance (less than 50% of brick production activities in the country comply) of the local regulation evidenced.	The project activity adopts a new technology. The local regulation does not require the brick manufacturers to install any specific technology of brick manufacturing. With regards to use of raw material in brick production - there is a local regulation on use of fly ash (one of the proposed raw material for project blocks) for the manufacturing of bricks. As per MoE&F Notification dated 14th September 1999 and its amendments dated 27th August 2003 and 3rd November 2009, use of 50% fly ash in brick manufacturing units set up within 100 km of a coal or lignite based thermal power plant is mandatory. Therefore local regulation requires the use of raw material fly-ash for manufacturing of bricks but the widespread non-compliance rate is very high. As per data taken from “Graph I: Model of Fly-ash Utilization for year 2009-10” on page 93 of the Central Electricity Authority Annual Report 2010 – 11 (Reference: http://www.cea.nic.in/reports/yearly/annual_rep/2010-11/ar_10_11.pdf), of the 62.6% utilization of fly ash generated (77.34 Million tons per annum), annually, that consumed in bricks manufacturing is a meagre 7%.that commensurate to 5.11MT per annum. The absence of compliance of the aforesaid

	notification has been mentioned in the report. Reasons behind the noncompliance vary from inappropriate quality of the fly ash available, to high transportation costs and lack of adequate technological and financial support from the regulatory or funding institutions, as have been reported in the experimental study by B.V.M Engineering College, Gujarat, and presented in the "National Conference on Recent Trends in Engineering and Technology" (Reference: Section on limitations regarding utilization of fly ash as provided in the report available at: http://www.bvmengineering.ac.in/docs/published%20papers/civilstruct/Civil/101004.pdf). The increase in cost of fly ash based bricks production, compared to the BAU practice of manufacturing clay bricks, resulting from the above factors deter the brick manufacturers from utilizing fly ash, thus leading to low compliance of the aforesaid notification, as has been mentioned in "Utilization of Fly-ash by Brick Manufacturers - Environmental Costs vs. Benefits", a report sponsored by the MoEF (GoI) (reference: Paragraph 4 of the study available at: http://www.mse.ac.in/completed/proj-flyash.htm). These facts have been further corroborated through studies published in the Indian Concrete Journal[4] and independent publications[5] by INSWAREB (Institute for Solid Waste Research& Ecological Balance – an NGO that has made significant contribution to the utilization fly ash in India) in response to the above notification. Hence, it can be concluded from the above discussion that: i. There is no regulation that mandates the use of any specific technology for brick manufacturing ii. There is widespread non-compliance of the regulation to use 50% of fly-ash for brick manufacturing within 100 km of a thermal power plant. Hence the applicability condition is not relevant for the project activity. However it should be noted that GBMIPL's plant is located within 100 km radius of a coal based thermal power plant

[4] Conclusion section in page 21 and point of view section in the report available at: http://www.icjonline.com/forum/point_of_view.pdf

[5] Pages 2, 3, 5 and 7 of the report available at: http://www.fal-g.com/nattach/files/SuggestionstoDNonFAdt._6-11-08.pdf

	and is using more than 50% fly ash, complying with the notification.
12. In cases where the project activity utilizes biomass sourced from dedicated plantations, applicability conditions prescribed in the tool "Project emissions from cultivation of biomass" shall apply.	The proposed project activity does not utilizes biomass. Thus the criterion under discussion is not applicable.
13. The following cases are exempted from 'determining the occurrence of debundling' as per the "Guidelines on assessment of debundling for SSC project activities": (a) Project activities that aggregate brick units with holistic production cycles i.e. from raw material procurement to finished product, where each unit is not larger than 5 per cent of the Type III small-scale CDM project activity thresholds i.e. 3,000 t CO_2e; or (b) Project activities that aggregate brick units, where each unit qualifies as Type III microscale CDM project activity and the geographic location of the project activity is a least developed countries/small island developing states (LDC)/(SIDS) or special underdeveloped zone (SUZ) of the host country as identified by the government in accordance with the guideline on "Demonstrating additionality of microscale project activities".	For PP, this is the first such project. Hence this condition is not relevant.

Thus, the project activity fulfils the applicability criteria of AMS-III.Z, version 5.0, and accordingly the application of the methodology is justified.

2.3 Project Boundary

Project boundary has been delineated in line with paragraph 13of the methodology, *"The project boundary is the physical, geographical site where the brick production takes place during both the baseline and crediting periods. It also includes all installations, processes or equipment affected by the switching. In cases where the renewable biomass is sourced from dedicated plantations it also includes the area of the plantations. In cases involving thermo-mechanical processing of the biomass (e.g. charcoal; briquettes; syngas) the sites where these processes are carried out shall be within the project boundary."*

In both Baseline & Project Scenario, boundary is depicted diagrammatically as below:

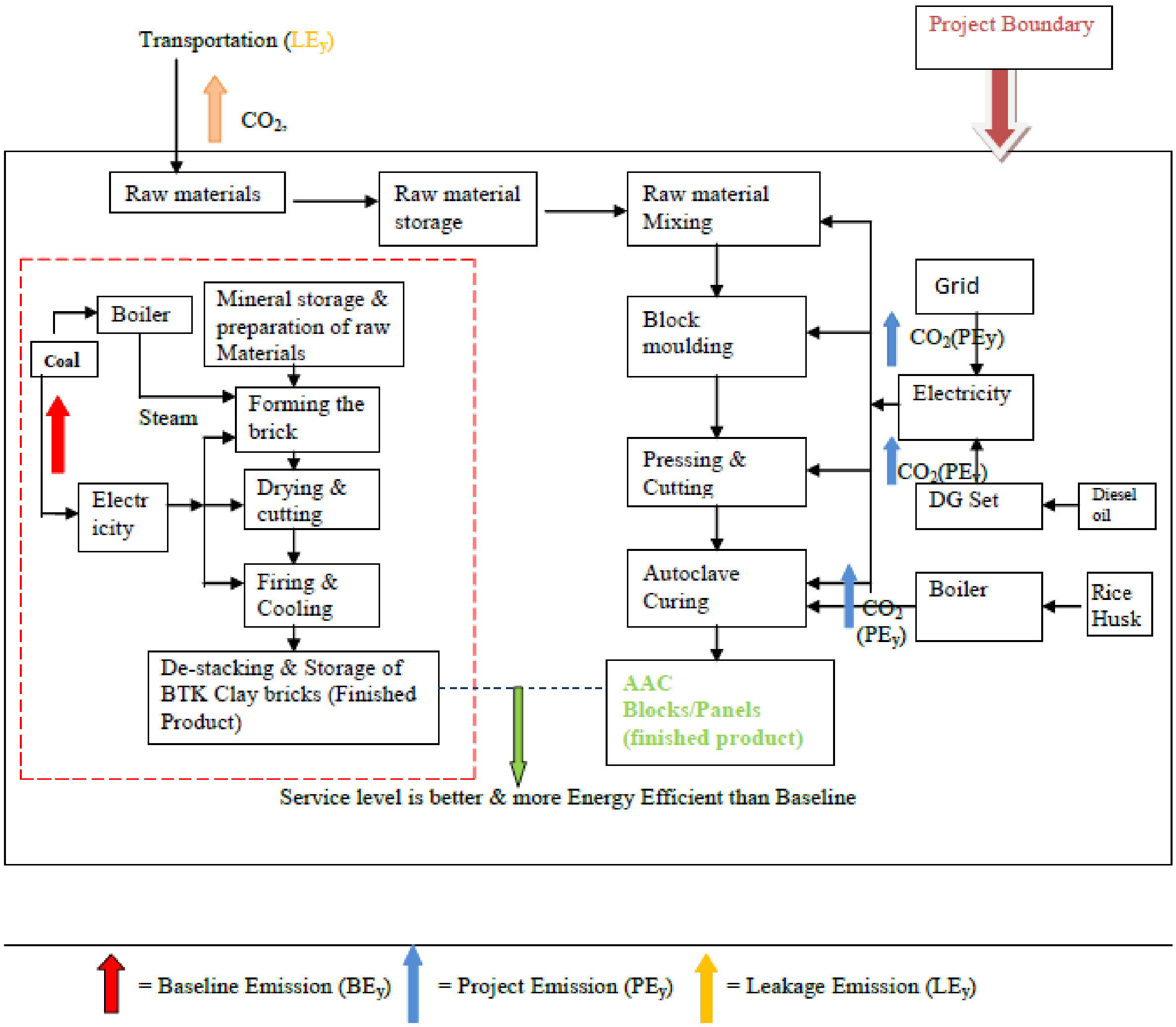


Figure 3: Schematic diagram of boundary at the crediting period

Source		Gas	Included?	Justification/Explanation
Baseline	Fossil fuel combustion in redclay brick kiln	CO_2	Yes	Main emission source
		CH_4	No	Neglected for simplicity
		N_2O	No	Neglected for simplicity
		Other	No	Neglected for simplicity
Project	Electricity consumption for operating plant machinery	CO_2	Yes	Main emission source
		CH_4	No	Neglected for simplicity
		N_2O	No	Neglected for simplicity
		Other	No	Neglected for simplicity
Leakage	GHG emissions during raw material production	CO_2	Yes	Main emission source
		CH_4	No	Neglected for simplicity
		N_2O	No	Neglected for simplicity
		Other	No	Neglected for simplicity
	GHG emissions during raw material transportation	CO_2	Yes	Main emission source
		CH_4	No	Neglected for simplicity
		N_2O	No	Neglected for simplicity
		Other	No	Neglected for simplicity

2.4 Baseline Scenario

As per paragraph 20 of the methodology AMS-III.Z Version 05,

"The baseline emissions are the fossil fuel consumption related emissions (fossil fuel consumed multiplied by an emissions factor) associated with the system(s), which were or would have otherwise been used, in the brick production facility (ies) in the absence of the project activity.

(a) *For projects that involve replacing, modifying or retrofitting systems in existing facilities, the average of the immediately prior three-year historical fossil fuel consumption data, for the existing facility, shall be used to determine an average annual baseline fossil fuel consumption value. Similarly, prior three year historical production data (excluding abnormal years) for the existing facility, shall be used to determine an average annual historical baseline brick production rate in units of weight or volume. For calculating the emission factor for fossil fuel, reliable local or national data shall be used. IPCC default values shall be used only when country or project specific data are not available or demonstrably difficult to obtain;*

(b) *For projects involving the installation of systems in a new facility or a capacity addition in an existing system, the average annual baseline fossil fuel consumption value and the baseline brick production rate shall be determined as that which would have been consumed and produced, respectively, under an appropriate baseline scenario. If the baseline scenario identification as per paragraph 4 above results in more than one alternative technologies with different levels of energy consumption, the alternative with* *the least emissions intensity should be chosen for determining the baseline emissions* of the facility."

The project activity is implemented at a new facility, i.e. it is a Greenfield project activity. As per the methodology AMS-III.Z Version 05 (Fuel Switch, process improvement and energy efficiency in brick manufacture), for new project activities, the project activity should be in compliance with the general guidelines to SSC CDM methodologies. Accordingly, the baseline to the project activity has been determined in line with the general guidelines. As per paragraph 37 of the General Guidelines to SSC CDM methodologies, Version 21, the baseline for Type II and Type III project activity types are established as follows:

"Type II and III Greenfield projects (new facilities) may use a Type II and Type III small scale methodology provided that they can demonstrate that the most plausible baseline scenario for this project activity is the baseline provided in the respective Type II and Type III small-scale methodology. The demonstration must include an assessment of the alternatives of the project activity using the following steps:

Step 1:
Identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.

Step 2:
List the alternatives identified in Step 1 that are in compliance with the local regulations. If any of the identified baselines is not in compliance with the local regulations, then exclude the same from further consideration.

Step 3:
Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests specified in "Guidelines on the demonstration of additionality of small-scale project activities".

Step 4:
If only one alternative remains that is:
(a) Not the proposed project activity undertaken without being registered as a CDM project activity; and
(b) Corresponds to one of the baseline scenarios provided in the methodology; then the project activity is eligible under the methodology. If more than one alternative remain that correspond to the baseline scenarios provided in the methodology, choose the alternative with the lowest emissions as the baseline."

<u>Step 1 of the Guidelines</u>
The alternative scenarios to the project activity comprises of different walling materials that are available in India. Based on the different walling materials, the alternatives available to GBMIPL which would have comparable levels of output are as follows:

Baseline alternative scenario	**Alternative Walling Materials**	**Alternative description**
A	AAC Blocks	The project activity undertaken without being registered as a VCS project activity, i.e., installation of a 150,000 m^3/annum AAC blocks manufacturing unit (1st phase installation, in subsequent phases the capacity will be limit to 240,000 m^3/annum. AC used for construction material. The AAC blocks produced would conform to relevant national standard.
B	Baked Clay Bricks	The prevailing alternative technology in the bricks sector, that deliver outputs or services (e.g. electricity, heat or cement)

		with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology. Prevailing alternative for walling material manufacturing in India is baked (fired) clay brick manufacturing through the application of various technologies [6] (as VSBK, Fixed Chimney BTK, Moveable Chimney BTK, Tunnel Kiln, Clamp and other Batch Kilns, etc.) and fuels[7]). These bricks have comparable properties with those of the AAC blocks, in terms of quality and application areas (construction purpose). The estimated production of burnt clay bricks is to the tune of 140 billion out of total 151.83 billion brick equivalent[8]. **Hence this is evidently the most prevailing alternative to the project activity.**
C	Fly-ash bricks	Manufacturing of fly-ash bricks having comparable quality and application area as AAC block. There is a local regulation on use of fly ash (one of the raw material for project blocks) for the manufacturing of bricks. As per MOEF Notification dated 14th September 1999 and its amendments dated 27th August 2003 and 3rd November 2009, use of 50% fly ash in brick manufacturing units set up within 100 km of a coal or lignite based thermal power plant is mandatory. As per data taken from "Graph I" on page 82 of the Central Electricity Authority Annual Report 2009 - 10[9], of the 57.11[10]% utilization of fly ash generated annually, that consumed in bricks manufacturing is a meager 9%. The absence of compliance of the aforesaid notification has been mentioned in the report [11] submitted jointly by Akanksha Tiwari and Anubhav Sogani to the regional MoEF office of the Western Region of India. Reasons behind the non-compliance vary from inappropriate quality of the fly ash available, to high transportation costs and lack of adequate technological and financial support from the regulatory or funding institutions, as have been reported in the experimental study[12] by B.V.M Engineering College, Gujarat, and presented in the "National Conference on Recent Trends in Engineering and Technology". In the state of Gujarat itself, incompatibility of the soil in mixing with the fly ash was cited

[6] Page 27 of the report: Strategies for Cleaner Walling Material in India; http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf
[7] Page 26 of the report: Strategies for Cleaner Walling Material in India; http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf
[8] Strategies for Cleaner Walling Material in India, footnote 3 in page 1 of the document; http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf
[9] http://cea.nic.in/reports/yearly/annual_rep/2009-10/ar_09_10.pdf
[1010] Page 82 of the report: http://moef.nic.in/downloads/public-information/MoEF-IIFM-thermal-power-plants.pdf
[11] Page 82 of the Report: http://moef.nic.in/downloads/public-information/MoEF-IIFM-thermal-power-plants.pdf
[12] Section on limitations regarding utilization of fly ash as provided in the report available at: http://webcache.googleusercontent.com/search?q=cache:http://www.bvmengineering.ac.in/docs/published%2520papers/civilstruct/civil/101004.pdf

		as one of the major reasons by the brick manufacturers contending[13] the notification. The increase in cost of fly ash bricks production, compared to the BAU practice of manufacturing clay bricks, resulting from the above factors deter the brick manufacturers from utilizing fly ash, thus leading to low compliance of the aforesaid notification, as has been mentioned in "Utilization of Fly-ash by Brick Manufacturers - Environmental Costs vs. Benefits", a report[14] sponsored by the MoEF (GoI). These facts have been further corroborated through studies published in the Indian Concrete Journal [15] and independent publications [16] by INSWAREB (Institute for Solid Waste Research& Ecological Balance – an NGO that has made significant contribution to the utilisation fly ash in India) in response to the above notification. Hence, it can be concluded from the above discussion that there is widespread non-compliance of the regulation to use 50% of fly-ash for brick manufacturing within 100 kms of a thermal power plant. Hence fly-ash bricks cannot be considered as an alternative to the project activity.
D	Cement stabilized soil blocks	Manufacturing of cement stabilized soil block having comparable quality and application area as AAC block. However the penetration of this technology is to the tune of only 0.1% [17]. Hence this cannot be construed as the prevailing alternative to the project activity.
E	Concrete blocks	Manufacturing of concrete blocks having comparable quality and application area as AAC block. The estimated production of concrete blocks is to the tune of 9 billion out of total 151.83 billion brick equivalent which corresponds to 5.9% of total walling materials[18]. Hence the production of concrete blocks as an alternate walling material cannot be construed as the prevailing alternative to the project activity.
F	FAL-G bricks	Manufacturing of FAL-G bricks having comparable quality and application area as AAC block. The estimated production of FAL-G bricks is to the tune of 2.4 billion out of total 151.83 billion brick equivalent which corresponds to only 1.6% of total walling materials[19]. Hence the production of FAL-G bricks as an alternate walling material cannot be construed as the prevailing alternative to the project activity

[13] Paragraph 4 of the news article available at: http://www.business-standard.com/india/news/brick-makers-seek-exemptiongreen-guidelines/188758/
[14] Paragraph four of the study available at: http://www.mse.ac.in/completed/proj-flyash.htm
[15] Conclusion section in page 21 and point of view section in the report available at: http://www.icjonline.com/forum/point_of_view.pdf
[16] Pages 2, 3, 5 and 7 of the report available at: http://www.fal-g.com/nattach/files/SuggestionstoDNonFAdt._6-11-08.pdf
[17] Strategies for Cleaner Walling Material in India, http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf
[18] Strategies for Cleaner Walling Material in India, http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf
[19] Strategies for Cleaner Walling Material in India, http://shaktifoundation.in/wp-content/uploads/2014/02/strategies%20for%20cleaner%20walling%20materials%20in%20india.pdf

Step 2 of the Guidelines
All the baseline alternatives identified under step 1 above, are in compliance with local laws and regulations.

Step 3 of the guidelines: Referring to "Guidelines on the demonstration of additionality of small-scale project activities", version 09:

"Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) **Investment barrier**: *a financially more viable alternative to the project activity would have led to higher emissions*
(b) **Technological barrier**: *a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions*
(c) **Barrier due to prevailing practice:** *prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions*
(d) **Other barriers**: *without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher."*

The project proponent has used the "barrier due to prevailing practice" and "other barriers" to determine the most plausible baseline for the project activity.

As demonstrated in Step 1 above, since burnt clay bricks are the prevailing walling material that is widely used in India and since the market share of other bricks/blocks manufacturing technology is negligible as compared to the burnt clay bricks, options C, D, E, & F have not been taken forward for further analysis. Hence only alternative A and alternative B have been carried forward for further analysis.

The barrier analysis for identified scenarios is carried out as follows:

Barrier	**Scenario A – Manufacture of fly ash based AAC blocks without CDM benefit in consideration**	**Scenario B – Baked clay brick manufacturing**
Barrier due to prevailing practice	Faces "Barrier due to prevailing practice — Fly ash based AAC block is not the prevailing walling material used or manufactured in India. As per, "Strategies for cleaner walling material in India"[20], AAC blocks have low penetration in India which is to the tune of only 0.2% and fired clay bricks are currently prevalent in Indian walling industry and the scenario is expected to be same in future. AAC block project activity technology, unlike the	Does not face Barrier due to prevailing practice – Baked clay bricks manufacturing is an age old and widely followed process for construction brick manufacturing in India. The brick manufacturing industry in India is predominantly constituted of conventional clay bricks manufacturing units. There are several small capacity kilns and few large capacity kilns in India. As per Status Report on VSBKs in India[21], there are more than 100,000 fired clay brick kilns in India, manufacturing more than 140 billion

[20] http://www.enzenglobal.com/pdf_downloads/strategy_walling.pdf(Page #10)
[21] http://www.cosmile.org/papers/brick_statuspaperVSBKsindia2003.pdf(page #2)

	traditional clay brick making, requires recipe control of several main ingredients namely fly ash, cement, lime and water etc. at the mixing step. In case there are changes to the sources of the raw materials, the chemistry and hence the recipe needs to be reworked. Hence it requires the intervention of advanced technologies leading to much higher investments. AAC blocks being a relatively newer product as compared to baked clay bricks in India, there is high scarcity of skilled operators for successfully running the AAC block manufacturing unit. For operating the unit, special on the job training needs to be provided to operators. On the contrary, clay brick production is a simple commonly used technological practice and is practiced at the cottage industry level. Small fired clay brick producers have no incentives to introduce alternate technologies, which require new investments, training to stabilize the operation, and a different business practice in long-term perspective. Burnt clay bricks are therefore the most prevalent walling material used and manufactured in India and is also expected to remain the most prevalent walling material in the future unless significant regulatory mechanisms are evolved and enforced. — Further, the price of AAC blocks has to be kept lower than burnt clay bricks due to the reasons of market resistance to fly ash containing AAC blocks, as mentioned below.	bricks per year. This is further corroborated through recent data published in "Strategies for cleaner walling material in India" [22] which estimates that out of 151.83 billion brick equivalent, burnt clay bricks contribute 140 billion brick equivalent. Hence there is an overwhelming prevalence of burnt clay bricks in walling materials used in India. The fuel used is coal. As a result, there is much easier availability of skilled operators for successfully running a clay bricks manufacturing unit. Raw material is clay which is available to the brick manufacturer from his surroundings. Manufacturing of burnt clay bricks does not require very sophisticated technology and the technique used is proven and widely practiced for many decades. Burnt clay bricks continue to be the most popular form of walling material, accounting for most of the total market in the country. This is supported by studies done by organizations like TERI[23].
Other Barriers – Market Acceptability barrier	— Building construction using AAC blocks is not a common practice in India. According to a studies conducted by market research agency IMRB International, given the wall area addition in India in	<u>Does not face this barrier</u> The consumer in India is preferentially biased towards clay bricks. A clay bricks manufacturer does not require any additional marketing efforts for selling the complete production output.

[22] http://www.enzenglobal.com/pdf_downloads/strategy_walling.pdf(Page #10)
[23] http://www.cosmile.org/papers/brick_statuspaperVSBKsindia2003.pdf

	2007 - 08, the share of AAC blocks is low at less than 1%. This fact is evidence of the extremely low market acceptance of the product, and poses additional risk to GBMIPL, in terms of reduced demand and corresponding under utilization of the plant. It may also be noted that the plant has been operating at a lower capacity due to lower demand of the AAC block — The research report alluded earlier to, also presents viewpoints of builders and consultants in construction industry, wherein the choice of AAC block as construction material is found to be negligible compared to clay bricks. The negative perception about the durability and quality of AAC blocks arises from low consumer awareness about the product. In addition to the grey color of AAC blocks imparted by the color of fly ash, the mere presence of ash in the product also creates negative perception, affecting the sales of product in the market.	

<u>Step 4 of the Guidelines</u>

From the above barrier analysis, it can be concluded that alternative B is the only alternative which is not prevented by any barrier. Thus, there is only one alternative remaining, which is not the project activity undertaken without VCS benefits in consideration. Thus, the most plausible alternative (Alternative B) derived from the above analysis is considered as baseline to the VCS project activity.

Thus, the baseline to the project activity is:

Manufacturing of fired-clay bricks through conventional fired clay brick production processes

The identified baseline scenario, as mentioned earlier, includes different technologies with different levels of energy consumption. Hence, a weighted average energy use of these technologies has been considered for determining the baseline emissions of the facility or facilities.

2.5 Additionality

The additionality of the project activity has been demonstrated in line with Guidelines on the demonstration of additionality of small-scale project activities", version 09" and additoanlity tool for small scale project

As per the guidelines:

Project participants shall provide an explanation to show that the project activity would not have occurredanyway due to at least one of the following barriers:

a) Investment barrier
b) Technological barrier
c) Barrier due to prevailing practice
d) Other barriers

The project proponent has used the "barrier due to prevailing practice" and "other barriers (market acceptability barrier)" to determine the most plausible baseline for the project activity.

Detailed analysis of the barriers being faced by the project activity has been undertaken as part of baseline determination under section 2.4 of the PD. The barriers being faced by the project activity introduces several risks to the project, which are expected to be mitigated through the additional revenue from sale of certified emission reductions (CERs) generated by the proposed CDM project activity.

Thus, in view of the above discussion, it can be concluded that the project activity is additional.

Analysis of local and national policies w.r.t the project activity:

There is no regulation in the state of Andhra Pradesh or from the Central Government of India, which mandates the installation of an AAC blocks manufacturing plant, nor is there any mandate that prevents the manufacturing of bricks through conventional processes.

Thus, the project activity is not mandated by any state or national agency of India.

2.6 Methodology Deviations

There are no methodology deviations in the project activity.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 BaselineEmissions

As per Section B.4 of the PDD, 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:

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

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 (EF_{BL}) 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 PD, the common practice technology in this sector is red clay fired clay bricks, across all plant capacities in India. Publicly available documents[24] 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. 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

[24] 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

3.2 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 (PE_y) 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"[25], version 4.0.

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:

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

Where:

PE_y	Project emissions in year *y* (tCO_2)
$PE_{elec,y}$	Project emissions due to electricity consumption in year *y* (tCO_2)
$PE_{fossilfuel,y}$	Project emissions due to fossil fuel consumption in year *y* (tCO_2)
$PE_{transporty}$	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".*

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

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[26] 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).
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

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

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)[27].

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

[27] 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				

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:

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 4.0) 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)[28]

2010-11	4,76,986.7213
2011-12	5,02,300.3809
2012-13	5,39,385.3723

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

Simple Operating Margin (t CO_2/MWh) (incl. Imports)[29]

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:

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

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

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

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[30]

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:

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

$EF_{grid,BM,y}$ = Build 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

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

[30]Refer the Emission Reduction sheet for detailed calculations

($EF_{grid,OM,y}$) 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[31]
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)

Option B2: Use the following conservative default values:

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

- 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.
CO_2 emission factor (TCO_2/TJ)	74.8	2006 IPCC Guidelines for National Greenhouse Gas Inventories Table 1.4 – Default CO_2 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	tCO_2/MWh

So emission factor for electricity generation determined as per guidance for scenario A: Electricityconsumption from the grid was found to higher and therefore more conservative than emission factor forelectricity generation determined as per guidance for scenario B: Electricity consumption from an off-gridcaptive 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 themanufacturing production site shall be accounted for following the procedures in AMS-III.AK “Biodieselproduction 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, theproject emissions from renewable biomass cultivation shall be calculated as per the relevantprovisions 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.

3.3 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 project activity, usage of rice husk is less compared to availability of rice husk in the region. The supply exceeds more than 50% than the demand by the project and usage in the other purpose. DPR is submitted in this effect to the validation team for checking.

“*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 Allumium Powder production has been considered as a conservative approach. On the other hand, the Gypsum is a by product from hydrofluoric acid and fertiliser 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

3.4 NetGHG Emission Reductions and Removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2013-14	59904	1583	23254	35067
2014-15	95846	2533	37206	56107
2015-16	95846	2533	37206	56107
2016-17	95846	2533	37206	56107
2017-18	95846	2533	37206	56107
2018-19	95846	2533	37206	56107
2019-20	95846	2533	37206	56107
2020-21	95846	2533	37206	56107
2021-22	95846	2533	37206	56107
2022-23	95846	2533	37206	56107
Total	922518	24380	358108	540030

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EF_{BL}
Data unit	$tCO2/m^3$
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[32] 2. "Energy Conservation and Pollution Control in brick kilns" report by Sameer Maithel, N Vasudevan, Lt. Col. Rakesh Joshi (Retrd.)[33] 3. Density of bricks taken from www.reade.com[34]
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
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

32 http://www.faculty.ait.ac.th/visu/Prof%20Visu's%20CV/Books%20and%20research%20reports/BRICK%20AND%20CERAMIC.pdf
33 http://www.cosmile.org/papers/brick_statuspaperVSBKsindia2003.pdf
34 http://www.reade.com/Particle_Briefings/spec_gra2.html

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:	<table><tr><td>Vehicle Class</td><td>Emission factor (gCO2/tKm)</td></tr><tr><td>Heavy Vehicles</td><td>129</td></tr></table>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	-

4.2 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:	240,000
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 in a year
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:	35760
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 in a year
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:	14160
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 in a year
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:	1200
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 in a year
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:	86.4
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 in a year
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 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:	101280
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:	3.75
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	$\mathbf{EC_{PJ,y}}$
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:	2400 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 can be done.
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	$\mathbf{D_{f,y}}$
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: 40

	Cement	260
	Lime	3348
	Gypsum	972
	Aluminium Powder	1022
	Rice husk	50
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	

4.3 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.
- 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	

Detailedresponsibilityofeachmemberinthemonitoring teamisprovided below:

Sr. No	Tasksdescription	Operator(s)	Supervisor	Plant Manager	CDM monitorin g project manager
Monitoring activity					
1	Recording of monitored data	√	√		
QualityAssurance & QualityControl					

2	Verification ofdata monitored (consistencyand completeness)		√	√	
3	Ensuring adequate training ofstaff			√	√
4	Ensuring adequate maintenance		√	√	√
5	Data archiving: ensuring adequate storage ofdata monitored (integrity and backup)			√	√
6.	Identificationofnon-conformanceand corrective/preventive actionsandmonitoring plan improvement			√	√
7	Emergency procedures		√	√	
Calculation of GHG emission reductions and reporting					
8	Processing ofdata and calculation of emission reductions				√
9	Monitoring report: managementreviewof monitoring report (internal audit)			√	√

All data would be 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 would been sourced by periodic verification of data by VCS monitoring project manager. All data would be stored for a minimum of 2 years 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.

5 ENVIRONMENTAL IMPACT

As per the prevailing regulations of the Host Party i.e. India represented by the Ministry of Environment and Forests (MoEF), Govt. of India, Environment Impact Assessment Notification no. 3067 dated 01/12/2009[35], and the project activity does not require Environment Impact Assessment to be conducted. The facility does not produce any pollution in manufacturing process but proposes to use the waste products like fly ash which create environmental pollution by increasing dust levels of atmosphere. The fossil fuel consumption by the baseline is avoided as demonstrated earlier, in the project activity. Hence there is positive impact on the environment due to this small scale project activity of reducing the pollution caused by fly ash and fossil fuels. The following conditions are applicable to establish that the project activity is environment friendly:

[35] http://www.moef.nic.in/downloads/rules-and-regulations/3067.pdf

i. There shall be no nuisance due to industrial activity to surroundings.
ii. The handling of fly ash *i.e.* transport, loading and storage shall be done in a scientific manner so as to avoid fugitive emissions and nuisance.
iii. Water shall be sprinkled on stored fly ash to avoid fugitive emissions.

The project activity has obtained the No Objection Certificate for Consent to Establishment & Operation from the State Pollution Control Board for establishing the manufacturing unit of Autoclaves Aerated Concrete (AAC) Blocks by using fly ash as the main raw material which is the by-products of the nearby thermal power station.

The facility does not produce any pollution in manufacturing process but proposes to use the waste products like fly ash which create environmental pollution by increasing dust levels of atmosphere.

Hence there is positive impact on the environment due to this small scale project activity of reducing the pollution caused by fly ash and fossil fuels.

6 STAKEHOLDER COMMENTS

The identified stakeholders were villagers, officers from the Municipal Corporation, farmers around the project area, and representatives of project developers. These identified stakeholders were invited through letters. Stakeholders were given project introduction and informed about its objective through a verbal presentation. The information shared included the project description, objective, environmental impacts and benefits, applicability of technology, implementation strategy, case studies where technology implemented has been successful internationally, global and local benefits, contribution towards sustainable development, and status of project implementation.

The presentation was followed by a detailed open discussion with the identified stakeholders.

The stakeholders‟ consultation started with a brief presentation from representatives of GBMIPL about the project activity and its benefits. The stakeholders' consultations were well attended with a number of participants coming from the local residents, farmers around the project area.

The consultation process started with welcome speech by GBMIPL representative, who gave brief description about the company, about the process of AAC block/panel manufacturing technology and its positive environmental benefits. The stakeholders raised their concern on environmental and social impact of the project, and were appropriately addressed by the project proponent.

The feedbacks from different stakeholders of the project activity are positive and encouraging.

Project Investors	Invitation Date	Meeting Date	Location of the Local Stakeholder Meeting		
			Village	District	State
Greenway Building Materials India Pvt. Ltd.	15/03/2014	24/03/2014	Paritala	Krishna	Andhra Pradesh[36]

[36] When the Local Stake holder meeting was conducted, the site was coming under Andhra Pradesh state. Now it is in new incorporate Telangana State.

Annex – 1

Sampling Plan:

Quality of the Product

Tests will be conducted to validate that the project bricks meet the performance requirements and specifications in line with the following sampling plan which includes the following information -

To validate that the service level of product is better than that of the baseline product, PP will monitor the mean value of the dry compressive strength of the project activity output at six-month intervals during the crediting period and with a 90/10 confidence. The product that does not match necessary compressive strength requirements will be excluded from the production.

Target population will be the production of AAC Blocks starting from the 1st output obtained on the date of commercial operation and thereafter every six months.

The simple random sampling method will be used.

Simple random sampling is suited to populations that are homogeneous. Since the AAC Blocks are manufactured through a fixed composition the output is homogenous in nature.

Sample size the estimated target number of "units" – pieces of equipment, solar cookers, buildings, motors, log-books, etc. – which are to be studied (i.e. the sample size).

The sample size calculations are based on a proportion (or percentage) of interest being the objective of the project, under Simple random sampling method. The following are pre-determined in order to estimate the sample size:

(a) The value that the proportion is expected to take;
(b) The level of precision, and confidence in that precision (90/10 for all small-scale projects)

The equation to give us the required sample size is:

$$n \geq [1.645^2 * N * p(1-p)] \div [(N-1) * 0.1^2 * p^2 + 1.645^2 p(1-p)]$$

Where:
n - Sample size
N - Total Production
p - Our expected proportion (0.50)
1.645- Represents the 90% confidence required
0.1 -Represents the 10% relative precision

Sampling frame would include the AAC Block production on the date of commercial operation and thereafter production every month.

Data will be collected randomly by the operators and submitted to Supervisor manager for further testing.