Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	'India-FaL-G-Brick and Blocks Project No.2'
Reference number of the project activity	4585
Version number of the monitoring report	Version number 01
Completion date of the monitoring report	May 06, 2013
Registration date of the project activity	Jun 20, 2011
Monitoring period number and duration of this monitoring period	Monitoring Report No.1 August 01, 2011 to March 31, 2013, inclusive of both the days.
Project participant(s)	Please Refer Section A.3
Host Party(ies)	India
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope : 04 Approved Methodology Type III, AMS-III-Z. Fuel Switch, Process improvement and energy efficiency in Brick Manufacture (Version 03).
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	18,823 ERs vide registered PDD for 1y 8m.
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	17,477 ERs for Aug 2011 to March 2013, for 1y-8m covered by this Monitoring Report.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

'India-FaL-G-Brick and Blocks Project No.2' is primarily a bundled activity of small and micro-industrial plants those practice an eco-friendly technology known as 'FaL-G Technology', using fly ash as one of the main inputs. FaL-G bricks replace sintered clay bricks, contributing to mineral and energy conservation. By avoiding use of thermal energy in the production of fly ash bricks the project contributes for conservation of fossil fuel (coal), and, in turn, abates associated emissions. Fly ash bricks replace clay bricks as walling material serving all functional and performance criteria with better engineering properties.

The Technology

It is a known art since millennia that addition of lime to fly ash initiates pozzolanic chemistry, which can be augmented through hydro-thermal treatment in autoclaves at high temperature (150-180 ^{o}C) and pressure (8-12 bar). The innovative part of FaL-G technology is to accelerate pozzolanic chemistry by adding gypsum by which the development of ettringite phase to threshold limits invigorate the strengths of fly ash-lime mix. Therefore, FaL-G does not require energy intensive equipments such as heavy duty-press and autoclave, which were otherwise required in case of erstwhile fly ash brick technologies. FaL-G technology completely eliminates thermal treatment, and does not require combustion of any fossil fuel.

The key ingredients of the FaL-G products are fly ash, lime, and gypsum, which are well-known mineral substitutes. All these materials are available in the form of byproducts from industrial activities and are available in adequate quantities in the areas, where the project activities are located. By-product lime is available at competitive cost over the mineral lime. Alternate to FaL-G in lime route, the technology has also been developed in cement (OPC) route, whereby the surplus lime in cement gets into pozzolanic chemistry. It is economical to use OPC than mineral lime and, hence, OPC is preferred in areas where by-product lime is scarce or not available, may be due to profuse FaL-G activity. In view of quality and logistical issues in procuring lime many entrepreneurs adopt FaL-G in OPC route.

The process-flow chart is enclosed as Figure 1.

The project also contributes to sustainable development in many ways as explained below, thus getting qualified under CDM. By displacing burnt clay bricks the project contributes for:

- Ecology protection by minimising eco-hostile practice of topsoil denudation and resultant land degradation;
- Pollution abatement otherwise caused by emission of unprocessed flues out of brick kilns.
- Environment protection by putting to use industrial wastes as value added building materials.

On social front, the project creates business opportunities for the small and micro enterprises. In contrast to the seasonal production-operations in the clay brick industry, FaL-G plants facilitate continuous yearlong operation, and hence provide employment all through the year for the skilled artisans and create self-help livelihood for the illiterate poor.

By taking advantage of CDM program, this project targets to catalyse proliferation of huze number of fly ash brick industries in the country, in order to prevent the use of 200 billion clay bricks and resultant emissions of over 48.40 million tons.

Notwithstanding the intrinsic environmental and social benefits of the project, the specific community benefit program, particularly the health and accident insurance schemes being implemented to meet the requirements of the Community Development Carbon Fund (CDCF) of the World Bank, would enhance the benefits further.

FaL-G has its antecedents from the ancient pozzolanic chemistry practiced over 2000 years back. The modern knowledge on material science has helped to pronounce the process with technical rationale. Basically two machines do involve for a plant; roller (pan) mixer for preparation of FaL-G and casting machine to cast the product.

It needs over 2 to 4 weeks for the development infrastructure. Otherwise the plant can be installed in one day and production can be started immediately. The plant is normally operated for single shift. However, depending on the seasonal demand, extra hours of operation is not uncommon. Similarly the efficiency of man power decides the output rather than the rated capacity of plant.

This project has earned 17,477 CERs for Aug 2011-Mar 2013, for the 1y-8m covered by this Monitoring Report.

The PDD and associated documents can be accessed from UNFCCC web site http://cdm.unfccc.int/Projects/DB/DNV-CUK1300267994.99/history

A.2. Location of project activity

Project activity is located in various districts of the State of Andhra Pradesh and Tamilnadu, India. Please refer Table 1 for details of the units and their geographical coordinates.

A.3. Parties and project participant(s)

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)	• Eco Carbon Private Limited (ECPL)	No
Canada	• Ministry of Foreign Affairs & International Trade	No

	Denmark	• Aalborg Portland A/S • Danish Ministry of Climate and Energy-Danish Energy Agency • Dong Naturgas A/S • Maersk Olie og Gas A/S • Nordjysk Elhandel A/S	No	
	Finland	• Ruukki Metals Oy	No	
	Luxembourg	• Ministry of the Environment	No	
	Italy	• International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (“CDCF”) • Ministry for the Environment, Land and Sea	No	
	Netherlands	• International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (“CDCF”) • Netherlands’ Ministry of Infrastructure and the Environment (IenM)	No	
	Spain	• Endesa Generación, S.A. • Hidroeléctrica del Cantábrico, S.A. • Ministry of Environment and Rural and Marine Affairs; Ministry of Economy and Finance • Gas Natural SDG, S.A. • EDP-Energias de Portugal, S.A.	No	
	Switzerland	• Schweizerische Ruckversicherungsgesellschafts AG (Swiss RE)	No	
	Belgium	Walloon Region Ministry of the EnvironmentBruxelles Environment - IBGE		
	Germany	• BASF SE • KfW	No	

Japan	• Daiwa Securities Capital Markets Co. Ltd. • FUJUFILM Corporation • Idemitsu Kosan Co. Ltd. • JX Nippon Oil and Energy Corporation • The Okinawa Electric Power Corporation,, Incorporated	No
Sweden	• Göteborg Energi AB	No
Norway	• Statoil ASA • Statkraft Carbon Invest AS	No
Austria	• Kommunalkredit Public Consulting GmbH	No

A.4. Reference of applied methodology

Approved Methodology Type III, AMS-III-Z. Fuel Switch, Process improvement and energy efficiency in Brick Manufacture (Version 03).

A.5. Crediting period of project activity

Fixed Ten years ie., August 01, 2011 - July 31, 2021, inclusive of both days.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The Start Date of the Project activity is 01/06/2004.

This CDM project has been submitted as a bundle of 11 plants located in different districts in the state of Andhra Pradesh and Tamilnadu, India, and operated by individual entrepreneurs called Sub-Project Entities (SPEs). However unit with ID No. AP/VZM/II/11 has defaulted on the agreement with regard to compliance of documents and hence subjected for termination in 2011; another unit with ID No. AP/GTR/II/6 has withdrawn voluntarily due to personal reasons. Hence no credits have been claimed for these two units since April 2011 onwards. Thereby, the number of operating units qualified for earning credits is 11 till March 2011 and reduced to 9 there on, and their aggregate capacities district-wise are as follows:

States	District	No. of Plants	Capacity m^3/year 2011-12
Tamilnadu	Kanchipuram	1	11,998
Andhra Pradesh	Prakasam	4	16,560
	Guntur		Voluntarily withdrawn
	Krishna	1	4,050
	East Godavari	2	7,110
	Visakhapatnam	1	3,600
	Vizianagaram		Terminated
TOTAL		**9**	**43,318**

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

Nil

B.2.2. Corrections

Nil

B.2.3. Permanent changes from registered monitoring plan or applied methodology

Nil

B.2.4. Changes to project design of registered project activity

Nil

B.2.5. Changes to start date of crediting period

Nil

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

The monitoring has been conducted in harmony with the monitoring plan discussed in PDD.

Tables in Section D elucidate the data to be monitored and the frequency of monitoring. Accordingly the data have been collected and archived as per schedule, and emission reductions have been computed at the end of the year.

<u>Monitoring Approach - QC & QA Measures Adopted:</u>

Project Entity (PE) developed templates on various data for monitoring and provided to SPEs. SPEs submit monthly reports to PE consisting of production on daily basis and other data on monthly basis. Upon receipt, the monthly reports are reviewed by the monitoring personnel of PE and electronically archived for consolidation. The total data, together with daily reports, are kept ready for submission to DOE for verification.

The monitoring personnel of PE make random visits to SPEs, during which they verify the production records, stock registers and purchase bills to check the diligence of the monthly data. The production output in a small-scale plant does not go by label capacity, and is governed by the manpower number, their efficiency and working hours in a day. Electricity consumption is recorded from the electricity bills issued by the State Electricity Department.

In arriving to baseline emissions total (actual) electricity consumption without any deductions would be taken as a conservative approach.

The responsibility for calibration of power meters lies with the State Electricity Board. The State Electricity Board is required to follow the national standard set by the Central Electricity Authority, Ministry of Power, Government of India, Clause 18 of Gazette Notification No. 502/70/CEA/DP&D dt. 17.3.2006, to undertake calibration of power meters once in 5 years. The consumer does not have any control over the process. Currently, State Electricity Boards do not have established calibration schedules and the government regulation is also not enforced stringently, especially for domestic consumers and small scale industrial consumers, like the FaL-G plants.

Monitoring Methodology as per AMS III.Z does not specify calibration requirements for electricity meters. The general guidance for SSC-CDM projects, paragraph 17 (c) and (d), specifies that "Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards". This sentence in the general guidance goes on to require that recalibration should be undertaken at least once in three year. Despite best of efforts if recalibration is not done as per the current CDM requirements, the project will submit a request for revision at the time of verification, referring to clause 7 of the *Guidelines for Assessing compliance with the calibration frequency requirement*. (Annex 60 of EB 52 meeting report).

The line diagram is attached as Figure II showing the monitoring points.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	EF_{BL}
Unit:	t CO_2/ m^3
Description:	The parameter is Annual production specific emission factor. The units are derived based on the calorific value of fuel, which was duly documented by TERI.
Source of data:	TERI (Emission Standards for Brick Kilns-an opportunity for technology upgradation. (http://www.brickindia.com/articledetail.asp?id=36&cat=5)
Value(s) applied):	0.2683 t CO_2/ m^3

Purpose of data:	The baseline coal consumption is determined considering different technologies used in the production of burnt clay bricks, as studied by TERI at national level. Since it is difficult to determine precisely a particular technology that would be used in the absence of project activity, a weighted average coal consumption of these technologies is considered to best represent the baseline coal consumption in lieu of the weighted average energy use suggested by methodology. The annual production specific emission factor is thus computed based on the weighted average coal consumption. Use of biomass represents less than 2% in terms of fuel input in the production of clay bricks, which is conservatively taken as 5%, keeping in view the periodical escalation that may take place in the future.
Additional comment:	This value is fixed ex-ante.

Data / Parameter:	**EF_{EL}**
Unit:	t CO_2/ MWh
Description:	The parameter is emission factor for electricity. The value for emission factor is taken from the Tool to make the project emissions due to electricity to be on higher side and ERs as conservative.
Source of data:	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01)"
Value(s) applied):	1.3 ton CO_2 per MWhe.
Purpose of data:	AMS III - Z recommends calculating the project emissions in accordance with the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". The tool has given options for determining the emission factor for electricity generation, and facilitated to adopt a conservative default value of 1.3 tCO_2/ MWh as one of the options. In this background the default value is taken for emission factor.
Additional comment:	The emission factor for electricity is fixed ex-ante. As and when there is revision in this value the revised value will be taken for Verification.

Data / Parameter:	**EF_{CO2}**
Unit:	**tCO_2/TJ**
Description:	The parameter is emission factor for diesel which is taken from 2006 IPCC Guidelines.
Source of data:	2006 IPCC Guidelines on National GHG Inventories:' Table 1.4 - Default CO_2 Emission factors for Combustion' of Chapter 1 of Vol 2. Default value at the upper limit of the uncertainty at a 95% confidence interval is taken as recommended.
Value(s) applied):	74.8 t CO_2/ TJ at NCV of 43TJ/Gg

Purpose of data:	AMS III-Z recommends calculating the project emissions from fossil fuel in accordance to the "Tool to calculate project or leakage emissions from fossil fuels (version02)". The tool has given four options for emission factor from diesel out of which IPCC default value is one option. This can be adopted in the absence of invoices by fuel supplier containing the emission factors. Such data are not available with small scale units who purchase diesel in small quantities.
Additional comment:	The emission factor and Net Calorific Value (NCV) of diesel, taken from IPCC 2006, is fixed ex-ante. However should there be any revision in IPCC values in future the same would be taken for Verification. While this default value is applicable on weight basis (per Gg ie., 1000 tons), the data from SPEs is monitored on volume basis based on the purchase bills that are mentioned with units in litres. Hence litres would be multiplied by density of 820kg/KL (http://www.siamindia.com/scripts/Diesel.aspx) in order to arrive to weight-units (tons).

Data / Parameter:	**EF_{OPC}**
Unit:	t CO_2/ ton of cement
Description:	The parameter is emission factor for OPC, which is on higher side for conservative approach. National average based on prevailing production practices of cement production in the country.
Source of data:	The value is taken based on the technical coverage in Press Information Bureau, Government of India. http://www.pib.nic.in/release/release.asp?relid=55724
Value(s) applied):	0.82 ton CO_2 per ton of cement as conservative approach. This value is fixed ex-ante.
Purpose of data:	To compute emissions due to leakage.
Additional comment:	With more and more concern for energy efficiency and conservation of fuel, cement industry in India is striving to reduce the emission factor for OPC. This has resulted in emission factor at as low as 0.77 in some cement plants. However a factor of 0.82 is taken as a conservative value.

Data / Parameter:	**EF_{ML}**
Unit:	t CO_2/ ton of CaO
Description:	The parameter is emission factor for mineral lime and is taken based on the commercially available lime .
Source of data:	2006 IPCC Guidelines for National Green House Inventories; Table 2.4 of Volume 3.
Value(s) applied):	0.42 t CO_2/ ton of CaO . The emission factor for lime is fixed ex-ante. However should there be any revision in IPCC values in future the same would be taken for Verification.

Purpose of data:	For computing emissions due to leakage.
Additional comment:	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 to ensure conservativeness, the highest lime purity of 53% for commercial limes is taken into consideration, and emission factor is computed using the stoichiometric ratio of 0.785 tones CO_2/ ton of CaO as per above referred table.

D.2. Data and parameters monitored

Data / Parameter:	**Production-**$P_{PJ,y}$
Unit:	m^3 bricks/ blocks
Description:	SPE maintains the actual quantities of production in number on daily basis, based on each size of brick/block, which is duly converted to volume (m^3) to facilitate computations.
Measured/ Calculated / Default:	Calculated based on production number. SPEs record the production of bricks/ blocks on daily basis. These are made available to PP once in a month.
Source of data:	Stock registers of SPE.
Value(s) of monitored parameter:	94,415.85 m3
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	Daily.
Calculation method (if applicable):	Number of bricks and blocks are converted to cubic meter for uniformity.
QA/QC procedures:	Upon receipt of the monthly data on brick/ block production and fuel use (electricity and or /diesel) from the plants, PE will review the data. The personnel of PE will make periodical visits to SPEs' plants to check the diligence of record keeping and the accuracy for ultimate diligence of emission computations.
Purpose of data:	For baseline emissions.
Additional comment:	N.A

Data / Parameter:	**Electricity-$EC_{PJ,j,y}$**
Unit:	kWh
Description:	The electricity consumption is monitored continuously by the Electricity Meter and recorded by the Service Provider (State Electricity Department) monthly or bimonthly based on which the Electricity bills are provided.

Measured/ Calculated / Default:	Measured out of meters by service provider
Source of data:	Electricity bills provided by the service provider (state electricity department).
Value(s) of monitored parameter:	202,183 kWh
Monitoring equipment:	Electricity meters installed by service providers.
Measuring/ Reading/ Recording frequency:	Monthly/bimonthly as decided by the service provider.
Calculation method (if applicable):	N.A
QA/QC procedures:	SPEs submit to PE the electricity bill as provided by the Service Provider. The information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose ECPL personnel are imparted with in-house training
Purpose of data:	To compute project emissions.
Additional comment:	Nil

Data / Parameter:	**Diesel-FC_y**
Unit:	Litre
Description:	Consumption of diesel would be provided by SPEs to PE on monthly basis.
Measured/ Calculated / Default:	Measured by diesel pumps at purchase point.
Source of data:	Stock register.
Value(s) of monitored parameter:	43,641 litres
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	Recorded in the stock register whenever purchased.
Calculation method (if applicable):	NA
QA/QC procedures:	Pumps at diesel filling stations are calibrated periodically as per statutory stipulations.
Purpose of data:	For computing project emissions.

Additional comment:	All the information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose in-house training is imparted to ECPL personnel. Consumption is cross checked with the purchase bills.

Data / Parameter:	**Cement-Q_{OPC}**
Unit:	Tons
Description:	Purchase details are provided by the SPEs through monthly statement.
Measured/ Calculated / Default:	Calculated based on purchase bills.
Source of data:	Purchase bills of cement.
Value(s) of monitored parameter:	5,009.86 tons
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	As and when purchased.
Calculation method (if applicable):	The leakage emissions for using Cement is derived based on the default values of national average.
QA/QC procedures:	Upon receipt of the monthly data of purchase bills, the personnel of PE will make periodical visits to SPEs' plants to check the diligence of record keeping.
Purpose of data:	To compute emissions due to leakage
Additional comment:	Quantities of cement as per purchase bills would be taken for computation of leakages.

Data / Parameter:	**Mineral Lime-Q_{ML}**
Unit:	Tons
Description:	Purchase details are provided by the SPEs through monthly statement.
Measured/ Calculated / Default:	Calculated based on purchase bills.
Source of data:	Purchase bills of lime
Value(s) of monitored parameter:	9,168.09 tons
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	As and when purchased.

Calculation method (if applicable):	Based on purchase bills.
QA/QC procedures:	All the information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose in-house training is imparted to ECPL personnel.
Purpose of data:	For computing emissions due to leakage
Additional comment:	The object of monitoring lime purchases is to compute the leakage emissions. Purchase bills may not be available when by-product lime is procured. In such case delivery challans would be accepted for computing the quantity of procurement. The leakage is taken into account only when lime from mineral source is procured. In the case of by product lime, the data is recorded, but no leakages are accounted for as the same would not have any impact.

Data / Parameter:	**Performance of project brick/block in terms of Compressive Strength once in six months**
Unit:	MPa
Description:	The brick/ block is tested in a Compressive strength Testing Machine (CTM) in any of the laboratories of polytechnics, engineering colleges, building centers, national laboratories etc., and the test certificates are provided by the laboratory.
Measured/ Calculated / Default:	N.A
Source of data:	Test Certificate as provided by the testing laboratories
Value(s) of monitored parameter:	MPa
Monitoring equipment:	The test procedure is followed as per Annex 9 of PDD.
Measuring/ Reading/ Recording frequency:	Once in six months.
Calculation method (if applicable):	N.A
QA/QC procedures:	Calibration of CTM for strength test is taken care by respective laboratories and outside the project boundary.
Purpose of data:	Quality control
Additional comment:	Nil

D.3. Implementation of sampling plan

Sampling plan has been implemented as per available methodology guidelines.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Baseline and its Development:

As per AMS III-Z the baseline emissions are the emissions related to fossil fuel consumption (fossil fuel consumed multiplied by an emission factor) associated with the systems(s), which were or would have otherwise been used, in the clay brick production facility in the absence of project activity.

The approved methodology suggests "For project involving installation of systems in a new facility, the average annual historical 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 identified includes different technologies with different levels of energy consumption, a weighted average energy use of these technologies can be considered for determining the baseline emissions of the facility or facilities."

The project activity involves setting up new facilities for production of bricks and blocks by adopting the FaL-G technology, which results in emission reductions. The baseline is therefore the fossil fuel consumption of the facilities that would otherwise be built in the absence of the project in order to meet the demand for walling material, comparable in quality and utility to that of bricks and blocks produced through FaL-G technology. Under Indian conditions coal is only fossil fuel used in the manufacture of clay brick. The data on walling material market (provided in table 1.2) show that burnt clay bricks represent more than 95% of the total walling material market. Production of burnt clay bricks is therefore considered the baseline scenario.

In the absence of the project activity, it is expected that the burnt clay brick manufacturing using conventional technologies will continue to meet the walling material demand in the country resulting in substantial CO_2 emissions. Production of burnt clay bricks employs different technologies with different levels of coal consumption. Since it is difficult to determine precisely a particular technology that would be used in the absence of project activity, a weighted average coal consumption of these technologies is considered to best represent the baseline coal consumption in lieu of the weighted average energy use suggested by methodology. The technologies, which are banned by regulation, have not been considered in calculating the weighted average coal consumption.

The different technologies that are used to produce burnt clay bricks include clamps, Movable Chimney- Bull Tranche Kilns (MCBTK), Fixed Chimney-Bull Tranche Kiln (FCBTK), High Draft Kilns (HDKs) and the recently introduced Vertical Shaft Brick Kiln (VSBK) technology. Concerned over the increasing pollution from brick industry, the Government of India has already banned the use of MCBTK and it does not issue any clearances/approvals to set up new brick units using MCBTK. Therefore, MCBTKs have not been considered in the baseline. The baseline specific coal consumption (coal use for production of unit volume of bricks/blocks) is determined by considering the remaining technologies and their prevalence in the market using the data presented in the table

1.1 below. Annual production specific emission factor is then computed based on the specific coal consumption and its calorific value. (source[1] : Emission Standards for brick kilns- An opportunity for Technology upgradation by Sameer Maithel, The Energy Research Institute (TERI), India).

In the context of applicability of above values it is to be clarified that baseline of brick manufacturing process is same as that of 500 years back. New technologies in clay brick such as VSBK would have caused reduction in energy consumption, but they could not penetrate due to various socio-logistical issues, and thus not widely used. Hence the applicability of thermal energy data can be much accepted.

Moreover, as conservative approach, baseline with weighted average thermal energy is taken as the basis out of various technological options available in clay brick production. Therefore the energy baseline continues to be the same.

Coal is the main source of energy used for manufacturing burnt clay bricks in India. The second choice of fuel is biomass, including fuel wood. In one of the studies undertaken by the FAO[2] the annual use of fuel wood in the entire brick industry in the country is reported to be only 300,000 tons, while the use of coal is reported to be about 14,000,000 tons. Thus use of fuel wood represents less than 2% in terms of fuel inputs of the total fuel requirement of the brick industry in all of India. Since the values reported in the FAO report do not distinguish between the renewable biomass and nonrenewable biomass, the actual fraction of renewable biomass (with zero emissions) is likely to be lower.

Further the situation with biomass, which was earlier available as a cheaper fuel, is changing rapidly nationwide. The ongoing initiatives for biomass-based power plants have introduced competition in the market, increasing the cost of biomass. In the absence of any precise information on the use of biomass in brick industry, it is proposed to fix the biomass usage in brick production conservatively at 5% of the total energy input, for all the areas included in the project. This figure is higher than the national average figure of less than 2% reported in the FAO report. In order to account for the zero emissions from the use of biomass, the emissions in burnt clay brick production is adjusted appropriately by multiplying it with a “biomass adjustment factor” (0.95 = 1 - 0.05). The baseline emission thus derived would be conservative.

The project activity is a bundle consisting of small scale units scattered throughout the country, resulting in variations in quality and quantum of coal used. Hence the project activity takes energy baseline based on National average. The amount of CO_2 emissions from burning of coal depends largely on the type of coal and its calorific value. Different types of coal are used in India for brick making. In order to address the variability in coal quality, the IPCC default carbon emission factor for Indian coal as 25.8 tC/TJ (IPCC) has been used to estimate the CO_2 emissions associated with burning of coal in the baseline.

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[1] http://www.brickindia.com/articledetail.asp?id=36&cat=5

[2] Source: FAO Field Document No. 35, “Regional Wood Energy Development Programme in Asia”, GCP/RAS/154/NET.

Estimating Baseline emissions:

Baseline Emissions are computed based on production of bricks and blocks in terms of m^3 as follows:

$BEy = EF_{BL} * P_{PJ,y}$ **Eq. 1**

where

BEy = The annual baseline emissions from fossil fuels displaced by the project activity in t CO_2e in year (of the crediting period)

EF_{BL} = The annual production specific emission factor for year y, in t CO_2/kg or m^3

$P_{PJ,y}$ = The annual net production of the facility in year y, in kg or m^3

The annual production specific emission factor (EF_{BL}) can be calculated ex ante as follows:

$EF_{BL} = (FC_{BL,i,j} \text{ x } NCV_j \text{ x } EF_{CO2,j}) / P_{Hy}$ **Eq. 2 (i)**

Where:

$FC_{BL,i,j}$ = Average annual baseline fossil fuel consumption value for fuel type *j* combusted in the process I, using volume or weight units

NCV_j = Average net calorific value of fuel type *j* combusted, TJ per unit volume of mass unit

$EF_{CO2,j}$ = CO_2 emission factor for fuel type j combusted in the process *i* in t CO_2/TJ

P_{Hy} = Average annual historical baseline brick production rate in units of weight or volume, kg or m^3

While Eq 8 gives gross emission in the baseline, biomass correction factor of 0.05 is taken for emissions and are deducted from gross emissions to be more conservative as already discussed under B.4. Thus net baseline emissions are computed as below and shown in ex-ante calculations of emission reductions.

Net BEy,x = BEy (1-0.05) **Eq. 2 (ii)**

The total emissions $BE_{y, total}$ in the baseline is represented by the formula

$BE_{y, total} = \Sigma \text{ Net BEy,x}$ **Eq. 3**

The total net emissions from the baseline scenario are estimated to be 24,065 tonnes of CO_2 equivalent per annum out of 9 plants included in the project. Ex-ante calculations vide Table under B6.3 may be referred for details.

E.2. Calculation of project emissions or actual net GHG removals by sinks

As per approved methodology III-Z project activity emissions (PEy) consist of those emissions associated with the use of electricity or fossil fuel or both and are calculated in accordance with the "Tool to calculate baseline, project and /or leakage emissions from electricity consumption" and/or "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (tCO_2e).

FaL-G plants do use electricity and/or diesel. In general wherever electricity is available, the same is used in the plant and, in places where electricity is not available, diesel is used to run the plant. However, in a few cases, some of those who run the plants with electricity do keep provision to operate diesel based generators in order to overcome intermittent power breakdowns.

Estimating emissions from electricity consumption

"Tool to calculate baseline, project and /or leakage emissions from electricity consumption" discusses the applicability of three scenarios to adopt the tool. Out of these three 'Scenario A' as given below is applicable for project activity.

Scenario A*: Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or. If any on-site captive power plant exists, it is not operating or it can physically not provide electricity to the source of electricity consumption.*

As per the tool the project emissions from the electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor for transmission losses, as follows:

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EL,j,y} \times (1+TDL_{j,y}) \qquad \textbf{Eq. 4}$$

Where:

$PE_{EC,y}$ Project emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,j,y}$ Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$ Emission factor for electricity generation for source j in year y (tCO_2/MWh)

$TDL_{j,y}$ Average technical and transmission and distribution losses for providing electricity to source j in year y

For determining the emission factor for electricity generation the tool facilitates to use conservative default value of 1.3 tCO_2 / MWh under Option A2 if Scenario A applies only to project and/ or leakage electricity consumption sources but not to baseline electricity consumption sources. Project activity falls under Scenario A hence uses the recommended default value of 1.3 tCO_2/ MWh for emission factor for electricity consumption as against the IPCC default value of 0.9 tCO2/MWh power generation. In the background of considering the conservative default value together with TDL, no additional TDL factor is considered in the project emissions due to electricity.

Thus project emissions due to electricity consumption are computed as below:

$$PE_{ECy,} = \sum_{j} EC_{PJ,j,y} \times EF_{EL,j,y}$$ **Eq. 5**

$PE_{EC,y}$ Project emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,j,y}$ Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$ Emission factor for electricity generation for source j in year y (tCO_2/MWh)

In arriving to baseline emissions total (actual) electricity consumption without any deductions would be taken as a conservative approach.

The responsibility for calibration of power meters lies with the State Electricity Board. The State Electricity Board is required to follow the national standard set by the Central Electricity Authority, Ministry of Power, Government of India, Clause 18 of Gazette Notification No. 502/70/CEA/DP&D dt. 17.3.2006, to undertake calibration of power meters once in 5 years. The consumer does not have any control over the process. Currently, State Electricity Boards do not have established calibration schedules and the government regulation is also not enforced stringently, especially for domestic consumers and small scale industrial consumers, like the FaL-G plants.

Monitoring Methodology as per AMS III.Z does not specify calibration requirements for electricity meters. The general guidance for SSC-CDM projects, paragraph 17 (c) and (d), specifies that "Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards". This sentence in the general guidance goes on to require that recalibration should be undertaken at least once in three year. Despite best of efforts if recalibration is not done as per the current CDM requirements, the project will submit a request for revision at the time of verification, referring to clause 7 of the *Guidelines for Assessing compliance with the calibration frequency requirement*. (Annex 60 of EB 52 meeting report).

The status of calibration of power meters of all the SPEs is given vide Table.2.

b). Estimating emissions from diesel consumption

Wherever electricity supply is not available, diesel is used to run the equipments and machinery in the plant. Consumption of diesel in the plant is monitored and recorded on a monthly basis, from which the annual consumption is calculated.

As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the default values of CO_2 emission factor of those fuels as follows:

$$PE_{FC,j,y,} = \sum_{i} FC_{i,j,y} \times COEF_{i,y}$$

$PE_{FC,y}$ = Project emissions from fossil fuel combustion in year y (tCO_2/yr)

$FC_{i,j,y}$ = Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i in year y (t CO_2/ mass or volume)

i = fuel types combusted in process j during the year y

Tool suggests calculating CO_2 emission coefficient based either on chemical composition or on net calorific value multiplied with CO_2 emission factor of the fuel type. In the present calculation the latter approach is considered. Accordingly the equation is as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

COEFi,y = the emission coefficient of fuel typei in year y (t CO2/mass or volume unit)

NCVi,y = the weighted average of net calorific value of the fuel type I in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = the weighted average CO2 emission factor of fuel type I in year y (t CO_2/GJ)

i = the fuel types combusted in process j during the year

Tool suggests four alternates for emission factor of diesel out of which one recommendation is to use IPCC default value. This is recommended in the absence of invoices, providing emission factors by the fuel supplier. The project activity consists of small scale units those purchase the diesel from retail dealers in small quantities but not on contract basis. Under these conditions no suggested data would be available. Hence recommended IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC guidelines on National GHG Inventories are taken for emissions from diesel.

Based on above, project emissions due to diesel consumption are computed as below:

$$PE_{FC,y,} = \sum_{i} FC_{i,jy} \times NCV \times EF_{CO2y} \qquad \textbf{Eq. 6}$$

$PE_{FC,y}$ = Project emissions from diesel consumed in year y (tCO_2/yr)

FC_y = Quantity of diesel consumed during the year y (litres/yr)

NCV_F = Net calorific value of diesel (GJ/t)

EF_{CO2y} = CO_2 emission factor (tCO_2/GJ)

The total project emissions PEy due to the project activities within the project boundary is thus represented by the formulae

$$PEy = \sum (PE_{ECy} + PE_{FC,y}) \qquad \textbf{Eq. 7}$$

E.3. Calculation of leakage

Estimating emissions due to leakage:

As per AMS III-Z leakage is applicable 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.

The activity outside the project boundary that leads to CO_2 emissions is the transport of raw materials to the FaL-G plants. Since substantial transport activity (for soil and coal) also occurs in the baseline to support clay brick activity (the baseline activity), as well as to support waste disposal activity (for various kinds of wastes - fly ash, gypsum etc.), net emissions associated with transport of raw materials, as per computation below, are observed to be insignificant and hence not included in the project emissions.

Emissions due to transport of raw materials

In the baseline activity

Production of bricks avoided, m^3/year	**4500**
Thermal energy requirement, GWhth/year @ 0.000725 GWhth/m^3	3.2625
Thermal energy requirement, kcal/year	2805245056
Thermal energy, kcal/year, after discounting for 5% use of biomass	2664982803
Calorific value of coal, kcal/kg	4500
Coal requirement, tons/year	592.2
Distance of availability of coal, kms	100-1000
Average distance of coal availability, kms	550
No. of trips @10 tons/trip	59.2
Diesel consumption, litres/year @ 4 litre/km	8143
CO_2 emission due to transport of coal, tCO_2/year@0.0032tCO_2/litre	**26.1**

In the project activity

For a typical FaL-G plant with production capacity of 4,500 m^3/ year
Lime route:

	Fly ash	**Lime**	**Gypsum**	**Stone dust**
Raw material requirement as % of product weight	14.50	8	2.50	75
Quantity in tons/year (FaL-G production @4,500 m^3/year)	1305	720	225	6750
Typical distance of raw material availability, kms	50-150	50-200	100-1000	10-50

Average distance of raw material availability, kms	100	125	550	30
Truck capacity, tons/trip	10	10	10	10
No. of trips per year	130.5	72	22.5	675
Distance travelled, kms/year	13050	9000	12375	20250
Fuel efficiency of trucks, km/litre	4	4	4	4
Diesel consumed, litres/year	3262.5	2250	3093.75	5062.5
CO2 emissions from diesel consumption @0.0032tons/litre(t CO_2/year)	10.44	7.2	9.9	16.2
CO_2 emissions due to transport of all raw materials = 10.44+7.2+9.9+16.2 t CO_2/ year	**43.74**			

OPC route:

	Fly ash	**OPC**	**Gypsum**	**Stone dust**
Raw material requirement as % of product weight	15.2	4.0	0.8	80
Quantity in tons/year (FaL-G production @4,500 m^3/year)	1368	360	72	7200
Typical distance of raw material availability, kms	50-150	50-200	100-1000	10-50
Average distance of raw material availability, kms	100	125	550	30
Truck capacity, tons/trip	10	10	10	10
No. of trips per year	136.8	36	7.2	720
Distance travelled, kms/year	13,680	4500	3960	21600
Fuel efficiency of trucks, km/litre	4	4	4	4
Diesel consumed, litres/year	3420	1125	990	5400
CO2 emissions from diesel consumption @0.0032tons/litre(t CO_2/year)	10.9	3.6	3.17	17.28
CO_2 emissions due to transport of all raw materials = 10.9+3.6+3.17+17.28 t CO_2/ year	**34.95**			

As per above computation of emissions due to transportation of the raw materials results as follows:

For baseline activity: 26.1 t CO_2
For project activity: 35 to 44 t CO_2 depending on the FaL-G recipe.

In the absence of data for energy consumption towards fly ash disposal, related leakage could not be computed. Otherwise, this is additional energy that the project conserves by consuming fly ash.

From above values it is evident that the net emissions out of transport are meagre and thus ignored.

In this project cement and lime are two inputs with significant emissions during their production and, thus need to be considered in the leakage computation.

As per AMS III-Z cement and / or lime would be monitored as per purchase bills and taken for computing leakages vide equations 5 and 6 respectively as below:

Leakage due to cement:

$E_{L,x} = E_{x,OPC} = Q_{OPC} \times EF_{OPC}$ **Eq. 8**

Where

Q_{OPC} = Quantity of OPC purchased (tons)

EF_{OPC} = CO_2 emission factor for OPC (tCO_2/ ton OPC)

Even though PPC is used the emission factor of which is lower in comparison to OPC, emission factor of OPC will be taken for computation as a conservative approach.

Leakage due to mineral lime:

$E_{L,x} = E_{x,ML} = Q_{ML} \times EF_{ML}$ **Eq. 9**

Where

Q_{ML} = Quantity of mineral lime purchased (tons)

EF_{ML} = CO_2 emission factor for mineral lime (tCO_2/ ton mineral lime)

EF_{ML} is arrived based on lime purity, which is tallying with IPCC default value

The total emissions due to leakage E_L is represented by the formulae

$$E_L = \sum_x E_{L,x}$$ **Eq. 10**

Emission Reductions:

Emission reduction generated by the project consisting of 9 plants (x=9) as computed by Eq.11 below is the difference between the baseline emissions, as represented by Eq.3 and, the project emissions as per Eq.7 and emissions due to leakage vide Eq.10

$ER = \sum(BEy, total - PEy - E_{L,x})$ **Eq. 11**

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Emission reductions are computed as the difference between baseline emissions and project emissions + emissions due to leakage.

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
2011-12 (8 m)	11,009.93	164.92	1,867.96	8,977.06
2012-13	13,055.25	213.03	4,341.69	8,500.54
Total	**24,065.18**	**377.95**	**6,209.65**	**17,477.60**

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)		
2011-12 (8 months)	7,529	8,977.06
2012-13	11,294	8,500.54
Total	**18,823**	**17,477.50**

E.6. Remarks on difference from estimated value in registered PDD

The difference may be attributed to various variables such as market demand, Unit performance and workers' availability. As done with large scale unit, this aspect cannot be attributed to specific reason due to heterogeneous locations and logistics.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	15,425	2,052

TABLE 1: LOCATION AND GEOMETRICAL COORDINATES

No.	Name & Address of SPE	SPE ID No.	Geographical Coordinates, Deg	
	Krishna District		North	East
	STATE OF TAMIL NADU			
	Kanchipuram Dist.			
1	NRK Infra Infra System Pvt. Ltd.,	TN/KCP/II/1	12.23	79.97
	Plot No. 62-64. Nallambakkam Village			
	Kattan Kulathyur Block,			
	Chengelput Taluk, TN			
	Kanchipuram Dist. TN			
	STATE OF ANDHRA PRADESH			
	Prakasam District			
2	Sagar Quality Bricks	AP/PSM/II/2	15.8	80.32
	Door No. 281/2. Nayuduvaripalem Village			
	Karamchedu Mandal, 523167			
	Prakasam Dist. AP			
3	Sri Varalakshmi Fly ash Bricks	AP/PSM/II/3	15.5	80.03
	Survey No. 83/1. Near Petrol Bunk,			
	Gundlapalle Village, Maddipadu Mandal			
	Prakasam Dist. AP			
4	Golden Brick Industries	AP/PSM/II/4	15.82	80.35
	Near AKP Junior College, Vadarevu Road,			
	Chirala, Prakasam Dist. AP			
5	Sai Niveditha Brick Industries	AP/PSM/II/5	15.68	80.22
	Near R.R.Exports, Polavari Palem			
	Chinna Ganjam, Prakasam Dist. AP			
	Guntur Distrrict			
6	Bhaskar Brick Industries	AP/GTR/II/6	15.9	80.47
	GBC Road, Vedullapalle - 522 317			
	Bapatla Mandal, Guntur Dist, AP			
	Krishna District			
7	Koneru Flyash Products	AP/KRIS/II/7	16.52	80.65
	opp: Madonna Deaf & Dumb School			

	Karmel Nagar			
	Gunadala, Krishna Dist. AP			
	East Godavari District			
8	Anaparthy Reddy FaL-G Brick Industry	AP/EG/II/8	16.54	82.23
	D. No. 1-215. Yanam Road, Uppalanka			
	Kakinada - 533016, East Godavari Dist			
9	Sai Lakshmi FaL-G Bricks	AP/EG/II/9	17.07	82.07
	Rajahmundry Road, Valuthimmapuram			
	Peddapuram Mandal, East Godavari Dist.			
	Visakhaptnam District			
10	Sri Sai Kripa Innovative Building Material	AP/VSP/II/10	17.6	83.07
	Industries, Survey No.163, Ravada Village			
	Paravada Mandal			
	Visakhapatnam Dist.			
	Vizianagaram District			
11	Sri Devi Building Material Industries	AP/VZM/II/11	17.9	83.22
	Appannadorapalem Village & Post			
	Kothavalasa Mandalam			
	Vizianagaram Dist. AP			

Table 2: Status of calibration of power meters of SPEs in Bundle 2

Sl. No.	Name of SPE	ID Number	Connected Load-HP	Date of Calibration	Class of meter
01.	NRK Infra Systems P. Ltd.	TN/KCP/II/1	89 KW	13.02.12	0.5
02.	Sagar Quality Bricks	AP/PSM/II/2	10	23.03.12	1.0
03.	Sri Varalakshmi Fly ash Bricks	AP/PSM/II/3	14.5	10.01.12	1.0
04.	Golden Bricks Industries	AP/PSM/II/4	10	08.02.12	1.0
05.	Sai Niveditha Brick Industries	AP/PSM/II/5	10	24.02.12	1.0
06.	Bhaskar Brick Industries	AP/GTR/II/6	Withdrawn		

07.	Koneru Fly ash Products	AP/KRIS/II/7	20	10.08.11	1.0
08.	Anaparthy Reddy FaL-G Brick Industry	AP/EG/II/8	N.A	Diesel	N.A
09.	Sai Lakshmi FaL-G Bricks	AP/EG/II/9	N.A	Diesel	N.A
10.	Sri Saikripa Innovative Building Material Industries	AP/VSP/II/10	25	29.06.12	1.0
11.	Sridevi Building Material Industries	AP/VZM/II/11	Terminated		

Note: As a practice by Service Provider (SP), the State Electricity Boards, calibration is not applicable to the units with connected load less than 20 HP. II/1, II/7 and II/10 do cross this limit. However, calibration was done by SP, upon being requested by SPEs at payment of special fee, in order to meet the requirement of the VVM.

Figure I: The schematic FaL-G process

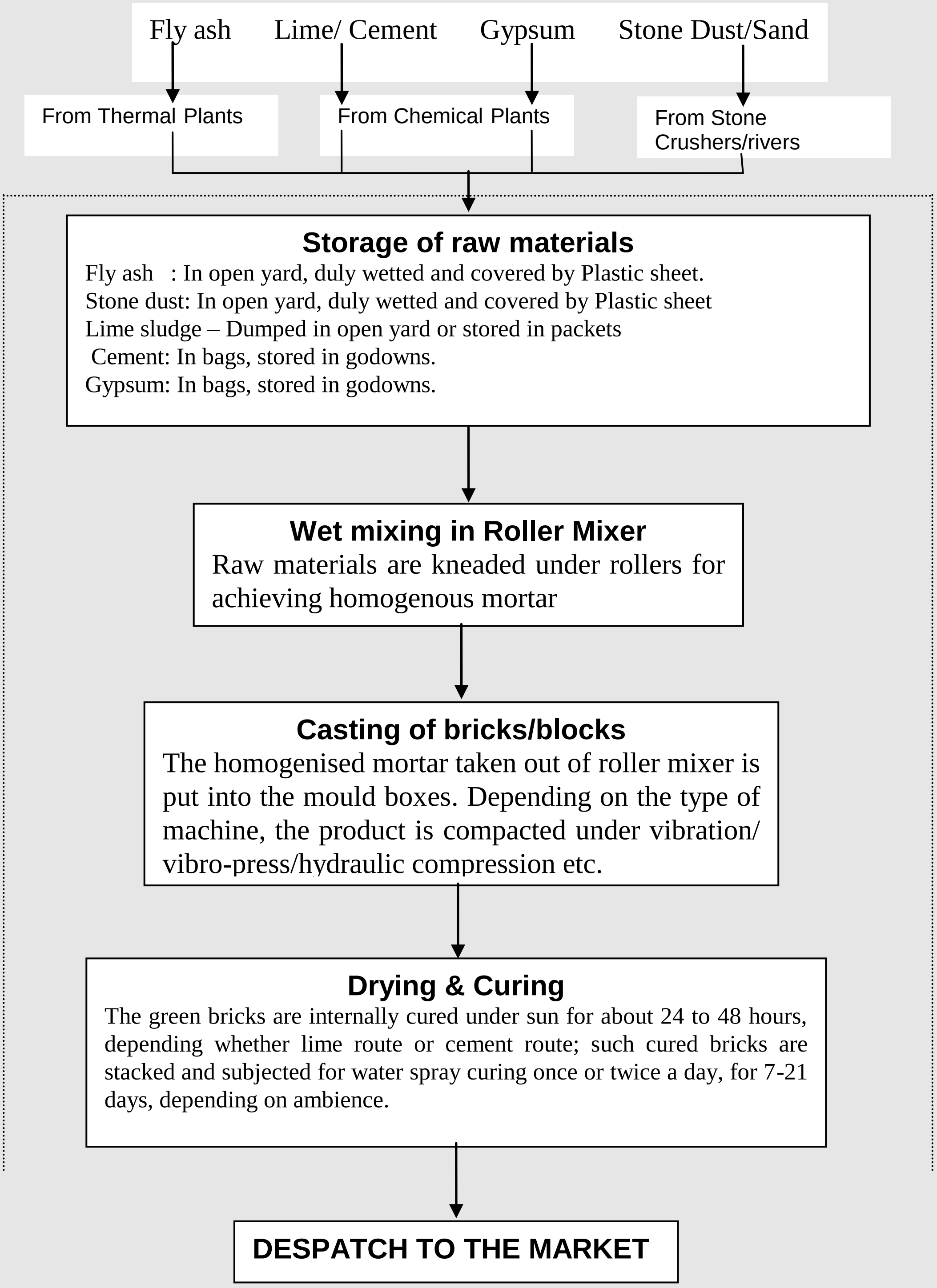

Figure II: Monitoring Information

Organisation Structure for Monitoring Activity

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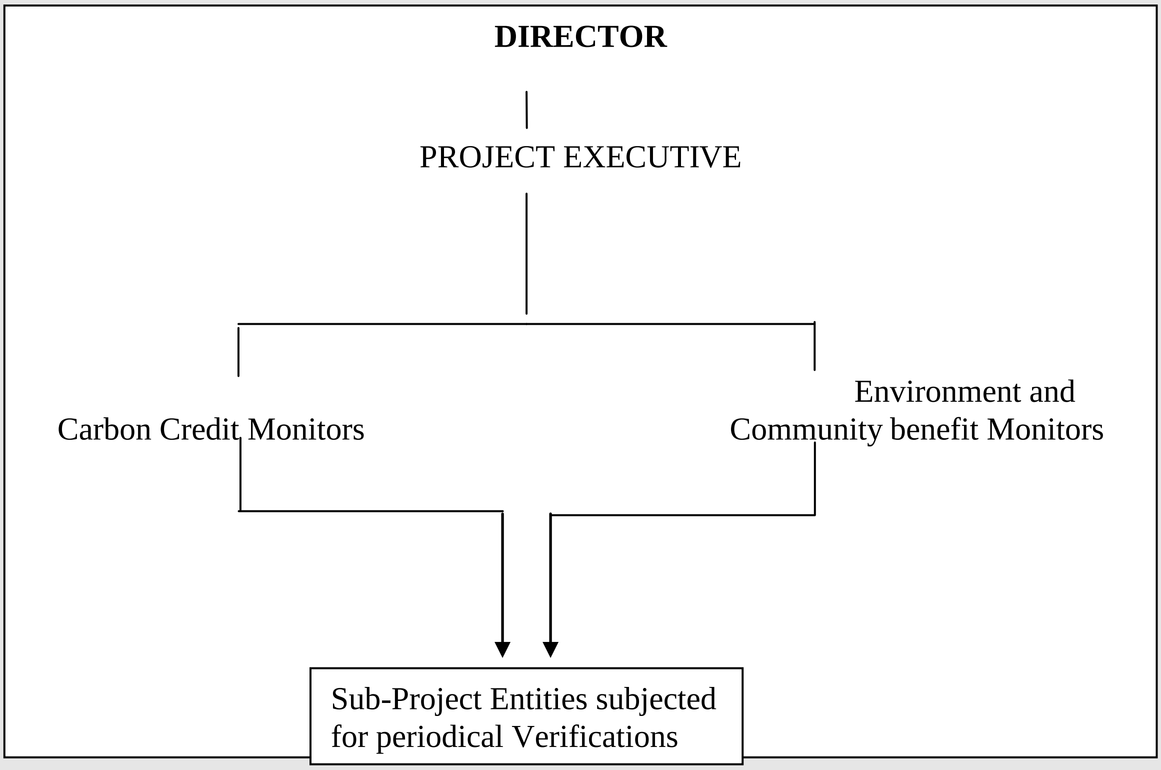

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
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