CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
India Cements WHR project
15th February 2006
Version 1

A.2. Description of the project activity:

>>
The project activity involves the installation of waste heat recovery systems to generate electricity at The India Cements Ltd., Vishnupuram cement plant. The plant is located in the state of Andhra Pradesh, India and has an annual capacity of 2.25m tonnes of cement production. The India Cements Limited is an experienced cement player, operating in the sector for over six decades, and is the third largest cement group in India with a capacity of 8.8m tonnes of cement production.

The objective of the project is to produce electricity from the waste gases in the cement manufacturing process. The project has been partly funded from the New Energy Industrial Development Organization (NEDO) of the Government of Japan and was envisaged as a Model Project for waste heat recovery in the Indian cement industry.

The Vishnupuram cement plant has two kilns, one of 1,750 tonnes per day and one of 4,500 tonnes per day. The waste heat recovery will take place using gases from the larger kiln. Two sources of waste heat gases are collected and utilised by the project activity. The cement plant has a four stage suspension pre-heater with exhaust gases from this unit having a temperature of 340°C, these gases will form one source for the waste heat recovery system. The second source of waste heat gases is the cooler exhaust gas of the cement kiln. The gases from this source have a temperature of 360°C. These gases will be collected and passed through waste heat recovery boilers with the resultant steam fed to a 7.7MW condensing type steam turbine generator for the generation of electricity.

The electricity from the waste heat recovery unit replaces grid based generation and this is demonstrated in section B2 where the baseline is determined. The cement plant has operated on grid based power and the contract demand has been increased as modifications have taken place. There are diesel generator sets at the plant but these have only been used in periods of non-availability of grid based power or other emergencies. The plant currently has a grid connection of 24MVA.

The project activity will promote sustainable development mainly through a reduction in greenhouse gas (GHG) emissions and other gases that are generated in the operation of grid based power plants. In the Southern region over 70% of generation is accounted for by coal. The operation of coal based power plants not only gives rise to (GHGs) but also NOx and SOx. Furthermore the disposal of ash from grid based power plants is a problem, especially given the high percentage of ash in Indian coal. The operation of the waste heat recovery power plant will result in a reduction in these gases and also ash and therefore provides a positive contribution to sustainable development.

An additional benefit that has also resulted from the installation of the project activity is an increase in direct employment at the plant. Eleven employees are directly associated with the project activity with a number of these positions being of a technical nature – engineers and mechanics. The provision of employment and moreover technical skills is an important step in the development of the economy and provides much needed rural employment.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	If Party wishes to be considered as a project participant
India (host)	Private entity: The India Cements Ltd	No
UK	Public entity: Department of Environment, Food and Rural Affairs Private entity: Agrinergy Ltd	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>
India

A.4.1.2. Region/State/Province etc.:

>>
Andhra Pradesh

A.4.1.3. City/Town/Community etc:

>>
Vishnupuram, Wadapally, Nalgonda District, 508355

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

>>
The plant is located at the following grid reference: latitude 16^{o} 45 mins N, longitude 79^{o} 39 mins E.

A.4.2. Category(ies) of project activity:

>>
Sectoral scopes 1 and 4
Energy industries (Renewable - / non - renewable sources)
Manufacturing industries

A.4.3. Technology to be employed by the project activity:

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The project activity involves the installation of two waste heat recovery boilers and one turbine generator. The boilers and turbine are manufactured by Kawasaki of Japan.

The technology encompasses two 15 bar waste heat recovery boilers of 28 tph and 14 tph capacities. The steam generated from these boilers are passed to a 7.7MW turbine generator with the resultant electricity fed to the cement plant. The boilers are installed at the pre-heater exhaust (PH boiler) and at the cooler exhaust from the kiln (AQC boiler).

The PH boiler is a forced circulation type boiler with a capacity of 28 tph. The exhaust gas of the pre-heaters are 340°C and once cooled in the boiler exit at 230°C and are then used in raw material drying. Due to the high dust content of the pre-heater gases and their adhesive properties a hammering device is installed in the boiler to remove the dust that adheres to the boiler surfaces and improve heat exchange. The AQC boiler utilises gases from the cooler attached to the kiln, these gases enter the boiler at 360°C. These gases typically have a high content of clinker dust and therefore a pre-dust collector is introduced before the gases enter the boiler.

The turbine generator is of 7.7MW capacity and is of a condensing type.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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The project activity will reduce emissions through the displacement of grid based power. The plant is located in the Indian Southern regional grid which is predominantly fossil fuel based, therefore the displacement of grid based electricity will reduce emissions associated with the generation of electricity from these sources.

The project is expected to give rise to 49,334 tonnes of CO_2e per annum.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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Year	Annual estimation of emission reductions in tonnes of CO_2e
Year 1	51,494
Year 2	51,494
Year 3	51,494
Year 4	51,494
Year 5	51,494
Year 6	51,494
Year 7	51,494
Year 8	51,494
Year 9	51,494
Year 10	51,494
Total estimated reductions (tonnes CO_2e)	514,940
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	51,494

A.4.5. Public funding of the project activity:

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The project received funding under the New Energy Industrial Development Organisation (NEDO) of the Government of Japan under the sub heading of Model Projects. As outlined in Annex 2, this does not fall under Japanese ODA.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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Baseline methodology for greenhouse gas reductions through waste heat recovery and utliszation for power generation at cement plants.
AM0024 version 1
30th September 2005

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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In terms of the applicability conditions outlined in the baseline methodology the project activity meets all the criteria, namely;

1. The electricity supplied by the project activity is used within the cement plant, no electricity will be exported to the grid nor was any electricity exported to the grid under the baseline scenario.
2. The electricity supplied by the project activity displaces grid based generation
3. The electricity grid is clearly identifiable.
4. Only waste heat is used in the project activity
5. The waste heat is only used in the project activity and the baseline scenario conforms to Type I Waste Heat Utilization. Under the baseline scenario waste heat was captured from the pre-heaters and passed through a gas conditioning tower to cool the gas before being used for the drying of raw materials (limestone) and fuel (coal), the cooler exhaust gas line was not utilised and vented. In the baseline the waste gases from the pre-heater were reduced in temperature from 350°C to 220°C in the gas conditioning tower before being sent to the vertical raw mill for drying raw materials. Under the project activity the exhaust gases from the pre-heater boiler are sent to the vertical raw mill for drying raw materials without compromising the temperature of the gases (the exhaust gas of the pre-heater boiler is 230°C).

Furthermore the baseline does not envisage waste heat being used outside the clinker making process nor will the project activity affect the process emissions of the cement plant.

B.2. Description of how the methodology is applied in the context of the project activity:

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The determination of the baseline scenario is undertaken through following the stepwise approach outlined in the methodology.

Step 1: Determination of technically feasible alternatives to the project activity

1A. The pre-project use of waste heat is limited to the drying of raw materials and fuel. This is undertaken however only with the pre-heater waste gases whilst the cooler exhaust gases are vented to the atmosphere. The project activity will still provide waste gas from the pre-heater boiler for the drying of raw materials and fuel. Whilst these gases are of a lower temperature than the waste gas from the pre-heater the baseline scenario also requires the waste gases to be passed through a gas conditioning tower and cooled. Therefore in the context of the cement plant under consideration the waste gases are still used for the same processes as in the baseline scenario (with the addition of waste heat recovery for power generation) and the project activity meets the criteria on Type 1 waste heat utilization. In cement plants in India waste gases from the cooler exhaust line are vented and waste gases from the pre-heater may be used for the drying of input materials to the process and aside from these processes, there are no other uses for waste heat gases in cement plants.

1B. The electricity demand of the plant is 33 MVA, made up of 24 MVA from the grid and 9 MVA from the waste heat recovery unit. In addition to these supplies there are five diesel generators, one 6 MW, two 4 MW, all supplied by Wartsila and two 1 MW sets of other make. In terms of the local context, cement plants in India generally operate on grid based supply and also captive coal based power plants with emergency/back-up supply afforded by diesel generators.

That the baseline is grid based supply is clearly identifiable from the historical contract demand of the plant. This cement plant was taken over by India Cements in 1998 from Raasi Cement Limited, when the factory was operating at 1.2 million tonnes against a capacity of 1.6 million tonnes. Throughout 2003/04 and 2004/05 modifications to re-balance the plant were carried out which increased the capacity to 2.25 million tonnes. Through this period there have been changes in the grid contract demand. When the plant was taken over in 1998 grid contract demand was 25 MVA but in the year 2000 demand for cement was low and the plant reduced its production and also reduced grid contract demand to 13 MVA. In 2002/03, as production at the cement plant has increased, grid based contract demand was increased by 5 MVA and again in 2005 it was increased by 6 MVA. Therefore it is apparent that any increase in demand, aside from the implementation of the waste heat recovery project, has been from grid based supplies.

The following table highlights the supply of electricity to the plant over the two years prior to the implementation of the project (E_{CEMENT}). The other local loads (E_{LOAD}) are limited to the supply of electricity to the colony which is 0.5MW per annum. The supply of electricity from the DG sets has also been included however this is not strictly a captive based power plant ($EG_{ATEXIST}$) as the supply is intermittent and drawn only in times of grid failure.

Baseline electricity consumption

	Grid	DG 6MW	DG 4MW	DG 1MW
	m kWh	Hours		
2002/03	70.4	2,150	2,498	1,100
2003/04	111.2	1,130	2,400	

From the history of the electricity supply to the plant and with the benefit of hindsight it is clear that the baseline electricity option is grid based supply. Furthermore the supply of electricity from the DG sets is not economic, its variable cost is Rs 6/kWh as compared to a variable cost of Rs 2.8/kWh for new grid based power.

Step 2: Compliance with regulatory requirements

The purchase of electricity from the grid is in compliance with the regulatory environment.

Step 3: Undertake economic analysis of all options that meets the regulatory requirements

Given that there is only baseline option, further analysis is not required and we can say that the purchase of electricity from the grid is the baseline scenario.

Table of baseline data

Baseline data	Key information	Source
Estimation of project emissions	Energy consumption per unit clinker	Factory records
Grid generation	Generation data of grid based generating units	Central Electricity Authority
Grid emissions	Fossil fuel consumption of grid based generating units	Central Electricity Authority
Capacity expansions	Timing of expansions to determine build margin	State electricity boards and generating companies
Net calorific value of fossil fuel used in grid plants		IPCC
Emissions factor of fossil fuel used in grid plants		IPCC
Oxidation factor of fossil fuel used in grid plants		IPCC

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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In line with the methodology the demonstration of additionality is shown through using the latest version of the Additionality Tool[1].

Step 0: Preliminary screening based on the starting date of the project activity

The project was commissioned in October 2004 and the starting date was October 2002. Even though the starting date falls between 1 January 2000 and the date of registration of the first CDM project, the recent guidance from the CDM Executive Board means that the project activity will not qualify to set the crediting period starting prior to registration[2]. The project activity did receive a contract for validation prior to 31st December but the transfer of equipment has delayed the proposal of a project as a CDM.

The project was undertaken under the Japanese NEDO Model Projects programme. The ownership of the equipment was initially with the Japanese government and was only transferred to the Indian government and India Cements in early 2006. Without ownership of the project India Cements was not in a position to submit a PDD for the project as a CDM.

The objective to mitigate climate change was clearly envisaged through the project activity as it was part of the NEDO Model Project programme which has the aim of promoting projects that reduce emissions of greenhouse gases[3].

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity

As set out in section B2 the alternatives to the project activity are:

- The use of grid based electricity
- The proposed project activity not undertaken as a CDM project activity

Sub-step 1b: Enforcement of applicable laws and regulations

[1] Tool for demonstration and assessment of additionality, version 2, 28th November 2005.

[2] http://cdm.unfccc.int/EB/Meetings/023/eb23rep.pdf

[3] http://www.nedo.go.jp/english/activities/3_kokusaikanren/1/p99034e.html

As set out in section B2 these alternatives are in compliance with applicable laws and regulations.

Step 2: Investment analysis

We have undertaken investment analysis of the project activity even though the main determinant in qualification is through the barrier analysis.

Sub-step 2a: Determine appropriate analysis method

As the project activity has a dual revenue stream, the revenue from the sale of emission reductions and the opportunity cost of power generated we have a choice of Option II or Option III. From these two options, we follow Option III as there is only one investment option in the baseline scenario.

Sub-step 2b - Option III: Apply benchmark analysis

The financial indicator calculated for the project activity will be the internal rate of return (IRR)[4] and the benchmark will be derived from the costs of financing, specifically commercial lending rates in India.

Sub-step 2c: Calculation and comparison of financial indicators

The calculation of the financial indicator for the project activity includes the initial investment cost and the costs and revenues associated with operating the power plant. The initial investment cost is Rs.1,013m. The revenues associated with the power plant relate to the opportunity cost of electricity which for the plant is currently Rs 2.66/kWh. The costs relate to labour charges, chemicals used in the process, spares and insurance.

The calculation of the IRR on this basis yields an IRR of 6.3%. The benchmark for the project activity is the Prime Lending Rate (PLR) in India (the rate at which banks are willing to lend at) which is conservatively estimated at 11%. PLRs are published in India in the financial press and the range quoted on 11th April 2006 was 11% to 12% from 5 major banks.[5] Using the PLR as the indicator is conservative as the most suitable benchmark would be the weighted average cost of capital for the company. This would be calculated on the basis of the cost of debt and the cost of equity but with the sharp appreciation in Indian stock markets any cost of equity based on stock market returns is unrealistic and overestimates the weighted average cost of capital.

Sub-step 2d: Sensitivity analysis

Applying sensitivity analysis to the results above revolves around the revenue side. The following table shows adjustments to the opportunity cost of electricity and its impact on the IRR.

Table of sensitivity analysis

Opportunity cost, Rs/kWh	2.00	2.25	2.50	2.75	3.00	3.25
IRR	0.31%	2.69%	4.93%	7.06%	9.09%	11.04%

Even with the upward revisions in the opportunity cost of electricity the IRR does not meet the benchmark.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of type of the proposed project activity

4 In line with the guidance "For the benchmark analysis, the IRR shall be calculated as project IRR."

5 Business Standard, Section II, 11th April 2006, page 3

The project activity is the "first of its kind": No waste heat recovery systems utilising pre-heater and cooler exhaust gases is currently operational in India.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

As grid based power is readily available to supply Indian cement plants the barrier identified barrier is not applicable to the baseline scenario.

Step 4: Common practice analysis

Sub-step 4a:Analyse other activities similar to the proposed project activity
Sub-step 4b: Discuss any similar options that are occurring

As the project is first of its kind in India, there are no other cement plants that are currently operating waste heat recovery systems. There is a project that is being implemented in India but this has not been commissioned as yet and is also being proposed as a CDM project activity[6].

Step 5: Impact of CDM registration

The registration of the project as a CDM will improve the financial returns and act as a catalyst to other cement plants to undertake these types of investments to produce clean electricity. There are already plans with India Cements to implement a second project of this type in one of its other cement plants and this proposed project will also be submitted for registration as a CDM.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>

The boundary as detailed in the methodology covers emissions that arise from the project activity and those in the baseline scenario.

Project activity emissions relate to the use of fossil fuels in the kiln and any increase in the use of fossil fuel to generate heat for use in the waste heat recovery system. These emission sources are limited to carbon dioxide.

The baseline emissions for the project activity relate to the grid based generation sources that serve the project activity. In the case of India there are a number of regional grids, the regional grids consist of separate State grids managed by the State Electricity Boards (SEBs). The SEBs have their own generation capacity and also purchase power from IPPs situated within the state. In addition to this, the SEBs purchase generation from central sector power stations that are situated within the regional grid. Thus the Andhra Pradesh state electricity board is allocated a proportion of the generation of central sector power stations situated in the Southern Region and this power is transmitted via the inter-regional transmission system. The Southern Region grid is becoming increasingly integrated and therefore the total Southern grid is selected as the project electricity system. Within this system the emission sources are limited to carbon dioxide.

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[6] Waste heat recovery power project at JK cement works(Unit of JK Cement), Nimbahera, Chittorgarh, Rajasthan, http://cdm.unfccc.int/Projects/TUEV-SUED1140718710.42/view.html

In line with the methodology leakage is not considered for the project activity.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>
Robert Taylor, Agrinergy Ltd, contact details as per Annex I
21/03/2006

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
The project starting date is 01 October 2002 and the project was commissioned in October 2004.

C.1.2. Expected operational lifetime of the project activity:

>>
20 years

C.2 Choice of the crediting period and related information:

A fixed crediting period has been chosen for the project activity.

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

Chosen crediting period

C.2.2.1. Starting date:

>>
01 August 2006

C.2.2.2. Length:

>>
10 years

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>
Monitoring methodology for greenhouse gas reductions through waste heat recovery and utilization for power generation at cement plants.
AM0024 version 1
30th September 2005

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>
In terms of the applicability conditions outlined in the baseline methodology the project activity meets all the criteria, namely;

1. The electricity supplied by the project activity is used within the cement plant, no electricity will be exported to the grid nor was any electricity exported to the grid under the baseline scenario.
2. The electricity supplied by the project activity displaces grid based generation
3. The electricity grid is clearly identifiable.
4. Only waste heat is used in the project activity
5. The waste heat is only used in the project activity and the baseline scenario conforms to Type I Waste Heat Utilization. Under the baseline scenario waste heat was captured from the pre-heaters and passed through a gas conditioning tower before being used for the drying of raw materials (limestone) and fuel (coal), the cooler exhaust gas line was not utilised and vented. In the baseline the waste gases from the pre-heater were reduced in temperature from 350^{o}C to 220^{o}C before being sent to the vertical raw mill for drying raw materials. Under the project activity the exhaust gas from the pre-heater boiler are sent to the vertical raw mill for drying raw materials without compromising the temperature of the gases (the exhaust gas of the pre-heater boiler is 230^{o}C).

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. PE_y	*Emission*	*Project emissions*	tCO_2	*c*	*Annually*	*100%*	*Electronic and paper*	
2. $COEF_{Fuel,y}$	*Emission factor*	*COEF for fuel used in clinker production*	tCO_2/TJ	*c*	*Monthly*	*100%*	*Electronic and paper*	
3. $NCV_{fuel,y}$	*Calorific value*	*NCV for fuel used in clinker production*	*TJ/t*	*m*	*Monthly*	*100%*	*Electronic and paper*	*NCV based on measurement at site or IPCC values*
4. $EF_{CO2,fuel,y}$	*Emission factor*	*EF for fuel used in clinker production*	tCO_2/TJ	*m*	*Monthly*	*100%*	*Electronic and paper*	*Default IPCC may be used*
5. $OXID_{fuel}$	*Fraction*	*OXID for fuel used in clinker production*	*%*	*e*	*At start of project*	*100%*	*Electronic and paper*	*Default IPCC may be used*
6. EI_{Py}	*Energy intensity*	*Energy consumption per unit clinker produced*	*TJ/t*	*c*	*Annually*	*100%*	*Electronic and paper*	
7. $F_{P,y}$	*Energy*	*Annual energy consumption of clinker making process after implementation of project*	*TJ*	*m*	*Continuously*	*100%*	*Electronic and paper*	
8.	*Quantity*	*Annual*	*t*	*m*	*Continuousl*	*100%*	*Electronic and*	

$O_{clinker,y}$		*production of clinker after implementation of project*			*y*		*paper*	

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

$$PE_y = (EI_{p,y} - EI_B) * O_{clinker,y} * COEF_{fuel,y}$$

Where:

$EI_{p,y}$ = the ex-post energy consumption per unit output of clinker for given year, y, in TJ/ton of clinker produced
EI_B = the pre-project energy consumption per unit output of clinker in TJ/ton of clinker produced
$O_{clinker,y}$ = the clinker output of the cement works in a given year y
$COEF_{fuel,y}$ = the carbon coefficient (tCO2/TJ of input fuel) of the fuel used in the cement works in year y to raise the necessary heat for clinker production

$$EI_{p,y} = \frac{F_{p,y}}{O_{clinker,y}}$$

Where:

$F_{p,y}$ = the monitored annual energy consumption in a year y, expressed in TJ, of clinker making process
$O_{clinker,y}$ = the monitored annual output, expressed in a year y, in tonnes of clinker

$$COEF_{Fuel,y} = NCV_{fuel,y} * EF_{CO_2,fuel,y} * OXID_{fuel}$$

Where:

$NCV_{fuel,y}$ = the net calorific value per mass of fuel used in clinker making process in year y
$EF_{CO2,fuel,y}$ = the CO_2 emissions factor per unit of energy of the fuel used in year y, tCO_2/mass
$OXID_{fuel,y}$ = the oxidation factor of the fuel expressed in percentage

EI_B is not monitored but determined ex-ante, the calculation of this constant is shown below for the sake of completeness.

$$EI_B = \frac{F_B}{O_{clinker,B}}$$

Where:

F_B = the average annual energy consumption, expressed in TJ, of clinker making process prior to the start of operation of the project activity

$O_{clinker,B}$ = the average annual output, expressed in tonnes, of clinker prior to the start of operation of the project activity

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
10. EB_y	*Emission quantity*	*Baseline emissions for year y*	*tCO_2*	*c*	*Annually*	*100%*	*Electronic and paper*	
11. $EG_{CF,y}$	*Electricity quantity*	*Quantity of electricity supplied to cement plant*	*MWh*	*m*	*Continuously*	*100%*	*Electronic and paper*	

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

$$EB_y = EG_{CF,y} * EF_{Elec,y} + EG_{Grid,y} * EF_{Grid,y}$$

Where:

$EG_{CF,y}$ = the electricity supplied from the project activity to the cement plant, MWh

$EF_{Elec,y}$ = the emissions factor of the baseline electricity supply sources, expressed as tCO_2/MWh
$EG_{Grid,y}$ =the electricity supplied form the project activity to the grid, MWh
$EF_{Grid,y}$ =is the emissions factor of the electricity grid, tCO_2/MWh

As the baseline scenario is grid electricity supply, $EF_{Elec,y}$ is equal to $EF_{Grid,y}$ and the equation may be simplified to the following given that the project activity only supplies electricity to the cement plant.

$$EB_y = EG_{CF,y} * EF_{Grid,y}$$

The determination of the grid emission factor ($EF_{Grid,y}$) follows the guidance in ACM0002 and is calculated as the combined margin (CM). As outlined in Annex 3 this will be determined *ex-ante* and held constant through the first and only crediting period. The monitoring of the variables that determine this factor are therefore not included in the monitoring plan.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

This section has been left blank on purpose

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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This section has been left blank on purpose

D.2.3. Treatment of leakage in the monitoring plan

This section has been left blank on purpose

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>
This section has been left blank on purpose

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
3-5	*Low*	*IPCC default values may be used*
1-2, 6-11	*Low*	*Any direct measurements with mass meters at the plant site should be cross-checked with energy balances that is based on purchased quantities and stock changes.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>
See Annex 4.

D.5 Name of person/entity determining the monitoring methodology:

>>
Robert Taylor, project participant, contact details as listed in Annex I.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

$$PE_y = (EI_{p,y} - EI_B) * O_{clinker,y} * COEF_{fuel,y}$$

Where:

$EI_{p,y}$ = the ex-post energy consumption per unit output of clinker for given year, y, in TJ/ton of clinker produced
EI_B = the pre-project energy consumption per unit output of clinker in TJ/ton of clinker produced
$O_{clinker,y}$ = the clinker output of the cement works in a given year y
$COEF_{fuel,y}$ = the carbon coefficient (tCO2/TJ of input fuel) of the fuel used in the cement works in year y to raise the necessary heat for clinker production

$$EI_B = \frac{F_B}{O_{clinker,B}}$$

Where:

F_B = the average annual energy consumption, expressed in TJ, of clinker making process prior to the start of operation of the project activity
$O_{clinker,B}$ = the average annual output, expressed in tonnes, of clinker prior to the start of operation of the project activity

From the presentation of data in Annex 3, EI_B is equal to the following:

$$EI_B = \frac{16,667.82}{5,173,971} = 0.00322$$

$$EI_{p,y} = \frac{F_{p,y}}{O_{clinker,y}}$$

Where:

$F_{p,y}$ = the monitored annual energy consumption in a year y, expressed in TJ, of clinker making process
$O_{clinker,y}$ = the monitored annual output, expressed in a year y, in tonnes of clinker

From estimates of the current production process efficiency, $EI_{p,y}$ is estimated as:

$$EI_{p,y} = \frac{444.68}{137,669} = 0.00323$$

$$COEF_{Fuel,y} = NCV_{fuel,y} * EF_{CO_2,fuel,y} * OXID_{fuel}$$

Where:

$NCV_{fuel,y}$ = the net calorific value per mass of fuel used in clinker making process in year y

$EF_{CO2,fuel,y}$ = the CO_2 emissions factor per unit of energy of the fuel used in year y, tCO_2/mass
$OXID_{fuel,y}$ = the oxidation factor of the fuel expressed in percentage

Using the factors specified in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1-1 and the country specific factors in Table 1-2 we arrive at the following calculation for $COEF_{Fuel,y}$ in tCO_2/t fuel:

$$COEF_{Fuel,y} = \frac{19.98 * 94.6 * 98\%}{1000} = 1.8523$$

Therefore:

$$PE_y = (0.00323 - 0.00322) * 1{,}652{,}028 * 1.8523 = 26$$

E.2. Estimated leakage:

>>
No leakage will arise as a result of the project activity.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>
As there is no leakage associated with the project activity this is equal to E1.

$$PE_y = 26$$

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

$$EB_y = EG_{CF,y} * EF_{Elec,y} + EG_{Grid,y} * EF_{Grid,y}$$

Where:
$EG_{CF,y}$ = the electricity supplied from the project activity to the cement plant, MWh
$EF_{Elec,y}$ = the emissions factor of the baseline electricity supply sources, expressed as tCO_2/MWh
$EG_{Grid,y}$ =the electricity supplied form the project activity to the grid, MWh
$EF_{Grid,y}$ =is the emissions factor of the electricity grid, tCO_2/MWh

As the baseline scenario is grid electricity supply, $EF_{Elec,y}$ is equal to $EF_{Grid,y}$ and the equation may be simplified to the following given that the project activity only supplies electricity to the cement plant.

$$EB_y = EG_{CF,y} * EF_{Grid,y}$$

$$EB_y = 55{,}440 * 0.9293 = 51{,}520$$

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

$$ER_y = EB_y - PE_y$$

Where:

ER_y = the emission reductions associated with the project activity in year y, tCO_2e
EB_y = the baseline emissions in year y, tCO_2e
PE_y = the project emissions due to possible fuel consumption changes in the cement kiln, of the cement works where the proposed project is located, as a result of the project activity in year y, tCO_2e

$$ER_y = 51{,}520 - 26 = 51{,}494$$

E.6. Table providing values obtained when applying formulae above:

>>

Year	Estimation of project activity emissions reductions (tCO_2e)	Estimation of baseline emissions reductions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of emissions reductions (tCO_2e)
Year 1	51,520	26	0	51,494
Year 2	51,520	26	0	51,494
Year 3	51,520	26	0	51,494
Year 4	51,520	26	0	51,494
Year 5	51,520	26	0	51,494
Year 6	51,520	26	0	51,494
Year 7	51,520	26	0	51,494
Year 8	51,520	26	0	51,494
Year 9	51,520	26	0	51,494
Year 10	51,520	26	0	51,494
Total (tCO_2e)	515,200	260	0	514,940

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
In relation to the baseline scenario no negative environmental impacts will arise as a result of the project activity. The cement plant operates under an existing EIA but the power plant is not required to obtain an EIA.

The positive environmental impacts arising from the project activity are:

- A reduction in carbon dioxide emissions from the replacement of fossil fuels which would be generated under the baseline scenario
- A reduction in the emissions of other harmful gases (NOx and SOx) that arise from the combustion of coal in power generation
- A reduction in ash in comparison to the baseline scenario.

The gases from the power plant are passed through an existing electrostatic precipitator at site and then fed to a common stack. Any waste water from the project activity is treated at the site and used internally.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
Environmental impacts are not considered significant.

SECTION G. Stakeholders' comments

>>

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The stakeholder review has been conducted on three levels:

A local stakeholder review

A national stakeholder review which will be undertaken through the approval by the Ministry of Environment and Forests (the Indian DNA)

An international stakeholder review which will be conducted at the time of validation.

The institutions are already in place for the national and international stakeholder review and any comments arising from these processes will be incorporated prior to registration. The project was submitted to the Indian designated national authority (the Ministry of Environment and Forests) in April 2006 and is awaiting their approval.

A notice has been placed in local newspapers in Teluga, the Enadu, on 26th April, 2006 providing information on the project and inviting comments. A letter has also been sent to "panchayat", again providing information on the project and inviting comments.

G.2. Summary of the comments received:

>>

No adverse comments have been received on the project to date.

G.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	The India Cements Ltd
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Represented by:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

As outlined in section A.4.5. the project received funding from the New Energy Industrial Development Organisation (NEDO) of the Government of Japan under the category of Model Projects.

This does not result in a diversion of official development assistance as the funding for Model Projects is decided outside of ODA budgetary considerations. The Japanese budgetary system allows for the allocation of expenditure from identified revenue accounts. The expenditure under the NEDO Model Projects is allocated from the "Account for Petroleum and Sophisticated Structure of Energy Supply and Demand" in accordance with the "Law on Special Accounts for Coal, Petroleum and Sophisticated Structure of Energy Supply and Demand".

Therefore the funding allocated to the project activity is separate from and is not counted towards the financial obligations of Japan.

Annex 3

BASELINE INFORMATION

The baseline information for the project activity revolves around the energy consumption in the kiln to generate clinker, EI_B, which is used in the calculation of project emissions and the determination of the grid emissions factor using the guidance in ACM0002.

Energy consumption in the kiln

$$EI_B = \frac{F_B}{O_{clinker,B}}$$

Where:

F_B = the average annual energy consumption, expressed in TJ, of clinker making process prior to the start of operation of the project activity

$O_{clinker,B}$ = the average annual output, expressed in tonnes, of clinker prior to the start of operation of the project activity

The following data shows the production of clinker in the kiln and the heat consumption required to produce the clinker.

	Clinker production, tonnes	Heat consumption, TJ
Jan-00	136,354	445.56
Feb-00	129,151	420.41
Mar-00	136,720	445.04
Apr-00	113,905	371.73
May-00	113,019	368.84
Jun-00	127,940	418.07
Jul-00	128,558	420.09
Aug-00	75,156	246.22
Sep-00		
Oct-00		
Nov-00	24,761	80.70
Dec-00	107,289	349.24
Jan-01	140,640	457.22
Feb-01	31,014	100.96
Mar-01	137,226	445.54
Apr-01	92,951	301.79
May-01	110,356	358.30
Jun-01	137,909	447.18
Jul-01	76,254	246.62
Aug-01	138,972	445.98
Sep-01	40,088	128.82
Oct-01	140,824	451.33
Nov-01	4,509	14.45
Dec-01	100,647	322.99
Jan-02	101,655	326.22
Feb-02	115,130	368.50

Mar-02	46,774	150.10
Apr-02	133,740	428.63
May-02	69,301	223.27
Jun-02	118,229	378.42
Jul-02	54,040	172.74
Aug-02		
Sep-02	66,612	221.29
Oct-02	40,485	130.77
Nov-02	54,093	173.14
Dec-02		
Jan-03	44,741	144.52
Feb-03	60,577	193.39
Mar-03	26,732	85.23
Apr-03	70,820	225.49
May-03	119,801	380.45
Jun-03	72,888	232.38
Jul-03	128,827	411.27
Aug-03	147,510	470.91
Sep-03	144,369	460.28
Oct-03	150,030	478.33
Nov-03	46,965	149.73
Dec-03	114,585	364.84
Jan-04	51,541	163.89
Feb-04	127,982	405.89
Mar-04	134,899	428.39
Apr-04	130,926	417.97
May-04	115,602	371.95
Jun-04	72,898	235.16
Jul-04	138,098	444.91
Aug-04	140,628	453.65
Sep-04	89,250	289.03
Total	5,173,971	16,668

From the data above EI_B is therefore equal to the following:

$$EI_B = \frac{16,668}{5,173,971} = 0.00322$$

<u>Grid based electricity emissions factor</u>

The electricity baseline emission factor ($EF_{electricity,y}$) is calculated as a combined margin (CM), consisting of the combination of the operating margin (OM) and build margin (BM).

The relevant grid for the determination of the combined margin is selected as the Southern Region grid. This is because although electricity generation and distribution remains largely in the hands of the Andhra Pradesh Electricity Board (TNEB), the regional grid is becoming more integrated. Moreover, central sector generation from the entire Southern Region is transmitted to Andhra.

Simple Operating Margin

In the Southern Region, low cost and must run resources constitute less than 50% of total grid generation (averaging some 20% over the previous five years). The simple operating margin is therefore selected as the appropriate method to calculate the operating margin emission factor. An ex-ante OM figure is selected and therefore a 3 year average is calculated. The simple operating margin is calculated directly from actual Central Electricity Authority (CEA) data on generation and fuel consumption combined with IPCC NCV, oxidation and emission factors. The CEA provides coal consumption data for individual coal based power plants, and these data are therefore used. In the case of gas, diesel and lignite stations, aggregate consumption at the state and regional level is provided and these data are then used to derive region average emission factors (0.487 tCO_2/MWh for gas stations, 0.542 tCO_2/MWh for diesel stations and 1.134 tCO_2/MWh for lignite stations). The results of the OM calculation is outlined below:

Table of Southern Region Fuel Consumption, Emissions and Generation, 2001-2 to 2004-5 (excluding hydro and nuclear)

	Fuel Cons. 04-05 (kt)	Fuel Cons. 03-04 (kt)	Fuel Cons. 04-05 (kt)	Emissions 04-05 (kt)	Emissions 03-04 (kt)	Emissions 02-03 (kt)	Generation 04-05 (GWh)	Generation 03-04 (GWh)	Generation 02-03 (GWh)
Coal Plants									
ANDHRA PRADESH									
K'Gunden	3617	3395	3839	6700	6288	7111	5363	4183	4999
K'Gunden new	2699	2533	2865	5000	4693	5307	4141	3994	3730
Vijawada	6863	7161	7227	12712	13264	13387	9849	10104	10288
R'Gunden	317	312	272	587	578	504	496	471	390
Nellore	150	148	157	278	274	291	154	146	147
Rayal Seema	2149	2246	2300	3981	4160	4260	3354	3331	3488
R'Gunden STPS	10490	10167	10452	19431	18832	19360	17170	16332	16839
Simhadri	5556	5231	3428	10291	9689	6350	8122	7722	4979
KARNATAKA									
Raichur	6923	6982	6613	12824	12933	12249	10718	11400	10290
TAMIL NADU									
Ennore	1156	1186	1663	2141	2197	3080	1223	1258	1747
Tuticorin	5563	5292	5053	10304	9802	9360	8180	8084	8187
Mettur	4852	4918	4846	8987	9110	8976	6684	6735	6739
North Chennai	2816	3086	3276	5216	5716	6068	3916	4347	4405
Gas Plants									
ANDHRA PRADESH									
Vijeswaran GT				971	1046	990	1993	2147	2031
Peddapuram CCGT				556	609	414	1141	1249	850
Jegurupadu GT				692	733	771	1420	1505	1583
Kondapalli GT				1095	1090	1207	2246	2238	2477
Godavari GT				669	536	609	1373	1100	1250
KERALA									
Cochin CCGT				54	483	149	112	991	305
Kayam Kulam GT				302	1032	1036	621	2118	2127
KARNATAKA									
Tanir Bavi				307	795	624	630	1631	1280
TAMIL NADU									
Basin Bridge GT				20	43	134	41	89	276

Nariman GT	0	0	0	0	0	0
Valuthur GT	272	327	51	558	671	104
Kuttalam GT	312	53	0	641	108	0
Kovikalappal	372	363	354	763	745	726
Karuppar GT	0	0	0	0	0	0
P Nallur CCGT	226	640	1057	464	1314	2169
Valantharvi GT	0	0	0			
PONDICHERRY						
Karaikal	134	135	129	276	277	265
Diesel Plants						
ANDHRA PRADESH						
LVS Power DG	133	0	1	246	0	2
KERALA						
Bramhapuram DG	74	144	145	136	266	267
Kojikode DG	87	170	209	161	313	385
Kasargode DG	9	42	80	16	78	148
KARNATAKA						
Yelhanka DG	147	208	387	271	384	715
Bellary DG	22	23	35	40	42	64
Belgaum DG	129	127	192	238	235	355
TAMIL NADU						
Samayanallur DG	207	248	319	382	457	589
Samalpatti DG	194	248	338	357	458	623
B. Bridge DG	413	537	655	762	992	1209
LAKSHADWEEP						
Laksh DG	13	0	0	23	0	0
Others						
KARNATAKA						
Torangallu - coal, blast furnace gas	0	0	0	516	766	872
TAMIL NADU						
Neyveli TPS (lignite)	1515	1582	460	1336	1395	406
Neyveli ST I (lignite)	4828	4989	5013	4258	4400	4421
Neyveli ST II (lignite)	10485	11342	11900	9247	10003	10495
Neyveli FST Ext (lignite)	3671	2260	101	3238	1993	89
Total	126360	127342	123662	112876	116072	112311
Operating Margin				**1.1195**	**1.0971**	**1.1011**

3 year average OM	**1.106**

Source: CEA, IPCC

Build Margin

Commissioning dates have been obtained from various sources for all plants located in the Southern Region. Total generation in the Southern grid in the period April 2004 to March 2005 was 142316.09 GWh. The most recent 5 capacity additions in the grid account for only 0.27% of this, and the most recent capacity additions accounting for 20% of generation must be taken as the base for the build margin calculation. These capacity additions and the associated fuel consumption and emissions are outlined below. (Generation data, fuel consumption and emissions are obtained as for the approximate operating margin.)

Table of Recent Capacity Additions, Generation and Emissions

Plant	Plant Type	Capacity Addition (MW)	Commissioning Date	Generation 04-05 (GWh)	Emissions 04-05 (kt)
Kadra	Hydro	150	01/07/1999	231	0
Kodasali	Hydro	120	01/07/1999	215	0
Kaiga	Nuclear	220	01/07/1999	1463	0
Harangi	Hydro	9	19/07/1999	0	0
Singur	Hydro	7.5	05/11/1999	1	0
Kojikode	DG	128.8	06/11/1999	161	87
Torangallu	WHR/Coal	130	15/12/1999	258	0
Karaikal	GT	32.5	03/01/2000	276	134
Singur	Hydro	7.5	31/03/2000	1	0
Bellary DG	DG	25.2	15/05/2000	40	22
Kondapalli	GT	350	01/07/2000	2246	1095
Kayam Kulam	GT	350	01/07/2000	621	302
Kaiga	Nuclear	220	26/09/2000	1463	0
Kovilkalappal	GT	107	30/09/2000	763	372
Kuttiadi	Hydro	50	27/01/2001	148	0
Kasargode DG	DG	21.9	15/03/2001	16	9
Srisailam LB	Hydro	150	26/04/2001	235	0
Pillaiperumal Nallur	GT	330.5	26/04/2001	464	226
Tani Bavi	GT	220	15/05/2001	630	307
Kuthungal	Hydro	21	01/07/2001	36	0
Gerusuppa	Hydro	240	01/07/2001	438	0
Belgaum DG	DG	81.3	01/07/2001	238	129
Madhavamantri	Hydro	3	15/07/2001	23	0
Samalpatti	DG	105.7	15/07/2001	357	194
Samayanallur DG	DG	106	22/09/2001	382	207
Srisailam LB	Hydro	150	12/11/2001	235	0
Peddapuram	CCGT	140	30/11/2001	726	354
Peddapuram	CCGT	80	30/11/2001	415	202
LVS	DG	36.8	15/01/2002	0	0
Simhadri	Thermal	500	15/02/2002	4061	5146
Srisailam LB	Hydro	150	19/04/2002	235	0
Simhadri	Thermal	500	15/08/2002	4061	5146
Neyveli Extn	Lignite	210	15/09/2002	1619	1836
Srisailam LB	Hydro	150	29/11/2002	235	0
Raichur	Thermal	210	10/12/2002	1531	1832
Neyveli	Lignite	250	16/12/2002	1336	1515
Valuthur GT	GT	60	24/12/2002	352	172

Valuthur GT	GT	35	13/03/2003	205	100
Neyveli Extn	Lignite	210	15/03/2003	1619	1836
Srisailam LB	Hydro	150	28/03/2003	235	0
Srisailam LB	Hydro	150	04/09/2003	235	0
Kuttalam GT	GT	64	30/11/2003	410	200
Chembukadavu	Hydro	6.5	30/12/2003	6	0
Urumi	Hydro	6.2	30/12/2003	1	0
Mini Hydel	Hydro	7.6	01/01/2004	5	0
Kuttalam GT	GT	36	30/03/2004	231	112
Malankara	Hydro	10.5	30/05/2004	3	0
Karuppur	GT	119.8	09/02/2005	0	0
Almatti DPH	Hydro	125	30/07/2005	139	0
Total				28603	21532
Build Margin					**0.753**

Applicable Emission Coefficient

As outlined in ACM0002, the baseline emission coefficient is taken as a weighted average of the operating margin and the build margin. The default weighting of 0.5, 0.5 is taken and therefore the CM is **0.929**.

Annex 4

MONITORING PLAN

The project activity will install a complete monitoring plan which covers the parameters outlined in section D.

The power plant is staffed by 11 people and part of the function of the manager is to report the daily electricity generation data of the waste heat recovery plant and the auxiliary consumption of the power plant. These systems are in place and operational.

The data from the heat consumption and output of the cement kiln is currently recorded in the plant. These are crucial operational parameters for the cement plant and are therefore monitored continuously. Again there are already systems in place to monitor the heat consumption and the output of the plant and the project activity will draw on these existing systems to record and report this data.

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