CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Project title: Fuel Switch at Corobrik's Driefontein Brick Factory in South Africa
Version number: 11
Version date: 10 October 2012

A.2. Description of the small-scale project activity:

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A fuel switch was implemented in December 2007 at Driefontein, which is an existing brick factory wholly owned by Corobrik (Pty) Ltd, (hereafter refer to as Corobrik) South Africa. This fuel switch entailed the conversion of the thermal fuel used in the clay brick-firing tunnel kiln at Driefontein Brick Factory. The fuel conversion was from coal to natural gas and involved the extension of the Sasol owned Natural Gas pipeline and the installation of a combustion system. The gasifiers that were used to burn the coal have been decommissioned and are currently in the process of being demolished.

Corobrik is the largest manufacturer, distributor and exporter of bricks and allied building products in Africa. Corobrik was established in Durban in 1902. Corobrik owns factories in Avoca, Driefontein, Glencoe, Lawley, Midrand, Odendaalsrus, Phesantekraal, Polokwane, Rietvlei, Springs and Witbank and employs over two thousand people countrywide.

The decision to develop the project under the CDM was made at the Board Meeting on 28 March 2007 where the project activity received the final approval from the Directors. The Driefontein conversion took place in December 2007 so the tunnel kiln has been operating on natural gas for the year of 2008. Registration of the project was held back in order to incorporate the lessons learnt in a similar fuel switch project at their Lawley factory (Project no. 0177). The Lawley fuel switch was registered in 6 March 2006 and was the first project in South Africa to receive carbon credits (13 June 2008). Hence, the Driefontein project is now applying for registration under the Clean Development Mechanism (CDM).

The project will reduce greenhouse gas emissions as natural gas is less Green House Gas (GHG) emission intensive than coal.

The project also results in a minor improvement in energy efficiency. The coal was combusted in gasifiers to generate producer gas. The producer gas was used in the tunnel kiln. The gasification process results in energy losses. The gasifiers at Driefontein have been commissioned in 1969 and 1973 were well maintained and would be able to remain operational and deliver producer gas to the kiln for a period exceeding the crediting period. In accordance with the UNFCCC tool for equipment lifetime an expert input was obtained to review the ongoing capital expenditure on the gasifier prior to the fuel switch, the maintenance record and actual state of the equipment. The production records for the last 20 years are used as proof that no industrial incident occurred that shortened the remaining technical lifetime of the gasifiers. The original coal gasifiers, used in the project baseline, have been decommissioned and are no longer operational.

The project makes positive contributions to sustainable development. The South African Designated National Authority (DNA) evaluates sustainability in three categories: Economic, environmental and social. The contribution of the project towards sustainable development is discussed in terms of these three categories:

Economic:
Once registered, the project will contribute to foreign reserve earnings for South Africa via the carbon credit sales revenue.

Environmental:
The project resulted in a healthier work environment as coal and its associated negative impacts were eliminated. The project led to a reduction in airborne particulate levels at the plant resulting from the combustion of coal. Furthermore, the burning of coal also resulted in sulphur emissions, which have been eliminated in this fuel switch. The gasifiers used to combust the coal and generate the producer gas have been decommissioned and will be disassembled and sold as scrap metal.

The project has led to a reduction in greenhouse gas emissions and an improvement in energy efficiency.

Social:
The Corobrik employees have benefited by the creation of a healthier work environment. Eighteen employees were affected by the fuel switch. They were re-deployed to the furnaces and there were no job losses. They received on-the-job training. The training included familiarisation and training on the gas line and total gas system in the factory. This included normal operation, maintenance and emergency procedures. These training sessions were held during the month of March 2009. All the operators and maintenance personnel were included in these training sessions.

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)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Corobrik (Pty) Ltd	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: *When the PDD is filled in support of a proposed new methodology (forms CDM-NBM and CDM-NMM),* at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

The Host Party is South Africa.

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

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Driefontein is located in the North West Province.

A.4.1.3. City/Town/Community etc:

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Driefontein is located 15 km from Carletonville. Driefontein falls within the Ramotshere Moiloa Local Municipality within the Ngaka Modiri Molema District Municipality.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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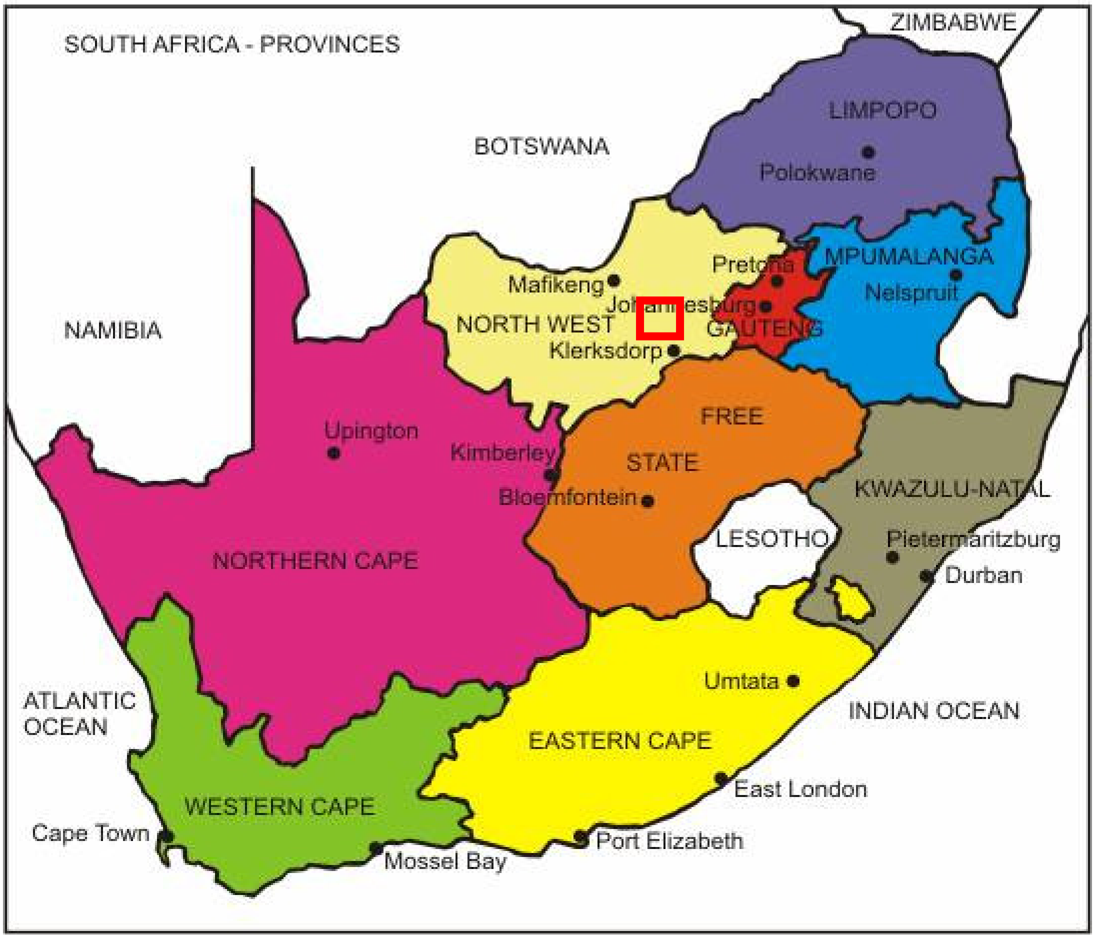
The physical address of the plant is:
Portion 23/27
Driefontein Farm
District Ngaka Modiri Molema
North West Province



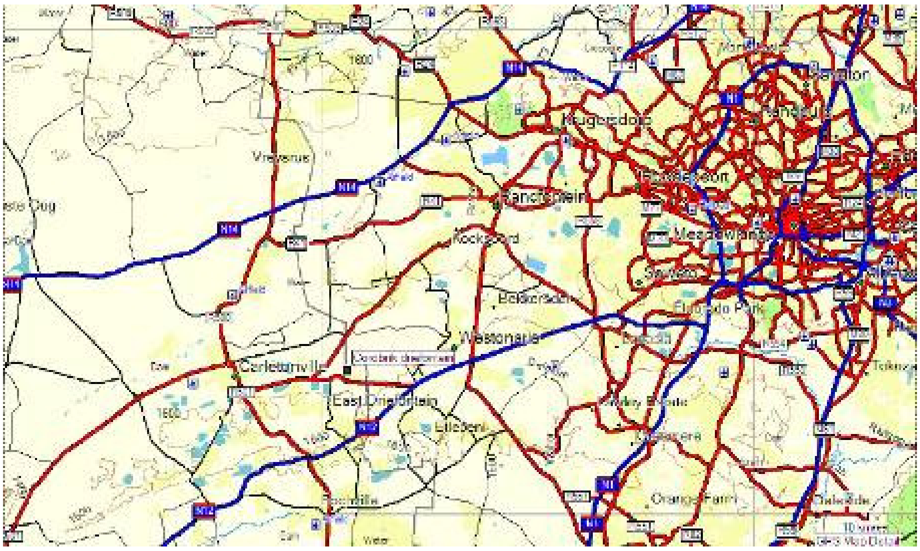


Figure 1: The Provincial Location of Corobrik Driefontein (http://www.id.org.za/policies/adopted-policies/policy-images/rsa_map.jpg)

The GPS co-ordinates of the site are:
26º21'08 S
27º31'43 E

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The relevant methodology for this small-scale project is AMS III. B: "*Switching fossil fuels*" (Version 15). The project activity is encompassed by Sectoral Scope 01: Energy industries (renewable / non-renewable sources).

The fuel switch and related new technology involved:

- The installation of a gas pipeline to connect Driefontein to the natural gas pipeline;
- The installation of kiln burners and fire control system consisting of:
    - 50 kiln burner plates
    - 124 burner plates
    - 16 burner spigots
    - 20 nozzles & 2 ignition transformers Swindell Dressler
    - 20 flamming electrodes for furnace zone burners
    - 20 Ignition electrodes for preheat zone burners
    - 20 flamming electrodes for preheat zone burners
    - ICS Burner control unit
- The installation of air, gas and electrical reticulation
- The installation of new thermocouples and compensating cables
- The upgrade of the kiln transformer, switchgear and cables
- The installation of a new instrumentation panel.

For more details and supporting documentation to the above technology description, reference is made to submitted document; 'Driefontein Factory Conversion to Natural Gas' (28-07-2010).

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions in tonnes of CO2e
1	37,131
2	37,131
3	37,131
4	37,131
5	37,131
6	37,131
7	37,131
Total estimated reductions (tonnes of CO2e)	259,918
Total number of crediting years	**7 (renewable twice)**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	37,131

A.4.4. Public funding of the small-scale project activity:

No public funding has been or will be used in the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

This project is not a debundled large scale project since it does not meet the criteria for a debundled component of a large project activity. This is illustrated in the table below. The text in italics is from the Compendium of guidance on the debundling for SSC project activities (Annex 27, EB 36).

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:	**Project activity**	**Was the applicability criteria for a debundled large scale project met?**
(a) With the same project participants	Corobrik has one registered project; which is the Lawley Fuel Switch and is a large scale project.	No
(b) In the same project category and technology/measure; and	There is no registered small-scale CDM project activity in the same project category and technology/measure.	No
(c) Registered within the previous 2 years, and	There is no registered small-scale CDM project activity that was registered within	No

	the previous two years.	
(d) *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.*	There are no registered CDM projects in the area.	No

Hence, the project is not a debundled component of a large scale project activity.

SECTION B. Application of a baseline and monitoring methodology

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

The approved small-scale baseline and monitoring methodology "*Type III.B. Switching Fossil Fuels*" (Version 15, EB 59 was selected.

The methodological tool "Tool to determine the remaining lifetime of equipment".(EB 50, Annex 15) was used.

The methodological tool "Tool for the demonstration and assessment of additionality" (EB 65, Annex 21) was used.

The 'Guidelines on the assessment of investment analysis' (EB 62, Annex 5) were used.

B.2 Justification of the choice of the project category:

The project activity is a switch from coal to natural gas. Hence, the project is aimed at reducing emissions through switching fuels. Therefore, the project activity is in line with "*Type III.B. Switching Fossil Fuels*". **The project activity meets all the applicability criteria of the methodology.**

No.	Type III.B. Switching Fossil Fuels	The project activity
1	*This methodology comprises fossil fuel switching in industrial, residential, commercial, institutional or electricity generation applications1 (e.g. fuel switch from fuel oil to natural gas in an existing captive electricity generation, or replacement of a fuel oil boiler by a natural gas boiler).*	The project activity incorporated a switch from coal to natural gas in an industrial application.
2	*Fuel switch may be in a single element process or may include several element processes within the facility. Multiple fossil fuel switching in an element process however is not covered under this methodology.*	The fuel switch is in a single element process and is a switch from coal to natural gas.

3	*This methodology is applicable for new facilities as well as for retrofit or replacement of existing installations[1].*	The fuel switch required a modification of the kiln at Driefontein.
4	*Fuel switching may also result in energy efficiency improvements. If the project activity primarily aims at reducing emissions through fuel switching, it falls into this methodology. If fuel switching is part of a project activity focussed primarily on energy efficiency, the project activity falls under a Type II methodology*	The project activity is aimed at reducing emissions through a complete fuel switch from coal to natural gas. The latter is the main aim of the project and the principle reason for implementation of the project by Corobrik. In addition there is no change in the specific energy consumption by the brick kiln as it stayed constant from 2005 to 2008 within a 95% confidence level between 6.66 and 9.47 GJ/1000 bricks. Supporting documentation is provided in the Excel 2012-04-23– Driefontein Fuelswitch Emission Reductions Calculations, the sheet 'Brick production' in the graph 'Average Energy consumption (GJ) per production of 1000 bricks before (2005-2007) and after (2008) project implementation' which can be found from row 77 downwards.
5	*New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the general guidelines to SSC CDM methodologies. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the general guidelines to SSC CDM methodologies. If the remaining lifetime of the affected systems increases due to the project activity, the crediting period shall be limited to the estimated remaining lifetime, i.e. the time when the affected systems would have been replaced in the absence of the project activity*	In accordance with the UNFCCC tool for equipment lifetime "Tool to determine the remaining lifetime of equipment (EB 50, Annex 15)" an expert input was obtained to review the ongoing capital expenditure on the gasifier prior to the fuel switch, the maintenance record and actual state of the equipment. The production records for the last 20 years are used as proof that no industrial incident occurred that shortened the remaining technical lifetime of the gasifiers. The original coal gasifiers, used in the project baseline, have been decommissioned and are no longer operational. The expert concluded that the expected lifetime of the decommissioned gasifiers exceeds the project lifetime as the gasifiers could produce gas indefinitely if maintained well.
6	*This methodology is not applicable to project activities that propose switch from fossil fuel use in the baseline to renewable biomass, biofuel or renewable energy in the project*	The project activity is not a switch from fossil fuel used in the baseline to renewable biomass, biofuel or renewable energy in the project scenario.

	scenario. A relevant Type I methodology shall be used for such project activities that generate renewable energy displacing fossil fuel use. This methodology is also not applicable to project activities involving the use of waste gas; these project activities might be eligible under AMS III.Q.	
7	*The facility may involve grid connected elemental processes however this methodology does not cover emission reductions on account of shift from use of grid electricity or electricity exported to a grid.*	The emission reductions are claimed for a shift from coal to natural gas and not a shift away from grid electricity.
8	*This category is applicable to project activities where it is possible to directly measure and record the energy use/output (e.g., heat and electricity) and consumption (e.g., fossil fuel) within the project boundary.*	.The only input into the burner is natural gas and the only output being hot air. The natural gas input into the burner is directly measured and recorded by a Sasol owned gas flow meter. The energy output of the element process is directly measured by the gas consumed by the burner. In addition, at the recipient end, the hot air temperature is measured directly using thermocouples, as is required by the methodology.
9	*Heat or electricity produced under the project activity shall be for on-site captive use and/or export to other facilities included in the project boundary. The generated electricity may also be supplied to users via mini/isolated grid(s) system exclusively supplied by fossil fuel units.*	The hot air is used on site within the brick kiln.
10	*In case energy produced by the project activity is delivered to another facility, or facilities, within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into specifying that only the facility generating the energy can claim emission reductions from the energy displacement.*	The energy is used on site.
11	*Regulations do not constrain the facility from using the energy sources*	Natural gas and electricity will be used in the project activity after the fuel switch.

	cited in paragraph 1 before or after the fuel switch. Regulations do not require the use of low carbon energy source (e.g., natural gas or any other fuel) in the element processes.	Supporting documentation to prove the previously used fuel (coal) neither the new fuel (Natural Gas) is against regulations: *environmental approval for the installation of the Sasol Natural Gas pipeline to Corobrik* confirms that Natural Gas is allowed to be used. Furthermore, this environmental approval states the previous use of coal, which means that the Department of Agriculture, Conservation and Environment was aware and approved of the use of coal at Corobrik. Supporting documentation to prove that regulations do not require the use of Natural Gas in Brick production facilities is the letter from the Claybrick association which states that only a minority of the Clay brick factories within South Africa make use of Natural gas in their brick production process
12	*The project activity does not result in integrated process change. The purpose is to exclude measures that affect other characteristics of the process besides switch of energy sources e.g., operational conditions, type of raw material processed, use of non-energy additives, change in type or quality of products manufactured etc.*	The project does not involve an integrated process change. As described in applicability criteria 4, the kiln operates the same and with the same energy efficiency. The process description as contained in the PDD was Validated by the DoE on their side visit.
13	*Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.*	The emission reductions resulting from the fuel switch are less than 60 kt CO_2 equivalent annually. The latest Excel document – Driefontein Fuelswitch Emission Reductions Calculations.xls in the sheet 'emission reductions', show that yearly reductions are 37,131tCO2 yearly.

The project meets all the conditions set forth in the approved small-scale methodology III B. Hence, the selected methodology is appropriate for the project activity.

B.3. Description of the project boundary:

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The project boundary consists of:

1. The tunnel kiln;
2. The Sasol owned natural gas pipeline;
3. The coal used prior to the switch;
4. The duff coal and tars sold;
5. The ash generated;
6. The natural gas used post the switch;

7. The decommissioned producer gas plant.

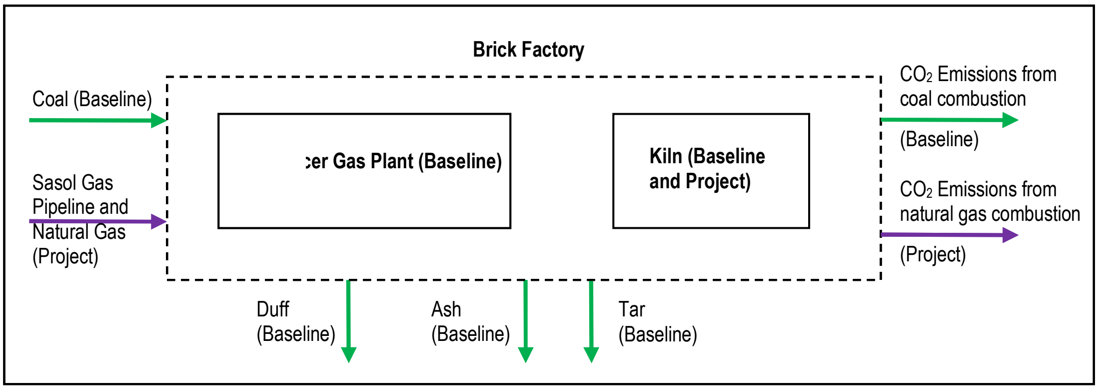

Figure 2: A diagram showing the project boundary

In order to be conservative, the reduction in emissions from no longer needing to transport the coal will not be included in the project boundary.

B.4. Description of baseline and its development:

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Methodology AMS-III.B (Version 15) states with regard to the baseline the following:

'In case of existing facilities historical information (detailed records) on the use of fossil fuels and the plant output in the baseline captive energy generation plant from at least three years prior to project implementation shall be used in the baseline calculations'.

The Corobrik Driefontein brick production facility historically used coal in its brick production process which is therefore the baseline as per AMS-III.B (version 15). Coal was replaced by natural gas as the CDM project activity.

It is important to note that in the baseline not all the energy in the consumed coal was used to generate the producer gas:

- The coal fines (duff coal) were screened out before the coal entered the gasifiers. The duff coal was sold.
- Tar and ash were produced as a result of the gasification reaction. Ash was stockpiled on site and used in the brick making process for aesthetic purposes. The tar was sold.
- Energy losses in the form of heat losses to atmosphere also occurred.

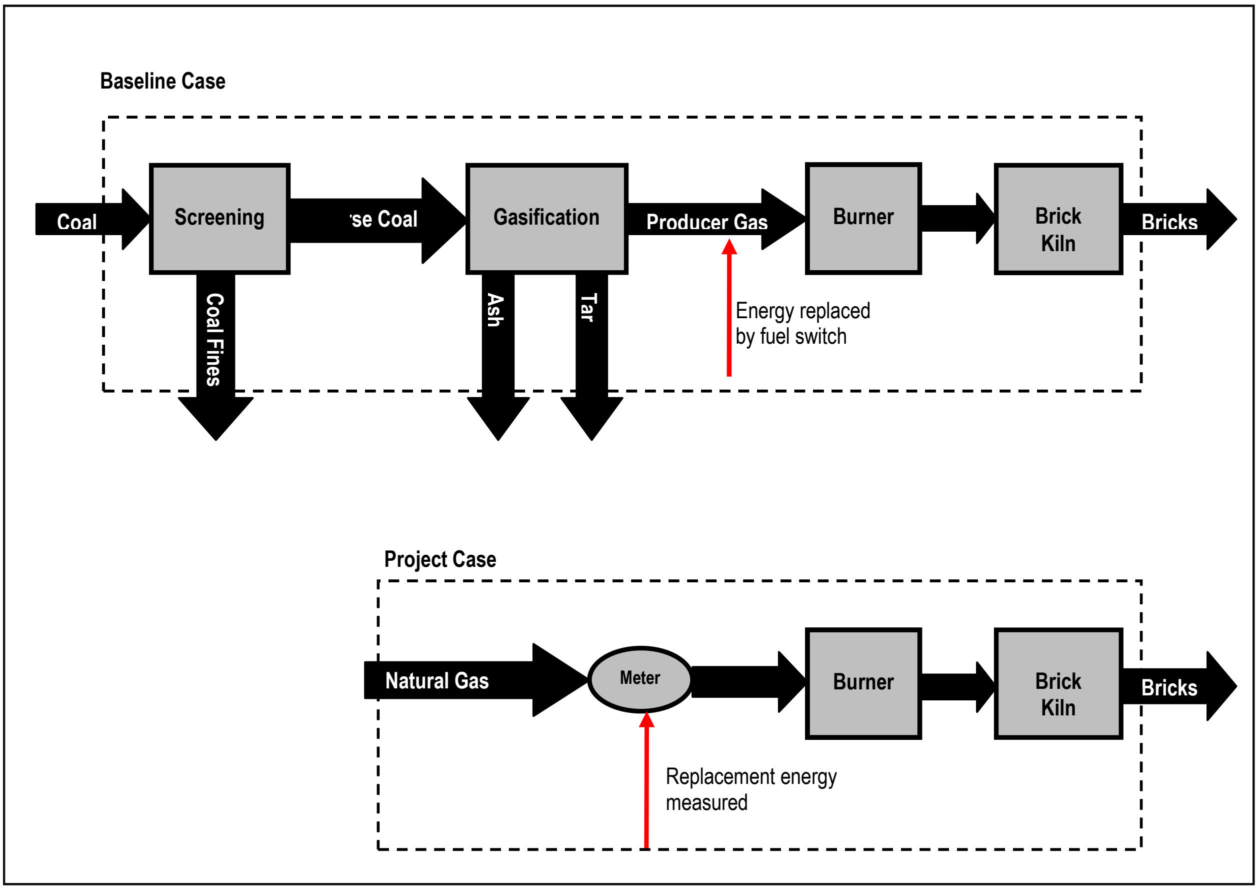

Figure 3: A diagram of the baseline case and project case

Coal crusher ash with a calorific value of 7.3 GJ/ton is used as an additive (body coal) for its visual impact. The same amount of coal ash was added to the bricks before and after the fuel switch. Therefore, the 'body coal' was excluded from both the baseline and the project emissions. There is enough coal ash on site to last for approximately 30 years of brick production.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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It was decided that an investment analysis would be the most suitable analysis method to prove additionality of the project.

The methodological tool "Tool for the demonstration and assessment of additionality" (version 05.2, EB 39, Annex 10) as well as the "Guidelines on the assessment of Investment Analysis" (version 05, EB 62, Annex 5) was used.

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

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

Alternative scenarios for generating the energy needed in the brick-firing kiln:

1. The use of coal to produce the energy needed for brick-firing (continuation of current activity)
2. The replacement of coal with natural gas without CDM funding
3. The replacement of coal with diesel
4. The replacement of coal with Heavy Furnace Oil (HFO)
5. The replacement of coal with renewable biomass
6. The use of Eskom electricity to produce the energy needed for brick firing

Sub-step 1b: Consistency with mandatory laws and regulations:

All these alternatives meet the legal and regulatory requirements.

Step 2: Investment Analysis

Sub- step 2a: Determine appropriate analysis method

Option II, the investment comparison analysis was decided to be the most appropriate analysis method

Sub-step 2b: Option II. Apply investment comparison analysis

The NPV has been identified as the most suitable financial indicator for comparison of the project alternatives.

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

The NPV value of each scenario is calculated as it is found to be the most suitable way to compare the different project alternatives.

The NPV value for the Biomass Alternative Project scenario could not be calculated, as no price for biomass fuel could be obtained as there is not sufficient biomass fuel available in the region (Eecofuels, 2011, Statement on biomass availability in the Driefontein region). This alternative scenario is therefore unrealistic and no longer considered a viable alternative to the project activity.

The NPV values for all scenario's as determined in step one are presented in the table below:

Scenario	Alternatives	NPV	Comments
Alternative Scenario	1. The use of coal[a] to produce the energy needed for brick-firing	-71,375,864	Lowest cost option
Alternative Scenario	2. The replacement of coal with natural gas[b]	-123,963,718	
Alternative Scenario	3. The replacement of coal with diesel[c]	430,651,778	
Alternative Scenario	4. The replacement of coal with HFO[d]	-263,481,419	
Alternative Scenario	5. The replacement of coal with renewable biomass	n.a: see Eecofuels statement on biomass availability in	

		Driefontein area	
Alternative Scenario	6. The use of Eskom electricity[e] to produce the energy needed for brick firing	-200,529,312	
Alternative Scenario	7. The project activity undertaken as CDM	-97,743,758	

Table 1: NPV values for the different project scenarios

Input data used for investment analysis:

Input Data	Source
Monetary value used is ZAR	-
The South African inflation rate is between 3%-6%. As an average value, 4.5% is applied	www.sarb.co.za Cobbett, J. (2008-10-21) Manuel, Mboweni agree on inflation target, Moneyweb. Mngoma, B. (2008-04-01) Inflation targeting a moving target,The Skills Portal.
A prime lending rate of 10.5% is applied	http://www.reservebank.co.za/internet/Historicdata.nsf/
Capital cost: ZAR30 million for the extension of the Sasol Gas Pipeline, and ZAR11,370,178 of fuel switch related costs	Capital costs can be found in supporting document 'Addendum to Gas Supply Agreement with SASOL, (26-09-2006)" The supporting docs for the ZAR 11,370,178 are "Conversion to Natural Gas Project Cost" and "Cost code 32BS.1650 for conversion"
Prices and costs as at February/March 2007 were used in the investment analysis calculations	-
Fuel Prices in 2007 a. Coal: ZAR 322.60/ton - Coal: ZAR 12.46/GJ b. Natural Gas: ZAR 32.48/GJ c. Natural Gas: ZAR 26/GJ d. Diesel: ZAR 151.10/GJ e. HFO fuel: ZAR 89.90/GJ f. Electricity: ZAR 240.52/MWh - ZAR 66.8/GJ	a. Cost of coal (26-03-2007), as obtained from internal order database - Based on calorific value Coal obtained from 'Coal Analysis Report, 2004-2007' b. Sasol Natural Gas invoices (February-November 2008) c. Sasol Gas contract (26 September 2006) d. Diesel price (R/l) was obtained from http://www.dme.gov.za/energy/historyprice07.stm. Average density of diesel was obtained from http://en.wikipedia.org/wiki/Diesel_fuel. LHV from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 1: Introduction, Table 1.2, pg 1.18. Calculations can be found in 2012-04-23-Driefontein Investment Analysis.xls, sheet 'Energy Cost'. e. HFO price (R/l) was obtained from document Supply of Sasol Fuel Oil 150

	(HFO 150). Average density and Lower Heating Value of HFO from the Renewable Fuels Agency - January 2008, *Carbon and sustainability reporting within the renewable transport fuel obligation.* Calculations can be found in Driefontein Investment Analysis.xls, sheet 'Energy Cost'. f. Tariffs for 2008: www.nersa.org.za Eskom's average tariff adjustment for the last 15 years: http://www.eskom.co.za/live/content.php?ItemID=937 Calculations can be found in Driefontein Investment Analysis.xls, sheet 'Energy Cost'.
Material Prices Duff: ZAR35.00/ton Tar: ZAR390/ton	Duff: Duff Supply Invoices November 2006, January-March 2007 used as a conservative approach. (Duff Supply Invoice April-May 2007 not conservative) Tar: Tar sales, March 2007
Once off maintenance on gasifiers ZAR217,500	Maintenance Invoice, 23-05-2006
Regular maintenance on gasifiers ZAR441,666	In-house maintenance cost
CER price €11.00	-
Cost of Demolition of Gasifiers ZAR 364,320	Brinkman, J. (2009) Demolition of redundant gasifiers
Steel from Demolished Gasifiers = 1000 tonnes	Carswell, R. (2010) Demolishing of gas producers
Steel price ZAR 1,800/ton	Carswell, R. (2010) Demolishing of gas producers

Table 2: Input data used for the Investment Analysis

As described in table 1, the NPV for the proposed project scenario where natural gas is used to produce the energy needed for brick-firing, is lower (more negative) than that of baseline scenario. The most economic option would be to continue using coal to produce energy needed for brick-firing.

Sub-step 2d: Sensitivity Analysis

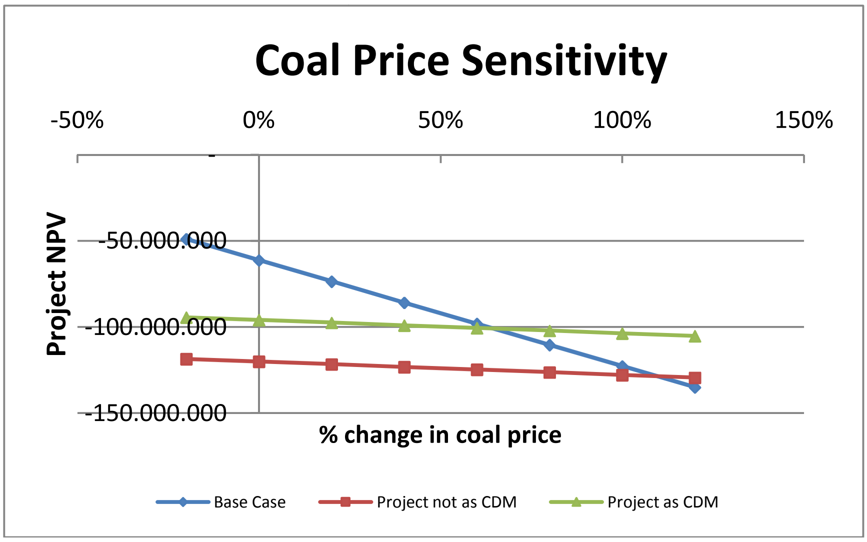
<u>Sensitivity Analysis:</u>

In accordance with EB 51 Annex 58 §17 and 18, the following sensitivity analyses have been performed:

1- Coal price
2- Natural gas price
3- Electricity price
4- Heavy fuel oil price
5- Diesel price
6- Investment cost

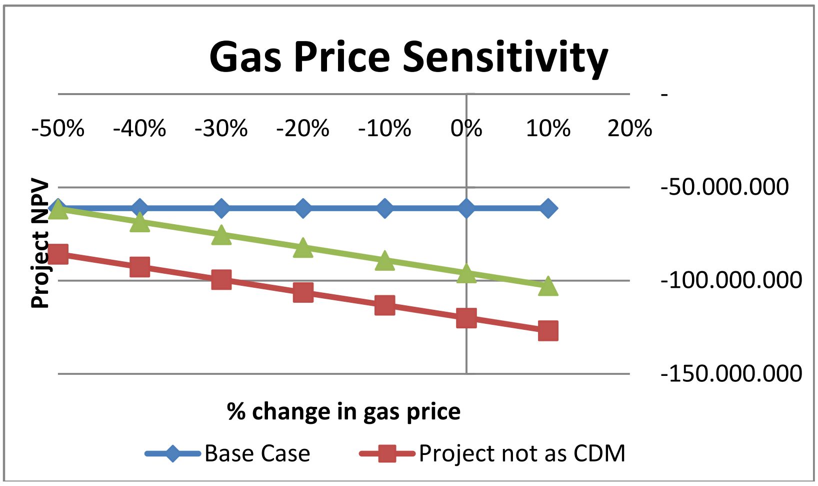
Sensitivity Analysis 1:

By how much must the coal price rise to make coal more expensive than natural gas?



From the above graph it can be seen that a rise of 109% in coal price would make the coal more expensive than natural gas. The probability of such an increase is extremely low given the availability of coal in South Africa.

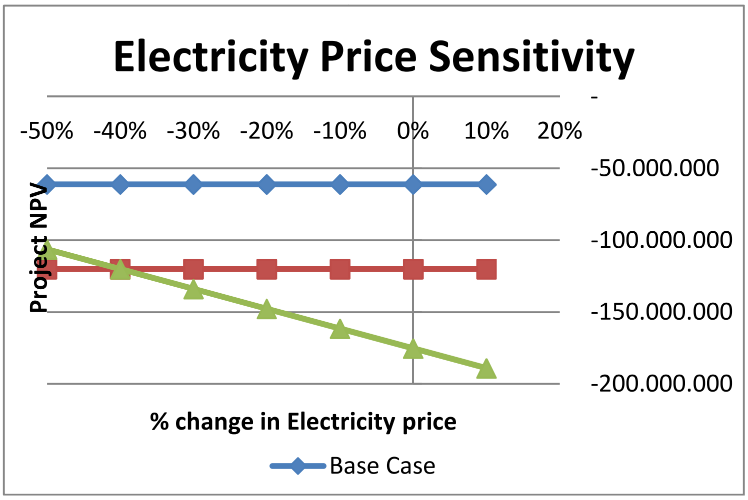
Sensitivity Analysis 2:
By how much must the natural gas price decrease to make coal more expensive than natural gas?



From the graph it can be seen that a decrease of 50% in natural gas price still doesn't make natural gas cheaper than coal. An 86% decrease in the gas price would make the project NPV of the project and base case equal. The probability of such a decrease is extremely low.

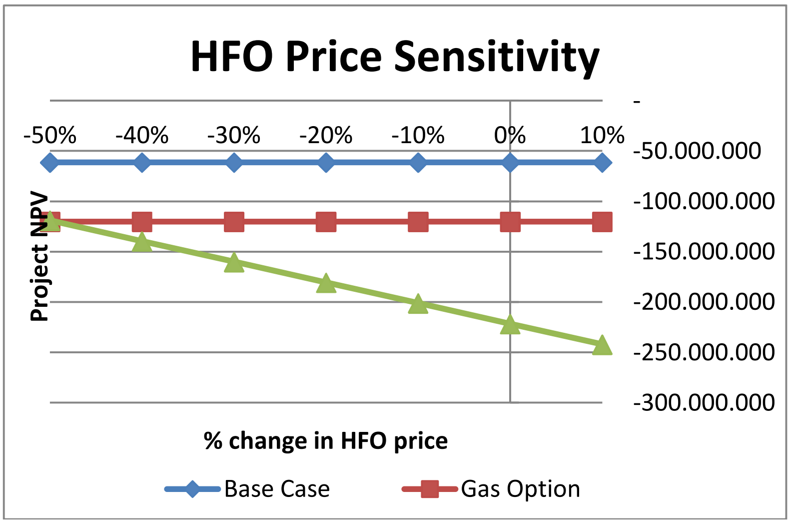
Sensitivity Analysis 3:

By how much must the electricity price decrease to make natural gas more expensive than electricity?



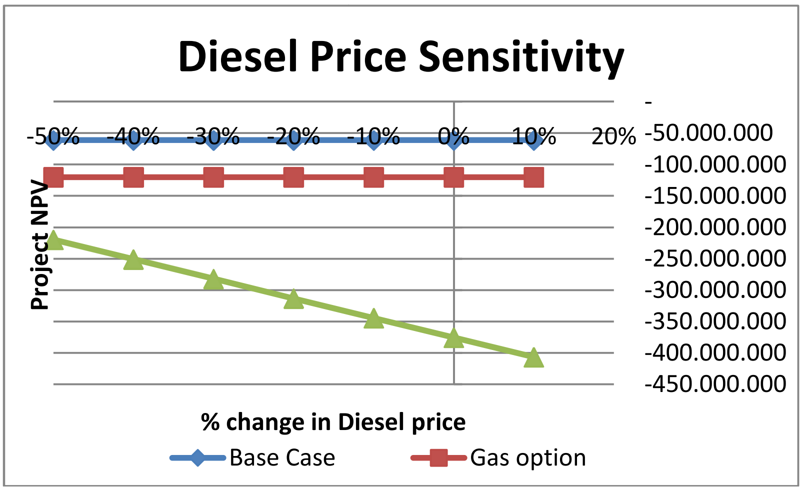
A decrease of approximately 40% in the electricity price makes the project as profitable as a natural gas fuel switch (without CERs). Based on the high electricity price increases of the last years and projected increases for the coming years (the National Energy Regulator of South Africa (NERSA) approved a yearly increase of approximately 25% from 2010 to 2014) such a decrease in electricity price is highly unlikely.

Sensitivity Analysis 4:
By how much must the Heavy Fuel Oil price decrease to make natural gas more expensive than Heavy Fuel Oil?



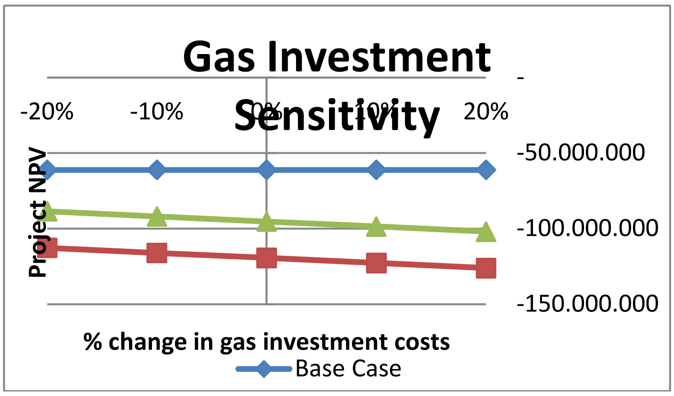
If heavy fuel oil prices decreases with approximately 50%, a fuel switch to heavy fuel oil will be more profitable than a natural gas fuel switch. This decrease in heavy fuel oil costs is however very unlikely as the heavy fuel oil price is related to crude oil prices, which are not expected to come down 50%.

Sensitivity Analysis 5:
By how much must the Diesel price decrease to make natural gas more expensive than Diesel?



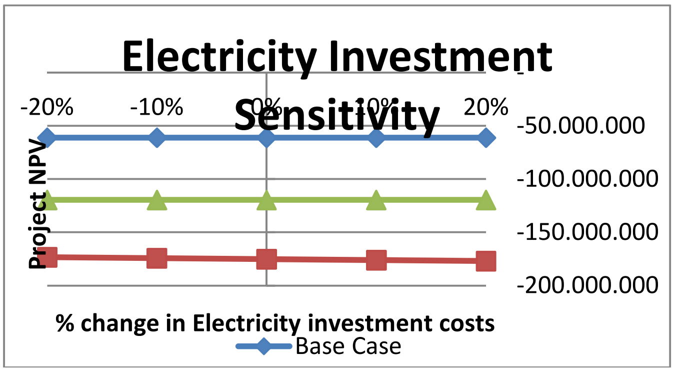
Diesel prices must be reduced with approximately 85% to make a diesel switch more profitable than a natural gas fuel switch. The same argument as for the heavy fuel oil price decrease is valid.

Sensitivity Analysis 6a:
By how much must the project (gas switch) investment costs decrease to make the project more profitable than the base case?



As shown in the graph above, a 20% investment cost reduction doesn't make the project NPV come close to the base case NPV. It is unlikely that the investment costs are reduced with more than 20% at any point in time.

Sensitivity Analysis 6b:
By how much must the electricity fuel switch investment costs decrease to make the project more profitable than the gas fuel switch?



The most profitable alternative fuel switch option after natural gas is a fuel switch to electricity. As a conservative assumption, only the burner costs of a natural gas fuel switch have been assumed to be the capital costs for all other alternative fuel switch options. Since the graph above shows that a 20% investment cost reduction on an electricity fuel switch project doesn't make it more profitable than the natural gas fuel switch, all other fuel switch scenarios have been excluded from investment sensitivity analysis.

Outcome of Step 2

The above presented sensitivity analyses show that the proposed project activity is not the most economically attractive option and is not financially feasible without the revenue from the sales of the CERs.

The results of the additionality tool to demonstrate additionality shows that the Driefontein fuel switch is additional as a CDM project.

Prior Consideration

In April 2005, Statkraft, the buyer of the carbon credits generated by the Lawley fuel switch project, visited Corobrik Driefontein to review and discuss the potential of a Driefontein fuel switch project being developed as a CDM project.

On the 7th of November 2005, there was a telephone conference between Statkraft (Stef Peters), Corobrik (Dirk Meyer) and Nu Planet (Anton-Louis Olivier) further discussing the Corobrik Driefontein fuel switch project as a CDM project.

These discussions resulted in Statkraft and Corobrik signing the amended ERPA for Corobrik Lawley which includes additional CERs, expectedly from the Corobrik Driefontein project in December 2005.

Date	Progress	Supporting documentation
22 Apr 2005	Statkraft Site Visit to Corobrik Driefontein to review and discuss the potential of the Driefontein fuel switch project being developed as a CDM project	Letter from Mr. Anton-Louis Olivier to Mr. Meyer (24-02-2012) 'Confirmation of the 2005 site visit and discussions about the potential Corobrik Driefontein fuel switch project as a CDM project' - confidential Letter from Mr. Stef Peters to Mr. Meyer (23-02-2012) 'Early consideration of

		Driefontein becoming a CDM project' - confidential Nu Planet Agenda for Statkraft visit to South Africa in April 2005
7 Nov 2005	Telephone conference between Statkraft (Stef Peters), Corobrik (Dirk Meyer) and Nu Planet (Anton-Louis Olivier) further discussing the Corobrik Driefontein fuel switch project as a CDM project	Letter from Mr. Anton-Louis Olivier to Mr. Meyer (24-02-2012) 'Confirmation of the 2005 site visit and discussions about the potential Corobrik Driefontein fuel switch project as a CDM project' - confidential Letter from Mr. Stef Peters to Mr. Meyer (23-02-2012) 'Early consideration of Driefontein becoming a CDM project'
8 Nov 2005	Plan of study for environmental scoping for extension of the pipeline	Plan of study for scoping for extension of the pipeline (08-11-2005)
Dec 2005	Statkraft and Corobrik sign the amended ERPA for Corobrik Lawley which includes additional CERs, expectedly from the Corobrik Driefontein project.	Letter from Mr. Anton-Louis Olivier to Mr. Meyer (24-02-2012) 'Confirmation of the 2005 site visit and discussions about the potential Corobrik Driefontein fuel switch project as a CDM project' - confidential Letter from Mr. Stef Peters to Mr. Meyer (23-02-2012) 'Early consideration of Driefontein becoming a CDM project' - confidential
3 Jul 2006	Completion of the environmental management plan for the extension of the pipeline	Completion of the environmental management plan for the extension of the pipeline (03-07-2006)
26 Sept 2006	Signing of the Sasol gas supply contract by Mr. Trevou, MD of Corobrik	Sasol gas supply contract (26-09-2006)
8 Dec 2006	Proposal to revamp the kiln to operate on natural gas	Proposal to revamp the kiln to operate on natural gas (08-12-2006).
17 Jan 2007	Preparation of the document for the meeting of the board members. The document refers to the CDM and potential revenue of the project.	Preparation of the document for the meeting of the board members (17-01-2007).
Jan 2007	Construction Licence for the extension of the pipeline was received	Construction License for the extension of the pipeline was received (January 2007).
13 Feb 2007	Record of Decision for the EIA for the pipeline extension was received	Department of Agriculture, conservation and Environment, Record of Decision for the EIA for the pipeline extension was received (13-02-2007)
28 Mar 2007	Board meeting with discussion of the Driefontein project	Board meeting with discussion of the Driefontein project (28-03-2007).
4 Jun 2007	Email from Statkraft about the development of the	Email from Statkraft about the

	PDD for the Driefontein Project: ERPA discussion	development of the PDD (04-06-2007) - confidential
01 Jun 2007	Invoice being raised by Sasol for R25 million for the Sasol pipeline to be constructed for Corobrik. A contract with Sasol was signed, which would become legally binding once all conditions precedent were met. Of the two conditions precedent (a positive environmental record of decision and all required licenses for the gas pipe), only the environmental record of decision was obtained when both parties agreed to continue with the project. This resulted in an invoice being raised on the 1st of June 2007 and the payment being raised on the 30th of June. The operation license for the Sasol pipeline was obtained 12-11-2010.	Sasol Invoice to Corobrik-Driefontein (01-06-2007) / National Energy Regulator of South Africa,12-11-2010, License for the operation of a gas transmission facility
11 June 2007	**Construction of the pipeline started. This date is seen as the first real action on the project and is therefore chosen as the starting date**	Minutes progress meeting pipeline construction (20-06-2007)
30 Jun 2007	A first payment of R25 million for the Sasol Pipeline is made by Corobrik (Pty) Ltd.	First payment of R25 million for the Sasol Pipeline (30-06-2007).
25 Sep 2007	Email sent to Nu Planet, CDM developer, to develop the Driefontein fuel switch as a CDM project	Email sent to Nu Planet , CDM developer (25-09-2007)
23 Oct 2007	First draft of the Driefontein PDD by NuPlanet	First draft of the Driefontein PDD by NuPlanet (23-10-2007).
Dec 2007	Implementation of the Driefontein fuel switch (Sasol gas invoices as reference)	Sasol invoices for Natural gas purchased (December 2007)
23 Jan 2008	Corobrik meeting to discuss progress of the Driefontein PDD	Corobrik meeting to discuss progress of the Driefontein PDD (23-01-2008).
15 Sep 2008	Corobrik contacts Promethium Carbon to work on Driefontein project	Corobrik contacts Promethium Carbon to work on the Driefontein project. (15-09-2008)
9 Oct 2008	Promethium proposal accepted and work on the PDD begins. Site visit by Promethium to Driefontein Factory	Promethium proposal accepted (09-10-2008)
20 Feb 2009	Stakeholder consultation for the CDM project commences	Stakeholder consultation for the CDM project commences_1 and Stakeholder consultation for the CDM project commences_2.
Feb 2009	Draft PDD completed by Promethium	Draft PDD completed by Promethium. (February 2009)
20 Mar 2009	Requested quote for validation of Driefontein Fuel Switch Project from SGS	Requested quote for validation of Driefontein Fuel Switch Project from SGS (20-03-2009)
14 Apr 2009	Requested quote for validation of Driefontein Fuel Switch Project from Tuev Nord and ERM	Requested quote for validation of Driefontein Fuel Switch Project from

		Tuev Nord (14-04-2009).
9 Apr 2009	Quote received from SGS	Quote received from SGS (09-04-2009)
8 May 2009	Quote received from ERM	Quote received from ERM (08-05-2009)
9 May 2009	Quote received from Tuev Nord	Quote received from Tuev Nord (09-05-2009)
19 Aug 2009	Tuev Nord quote is accepted by Corobrik, but unfortunately it had expired. Hence, an updated quote was requested from Tuev Nord.	Tuev Nord quote is accepted by Corobrik, but unfortunately it had expired (19-08-2009)
Aug - Nov 2009	Follow up on proposal from Tuev Nord	Follow up on proposal from Tuev Nord_1 to _10 (August to November 2009)
20 Nov 2009	Updated quote received from Tuev Nord	Updated quote received from Tuev Nord (20-11-2009)
1 Feb 2010	PDD uploaded for global stakeholder consultation by Tuv Nord	PDD uploaded for global stakeholder consultation by Tuv Nord (01-02-2010)

It is important to note that the implementation of the project could only take place in December of any given year in order to coincide with the holidays of the construction industry. Less bricks are required during the holidays for the construction industry.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The project is a fuel switch from coal to natural gas; which uses methodology ASM III. B. The emission reductions were calculated as follows:

Baseline Emissions

$$BE_y = EF_{BSL} \times Q_{PJ,y} \quad (1)$$

Where:

BE_y	Baseline emissions in the project activity in year y (tCO_2e)
EF_{BSL}	Emission factor for the baseline situation (tCO_2/MWh)
$Q_{PJ,y}$	Net energy output in the project activity in year y (MWh)

The net energy output in the project activity is calculated using the following equation:

$$Q_{PJ,y} = \frac{FC_y \times NCV \times 1000}{CF_{power}} \quad (1b)$$

Where:

FC_y	Amount of fossil fuel (natural gas) consumed for captive energy generation in the project activity in year *y* (Nm^3)
NCV	Net calorific value for the fossil fuel (natural gas) (TJ/Nm^3)

CF_{power} 3.6 (Conversion factor from GJ to MWh)

The baseline emission factor was calculated using Equation 2:

$$EF_{BSL} = \sum_{i,j} \left(FC_{i,j,BL,y} \times NCV_j \times EF_{CO2,j}\right) / Q_{BSL,j} \qquad (2)$$

Where:

$FC_{i,j,BL,y}$	Total amount of fossil fuel consumed for captive energy generation in the baseline situation (Nm^3)
$EF_{CO2,j}$	CO_2 emission factor for the baseline producer gas (tCO_2/TJ)
NCV_j	Net calorific value for the baseline producer gas (TJ/Nm^3)
$Q_{BSL,j}$	Net energy generated in the captive plant in the baseline situation during the corresponding period of time for which the total fuel consumption was taken, in accordance with paragraph 15 (MWh)

Project Emissions

The project emissions are associated with the use of natural gas.

$$PE_y = FC_y \times NCV \times EF_{CO2} \qquad (3)$$

Where:

PE_y	Project emissions in the project activity in year y (tCO_2e)
FC_y	Amount of fossil fuel (natural gas) consumed for captive energy generation in the project activity in year *y* (Nm^3)
EF_{CO2}	CO_2 emission factor for fossil fuel (natural gas) (tCO_2/TJ)
NCV	Net calorific value for the fossil fuel (natural gas) (TJ/Nm^3)

Leakage Emissions

No leakage needs to be accounted for under the applicable methodology.

Emission Reductions

The emission reductions were calculated using Equation 4:

$$ER_y = BE_y - PE_y \qquad (4)$$

Where:

ER_y	Emission reductions in year y (tCO_2e)
BE_y	Baseline emissions in the project activity in year y (tCO_2e)
PE_y	Project emissions in the project activity in year y (tCO_2e)

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	**$FC_{i,jBL,y}$**
Data unit:	Nm^3
Description:	Total amount of producer gas consumed for captive energy generation in the baseline situation
Source of data used:	Corobrik factory operation records for 2005-2008 and thermodynamic properties of the gas
Value applied:	61,338,465
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methodology specifies that three years of historical data must be used in the case of an existing facility. Detailed data and calculation of the parameter are presented in Annex 3.
Any comment:	

Data / Parameter:	**$EF_{CO2,j}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for the baseline producer gas
Source of data used:	Corobrik factory operation records 2005-2008
Value applied:	154.19
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methodology specifies that three years of historical data must be used for the calculation of the emission factor in the case of an existing facility. The emission factor for the producer gas was calculated based on the following data: • Coal NCV obtained from coal analysis data for the period 2004-2007 and a default emission factor obtained from the IPCC 2006 guidelines • Duff NCV obtained from coal/duff analysis for the period 2004-2007 and a default emission factor obtained from the IPCC 2006 guidelines • The carbon content (measured for the period 2004-2007) of ash • IPCC (2006 guidelines) default factors for Tar calorific value and emission factor
Any comment:	The emission factor of the producer gas was calculated by performing a carbon balance and a mass balance.

Data / Parameter:	**NCV_j**
Data unit:	TJ/Nm^3
Description:	Net calorific value for the baseline producer gas
Source of data used:	Gas composition and thermodynamic properties
Value applied:	0.0000064
Justification of the choice of data or	The methodology specifies that three years of historical data must be used in the case of an existing facility. Detailed data and calculations are presented in

description of measurement methods and procedures actually applied :	Annex 3.
Any comment:	The calorific value of the producer gas was calculated using the gas composition and energy content.

Data / Parameter:	$\mathbf{Q_{BSL,j}}$
Data unit:	MWh
Description:	Net energy generated in the captive plant in the baseline situation
Source of data used:	Production data for 2005-2008
Value applied:	114,698
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methodology specifies that three years of historical data must be used in the case of an existing facility.
Any comment:	The energy generated in the baseline was calculated from an energy balance.

Data / Parameter:	$\mathbf{CF_{power}}$
Data unit:	MWh/GJ
Description:	Conversion factor from GJ to MWh
Source of data used:	The International System of Units
Value applied:	3.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	The International System of Units is the modern form of the metric system. It is the world's most widely used system of measurement in science
Any comment:	

Data / Parameter:	$\mathbf{EF_{CO2}}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for fossil fuel (natural gas) used in the project case
Source of data to be used:	2006 IPCC lower default emission factor
Value of data	58.3
Justification of the choice of data or description of measurement methods and procedures actually applied:	The CO_2 emission factor for natural gas is the default as per 2006 IPCC Greenhouse Gas Inventory.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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The Baseline Emissions

Equation 1

$$BE_y = EF_{BSL} \times Q_{PY,y}$$

Year	BE_y	EF_{BSL}	$Q_{PY,y}$
	(tCO_2e)	(tCO_2/MWh)	(MWh)
1	61,812	0.53	117,595
2	61,812	0.53	117,595
3	61,812	0.53	117,595
4	61,812	0.53	117,595
5	61,812	0.53	117,595
6	61,812	0.53	117,595
7	61,812	0.53	117,595

Equation 2

$$EF_{BSL} = \sum_{i,j} \left(FC_{i,j,BL,y} \times NCV_j \times EF_{CO2,j} \right) / Q_{BSL,j}$$

Year	EF_{BSL}	FC_{BSL}	$EF_{CO2,PG}$	NCV_{PG}	Q_{BSL}
	(tCO_2/MWh)	(Nm^3)	(tCO_2/TJ)	(TJ/Nm^3)	(MWh)
1	0.53	61,338,465	154	0.0000064	114,698
2	0.53	61,338,465	154	0.0000064	114,698
3	0.53	61,338,465	154	0.0000064	114,698
4	0.53	61,338,465	154	0.0000064	114,698
5	0.53	61,338,465	154	0.0000064	114,698
6	0.53	61,338,465	154	0.0000064	114,698
7	0.53	61,338,465	154	0.0000064	114,698

The net output in the project activity is calculated using the following equation

$$Q_{PY,y} = \frac{FC_y \times NCV \times 1000}{CF_{power}}$$

Year	$Q_{PY,y}$	FC_y	NCV	CF_{power}
	(MWh)	(Nm^3)	(TJ/Nm^3)	
1	117,595	11,569,860	0.00003659	3.6
2	117,595	11,569,860	0.00003659	3.6
3	117,595	11,569,860	0.00003659	3.6

4	117,595	11,569,860	0.00003659	3.6
5	117,595	11,569,860	0.00003659	3.6
6	117,595	11,569,860	0.00003659	3.6
7	117,595	11,569,860	0.00003659	3.6

The Project Emissions

Equation 3

$$PE_y = FC_y \times NCV \times EF_{CO2}$$

Year	PE_y	FC_y	EF_{CO2}	NCV
	(tCO_2e)	(Nm^3)	(tCO_2/TJ)	(TJ/Nm^3)
1	24,681	11,569,860	58	0.00003659
2	24,681	11,569,860	58	0.00003659
3	24,681	11,569,860	58	0.00003659
4	24,681	11,569,860	58	0.00003659
5	24,681	11,569,860	58	0.00003659
6	24,681	11,569,860	58	0.00003659
7	24,681	11,569,860	58	0.00003659

The Emission Reductions

Equation 4

$$ER_y = BE_y - PE_y$$

Year	ER_y	BE_y	PE_y
	(tCO_2e)	(tCO_2e)	(tCO_2e)
1	37,131	61,812	24,681
2	37,131	61,812	24,681
3	37,131	61,812	24,681
4	37,131	61,812	24,681
5	37,131	61,812	24,681
6	37,131	61,812	24,681
7	37,131	61,812	24,681

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Year	**Estimation of project activity emissions (tonnes of CO_2 e)**	**Estimation of baseline emissions (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of overall emission reductions (tonnes of CO_2 e)**
1	24,681	61,812	0	37,131
2	24,681	61,812	0	37,131
3	24,681	61,812	0	37,131
4	24,681	61,812	0	37,131

5	24,681	61,812	0	37,131
6	24,681	61,812	0	37,131
7	24,681	61,812	0	37,131
Total (tonnes of CO_2 e)	**172,765**	**432,684**	**0**	**259,918**

B.7 Application of a monitoring methodology and description of the monitoring plan:

As per methodology AMS-III.B (version 15), the following monitoring shall take place:

- Monitoring of the fossil fuel use (FC_y) and output of element process *i* after the project activity has been implemented ($Q_{PJ,y}$) - e.g. gas use and heat output by a district heating plant, gas use and electricity generated by a generating unit;
- For electricity/thermal energy exported to other facilities, monitoring of the use of electricity and thermal energy shall be undertaken in the recipient end

The only input into the burner is natural gas and the only output being hot air. The natural gas input into the burner is directly measured and recorded by a Sasol owned gas flow meter. The energy output of the element process is directly measured by the gas consumed by the burner. At the recipient end, the hot air temperature is measured directly, as is required by the methodology, using thermocouples.

Data / Parameter:	**NCV**
Data unit:	TJ/Nm^3
Description:	Net calorific value for the fossil fuel (natural gas) used in the project case
Source of data to be used:	Sasol invoices supply the monthly gross calorific value (GCV) for natural gas used. This is converted to net calorific value (NCV) by multiplying the GCV value by the factor 0.9031.
Value of data	0.00003659
Description of measurement methods and procedures to be applied:	The Sasol invoices for natural gas contain the gross calorific value of the gas. The calorific value is typically in GJ/Nm^3 and can be converted into TJ/Nm^3 by dividing by 1000.
QA/QC procedures to be applied:	Check that there are no significant changes in the calorific value every month.
Any comment:	The Sasol invoices contain the GCV of the natural gas. In future NCV might appear directly on the invoice; however until that is the case, the reported GCV will be converted to NCV by multiplying the GCV value by the factor 0.9031, as per Sasol gas specification.

Data / Parameter:	**FC_y**
Data unit:	Nm^3
Description:	Amount of fossil fuel (natural gas) consumed for captive energy generation in the project activity in year y
Source of data to be used:	The natural gas consumption is recorded on the Sasol invoices.
Value of data	11,569,860
Description of measurement methods	The Sasol natural gas meter is compensated for temperature and pressure.

and procedures to be applied:	
QA/QC procedures to be applied:	The Sasol gas invoices will be checked against the Corobrik Driefontein gas meter readings. Should there be a material discrepancy in the trend of the data from the invoices and the Corobrik meter (taking into consideration that the Corobrik meter is not compensated for temperature and pressure), the source of the variation will be identified. Corrective actions will be taken.
Any comment:	

Data / Parameter:	**$Q_{PJ,y}$**
Data unit:	(MWh)
Description:	Energy content of the heat output from the burner per year
Source of data to be used:	FC_y , NCV and CF_{power} $(FC_y * NCV *1000)/ CF_{power} = Q_{PJ,y}$
Value of data	117,595
Description of measurement methods and procedures to be applied:	The only output from the burner is hot air. The energy output of the element process is directly measured by the gas consumed by the burner. The natural gas consumption (Nm^3) is recorded on the Sasol invoices. The Sasol invoices for natural gas contain the gross calorific value of the gas (TJ/Nm^3).
QA/QC procedures to be applied:	It will be checked that there are no significant changes in the calorific value every month. The Sasol gas invoices will be checked against the Corobrik Driefontein gas meter readings. Should there be a material discrepancy in the trend of the data from the invoices and the Corobrik meter (taking into consideration that the Corobrik meter is not compensated for temperature and pressure), the source of the variation will be identified and appropriate action taken.
Any comment:	

Data / Parameter:	**Temperature in the zones of the kiln**
Data unit:	˚C
Description:	The temperature of the hot air, which is the only output from the burner, will be directly measured and reported on in the monitoring report, as per the requirement of the methodology (AMS-III.B version 15).
Source of data to be used:	Temperature is continuously measured by the thermocouples in the kiln. This will be collated monthly and presented for the different zones in the monitoring report.
Value of data	Dictated by the type of brick in the kiln
Description of measurement methods and procedures to be applied:	Measured continuously and recorded daily
QA/QC procedures to be applied:	The quality of bricks is impacted directly by the temperature in the kiln. Quality tests on the bricks are performed on a daily basis. Corrective action is taken

	immediately should quality deviations caused by incorrect kiln temperatures be detected as bricks that do not conform with the strict quality requirements cannot be sold and impacts significantly on the turnover and profitability of the business. 44 thermocouples are installed within the kiln. If one of the thermocouples records a temperature significantly different than the surrounding thermocouples, this thermocouple is replaced by a new, calibrated thermocouple.
Any comment:	

B.7.2 Description of the monitoring plan:

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The purpose of this Monitoring Plan (MP) is to provide a standard by which Corobrik Driefontein will conduct the monitoring of the proposed project activity. The MP is in accordance with all relevant rules and regulations of the CDM.

Driefontein will follow the MP in order to measure and track the project activity and prepare for the periodic verification process required to confirm the amount of CERs received. The management and operation of the project is the responsibility of Driefontein.

1 Overall project management

The Driefontein Plant has a clear and well defined management structure. The management structure has been developed over the years that the plant has been in operation and is based on Corobrik's extensive experience in running brick plants. Corobrik Driefontein plant has been ISO certified. Overall responsibility at the plant lies with the Factory Manager who also has final responsibility for the CDM project at the Driefontein plant. The Assistant Factory Manager who reports directly to the Factory Manager is directly responsible for all aspects related to this monitoring plan.

2 Data to be monitored

The data that needs to be monitored is the quantity of natural gas consumed (to produce the energy needed for brick-firing),the calorific value of the natural gas, the energy content of the heat output of the burner based on the gas consumed by the burner and the temperature of the hot air in the kiln. The emission factor of the natural gas will be the latest IPCC default emission factor.

3 Data collection and storage

The natural gas consumption and the calorific value of the gas will be obtained from a monthly invoice received from Sasol, the gas supplier. These invoices will be stored on-site for a minimum period of two years after the end of the crediting period. The temperature measurements in the kiln take place continuously and will be recorded daily and stored on-site for a minimum period of two years after the end of the crediting period.

4 Installation, maintenance and calibration of monitoring equipment

The only relevant monitoring equipment for this project relates to the consumption of natural gas and the temperature of the hot air in the kiln. Two natural gas consumption measuring stations have been

installed on site. The monitoring equipment at the Sasol meter station is operated and maintained by Sasol, the natural gas provider. The monitoring equipment at the TVA kiln is operated by Corobrik. The Sasol metering equipment was calibrated (by Sasol) and is checked on an annual basis by a competent entity. This equipment is compensated for temperature and pressure. Routine maintenance is conducted as specified by the relevant industrial safety acts and at regular intervals.

Only calibrated thermocouples are installed in the kiln. As 44 thermocouples are installed, non accurate thermocouples will be identified and replaced. Temperature measurements from the thermocouples (monitoring continuously) are examined and compared daily by process controlers.

5 Monitoring procedures

The day to day record keeping of the natural gas consumption and temperature of the hot air in the kiln is the responsibility of the Assistant Factory Manager.

An invoice for the natural gas consumption of the factory is received on a monthly basis from Sasol. The gas consumption presented in this monthly invoice is used in the annual emission reduction calculations.

The energy output of the element process is directly measured by the gas consumed by the burner. At the recipient end, the hot air temperature is measured directly, using thermocouples. These thermocouples measure continuously and are recorded daily. This data will be reported on as monthly averages in the monitoring report. An annual monitoring report will be compiled and will contain the monitored data and record or any monitoring problems. The report will be reviewed by factory management.

All records will be retained for two years after the end of the crediting period.

6 QA/QC procedure

The data from the Sasol invoices (indirectly the Sasol meter) will be checked against the Corobrik meter readings for quality control purposes. Should there be any major discrepancies in the data trend of the two data sources, the cause of the variation will be identified, be it the main measured value or the quality control value and corrective actions will be taken. Minor differences are to be expected due to the fact that the Corobrik meter is not adjusted for temperature and pressure whereas the Sasol meter is.

There are 44 thermocouples in the kiln, which measure the temperature in the kiln continuously. If one of the thermocouples reports a different temperature than the thermocouples around it, this thermocouple is replaced. Only calibrated thermocouples are installed in the kiln. The thermocouples have to be accurate, as a temperature inaccuracy will cause the bricks not to comply with the strict quality requirements. Bricks that don’t comply with set quality requirements, can’t be sold which will impact on the company’s financial performance.

Development of the monitoring report and verification audits will be the responsibility of Corobrik.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

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The baseline and monitoring methodology was completed by Promethium Carbon (Pty) Ltd on 10/10/2012

Contact information for the entity responsible for the application of the baseline and monitoring information:
Promethium Carbon (Pty) Ltd
Coral House
20 Peter Place
Bryanston 2021
Johannesburg
Telephone: +27 11 706 8185

Promethium Carbon is not a project participant.

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:

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.
(11/06/2007) is the project start date as on this day the first real action took place, namely the start of the construction of the pipeline.

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

>>
The life of the plant depends on the clay reserves. It is estimated that the clay reserves will last at least another 100 years. Maintenance is carried out every four years on the kiln. Therefore, the life of the brick factory is expected to exceed the crediting period.

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

C.2.1. Renewable crediting period

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

>>
15/07/2012 (or date of project registration)

C.2.1.2. Length of the first crediting period:

>>
7 years (renewable twice)

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not applicable

C.2.2.2. Length:

>>
Not applicable

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
The project has and will continue to have positive environmental impacts; which create a cleaner working environment.

The project involved the extension of the natural gas pipeline to the project site. For this extension, an Environmental Impact Assessment (EIA) was conducted in accordance with section 21, 22 and 26 of the Environmental Conservation Act (Act No.73 of 1989). The EIA report for this pipeline extension is available.

D.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:

>>
The use of natural gas has many positive environmental impacts:

- The emission of particulates from coal combustion has been eliminated.
- The emission of SO_2 from the coal combustion is eliminated.
- The gasifiers used to combust the coal and generate the producer gas have been decommissioned and will be disassembled and sold as scrap metal.
- The environmental impact of coal mining is reduced.
- The environmental impacts and emissions associated with coal transport are avoided.

Overall, the working environment has become cleaner.

SECTION E. Stakeholders' comments

>>

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

>>
Stakeholders were identified as active community groups and individuals in the area where the project would be implemented. The public consultation process around the gas pipeline was done in accordance

with the requirements of the National Environmental Management Act (NEMA). In addition the general public in the area was informed via articles and advertisements in the local regional newspaper.

The fuel switch project involved the extension of the Sasol Gas pipeline to connect Driefontein to the natural gas network. For this extension, an Environmental Impact Assessment (EIA) was conducted. The EIA includes Public Participation which included:

- An advertisement about the project proposal was published in the Krugersdorp North local newspaper (10 March 2006) as well as a local newspaper in Carletonville (24 February – 2 March 2006). A database had been developed where comments of interested and affected parties were recorded.
- Site notices about the gas pipeline extension were posted
- Meetings were conducted with the relevant councillors ward committees(14 June 2006 at Kloof Mine, Libanon; 5 April 2006 with merafong City Municipality Councillors Wars Committee; 12 April 2006 with Westonaria City Municipal Councillors Ward Committee. The minutes of the meetings were recorded.

Corobrik also placed advertisements in English and Afrikaans for the fuel switch project in the local newspaper the Carletonville Herald (20 February 2009).

E.2. Summary of the comments received:

>>

Table 1 summarises the comments received at the Public Participation.

Table 3: Comments Received

NAME	ISSUE / CONCERN
1. Nokukhanya Maluleke, Goldfields (also on behalf of the Far West Rand Dolomitic Water Association). Represent 26 properties affected by the gas pipeline.	• When will construction start? • Will the gas pipeline be buried underground? • With reference to the environmental impacts that were identified, what are “muti” plants? • If any liability arises during construction, how will it be handled?
2. D Kotze, Intersite (Spoornet)	• He wanted to confirm that the pipeline would not affect the railway line.
3. M Vicente Sr, owner of Elandsfontein Properties	• How wide will the servitude be? • Will I be compensated for damage and land use? • Will cars be able to travel over the pipeline once it has been buried? • We have no objection against the gas pipeline.
4. M Vicente Jr	• No objection.
5. Andre Jacobs, Randfontein	• We welcome the gas pipeline crossing the open veldt opposite our houses. Please take away the slight hill behind

	which thieves are hiding.
6. Kenny Stuart, landowner	• Wants to use gas for his roadside tuck shop.
7. Quinton Stuart, landowner	• Will I have to take down my tuck shop?

No comments regarding the actual onsite fuel switching process were received.

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

>>

Table 4: Summary of responses to comments received

NAME	ISSUE / CONCERN	RESPONSE
1. Nokukhanya Maluleke, Goldfields (also on behalf of the Far West Rand Dolomitic Water Association). Represent 26 properties affected by the gas pipeline.	• When will construction start?	• *As soon as environmental authorization has been received and after the 30-day appeal period has lapsed.*
	• Will the gas pipeline be buried underground	• *Yes*
	• With reference to the environmental impacts that were identified, what are "muti" plants?	• *Plants occurring in the natural environment and used for medicinal purposes.*
	• If any liability arises during construction, how will it be handled?	• *Sasol Gas will enter into a servitude agreement with the landowner, which will include compensation for possible damages. It will be done in consultation with the landowner and lessee.*
2. D Kotze, Intersite (Spoornet)	• He wanted to confirm that the pipeline would not affect the railway line.	• *Confirmed, no affect.*
3. M Vicente Sr, owner of Elandsfontein Properties	• How wide will the servitude be?	• *Construction (temporary): 23 meters; final servitude over the pipeline: 6 meters.*
	• Will I be compensated for damage and land use?	• *Yes, Sasol will make an appointment with you.*
	• Will cars be able to travel over the pipeline once it has been buried?	• *Yes*

	• We have no objection against the gas pipeline.	
4. M Vicente Jr	• No objection.	
5. Andre Jacobs, Randfontein	• We welcome the gas pipeline crossing the open veldt opposite our houses. Please take away the slight hill behind which thieves are hiding.	• *Earth moving will be limited to the installation of the gas pipeline.*
6. Kenny Stuart, landowner	• Wants to use gas for his roadside tuck shop.	• *The matter will be investigated.*
7. Quinton Stuart, landowner	• Will I have to take down my tuck shop?	• *No, the gas pipeline will deviate around the shop.*

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Corobrik (Pty) Ltd
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Represented by:	Daniele Torricelli
Title:	Director of Engineering
Salutation:	Mr
Last Name:	Torricelli
Middle Name:	
First Name:	Daniele
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was used in either the development or implementation of this project.

Annex 3

BASELINE INFORMATION

A. Calculation of the total amount of fossil fuel (producer gas) consumed for captive energy generation in the baseline situation (FC_{BSL}):

Producer Gas	Composition	in 1 Nm^3 gas	Specific Volume	Mass	Composition	Specific Heat	Specific Heat contribution	Specific energy
Component	Vol %	Nm^3	Nm^3/kg	kg	mass %	kJ/kg.K	kJ/kg.K	kJ/kg
CO_2	4	0.04	0.53	0.07	0.07	0.953	0.069	19.0
CO	29	0.29	0.80	0.36	0.35	1.063	0.372	102.7
CH_4	3	0.03	1.39	0.02	0.02	2.672	0.055	15.3
H_2	15	0.15	11.11	0.01	0.01	14.463	0.188	52.1
N_2	49	0.49	0.87	0.56	0.54	1.035	0.563	155.6
Total	**100**	**1**		**1.04**	**1.00**		**1.248**	**344.8**

ΔT = 276 K

Density of Producer Gas 1.036 kg/Nm^3
NCV_{PG} 0.006374 GJ/Nm^3 (See calculation B below)

$= 8.02$ GJ/1000 bricks

ect

Energy consumption in project scenario 423,341 GJ
Brick production in project scenario 52,754,451 bricks
Brick production in baseline scenario 51,454,851 bricks

Hence Energy consumption in baseline scenario 412,912 GJ

$$(NCV_{PG} + q_{PG}) \times m = Energy_{baseline}$$

$$q_{PG} = C_p(\Delta T)$$

q_{PG} 344.75 kJ/kg

C_p 1.248 kJ/kg.K

m 63,569,823 kg

Hence,

Volume of Producer Gas 61,338,465 Nm^3

B. Calculation of the net calorific value for the baseline producer gas (NCV_{PG}):

Producer Gas	Composition	Lower Heating Value	Specific Volume	Volume	Mass	Energy
Component	Vol %	GJ/ton	Nm^3/kg	Nm^3	tons	GJ
CO_2	4					
CO	29	10.11	0.80	0.29	0.000363	0.003666
CH_4	3	50.01	1.39	0.03	0.000022	0.001076
H_2	15	120.97	11.11	0.15	0.000014	0.001633
N_2	49					

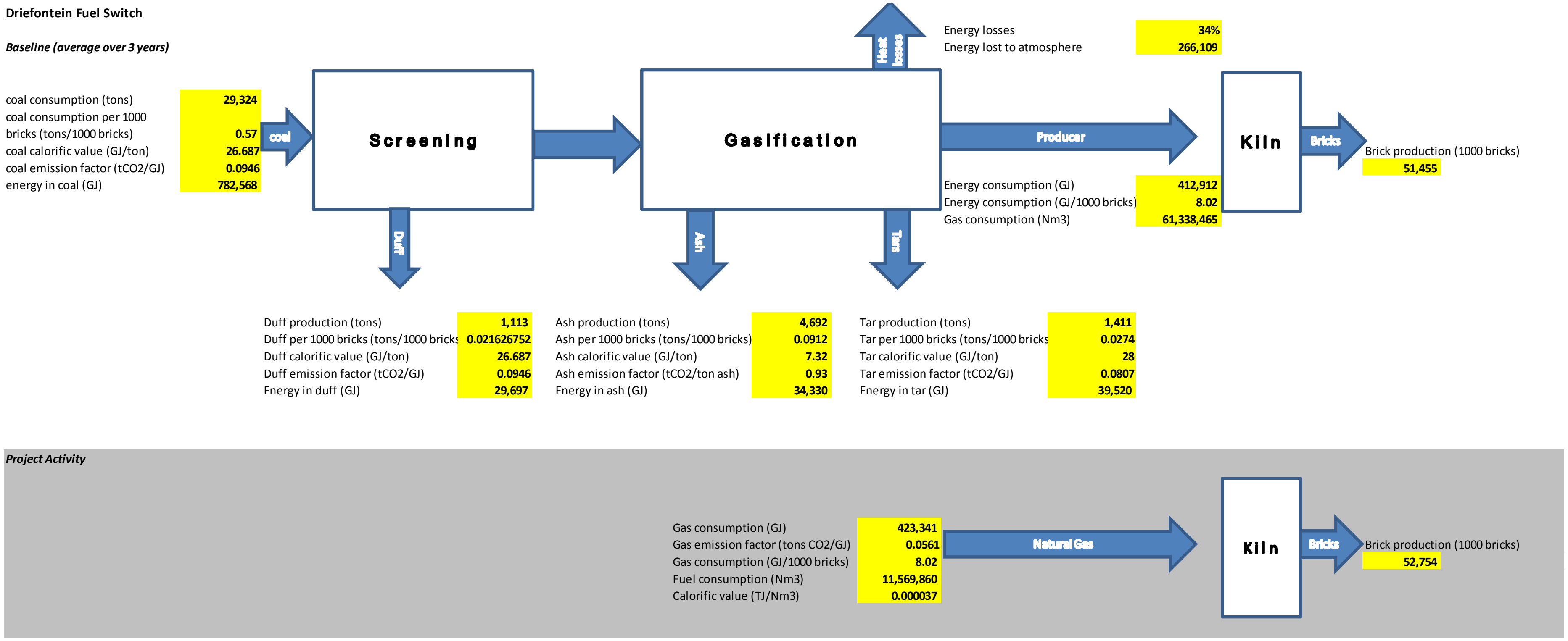
Hence

NCV of Producer Gas 0.006374 GJ/Nm^3

C. Calculation of the net energy generated in the captive plant in the baseline situation during the corresponding period of time for which the total fuel consumption was taken (Q_{BSL})

Energy consumption in baseline scenario (calculation A) in GJ converted to MWh.

D. Calculation of the CO_2 emission factor for the baseline producer gas ($EF_{CO2,PG}$)



$EF_{CO2,PG}$ = Average CO_2 in producer gas over the last three years ÷ Average energy in producer gas over the last three years

CO_2 in producer gas = CO_2 in coal - CO_2 in duff - CO_2 in ash - CO_2 in tar

Year	tons CO_2
2007	68,603
2006	61,028
2005	61,374
Average	**63,668**

Detailed calculations of the values in the table above are included in the emission reduction calculations worksheet

See calculation A for average energy in producer gas.

Hence: 63,668 t CO_2 / 412.912 TJ

$EF_{CO2,PG}$ **154 t CO_2/TJ**

The following documents were used to support the baseline and additionality arguments:

- Foster Thermal (20-01-2006), Maintenance invoice
- Foster Thermal (15-11-2005), Maintenance invoice
- Foster Thermal (20-07-2005), Maintenance invoice
- Foster Thermal (23-05-2006), Maintenance invoice
- Corobrik-Driefontein (1991-2006), Sales and production Historical dataFFS Refiners (PTY) Ltd (30-01-2007), Coal Tar Supplied in Bulk
- Duff supply Invoice (November 2006)
- Duff supply Invoice (January-March 2007)
- Duff supply Invoice (April-May 2007)
- Driefontein Factory, conversion to natural gas (21-10-2008)
- Supply of Sasol Fuel Oil (28-02-2008)
- Sasol invoices for February 2008to November 2007 for Natural Gas

- Coal Analysis Report, 2004-2007
- Coal Analysis Report, 09-10-2007
- Central Laboratory Coal Analysis, 15-03-2002
- Coal Analysis Report, 30-05-2005
- Coal Analysis Report, 31-07-2006
- Coal Analysis Report, 29-03-2007
- Corobrik Fuel and Production History
- Industrial Combustion Systems (PTY) Ltd (22-04-2010) Re-Evaluation of Driefontein Factory Producer Gas Plant
- Historic Coal data, (2004-2006)
- Historic Coal, Tar and Duff Sale Data (2007)
- PGK Consulting CC (June, 2007) Duff sold in June 2007
- Slaghuis, Raijmakers (2003), The use of thermogravimetry in establishing the Fischer tar of a series of South African coal types
- Driefontein brick production data (2005-2007)
- Driefontein brick production data (2008)
- Corobrik Transvaal Ltd (17-02-2010) Gas Temperatures from Producer to Kiln
- Sasol Gas Limited (10-08-2006), Producer gas composition
- Sasol Gas technical for the period Jan 2008- July 2008
- Jdedwards (26-03-2007) Cost of Coal
- Driefontein Inhouse maintenance costs
- Jetdemolition (26-06-2009) Personal communication on demolition of redundant gasifiers
- Corobrik Driefontein factory (26-01-2010) Internal communication on demolishing costs of gas producers

Annex 4

MONITORING INFORMATION

- - - - -

PE_y Amount of fossil fuel (natural gas) consumed for captive energy generation in the project activity in year y

Month	**FC_y** (Nm^3 of natural gas consumed in the project activity)	**GCV** (gross calorific value of natural gas) GJ/Nm^3	**NCV** (net calorific value of natural gas) GJ/Nm^3
January	765,529	0.040516	0.0365900
February	915,301	0.040646	0.0367070
March	990,572	0.040654	0.0367142
April	992,444	0.040658	0.0367178
May	1,014,780	0.040387	0.0364731
June	1,001,895	0.040538	0.0366095
July	1,017,745	0.040317	0.0364099
August	1,033,534	0.040518	0.0365914
September	957,474	0.040462	0.0365408
October	958,541	0.040402	0.0364867
November	939,833	0.040582	0.0366492
December	982,212	0.040516	0.0365900
TOTAL	**11,569,860**		**Average: 0.0365900**

The monitoring of the net calorific value (NCV) for the natural gas used in the project case might in the future appear directly on the monthly invoices received from Sasol. However until then, the reported gross calorific value (GCV) will be converted to NCV by multiplying the GCV value by the factor 0.9031, as per the Sasol gas specification sheets.