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:

Rosslyn Brewery Fuel-Switching Project

Version 05 – 11 August 2006

A.2. Description of the project activity:

The project activity primarily aims at reducing GHG emissions through fuel switching. The project consists of investment to replace the use of coal by natural gas, funded through the sale of carbon credits in the context of the Clean Development Mechanism (CDM) of the Kyoto Protocol.

South African Breweries Ltd. leads this fuel-switching project, which involves the replacement of equipment at the boiler room of Rosslyn Brewery plant.

The South African Breweries Limited was founded in 1895. The company became SABMiller plc in 2002 when it purchased the Miller Brewing Company in the United States. SABMiller is listed in London and Johannesburg, and is the world's third largest brewer by volume.

The company has interests in more than 40 countries on four continents, and operates more than 120 breweries, producing almost 100 brands and employing over 40,000 people.

SAB Ltd is the South African operation of SABMiller plc and currently produces 25,000,000 hectolitres a year. SABMiller produces 137,000,000 hectolitres a year. Rosslyn Brewery is the second largest capacity brewery in the SAB Ltd. Group.

The extra income derived from the sale of carbon credits will allow SAB's Rosslyn Brewery to pay for part of the fuel substitution cost and offset some of the higher fuel cost, keeping in mind the lower price of coal at 8.61 R/GJ in comparison with the price of natural gas at 21.25 R/GJ.

The proposed project activity has the capacity to produce GHG emission reductions by 709,895 tCO_2e over the first 7-year crediting period.

The project also brings the inherent benefits of switching coal to natural gas:

- Higher air quality due to less emissions of pollutants such NO_x and SO_x, and particulate matter to local air.
- Improvement of labour and health conditions of its employees. Less number of accidents and sickness.
- Lower maintenance of the equipment.
- Lower dirtiness and corrosion at the plants.
- Continuous source of fuel.
- Less electricity consumption due to the current coal boilers demand more energy than new natural gas boilers, and therefore less emission of pollutants and particulate matter from power plants to local air.

- Less vehicular traffic due to elimination of coal delivery trucks and therefore less risk of accidents as well as the elimination of tailpipe emissions from these vehicles.

Thus, the project brings social, environmental, and economic benefits, contributing to sustainable development objectives of the South African Government, in accordance with the National Environmental Management Act Nº 107 of 1998 (http://www.info.gov.za/gazette/acts/1998/a107-98.pdf).

The project has the written approval of South African DNA (Department of Minerals and Energy of South Africa) for voluntary participation, confirming that the project supports sustainable development (see Annex 7).

A.3. Project participants:

Table 1: Project participants

Name of Party involved	Private or public entity	Is the Party involved a project participant?
South Africa (Host)	South African Breweries Ltd.: Private	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of South Africa

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

Gauteng Province

A.4.1.3. City/Town/Community etc:

Tshwane

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

The project is located at the Rosslyn Brewery plant, in the industrial area of Rosslyn. This industrial area is located in Gauteng Province, in the north east of the country (Figure 1).

Gauteng's area is 17,010 km^2; that represents 1.4% of the land area of South Africa, making it the smallest of the nine provinces of the country. Nevertheless, Gauteng is the second most populated province of South Africa. It is home to 8.8 million people (according to the October 2001 census), almost 20% of the total South-African population. Being also the province with the fastest growing population (over 20% increase of population between the 1996 and 2001 census), Gauteng is likely to soon become the most populated province of South Africa.

Its limits are Limpopo Province in the North, Free State Province in the South, North West Province in the West, and Mpumalanga Province in the East.

Gauteng Province includes three Metropolitan Municipalities (City of Johannesburg, City of Tshwane or Pretoria, and Ekurhuleni), and three District Municipalities (Metsweding, Sedibeng, and West Rand). Rosslyn industrial area is located in Akasia, in the City of Tshwane (Figures 2 and 3).

Figure 1: Map of South Africa showing the provinces.

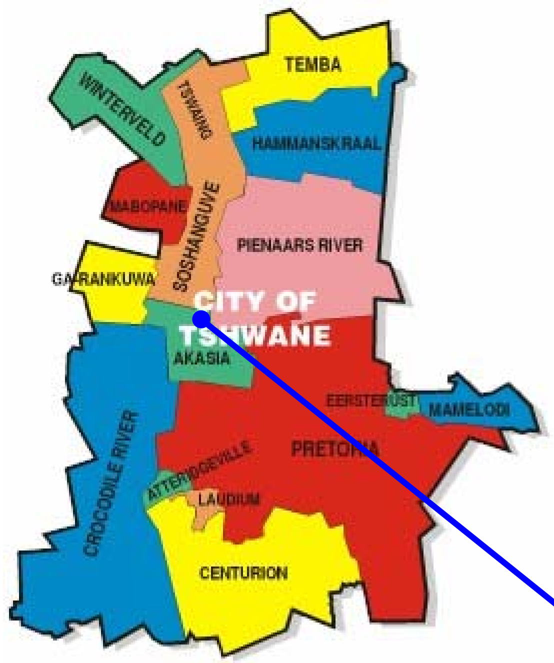

Figure 2: Map of the City of Tshwane (Pretoria)

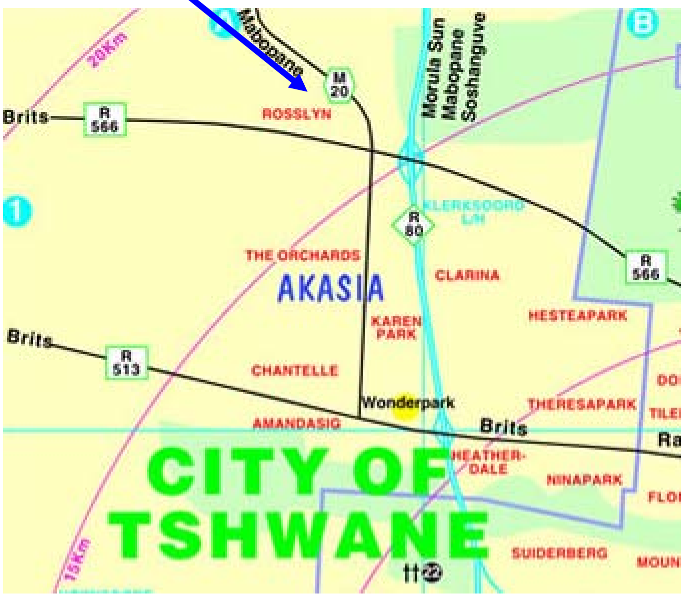

Figure 3: Location of Rosslyn

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

The project activity involves fuel switching from coal to natural gas at an industrial facility.

The corresponding category is: (4) Manufacturing industry.

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

The boiler room of the industrial facility has seven coal-fired boilers. The boilers #1 to #3 are connected to one common chimney, and the boilers #4 to #7 are connected to a second common chimney. The plant currently operates three to four of the boilers #4 to #7 as required to meet peak steam production. However, according to the projected beer production increase for the next years, in the absence of the project, Rosslyn would have had to use more than four of the existing coal boilers.

The specifications of the current boilers are shown in the table below.

Table 2: Technical characteristics of equipment

Technical characteristics of the boilers #1 to #7	
Manufacturer	John Thompson Afripac mk3
Year of manufacture	1982 (boilers #1 to #3) 1984 (boilers# 4 to #7)
Fuel used	Coal
Capacity	20 tonnes/hour of steam
Primary air fans	Quantity: 2 Motor size: 11 kW; 380 V; 3 phases
Induced air fan	Quantity: 1 Motor size: 55 kW; 380 V; 3 phases
Coal grate drive motors	Quantity: 2 Motor size: 0.55 kW; 380 V; 3 phases
Coal feed valves	Quantity: 2 motorized coal feed valves Motor size: 0.37 kW; 380V; 3 phases

The project is based on fuel switching from coal to natural gas, and involves the installation of new boilers, which are likely to be sourced from a European country, contributing to technology transfer to South Africa[1].

The new boilers will have one fire box/boiler. Additionally, the boilers will be equipped with CO_2 analyzers and fuel-trim system to control excess air as well as variable speed controls for the boiler feed-water pump and forced draft combustion air fan.

[1] The capacity of the new boilers will be in the range of 25 to 35 tonnes/hour of steam each. Rosslyn Brewery would initially install three or four new boilers (depending on the size selected) and later would install an additional one as required by projected plant steam requirements, but under no circumstance would the total installed capacity of the boiler room exceed the current capacity of 140 tonnes/hour of steam.

The following composition of natural gas[2] is expected:

Table 3: Typical composition of natural gas

	% vol
Methane	98.13
Carbon Dioxide	0.49
Nitrogen	0.35
Ethane	0.61
Propane	0.27
Butane	0.15

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:

The proposed CDM project would reduce the emissions of GHG by replacing a more carbon intensive fuel (coal) by natural gas.

Reduced coal consumption at the project site would reduce carbon dioxide emissions from coal transport that would no longer be needed.

Additionally, the project would reduce electricity consumption due to steam generated by current coal boilers demands more energy than steam generated by new natural gas boilers. Thus, the project also reduces carbon dioxide emissions from fuel combustion at the power plants connected to the grid. Such emission reductions are not considered for this project activity as a conservative assumption.

On the other hand, increased natural gas use at the project site would increase fugitive methane emissions in the natural gas processing and pipeline supply to the project site, and leaks at the site.

Thus the project affects carbon dioxide, methane, and nitrous oxide emissions. Overall, the project has the capacity to reduce GHG emissions by 709,895 tCO_2e over the first 7-year crediting period.

Project additionality is analysed using the tool proposed in the approved baseline methodology AM0008*:* "*Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility*".

Details are provided in Section B.3 of this PDD.

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

The project has the capacity to reduce GHG emissions by 709,895 tCO_2e over the first 7-year crediting period.

[2] Source: Sasol Gas Limited, December 2004.

Table 4: Emission reductions during the first 7-year crediting period

Years[3]	Annual estimation of emission reductions (tonnes of CO_2e)
2007	75,395
2008	95,760
2009	95,760
2010	110,059
2011	110,515
2012	110,973
2013	111,432
Total estimated reductions (tCO_2e)	**709,895**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tCO_2e)	**101,414**

A.4.5. Public funding of the project activity:

South African Breweries will not receive any national or international public funding whatsoever for the development of this project.

[3] It is defined as the time period between June of a year and May of the subsequent year.

SECTION B. Application of a baseline methodology

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

The project activity uses an already existing baseline methodology (AM0008), which has been approved and made publicly available by the CDM Executive Board in June 2004. The baseline methodology is designated ***"Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility"***.

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

The methodology AM0008 is applicable to a project activity, which is to switch the industrial fuel currently used in some element processes of a facility to natural gas from coal and/or petroleum fuels that would otherwise continue to be used during the crediting period under the following conditions:

- The local regulations/programs do not constrain the facility from using coal/petroleum fuels;
- Use of coal and/or petroleum fuels is less expensive than natural gas per unit of energy in the country and sector;
- The facility would not have major efficiency improvements during the crediting period;
- The project activity does not increase the capacity of final outputs and lifetime of the existing facility during the crediting period, and
- The proposed project activity is defined as fuel switching applied to element processes and does not result in integrated process change, except for possible changes in other energy use associated to fuel switching.

As mentioned above, the proposed project activity involves fuel switching from coal to natural gas at the boiler room of an industrial facility of SAB, the Rosslyn Brewery plant[4]. The project does not result in integrated process change, but only involves fuel switching at the boiler room of the facility.

The continuation of the current situation is in line with applicable regulations in South Africa. Legally binding norms, established by the government that can be related to the project activity, are those dealing with air quality, under the authority of the Department of Environmental Affairs and Tourism (DEAT). Neither of these norms constrains the facility from using coal. The continuation of the current situation has no any problem with regulations.

Coal is cheaper than natural gas in the region. Moreover, converting from coal to natural gas would require investment in new equipment. The additional investments and the higher fuel bill imply that the project would not be cost effective.

Rosslyn Brewery does not expect to increase the capacity of final outputs of the existing facility during the crediting period. Rosslyn Brewery is used as a "swing brewery". Consequently, its production varies from year to year depending on the overall beer sales. Effectively, if sales decrease, the other SAB breweries are maintained at full production capacity while Rosslyn's production is reduced. Current corporate thinking is to change the function of Rosslyn Brewery from a "swing brewery" to a

[4] For this project activity, the element process considered is the steam generation at the boiler room consuming coal in the baseline scenario and natural gas in the project scenario.

full production capacity brewery, due to the increase of beer consumption in the region. As a consequence, Rosslyn Brewery will have a substantial production increase over the next years, until reaching the 100% of its existing production capacity.

Neither does Rosslyn expect to increase the lifetime of the existing facility during the crediting period. Rosslyn has decided to replace the existing boiler, instead of converting them, due to business strategy. However, the lifetime of existing boilers of the plant are longer than the crediting period.

Additionally, Rosslyn Brewery does not expect to carry out significant efficiency improvements. There will be only the minor electricity savings inherent to switching coal to natural gas.

Thus the proposed project activity meets the conditions under which the methodology AM0008 is applicable.

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

The methodology AM0008 is simple to apply.

In order to calculate *ex-ante* baseline emissions from fuel combustion, coal consumption at the boiler room during the crediting period is estimated according to the annual volumes of beer production foreseen by the company.

However, the actual baseline proposed is dynamic, taking into account actual changes in fuel consumption over time, following project implementation. Thus *ex-post* baseline emissions are calculated during the monitoring process. Such a dynamic baseline is both realistic and easy to determine using the same monitoring and verification protocol used to determine project emissions.

The consumption of natural gas following project implementation would be replacing a certain amount of coal, in the absence of the project. Thus, baseline emissions from fuel combustion are not fixed to a predetermined time-dependent value but are updated annually through the monitoring process. The baseline and project fuel consumption values (in energy units) are related to each other by the fuel efficiency of the equipment using coal prior to fuel switching, and using natural gas following project implementation. The heat output of the equipment is considered the same in the baseline and project scenarios.

A dynamic baseline is likely to increase the environmental integrity of the project. The time-varying nature of the dynamic baseline is more suited to the project situation, since fuel consumption depends on plant output, which depends on market and other conditions. Plant output does not depend on the fuel Rosslyn Brewery plant is using in the production process (coal under the baseline or natural gas under the CDM project activity).

GHG emissions are made up of carbon dioxide, methane, and nitrous oxide emissions from fuel combustion, carbon dioxide emissions from coal transport, and fugitive methane emissions from coal mining and natural gas production, processing, transport, and distribution.

- Carbon dioxide emissions from fuel combustion are determined from the emissions factor given by the IPCC for each fuel.
- Methane and nitrous oxide produced in combustion are estimated using IPCC standard emissions factors for each fuel and equipment type.
- Carbon dioxide emissions from coal transport are determined by the coal consumption of each year, using the specific energy consumption of the mean of transport estimated below in Section D.2.3.2.

- Fugitive methane emissions from coal mining are obtained by the coal consumption of each year, using a default emission factor given by IPCC.
- Fugitive methane emissions from natural gas production, processing, transport and distribution are obtained by the natural gas consumption of each year, using a region-specific emission factor given by IPCC.

Total methane emissions (from fuel combustion and fugitive emissions) are converted to equivalent CO_2 emissions using the GWP of 21, as agreed on for the First Commitment Period of the Kyoto Protocol.[5]

Similarly, nitrous oxide emissions are converted to equivalent CO_2 emissions using the GWP of 310, as agreed on for the First Commitment Period of the Kyoto Protocol.

According to the baseline methodology, the key data used to determine *ex-post* the baseline scenario is given in the following table.

[5] Article 5.3 of the Kyoto Protocol establishes: "The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session. Based on the work of, *inter alia*, the Intergovernmental Panel on Climate Change and advice provided by the Subsidiary Body for Scientific and Technological Advice, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall regularly review and, as appropriate, revise the global warming potential of each such greenhouse gas, taking fully into account any relevant decisions by the Conference of the Parties. Any revision to a global warming potential shall apply only to commitments under Article 3 in respect of any commitment period adopted subsequent to that revision."

Table 5: Key data

Parameters	Data sources
Carbon dioxide emission factor of coal, CEF_{coal} ($kgCO_2/GJ$)	IPCC default value
Methane emission factor of coal, MEF_{coal} ($kgCH_4/TJ$)	IPCC default value
Nitrous oxide emission factor of coal, NEF_{coal} (kgN_2O/TJ)	IPCC default value
Methane emission factor from coal mining, $FE_{coal}\ (CH_4)$ (tCH_4/t coal)	IPCC default value
Specific energy consumption of the trucks for transporting of coal, $SEC_{diesel\ COAL}$ (GJ/t coal)	See Section D.2.3.2 below
Carbon dioxide emission factor of diesel, CEF_{diesel} ($kgCO_2/GJ$)	IPCC default value
Global Warming Potential of methane, $GWP\ (CH_4)$	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3
Global Warming Potential of nitrous oxide, $GWP\ (N_2O)$	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3
Lower heating value of coal, LHV_{coal} (kJ/kg)	Graspan Colliery Limited (coal supplier)
Lower heating value of natural gas, LHV_{NG} (kJ/m^3)	Sasol Gas Limited (gas supplier)
Efficiency of the boiler room using coal prior to project implementation, η_{coal}	Rosslyn Brewery plant
Variables	**Data sources**
Quantity of natural gas consumed at the boiler room following project implementation, PFC_{NG} (m^3)	Rosslyn Brewery plant
Efficiency of the boiler room using natural gas following project implementation, η_{NG}	Rosslyn Brewery plant

The assumptions regarding heating values and emission factors are unchanged throughout the crediting period.

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:

As mentioned above, project additionality was analysed using the tool proposed in the approved baseline methodology AM0008: "*Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility*".

Legal and regulatory requirements

The continuation of the current situation is in line with applicable regulations in South Africa. Legally binding norms, established by the government that can be related to the project activity, are those dealing with air quality, under the authority of the Department of Environmental Affairs and Tourism. The National Environmental Management Air Quality Act was promulgated into law in 2004. It can be seen at http://www.info.gov.za/gazette/acts/2004/a39-04.pdf.

Neither of these norms is forcing the company to implement the proposed project activity. The continuation of the current situation has no any problem with regulations. Moreover, authorities do not even require the elaboration of environmental impact studies for this kind of project activity. The only approval required to install the new natural gas boilers is the already obtained Environmental Approval.

Trends in coal and natural gas consumption in the country[6]

There are a few companies that have some of their boilers using natural gas, but most of them were initially installed to fire manufactured gas (produced by Sasol from coal) and they subsequently switched to natural gas when it became available in 2004 because Sasol stopped providing the manufactured gas, since the pipeline network that Sasol used to supply manufactured gas is now used to transport natural gas.

Note that, in general, the companies that have converted its boilers were consuming heavy fuel oil, since the use of oil in South Africa is more expensive than the use of manufactured gas or natural gas.

Also, using electricity commits the plant to long-term contract and possible interruptions to electricity due to the projected electricity shortage by the year 2007/08.

Of the four companies that went from coal to natural gas, Riverview Paper Mill and Foscor had converted to manufactured gas in 1997 and 2003 respectively, and were subsequently converted to natural gas when it became available. Consequently only African Products and Bokomo are the true converters from coal to natural gas.

Thus there are only two companies, which have switched from coal to natural gas, from over thousands of industrial facilities (with a total of about 7,000 boilers) in the country.

In the case of African Products, the company switched a boiler with a capacity of 20 tonnes/hour of steam in 2003. That boiler is maintained on standby and it is used only to meet the plant’s peak steam load.

The other company, Bokomo, decided to buy a natural gas boiler with a capacity of 5 tonnes/hour of steam, instead of buying a coal boiler, in 2004. Considering the small quantity of emission reductions that generate this activity and the cost of going through the CDM, the company has decided not to strive for submitting the project as CDM project, since the potential revenue at the time of the decision was not enough to run the risk.

The following table shows the full list of companies that are using natural gas in boilers.

[6] Source: Sasol Gas Limited

Table 6: Boiler conversions

Company	Original fuel	Year of conversion
African Products	Coal	2003
Bokomo	Coal	2004
Feltex Foam	HFO	2000
CTP	HFO	2001
Revertex Chemicals	HFO	2004
Riverview Paper Mill	Coal	1997
Sappi - Tugela Mill	HFO	1996
S C Zeolites (Afchem)	HFO	1998
Foscor	Coal	2003
Robertson's	HFO	1999
Schenectady	HFO	2001
Mondi Paper - Merebank	HFO	2000
Colour-On Dyers	Electricity	2001
Beacon Sweets	Kerosene	2001
Rafalo Paper Mills	HFO	2000
DOW	HFO	2001

In addition, a new fuel-switching project located at an industrial facility in the South African province of Gauteng, was submitted recently. This fact shows how the CDM is necessary to carry out this kind of project activities in the region.

Investment analysis

Due to fuel pricing issues, the use of coal in the future operation of the plants is expected. Coal is cheaper than natural gas in the region. Thus, converting from coal to natural gas involves an increase in the annual fuel bill of the Roslyn Brewery plant. Moreover, the project requires a huge initial investment. The additional investments and the higher fuel bill imply that the project would not be cost effective.

As a consequence of the above, if the project activity is not undertaken, the continuation of the current practice in the industrial facility is the most likely and will be considered as the baseline scenario, since it involves lower investment, and risk. Thus it is concluded that coal is the fuel that would have been consumed in the absence of the project activity.

The investment analysis is carried out through the use of net present value (NPV) analysis. In calculation of project NPV, it is considered that:

- The additional investment for installing gas lines within the plant and replace the equipment would add up to 18,65 million Rands.
- The overall efficiency of the boiler room is 71% prior to project implementation, and 86%, following project implementation (based on higher heating values[7])
- A 7-year crediting period renewable two times (21 years in total) is selected for the proposed project activity, since the remaining lifetime of the existing equipment exceeds the selected crediting period.

[7] While carbon analysis is performed using efficiencies based on lower heating values as a conservative approach, investment analysis is carried out taking into account efficiencies based on higher heating values, since fuel bills are determined on a higher heating value base.

- A discount rate of 11.17% a year is used.
- The prices of coal and natural gas considered for NPV calculation are 8.61 R/GJ and 21.25 R/GJ, respectively.

Considering the investment and the difference in fuel prices and other operating cost, project NPV results –105 million Rands without carbon credits.

Sensitivity Analysis

The parameters that are considered relevant for this analysis are:

- Discount rate
- Coal price
- Natural gas price

Considering the investment, the difference in fuel prices and other operating cost, and the extra income from CDM revenues, project NPV results –83 million Rands considering a CER price of 29.2 Rands (US$ 5), –72 million Rands considering a CER price of 43.8 Rands (US$ 7.5), and –61 million Rands considering a CER price of 58.4 Rands (US$ 10). In this way, it can be seen that in the medium scenario, the impact of CDM registration allows Rosslyn to alleviate, by more than 30%, the economic hurdles related to project implementation.

For this analysis, the medium scenario is considered, thus, the project NPV change from –105 million Rands to –72 million Rands as a consequence of CDM. Such a benefit is comparable to that would be obtained without CDM revenues if the discount rate increase grows up from 11.17 to 17.54%, or if the coal price increases from 231 to 294 Rands per tonne, or if the natural gas price decreases from 21.25 to 18.42 Rands per GJ.

Impact of CDM Registration

CDM registration will allow SAB to alleviate the economic hurdles mentioned above. CDM registration will provide benefits and incentives, such as anthropogenic GHG emission reductions, the financial benefit of the revenue obtained by selling CERs, and public recognition due to the environmental benefits of the project, contributing to avoiding health costs.

Thus, CDM registration resulted very relevant for the decision-making process leading to go ahead with the proposed project activity.

Summarising, it is clear that continuing with the use of coal in the facility represents the baseline scenario, whose emissions are greater than project emissions (since coal is a more carbon intensive fuel than natural gas). Thus, the proposed project activity is additional.

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

The project boundary encompasses the physical, geographical site of the boiler room of Rosslyn Brewery plant.

Emission reductions should be adjusted for leakage. Leakage is defined in the CDM M&P as the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity.

In accordance with this, the following table shows emissions and leakage in the project and baseline scenarios.

Table 7: Emissions and leakage in the project and baseline scenarios

	Project Scenario	Baseline Scenario
Emissions	▪ Carbon dioxide (CO_2) emissions associated with natural gas combustion at plant site. ▪ Methane (CH_4) and nitrous oxide (N_2O) emissions from natural gas combustion at plant site. ▪ Methane (CH_4) emissions from natural gas leaks at plant site.	▪ Carbon dioxide (CO_2) emissions from coal combustion at plant site in the baseline. ▪ Methane (CH_4) and nitrous oxide (N_2O) emissions from coal combustion at plant site in the baseline.
Leakage	▪ Methane (CH_4) emissions from natural gas production, processing and pipeline leakage (natural gas pipeline outside project site). The source of natural gas is Mozambique, a non-Annex 1 party. Thus, methane emissions in that country should be counted as leakage for this project activity. ▪ Other leakage would be associated with gas pipeline construction to bring natural gas to the project site area. This is not included, since there are likely to be many other users as well, and in each case there will be reduced carbon dioxide (CO_2) emissions from fuel switching. These emissions are excluded.	▪ Methane (CH_4) emissions from coal mining. The coalmine is located in South Africa. Thus, methane emissions should be counted as leakage. ▪ Carbon dioxide (CO_2) emissions from coal transport from the mine to the plant site.

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:

Date of completing the final draft of this baseline section: 25/12/2004

Name of person/entity determining the baseline:

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Marisa Zaragozi, Fabián Gaioli, and Vincent Donato are not project participants.

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 is expected to be operating in June 2007 (01/06/2007).

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

More than 30 years

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

Renewable crediting period

C.2.1. Renewable crediting period

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

01/06/2007

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

N/A

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Application of a monitoring methodology and plan

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

The project activity uses an already existing monitoring methodology (AM0008), which has been approved and made publicly available by the CDM Executive Board in June 2004. The monitoring methodology is designated ***"Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility"***.

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

The methodology AM0008 is applicable to a project activity, which is to switch the industrial fuel currently used in some element processes of a facility to natural gas from coal and/or petroleum fuels that would otherwise continue to be used during the crediting period under the following conditions:

- The local regulations/programs do not constrain the facility from using coal/petroleum fuels;
- Use of coal and/or petroleum fuels is less expensive than natural gas per unit of energy in the country and sector;
- The facility would not have major efficiency improvements during the crediting period;
- The project activity does not increase the capacity of final outputs and lifetime of the existing facility during the crediting period, and
- The proposed project activity is defined as fuel switching applied to element processes and does not result in integrated process change, except for possible changes in other energy use associated to fuel switching.

As mentioned above, the proposed project activity involves fuel switching from coal to natural gas at the boiler room of an industrial facility of SAB, the Rosslyn Brewery plant[8]. The project does not result in integrated process change, but only involves fuel switching at the boiler room of the facility.

The continuation of the current situation is in line with applicable regulations in South Africa. Legally binding norms, established by the government that can be related to the project activity, are those dealing with air quality, under the authority of the Department of Environmental Affairs and Tourism (DEAT). Neither of these norms constrains the facility from using coal. The continuation of the current situation has no any problem with regulations.

Coal is cheaper than natural gas in the region. Moreover, converting from coal to natural gas would require investment in new equipment. The additional investments and the higher fuel bill imply that the project would not be cost effective.

Rosslyn Brewery does not expect to increase the capacity of final outputs of the existing facility during the crediting period. Rosslyn Brewery is used as a "swing brewery". Consequently, its production varies from year to year depending on the overall beer sales. Effectively, if sales decrease, the other SAB breweries are maintained at full production capacity while Rosslyn's production is reduced. Current corporate thinking is to change the function of Rosslyn Brewery from a "swing brewery" to a

[8] For this project activity, the element process considered is the boiler room consuming coal in the baseline scenario and natural gas in the project scenario.

full production capacity brewery, due to the increase of beer consumption in the region. As a consequence, Rosslyn Brewery will have a substantial production increase over the next years, until reaching the 100% of its existing production capacity.

Neither does Rosslyn expect to increase the lifetime of the existing facility during the crediting period. Rosslyn has decided to replace the existing boiler, instead of converting them, due to business strategy. However, the lifetime of existing boilers of the plant are longer than the crediting period.

Additionally, Rosslyn Brewery does not expect to carry out significant efficiency improvements. There will be only the minor electricity savings inherent to switching coal to natural gas.

Thus the proposed project activity meets the conditions under which the methodology AM0008 is applicable.

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	*Quantity of natural gas consumed at the boiler room following project implementation* *PFC_{NG}*	*Rosslyn Brewery and Sasol Gas Limited*	m^3	*M*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*This value will be measured using Sasol's gas meters and will be confirmed by the natural gas purchase record. Before calculation of project emissions, it shall be converted to energy units (GJ) by multiplying it by its Lower Heating Value.*
2	*Project emissions E*	*Rosslyn Brewery*	tCO_2e	*C*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1, as explained in Section D.2.1.2.*

Data will be archived until two years after finishing the crediting period.

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

Project GHG emissions within the project boundary correspond to emissions from fuel combustion at the boiler room in Rosslyn Brewery plant following project implementation.

In this project activity, the new boilers are bundled to one, since their input and output are identical.

Project emissions E (tCO_2e/year) are given by:

$$E = PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP\ (CH_4) + NEF_{NG} \times GWP\ (N_2O)] \quad (1)$$

where:

PFC_{NG}	Consumption of natural gas used in the project scenario, in energy units (GJ/year) and based on lower heating value
CEF_{NG}	Carbon dioxide emission factor per unit energy of combusted natural gas (tCO_2e/GJ)
MEF_{NG}	Methane emission factor per unit energy of combusted natural gas (tCH_4/GJ)
$GWP\ (CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period
NEF_{NG}	Nitrous oxide emission factor per unit energy of combusted natural gas (tN_2O/GJ)
$GWP\ (N_2O)$	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1st commitment period

Ex-ante project emissions are determined through equation (1) above, using estimated values of total project natural gas consumption at the boiler room.

Natural gas consumption is estimated *ex-ante* in such a way that the total heat output of the element process is the same in the baseline and project scenarios, using the following constraint relation:

$$BFC_{COAL} \times \eta_{COAL} = PFC_{NG} \times \eta_{NG} \quad (2)$$

where:

BFC_{COAL}	Consumption of coal at the boiler room in the baseline scenario, in energy units (GJ/year) and based on lower heating value
PFC_{NG}	Consumption of natural gas at the boiler room in the project scenario, in energy units (GJ/year) and based on lower heating value
η_{COAL}	Efficiency of the boiler room using coal in the baseline scenario based on lower heating value (%)
η_{NG}	Efficiency of the boiler room using natural gas in the project scenario based on lower heating value (%)

Baseline coal consumption at the boiler room during the crediting period is estimated according to the annual volumes of beer production foreseen by the company.

Efficiency of the boiler room using coal in the baseline is measured prior to fuel switching as a function of the load factor. These measurements enable the determination of the average efficiency corresponding to the representative operating mode of the boiler room using coal. Such average efficiency is considered as the efficiency of the boiler room using coal in the baseline scenario during the entire crediting period.

In addition, estimated efficiency of the boiler room using natural gas in the project should be considered in the *ex-ante* estimation of project natural gas consumption.

Thus, the *ex-ante* project natural gas consumption is estimated using the equation (2), as follow:

$$PFC_{NG} = BFC_{COAL} \times \eta_{COAL} / \eta_{NG} \quad (3)$$

Following project implementation, natural gas consumption at the boiler room will be monitored in Rosslyn Brewery plant, and the measured values will be used for the *ex-post* calculation of project emissions using the equation (1) above.

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), or estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*Quantity of natural gas consumed at the boiler room following project implementation* PFC_{NG}	*Rosslyn Brewery and Sasol Gas Limited*	m^3	*M*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*This value will be measured using Sasol's gas meters and will be confirmed by the natural gas purchase record.* *Before calculation of baseline coal consumption, it shall be converted to energy units (GJ) by multiplying it by its Lower Heating Value.*
3	*Efficiency of the boiler room using natural gas following project implementation* η_{NG}	*Rosslyn Brewery*	*%*	*M*	*Once at the early stage of each crediting period*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*The measurement of efficiency will be carried out as a function of the load factor in order to determine the average efficiency of the representative operating mode of the boiler room using natural gas. It is based on Lower Heating Value.*
4	*Quantity of coal consumed at the boiler room in the baseline* BFC_{COAL}	*Rosslyn Brewery*	*GJ*	*C*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data number 1 and 3 as explained in Section D.2.1.4.*

5	*Local regulation constraint*	*Rosslyn Brewery*		*Checked*	*At the renewal of the crediting period*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
6	*Baseline emissions BE*	*Rosslyn Brewery*	*tCO_2e*	*C*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 4, as explained in Section D.2.1.4.*

Data will be archived until two years after finishing the crediting period.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

Baseline GHG emissions within the project boundary correspond to emissions from coal combustion at the boiler room in Rosslyn Brewery plant prior to project implementation.

In this project activity, the seven existing boilers are bundled to one, since their input and output are identical.

Baseline emissions *BE* (tCO_2e/year) are given by:

$$BE = BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP(CH_4) + NEF_{COAL} \times GWP(N_2O)] \quad (4)$$

where:

BFC_{COAL}	Consumption of coal used in the baseline scenario, in energy units (GJ/year) and based on lower heating value of coal
CEF_{COAL}	Carbon dioxide emission factor per unit energy of coal (tCO_2/GJ)
MEF_{COAL}	Methane emission factor per unit energy of coal (tCH_4/GJ)
$GWP(CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period
NEF_{COAL}	Nitrous oxide emission factor per unit of energy of coal (tN_2O/GJ)
$GWP(N_2O)$	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1st commitment period

Ex-ante baseline emissions are determined through equation (4) above, using values of total baseline coal consumption at the boiler room estimated according to the annual volumes of beer production foreseen by the company.

The *ex-post* baseline emissions will be calculated through equation (4) above, using values of total baseline coal consumption determined in a dynamic manner from monitored project data.

Baseline coal consumption will be determined *ex-post* in such a way that the heat output of the element process is the same in baseline and project scenarios. In other words, baseline emissions related to fuel consumption would correspond to the consumption of fuels used in the baseline scenario in order to provide the same amount of heat as is actually measured in the project scenario.

Fuel consumption in the baseline and project scenarios are linked with the constraint relation shown above in Section 2.1.2:

$$BFC_{COAL} \times \eta_{COAL} = PFC_{NG} \times \eta_{NG} \quad (2)$$

where:

BFC_{COAL}	Consumption of coal at the boiler room in the baseline scenario, in energy units (GJ/year) and based on lower heating value
PFC_{NG}	Consumption of natural gas at the boiler room in the project scenario, in energy units (GJ/year) and based on lower heating value
η_{COAL}	Efficiency of the boiler room using coal in the baseline scenario based on lower heating value
η_{NG}	Efficiency of the boiler room using natural gas in the project scenario based on lower heating value

As mentioned above in Section 2.1.2, the efficiency of the boiler room using coal is measured prior to fuel switching as a function of the load factor. These measurements enable the determination of the average efficiency corresponding to the representative operating mode of the boiler room using coal. Such average efficiency is considered as the efficiency of the boiler room using coal in the baseline scenario during the entire crediting period.

In another way, following project implementation, the efficiency of the boiler room using natural gas will be also measured as a function of the load factor. These measurements will be carried out at the early stage of each crediting period, enabling the determination of the average efficiency corresponding to the representative operating mode of the boiler room using natural gas. Such average efficiency will be considered as the efficiency of the boiler room using natural gas in the project scenario during each crediting period.

Monitored values of project natural gas consumption and determined values of boiler room efficiencies in the baseline and project scenarios will be used to calculate the *ex-post* baseline coal consumption using equation (2), as follows:

$$BFC_{COAL} = PFC_{NG} \times \eta_{NG} / \eta_{COAL} \qquad \textbf{(5)}$$

At the end of each crediting period, economical investment analysis will be done using the fuel price data at that time to judge whether the project is still additional. Rosslyn Brewery shall assess the additionality of the project activity and monitor, in particular, the price differential between coal and gas in the host country. Prices will be monitored, so that changes in price differentials can be seen.

In addition, local regulations shall be used to check whether the applicability conditions are met. If local regulation does not allow utilizing coal, the project is no longer additional.

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

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

N/A

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

N/A

D.2.3. Treatment of leakage in the monitoring plan 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
1	*Quantity of natural gas consumed at the boiler room following project implementation* PFC_{NG}	*Rosslyn Brewery and Sasol Gas Limited*	m^3	*M*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*This value will be measured using Sasol's gas meters and will be confirmed by the natural gas purchase record.* *Before calculation of leakage, it shall be converted to energy units (GJ) by multiplying by its Lower Heating Value.*
4	*Quantity of coal consumed at the boiler room in the baseline* BFC_{COAL}	*Rosslyn Brewery*	*GJ*	*C*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data number 1 and 3 as explained in Section D.2.1.4.* *Before calculation of leakage, it shall be converted to mass units by dividing by its Lower Heating Value.*
7	*Leakage* *LE*	*Rosslyn Brewery*	tCO_2e	*C*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1 and 4 as explained in Section D.2.3.2.*

Data will be archived until two years after finishing the crediting period.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

Fugitive methane emissions from coal mining and natural gas production, processing, pipeline, and distribution, and CO_2 emissions from coal transportation are considered as leakage.

Leakage *LE* (tCO_2e/year) is given by:

$$LE = [PFC_{NG} \times FE_{NG}(CH_4) - BFC_{COAL} \times FE_{COAL}(CH_4)] \times GWP(CH_4) - BTF_{diesel\ COAL} \times EF_{diesel} \quad (6)$$

where:

PFC_{NG}	Consumption of natural gas in the project scenario, in energy units (GJ/year) and based on lower heating value
$FE_{NG}(CH_4)$	IPCC default methane emission factor associated with natural gas production, processing, pipeline and distribution in the project (tCH_4/GJ)
BFC_{COAL}	Consumption of coal in the baseline scenario, in mass units (tonnes/year)
$FE_{COAL}(CH_4)$	IPCC default methane emission factor associated with coal mining in the baseline (tCH_4/t coal)
$GWP(CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period
$BTF_{diesel\ COAL}$	Quantity of diesel consumed in transporting coal to the facility in the baseline, in energy units (GJ/year) and based on lower heating values
EF_{diesel}	Carbon dioxide emission factor per unit of energy of diesel consumed in the baseline by the truck, (tCO_2e/GJ)

Fugitive methane emissions from coal mining operations are calculated using a default emission factor given by the IPCC Guidelines for National Greenhouse Gas Inventories Volume 3, Reference Manual (1996). The IPCC does not give a specific emission factor for coal mining in South Africa, where the coal consumed in Rosslyn Brewery comes from. However, page 1.105 provides a range of estimates for methane emissions from coal mining underground from 10 to 25 m^3 of methane per tonne of coal, along with a methane density of 0.67 kg/m^3 at 1 atm and 20 ºC. An average value of 17.5 m^3/t coal (0.0117 tCH_4/t coal) is assumed.

Fugitive methane emissions associated with natural gas occur in natural gas production and processing as well by leakage from the pipeline supplying the project site. These are emissions outside the project boundary. There would also be fugitive emissions from the natural gas distribution network within the project site. For simplicity in calculations, we consider all of these fugitive methane emissions to be outside the project boundary.

Since measured data on natural gas production, processing and pipeline leakage are not available, standard estimates are used, as suggested in IPCC Guidelines for National Greenhouse Gas Inventories Volume 3, Reference Manual (1996). Table 1-64, p. 1.131 indicates values corresponding to the "Rest of the world", region where Mozambique and South Africa would fall: 39.59 to 96.00 tonnes of methane per PJ of natural gas for its production and 116.00 to 340.00 tonnes of methane per PJ of natural gas for its processing, pipeline and distribution.

Average values of 70.00 tCH_4/PJ (0.00007 tCH_4/GJ) for natural gas production and 230.00 tCH_4/PJ (0.00023 tCH_4/GJ) for natural gas processing, pipeline and distribution are assumed. Thus, for natural gas production, processing, pipeline and distribution, the methane emission factor considered is 0.0003 tCH_4/GJ of natural gas consumption.

In this case, the energy content (GJ) is based on the *lower* heating value of the fuel.

The second term in the above formula refers to emissions from coal transportation in the baseline scenario, shown as a product of the energy content of the diesel consumed in transporting coal to the facility and the corresponding CO_2 emission factor for the diesel consumed by the truck. In view of the relatively small magnitude of CO_2 emissions from fuel transportation to typical industrial facilities, IPCC emission factors can be used.

The quantity of diesel consumed in transporting coal to the facility can be obtained in a facility-specific way, as follow:

$$BTF_{diesel\ COAL} = SEC_{diesel\ COAL} \times BFC_{COAL} \quad (7)$$

where:

BFC_{COAL}	Quantity of coal transported in the baseline (consumption of coal in the baseline), in mass units (kg/year)
$SEC_{diesel\ COAL}$	Specific energy consumption. Quantity of diesel consumed per unit of coal transported in the round trip in the baseline, in energy units (based on lower heating values) per unit of mass (GJ/kg)

The specific energy consumption of the truck is determined *ex-ante* from historical data or estimations, and it is considered fixed during the crediting period. This simplification is valid since the relatively small magnitude of CO_2 emissions from fuel transportation to typical industrial facilities.

The specific energy consumption of the trucks $SEC_{diesel\ COAL}$ is calculated in the following way:

Input data[9]

(1) Distance traveled by truck: 155 km each way

(2) Truck specific diesel consumption: 2.4 km/litre[10]

(3) Quantity of coal transported per trip: 24 tonnes

(4) Lower heating Value of diesel[11]: 0.0361 GJ/litre

[9] Data provided by Rosslyn Brewery.
[10] Source: coal transport company. A loaded coal truck gets 2.2 km/litre while an empty one gets 2.6 km/litre. An average value is used.
[11] Source: Sasol Gas Limited.

Output:

(5) Fuel consumption per round trip: (1) × 2/(2) = 155 × 2/2.4= 129.2 litres of diesel

(6) Specific fuel consumption: (5)/(3) = 129.2 / 24 = 5.382 litres diesel/tonne coal

Specific energy consumption, $SEC_{diesel\ COAL}$:

(4) × (6) = 0.0361 × 5.382 = **0.1943 GJ/t coal**

Finally, the leakage *LE* (tCO_2e/year) is given by:

$$LE = [PFC_{NG} \times FE_{NG} (CH_4) - BFC_{COAL} \times FE_{COAL} (CH_4)] \times GWP (CH_4) - SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel} \quad (8)$$

Thus, to estimate the leakage before and after project implementation it is necessary to calculate the *ex-ante* and *ex-post* consumption of fuels at the industrial facility used in the baseline and project scenario *(BFC_{COAL}* and *PFC_{NG})*, which can be determined as explained in Sections D.2.1.2 and D.2.1.4.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

As mentioned above, baseline emissions *BE*, project emissions *E*, and leakage *LE* (tCO_2e/year) are given by:

$$BE = BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP (CH_4) + NEF_{COAL} \times GWP (N_2O)] \quad (4)$$

$$E = PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP (CH_4) + NEF_{NG} \times GWP (N_2O)] \quad (1)$$

$$LE = [PFC_{NG} \times FE_{NG} (CH_4) - BFC_{COAL} \times FE_{COAL} (CH_4)] \times GWP (CH_4) - SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel} \quad (8)$$

Thus the emission reductions *ER* (tCO_2e/year) achieved by the project activity are given by:

$$
\begin{aligned}
ER = \; & BE - E - LE = \qquad (9) \\
= \; & BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP\ (CH_4) + NEF_{COAL} \times GWP\ (N_2O)] - \\
& - PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP\ (CH_4) + NEF_{NG} \times GWP\ (N_2O)] - \\
& - [PFC_{NG} \times FE_{NG}\ (CH_4) - BFC_{COAL} \times FE_{COAL}\ (CH_4)] \times GWP\ (CH_4) + \\
& + SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel}
\end{aligned}
$$

Total emission reductions should be estimated *ex-ante* as is shown below in Section E.5, and determined *ex-post* as explained in Sections D.2.1.2, D.2.1.4, and D.2.3.2 above.

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.*
1. PFC_{NG}	*Low*	*Natural gas consumption is measured by two gas meters installed by Sasol in the gas supply line. The readings are registered on Sasol's system and invoiced each month. In addition, Rosslyn Brewery can wire the meters to its PLC in order to develop and maintain the spreadsheet, in which the daily natural gas consumption is recorded. Rosslyn is also able to monitor conditions such spikes, baseload, and leakages, as well as verify the monthly account received from Sasol.*
3. η_{NG}	*Low*	*The efficiency is obtained as a ratio of the output energy to the input energy and is verify by an external consultant.*

Rosslyn Brewery and Sasol have a series of internal procedures that ensures data have low uncertainties during monitoring process (see Section D.4)

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

Table 8: Operational and management structure

Department	Responsibility	Monitoring	Methodology
Rosslyn Engineering Department	Alistair Fisher, Utilities Engineer	Continuous fuel flow measurement on line to the boilers	By having two flow meters installed in the gas supply line, Sasol is able to verify the readings. If variations occur beyond the specification, calibration is performed. Calibration is also performed on a scheduled period basis and in accordance to Sasol's standards. Data is archived by a chart recorded measurement.
		Efficiency measurements at the boiler room	Fuel efficiency is determined as a ratio of the output energy to the input energy and is verify by an external consultant. The data to be collected is the following: - Steam flow - Steam pressure - Boiler feedwater temperature - Fuel consumption - Calorific content of fuel
	Thabo Nkitseng, Asset Care Specialist	Quality assurance for low uncertainties in the measurement instruments	This is in accordance to ISO 9001 instructions, procedures and maintenance planning.

The ISO 9001 quality management system adopted by Rosslyn Brewery also includes the following issues:

- Identification of training needs for the project (operation, maintenance, monitoring, etc.) and imparting the trainings.
- Procedures addressing what records to keep, storage area of records, and how to process performance documentation.
- Procedures identified for internal audits of GHG project compliance with operational requirements.
- Procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting.

An emergency in the project can result in unintended emissions from the project site. If natural gas line ruptures within the gas line at the plant site, some natural gas would discharge to atmosphere until the flow in the ruptured line was stopped. The probability of this incident to occur is minimal. However, if it happens, there are valves at the Pressure Reducing Station to shut off flow.

If for whatever reason, one of the boilers fails, Rosslyn will have a standby boiler, which can be brought on stream.

In addition to the monitoring data for the determination of emission reduction, the contribution of the project to sustainable development will be also monitored using the following indicators:

Environmental indicators

Emissions of NO_x, SO_x, and particulate matter will be measured in order detect environmental impacts of the project and to ensure compliance with environmental regulations.

Responsibility: Sanjay Premraj – Risk Department, Rosslyn

Title: Risk Manager

Measurements

Frequency of data measurements: continuous monitoring of stack emissions

Reporting frequency: quarterly

Quality control: monitoring equipment calibration every six months

Responsibility: Alistair Fisher – Utilities Department, Rosslyn

Title: Utilities Manager

Accountability: Jan Nothnagel – Engineering Department, Rosslyn

Title: Engineering Manager

Social indicators

The company will monitor occupational health in order to detect if the project has substantially improved the health condition of its employees. This will be based on internal health records and records of absenteeism due to sickness.

Responsibility: Sanjay Premraj - Risk Department, Rosslyn

Title: Risk Manager

Reporting Frequency: quarterly

Accountability: Jan Nothnagel – Engineering Department, Rosslyn

Title: Engineering Manager

Economic indicators

The company will monitor the positive contribution to FDI through the sale of CERs to Annex 1 countries generated by the project.

Responsibility: Finance Department Central Office

Title: Treasury Manager

Reporting Frequency: annually

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

Marisa Zaragozi and Fabián Gaioli, MGM International SRL.
Junín 1655, 1º B
C1113AAQ, Buenos Aires, Argentina
Tel./Fax: (54 11) 5219-1230/32
e-mail: mzaragozi@mgminter.com

Marisa Zaragozi and Fabián Gaioli are not project participants.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

As mentioned in Section D, project GHG emissions within the project boundary correspond to emissions from fuel combustion at the boiler room in Rosslyn Brewery plant following project implementation.

Thus *ex-ante* project emissions *E* (tCO_2e/year) are given by:

$$E = PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP\ (CH_4) + NEF_{NG} \times GWP\ (N_2O)] \quad (1)$$

$$= PFC_{NG} \times (56.1 + 0.0014 \times 21 + 0.0023 \times 310)/1{,}000\ tCO_2e/GJ$$

As mentioned in Section D, the *ex-ante* project emissions are determined through equation (1) above, using values of total project natural gas consumption at the boiler room

Natural gas consumption is estimated in such a way that the total heat output of the element process is the same in baseline and project scenarios, using the following constraint relation:

$$BFC_{COAL} \times \eta_{COAL} = PFC_{NG} \times \eta_{NG} \quad (2)$$

Baseline coal consumption at the boiler room during the crediting period is estimated according to the annual volumes of beer production foreseen by the company.

Efficiency of the boiler room using coal is measured prior to fuel switching as a function of the load factor. These measurements enable the determination of the average efficiency corresponding to the representative operating mode of the boiler room using coal. Such average efficiency is considered as the efficiency of the boiler room using coal in the baseline scenario during the entire crediting period.

In addition, estimated efficiency of the boiler room using natural gas in the project should be considered in the *ex-ante* estimation of total project natural gas consumption.

Thus, the *ex-ante* project natural gas consumption is estimated using the equation (2), as follow:

$$PFC_{NG} = BFC_{COAL} \times \eta_{COAL} / \eta_{NG} \qquad (3)$$
$$= BFC_{COAL} \times 0.741 / 0.94$$

The *ex-ante* estimations of project emissions inside the plant are shown in the following table:

Table 9: *Ex-ante* project emissions

Years[12]	Coal consumption in the baseline[13] (GJ – dry basis)	Natural gas consumption in the project (GJ)	Project emissions (tCO_2e)
2007	1,319,649	1,040,162	59,125
2008	1,676,106	1,321,125	75,096
2009	1,676,106	1,321,125	75,096
2010	1,926,384	1,518,397	86,309
2011	1,934,360	1,524,683	86,667
2012	1,942,368	1,530,995	87,025
2013	1,950,409	1,537,334	87,386
Total	**12,425,383**	**9,793,820**	**556,704**

E.2. Estimated leakage:

As mentioned in Section D, fugitive methane emissions from coal mining and natural gas production, processing, pipeline, and distribution, and CO_2 emissions from coal transportation are considered as leakage for this project activity.

Thus, the *ex-ante* leakage *LE* (tCO_2e/year) is given by:

$$LE = [PFC_{NG} \times FE_{NG}(CH_4) - BFC_{COAL} \times FE_{COAL}(CH_4)] \times GWP(CH_4) - SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel} \qquad (8)$$
$$= [PFC_{NG} \times 0.0003\ tCH_4/GJ - BFC_{COAL} \times 0.0117\ tCH_4/t\ coal] \times 21\ tCO_2e/tCH_4 - 0.1943 \times BFC_{COAL} \times 74.07\ tCO_2e/t\ coal$$

The *ex-ante* estimations of leakage are shown in the following table:

[12] It is defined as the time period between June of a year and May of the subsequent year.
[13] Coal received by Rosslyn Brewery plant has about 3.3% of moisture. In order to estimate natural gas consumption in the project, coal consumption in the baseline should be considered in a dry basis. Thus, coal energy consumption is calculated by multiplying the quantity of dry coal used (total quantity of coal reduced by 3.3%) by the correspondent lower heating value.

Table 10: *Ex-ante* leakage

Years[14]	Natural gas consumption in the project (GJ)	Coal consumption in the baseline (tonnes – wet basis)	Leakage (tCO_2e)
2007	1,040,162	52,337	-7,059
2008	1,321,125	66,474	-8,966
2009	1,321,125	66,474	-8,966
2010	1,518,397	76,400	-10,305
2011	1,524,683	76,716	-10,348
2012	1,530,995	77,034	-10,391
2013	1,537,334	77,353	-10,434
Total	**9,793,820**	**492,788**	**-66,469**

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

The *ex-ante* estimations of total project emissions are the following:

Table 11: *Ex-ante* total project emissions

Years[15]	Project emissions (tCO_2e)	Leakage (tCO_2e)	Total project emissions (tCO_2e)
2007	59,125	-7,059	52,066
2008	75,096	-8,966	66,130
2009	75,096	-8,966	66,130
2010	86,309	-10,305	76,004
2011	86,667	-10,348	76,319
2012	87,025	-10,391	76,635
2013	87,386	-10,434	76,952
Total	**556,704**	**-66,469**	**490,236**

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

Baseline GHG emissions within the project boundary correspond to emissions from coal combustion at the boiler room in Rosslyn Brewery plant prior to project implementation.

[14] It is defined as the time period between June of a year and May of the subsequent year.
[15] It is defined as the time period between June of a year and May of the subsequent year.

Thus, *ex-ante* baseline emissions *BE* (tCO_2e/year) are given by:

$$BE = BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP\ (CH_4) + NEF_{COAL} \times GWP\ (N_2O)] \quad (4)$$

$$= BFC_{COAL} \times (96.07 + 0.001 \times 21 + 0.0016 \times 310)/1{,}000\ tCO_2e/GJ$$

The *ex-ante* baseline emissions are determined through equation (5) above, using values of total baseline coal consumption at the boiler room estimated according to the annual volumes of beer production foreseen by the company (see Annex 3).

The *ex-ante* estimations of baseline emissions are the following:

Table 12: *Ex-ante* baseline emissions

Years[16]	Coal consumption in the baseline[17] (GJ – dry basis)	Baseline emissions (tCO_2e)
2007	1,319,649	127,461
2008	1,676,106	161,890
2009	1,676,106	161,890
2010	1,926,384	186,064
2011	1,934,360	186,834
2012	1,942,368	187,607
2013	1,950,409	188,384
Total	**12,425,383**	**1,200,130**

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

As mentioned above, baseline emissions *BE*, project emissions *E*, and leakage *LE* (tCO_2e/year) are given by:

$$BE = BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP\ (CH_4) + NEF_{COAL} \times GWP\ (N_2O)] + \quad (4)$$

$$E = PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP\ (CH_4) + NEF_{NG} \times GWP\ (N_2O)] \quad (1)$$

[16] It is defined as the time period between June of a year and May of the subsequent year.

[17] Coal received by Rosslyn Brewery plant has about 3.3% of moisture. In order to calculate emissions from fuel combustion in the baseline, coal consumption should be considered in a dry basis. Thus, coal energy consumption is calculated by multiplying the quantity of dry coal used (total quantity of coal reduced by 3.3%) by the correspondent lower heating value.

$$\boldsymbol{LE = [PFC_{NG} \times FE_{NG}(CH_4) - BFC_{COAL} \times FE_{COAL}(CH_4)] \times GWP(CH_4) - SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel}} \quad (8)$$

Thus the emission reductions *ER* (tCO_2e/year) achieved by the project activity are given by:

$$\begin{aligned} \boldsymbol{ER} &= \boldsymbol{BE - E - LE =} \quad (9) \\ &= \boldsymbol{BFC_{COAL} \times [CEF_{COAL} + MEF_{COAL} \times GWP(CH_4) + NEF_{COAL} \times GWP(N_2O)] -} \\ &\quad \boldsymbol{- PFC_{NG} \times [CEF_{NG} + MEF_{NG} \times GWP(CH_4) + NEF_{NG} \times GWP(N_2O)] -} \\ &\quad \boldsymbol{- [PFC_{NG} \times FE_{NG}(CH_4) - BFC_{COAL} \times FE_{COAL}(CH_4)] \times GWP(CH_4) +} \\ &\quad \boldsymbol{+ SEC_{diesel\ COAL} \times BFC_{COAL} \times EF_{diesel}} \end{aligned}$$

Thus, *ex-ante* emission reductions are given by:

$$\begin{aligned} \boldsymbol{ER} = &\ \boldsymbol{BFC_{COAL}} \times (96.07 + 0.001 \times 21 + 0.0016 \times 310)/1{,}000\ tCO_2e/GJ - \\ &- \boldsymbol{PFC_{NG}} \times (56.1 + 0.0014 \times 21 + 0.0023 \times 310)/1{,}000\ tCO_2e/GJ - \\ &- [\boldsymbol{PFC_{NG}} \times 0.0003\ tCH_4/GJ - \boldsymbol{BFC_{COAL}} \times 0.0117\ tCH_4/t\ coal] \times 21\ tCO_2e/tCH_4 + \\ &+ 0.1943 \times \boldsymbol{BFC_{COAL}} \times 74.07\ tCO_2e/t\ coal \end{aligned}$$

Ex-ante emissions reductions are determined through equation (8) above, using values of total fuel consumption at the boiler room in the baseline and project scenarios.

Baseline coal consumption at the boiler room during the crediting period is estimated according to the annual volumes of beer production foreseen by the company.

Project natural gas consumption is estimated in such a way that the total heat output of the element process is the same in the baseline and project scenarios, using the following constraint relation:

$$\boldsymbol{BFC_{COAL} \times \eta_{COAL} = PFC_{NG} \times \eta_{NG}} \quad (2)$$

Efficiency of the boiler room using coal is measured prior to fuel switching as a function of the load factor. These measurements enable the determination of the average efficiency corresponding to the representative operating mode of the boiler room using coal. Such average efficiency is considered as the efficiency of the boiler room using coal in the baseline scenario during the entire crediting period.

In addition, estimated efficiency of the boiler room using natural gas in the project should be considered in the *ex-ante* estimation of project natural gas consumption.

Thus, the *ex-ante* project natural gas consumption is estimated using the equation (2), as follow:

$$PFC_{NG} = BFC_{COAL} \times \eta_{COAL} / \eta_{NG} \quad (3)$$

$$= BFC_{COAL} \times 0.741 / 0.94$$

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

The project has the capacity to reduce GHG emissions by 709,895 tCO_2e over the first 7-year crediting period.

The results obtained applying the formulae above are shown in the following tables.

Table 13: *Ex-ante* emission reductions during the first 7-year crediting period (tCO_2e)

Years[18]	Baseline emissions	Project emissions	Leakage	Emission reductions
2007	127,461	59,125	-7,059	75,395
2008	161,890	75,096	-8,966	95,760
2009	161,890	75,096	-8,966	95,760
2010	186,064	86,309	-10,305	110,059
2011	186,834	86,667	-10,348	110,515
2012	187,607	87,025	-10,391	110,973
2013	188,384	87,386	-10,434	111,432
Total	**1,200,130**	**556,704**	**-66,469**	**709,895**

[18] It is defined as the time period between June of a year and May of the subsequent year.

SECTION F. Environmental impacts

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

The substitution of coal by natural gas has positive environmental impact on several grounds.

Coal burning produces a number of gaseous and particulate matter emissions that are local air pollutants. The particulate emissions are almost completely eliminated by switching to natural gas. Gaseous pollutants are also substantially reduced since natural gas burn cleaner than coal.

Eliminating coal use at the plant reduces coal consumption and thus the environmental impact of coal mining and coal transportation from the mine to the plant site is eliminated.

In addition, the project reduces gaseous and particulate matter emissions from fuel combustion in the power plants, due to the decrease of electricity consumption at the boiler room and the consequent reduction of electricity generation outside the industrial facility.

The project implementation involves the construction of a gas distribution network at the Rosslyn Brewery plant site and the installation of equipment permitting the use of natural gas. The environmental impact of these activities is expected to be insignificant.

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:

No significant negative environmental impact is expected from project activities and an environmental impact study is not required by South African authorities.

SECTION G. Stakeholders' comments

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

The process followed to collect stakeholder comments of the Rosslyn Brewery Fuel-Switching Project was through a survey developed during the EIA Forum on 22th March 2005 as stipulated by the Gauteng Department of Agriculture, Conservation, and Environment.

Stakeholders selected for consultation by Rosslyn Brewery included representatives of local NGOs (as recommended by Mr. Kevin Nassiep, Chief Director of Energy Planning within the Department of Minerals and Energy and responsible for the South African DNA) and representatives of the following government agencies:

- Gauteng Department of Agriculture
- Conservation & Environmental Affairs
- Department of Minerals and Energy

In addition, in order to ensure other interested parties were also invited, Rosslyn Brewery published advertisements in local papers.

The following set of questions was given to stakeholders present at the EIA Forum:

1. In relation with the information that you have and your knowledge about Environmental issues, Climate Change, Kyoto Protocol, Clean Development Mechanism, and Global Carbon Market; please express your opinion on the Rosslyn Brewery Fuel Switching Project.
2. Would you recommend to private companies, government authorities or another organization to develop this kind of projects (industrial fuel switching under the Clean Development Mechanism)?
3. Do you consider that the Rosslyn Brewery Fuel Switching Project will contribute to sustainable development of the region and South Africa?
4. Any additional comment that you want to express.

The questionnaire was completed by the following persons:

Table 14: Stakeholders that responded to the questions

Name	Position	Company/Institution
Ronnie Peters	Energy Advisor	Sasol
Russell Baloyi	Energy & Environmental Advisor	SA Local Government Association
David Bambatha	Sustainable Development Coordinator	SA Local Government Association
Jaco Grobler	Technical Support Group Manager	African Products
Willem Jooste	General Works Manager	Lion Match
Lungi Mbanga	Project Officer	CBLA

For more details see Annex 5.

G.2. Summary of the comments received:

The following table shows a synthesis of the comments received:

Table 15: Comments received

Question	1	2	3	4
Ronnie Peters	A necessary project.	Yes.	Step in the right direction.	Exemplary.
Russell Baloyi	It's a good project and helps with diversifying the supply option and conserving the environment.	As a sound Project and CDM can be an additional Benefit.	With good monitoring and evaluation. Yes!	
David Bambatha	A project of this nature will contribute positively in conserving environmental damage.	One would recommend such more, as it has intentions of conserving the environment.	One would recommend, and is of the view that the project addresses sustainable development issues.	
Jaco Grobler	Given new ideas. Will definitely be of benefit to SAB and community.	Yes.	Yes.	
Willem Jooste	A good and needed project.	Yes, if it is economically viable through CDM.	Yes.	The current price of gas is a negative.
Lungi Mbanga	Kyoto is allows developing countries to take the opportunity of CDM to reduce GHG's so it becomes viable financially and environmentally friendly as explained. Therefore the project is best; we need to take advantage of this as an investment and to hedge post 2012 obligations.	Off-course – CDM is a strategic direction that companies should be encouraged to take in South Africa and Africa as a whole.	Yes, socially – may create jobs in the region, environmental friendly; and is sustainable for South Africa.	Develop even more projects so as to encourage other companies in the business.

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

Six comments have been received and they were very positive for project implementation.

South African Breweries invites comments from other stakeholders, once the PDD has been published at the DNV website during the validation process:

http://www.dnv.com/certification/climatechange/Projects/ProjectList.asp

Depending on the comments, proper account will be taken, if necessary.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No funds from public national or international sources were used in any aspect of the proposed project.

Annex 3

BASELINE INFORMATION

The key data used to determine the *ex-ante* baseline scenario are given in the following table.

Table 16: Key data

Data	Value	Data sources
Carbon dioxide emission factor of coal, CEF_{coal}	96.07 $kgCO_2/GJ$	Ref. 1 Table 1-1 p. 1.13, Sub-bit. Coal: 26.2 t C/TJ lower heating value basis.
Methane emission factor of coal, MEF_{coal}	1 $kgCH_4/TJ$	Ref. 1, Table 1-16, p. 1.54. Bit./Sub-bit. Overfeed Stoker Boilers.
Nitrous oxide emission factor of coal, NEF_{coal}	1.6 kgN_2O/TJ	Ref. 1, Table 1-16, p. 1.54. Bit./Sub-bit. Overfeed Stoker Boilers.
Methane emission factor from coal mining, FE_{coal} (CH_4)	0.0117 tCH_4/t coal	Ref. 1, page 1.105. Underground Mines.
Specific energy consumption of the trucks for transporting of coal, $SEC_{diesel\ COAL}$	0.1943 GJ/t coal	See Section D.2.3.2 above.
Carbon dioxide emission factor of diesel, CEF_{diesel}	74.07 $kgCO_2/GJ$	Ref. 1 Table 1-1 p. 1.13, Diesel Oil: 20.2 t C/TJ lower heating value basis.
Global Warming Potential of methane, $GWP\ (CH_4)$	21	Ref. 2, for methane this was 21.
Global Warming Potential of nitrous oxide, $GWP\ (N_2O)$	310	Ref. 2, for nitrous oxide this was 310.
Lower heating value of coal, LHV_{coal}	26.075 GJ/ t coal	Graspan Colliery Limited (coal supplier).
Coal moisture	3.3%	Rosslyn Brewery. This value comes from the analysis carried out by an independent laboratory.

References: 1. IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996).

2. According to Article 5, section 3 of the Kyoto Protocol, GWP value is as agreed on at COP3.

The following table shows baseline coal consumption at the boiler room during the crediting period estimated according to the annual plant beer production volumes foreseen by the company and based on historical data of the plant.

Table 17: Baseline coal consumption

Years[19]	Beer production (hl)	Coal consumption (kg)	
		Wet basis (3.3% of moisture)	Dry basis
Base[20]	5,407,974	31,281,750	30,249,452
2007	9,048,000	52,337,026	50,609,904
2008	11,492,000	66,474,038	64,280,395
2009	11,492,000	66,474,038	64,280,395
2010	13,208,000	76,400,026	73,878,825
2011[21]	13,262,681	76,716,322	74,184,683
2012	13,317,589	77,033,928	74,491,808
2013	13,372,723	77,352,848	74,800,204

[19] It is defined as the time period between June of a year and May of the subsequent year.
[20] Beer production and coal consumption at the boiler room using coal for base year are actual from April 2004 to March 2005.
[21] Annual growth in production volume from 2011 onward is at rate of 1.00414 per year.

Annex 4

MONITORING PLAN

The Monitoring and Verification Plan describes the procedures for data collection, and auditing required for the project, in order to determine and verify emissions reductions achieved by the project. This project will require only very straightforward collection of data, described below, most of which is already collected routinely by the staff of Rosslyn Brewery plant, where the proposed CDM project is to be implemented.

The Monitoring and Verification Plan (MVP) document fulfills the CDM Executive Board requirement that CDM projects have a clear, credible, and accurate set of monitoring and verification procedures. The purpose of these procedures is to direct and support continuous monitoring of project performance and periodic auditing, verification and certification activities to determine project outcomes, in particular in terms of greenhouse gas (GHG) emission reductions. The MVP is a vital component of project design, and as such is subject to a formal third-party validation process —along with the project baseline and other project design features.

Managers of the Project must maintain credible, transparent, and adequate data estimation, measurement, collection, and tracking systems to successfully develop and maintain the proper set of information to undergo an audit for a greenhouse gas (GHG) emission reduction investment. These records and monitoring systems are needed to subsequently allow an Operational Entity to verify project performance as part of the verification and certification process. In particular, this process reinforces the fact that GHG reductions are real and credible to the buyers of the Certified Emissions Reductions (CERs). This set of information will be needed to meet the evolving international reporting standards developed by the UNFCCC.

The document must be used by the project implementers and operators of the Technical Departments of the Rosslyn Brewery plant. Strict adherence to the guidelines set out in this monitoring plan is necessary for the project managers and operators to successfully measure and track project impacts for audit purposes. MGM International will provide capacity building to the Technical Departments Rosslyn Brewery plant, in order to meet the requirements presented in this MVP.

The new methodology describes the procedure and equations for calculating project and baseline emissions from monitored data. For the specific project, the methodology is applied through a spreadsheet model. The staff responsible for project monitoring must complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved through the project.

The model contains a series of worksheets with different functions:

- Data entry sheet (*fuel consumption, efficiencies*)
- Calculation sheets (*natural gas, coal*)
- Result sheet (*emission reductions*)

There are worksheets where the user is allowed to enter data. All other cells contain model fixed parameters or computed values that cannot be modified by the staff.

A color-coded key is used to facilitate data input. The key for the code is as follows***:***

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display key result lines as calculated by the model.

The last sheet shows the results, comparing year-by-year GHG emissions with the project with baseline values in order to determine annual emissions reductions, shown in the last column.

All electronic data will be backed up on a monthly basis, and two electronic copies of each document will be kept in different locations (the plant and its respective Head Office).

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