CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[1] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[2] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

>>
Title: Cogeneration and/or trigeneration at commercial sites, number 001, Centurion.
Version: 01
Date: 08/07/2011

A.2. Description of the small-scale CPA:

>>

(i) Purpose of the CPA

The purpose of the CPA is to reduce the greenhouse gas emissions at Mobile Telephone Networks (MTN) Centurion, through the installation of an on-site trigeneration facility. This plant will see the simultaneous production of electricity and cooling and heating from a single fuel source - methane-rich natural gas. The outputs from the trigeneration plant will be used to meet part of the energy requirements of the commercial site.

The CPA will be developed under the registered PoA: 'Cogeneration and/or trigeneration at commercial sites in South Africa'.

(ii) Measures undertaken to reduce greenhouse gas emissions

The installation of the trigeneration system at MTN Centurion will see a reduction in electricity consumption from South Africa's national grid. This grid is predominantly coal-fired (coal accounts for more than 92% of the fuel used in South Africa's electricity generation[3]) and therefore, heavily carbon-intensive. The reduction in electricity consumption from the grid will result in a reduction of greenhouse gas emissions, as well as all of the negative impacts of coal mining.

The historically low cost of electricity also means that carbon intensive electricity is cheaper than any other source of power. This has made it difficult for energy efficiency projects to compete with coal based power[4]. The CPA provides MTN with a framework on which to overcome this barrier.

(iii) Contribution of the CPA to sustainable development

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

[3] Department of Water and Environmental Affairs. (2010). *National Climate Change Response Draft Green Paper, pg 13, para..3.* Retrieved from South Africa Government Online: http://www.environment.gov.za

[4] Department of Water and Environmental Affairs. (2010). *National Climate Change Response Draft Green Paper, pg 13, para. 5.* Retrieved from South Africa Government Online: http://www.environment.gov.za

Environmental

This programme supports South Africa's emission mitigation actions. According to a letter sent to the United Nations Framework Convention on Climate Change (UNFCCC) on 29/01/2010, South Africa committed to "taking nationally appropriate mitigation actions to enable a 34% deviation below the 'Business as Usual' emissions growth trajectory by 2020 and a 42% deviation below the 'Business as Usual' emissions growth trajectory by 2025.

The CPA will reduce electricity consumption from a predominantly coal-fired grid, which will result in a reduction in all of the negative impacts associated with coal mining. These impacts include: the impact of coal mining, the utilisation of scarce water resources, SO_2 emissions and the impacts associated with the disposal of coal ash.

Economic

South Africa's national electricity provider, Eskom, carried out planned electricity supply interruptions at the beginning of 2008. These interruptions were caused by the demand for electricity exceeding the supply of electricity. During the interruptions, grid electricity was not accessible. Developing a trigeneration project at MTN Centurion will reduce the pressure on energy infrastructure, thereby making important contributions the country's economic sustainability.

There will also be a transfer of knowledge from the country's supplying the technology to South Africa.

Social

The programme will create jobs in the construction and operations phases of the programme.

A.3. Entity/individual responsible for the small-scale CPA:

>>
MTN is responsible for the small-scale CPA, and will hence forth be referred to as the CPA implementer. Promethium Carbon (Pty) Ltd is the managing entity of the programme, as indicated in the PoA.

A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

>>
Cogeneration and/or trigeneration at commercial sites, number 001, Centurion

A.4.1.1. Host Party:

>>
Republic of South Africa

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

>>

The CPA implementer(s) shall complete the following table, to allow for the unique identification of the small-scale CPA.

Name and contact details of the CPA implementer(s)	MTN South Africa 216 14th Ave, Fairland, Johannesburg +27 11 912 3000 http://www.mtn.co.za
Responsible person	Pierre Lombard +27 83 212 5612
Region	Centurion
Street address	20 Watershed Close, Louwlardia
GPS coordinates	S 25^0 54’ 57.8” E 28^0 10’ 20.2”

The map below gives the location of the programme site.

Figure 1: Map of Southern Africa[5]

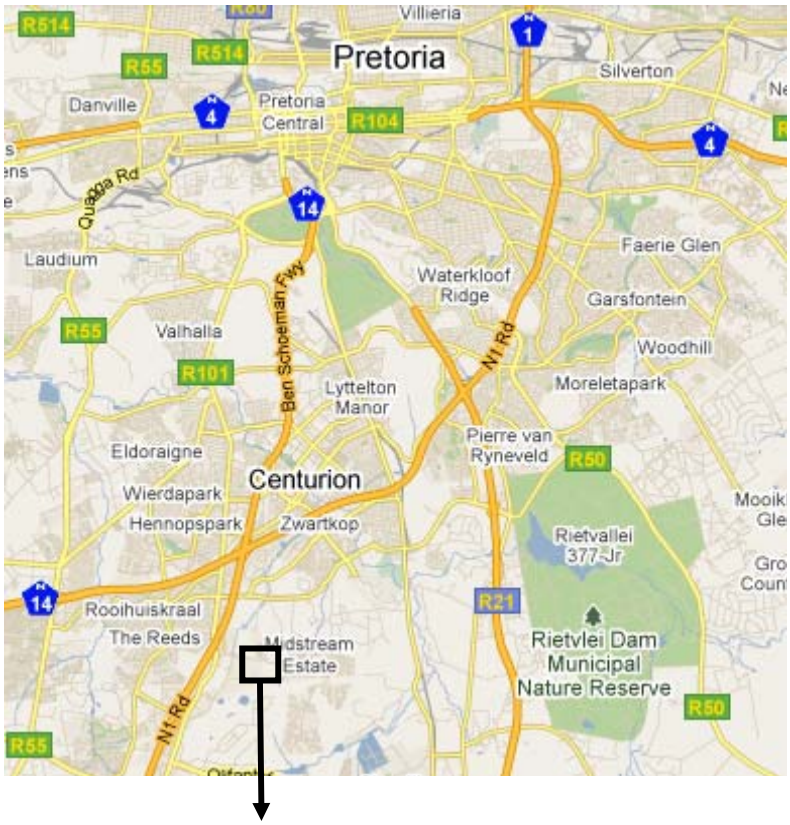

Figure 2: Programme site location[6]

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

>>

According to the Glossary of CDM terms, Version 05, *the starting date of a CDM programme activity is the earliest date at which either the implementation or constructing or real action of a programme activity begins. The starting date of the CPA cannot be prior to the commencement of validation of the programme of activities.*

The proposed starting date of the small scale CPA is 18/07/2011. This is the tentative date that internal combustion engines will be ordered (after the PoA is uploaded for Global Stakeholder Participation).

[5] Retrieved from http://maps.google.co.za/maps

[6] Retrieved from http://maps.google.co.za/maps

A.4.2.2. Expected operational lifetime of the small-scale CPA:

>>
The expected operational lifetime of the CPA is a minimum of 10 years and 0 months.

A.4.3. Choice of the crediting period and related information:

Fixed Crediting period

A.4.3.1. Starting date of the crediting period:

>>
The anticipated starting date of the crediting period is 01/01/2012. This is the proposed date that CPA number 001 will be included in the registered PoA.

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

>>
10 years 0 months

Please note that the duration of crediting period of any CPA shall be limited to the end date of the PoA regardless of when the CPA was added.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>
The CPA implementer(s) shall estimate the amount of emission reductions over the chosen crediting period.

Years	Estimation of annual emission reductions in tonnes of CO_2e
2012	15,284
2013	15,284
2014	15,284
2015	15,284
2016	15,284
2017	15,284
2018	15,284
2019	15,284
2020	15,284
2021	15,284
Total estimated reductions (tonnes of CO_2e)	152,840
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO_2e)	15,284

A.4.5. Public funding of the CPA:

>>
No public funding will be used in the development or in the implementation of this project.

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

>>
This CPA is the first CPA to be included in the PoA 'Cogeneration and/or trigeneration at commercial sites', and, as such, is not a debundled component.

A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

>>
Currently, there are no registered CDM project activities or PoAs relating to cogeneration and/or trigeneration at commercial buildings. The managing entity has developed methodology AMS II.K. specifically for this programme.

Prior to the registration of this CPA under the PoA, the managing entity will check the UNFCCC website to ensure that CPA number 001 is not part of another PoA, nor has been registered as an individual CDM project activity.

Since the CPA implementer signs an agreement with managing entity to transfer the emission reduction rights, it can be also be assured that the project has not been previously registered under the CDM.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

>>
Cogeneration and/or trigeneration at commercial sites in South Africa under reference number 001.

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA:

>>
The small scale CPA is eligible to be included in the registered PoA, as it meets all of the criteria set out in section A.4.2.2 of the PoA. This is justified below:

Item	Eligibility criteria	Justification
1	Each CPA shall conform to the technical description in A.4.2.1 of the PoA. Due to the nature of the project (i.e. it is not a technology specific PoA), the precise technology employed by each CPA may vary.	This CPA involves the installation of a new trigeneration system employing internal combustion engines. This conforms to the technical description in section A.4.2.1 of the PoA.
2	Each CPA will be uniquely identified by the description of the site on which it is implemented. This will include a plot plan and/or plot/erf number and/or GPS coordinates. The site may not overlap with another site that has a project applicable	The programme site has been uniquely identified in section A.4.1.2 of this CPA. The CPA does not overlap with another

	under AMS II.K.	site that has a project applicable under AMS II.K.
3	Each CPA shall fall within the geographical boundary of South Africa, as stipulated in section A.4.1.2.	The CPA is located in Centurion, South Africa.
4	Each CPA shall meet with the applicability criteria in version 01 of the baseline and monitoring methodology AMS II.K. *Installation of co-generation or tri-generation systems supplying energy to commercial buildings*.	The CPA complies with all of the applicability criteria in methodology AMS II.K. version 01.
5	Each CPA to be included in this PoA shall meet with the debundling rules relevant to PoAs.	The managing entity of the PoA has confirmed that the project boundary of this CPA is not within 1km of an adjacent CPA with the same activity implementer. This CPA is the first CPA to be included in the PoA 'Cogeneration and/or trigeneration at commercial sites', and, as such, is not a debundled component.
6	Each CPA shall not be registered, or be in the process of registration, as an individual CDM project activity.	The CPA is not registered nor is it in the process of registering as an individual CDM project activity. This is verified on the UNFCCC website.
7	Each CPA shall not be included in another registered PoA.	The CPA is not included in another registered PoA. At the time of GSP, there were no registered PoAs applying the same baseline and monitoring methodology.
8	Each CPA shall sign an agreement with the managing entity to (a) participate in the programme, and (b) transfer the emission reduction rights to the managing entity.	A signed agreement with the managing entity is in place and is available for verification.
9	Each CPA must be approved by the managing entity and DOE prior to its incorporation into the PoA.	The managing entity has approved the CPA's incorporation on the registered PoA.
10	The starting date of each CPA will not be before the Global Stakeholder Process of the PoA	The internal combustion engines for this programme activity will only be ordered after the PoA is uploaded on the UNFCCC website for Global Stakeholder Participation.
11	The monitoring plan of each CPA will be in line with the monitoring requirements of the PoA	The monitoring plan of this CPA is in line with monitoring requirements of the PoA.

12	Each CPA shall demonstrate additionality in accordance with section A.4.3 of the PoA.	This CPA will demonstrate additionality in accordance with section A.4.3. of the PoA. This is shown below in section B.3.

B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:

>>

Since this is not a microscale project, this CPA will demonstrate additionality by Approach 2 (from section E.5.2 of the PoA). Using Attachment A to Appendix B of the 'Simplified modalities and procedures for small-scale CDM project activities' it will be shown below that this programme activity would otherwise not be implemented due to the existence of several barriers.

Investment barrier

The cost of the project activity is significantly higher than the continuation of the current situation (which is importing electricity from the grid, and sourcing the building's heating and cooling requirements from conventional electric heaters and chillers). Although it is associated with higher emissions, importing electricity from the national grid is a viable alternative.

The capital expenditure of this project activity is approximately R56 million.

Technological barrier

Importing electricity from the national grid (the business as usual practice) is the least technologically advanced option with little risk as the electricity generation is spread over nine entities in the Southern African Power Pool. The distribution of natural gas, however, is only through SASOL.

Barrier due to prevailing practice

It is standard practice in South Africa for commercial sites to use grid electricity for base load supply. There are no policies or schemes which supports cogeneration and/or trigeneration at commercial sites in South Africa.

Other barriers

A telecommunications business such as MTN does not typically have the capacity to implement, operate and maintain electricity generating equipment.

This CPA enables MTN to opt for an onsite trigeneration system. In the absence of the CDM, the proposed voluntary measure would not have been implemented.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

>>

According to methodology AMS II.K. version 01, the project boundary encompasses the physical site of the facility where the cogeneration or trigeneration system is being implemented and the facility(ies) consuming the energy generated by the project activity.

The GHG reduced through this CPA is CO_2. The reduction takes place through the avoidance of fossil fuels (predominantly coal) used in the production of electricity. The gases and sources relevant to the CPA are listed below, based on methodology AMS II.K. version 01.

	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	The main source of emissions in the baseline.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption due to steam generation	CO_2	Included	Only in case where steam generating systems are used in the baseline.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Fossil fuel consumption due to the CPA project activity	CO_2	Included	The main source of emissions in the project activity.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplemental electricity consumption	CO_2	Included	The main source of emissions in the project activity.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2e/MWh
Description:	Amount of electricity displaced by the project in year *y*.
Source of data used:	'Tool to calculate the emission factor for an electricity system' (Version 02.1).
Value applied:	1.04
Justification of the choice of data or description of measurement methods	As per applied tool, this value will be calculated ex-ante. The calculations for this tool are provided in Annex 3.

and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{ELEC,y}$
Data unit:	tCO_2e/MWh
Description:	Emission factor of the grid
Source of data used:	This parameter is calculated in accordance with the 'Tool to calculate the emission factor for an electricity system', Version 02.1.
Value applied:	1.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per applied tool, this value will be calculated ex-ante. The calculations for this tool are provided in Annex 3.
Any comment:	

Data / Parameter:	$COP_{C,i}$
Data unit:	MWh_{th}/MWh_e (MWh thermal output/MWh electrical input
Description:	The Coefficient of Performance of the baseline scenario chiller(s) *i*.
Source of data used:	Manufacturer specifications.
Value applied:	2
Justification of the choice of data or description of measurement methods and procedures actually applied :	To be conservative, the Coefficient of Performance of the entire cooling system must be used.
Any comment:	

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for the project electricity system in year *y*
Source of data used:	This parameter is calculated in accordance with the 'Tool to calculate the emission factor for an electricity system', Version 02.1
Value applied:	1.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per applied tool, this value will be calculated ex-ante. The calculations for this tool are provided in Annex 3.
Any comment:	

Data / Parameter:	$TDL_{j,y}$
Data unit:	Fraction
Description:	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
Source of data used:	Eskom annual report
Value applied:	0.067
Justification of the choice of data or description of measurement methods and procedures actually applied :	Eskom measures the losses on their system every year and publishes them in the annual report.
Any comment:	

B.5.2. Ex-ante calculation of emission reductions:

>>

The baseline emissions, BE_y, are calculated using equation (1) of the applied methodology:

$$BE_y = BE_{grid,y} + BE_{capt,y} + BE_{BC,y} + BE_{BH,y}$$ (AMS II.K. equation 1)

Year	BE_y	$BE_{grid,y}$	$BE_{capt,y}$	$BE_{BC,y}$	$BE_{BH,y}$
	tCO_2e/y	tCO_2e/y	tCO_2e/y	tCO_2e/y	tCO_2e/y
2012	27,059	19,167	0	6,990	902
2013	27,059	19,167	0	6,990	902
2014	27,059	19,167	0	6,990	902
2015	27,059	19,167	0	6,990	902
2016	27,059	19,167	0	6,990	902
2017	27,059	19,167	0	6,990	902
2018	27,059	19,167	0	6,990	902
2019	27,059	19,167	0	6,990	902
2020	27,059	19,167	0	6,990	902
2021	27,059	19,167	0	6,990	902

The baseline emissions associated with grid electricity for the project, $BE_{grid,y}$, are calculated using equation (2) of the applied methodology:

$$BE_{grid,y} = E_{grid,y} \times EF_{grid,y}$$ (AMS II.K. equation 2)

Year	$BE_{grid,y}$	$E_{grid,y}$	$EF_{grid,y}$
	tCO_2e/y	MWh/y	tCO_2e/MWh
2012	19,167	18,430	1.04
2013	19,167	18,430	1.04

2014	19,167	18,430	1.04
2015	19,167	18,430	1.04
2016	19,167	18,430	1.04
2017	19,167	18,430	1.04
2018	19,167	18,430	1.04
2019	19,167	18,430	1.04
2020	19,167	18,430	1.04
2021	19,167	18,430	1.04

The baseline emissions associated with the electricity consumed to produce chilled water within the project boundary are calculated using equation (5) of the applied methodology:

$$BE_{BC,y} = EF_{ELEC,y} \times \sum_i \frac{C_{P,i,j}}{COP_{c,i}}$$ (AMS II.K. equation 5)

Year	$BE_{BC,y}$	$EF_{ELEC,y}$	$C_{P,i,j}$	$COP_{c,i}$
	tCO_2e/y	tCO_2e/MWh	MWh_{th}/yr	MWh_{th}/MW_{he}
2012	6,990	1.04	13,442	2
2013	6,990	1.04	13,442	2
2014	6,990	1.04	13,442	2
2015	6,990	1.04	13,442	2
2016	6,990	1.04	13,442	2
2017	6,990	1.04	13,442	2
2018	6,990	1.04	13,442	2
2019	6,990	1.04	13,442	2
2020	6,990	1.04	13,442	2
2021	6,990	1.04	13,442	2

The baseline emissions associated with the electricity consumed to produce hot water within the project boundary are calculated using equation (7) of the applied methodology:

$$BE_{BH,y} = EF_{ELEC,y} \times \sum_{h=1}^{8,760} \frac{m_h \times C_{pw} \times \Delta T_h}{3600}$$ (AMS II.K. equation 7)

Year	$BE_{BH,y}$	$EF_{ELEC,y}$	$\Sigma m_h.C_{pw}.\Delta T_h/3600$
	tCO_2e/y	tCO_2e/MWh	MWh/y
2012	902	1.04	867
2013	902	1.04	867
2014	902	1.04	867
2015	902	1.04	867
2016	902	1.04	867
2017	902	1.04	867
2018	902	1.04	867
2019	902	1.04	867
2020	902	1.04	867
2021	902	1.04	867

The project emissions are calculated as per methodology AMS II.K:

$$PE_y = PE_{FC,j,y} + PE_{EC,y} + PE_{LR,y}$$

Year	PE_y	$PE_{FC,j,y}$	$PE_{EC,y}$	$PE_{LR,y}$
	tCO_2e/y	tCO_2e/y	tCO_2e/y	tCO_2e/y
2012	11,775	9,260	2,516	0
2013	11,775	9,260	2,516	0
2014	11,775	9,260	2,516	0
2015	11,775	9,260	2,516	0
2016	11,775	9,260	2,516	0
2017	11,775	9,260	2,516	0
2018	11,775	9,260	2,516	0
2019	11,775	9,260	2,516	0
2020	11,775	9,260	2,516	0
2021	11,775	9,260	2,516	0

The project emissions from the consumption of natural gas are calculated using equation 1 of the tool:

$$PE_{FC,j,y} = FC_{j,y} \times COEF_{i,y}$$ (Tool equation 1)

Year	$PE_{FC,j,y}$	$FC_{j,y}$	$COEF_{i,y}$
	tCO_2e/y	m^3/y	tCO_2e/m^3
2012	9,260	5,157,993	0.00180
2013	9,260	5,157,993	0.00180
2014	9,260	5,157,993	0.00180
2015	9,260	5,157,993	0.00180
2016	9,260	5,157,993	0.00180
2017	9,260	5,157,993	0.00180
2018	9,260	5,157,993	0.00180
2019	9,260	5,157,993	0.00180
2020	9,260	5,157,993	0.00180
2021	9,260	5,157,993	0.00180

The CO_2 emission factor of natural gas is calculated using option B of the tool:

$$COEF_{i,y} = NCV_{NG,y} \times EF_{CO_2,NG,y}$$ (Tool option B)

Year	$COEF_{i,y}$	$NCV_{CO2,y}$	$EF_{CO2,NG,y}$
	tCO_2e/m^3	MJ/m^3	tCO_2e/MJ
2012	0.00180	32	0.0000561
2013	0.00180	32	0.0000561
2014	0.00180	32	0.0000561
2015	0.00180	32	0.0000561
2016	0.00180	32	0.0000561
2017	0.00180	32	0.0000561
2018	0.00180	32	0.0000561
2019	0.00180	32	0.0000561
2020	0.00180	32	0.0000561
2021	0.00180	32	0.0000561

The electricity consumption of the project is calculated using equation (1) of the tool:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \text{(Tool equation 1)}$$

Year	$PE_{EC,y}$	$EC_{PJ,j,y}$	$EF_{EL,j,y}$	$TDL_{j,y}$
	tCO_2e/y	MWh/y	tCO_2e/MWh	-
2012	2,516	2,419	1.04	0.067
2013	2,516	2,419	1.04	0.067
2014	2,516	2,419	1.04	0.067
2015	2,516	2,419	1.04	0.067
2016	2,516	2,419	1.04	0.067
2017	2,516	2,419	1.04	0.067
2018	2,516	2,419	1.04	0.067
2019	2,516	2,419	1.04	0.067
2020	2,516	2,419	1.04	0.067
2021	2,516	2,419	1.04	0.067

The emission reductions of the programme activity are calculated using the equation below:

$$ER_y = BE_y - PE_y - LE_y$$

Year	ER_y	BE_y	PE_y	LE_y
	tCO_2e/y	tCO_2e/y	tCO_2e/y	tCO_2e/y
2012	15,284	27,059	11,775	0
2013	15,284	27,059	11,775	0
2014	15,284	27,059	11,775	0
2015	15,284	27,059	11,775	0
2016	15,284	27,059	11,775	0
2017	15,284	27,059	11,775	0
2018	15,284	27,059	11,775	0
2019	15,284	27,059	11,775	0
2020	15,284	27,059	11,775	0
2021	15,284	27,059	11,775	0

B.5.3. Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2012	11,775	27,059	0	15,284
2013	11,775	27,059	0	15,284
2014	11,775	27,059	0	15,284
2015	11,775	27,059	0	15,284
2016	11,775	27,059	0	15,284
2017	11,775	27,059	0	15,284
2018	11,775	27,059	0	15,284
2019	11,775	27,059	0	15,284
2020	11,775	27,059	0	15,284
2021	11,775	27,059	0	15,284
Total (tonnes of CO_2e)	117,752	270,592	0	152,840

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

>>

The monitoring plan will ensure that the project emission reductions for each CPA are accurately monitored, recorded and reported. The CPA implementer(s) shall follow the monitoring plan provided in section E.7.2. of the PoA. The CPA implementer(s) shall also complete the following tables (where applicable), and may also add additional information to the table where necessary. The CPA implementer(s) shall delete the tables not applicable to the CPA.

Data / Parameter:	$E_{grid,y}$
Data unit:	MWh/year
Description:	Amount of grid electricity displaced by the project in year *y*.
Source of data to be used:	Measured at project site.
Value of data	2012 – 2021: 18,430
Description of measurement methods and procedures to be applied:	The amount of grid electricity displaced by the project activity will be monitored continuously using an energy meter. The readings from this meter will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	$C_{P,t,i}$

Data unit:	MWh_{th}/year
Description:	Cooling output of baseline scenario chillers in year *y*
Source of data to be used:	Measured at project site.
Value of data	2012 – 2021: 13,422
Description of measurement methods and procedures to be applied:	The cooling output of the baseline scenario chillers will be monitored continuously using energy meters. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	m_{Cih}
Data unit:	tonnes/hour
Description:	The chilled water mass flow rate for chiller(s) i produced by the project in hour *h* of year *y*.
Source of data to be used:	Measured at project site.
Value of data	Not used for the purposes of estimating ex-ante emission reductions.
Description of measurement methods and procedures to be applied:	The chilled water mass flow rate will be monitored continuously using thermal energy meters. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	ΔT_{Cih}
Data unit:	°C
Description:	Differential temperature of inlet and outlet chilled water for chiller(s) *i* in hour *h* of year *y* of incoming and outgoing water from project
Source of data to be used:	Measured at project site.
Value of data	Not used for the purposes of estimating ex-ante emission reductions.
Description of measurement methods and procedures to be applied:	Each chiller has a chilled water supply and return temperature sensor, which will be used to measure the incoming and outgoing chiller water continuously. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	m_{Fh}
Data unit:	tonnes/hour
Description:	The water mass flow rate from heater(s) during hour *h* in year *y*.
Source of data to be used:	Measured at project site.
Value of data	Not used for the purposes of estimating ex-ante emission reductions.
Description of measurement methods and procedures to be applied:	The water mass flow rate from the heat exchanger will be monitored continuously using thermal energy meters. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	ΔT_h
Data unit:	°C
Description:	Differential temperature of inlet and outlet hot water from heater(s) during hour *h*
Source of data to be used:	Measured at project site.
Value of data	Not used for the purposes of estimating ex-ante emission reductions.
Description of measurement methods and procedures to be applied:	The heat exchanger has a hot water supply and return temperature sensor, which will be used to measure the incoming and outgoing water continuously. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format
Any comment:	

Data / Parameter:	FC_{fy}
Data unit:	m^3/yr
Description:	Quantity of fuel consumed by the project activity in year *y*
Source of data to be used:	Measured at project site.
Value of data	2012 – 2021: 5,157,993
Description of measurement methods and procedures to be applied:	The quantity of fuel consumed by the project activity will be monitored continuously using thermal mass flow meters. These meters measure the gas flow rate of the main supply line. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	
Any comment:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format

Data / Parameter:	$NCV_{NG,y}$
Data unit:	MJ/m^3
Description:	Net calorific value of natural gas in year *y*
Source of data to be used:	Manufacturer specifications
Value of data	32
Description of measurement methods and procedures to be applied:	The energy content of the natural gas used in the project activity, as specified by Egoli gas.
QA/QC procedures to be applied:	
Any comment:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be maintained in both soft copy and hard copy format

Data / Parameter:	$EF_{CO_2,NG,y}$
Data unit:	tCO_2e/GJ
Description:	Emission factor of natural gas in year *y*
Source of data to be used:	IPCC guidelines
Value of data	0.0561
Description of measurement methods and procedures to be applied:	The IPCC default value for the emission factor of natural gas, according to the IPCC 2006 guidelines.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$EC_{PJ,j,y}$
Data unit:	MWh/yr
Description:	Quantity of electricity consumed by the project electricity consumption source *j* in year *y*
Source of data to be used:	Measured at project site.
Value of data	2012 – 2021: 2,419
Description of measurement methods and procedures to be applied:	The quantity of electricity consumed by the project electricity consumption source will be monitored continuously using power meters. The readings from these meters will be aggregated monthly for use in the emission reduction report.
QA/QC procedures to be applied:	
Any comment:	The data will be kept for a minimum of two years after the end of crediting period or the last issuance of CERs, whichever occurs later. The data will be

	maintained in both soft copy and hard copy format

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

X Please tick if this information is provided at the PoA level. In this case sections C.2. and C.3. need not be completed in this form.

This information is provided in the PoA. The environmental analysis is done at a PoA level, as each CPA will have similar environmental impacts.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

Not applicable. This section is intentionally left blank.

C.3. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:

>>

Not applicable. This section is intentionally left blank.

SECTION D. Stakeholders' comments

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

☐ Please tick if this information is provided at the PoA level. In this case sections D.2. to D.4. need not be completed in this form.

The local stakeholders will vary for every CPA included in the PoA. Hence, it is proposed to undertake local stakeholder consultation at a CPA level.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

Employees, visitors, and the general public were invited to be local stakeholders for this project. The following stakeholder consultation was conducted:

MTN posted notices around the head office during the month of August 2009. These notices invited employees (and visitors) to comment on the proposed CDM project

MTN also posted a newspaper advertisement in the Daily Sun on 18/08/2009. The Daily Sun is South Africa's biggest daily newspaper, with over 500,000 sales in Gauteng (the provincial location of the project activity), and surrounding regions.

The newspaper advertisement provided some background information about the proposed trigeneration project. The advertisement also explained that it aimed to be a carbon credit project, which would offset some of the costs of the trigeneration plant and purchased gas. Any reader with comments or concerns about the proposed project was invited to contact an MTN employee during a 21 day advertising period, ending on the 8th of September 2009.

D.3. Summary of the comments received:

Several verbal comments were received. Members of staff and the public were interested in finding out more about MTN's drive to green its environment and reduce its carbon footprint.

Eight telephonic enquiries were received. Seven of the respondents enquired whether MTN would be in a position to assist them with their employment at MTN head office. The response provided to these individuals was that MTN has a number of contracts with companies for the provision of such services, and unfortunately does not employ any extra staff for these purposes. One respondent enquired whether MTN was interested in making use of an entertainer to do a road show for the purposes of promoting MTN's green initiatives.

D.4. Report on how due account was taken of any comments received:

Since no negative comments were received, there was no need to make adjustments on the design, construction, or operation of the project.

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Organization:	MTN South Africa
Street/P.O.Box:	216 14th Ave, Fairland
Building:	Phase 1 Innovation centre
City:	Johannesburg
State/Region:	Gauteng
Postfix/ZIP:	2118
Country:	South Africa
Telephone:	+27 11 912 3000
FAX:	+27 83 705 7171
E-Mail:	lombar_p@mtn.co.za
URL:	http://www.mtn.co.za
Represented by:	
Title:	Mr.
Salutation:	
Last Name:	Lombard
Middle Name:	
First Name:	Pierre
Department:	Network Group
Mobile:	+27 83 212 5612
Direct FAX:	
Direct tel:	
Personal E-Mail:	plombard@mweb.co.za

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding will be used in the development or in the implementation of this project. MTN will fund this project off its own balance sheet.

Annex 3

BASELINE INFORMATION

The calculations for the grid emission factor of the Southern African Power Pool are provided below.

Step 1: Identify the relevant electricity systems

This tool will serve project activities that prospect displace grid electricity in countries that form part of the Southern African Power pool.

The **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be displaced without significant transmission constraints.

Similarly, a **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints, but transmission to the project electricity system has significant transmission constraints.

None of the DNAs of Southern African countries have published delineations of their project electricity systems or connected electricity systems. There is however information available on the countries that is part of the SAPP grid[7]; generated and exported electricity[8], as well as connected transmission lines between countries and the maximum ratings[9].

The countries that are *physically connected* in the SAPP are (excluding countries that are part of SAPP, but not connected) (connected utilities indicated in brackets):

- Namibia (NamPower);
- South Africa (Eskom and non-Eskom stations);
- Zimbabwe (ZESA);
- Zambia (ZESCO);
- Mozambique (EDM);
- Botswana (BPC);
- Democratic Republic of Congo (SNEL);
- Lesotho (LEC);
- Swaziland (SEB).

[7] The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1
[8] The Southern African Power Pool, *Annual Reports*, http://www.sapp.co.zw/viewinfo.cfm?id=71&linkid=2&siteid=1
[9] The Southern African Power Pool, 2007, *Interconnector limits*, http://www.sapp.co.zw/viewinfo.cfm?id=74&linkid=12&siteid=1

To determine which of the connected utilities are part of the **project electricity system** and which are **connected electricity systems**, the existence of significant transmission constraints between utilities has to be determined.

The existence of significant transmission constrains from the connected electricity system to the project electricity system are determined by the following criteria:

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year
- The transmission line operates at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

Spot markets are not applicable for this electricity system. The SAPP does have a Short Term Energy Market (STEM). STEM is designed to be a day-ahead market and compliments the bilateral market through the provision of another technique for the pricing of electrical energy. A day-ahead market is a physical market where prices and amounts are based on supply and demand. SAPP said in 2004: "*The ambition of SAPP is to establish a regional spot market where electricity would be traded in real time and provide the necessary basis for the development of subsequent financial markets*"[10]. This has not been implemented to date as the STEM "Book of Rules" currently in use is still the 2003 version[11].
A 3-year average (2007-2009 financial years; 1 April – 31 March) for each utility's electricity combined imports and exports are obtained from the SAPP annual reports. This is used, together with 90% of the rated interconnector limits to calculate the percentage of hours in a year operated at 90% of rated capacity.

It was found that there is no significant transmission constrains between any of the connected SAPP countries, and thus no **connected electricity systems**. Therefore, all the suppliers listed (above) comprise the **project electricity system**, from which the project activity sources electricity.

Step 2: Chose whether to include off-grid power plants in the project electricity system (optional)

The grid emission factor is calculated from only grid power plants (Option I). Off-grid power plants are not included in the calculations.

Step 3: Select a method to determine the operating margin (OM)

The OM is calculated using the simple OM method (Option (a)). The simple OM method can be used provided that the low-cost/must-run resources constitute less than 50% of the total grid generation in average of the five most recent years.

[10] Dr. L. Musaba, P. Naidoo, W. Balet and A. Chikova, Developing a competitive market for regional electricity cross border trading: The case for the Southern African Power Pool, http://www.sapp.co.zw/documents/P12%20-%20SAPP%20Publication%20for%20IEE%20-%20JAN%202004.pdf as accessed on 2 June 2010

[11] http://www.sapp.co.zw/docs/STEM%20Book%20of%20Rules%20-%20%20APRIL%202003.pdf as accessed on 2 June 2010

The total generated electricity for the different utilities were obtained from the SAPP annual reports, but data for the electricity resources and generation capacities were not readily available in the public domain. The source and type of data that were used to establish the low-cost/must-run resources of each utility can be found in Table 1 (actual values used are shown in Table 4).

Table 1: Utility power generation resources

Country (Utility)	Data description	Source
Namibia (NamPower)	General fractions for different electricity production resources	Developing Renewables, *Country Energy Information, Namibia*, 2006, http://www.energyrecipes.org/reports/genericData/Africa/061129%20RECIPES%20country%20info%20Namibia.pdf
South Africa (Eskom)	Actual generation (GWh) for 2006-2008.	Eskom Holdings Limited, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
Zimbabwe (ZESA)	Generation capacity (MW) of different resources.	Stuart Doran, 2009, *Zimbabwe's economy*, http://www.thebrenthurstfoundation.org/Files/Brenthurst_Commisioned_Reports/BD0908-Zimbabwe.pdf
Zambia (ZESCO)	General fractions for different electricity production resources	ZESCO official website, http://www.zesco.co.zm/index.php?option=com_content&task=view&id=1&Itemid=
Mozambique (EDM)	Actual generation (GWh) for 2000-2004 (average taken).	*Brief analysis of energy sector in Mozambique*, EDM Annual Statistical Reports 2000-2004, http://www.mozergy.com/articles/MozambiqueEnergyOverview.pdf
Botswana (BPC)	General fractions for different electricity production resources	Nationmaster website, http://www.nationmaster.com/country/bc-botswana/ene-energy
Democratic Republic of Congo (SNEL)	General fractions for different electricity production resources	Geni website and SAPP, http://www.geni.org/globalenergy/library/national_energy_grid/democratic-republic-of-the-congo/demrepubliccongonationalelectricitygrid.shtml
Lesotho (LEC)	General fractions for different electricity production resources	The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1

The average percentage of low-cost/must-run resources, for the entire SAPP grid, amount to 15.79% of the total grid generation. Therefore, Option (a) is applicable to the SAPP grid emission factor calculations.

In terms of data vintages, the *ex ante* option were chosen to calculate the simple OM. In this option a 3 year generation-weighted average are used for the grid power plants. Using this option also means that the emission factor is determined only once at the validation stage, thus no monitoring and recalculation is required during the crediting period.

The data used in OM calculations are for the 3 year period of 1 April 2006 – 31 March 2009 (SAPP financial year runs from 1 April – 31 March). This is the latest available data.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. Hence, the hydro and nuclear power plants are excluded from the calculation of the OM.

Option B is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation of all power plants serving the system and the fuel types and fuel consumption of the project electricity system. Option B is used seeing that:

a) The necessary data for Option A (electricity generation and emission factor for each power unit) is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is know; and
c) Off-grid power plants are not included in the calculation.

In addition to data and sources already provided in this report, Table 2 depicts data descriptions and sources that were used in the calculation of the simple OM (actual values used can be found in Tables 3 and 4).

Table 2: Other data used in calculations

Country (Utility)	Data description	Source
Namibia (NamPower)	Fuel efficiencies for Paratus and Van Eck power stations.	Republikein, *Namibia's power is in your hands; Use it wisely*, April 2008, www.republikein.com.na/fileadmin/pdf/2008/nampower.pdf
South Africa (Eskom)	Coal-fired stations fuel efficiency (average for all stations).	Eskom Holdings Limited, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
South Africa (Eskom)	Gas turbine stations fuel efficiency (average for all stations).	Eskom Website (data used for 2005; latest available), http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en%2F0
Zimbabwe (ZESA)	Fuel efficiency of Hwange coal-fired station.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
Zimbabwe (ZESA)	Net calorific value (NCV) and emission factor (EF) for Zimbabwean coal.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
General	NCV and EF for sub-bituminous coal and heavy fuel oil (HFO) (residual fuel oil values used from IPCC).	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

Equation 7 (in the methodological tool) is used to calculate the average OM:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y} \quad (7)$$

Where:

$EF_{grid, OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
i = All fossil fuel types combusted in power sources in the project electricity system in year y
y = The relevant year as per data vintage chosen in Step 3.

The constants used in calculations appear in Table 3, while all the values and final calculated operating margin emission factor can be seen in Table 4.

Table 3: Constants used in calculations (refer to Table 2 for references)

Constants		
$NCV_{sub\text{-}bituminous\ coal}$	18.9	GJ/T
$NCV_{HFO\ (Residual\ Fuel\ Oil)}$	40.4	GJ/T
$NCV_{kerosene}$	43.8	GJ/T
$EF_{CO2,\ sub\text{-}bituminous\ coal}$	0.0961	tCO_2/GJ
$EF_{CO2,HFO\ (Residual\ Fuel\ Oil)}$	0.0774	tCO_2/GJ
$EF_{CO2,kerosene}$	0.0719	tCO_2/GJ
$Density_{HFO\ (Residual\ Fuel\ Oil)}$	930	kg/m^3
$NCV_{coal,\ Zimbabwean}$	25.75	GJ/T
$EF_{CO2,coal,\ Zimbabwean}$	0.0946	tCO_2/GJ

Table 4: Electricity generation, fuel consumption, and calculated OM

Supplier	**3 yr avg. (GWh)**	**Fuel Efficiency (T/GWh)**	**Fuel Consumed (T)**	**$EF_{grid,OMsimple}$ (tCO_2/MWh)**
Namibia (NamPower)	1,584.67	-	-	
Hydro (Ruacana)	1,537.13	-	-	
Heavy Fuel Oil (Paratus)	47.54	260.40	12,379.42	
Coal (van Eck)	-	570.00	-	
South Africa (Eskom)	230,011.67	-	-	**1.04**
Coal Fired	213,459.10	552.70	117,979,150.89	
Hydroelectric	1,361.91	-	-	
Pumped-storage	1,935.18	-	-	
Gas turbine (kerosene)	404.07	365.50	147,688.57	

Nuclear power	7,522.33	-	-	
Zimbabwe (ZESA)	7,781.00	-	-	
Coal (Hwange)	1,897.80	505.00	958,391.46	
Hydro (Kariba)	5,883.20	-	-	
Zambia (ZESCO)	9,771.00	-	-	
Hydro	9,761.23	-	-	
Diesel	9.77	No Data	No Data	
Mozambique (EDM)	261.67	-	-	
Hydro	223.90	-	-	
Diesel	37.77	No Data	No Data	
Botswana (BPC)	728.00	-	-	
Coal Fired	696.84	No Data	No Data	
Oil	31.16	No Data	No Data	
DRC (SNEL)	7,345.33	-	-	
Hydro	7,345.33	-	-	
Lesotho (LEC)	479.33	-	-	
Hydro	479.33	-	-	
Swaziland (SEB)	137.30	-	-	

Step 5: Identify the group of power units to be included in the build margin (BM)

The build margin must consist of either:

a) The set of five power plants most recently built; or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation and that have been most recently built.

The set of power plants that comprise the larger annual generation should be used.
Only data from NamPower, Eskom, and ZESA are available in the public domain, therefore Option (a) is used.

In order to determine the vintage of data, one of the following options must be selected:
Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available at the time of CDM-PDD submission to the DOE for validation.
Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity.

Option 1 is used for this project due to the lack consistent data from the same vintage for the NamPower, Eskom, and ZESA power plants.

The commissioning dates for the Eskom and power plants appear in on the Eskom website[12]. NamPower and ZESA power plants are listed in Table 5 with their commissioning dates.

[12] Eskom Holdings Limited, 2010, *CDM Calculations, General Information,* http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0 *[Accessed 1November 2010]*

Table 5: Supplementary commissioning dates

Power Plant	Commissioning Date	Reference
Ruacana	1977	NamPower, *http://www.nampower.com.na/pages/ruacana.asp*
Paratus	1976	NamPower, *http://www.nampower.com.na/pages/paratus.asp*
Van Eck	1979	NamPower, http://www.nampower.com.na/pages/van-eck.asp
Hwange	1984	Power plants around the world, *Coal-fired power plants in Africa*, November 2009, *http://www.industcards.com/st-coal-africa.htm*

The five most recently built power plants and their emission factors appear in Table 6. Generation and fuel consumption data for Eskom power stations were obtained from the Eskom website (for the financial year ending 31 March 2010[13]). This is the latest available data.

Table 6: Power plants included in the BM

Station	On-Line Year	Generation (MWh)	Fuel Consumption (Tons)	$EF_{EL,m,y}$
Kendal (Eskom)	1988	23,307,031.00	13,866,514.00	1.08
Lethabo (Eskom)	1985	25,522,698.00	18,170,227.00	1.29
Majuba (Eskom)	1996	22,340,081.00	12,261,833.00	1.00
Matimba (Eskom)	1987	27,964,141.00	14,637,481.00	0.95
Tuktuka (Eskom)	1985	19,847,894.00	10,602,839.00	0.97

Step 6: Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(13)}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/GJ)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available.

[13] Eskom Holdings Limited, 2010, *CDM Calculations, General Information,* *http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0* *[Accessed 1 November 2010]*

The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 3 (a) for the simple OM, using option A1 using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

If for a power unit *m* data on fuel consumption and electricity generation is available the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_m EG_{m,y}} \quad \textbf{(2)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) fossil fuel type *i* in year y (GJ/mass or volume)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year y (tCO_2/GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	=	All power plants/units serving the grid in year y except low-cost/must-run power plants/units
i	=	All fossil fuel types combusted in power plant/unit m in year y
y	=	The relevant year as per data vintage chosen in Step 3.

Emission factors for individual power plants appear in Table 7.

Using equation 13, the BM is calculated as **1.06** tCO_2e/MWh.

Step 7: Calculate the combined margin (CM) emission factor

The combined margin factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(14)}$$

Where:

$EF_{grid,BM,y}$	=	Build Margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emissions factor (%)
w_{BM}	=	Weighting of build margin emissions factor (%)

The emission factors for the operating margin, the build margin, and the final combined margin appear in Table 8.

Table 7: CM emission factor

$EF_{grid,OM,y}$	1.01
$EF_{grid,BM,y}$	1.06
w_{OM}	0.5
w_{BM}	0.5
$EF_{grid,CM,y}$	**1.04**

Annex 4

MONITORING INFORMATION