CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

Natural Gas-Fired Cogeneration Plant Replacing Oil-Fired Boilers

A.2. List of category(ies) of project activity to which the methodology may apply:

Sector: Energy

Source category: Supply side energy efficiency improvement through cogeneration

A.3. Conditions under which the methodology is applicable to CDM project activities:

The methodology was developed based on the circumstances at Corn Products Brasil Cogeneration Plant.

There is no methodology approved for the same conditions of application.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

The potential strengths of the proposed new methodology are based on the fact that the claimed emission reductions stem from two very well understood concepts at industrial sites—fuel switching and efficiency improvements. In this case, the fuel switching benefits derive from heavy oil to natural gas and the efficiency improvements derive from replacing older conventional boilers with a state-of-the-art natural gas-fired cogeneration system. The methodologies from calculating the emission changes from this project activity are transparent and easily verifiable. The emission reductions from fuel switching are based on standard emission factors recommended by the IPCC National Greenhouse Gas Inventory Methodologies and typical fuel quantity information collected at any site. The emission reductions from adoption of the cogeneration process are easily calculated by determining the reductions in the amount of energy consumed from the more efficient cogeneration process. The electricity reductions are calculated based on the heat rate differences (joules per kilowatthour) between the Brazilian electric grid (as defined by the weighted average performance of generating units purchased specifically for Brazil over a two year period) versus the operating performance of the cogeneration unit at the site. The marginal analysis used to demonstrate the type of generation units on the margin in Brazil is very common in energy market analysis, easily replicable for other projects, and reflective of specific circumstances in Brazil since it recognizes the capacity-constrained reality of the Brazilian electric market.

Furthermore, the additionality tests for this project are very strong. The project activity passes a financial additionality test since it was not the least cost option for Corn Products. It also passes more than one market barrier additionality test since natural gas-fired cogeneration systems are not common to Brazil (or virtually all of Latin America for that matter) and Brazil does not have experience with operating this state-of-the-art cogeneration technology.

It may be perceived as a weakness that this project does not follow the methodology approved by the CDM EB for the Valle do Rosario project. However, we do not believe this to be true. First, this PDD and the accompanying methodology were actually developed prior to approval and public announcement by the CDM EB of the approved Valle do Rosario methodology. Second, this methodology is actually more conservative at the time of this writing in that the methodology proposed herein assumes a lower marginal GHG emission rate for the Brazilian electric grid than the methodology used for the Rosario project. That is, the quantity of emission reductions claimed by the Corn Products methodology are lower than what would have been estimated if the Rosario methodology had been used.

The potential strength of the monitoring methodology relies on straightforward collection and quality control of the main data needed to estimate baseline and project emissions, i.e., fuel consumption data for oil and natural gas, electricity consumption data at the plant, and quantity of corn processed at the plant, among other factors. Data collection and storage is subject to rigorous QA/QC procedures at the plant, ensuring that any claim of emission reductions is readily transparent and verifiable. Overall, the data needed to determine any emission reduction estimates is the type of information that would readily be collected at any industrial site for supplying internal steam and electric demands. The only variable unique to the Corn Products Brasil facility is the quantity of corn processed each year (in tons). This data element can also be verified in a transparent, accurate manner. Therefore, while the overall methodology proposed in the PDD is new, the monitoring methodology itself is not unusual and should result in a level of accuracy and completeness very comparable to any approved methodology.

While any data acquisition and QA/QC plan is subject to potential problems without sufficient due diligence on the part of the company responsible for implementation of such procedures, we foresee no potential weaknesses with the monitoring methodology.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

The following basic data will be monitored in order to estimate the emission reductions of the project: natural gas consumed by the cogeneration system; amount of electricity and heat supplied to the industrial plant by the cogeneration system; amount of electricity sold to the grid (if any); and production in terms of tons of corn processed at the Mogi Plant. The specific data requirements are outlined in greater detail in Section B.3.

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

B.2.1. Data to be collected or used 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 B.7)*	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	Volume of natural gas consumed		M^3	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	
2	Cogeneration electricity supplied to industrial plant		MWh	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	
3	Cogeneration vapour supplied to industrial plant		Ton	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	
4	Cogeneration electricity sold to grid		MWh	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	
5	Production of the plant		ton	M (Quantity of corn processed)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Project emissions derive from two sources:

1. Consumption of energy for the production of steam
2. Consumption of energy for the production of electricity

In both of these cases the energy source is natural gas. Emissions from these sources were determined by the following formulae (all calculations based on net heating value):

For steam production:

(Quantity of natural gas for steam production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

For electricity production:

(Quantity of natural gas for electricity production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	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
5	Production of the plant		Ton	M (Quantity of corn processed)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	Data will be collected based on historical record which is already available
6	Annual amount of electricity from the grid		MWh	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	Data will be collected based on historical record which is already available
7	Annual amount of oil purchased		Ton	M (on-site meter)	Monthly	100%	Electronic (project lifetime) and Paper (5y)	Data will be collected based on historical record which is already available
8	Emission factor for electricity from the grid		Btu/KWh	C	Annually	100%	Electronic (project lifetime) and Paper (5y)	Data will be collected based on the weighted average heat rate from generating units purchased for Brazil for 2000-01, all of which were fired by natural gas.

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Baseline emissions derive from two sources:

1. Consumption of oil for the production of steam at the plant

2. Consumption of natural gas for the production of electricity at grid-based, combined cycle power plant

Emissions from these sources were determined by the following formulae (all calculations based on net heating value):

For steam production:

(Quantity of heavy oil for steam production, tons)*(Energy content of residual oil, 39.57 GJ/ton for type 4A oil at the plant; 39.49 GJ/ton for type 7A oil)*(Carbon emission factor for residual oil, 21.1 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

For electricity production:

(Quantity of natural gas for electricity production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

B.3.1. Data to be collected or used 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 B.7)*	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

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

B.4. Treatment of leakage in the monitoring plan:

GHG emissions within the project boundaries derive from CO_2 from natural gas combustion. There are likely to be small amounts of CH_4 resulting from leakage of natural gas during transmission and distribution to the plant as well as any leakages of natural gas at the plant site that may occur. These leakages would be expected to occur in the baseline during transmission and distribution of natural gas to a grid-based natural gas-fired combined cycle unit and combustion activities at the grid-based site. These CH_4 emissions in both the baseline and project activity are believed to be relatively small and equal in magnitude in both cases. There are also small amounts of CH_4 and N_2O emissions that occur from combustion in both the project and baseline activities. These emissions are also believed to be small and equal in magnitude. In the baseline, there are also efficiency losses during transmission and distribution (T&D) of the electricity that have not been considered as an added benefit of the project. Similarly, there are emission reductions resulting from the fuel savings since fuel supply trucks no longer need to deliver oil to the plant, as they were required to do in the baseline. There were approximately 2,000 truck trips per year, averaging 180 kilometers per trip. Consideration of these T&D losses and avoided truck fuel consumption would increase the amount of emission reductions available. However, these emission reductions have not been included as project benefits.

B.4.1. 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 B.7)*	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

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not Applicable.

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The net emission reductions from the cogeneration plant can be calculated by:

Project Life-time Emission Reductions = Σ_{yr} (Annual Emissions Reductions) = Σ_{yr} [($Em_{baseline}$ - Em_{proj})]

where:

$Em_{baseline}$ = baseline emissions

Em_{proj} = project emissions

Yr = project years

Baseline emissions derive from two sources:

1. Consumption of oil for the production of steam at the plant
2. Consumption of natural gas for the production of electricity at grid-based, combined cycle power plant

Emissions from these sources were determined by the following formulae (all calculations based on net heating value):

For steam production:

(Quantity of heavy oil for steam production, tons)*(Energy content of residual oil, 39.57 GJ/ton for type 4A oil at the plant; 39.49 GJ/ton for type 7A oil)*(Carbon emission factor for residual oil, 21.1 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

For electricity production:

(Quantity of natural gas for electricity production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

Project emissions derive from two sources:

1. Consumption of energy for the production of steam
2. Consumption of energy for the production of electricity

In both of these cases the energy source is natural gas. Emissions from these sources were determined by the following formulae (all calculations based on net heating value):

For steam production:

(Quantity of natural gas for steam production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

For electricity production:

(Quantity of natural gas for electricity production, M^3)*(Energy content of natural gas, 35.99 MJ/ M^3)*(Carbon emission factor for natural gas, 15.3 kg C/GJ)*44/12, divided by 1000, to determine tons of carbon dioxide in metric tons.

It should be noted that the emission reduction credits from the project are based on the actual amount of energy needed for processing each year's quantity of corn. This adjustment is done to ensure that any emission reduction credits are based on the efficiency and environmental improvements at the plant, not on year-to-year fluctuations in the amount of business (as measured by the quantity of corn processed).

B.6. Assumptions used in elaborating the new methodology:

- All the information related to oil and electric energy consumption at the plant was provided by Corn Products Brasil.

- Heating Values of Heavy Oil 7A and 4A were provided by Corn Products Brasil based on fuel quality characteristics at the plant.

- Heavy Oil and Natural Gas Carbon Factors were taken from "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual," Volume 3, OECD/IEA.

- Grid efficiency based on assumption of 8,612 Btu/KWh (converted to KJ/KWh at 1 Btu = 1055 joules) was taken from the Gas Turbine Handbook (based on the capacity of each unit) for all natural gas-fired units purchased for the Brazilian market during 2000-2001 (our baseline period). Heat rate assumptions were supplied by the manufacturers.

- Onsite efficiency based on assumption of 12,000 Btu/KWh (typical efficiency of new on-site diesel generation unit), converted to KJ/KWh at 1 Btu = 1055 joules.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items 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	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
2	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
3	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
4	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
5	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
6	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
7	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.
8	Low	There will be QA/QC procedures for these data based on Corn Products' ISO 9000 and 14000 procedures, mainly because these data will be used for calculation of emissions reductions.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

This methodology was developed especially for the Corn Products Brasil natural gas cogeneration system.

Nevertheless, the presented monitoring methodology can be generalized and replicated to other cogeneration projects. Many of the key elements have been used in industry for a long time; as a result, there is a high degree of confidence in the accuracy of this methodology. For example, for the baseline scenario it is very common to monitor the quantity of oil consumed at industrial plants and the amount of electricity consumed. Determining the resulting emissions is a straightforward calculation based on the carbon content of the oil, as reported by the IPCC, and the carbon emission rates of the Brazilian grid, as defined by the engineering specifications of the power plants on the margin providing power and the carbon contents of the fuel consumed at these plants, as reported by the IPCC. Similarly, the emissions from the project activity can be monitored by information readily available at industrial sites, including the quantity of gas consumed, the use of IPCC emission factors to determine the carbon content of the fuel, and the level of production at the plant. In general, this proposed methodology has some similarities with the approved methodology 'Metrogas Package Cogeneration".

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