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

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SECTION A. General description of project activity

A.1 Title of the project activity:

Natural Gas-Fired Cogeneration Plant Replacing Oil-Fired Boilers

A.2. Description of the project activity:

Corn Products began operations in Brazil in 1929, when its first factory started operating in the city of São Paulo, in the southeast of the country. Corn Products Brasil is committed to continual improvement in technology, quality, human resources, and the environment as demonstrated by the certification of its five factories in Brazil in accordance with ISO 9000 and ISO 14001 standards.

The Mogi Guaçu Factory is Corn Products' largest factory in Brazil and its second biggest corn processor worldwide. The factory is located in an industrial complex and occupies an area of 570,000 square meters.

Corn Products Brasil had been purchasing electricity from the grid and producing hot steam for use on-site through the use of four boilers fired by heavy oil. The company decided to evaluate a variety of alternatives to the existing energy supply structure, including keeping the oil-fired steam boilers, replacement with cogeneration utilizing oil-fired steam boilers, cogeneration utilizing gas turbine technology, and cogeneration utilizing combined cycle technology. Despite the fact that all alternatives were more costly than simply keeping the existing oil-fired boilers, Corn Products Brasil decided to invest in a natural gas-fired combined cycle cogeneration system (see below for further discussion of the project's financial analysis). Corn Products Brasil decided that the higher financial investment was warranted due to the environmental benefits of the gas-fired cogeneration system as well as enhanced reliability and control from on-site steam and electricity production.

Corn Products Brasil has contracted a third party through an Energy Service Agreement to construct and operate an Electric and Thermal Energy Cogeneration Plant at its Mogi Guaçu Factory complex. This company, EnergyWorks, provides full service utility outsourcing solutions to industrial and commercial consumers of electricity, thermal and other services. The natural gas fired cogeneration plant began operations in April 2003 and generates the necessary energy to supply the factory's internal consumption[1]. The proposed project consists of two major components: a cogeneration system and a fuel switching project.

As noted above, the original investment analysis demonstrated that oil-fired boilers were the least cost option. When the cogeneration project was first proposed, it involved the installation of an oil-fired cogeneration system to supply electricity and steam to the Corn Products Brasil industrial plant. Part of the claimed CO_2 emission reductions come from adoption of the cogeneration system, which resulted in a reduction in the amount of gross energy needed to provide electricity and heat to the plant.

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[1] Corn Products would like to note that in the event of unforeseen shutdowns, e.g., for unscheduled maintenance, it plans to purchase electricity from the grid. In the future any emissions from such purchases will need to be included in the project emissions.

The feasibility study for energy supply options at the plant demonstrated that the actual oil-fired system would have been the most cost-effective option, as summarized in Table 1.

COST ELEMENT	EXISTING OIL-FIRED SYSTEM 2001	COGENERATION SYSTEM GAS-FIRED
Cogeneration Capital Costs	0	3,471
Fuel Costs	9,410	12,022
Grid-Based Electricity Costs	6,285	0
Variable Costs for Cogeneration	0	578
TOTAL	**15,695**	**16,071**

Table 1 – Cost Comparison for Energy Supply Options at Mogi Guaçu Plant (thousands of US dollars)

However, oil consumption causes much more significant adverse environmental impacts when compared to the more expensive alternative – gas as the fuel. These environmental impacts are summarized in Table 2. Thus, Corn Products Brasil decided that the fuel for the cogeneration project would be natural gas rather than oil in order to improve air quality in the local community and capture other environmental benefits. Corn Products Brasil also felt that an on-site cogeneration system will give them higher reliability of energy supply due to reliability problems from the Brazilian grid.

The project will produce a total of 903 thousand tons of CO_2 equivalent emissions reductions over a 10-year time frame, considering both the emission reductions from adopting a cogeneration system and the decision to convert from oil to natural gas. The amount of emission reductions by activity is shown below:

- Reductions from going to conventional steam production to cogeneration: 328 thousand tons of CO_2 equivalent.

- Reductions from switching from oil to gas: 575 thousand tons of CO_2 equivalent.

The project also brings numerous and significant environmental, social and economic benefits, contributing to sustainable development objectives of the Brazilian Government.

Environmental Aspect	Before cogeneration	After cogeneration
Dangerous solid waste	Material contaminated by oil	No solid waste
Air quality	Emission of particulate matter, SOx	Significant emission reduction
Odor	Burning of heavy oil	Burn of natural gas

Table 2 – Environmental comparison between a typical generation system and Corn Products cogeneration system

This combined cycle cogeneration plant is the first in Corn Products' operations in Latin America. If the company is able to achieve Certified Emission Reductions (CERs) from this project, it will provide a template for the installation of similar plants in other Corn Products' operations in Brazil and other developing countries, such as Argentina, Chile and Colombia.

A.3. Project participants:

1. Project Developer: Corn Products Brasil – Ingredientes Industriais Ltda.

Corn Products International, Inc., headquartered in Westchester, USA, is one of the world's largest corn refiners. Dating back almost a century, Corn Products International is a leading supplier of products from the corn-refining process. With net sales of $1.9 billion for 2002, the Company, through its company-owned operations, joint ventures, alliances and technical licenses, has 37 plants in 18 countries. Corn Products is the number-one worldwide producer of dextrose and a leading regional manufacturer of starch, high fructose corn syrup and glucose. The Company has customers in approximately 60 industries, including food, soft drink, brewing, pharmaceutical, corrugating, paper and textile.

In Brazil, Corn Products Brasil – Ingredientes Industriais Ltda., operates three corn wet milling plants, one manioc root processing plant and one caramel color and adhesive plant throughout the country. The company's main products include glucose and high maltose syrup and solids, various starches, dextrose, maltodextrin, crude oil, adhesives, and polyols.

2. PDD Consultant: ICF Consulting

ICF Consulting is a leading management, technology, and policy consulting firm. Drawing upon extensive industry knowledge, distinguished professionals, and innovative analytics, the firm develops solutions to complex energy, environment, emergency management, community development, and transportation issues. ICF Consulting's approach to these issues is strengthened by its expertise in information technology, organizational improvement, program management, and communications. Since 1969, ICF Consulting has been serving major corporations, government at all levels, and multinational institutions. More than 1,000 employees serve these clients from key business centers in the Americas, Europe, and Asia. ICF played a key role in one of the first two CDM projects approved by the EB, conducting the PDD including baseline and monitoring and verification protocol for the Salvador de Bahia landfill gas to energy project.

See Contact Information in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

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

São Paulo.

A.4.1.3. City/Town/Community etc:

Mogi Guaçu.

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 Corn Products Brasil Mogi Guaçu factory in the city of Mogi Guaçu, a little more than 170km north of the city of São Paulo, the world's second most populous, and Brazil's economic capital. The map below shows the details of the project location (Figure 1).

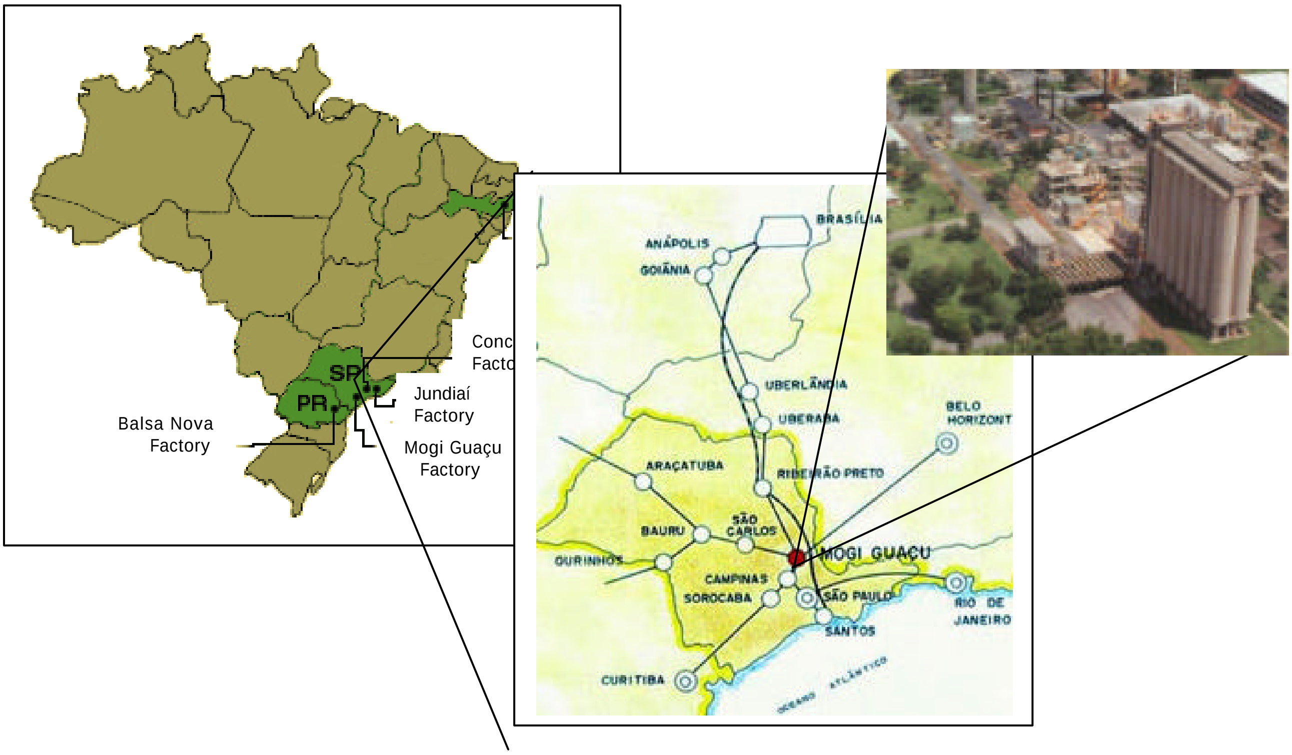

Figure 1 – Map of Brazil, showing location of Mogi Guaçu and Corn Products Plant.

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

Sector: Energy

Source category: Supply side energy efficiency improvement through cogeneration

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

Cogeneration units producing steam and electricity increase the fuel efficiencies over typical electric utility power plants, provide steam more efficiently, and also achieve significant environmental benefits compared to a power plant alone. The primary reason for the efficiency advantage is the use of waste heat from the combustion process for the simultaneous production of electricity and steam.

The process could be described as production of electricity and useful heat using a single energy input. Without cogeneration, this steam would have to be supplied in some other manner (boiler steam, direct heating with natural gas, etc.).

Most of the efficiency losses associated with a typical fossil fired power plant are due to heat losses. When cogeneration technology is utilized, these heat losses are reduced as fuel is burned to generate electricity and steam is produced from the residual heat load to meet some industrial plant heat load. Another point to consider is that cogeneration units are built close to the sites where their power is consumed, thereby reducing power losses during transmission and distribution. This reduction in the need for transmission and distribution alleviates potential transmission congestion and reduces the need to build additional transmission lines in many regions of the country. These benefits of reduced transmission and distribution are noted here, but no emission credits from these benefits have been included in this project.

A basic scheme of the cogeneration system is given in the figure below (Figure 2).

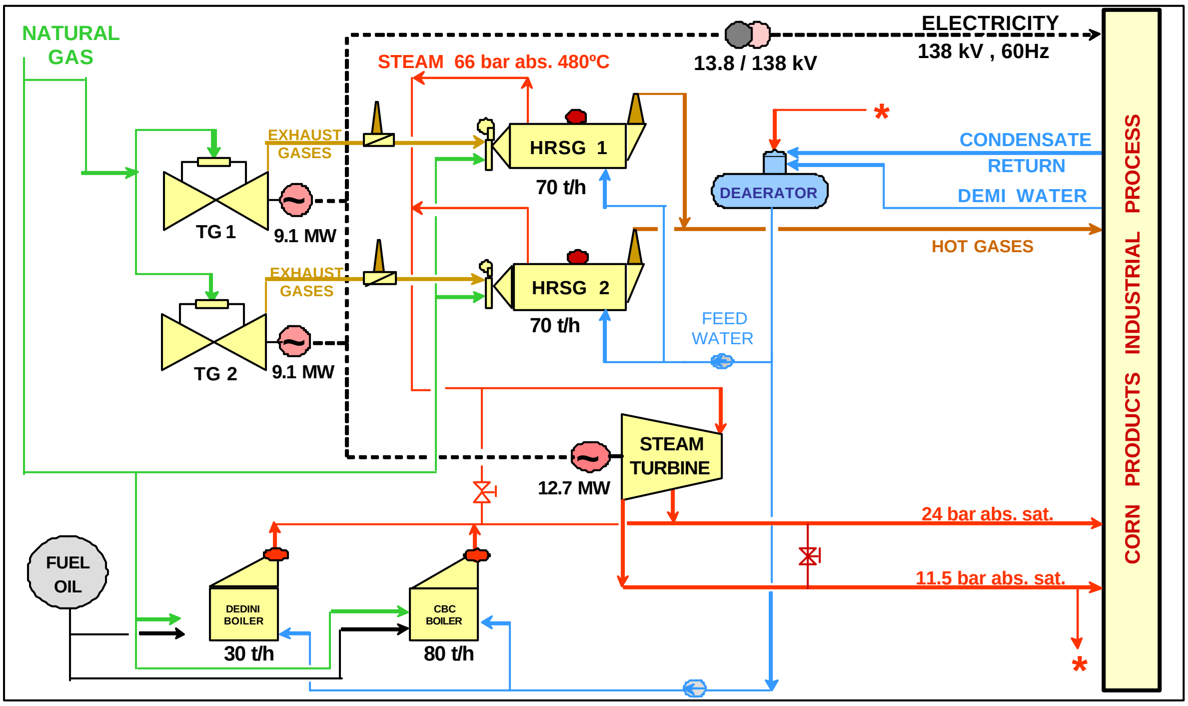

Figure 2 – Proposed Combined Cycle Cogeneration.

System description:

The alternative consists of two Solar Mars 100 gas turbines and two heat recovery steam generators (HRSG). Two of the existing boilers remain as backup and have been converted to burn oil and/or gas. The other two existing boilers have been retired.

In the beginning, 5 types of energy supply alternatives were considered and evaluated: Oil Fired Rankine Cycle, Gas Fired Rankine Cycle, Combined Cycle Cogeneration, Combined Cycle Cogeneration with Grid Export and Gas Turbine Cogeneration. Preliminary studies showed the Oil Fired Rankine Cycle to be the system that would be the most profitable choice.

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:

By combining the production of steam and power, cogeneration facilities burn far less fuel and release fewer emissions, including greenhouse gas (CO_2) emissions, than the combined emissions from separate utility power plants and industrial steam generation facilities. Cogeneration from this project provides electricity and heat to the industrial facility, which therefore needs to purchase less electricity from the power grid and consume less energy to generate steam. Including the switch from consuming heavy oil to

consuming natural gas, the cogeneration system provides a substantial reduction in GHG emissions. The total estimated reduction for switching from a more traditional steam boiler to cogeneration is 328 thousand tons CO_2e (over the entire 10 year crediting period). GHG emissions from this part of the project are calculated in Section E of this PDD.

The reductions mentioned above are the results of project activity that would not have occurred anyway due to several barriers. As noted earlier, the least cost alternative for Corn Products Brasil was to keep the existing oil-fired steam boilers. However, given Corn Products' concerns over the greater environmental impacts of oil usage, the decision was made to go with a cogeneration system fired by natural gas. This selection of a cogeneration system is an advanced alternative to current typical industry practice in Brazil of purchasing electricity from the grid and generating steam requirements on-site. For example, while industrial cogeneration may be common in many industrialized countries, in Brazil electricity production from cogeneration has accounted for only about 2% of total production. Since Brazilian companies like Corn Products Brasil are not familiar with cogeneration plant operations, the natural gas-fired cogeneration alternative includes additional risk in terms of financial investment and unfamiliar operation and maintenance practices.

The estimated reductions from replacing the heavy oil with natural gas are 575 thousand tons CO_2e over the 10-year crediting period. Overall, the project's estimated emission reductions are 903 thousand tons CO_2 equivalent over a 10-year period.

As discussed in Section A.2, oil is less expensive than natural gas. The revenue from GHG emission reductions would help to offset the higher operating costs of using natural gas in a cogeneration system. The baseline adopted for the project is based on the assumption that in the absence of concerns over environmental impacts, Corn Products Brasil would have continued to operate its plant with oil-fired steam boilers rather than natural gas-fired cogeneration systems.

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

Overall, the project's estimated emission reductions are 903 thousand tons CO_2 equivalent over a 10-year period.

A.4.5. Public funding of the project activity:

Corn Products Brasil has not and will not receive any national or international public funding for this project.

SECTION B. Application of a baseline methodology

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

There is no approved baseline methodology for a natural gas cogeneration system replacing oil-fired steam boilers (as of March 2004). Thus, a new methodology is proposed here: "Baseline methodology for natural gas-fired cogeneration system replacing oil-fired boilers".

This new methodology is presented in more detail below and in the document 'CDM_NMB Corn Products'.

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

Corn Products' Mogi-Guaçu Factory, where the cogeneration system began operations in 2003, is a food processing plant that used to purchase electricity from the power grid and produce hot steam to meet the plant's heat requirements with boilers fired by heavy oil. This reliance on oil-fired steam boilers for steam requirements and the purchase of electricity from the gird is treated as the baseline. After consideration of several alternatives, Corn Products Brasil decided to invest in a higher cost alternative involving the installation of a cogeneration system that consumes natural gas and provides electricity and heat to meet all the requirements of the industrial plant, plus some sales of electrical power back to the grid (Brazilian Electricity Regulatory Agency - ANEEL's Resolution n.82).

From Table 1 it is evident that the most cost-effective alternative for Corn Products Brasil was to continue to meet its internal steam demands with oil-fired boilers and to purchase electricity from the Brazilian electricity grid. All the other options were more expensive than the existing system: power from the grid plus oil-fired steam boilers. In summary, the baseline emissions are calculated from:

- Emissions from heavy oil burned in the boilers to produce steam for use at the plant.
- Emissions from natural gas consumed by the electric utilities to supply electricity to the grid, as based on market conditions in Brazil.

Emissions in the baseline 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.

These two values are then added together to estimate total CO_2 emissions from the baseline operations. This emissions value is then divided by the quantity of corn processed during the year to create a metric defining the quantity of CO_2 emissions produced per ton of corn processed. This calculation was done for both the year 2000 and 2001, with results being averaged to represent typical baseline conditions. This calculation provides an acceptable metric to factor out year-to-year fluctuations in the business cycle (2002 data was not used for the baseline because Corn Products had signed a contract for the natural gas to be consumed in the cogeneration unit, but the cogeneration system was not yet operational. Since Corn Products had contracted for the gas without a contingency related to the operational date of the cogeneration unit, its only option was to burn the gas in the existing boilers until construction of the cogeneration unit was complete).

Actual emission reductions from the project take the project value of CO_2 emissions/ton of corn processed (defined in E.1), subtract it from the baseline value of CO_2 emissions/ton of corn processed, which provides a net reduction in CO_2 emissions per ton of corn processed. This net reduction value is then multiplied by the amount of corn processed in the project year to determine the total reduction in CO_2 emissions that has occurred from the project.

Emissions from the project 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.

These two values are then added together to estimate total CO_2 emissions from the cogeneration operations. This emissions value is then divided by the quantity of corn processed during the year to create a metric defining the quantity of CO_2 emissions produced per ton of corn processed. This calculation provides an acceptable metric to factor out year-to-year fluctuations in the business cycle.

Actual emission reductions from the project take this project value of CO_2 emissions/ton of corn processed, subtract it from the baseline value of CO_2 emissions/ton of corn processed, which provides a net reduction in CO_2 emissions per ton of corn processed. This net reduction value is then multiplied by the amount of corn processed in the project year to determine the total reduction in CO_2 emissions that has occurred from the project.

The key arguments determining project additionality include the lack of similar projects in Brazil and the higher costs associated with the project activity. That is, Corn Products Brasil had been purchasing electricity from the grid and producing hot steam for use on-site through the use of boilers fired by heavy oil. The company decided to evaluate a variety of alternatives to the existing energy supply structure, including keeping the existing oil-fired steam boilers, replacement with cogeneration utilizing oil-fired steam boilers, cogeneration utilizing gas turbine technology, and cogeneration utilizing combined cycle technology. Despite the fact that all alternatives were more costly than simple keep the existing oil-fired boilers, Corn Products Brasil decided to invest in a natural gas-fired combined cycle cogeneration system. Corn Products Brasil decided that the higher financial investment was warranted due to the environmental benefits of the gas-fired cogeneration system as well as enhanced reliability and control from on-site steam and electricity production. This investment in the cogeneration system was made even though there were many years of boiler life remaining on the existing oil-fired units. The boilers at Mogi Guaçu were designed and maintained to have an operating life of at least 50 years, likely longer. The oldest boiler would not have reached this milestone until 2013, while the newest boiler would have been 50 years old in 2046.

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

The cogeneration system meets all the heat and electricity requirements of the plant. The net emission reductions from the cogeneration plant can be calculated by:

Project Life-time Emission Reductions = S_{yr} (Annual Emissions Reductions) = S_{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 and simple cycle power plants

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). This methodology is explained in more detail in Section E.

Key elements used to determine the baseline for the project activity:

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.

Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary:

Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency
Production of the plant	Ton	M (Quantity of corn processed)	Monthly
Annual amount of electricity from the grid	MWh	M (on-site meter)	Monthly
Annual amount of oil purchased	Ton	M (on-site meter)	Monthly
Emission factor for electricity from the grid	Btu/KWh	C	Annually

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 described in Section A.4.4, the proposed project meets the additionality criterion because it overcomes a number of barriers. The most significant barrier is the fact that Corn Products Brasil had lower cost options available at the plant, but chose to invest in the natural gas cogeneration system for the environmental benefits.

Another barrier Corn Products Brasil is addressing is the tendency for Brazilian industry to rely on off-site, grid-supplied power. Early in the 20^{th} century it was common for almost all of the power needed in the industrial sector to be generated on-site. However, beginning in the 1940's centralized generation became more widespread, reducing the interest in distributed generation. As a result, technological development for distributed generation virtually stopped.

Since then, the electricity supply in Brazil has been based on central hydro generation plants, with this primary source currently meeting about 91% of Brazil's needs. Cogeneration has been limited to emergency use and to a few companies that produce (off-grid) about 2% of Brazil's total power.

Due to the increase in power outages, an emergency project to build 49 new thermal plants in three years (about 15,000 MW) was announced by the Government at the beginning of 2000 (Priority Thermal Power Plant program - TPP, established by Government decree). However, the transition has been much more difficult than was anticipated. Besides the typical problems that large infrastructure projects encounter, the Government had to cope with a situation where the marginal costs for thermal generation were much higher than the historical average prices of power supplied by the hydro system. Moreover, the price that generators had to pay for natural gas was indexed in dollars, while the end user of electricity paid for power in tariffs indexed in the local currency, reais. This often created an uneconomic situation for providing natural gas-fired power. At the same time, power project economics became increasingly dependent on foreign currency, with Brazil shifting from a relatively stable exchange rate to a floating exchange rate that had the tendency to reduce the attractiveness of the power generation business. As a result, project financing has been nearly impossible to obtain for new plants. Investments in new power generation have been much slower than expected and have not met the country's increasing demand for power.

As a result of the TPP, only a few power plants have been developed, with the majority constructed by the Government-controlled petroleum company, Petrobras. By the end of the rainy season of 2001, a relatively dry year, the situation had become unsustainable. To address the crisis, the Government has announced its intention to pursue a more sustainable future. Nevertheless, Brazil continues to rely heavily on large, central hydro power generation.

According to the São Paulo Association of Cogeneration (*Associação Paulista de Co-geração de Energia* - www.cogensp.com.br), in the State of São Paulo, the state with the largest economy in Brazil, only 500 MW are generated by cogeneration, 400 MW from biomass at sugar mills and another 100 MW with natural gas. The potential for cogeneration in the State is estimated to be 10,000 MW.

In the project described here, the selection of the baseline is determined by the fact that natural gas-fired combined cycle and simple cycle generation is typically the technology of choice for new grid-based generation systems and, therefore, in this baseline analysis natural gas-fired generation alternatives are assumed to be on the margin. This is the case despite the fact that currently 91% of the electric power supplied by the Brazilian grid is generated by hydropower. Current and future expansion plans, especially in the southeast region of the country where the project is located, are based primarily on conventional natural gas-fired combined cycle units, with some simple cycle units selected in some instances.

This trend is aptly illustrated by recent power planning documents. For example, according to the Strategic Program to Increase Offers: 2001-2004 ("*Programa Estratégico de Aumento de Oferta 2001-2004*"), prepared by Brazil's Ministry of Mines and Energy, hydroelectric power plants (responsible for 89% – including Itaipu Hydroelectric – of installed power in 2001) will decline to 73% of installed power by 2004. Consequently, the percent of installed power from thermoelectric plants will increase from 9% (2001) to 17% (2004), as indicated in the table below.

Type of Generation	Installed Power 2001 (MW)		Forecast 2004 (MW)	
Hydroelectric Plant	61,555	82%	69,448	67%
Thermoelectric Plant	6,944	9%	17,024	17%
Nuclear Plant	1,966	3%	1,966	2%
Alternative Sources (biomass, small hydroelectric plant, wind energy)	2,345	3%	5,645	5%
SUBTOTAL	**72,810**	**92%**	**94,083**	**91%**
Itaipu Import	5,500	7%	6,200	6%
Other Import	1,150	1%	3,438	3%
TOTAL	**79,460**	**100%**	**103,721**	**100%**

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Table 3 - Strategic Program to Increase Offers: 2001-2004

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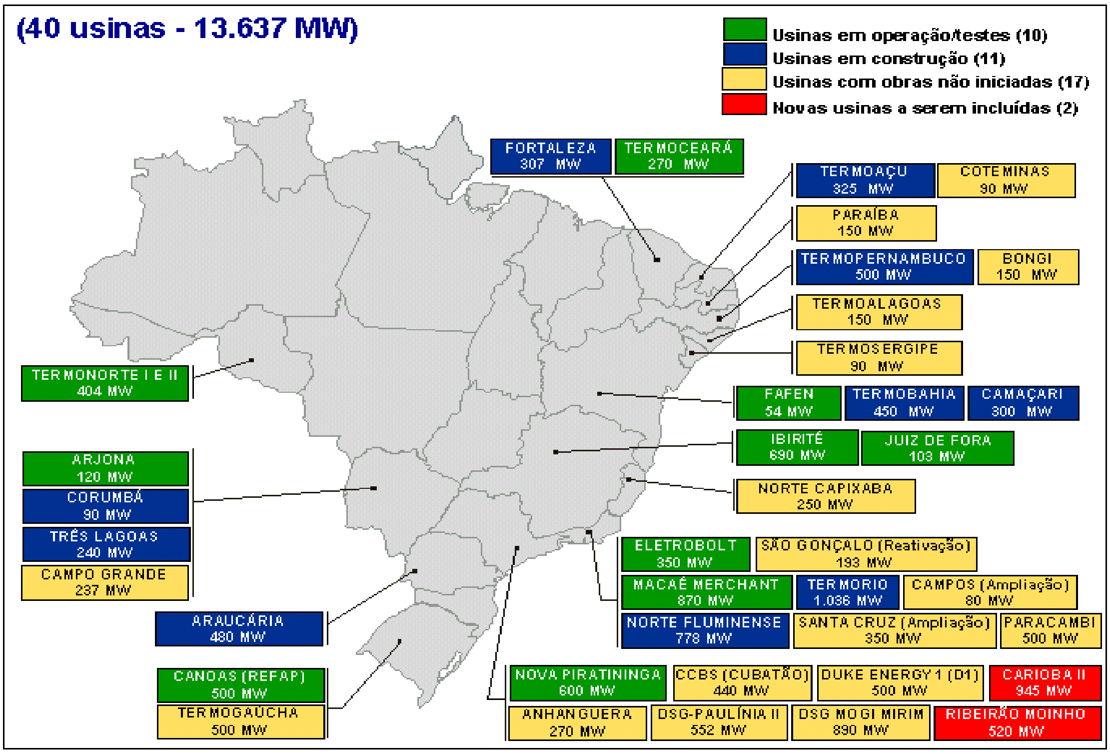


Figure 3 – Thermoelectric Plants Implementation Scheme

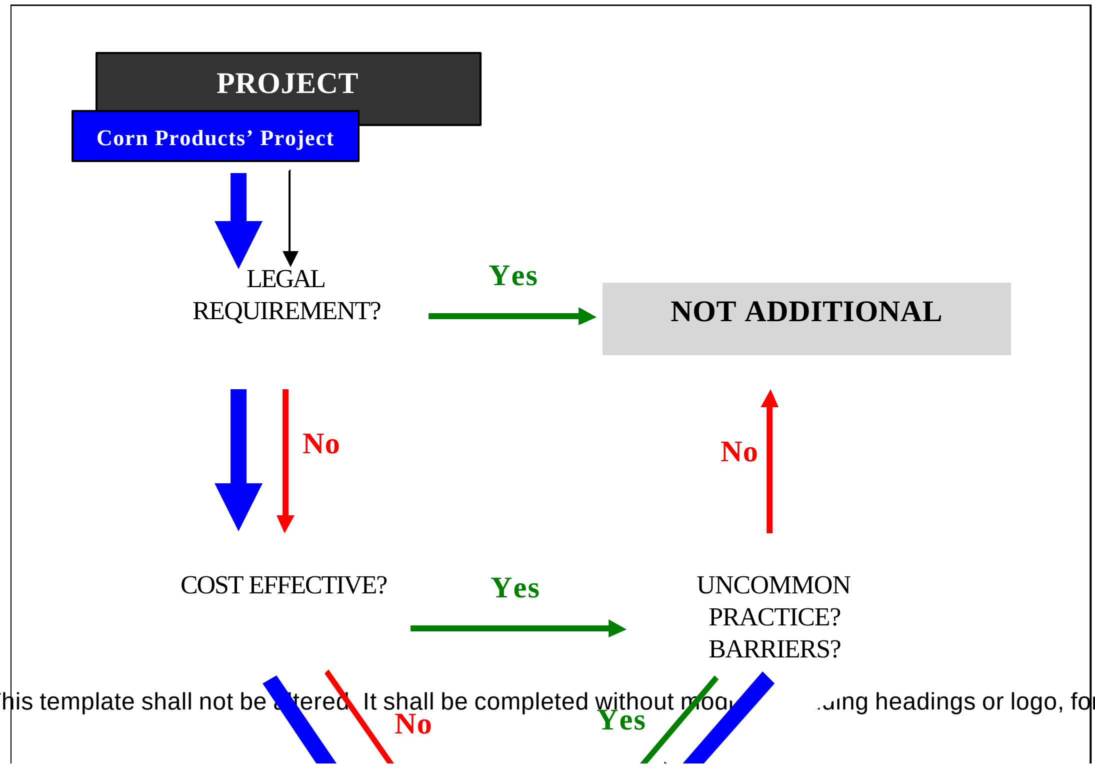
In addition, studies prepared by a governmental board, Electric Sector Model Revitalization Committee of MME (“*Comitê de Revitalização do Modelo do Setor Elétrico*”), support the choice of thermoelectric plants to meet expansion requirements (Progress Report number 1 and 3). The 4th Progress Report of the same program indicates that, depending on the availability of natural gas pipelines, the thermoelectric plants will generally be gas-fired. Alternative sources, such as biomass, small hydroelectric plants, and wind, are also considered, but are expected to provide only small amounts of power. Thus, the calculation of baseline emissions must be estimated from two factors:

1. **Emissions to meet steam demand, using oil fired boilers**

2. **Emissions from electricity consumption based on generation from the grid**

This choice of traditional oil-fired steam generation combined with electricity purchases from the grid is appropriate as the baseline largely because it would have been more economical to stay with the oil fired boilers than investing in a natural gas-fired cogeneration system, as shown in Table 1 above. This table reflects the economics of the market Corn Products Brasil was facing in 2001 when it was considering its options for meeting energy requirements at the plant. This investment in the cogeneration system was made even though there were many years of boiler life remaining on the existing oil-fired units. The boilers at Mogi Guaçu were designed and maintained to have an operating life of at least 50 years, likely longer. The oldest boiler would not have reached this milestone until 2013, while the newest boiler would have been 50 years old in 2046.

In the absence of the CDM project activity, Corn Products Brasil would be generating steam through the use of on-site steam boilers fired by heavy oil and meeting its electrical requirements through the purchase of electricity from the grid. This option would have been the most cost-effective option, as discussed above in Section A.2. With its investment in the natural gas-fired cogeneration system, Corn Products Brasil has reduced emissions globally because the cogeneration system is more energy efficient than separate reliance on a traditional steam boiler and grid-supplied electricity and the use of natural gas rather than heavy oil utilizes a less carbon-intensive fuel. Corn Products’ project meets all the requirements to confirm its additionality (Figure 4).



Estimates of project and baseline emissions have been calculated in the attached spreadsheet model (see Annex 5 or Excel file "CornProductsCogenPlant.xls"). Assuming a 10-year crediting period, the summary emission values are:

Baseline emissions	2,925 thousand tons CO_2e
Project emissions	2,022 thousand tons CO_2e
Emissions reductions	903 thousand tons CO_2e

Assuming the grid efficiency as 9,086 KJ/KWh, the carbon intensity of the alternative marginal supply source was assumed to be 509.7 t CO_2/GWh, as noted in the attached spreadsheet ("CornProductsCogenPlant.xls").

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 is the installation of a cogeneration system whose input is natural gas from a gas pipeline. The project outputs are electricity and heat supplied to a corn processing plant with demand for heat and electricity. Although the project is installed at the industrial site, the project boundary is strictly the cogeneration system.

The cogeneration plant is sized to provide electricity and heat to Corn Products' Mogi Guaçu Plant.

Prior to project installation, and in the absence of the project, Corn Products Brasil acquired all of its electricity from the power grid and met all of the heat requirements with the oil-fired boilers. Since the project was installed, Corn Products Brasil has not needed to purchase any electricity from the grid or oil from oil suppliers.

Thus, the baseline is determined by the electricity purchased by Corn Products Brasil from the grid and oil burned inside the factory. These activities are avoided as a result of electricity and heat supplied from the cogeneration plant to Corn Products Brasil.

By defining the project boundary as proposed here, the only concern is with the impact of the cogeneration system on emissions.

This definition of the project boundary makes sense for several reasons:

The project emissions depend entirely on gas input to the cogeneration system, while emissions avoided (baseline emissions) can be determined from the oil burned by the existing boilers and the amount of electricity produced by the grid and utilized by Corn Products Brasil before the installation of the cogeneration system. Thus, we need only to estimate emissions associated with natural gas consumption of the cogeneration system, and the emissions avoided at the industrial plant, because of the heat and electricity output of the cogeneration system. The associated Monitoring and Verification Plan provides the information needed to determine both project and baseline emissions.

Project and baseline emissions, direct and indirect, estimated and not estimated		
Sources	Project	Baseline
Direct, Estimated	▪ CO_2 emissions from the natural gas burned by the cogeneration system	▪ CO_2 emissions from heavy oil consumption in heat producing equipment (boilers at industrial site)
Direct, Not Estimated	▪ Methane (CH_4) and nitrous oxide (N_2O) emissions from natural gas combustion by the cogeneration system.	▪ Methane (CH_4) and nitrous oxide (N_2O) emissions from oil combustion in steam boilers
Indirect, Estimated	▪ None	▪ CO_2 emissions from grid-based electricity
Indirect, Not Estimated	▪ Methane (CH_4) emissions from natural gas production and pipeline leakage, associated with gas consumption in cogeneration system.	▪ Methane (CH_4) emissions from natural gas production and pipeline leakage, associated with gas consumption at grid-based power plants ▪ CO_2 emissions from grid electricity generation replaced by cogeneration system, including associated transmission and distribution losses. ▪ CO_2, methane and N_2O emissions from 2,000 truck trips per year (180 km per trip) to bring oil to the plant.

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:

March 16th, 2004, except for re-formatting PDD into July 2004 PDD format, as requested by the DOE, DNV, following the initial validation.

Name of person/entity determining the baseline:

Mr. José Wagner R. da Silva, Corn Products Brasil
Mr. Sérgio L. Ferreira, Corn Products Brasil
Mr. Craig Ebert, ICF Consulting
Ms. Christianne Maroun, ICF Consultoria do Brasil
Mr. Augusto Mello, ICF Consultoria do Brasil
Mr. David Gerhardt, ICF Consulting

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:

01/04/2003

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

30 y

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

C.2.1. Renewable crediting period

Not selected.

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/01/2005 (will begin once project is registered with CDM)

C.2.2.2. Length:

10y

SECTION D. Application of a monitoring methodology and plan

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

There is no approved monitoring methodology for natural gas cogeneration systems replacing oil-fired boilers. Thus, a new methodology is proposed here: "Monitoring methodology for natural gas-fired cogeneration system replacing oil-fired boilers".

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

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

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 D.2.2.

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	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)	

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 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.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
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.

D.2.1.4. 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 and simple cycle power plants

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.

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

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

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

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.

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

Not applicable.

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

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

Project Life-time Emission Reductions = S_{yr} (Annual Emissions Reductions) = S_{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 and simple cycle power plants

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).

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	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.

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

Corn Products Brasil has its quality and environmental management systems certified, according to ISO 9000 and ISO 14.000 guidelines. The Integrated Management System assures that all necessary records are kept and procedures established for all data, including procedures for monitoring, measuring and calibrating equipment used to conduct these activities.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

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

ICF Consulting: Craig Ebert, 9300 Lee Highway, Fairfax, VA, 22201, USA. Telephone: 1.703.934.3505; Email: craigebert@icfconsulting.com

ICF Consultoria do Brasil: Christianne Maroun / Augusto Mello - Avenida das Américas, 700 – Bl. 6 – Sl. 250 Cittá América – Barra da Tijuca – Rio de Janeiro, RJ – Brasil; Telephone: 55 21 2132-7324; E-mail: cmaroun@icfconsulting.com ; amello@icfconsulting.com

Corn Products Brasil: José Wagner R. Silva - Av. do Café, 277 Tower B 2º floor – São Paulo, SP – Brasil; Telephone: 55 11 5070-7765; E-mail: jwrsilva@cornproducts.com.br

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Emissions from the project 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.

These two values are then added together to estimate total CO_2 emissions from the cogeneration operations. This emissions value is then divided by the quantity of corn processed during the year to create a metric defining the quantity of CO_2 emissions produced per ton of corn processed. This calculation provides an acceptable metric to factor out year-to-year fluctuations in the business cycle. 2003 is the year in which Corn Products switched from the existing oil-fired boilers to the natural gas-fired cogeneration system. 2003 data was not used because it represents a combination of energy consumption information for both systems, including the transfer to a new system with its accompanying shakedown period. Therefore, 2003 data does not represent reliable baseline or project conditions. Also, as noted, actual operating data for an entire year with the new cogeneration system was not available, so the 2004 data represents expected operating parameters for the cogeneration system throughout 2004.

Actual emission reductions from the project take this project value of CO_2 emissions/ton of corn processed, subtract it from the baseline value of CO_2 emissions/ton of corn processed, which provides a net reduction in CO_2 emissions per ton of corn processed. This net reduction value is then multiplied by the amount of corn processed in the project year to determine the total reduction in CO_2 emissions that has occurred from the project.

E.2. Estimated leakage:

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 largely 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. 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. Consideration of these T&D losses would increase the amount of emission reductions available. There would also be upstream emissions from the production of oil in the baseline, which would tend to increase baseline emissions. There would also be avoided methane emissions in the baseline from the production of steam using oil rather than natural gas, as is the project case. These higher emissions in the project activity would tend to lower project benefits. Both of these last two factors are believe to be very insignificant and tend to offset each other. Therefore, they have not been included in this analysis.

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

Because there are no significant leakage values that would adversely affect claimed emission reductions, the project activity emissions are expressed in E.1.

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

Emissions in the baseline 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 and simple cycle power plants

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.

These two values are then added together to estimate total CO_2 emissions from the baseline operations. This emissions value is then divided by the quantity of corn processed during the year to create a metric

defining the quantity of CO_2 emissions produced per ton of corn processed. This calculation was done for both the year 2000 and 2001, with results being averaged to represent typical baseline conditions. This calculation provides an acceptable metric to factor out year-to-year fluctuations in the business cycle. 2002 data was not used for the baseline because Corn Products had signed a contract for the natural gas to be consumed in the cogeneration unit, but the cogeneration system was not yet operational. Since Corn Products had contracted for the gas without a contingency related to the operational date of the cogeneration unit, its only option was to burn the gas in the existing boilers until construction of the cogeneration unit was complete. This option was not economically sustainable for Corn Products Brasil and ceased once the cogeneration unit was constructed.

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

Actual emission reductions from the project take the project value of CO_2 emissions/ton of corn processed (defined in E.1), subtract it from the baseline value of CO_2 emissions/ton of corn processed (defined in E.4), which provides a net reduction in CO_2 emissions per ton of corn processed. This net reduction value is then multiplied by the amount of corn processed in the project year to determine the total reduction in CO_2 emissions that has occurred from the project.

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

The entire methodology for calculating emissions in the baseline and the project activity, including subsequent emission reductions, is presented in spreadsheet 'CornProductsCogenPlant'. All the information related to oil and electric energy consumption was provided by Corn Products Brasil. The values for the key variables are provided below for the year 2004.

PROJECT EMISSIONS—Steam Production		
Quantity of natural gas for steam production	M^3	79,121,410
Energy content of natural gas	MJ/ M^3	35.986
Carbon emission factor for natural gas	kg C/GJ	15.3
Quantity of corn processed	Tons	813,820
Tons of CO_2 per year		159,731

PROJECT EMISSIONS—Electricity Production		
Quantity of natural gas for electricity production	M^3	21,012,433
Energy content of natural gas	MJ/ M^3	35.986
Carbon emission factor for natural gas	kg C/GJ	15.3
Quantity of corn processed	Tons	813,820
Tons of CO_2 per year		42,420

Total CO_2 emissions in 2004 for the project activity would be 202,152 tons, which were emitted by grinding 813,820 tons of corn. This provides an emissions intensity value for the project activity of 0.2484 tons of CO_2 per ton of corn processed at the plant.

Baseline emissions were calculated by deriving an emissions intensity factor for the years 2000 and 2001. Key variables are provided below.

BASELINE EMISSIONS—Steam Production in Years 2000 and 2001		
Quantity of heavy oil 4A for steam production	Tons	22,078
Quantity of heavy oil 7A for steam production	Tons	104,101
Energy content of residual oil for type 4A oil	MJ/M^3	39.565
Energy content of residual oil for type 7A oil	MJ/M^3	39.486
Carbon emission factor for residual oil	kg C/GJ	21.1
Quantity of Corn processed	Tons	1,558,966
Tons of CO_2 in Years 2000-01		385,599

BASELINE EMISSIONS—Electricity Production in Years 2000 and 2001		
Quantity of Electricity Consumed	MWh	339,023
Heat Rate for Grid-Supplied Electricity	KJ/kWh	9,086
Quantity of natural gas for electricity production	Gigajoules	3,080,363
Quantity of natural gas for electricity production	M^3	85,598,927
Energy content of natural gas	MJ/M^3	35.986
Carbon emission factor for natural gas	kg C/GJ	15.3
Tons of CO_2 in Years 2000-01		174,659[1]

[1] Includes1,851 tons CO_2 from emergency on-site diesel generation in 2001.

Total CO_2 emissions in 2000-01 for the baseline activity would be 560,258 tons, which were emitted by grinding 1,558,966 tons of corn. This provides an emissions intensity value for the baseline activity of 0.3594 tons of CO_2 per ton of corn processed at the plant. If the quantity of corn processed in 2004 (813,820 tons) had been milled using the baseline fuel/technology combination, CO_2 emissions would have been 292,469 tons. Since the natural gas-fired cogeneration system emitted only 202,152 tons of CO_2 in 2004, the emission reductions created by the project activity were 90,318 tons of CO_2, or an emissions saving of 0.1100 tons of CO_2 per ton of corn processed.

CORN PRODUCTS BRASIL - Ingr.Inds.Ltda. PLANT : MOGI GUAÇU		ACTUAL 2000	ICF ACTUAL 2000	ICF Emission Estimate 2000	ACTUAL 2001	ICF ACTUAL 2001	ICF Emission Estimate 2001	ACTUAL 2002	ICF ACTUAL 2002	ICF Emission Estimate 2002	ESTIMATE 2004	ICF Estimate 2004	ICF Emission Estimate Gas 2004	ICF Emission Estimate Oil 2004
				tons CO2			tons CO2			tons CO2			tons CO2	tons CO2
GRIND (production)	**TONS**	**777,931**			**781,035**			**762,909**			**813,820**			
			Gigajoules			**Gigajoules**			**Gigajoules**					
STEAM	**TONS**	**933,402**			**964,391**			**962,157**			**1,028,887**			
ELECTRICITY	**MWh**	**172,915**			**167,979**			**219,995**			**183,997**			
Energy Supply:														
STEAM			**Gigajoules**			**Gigajoules**			**Gigajoules**			**Gigajoules**		
BOILERS	TONS	933,402	2,171,360		964,391	2,243,439		962,157	2,238,242		0	0		
COGEN	Tons	0			0			0			1,028,887	2,393,474		
TOTAL	Tons	933,402	2,171,350		964,391	2,243,439		962,157	2,238,242		1,028,887	2,393,474		
ELECTRICITY														
Cogen GENERATORS	MWh							0			183,997	627,798		
onsite Disel Generators	MWh	0	0		1,871	6,735			0			0		
GRID	MWh	172,915	622,435		166,108	597,932		219,995	791,907		0	0		
TOTAL	MWh	172,916	622,435		167,979	604,687		219,995	791,907		183,997	627,798		
Total Useful Energy Out			2,793,785			2,848,106			3,030,149			3,021,272		
Fuel Consumption:														
STEAM BOILERS			**Gigajoules**			**Gigajoules**			**Gigajoules**			**Gigajoules**		
HEAVY OIL 4A	TONS	11,015	435,808	33717	11,063	437,708	33,864	9,677	378,914	29316	0	0	0	0
HEAVY OIL 7A	TONS	51,548	2,035,424	157474	52,553	2,075,108	160,544	17,489	690,571	53427	0	0	0	0
NATURAL GAS	M³	0			0			37,179,390	1,337,938	76058	0	0	0	0
Electricity	MWh							51,621	166,458	10404			0	0
ELECTRICITY														
ELECTRICITY	MWh	0		0	0		0			0	0		0	0
Grid Electricity	MWh	172,915	1,571,106	88139	166,108	1,509,257	84,669	219,995	1,998,875	112137		0	0	0
onsite Disel Generators	MWh	0	0		1,871	23,687	1,861		0			0		
Cogen														
STEAM COGEN :														
NATURAL GAS	M³	0			0			0			79,121,410	2,847,263	159731	220283
ELECTRICITY COGEN :														
NATURAL GAS	M³	0			0			0			21,012,433	756,153	42420	58501
Total Fuel In			4,042,338	279,330		4,045,760	280,928		4,406,297	280,342		3,603,416	202,152	278,784
Tons of CO2/Ton of Corn Milled				0.36			0.36			0.37			0.26	0.34
Energy Flow Checks														
Boiler Efficiency	%		0.88			0.89			0.86					
Production Efficiency (kJ/kJ)	%		0.69			0.70			0.69			0.84		
Cogen Power to heat ratio	kJe/kJt											0.26		
Energy Intensity	GJ/ton of corn		5.20			5.18			5.78			4.43		
Cogen Electric Efficiency	%											0.83		
Cogen Steam Efficiency	%											0.84		
Implied Heat Rate (total)	kJ/kwhe											19,684		

Heating value of Heavy Oil 7A(LHV)	kJ/kg	39,486
Heating value of Heavy Oil 4A(LHV)	kJ/kg	39,566
Heating value of gas(LHV)	kJ/M3	35,986
assumption of grid efficiency	kJ/kwh	9,086
assumption of onsite diesel gen eff	kJ/kwh	12,660

CO2 Intensity Calculation for Electricity	t CO2/Gwh	609.7
CO2 Intensity Calculation for Steam		
Baseline	t CO2/t steam	0.20
Project	t CO2/t steam	0.16
Energy Intensity Calculation for Steam		
Baseline	GJ/t steam	2.63

Emission Credit Potential in 2004

2004 Using	Baseline 00-01	Project2004	Delta
Avy Intensity Fa	0.3594		
Annual	292,469	202,152	90,318
Over 10 yrs	2,924,692	2,021,517	903,175

Emission Reductions from Fuel Switching (affects steam only)	
Emissions Assuming Heavy Oil	209,052
Emissions Assuming Natural Gas	151,588
Annual Reductions	57,465
Over 10 years	574,646
Emission Reductions from Cogeneration	328,529

References:

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

Heating Value of Heavy Oil 7A and 4A provided by Corn Products based on fuel quality characteristics at the plant

Grid efficiency based on assumption of 8,612Btu/kwh (average efficiency of new gas-fired turbines ordered for Brazil during 2000-2001), converted to kJ/kwh at 1 Btu = 1055 joules. See tab labelled "Gas Turbines" for more detail.

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

SECTION F. Environmental impacts

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

In the case of the installation of the cogeneration plant at Corn Products' Mogi-Guaçu factory, the environmental impacts are expected to be positive compared to the baseline activity. This is due to two major factors: (1) the cogeneration plant utilizes a more environmentally-beneficial fuel (natural gas) compared to the heavy oil consumed in the baseline and (2) the cogeneration plant provides electricity more efficiently to the plant compared to grid-based electrical power from natural gas-fired combined cycle and simple cycle units. There are transboundary impacts that were discussed in Section D.2.3; on balance the environmental impacts of the project will be positive.

Table 9 below summarizes the environmental benefits of the cogeneration installation at the plant compared to the baseline situation.

Solid waste	Before cogeneration	After cogeneration
Dangerous solid waste	material contaminated by oil	no waste
Quality of life		
air quality	emission of particulate matter, SOx	Significant emission reduction
odor	burn of heavy oil	burn of natural gas
Air Emissions	**Before cogeneration**	**After cogeneration**
SOx	1592 ton/year	1 ton/year
Particulate matter	107 ton/year	12 ton/year
NOx	487 ton/year	159 ton/year
CO	36 ton/year	185 ton/year
HCT	8 ton/year	38 ton/year
VOC	6 ton/year	10 ton/year

Table 9 - Summary of Environmental Impacts before and after Cogeneration

For social impacts some indicators will be created in order to evaluate the benefits. For example: number of employees hired during the plant building and operation phases; number of people complaining from the local community regarding black smoke or pollution (before and after the cogeneration); and a community satisfaction index.

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:

The Environmental Agency of the State of São Paulo, responsible for environmental enforcement in the region where the project was installed, asked for an environmental study to be conducted. Environmental License number L.O.43000319 was issued and the mentioned report is available for review.

The conclusion of this study was that no significant negative impacts would be observed due to the project installation and operation.

SECTION G. Stakeholders' comments

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

Local stakeholders visited the cogeneration plant. They have been to the plant and were able to discuss the advantages and disadvantages of the new process installed.

The visits were organized by Corn Products Brasil and included a brief explanation of the cogeneration process.

Besides this visit invitations for comments were sent to the following stakeholders:

Hélio Miachon Bueno Prefeito Prefeitura Municipal de Mogi Guaçu Rua Henrique Coppi, 200 - Mogi Guaçu – SP
Dr. Alair Assis Secretário Municipal SAAMA – Secretaria Agric. Abastecimento e Meio Ambiente Prefeitura Municipal de Mogi Guaçu Av. Mogi Mirim, 93 – Mogi Guaçu – SP
Emilio Vilela Presidente Associação de Amigos de Bairro dos Jardins Zaniboni II e Esplanada Rua Paulinea, 76 – Jardim Zaniboni II – Mogi Guaçu – SP
Dr. Darci Luiz Leite Kirst Diretor Presidente Thermo Quality – Engenharia Ind. Comercio Ltda. Rua Filipinas, 515 – São Paulo – SP
Eng° Dr. Celio Luis Franco de Almeida Presidente Aproma – Associação de Proteção ao Meio Ambiente de Mogi Guaçu Av. Melvin Jones, 342 – Mogi Guaçu – SP
Marcos Vinicius Secretário Comitê da Bacia Hidrográfica do Rio Mogi Guaçu Rua Joaquim Procópio de Araujo, 2042 – Pirassununga - SP
Faculdade de Engenharia Ambiental Franco Montoro Rua Hugo Pancieira, 286 – Mogi Guaçu –SP

G.2. Summary of the comments received:

As mentioned in Section G.1, a list of stakeholders was drawn up, encompassing the most significant sectors directly or indirectly involved in the project. Among those in the above-mentioned list, the following stakeholders replied to the invitation sent out: the Mogi Guaçu Municipal Secretary for the Environment; the Chairman of the NGO "Aproma" (Mogi Guaçu Environment Protection Association); the Chairman of the Association of Friends of the "Jardins Zaniboni II" and "Esplanada" Districts and the Mogi Guaçu Center for Child Assistance; the Mayor of the Municipality of Mogi Guaçu; the Professor of the Environmental Engineering Course at the Prof. Franco Montoro Municipal University in Mogi Guaçu; and a Member of the ABNT (Brazilian Technical Norms Association) Commission and CEO of Thermo Quality Engenharia Indústria e Comércio.

Those stakeholders consulted believe that the Cogeneration Project of Corn Products Brasil for the Reduction of Greenhouse Gases has contributed, in fact, to the sustainable development both of the region within which the project is established, and of Brazil. The use of a less polluting fuel, together with more modern and efficient technology, is extremely important to the environment and in order to save sources of energy. According to the opinion of the Mayor of Mogi Guaçu, the project should be considered "an example for other companies to follow".

In the opinion of most stakeholders, this type of project, which has been proposed by university segments for some years, contributes to the transfer of technology to Brazil. One of those consulted, however, is of the opinion that technology in Brazil is already well developed, and therefore the project does not make a big contribution to Brazil in terms of technology.

There has been an improvement in the social and environmental situation of that region, thanks to the implementation of the project. This was observed by some of the stakeholders, including the Chairman of the Residents Association and the Mayor of Mogi Guaçu. In the perception of other stakeholders consulted, the project will be beneficial, but they think that it is still too early for such benefits to be measured.

The stakeholders suggest that the project should be widely publicized, so that the population can learn about the efforts that are being made with a view to reducing greenhouse gas emissions and other emissions, and also for the population to be able to evaluate the results achieved by the project.

In general, the stakeholders are thoroughly happy with the project, and they understand and realize the improvements the project will bring to the environment. Up to the present time, there has been no demand or comment that might lead to an alteration in the project.

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

Comments received did not require any significant modification of the project.

Model of the invitation of comments given to the stakeholders listed in the item G.1.

CornProducts
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SUA OPINIÃO É MUITO IMPORTANTE PARA NÓS.
SEUS COMENTÁRIOS SERÃO ENCAMINHADOS
PARA A ENTIDADE RESPONSÁVEL PELO PROJETO.

RESPONDA ÀS PERGUNTAS ABAIXO E FAÇA SEUS COMENTÁRIOS

1. Você acredita que o Projeto de Cogeração da Corn Products Brasil de Redução de Gases de Efeito Estufa contribuiu para o desenvolvimento sustentável do Brasil?

____
____
____

2. Na sua opinião, o projeto contribuiu para a transferência de tecnologia para o Brasil?

____
____
____

3. Houve melhoria na situação sócio-ambiental da região, com a implantação do projeto?

____
____
____

4. Que outras críticas e/ou comentários você tem a fazer?

____
____
____

Por favor, envie este folheto para o endereço abaixo. Obrigado.

NOME: ____

ENTIDADE: ____

TEL.: ____

CornProducts
B R A S I L

Av. do Café, 277 – Torre B – 2º andar
Cep 04311-000 São Paulo – SP

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Corn Products Brasil has not and will not receive any national or international public funding for this project.

Annex 3

BASELINE INFORMATION

Key elements used to determine the baseline for the project activity:

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.

Annex 4

MONITORING PLAN

All data shown in part D

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