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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Petrotemex Energy Integration Project

Version 02 – May 2005

A.2. Description of the project activity:

The project activity aims at reducing GHG emissions (mainly carbon dioxide and, to a lesser extent, methane and nitrous oxide) through the implementation of a series of mitigation measures that involve fuel and electricity savings as well as the installation of new electricity self-generation equipment. These goals will be achieved through process energy integration, leading to lower steam consumption that will reduce overall fuel usage and electricity demand. Taking advantage of remaining low-quality steam, additional power will be generated.

Petrotemex will lead this project activity that involves its two plants, located at Cosoleacaque and Altamira, in Mexico. These plants produce Pure Terephthalic Acid ("PTA"), a raw material for the production of polyester yarn, PET, and other products.

The project activity has the capacity to reduce 2,996,245 tonnes of CO_2 equivalent emissions over a 10-year time frame.

The project activity also generates the inherent benefits of fuel and electricity savings, and self-generation:

- Higher air quality. Less quantity of pollutants and particulate matter in local air.
- Improvement of labor and health conditions of its employees.
- Economic benefits (CER related revenue) that allow Petrotemex to continue implementing mitigation measures.

Thus, the project activity involves social, environmental, and economic benefits, contributing to sustainable development objectives of Mexican federal and state authorities, in accordance with the development plans of Mexico (Plan Nacional de Desarrollo 2001-2006, http://www.presidencia.gob.mx/documentos), Veracruz State (Plan Veracruzano de Desarrollo 1999-2004, http://www.veracruz.gob.mx/), and Tamaulipas State (Plan Estatal de Desarrollo 1999- 2004 del Estado de Tamaulipas, http://www.tamaulipas.gob.mx/).

A.3. Project participants:

Non-Annex 1 Party: United Mexican States ("Mexico")

Company: Grupo Petrotemex, S.A. de C.V. ("Petrotemex")

Petrotemex is a business of Alpek Group, subsidiary of Alfa, S.A. de C.V. (http://www.alfa.com.mx), oriented to the production of raw materials for polyester yarn, PET and other products.

Annex 1 Party: Japan

Company: Electric Power Development Company, Ltd. (EPDC).

EPDC is a Japanese electricity generation company, with power plants in Japan and other countries.

Official CDM contact:

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A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Mexico

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

Veracruz and Tamaulipas States

A.4.1.3. City/Town/Community etc:

Cosoleacaque (Veracruz) and Altamira (Tamaulipas)

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

The project activity will be implemented at the production facilities of Petrotemex, located in Cosoleacaque and Altamira, in the States of Veracruz and Tamaulipas respectively.

Veracruz and Tamaulipas States are located in the east of Mexico (Figure 1).

Veracruz State is home to 6.7 million people (Census 1995), and has an area of 72,815 km^2, representing the 3.7% of the national territory. Its capital is Xalapa Enríquez, and its limits are Tamaulipas and the Gulf of Mexico in the North, Chiapas and Oaxaca in the South, Puebla, Hidalgo, and San Luis Potosí in the West, and the Gulf de Mexico, Tabasco, and Chiapas in the East (Figure 2).

Tamaulipas State has 2.5 million inhabitants (Census 1995), and has an area of 79,829 km^2, representing the 4.1% of the national territory. Its capital is Ciudad Victoria, and its limits are the United States of America and Nuevo León in the North, the Gulf of Mexico, Veracruz and San Luis Potosí in the South, Nuevo León and San Luis Potosí in the West, and United States of America and the Gulf of Mexico in the East (Figure 3).

Figure 1: Map of Mexico

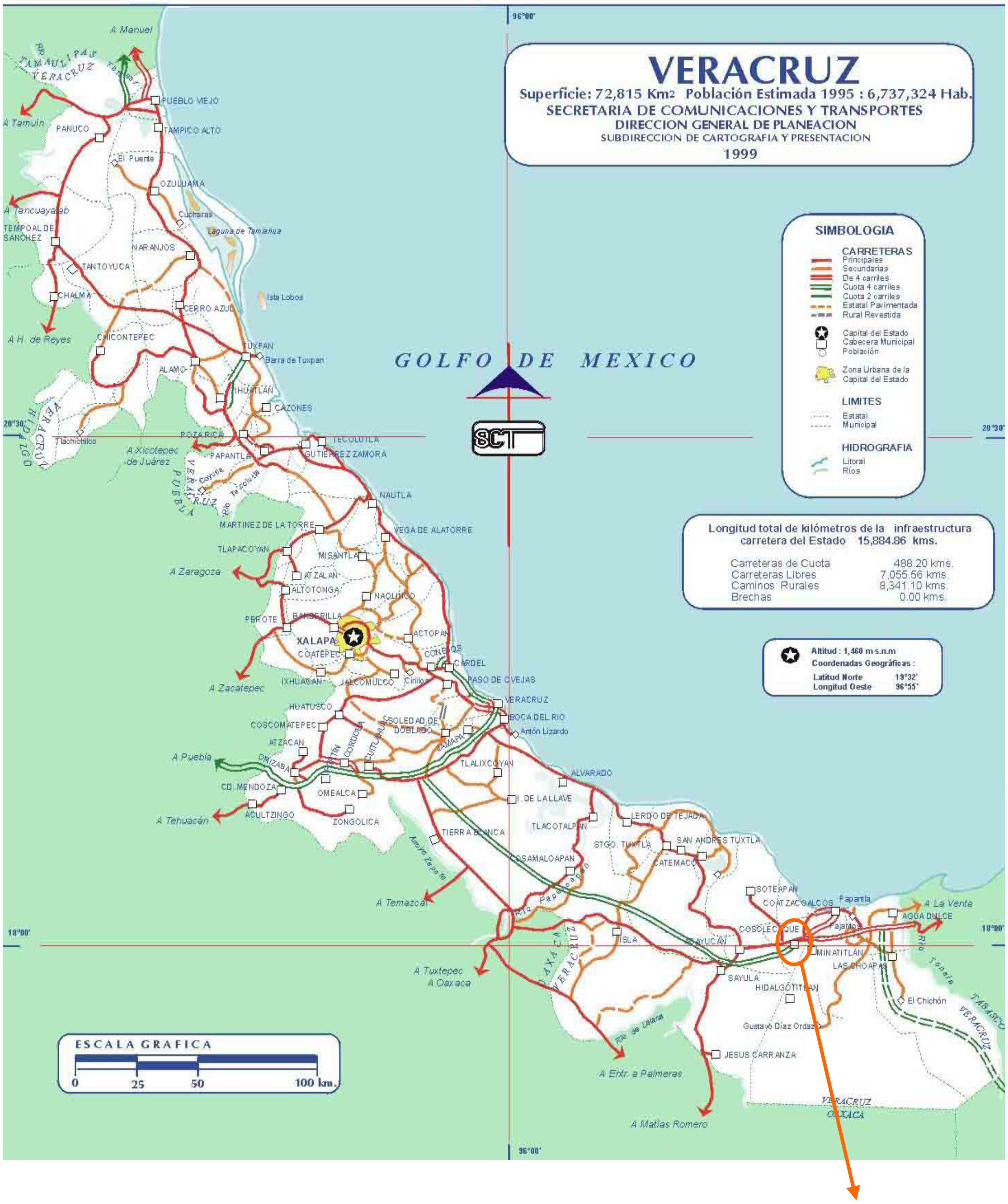

Figure 2: Map of Veracruz State

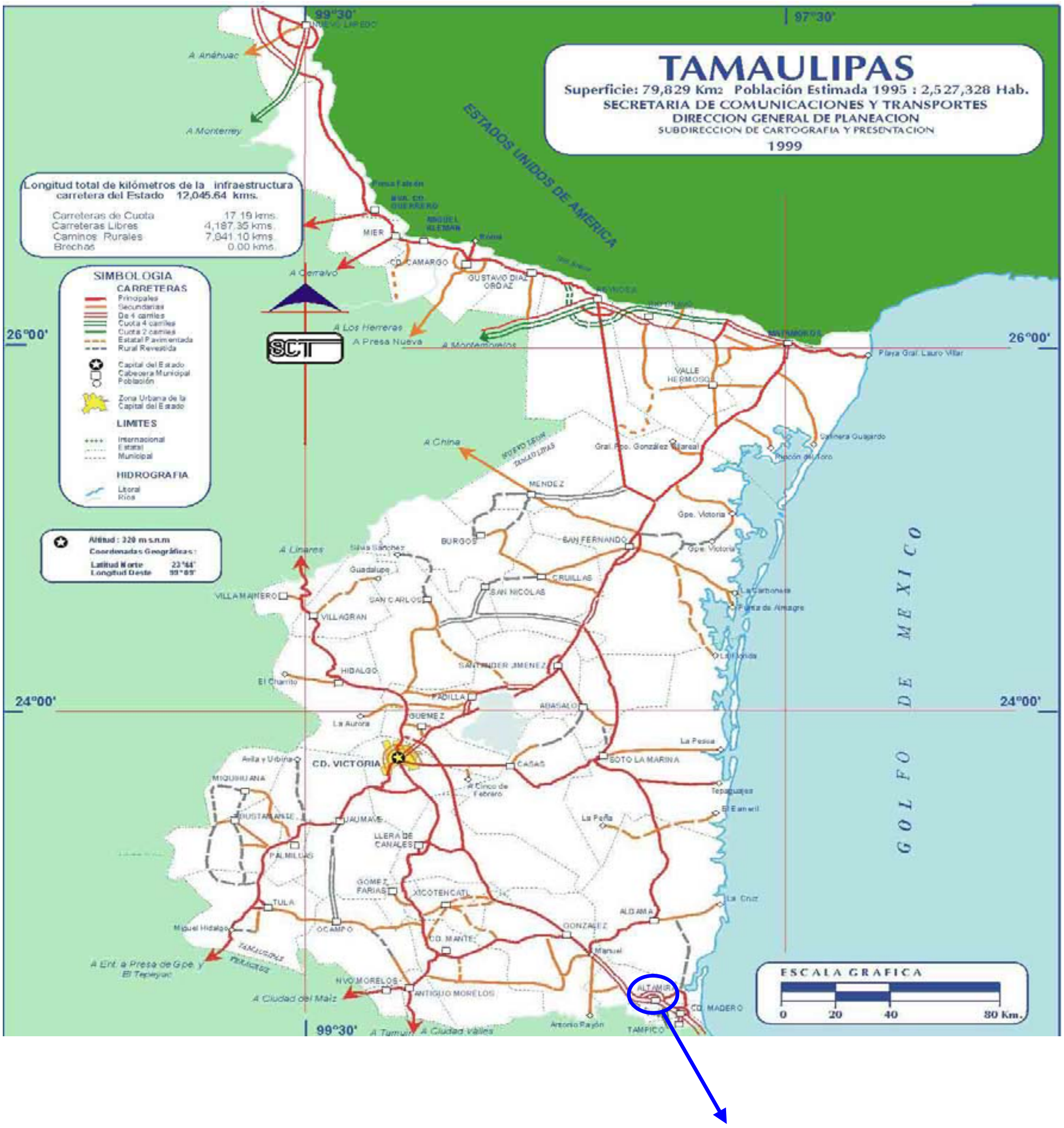

Figure 3: Map of Tamaulipas State

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

The project activity involves improvements in the petrochemical industry processes, related to a more efficient use of energy giving rise to fuel and electricity savings as well as electricity self-generation.

The UNFCCC CDM web site does not provide a list of categories of project activities, from which one might choose one that might be applicable for this proposed project.

If one were to use the "Sectoral Scope" classification as applied to Designated Operational Entities, possible categories might be: (3) Energy demand, (4) Manufacturing industry or (5) Chemical industry.

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

As mentioned above, the project activity involves the two PTA production plants of Petrotemex. One located in Cosoleacaque and the other one in Altamira.

PTA is commonly produced through the exothermic oxidation of p-xilene, using acetic acid as solvent.

Cosoleacaque plant

The plant has the following general characteristics:

Table 1: General characteristics of Cosoleacaque plant

Main Product	Pure Terephthalic Acid	
Beginning of operations	1978	
Plant Useful life	More than 30 years	
Plant Capacity	1978	135,000 t/year
	1997	600,000 t/year
	2004	630,000 t/year

The plant has two dehydration columns (**BT-701** and **BT-703**) in the oxidation area, whose function is to separate the water resulting from the reaction and, at the same time, to recover the acetic acid used as solvent. These columns work by binary atmospheric distillation process.

The dehydration columns use, as condensers, heat exchangers consisting of radiators with finned tubes and integrated fans. Each bay of the condensers has two integrated electric fans. The BT-701 column has 7 bays split in sections of 5 and 2, with 14 fans of 25 HP each (totaling 350 HP) and BT-703 column has 5 bays with 10 fans of 40 HP each (totaling 400 HP). The condensers of such dehydration columns require in sum 750 HP that represent a 560 kW power consumption.

The oxidation process of p-xylene requires an inflow of compressed air. Said flow of air is provided by a series of compressors (**AC-101**, **AC-102**, **AC-103**, and **AC-104)** that are designed to reach 32 kg/cm^2 of discharge pressure after six compressing stages linked to five intercoolers, where air humidity is condensed and removed. Three of the mentioned compressors are operated by means of steam turbines,

while the AC-102 compressor runs on electric power. Technical characteristics of the compressors are shown in Annex 5 submitted with this PDD.

In addition, the plant has 4 boilers to produce overheated steam, which consume heavy fuel oil (*combustóleo*) and natural gas, and whose technical characteristics are shown in Annex 5 submitted with this PDD.

The energy integration project activity is divided into five parts:

- Switching from binary distillation to azeotropic distillation in dehydration columns;
- Installation of a new highly efficient turbo-compressor using low-pressure steam to which an electric power generator will be added;
- Switching the current dehydration columns' condensers to condensers that generate low-pressure steam;
- Installation of new systems generating low-pressure steam using the heat released by the oxidation reaction of p-xylene;
- Incorporation of a new process of thermo-compression of the steam used in the reboiler of the BT-703 dehydration tower.

The consequences of the proposed project activity are the following:

1. Reduce 5.3 kg/cm^2 steam consumption used as means of heating in reboilers in BT-701 and BT-703 dehydration columns by (i) switching from binary distillation to azeotropic distillation and (ii) the thermo-compression process;
2. Reduce 2.1 and 5.3 kg/cm^2 steam consumption by shutting down the low-pressure steam turbine connected to AC-103 turbo-compressor;
3. Reduce electric power consumption by shutting down the AC-102 moto-compressor;
4. Reduce overheated steam generation (42 kg/cm^2 and 400 °C) in boilers, by switching from AC-101, AC-103 and AC-104 turbo-compressors to a new high-efficiency turbo-compressor. The new turbine of such compressor will not utilize overheated steam but low-pressure steam generated in the PTA production process;
5. Generate 0.05 and −0.33 kg/cm^2 steam in the new generators associated to the oxidation reactors;
6. Generate −0.33 kg/cm^2 steam in the dehydration towers;
7. Reduce power consumption by shutting down the condenser fans of the dehydration towers;
8. Self-generate electricity in the generator integrated to the new compression train to obtain the complete use of energy resulting from the availability of low-pressure steam flows mentioned above.

Currently the plant purchases electricity from a private party and the Mexican interconnected grid (managed by Comisión Federal de Electricidad "CFE", which is the electricity generation, transformation, transmission, distribution, and commercialisation company). As mentioned above, the project involves

energy (fuel and electricity) savings and electricity self-generation; in consequence, the proposed project activity will lead to GHG emission reductions from displacing electricity generated outside the plant site.

The new turbo-generator (**BN-101**) has the following technical characteristics.

Table 2: Technical characteristics of the generator

Generator type	Horizontal synchronic
Power output	11,500 kVA
Voltage	4,160 V
No. Phases	3
Frequency	60 Hz
Current intensity	1,733 A
Synchronic speed	900 rpm
Temperature	85 ºC

Table 3: Technical characteristics of the steam turbine

Turbine type	Total condensation
Capacity	27,700 kW
Inlet steam pressure	5.3, 2.1, 0.05, and –0.33 kg/cm^2 man
Outlet steam pressure	3.24 In Hg abs
Outlet steam temperature	48 ºC
Synchronic speed	3,000 rpm

Altamira plant

The plant has the following general characteristics:

Table 4: General characteristics of Altamira plant

Main Product	Pure Terephthalic Acid
Beginning of operations	1997
Plant Useful life	More than 30 years
Plant Capacity	450,000 t/year

The plant has one dehydration column (**BT-701**) in the oxidation area, whose function is to separate the water resulting from the reaction and, at the same time, to recover the acetic acid used as solvent. This column works by binary atmospheric distillation process.

The project activity involves the following activities:

- Switching from binary to azeotropic distillation in the dehydration column;
- Installation of a new electric power turbo-generator with a maximum generation capacity of 6.5 MW, which uses low-pressure steam.

The consequences of the proposed project activity are the following:

1. Reduce 5.3 kg/cm^2 steam consumption used as means of heating the reboilers in BT-701 dehydration column, by switching from binary to azeotropic distillation;
2. Generate 3.3 MW of electricity in the new turbo-generator to obtain the complete use of energy resulting from the availability of low-pressure steam flow mentioned above;
3. Obtain additional energy benefits when expanding plant capacity to 900,000 tPTA/year, generating 2.1kg/cm^2 steam that can be used in the turbo-generator to produce an additional 2.1 MW power output. The proposed project activity already considers such an expansion so as to capture these future benefits with no additional investment.

Currently the plant purchases electricity from a private party. Thus, the proposed project activity will lead to GHG emission reductions from electricity generation outside the plant site.

The new turbo-generator that will be installed at the facility includes a generator and a steam turbine, whose technical characteristics are shown in the following tables.

Table 5: Technical characteristics of the generator

Generator type	Horizontal synchronic
Power output	9,375 kVA, 7,500 kW
Voltage	13,800 V
No. Phases	3
Frequency	60 Hz
Current intensity	1,733 A
Synchronic speed	1,800 rpm
Temperature	80 ºC

Table 6: Technical characteristics of the steam turbine

Turbine type	Total condensation
Nominal capacity	7,343 kW
Inlet steam pressure	5.3 kg/cm^2 man
Outlet steam pressure	0.14 kg/cm^2
Outlet steam temperature	52 ºC
Synchronic speed	4,200 rpm

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:

As explained in Section A.4.3, the project activity consists of the implementation of a series of mitigation measures that involve fuel and electricity savings as well as the installation of new electricity self-generation equipment. As a result, there will be an improvement in plant efficiency in a thermodynamic sense, reducing fuel burning at the plant site, and reducing electricity purchases, thus decreasing electricity generation outside the industrial facility.

As a consequence of all aspects of project implementation, overall emissions of CO_2, and to a minor extent other GHGs, will be reduced, compared to the baseline scenario.

Project additionality was analysed using the tool proposed in the baseline methodology submitted with this PDD: "*Baseline methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration measures at an industrial facility*".

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

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

The total *ex-ante* emission reductions are estimated to be 2,996,245 tCO_2e during the 10-year crediting period.

Table 7: Total emission reductions during the 10-year crediting period

Years[1]	Annual estimation of emission reductions (tonnes of CO_2 e)
2005	299,624
2006	299,624
2007	299,624
2008	299,624
2009	299,624
2010	299,624
2011	299,624
2012	299,624
2013	299,624
2014	299,624
Total estimated reductions (tonnes of CO_2 e)	**2,996,245**
Total number of years	**10**

A.4.5. Public funding of the project activity:

Petrotemex will not deviate any official development assistance whatsoever for project implementation.

[1] It is defined as the time period between August of a year and July of the subsequent year.

SECTION B. Application of a baseline methodology

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

The project activity uses the following baseline methodology presented with this PDD as a "new methodology" for submission to and approval by the CDM Executive Board.

The baseline methodology is designated ***"Baseline methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration measures at an industrial facility"***

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

This methodology is applicable under the following conditions:

1. The project activity involves an energy integration aimed primarily at energy efficiency in industrial facilities that produce only one product, where different mitigation options can be included:
   - Changes in the energy efficiency of any equipment (fuel and electricity savings),
   - Addition of electricity self-generation equipment or changes in electricity self-generation equipment,
   - Addition of electricity cogeneration equipment or changes in electricity cogeneration equipment.

The proposed project activity is located in two industrial facilities producing PTA, and involves energy integration which consists of the implementation of a series of mitigation measures leading to fuel and electricity savings as well as the installation of new electricity equipment for self-generation, which takes advantage of additional amounts of process steam able to be used due to technological innovation under an energy integration and cleaner production scheme.

2. The production processes at industrial facilities involve variables that are difficult to predict and where an individual monitoring of equipment turns out to be impractical. For such production processes, the baseline is determined from data representing different operation and energy use conditions, in order to correlate baseline fuel consumption and the production of the industrial facility and also correlate baseline electricity purchase/sale and production of the industrial facility, separately. For such processes it is necessary to have sufficient data available to determine representative average curves, in which the average global performance of the plant for a determined value of the production does not depend on any particular condition.

In Petrotemex's industrial facilities, the operation and energy use conditions change frequently in an unscheduled way, making it almost impossible to determine a one-to-one correlation between energy fluxes and consumption patterns. In addition, electricity and fuel prices are competing, thus influencing Petrotemex's decision regarding the operation mode of the turbo-steam generator consuming steam from boilers (burning fuels). This turbo-steam generator is not changed and its operation is not modified by the project activity.

It is required that the effects of this equipment are separated, in such a way that fuel consumption and electricity purchase/sale are independent variables, removing the constraints among them. For this project, the relations are split into two families of curves, depending on whether the turbo-steam generator is used or not during a given day.

In order to determine correlations between baseline fuel consumption and the production of the industrial facility, and correlations between baseline electricity purchase/sale and the production of the industrial facility, it is used daily historical data of the industrial facility corresponding to a three-years period. In consequence, there are sufficient data available to determine representative average curves, in which the average global performance of the plant for a determined value of the production does not depend on any particular condition.

3. Project activities where the continuation of current practice is not prevented by any circumstance.

In the case of this project activity, the baseline scenario considered involves the continuation of the current practice since there are neither any barriers preventing the continuation of current practice (e.g. regulatory requirements or high maintenance costs as a consequence of obsolescence of equipment) nor any sectoral circumstances driving efficiency measures (see Section B.3.).

As it is shown above, the proposed project activity meets the conditions under which the methodology is applicable.

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

These industrial facilities have identified a less energy-intensive manner to recover acetic acid that would produce a low-pressure steam flow that can be used to generate electricity and compressed air, as opposed to discarding this energy stream in cooling towers or steam venting.

Specifically, the Cosoleacaque plant contemplates the substitution of three turbo-compressors and one moto-compressor by a sole high-efficiency turbo-compressor with enough capacity to generate the required compressed air for a 100% plant capacity factor. This new turbo-compressor has a generator installed in the shaft with enough capacity to produce up to 11 MW, maximizing the energy available at the site. By self-generating electricity, the plant reduces the purchase of power from third parties. At the end, the plant will become nearly self-sufficient in electric power supply. Moreover, the plant reduces its fuel consumption since the new turbo-compressor does not utilize overheated steam from boilers.

In addition, the Altamira plant will self-generate 3.3 MW. Then, an expected expansion will increase this generation to 5.4 MW. This power generation is achieved by maximizing the use of energy available at the plant. The turbine associated with this project activity is tailor-made, not commercially available. By self-generating, the plant reduces the purchase of power from a third party.

In the following Sections of this PDD we strictly follow the key methodological steps in determining the baseline scenario.

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

Table 8: Key data

Parameters	Data sources
Carbon dioxide emission factor per unit energy of fuel *j*, CEF_j ($kgCO_2$/MMBtu)	IPCC default values
Methane emission factor per unit energy of fuel *j*, MEF_j ($kgCH_4$/MMBtu)	IPCC default values
Nitrous oxide emission factor per unit of energy of fuel *j*, NEF_j (kgN_2O/MMBtu)	IPCC default values
Global Warming Potential of methane, *GWP* (CH_4)	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3
Global Warming Potential of nitrous oxide, *GWP* (N_2O)	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3
Variables	**Data sources**
PTA annual production, P_{PTA} (tonnes)	Petrotemex
Proportion of each fuel *j* used during the day *i*, $\%_{ij}$	Petrotemex
Consumption of fuel *j* used in the baseline scenario corresponding to the monitoring day *i*, based on lower heating values of fuel *j*, BFC_{ij} (MMBtu)	Petrotemex
Net electricity purchased prior to project implementation corresponding to the monitoring day *i*, $NEPp_i$ (MWh)	Petrotemex
Net electricity sold following project implementation during the day *i*, $NESf_i$ (MWh)	Petrotemex
Baseline emission factor from electricity generation by the grid, *EFel* ($kgCO_2e$/MWh)	This emission factor is calculated using ACM0002

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:

In order to demonstrate the additionality of this project activity, it is used the tool proposed in the baseline methodology submitted with this PDD: "*Baseline methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration measures at an industrial facility*".

Step 1. The continuation of the current practice is not prevented by barriers or circumstances.

Legal and regulatory requirements

The continuation of current practice is in line with applicable federal and state regulations in Veracruz and Tamaulipas States. The Mexican Norm NOM-085-ECOL-1994 published on Dec 2, 1994 in the Official Bulletin of the Federation specifies limits regarding emissions of NO_x, SO_x, and particulate matter released from the combustion of primary fuels by stationary sources. Nevertheless, this Norm was later modified on Oct 7, 1997 in order to accommodate those stationary sources for which there is no

availability of fuels fulfilling the environmental quality established by the corresponding Mexican Official Norms.

Barriers to the current practice

There are no barriers that prevent the continuation of current practice since it involves lower investment and risk.

Sectoral and market conditions

Petrotemex is the only PTA producer in Mexico. Its production is completely placed at national and international markets under current practice. Thus, current production costs are shown to be competitive in these markets and Petrotemex has no needs to implement energy saving measures to produce at lower costs in order to ensure the sale of its product. Sectoral circumstances are neither affecting Petrotemex current practice nor promoting technological improvements at private companies. Therefore, there are not sectoral-based or market-driven reasons for discontinuation of current practice.

If the project activity is not undertaken, the continuation of current practice results a potential baseline scenario.

Step 2. The project activity faces prohibitive barriers that prevent its implementation without CDM registration.

The proposed project not undertaken as a CDM project activity represents a high risk due to the uncertainty involved after implementation and the huge capital expenditures necessary to implement the project activity. Thus, it is considered the CDM as a trigger mechanism contributing to overcome an investment prohibitive barrier.

Barrier analysis

Investment barrier: The project activity requires a huge investment. In the last five years Petrotemex has not invested in any project of the magnitude of the one proposed here. The investment needs are around twice the total amount invested in the last five years in the plants related to the project activity (Cosoleacaque and Altamira). In order to minimize the associated risk, Petrotemex has applied to national funds for technological innovation to cover a part of the necessary investment. A part of the rest is expected to be compensated by the CDM, mainly contributing to cover unexpected implementation costs (which are typical for technology innovation projects) and to finance additional investment for continuous improvements.

Technological barrier: The project activity involves high risks due to the typical uncertainties of the application of new technology. The first problem is that, as far as we know, there are no international references which detail about taking advantage of low-quality steam and residual process gases for power generation. Usually, the highest steam quality obtained from fuel combustion is used for power generation. On the other hand, there are not facilities around the world combining high-efficiency structural packing technologies with azeotropic distillation, thermal-compression and low-pressure steam generation to condensate steam in the cooling towers. The proposed structural packing has not been proven before in azeotropic distillation of water-acetic acid solutions, and combined with thermal-

compression allows Petrotemex to use low quality steam together with medium-pressure steam to obtain enough energy to separate the mixture. All these new developments have an associated risk. New technology is subject to produce unexpected costs not foreseen at the time of implementing the project activity.

Barrier due to prevailing practice: As a consequence of technology innovation as detailed above, this project can be considered as the "first of a kind."

Project registration as CDM Project

According to the expected emission reductions, there is an interesting income owing CER revenue. The benefit obtained by selling CERs will allow Petrotemex to invest in further research and development and to cover part of the initial investment and the unexpected costs of project implementation. Thus, CDM registration becomes very relevant to the decision-making process leading to go ahead with the proposed project activity.

Start date of the project activity

The project activity has partially started, as it takes time to perform the basic and detailed engineering of the core equipment. However, an increase from the required initial investment of more than 50% has put the project on halt. The additional benefits associated by considering it as a CDM project are crucial for the approval of additional funds needed to implement the project activity.

Legal and regulatory requirements

The project activity is in line with applicable federal and state regulations in Veracruz and Tamaulipas States. The Mexican Norm NOM-085-ECOL-1994 published on Dec 2, 1994 in the Official Bulletin of the Federation specifies limits regarding emissions of NO_x, SO_x, and particulate matter released from the combustion of primary fuels by stationary sources. Nevertheless, this Norm was later modified on Oct 7, 1997 in order to accommodate those stationary sources for which there is no availability of fuels fulfilling the environmental quality established by the corresponding Mexican Official Norms. This has been the case for the Cosoleacaque plant and will likely remain for the project activity once started, since the fuel supplier has been providing heavy fuel oil with a lower quality than the one specified in the norm for fuels.

Eventual problems with SO_2 and particulate matter emissions will be dealt with monitoring procedures and other projects currently under development, in order to control those emissions as a part of the air quality component of the environmental management plan.

Common practice analysis

Petrotemex is the only company in Mexico producing PTA. As explained above, there are no known projects similar to the one proposed here.

No similar options are occurring around the world.

Thus, the proposed project activity is additional and it is different from the baseline scenario, which consist of continuing whit the current practice of the industrial facilities

It is clear that baseline emissions are greater than project emissions, since in the baseline case no fuel and electricity savings are included with their corresponding emission reductions.

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

The project boundary encompasses the physical, geographical site of the industrial facility.

This boundary includes two disconnected boundaries, each one located at the corresponding industrial facility (Cosoleacaque or Altamira).

Taking into account that a combined margin (as outlined in ACM0002) is considered to calculate emission reductions from avoided electricity generation of power plants connected to the power-grid, the spatial extent of the project boundary includes the project site and also all power plants connected physically to the electricity system that the industrial facility is connected to.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Date of completing the final draft of this baseline section: 25/10/2004

Name of person/entity determining the baseline:

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Marisa Zaragozi, Ivana Cepón, and Fabián Gaioli are not project participants.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The project activity is expected to be operating in August 2005.

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

30 years

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

Fixed crediting period

C.2.1. Renewable crediting period

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

N/A

C.2.1.2. Length of the first crediting period:

N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/08/2005

C.2.2.2. Length:

10 years

SECTION D. Application of a monitoring methodology and plan

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

The project uses the following monitoring methodology presented with this PDD as a "new methodology" for submission to and approval by the CDM Executive Board.

The monitoring methodology is designated: ***"Monitoring methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration measures at an industrial facility"***

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

1. The project activity involves an energy integration aimed primarily at energy efficiency in industrial facilities that produce only one product, where different mitigation options can be included:
    - Changes in the energy efficiency of any equipment (fuel and electricity savings),
    - Addition of electricity self-generation equipment or changes in electricity self-generation equipment,
    - Addition of electricity cogeneration equipment or changes in electricity cogeneration equipment.

The proposed project activity is located in two industrial facilities, and involves energy integration which consists of implementation of a series of mitigation measures leading to fuel and electricity savings as well as the installation of new electricity equipment for self-generation, which takes advantage of additional amounts of process steam able to be used due to technological innovation under an energy integration and cleaner production scheme.

2. The production processes at industrial facilities involve variables that are difficult to predict and where an individual monitoring of equipment turns out to be impractical. For such production processes, the baseline is determined from data representing different operation and energy use conditions, in order to correlate baseline fuel consumption and the production of the industrial facility and also correlate baseline electricity purchase/sale and production of the industrial facility, separately.

In Petrotemex's industrial facilities, the operation and energy use conditions change frequently in an unscheduled way, making it almost impossible to determine a one-to-one identification between energy fluxes and consumption patterns. In addition, electricity and fuel prices are competing, thus influencing Petrotemex's decision regarding the operation mode of the turbo-steam generator consuming steam from boilers (burning fuels). It is required that the effects of this equipment are separated, in such a way that fuel consumption and electricity purchase/sale are independent variables, removing the constraints among them. For this project, the relations are split into two families of curves, depending on whether the turbo-steam generator is used or not during a given day.

3. Project activities where the continuation of current practice is not prevented by any circumstance.

In the case of this project activity, the baseline scenario considered involves the continuation of the current practice since there are neither any barriers preventing the continuation of current practice (e.g. regulatory requirements or high maintenance costs as a consequence of obsolescence of equipment) nor any sectoral circumstances driving efficiency measures (see Section B.3.).

As it is shown above, the proposed project activity meets the conditions under which the methodology is applicable.

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

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*Quantity of heavy fuel oil consumed during the day i at Cosoleacaque's plant in the project* QF_{iHFO}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*Before calculation of project emissions, it shall be converted to energy units (MMBtu/yr) by multiplying by its Lower Heating Value.*
2	*Quantity of natural gas consumed during the day i at Cosoleacaque's plant in the project* QF_{iNG}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*Before calculation of project emissions, it shall be converted to energy units (MMBtu/yr) by multiplying by its Lower Heating Value.*
3	*Quantity of any other fuel consumed during the day i at Cosoleacaque's plant in the project* QF_{ij}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*Before calculation of project emissions, it shall be converted to energy units (MMBtu/yr) by multiplying by its Lower Heating Value.*
4	*Project emissions* *E*	*Petrotemex*	tCO_2e	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1 to 3 as explained in Section D.2.1.2.*

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

Project GHG emissions within the project boundary correspond to emissions from fuel combustion at the boiler room ("BR") and the furnaces in Cosoleacaque plant.

Project emissions comprise the following components:

a) CO_2 emissions from combustion of fuels, corresponding to those used during the project activity.
b) CH_4 emissions from combustion of fuels, corresponding to those used during the project activity.
c) N_2O emissions from combustion of fuels, corresponding to those used during the project activity.

The methodology and formulae for estimating these components of project emissions are described in the new methodology presented with this PDD, and applied below.

The project emissions ***E*** (expressed in tonne of CO_2 equivalent, tCO_2e/year) are given by:

$$E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

where:

PFC_{ij}	Consumption of fuel *j* used in the project scenario corresponding to the monitoring day *i*, expressed in energy units (MMBtu), and based on lower heating values of each fuel
CEF_j	Carbon dioxide emission factor per unit energy of combusted fuel *j* ($kgCO_2e$/MMBtu)
MEF_j	Methane emission factor per unit energy of combusted fuel *j* ($kgCH_4$/MMBtu)
$GWP(CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1^{st} commitment period
NEF_j	Nitrous oxide emission factor per unit energy of combusted fuel *j* ($kgCH_4$/MMBtu)
$GWP(N_2O)$	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1^{st} commitment period

During the crediting period, fuel consumption at the BR and the furnaces will be monitored in Cosoleacaque plant, and the measured values will be used for the *ex-post* calculation of project emissions.

In the Altamira plant fuel consumption will not change as a consequence of the project activity. Thus, no fuel saving is considered for this plant.

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
1	*Quantity of heavy fuel oil consumed during the day i at Cosoleacaque's plant in the project* QF_{iHFO}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
2	*Quantity of natural gas consumed during the day i at Cosoleacaque's plant in the project* QF_{iNG}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
3	*Quantity of any other fuel consumed during the day i at Cosoleacaque's plant in the project* QF_{ij}	*Petrotemex*	m^3	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
5	*PTA annual production during the day i at Cosoleacaque's plant* P_{PTAi}	*Petrotemex*	*tonnes*	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It is considered the same value for both baseline and project scenarios.*

6	*Proportion of heavy fuel oil consumed during the day i at Cosoleacaque's plant* $\%_{iHFO}$	*Petrotemex*		*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It is considered the same value for both baseline and project scenarios. It will be calculated using data 1, 2, and 3 as explained in Section B.2.4. Before calculation of the proportions, the quantities of fuel consumed in the project shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*
7	*Proportion of natural gas consumed during the day i at Cosoleacaque's plant* $\%_{iNG}$	*Petrotemex*		*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It is considered the same value for both baseline and project scenarios. It will be calculated using data 1, 2, and 3 as explained in Section B.2.4. Before calculation of the proportions, the quantities of fuel consumed in the project shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*
8	*Proportion of any other fuel j consumed during the day i at Cosoleacaque's plant* $\%_{ij}$	*Petrotemex*		*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It is considered the same value for both baseline and project scenarios. It will be calculated using data 1, 2, and 3 as explained in Section B.2.4. Before calculation of the proportions, the quantities of fuel consumed in the project shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*
9	*Quantity of heavy fuel oil consumed during the day i at Cosoleacaque's plant in the baseline* BFC_{iHFO}	*Petrotemex*	*MMBtu*	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 5 and 6 as explained in Section D.2.1.4.*

10	*Quantity of natural gas consumed during the day i at Cosoleacaque's plant in the baseline* BFC_{iNG}	*Petrotemex*	*MMBtu*	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 5 and 7 as explained in Section D.2.1.4.*
11	*Quantity of any other fuel j consumed during the day i at Cosoleacaque's plant in the baseline* BFC_{ij}	*Petrotemex*	*MMBtu*	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 5 and 8 as explained in Section D.2.1.4.*
12	*Electricity purchased prior to project implementation consumed during the day i at Cosoleacaque's plant* EPp_i	*Petrotemex*	*MWh*	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 5 as explained in Section D.2.1.4.*
13	*Electricity purchased following project implementation during the day i at Cosoleacaque's plant* EPf_i	*Petrotemex*	*MWh*	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
14	*Electricity generation during the day i at Altamira's plant in the project* EG_i	*Petrotemex*	*MWh*	*m*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
15 ACM0002	*Amount of each fossil fuel consumed by each power source / plant of the grid* $F_{i,y}$	*Power producers, dispatch centers or latest local statistics*	*Unit of mass or volume (e.g.: m^3, tonnes)*	*m*	*Annually*	*100%*	*Electronic*	

16 ACM0002	*CO_2 emission coefficient of each fuel type i $COEF_i$*	*Plant or country specific values to calculate COEF are preferred to IPCC default values.*	*tCO_2/mass or volume unit*	*m*	*Annually*	*100%*	*Electronic*	
17 ACM0002	*Electricity imports to the project electricity system*	*Latest local statistics. If local statistics are not available, IEA statistics are used to determine imports.*	*kWh*	*c*	*Annually*	*100%*	*Electronic*	
18 ACM0002	*CO_2 emission coefficient of fuels used in connected electricity systems (if imports occur) $COEFi_{,j\ y\ IMPORTS}$*	*Latest local statistics. If local statistics are not available, IPCC default values are used to calculate.*	*tCO_2 /mass or volume unit*	*c*	*Annually*	*100%*	*Electronic*	
19 ACM0002	*Identification of power source / plant of the grid for the OM*	*Petrotemex*		*e*	*Annually*	*100% of set of plants*	*Electronic*	*Identification of plants (j, k, or n) to calculate Operating Margin emission factors*

20 ACM0002	*Electricity generation of each power source / plant j, k or n of the grid $GEN_{j/k/n,,y}$*	*Power producers, dispatch centers or latest local statistics*	*MWh/a*	*m*	*Annually*	*100%*	*Electronic*	
21 ACM0002	*Operating Margin emission factor of the grid $EFOM,_y$*	*Petrotemex*	*tCO_2/MWh*	*c*	*Annually*	*100%*	*Electronic*	*It is selected the Simple OM of the ACM0002. Calculated as indicated in the relevant OM baseline method of ACM0002.*
22 ACM0002	*Identification of power source / plant of the grid for the BM*	*Petrotemex*		*e*	*Annually*	*100% of set of plants*	*Electronic*	*Identification of plants (m) to calculate Build Margin emission factors*
23 ACM0002	*Build Margin emission factor of the grid $EFBM,_y$*	*Petrotemex*	*tCO_2/MWh*	*c*	*Annually*	*100%*	*Electronic*	*Calculated as [∑i Fi,y*COEFi] / [∑m GENm,y] over recently built power plants defined in the baseline methodology ACM0002.*
24 ACM0002	*Emission factor of the grid EFel*	*Petrotemex*	*tCO_2/MWh*	*c*	*Annually*	*100%*	*Electronic*	*It is selected the Simple OM of the ACM0002. Calculated as a weighted sum of the OM and BM emission factors, as indicated in the ACM0002.*
25	*Mode of operation of "fuel to electricity" equipment (existing turbo-generator)*	*Industrial facility*		*e*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*Mode of operation (on/off) of equipment giving rise to an eventual interdependence between fuel consumption and electricity purchase.*
26	*Baseline emissions BE*	*Petrotemex*	*tCO_2e*	*c*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 9 to 14, 24, and 25 as explained in Section D.2.1.4.*

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 GHG emissions within the project boundary correspond to emissions from fuel combustion at the BR and the furnaces (in Cosoleacaque plant), and CO_2 emissions from avoided electricity generation outside the facilities (Cosoleacaque and Altamira plants) in the absence of the project activity. Baseline emissions comprise the following components:

a) CO_2 emissions from combustion of fuels, corresponding to those used in the baseline situation.

b) CH_4 emissions from combustion of fuels, corresponding to those used in the baseline situation.

c) N_2O emissions from combustion of fuels, corresponding to those used in the baseline situation.

d) CO_2 emissions corresponding to electricity purchased in the baseline and project scenarios. With the project situation, there is surplus electricity generation, avoiding power demand elsewhere. This generation offsets CO_2 emissions outside the industrial facilities, emissions that would be present if the project were not implemented. It is considered those emissions as another component of baseline emissions.

The methodology and formulae for estimating these components of baseline emissions are described in the new methodology presented with this PDD, and applied below.

Baseline emissions ***BE*** (expressed in tonne of CO_2 equivalent per year, tCO_2e/year) are given by:

$$BE = \Sigma_i \{\Sigma_j\, BFC_{ij} \times [CEF_j + MEF_j \times GWP\,(CH_4) + NEF_j \times GWP\,(N_2O)] + \\ + \Sigma_k\, (NEPp_{ik} + NESf_{ik}) \times EFel_k\}$$

where the sum over *i* extends to all the days in a given year, the sum over *j* extends to all the fuels and the sum over *k* extends to all the electricity sources, and:

BFC_{ij}	Consumption of fuel *j* used in the baseline scenario corresponding to the monitoring day *i*, expressed in energy units (MMBtu), and based on lower heating values of fuel *j*
CEF_j	Carbon dioxide emission factor per unit energy of fuel *j* (tCO_2/MMBtu)
MEF_j	Methane emission factor per unit energy of fuel *j* (tCH_4/MMBtu)
$GWP\,(CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period[2]

[2] IPCC, Second Assessment Report, "1995 IPCC GWP values" adopted by COP3, Decision 2/CP.3, FCCC/CP/1997/7/Add.1. Article 5.3 of the Kyoto Protocol establishes: "The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session. Based on the work of, *inter alia*, the Intergovernmental Panel on Climate Change and advice provided by the Subsidiary Body for Scientific and Technological Advice, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall regularly review and, as appropriate, revise the global warming potential of each such greenhouse gas, taking fully into account any relevant decisions by the Conference of the Parties. Any revision to a global warming potential

NEF_j	Nitrous oxide emission factor per unit of energy of fuel *j* (tN_2O/MMBtu)
$GWP\ (N_2O)$	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1st commitment period
$NEPp_i$	*Net* electricity purchased prior to project implementation (MWh) corresponding to the monitoring day *i*: $NEPp_i = EPp_i – ESp_i$ (electricity purchase less electricity sale)
$NESf_i$	*Net* electricity sold following project implementation (MWh) during the day *i*: $NESf_i = Esf_i – EPfi$ (electricity sale less electricity purchase)
EFel	Baseline emission factor from electricity generation (tCO_2/MWh). This emission factor is calculated using ACM0002.

Emission factor for power generation outside the industrial facility

The emissions associated with electricity generation outside the industrial facilities depend on the sum of the power purchased in the baseline and project scenarios, and the emission factor for power generation, which is taken from the simple operating margin approach of ACM0002.

The project activity involves savings in purchases of electricity from the grid. Thus contributing to reduce CO_2 emissions elsewhere in the interconnected grid, considered as baseline emissions. The CDM Executive Board has already approved a consolidated methodology for determining this emission factor, ACM0002.

Note that ACM0002 is actually designated “Consolidated baseline methodology for grid-connected electricity generation from renewable sources.” When the project involves electricity generation from renewable sources, project emissions for electricity generation are negligible, and the baseline emissions are emissions avoided elsewhere in the power grid. The new methodology being proposed here is related to electricity generation at industrial facilities using fuels, which are not renewable. However, the emissions from these fuels are being estimated and counted as part of project emissions, and thus, as far as the baseline is concerned, ACM0002 is applicable.

Power purchased from the grid for the two plants, through an intermediate plant, barely overpass the 15 MW-equivalent threshold set for small-scale project activities. The electricity component of the project is small and can be calculated in the same way as it was used in the already validated project “El Gallo Hydroelectric Project.” (By the way, NM0023 was also approved by the CDM Executive Board, AM0005 “Small grid-connected zero-emissions renewable electricity generation,” and was taken into account for the first option of ACM0002, namely Simple OM.) Note that the electricity component of the proposed project activity is equivalent to a zero-emissions generation, since it takes advantage of residual process steam to self-generate electricity at the facilities sites, reducing power generation elsewhere in the power grid. Since applicability conditions are met, we use the emission factor estimated in that project using a combined margin approach.

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shall apply only to commitments under Article 3 in respect of any commitment period adopted subsequent to that revision.” These GWP for methane and nitrous oxide shall be thus adjusted following relevant COP/MOP decisions.

Petrotemex purchases part of its power demand from a private party. Even though the project implies that Petrotemex could reduce power intake from both, the private party and CFE, avoided CO_2 emissions are those of the national interconnected power grid. The reason is the following:

The private electricity supply could be considered as more competitive than the equivalent CFE supply. Therefore, the power not required by Petrotemex will be available for third parties currently purchasing power from CFE. In this sense, self-generation by Petrotemex will avoid emissions from CFE's marginal plants within the National Electrical System. Conservatively, we have assumed a grid emission factor given by the Simple Operating Margin approach.

In particular, the expected capacity expansions of plants in the Altamira complex would have implied a greater power demand from the private party in the mid-term. Without the implementation of the project activity —which reduces power demand from the private party— this party would have not been able to supply the increased demand. Thus, the additional demand would have been met by CFE.

Baseline emissions in Cosoleacaque's Plant

Baseline emissions in Cosoleacaque's plant correspond to GHG emissions from fuel combustion at the plant site and CO_2 emissions from avoided electricity generation outside the facility in the absence of the project activity. For Cosoleacaque's plant, $NEPp_i$, which is defined as electricity purchased less electricity sold prior to project implementation, only includes electricity purchased (EPp_i). In the same way, NES_{fi}, which is defined as electricity sold less electricity purchased following project implementation, only includes electricity purchased (EP_{fi}), so that this term is negative in equation set above.

The *ex-post* baseline emissions related to fuel consumption in Cosoleacaque's plant will be determined in a *quasi*-dynamic manner from project monitoring data and relations between fuel consumption in the baseline and the PTA production level of the industrial facility. In the same way, *ex-post* baseline emissions related to *net* electricity purchase by Cosoleacaque's plant prior to project implementation will be determined from project monitoring data and relations between electricity purchase prior to project implementation and PTA production level of the plant.

The relations established are based on values that are highly scattered. Dispersion occurs as a consequence of varying operating conditions. The great amount of data available allows the determination of representative average curves, with good statistics, in which the average global performance of the plant for a determined value of the total production does not depend on any particular condition.

As mentioned in Section B.1.1, the operating schemes are very dynamical in these plants due to the following causes:

- using heavy fuel oil as fuel that requires frequent maintenance labours of the fuel consuming equipment (e.g. boilers);
- variability of the electric power supplied by the grid, which can lead to total shutdown of equipment;
- reduction of PTA production level due cleaning labours of a PTA production line, reducing the availability of process steam from the exothermal reaction that should be provided with steam from boilers;

- there are test periods in which process improvements are performed, new energy recovering systems not installed in the original design of the plants being under testing conditions, process modifications that require using reheating steam, etc.

As mentioned in Section B.1.1, electricity and fuel prices are competing, thus influencing Petrotemex's decision regarding the operation mode of the turbo-steam generator (**ANT-301**) consuming steam from boilers (burning fuels) at Cosoleacaque's plant.

When the turbo-generator is used, it is obtained higher values of fuel consumption and lower values of electricity purchase. In another way, when the turbo-generator is not used, it is obtained higher values of electricity purchase and lower values of fuel consumption.

In order to decouple the thermal energy associated to fuel consumption and electrical energy, the relations are split into two families of curves, depending on whether the turbo-steam generator is used or not during a given day. Therefore, two different curves shall be obtained for the relation between fuel consumption and PTA production level and other two curves for the relation between electricity purchase and PTA production level.

These relations have a lower dispersion that occurs as a consequence of varying operating conditions. Thus, the statistic method ―proposed in the baseline methodology submitted with this PDD: "*Baseline methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration measures at an industrial facility"* ― is applied in order to fix a one-to-one correspondence between fuel consumption in the baseline and the PTA production level, and between electricity purchase prior to project implementation and the PTA production level. The great amount of data available allows the determination of curves with good statistics, in which the average global performance of the plant for a determined value of the production does not depend on the details of how the industrial plant is operated.

The relations cover a range of PTA production level from cero to the maximum production capacity of Cosoleacaque's plant.

Baseline emissions from fuel combustion in Cosoleacaque's Plant

As mentioned above, the *ex-post* baseline emissions related to fuel consumption will be determined in a *quasi*-dynamic manner from project monitoring data and relations between fuel consumption in the baseline and the PTA production level of the industrial facility.

The procedure involves the establishment of adequate relations between fuel consumption in the baseline (MMBtu/day) and PTA production level of the industrial facility (tPTA/day). These relations are determined based on trends in consumption prior to project implementation, since the baseline scenario considers the continuation of current practices at the facility. The relations are established once a time and forever, and will be considered unalterable during the crediting period.

To obtain the relation that best represent the baseline fuel consumption, the statistical method proposed in the new baseline methodology submitted with this PDD has been applied, resulting in a polynomial of third order.

Following project implementation, the *ex-post* baseline fuel consumption will be determined through the relations previously established with and without turbo-generator, based on measurements of the PTA production level of the plant. Total baseline fuel consumption is the quantity of fuel (in energy units) that would be consumed in the baseline scenario, when the PTA production level has the value measured in the project scenario.

The procedure is the following:

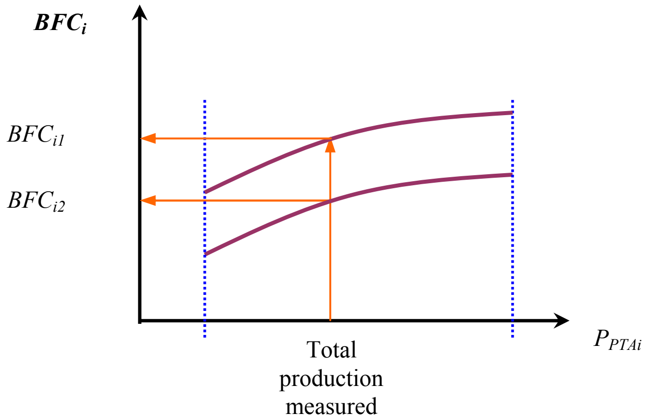

Figure 4: Determination of total fuel consumption in the baseline scenario

In order to determine total baseline fuel consumption during the day *i* (BFC_i), it is considered, for the baseline scenario, the same operation mode applied on that day (to use or not the turbo-generator) in the project, since the decision on whether purchase the electricity or produce it is independent of the project activity.

The *ex-post* total fuel consumption in the baseline scenario during the day *i* is given by

$$BFC_i = BFC_{i1}$$

if the turbo-generator is used on that day in the project, or is given by

$$BFC_i = BFC_{i2}$$

if the turbo-generator is not used on that day in the project,

where:

BFC_i	Total fuel consumption in the baseline scenario during the day *i*, in energy units (MMBtu), and based on lower heating value of each fuel.
BFC_{i1}	Total fuel consumption in the baseline scenario during the day *i* with turbo-generator (MMBtu). It is obtained from the relation established *ex-ante*.
BFC_{i2}	Total fuel consumption in the baseline scenario during the day *i* without turbo-generator (MMBtu). It is obtained from the relation established *ex-ante*.

If, following project implementation, heavy fuel oil, natural gas or any other fossil fuel(s) are consumed, it is considered that, in the baseline scenario, the same kind and proportion of fuels that are consumed following project implementation would be consumed.

Thus, *ex-post* consumption of fuel *j* used in the baseline scenario is given by:

$$\boldsymbol{BFC_{ij} = BFC_i \times \%_{ij}}$$

where:

BFC_{ij}	Consumption of fuel *j* used in the baseline scenario, corresponding to the monitoring day *i*, expressed in energy units (MMBtu), and based on lower heating value of each fuel. It is considered the same type of fuel as the one consumed in the project.
BFC_i	Fuel consumption in the baseline scenario, corresponding to the monitoring day *i*, expressed in energy units (MMBtu), and based on lower heating value of each fuel. It is obtained from the relation established prior to project implementation.
$\%_{ij}$	Proportion of each fuel *j* used in the baseline scenario, corresponding to the monitoring day *i*. It is considered the same proportion as the one used in the project. In consequence, it is calculated based on monitored fuel consumption during the day *i*, as follow: $\%_{ij} = PFC_{ij} / (\Sigma_j PFC_{ij})$

As explained in the baseline methodology submitted with this PDD, if following project implementation there were any modification not previously contemplated that involves fuel saving, this could be considered in the *ex-post* emission reduction calculation, unless such modification is beyond the maximum PTA production capacity of the plant.

Baseline emissions associated with purchase of electricity in Cosoleacaque's Plant

Electricity purchase prior to project implementation

As mentioned above, the *ex-post* baseline emissions related to electricity purchase will be determined in a *quasi*-dynamic manner from project monitoring data and relations between electricity purchase in the baseline and the PTA production level of the plant.

The procedure involves the establishment of adequate relations between electricity purchase in the baseline (MWh/day) and PTA production level of the industrial facility (tPTA/day). These relations are determined based on trends in electricity purchase prior to project implementation, since the baseline scenario considers the fuels and energy-intensive equipment actually in use at the facility. The relations are established once a time and forever, and will be considered unalterable during the crediting period.

To obtain the relation that best represent the *net* electricity purchase prior to project implementation, the statistical method proposed in the new baseline methodology submitted with this PDD has been applied, resulting in a polynomial of third order.

Following project implementation, the *ex-post* baseline electricity purchase will be determined through the relations previously established with and without turbo-generator, based on measurements of the PTA production level of the plant. Total baseline electricity purchase is the quantity of electricity (in energy units) that would be purchased in the baseline scenario, when the PTA production level has the value measured in the project scenario.

The procedure is the following:

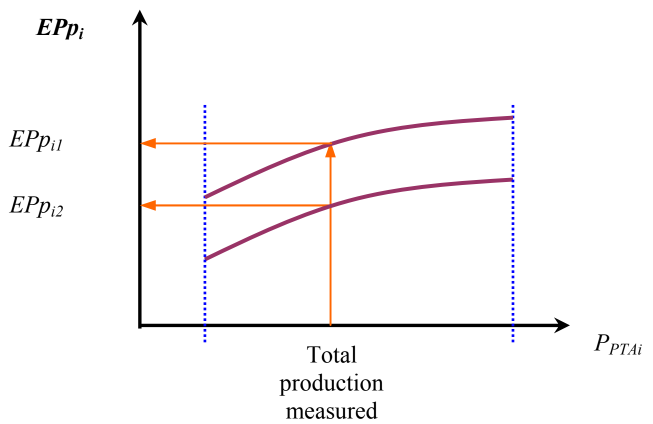

Figure 4: Determination of total fuel consumption in the baseline scenario

In order to determine total electricity purchase during the day *i* (EPp_i), it is considered, for the baseline scenario, the same operation mode applied on that day (to use or not the turbo-generator) in the project, since the decision on whether purchase the electricity or produce it is independent of the project activity.

The *ex-post* total electricity purchase in the baseline scenario during the day *i* is given by

$$EPp_i = EPp_{i1}$$

if the turbo-generator is used on that day in the project, or is given by

$$EPp_i = EPp_{i2}$$

if the turbo-generator is not used on that day in the project,

where:

EPp_i Total electricity purchased in the baseline scenario during the day *i*, in energy units (MWh).

EPp_{i1} Total electricity purchased in the baseline scenario during the day *i* with turbo-generator

(MWh). It is obtained from the relation established *ex-ante*.

EPp_{i2} Total electricity purchased in the baseline scenario during the day *i* without turbo-generator (MWh). It is obtained from the relation established *ex-ante*.

As explained in the baseline methodology submitted with this PDD, if following project implementation there were any modification not previously contemplated that involves electricity saving, this could be considered in the *ex-post* emission reduction calculation, unless such modification is beyond the maximum PTA production capacity of the plant.

Electricity purchase following project implementation

The *ex-post* baseline emissions related to electricity purchase in the project scenario can be determined from project monitoring data.

Baseline emissions in Altamira's Plant

In the Altamira plant fuel consumption will not change as a consequence of the implementation of the project activity. Thus, no fuel consumption is considered for this plant.

For this plant, *NEPp*, which is defined as electricity purchased less electricity sold prior to project implementation, only includes electricity purchased (*EPp*). In the same way, *NESf*, which is defined as electricity sold less electricity purchased following project implementation, only includes electricity purchased (*EPf*).

In this particular case, since no self-generation exists prior to project implementation, it is more convenient to directly working with the sum of *net* electricity purchase prior to project implementation plus net electricity sale in the project scenario instead of dealing with each term separately. In consequence, according to the baseline methodology submitted with this PDD, it is not necessary to use the *quasi*-dynamic baseline, due to the sum can be directly obtained from monitoring data.

For Altamira's plant only self-generated power will be monitored *ex-post* to determine displaced energy from the CFE grid, since the difference between electricity purchase in the baseline and project scenario is the quantity of electricity generated by the new turbo-generator in the project (EG_i). It means:

$$NEPp_i + NESf_i = (EPp_i - ESp_i) + (ESf_i - EPf_i) = (EPp_i - EPf_i) = EG_i$$

Total baseline emissions in Cosoleacaque and Altamira Plants

According with the explanation above, total baseline emissions ***BE*** (expressed in tonne of CO_2 equivalent per year, tCO_2e/year) are given by:

$$BE = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] +$$
$$+ (EPp_i - EPf_i + EG_i) \times EFel\}$$

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

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N/A

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

N/A

D.2.3. Treatment of leakage in the monitoring plan **D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

No significant leakage (***LE***) is envisaged in this project, since only fuel saving is involved, implying an extremely low impact on emission reductions. Moreover, it is conservative to disregard these emissions here, since they would have been accredited in favor of project participants.

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

N/A

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.)

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

$$BE = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] + (EPp_i - EPf_i + EG_i) \times EFel\}$$

$$E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

As mentioned above, no significant leakage ***LE*** is envisaged in this project.

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

$$ER = BE - E - LE = = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] + (EPp_i - EPf_i + EG_i) \times EFel\} - E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

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

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.*
1 QF_{iHFO}	*Low*	*Petrotemex has a series of internal procedures that ensures data have low uncertainties during monitoring process (See Section D.4 below). Fuel consumption is measured by fuel meters at the industrial facility to the best accuracy possible. The accuracy of the meter readings will be cheeked against fuel purchase receipts and inventory data.*
2 QF_{iNG}	*Low*	
3 QF_{ij}	*Low*	
5 P_{PTAi}	*Low*	*Petrotemex has a series of internal procedures that ensures data have low uncertainties during monitoring process (See Section D.4 below). PTA production is measured by automatic weighing balance at the industrial facility to the best accuracy possible. The accuracy of the meter readings will be cheeked against sale records and inventory data.*
13 EPf_i	*Low*	*Electricity purchase is measured by electricity recording meters at the industrial facility to the best accuracy possible. The accuracy of the meter readings for electricity purchased will be cheeked against purchase receipts.*
14 EG_i	*Low*	*Electricity generated is measured by electricity recording meters at the industrial facility to the best accuracy possible.*

All variables related with calculation of emission factors of the grid using the methodology proposed in the ACM0002, are publicly available official data. Default data (for emission factors) and IEA statistics (for energy data) are used to check the local data.

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

Measurements in the levels of fuel consumption as well as electric generation and purchases so as to determine the decrease in energetic intake after the project implementation will be made by the production departments of the respective plants.

Table 9: Operational and management structure

Department	Responsibility	Monitoring	Methodology
Utilities	Roberto Gómez Gómez	Continuous fuel flow measurement on line to the boilers and furnaces	Chart Recorded measurement of fuel consumption (DCS, PI and meter calibration)
Raw Material	Fernando Vásquez	Daily Inventory consumption	Physical tanks Level Measurement & balance in-out
Instruments Maintenance	Juan Alonso Iparrea	Quality assurance for low uncertainties in the measurement instruments	ISO-9001 Instructions, procedures and planning Maintenance
Environmental	Carlos R. Vergara H.	Emissions of NO_x, CO_x, SO_x, and particulate matter	For third party inspection (External company)

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

Marisa Zaragozi, Ivana Cepón, and Fabián Gaioli, MGM International SRL.

Junín 1655, 1º B

C1113AAQ, Buenos Aires, Argentina

Tel./Fax: (54 11) 5219-1230/32

e-mail: mzaragozi@mgminter.com

Marisa Zaragozi, Ivana Cepón, and Fabián Gaioli are not project participants.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

As mentioned in Section D, project GHG emissions within the project boundary correspond to emissions from fuel combustion at the boiler room and the furnaces in Cosoleacaque plant.

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

$$E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

Ex-ante project emissions are not estimated since available historical data allow one to calculate emission reductions directly. However, following project implementation, the *ex-post* project emissions will be determined —from project monitoring data— using the equation above.

E.2. Estimated leakage:

N/A

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

N/A

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

As mentioned in Section D, baseline GHG emissions within the project boundary correspond to emissions from fuel combustion at the boiler room and the furnaces (in Cosoleacaque plant), and CO_2 emissions from avoided electricity generation outside the facilities (Cosoleacaque and Altamira plants) in the absence of the project activity.

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

$$BE = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] + \\ + (EPp_i - EPf_i + EG_i) \times EFel\}$$

Ex-ante baseline emissions are not estimated since available historical data allow one to calculate emission reductions directly. However, following project implementation, the *ex-post* baseline emissions will be determined —from project monitoring data and through correspondences previously established— using the equation above.

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

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

$$BE = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] + (EPp_i - EPf_i + EG_i) \times EFel\}$$

$$E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

No significant leakage ***LE*** is envisaged in this project.

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

$$ER = BE - E - LE = = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] + (EPp_i - EPf_i + EG_i) \times EFel\} - E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

For the *ex-ante* calculation of emission reductions related to fuel combustion, it is considered that only heavy fuel oil will be consumed at the Cosoleacaque plant in the project scenario as well as in the baseline scenario. Therefore, *ex-ante* emission reductions related to fuel combustion are proportional to the emission factors of heavy fuel oil (see Annex 3).

As a consequence of self-generating electricity and the reduction of electricity consumption through the implementation of the project activity, Petrotemex will avoid emissions in the CFE grid. Thus, total emission reductions related to avoided electricity generation outside the facilities are proportional to the emission factors of the grid (see Annex 3).

Thus *ex-ante* emission reductions (tCO_2e/year) are calculated in the following way:

$$ER = (BFC_{HFO} - PFC_{HFO}) \times [CEF_{HFO} + MEF_{HFO} \times GWP(CH_4) + NEF_{HFO} \times GWP(N_2O)] + (EPp - EPf + EG) \times EFel$$

***Ex-ante* calculation of emission reductions related to fuel combustion**

As mentioned above, project emissions from fuel combustion correspond to the emissions from fuels burnt at the boiler room and the furnaces, in Cosoleacaque plant.

According to the project boundary definition, total fuel consumed at the boilers is only accessible through monitoring. Only a part of this consumption will be affected by the proposed project activity, since there is fuel consumed for operation of equipment that is not involved in the project activity.

For the *ex-ante* calculation of emission reductions related to fuel savings, since the three turbo-compressors will be left as backup of the new equipment in the project scenario, it is considered that these turbo-compressors will not consume steam from boilers anymore. As a consequence, fuel consumption in the boilers will be lower than the baseline fuel consumption.

Total fuel saved by the project is the fuel that would have been consumed for generating the steam used in the turbo-compressors in the absence of the project activity (in energy units).

The *ex-ante* baseline information, used for the *ex-ante* estimation of emission reductions, are based on historical data of Cosoleacaque's plant, while the *ex-ante* project information are based on estimations given by the industrial facility.

A PTA annual production of 600,000 tonnes in Cosoleacaque plant for the next 10 years is estimated. For this PTA annual production, the difference between the historical average fuel consumption of the plant (*BFC*) and the estimated value of fuel consumption in the project (*PFC*) is 2,589,580 MMBtu/year, and correspond to the quantity of fuel saved (in energy content) through the project activity.

Thus total fuel saved through the project activity in Cosoleacaque's plant is:

$BFC_{HFO} - PFC_{HFO}$ = 2,589,580 MMBtu/year

***Ex-ante* calculation of emission reductions related to electricity purchase**

Cosoleacaque's plant

As a consequence of self-generating electricity and the reduction of electricity consumption through the implementation of the project activity, the plant will decrease its power intake from the private party and CFE.

The *ex-ante* baseline information, used for the *ex-ante* estimation of emission reductions, are based on historical data of Cosoleacaque's plant, while the *ex-ante* project information are based on estimations given by the industrial facility.

For a production level of 600,000 tPTA/year, the difference between the historical average electricity power equivalent purchase of the plant and the estimated value of electricity power equivalent purchase in the project is 12.5 MW, and correspond to the avoided electricity power equivalent generation outside the industrial facility through the project activity.

Considering that power generators are working 24 hours per day, during 350 days per year on average, the avoided energy generation in the CFE grid through the project activity in Cosoleacaque's plant is:

EPp – EPf = 12.5 MW × 24 hour/day × 350 day/year = 105,000 MWh/year

Altamira's plant

Altamira plant has the potential to self-generate 3.3 MW of electricity power equivalent through the implementation of the project activity. An expected expansion will increase this generation to 5.4 MW.[3]

Since no self-generation exists prior to project implementation, energy self-generated corresponds to avoided emissions in the CFE grid. In consequence, the difference between electricity purchase in the baseline and project scenario is the quantity of electricity generated by the new turbo-generator in the project (*EG*).

Considering that power generators are working 24 hours per day, during 350 days per year on average, avoided energy generation in the CFE grid through the project activity in Altamira's plant is:

EG = 5.4 MW × 24 hour/day × 350 day/year = 45,360 MWh/year

***Ex-ante* calculation of emission reductions**

As explained above, *ex-ante* emission reductions are calculated in the following way:

$$ER = (BFC_{HFO} - PFC_{HFO}) \times [CEF_{HFO} + MEF_{HFO} \times GWP(CH_4) + NEF_{HFO} \times GWP(N_2O)] + (EPp - EPf + EG) \times EFel$$

$$ER = 2{,}589{,}580 \text{ MMBtu/year} \times (81.63 + 0.0032 \times 21 + 0.0003 \times 310)/1000 \text{ tCO}_2\text{e/MMBtu} + (105{,}000 \text{ MWh/year} + 45{,}360 \text{ MWh/year}) \times 0.584 \text{ tCO}_2\text{/MWh}$$

$$ER = 211{,}814 \text{ tCO}_2\text{e/year} + 87{,}810 \text{ tCO}_2\text{/ year}$$

$$ER = \mathbf{299{,}624tCO_2/year}$$

[3] For the *ex-ante* estimation of emission reductions we consider the expanded capacity of Altamira's plant for the entire crediting period. However, this expansion is only on a pre-feasibility stage. Actual electricity self-generation will be monitored following project implementation.

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

The project activity has the capacity to reduce 2,996,245 tonnes of CO_2 equivalent emissions over a 10-year time frame.

The following tables summarises the values obtained above:

Table 10: *Ex-ante* emission reductions in Cosoleacaque plant

(tonnes of CO_2 equivalent)

Years[4]	Emission reductions related to fuel combustion	Emission reductions related to electricity purchases	Total emission reductions
2005	211,814	61,320	273,134
2006	211,814	61,320	273,134
2007	211,814	61,320	273,134
2008	211,814	61,320	273,134
2009	211,814	61,320	273,134
2010	211,814	61,320	273,134
2011	211,814	61,320	273,134
2012	211,814	61,320	273,134
2013	211,814	61,320	273,134
2014	211,814	61,320	273,134
Total	**2,118,143**	**613,200**	**2,731,343**

4 It is defined as the time period between August of a year and July of the subsequent year.

Table 11: *Ex-ante* emission reductions in Altamira plant

(tonnes of CO_2 equivalent)

Year[5]	Emission reductions related to fuel combustion	Emission reductions related to electricity purchases	Total emission reductions
2005	---	26,490	26,490
2006	---	26,490	26,490
2007	---	26,490	26,490
2008	---	26,490	26,490
2009	---	26,490	26,490
2010	---	26,490	26,490
2011	---	26,490	26,490
2012	---	26,490	26,490
2013	---	26,490	26,490
2014	---	26,490	26,490
Total	---	**264,902**	**264,902**

Table 12: *Ex-ante* emission reductions during the 10-year crediting period

(tonnes of CO_2 equivalent)

	Emission reductions related to fuel combustion	Emission reductions related to electricity purchases	Total emission reductions
Cosoleacaque	2,118,143	613,200	**2,731,343**
Altamira	---	264,902	**264,902**
Total	**2,118,143**	**878,102**	**2,996,245**

[5] It is defined as the time period between August of a year and July of the subsequent year.

SECTION F. Environmental impacts

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

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:

SECTION G. Stakeholders' comments

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

G.2. Summary of the comments received:

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

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Other than the technological fund awarded by Mexican authorities mentioned in Section B.3, no funds from public sources were used in any aspect of the proposed project activity.

Annex 3

BASELINE INFORMATION

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

Table 13: Key data

Data	Value	Data sources
Carbon dioxide emission factor per unit energy of heavy fuel oil	81.63 $kgCO_2$/MMBtu	IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3 (1996), Table 1-1, Page 1.13, Residual Fuel Oil: 21.1 tC/TJ = 77.37 tCO_2/TJ = 81.63 $kgCO_2$/MMBtu
Methane emission factor per unit energy of heavy fuel oil	0.0032 $kgCH_4$/MMBtu	IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3 (1996), Table 1-16, Page 1.54, Residual Fuel Oil Boilers: 3 $kgCH_4$/TJ = 0.0032 $kgCH_4$/MMBtu
Nitrous oxide emission factor per unit of energy of heavy fuel oil	0.0003 kgN_2O/MMBtu	IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3 (1996), Table 1-16, Page 1.54, Residual Fuel Oil Boilers: 0.3 kgN_2O/TJ = 0.0003 kgN_2O/MMBtu
CFE emission factor	0.584 tCO_2/MWh	El Gallo Hydroelectric Project
Global Warming Potential of methane	21	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3. For Methane this was 21.
Global Warming Potential of nitrous oxide	310	According to Article 5, Section 3 of the Kyoto Protocol, GWP is as agreed on at COP3. For Nitrous oxide this was 310.
Lower Heating Value of heavy fuel oil	38.25 MMBtu/m^3	Petrotemex
Lower Heating Value of natural gas	0.0356 MMBtu/m^3	Petrotemex
PTA annual production	600,000 tPTA/year	Petrotemex
Quantity of fuel saved at Cosoleacaque's plant	2,589,580 MMBtu/year	Petrotemex
Avoided energy generation in the CFE grid at Cosoleacaque and Altamira plants	150,360 MWh/year	Petrotemex

For the *ex-ante* calculation of emission reductions in Cosoleacaque's plant, it is estimated a PTA annual production of 600,000 tonnes per year for the next 10 years. For this PTA annual production, the fuel saved (in energy content) is 2,589,580 MMBtu/year, and the avoided power generation in the CFE grid is 12.5 MW equivalent. The *ex-ante* baseline information, used for the *ex-ante* estimation of emission reductions, are based on historical data of Cosoleacaque's plant, while the *ex-ante* project information are based on estimations given by the industrial facility.

For the *ex-ante* calculation of emission reductions in the Altamira plant, we consider that the plant has the potential to self-generate 5.4 MW of electricity power equivalent. Since no self-generation exists prior to project implementation, energy self-generated corresponds to avoided emissions in the CFE grid.

For the ex-ante calculation of emission reductions related to fuel combustion, it is considered that only heavy fuel oil will be consumed at the Cosoleacaque plant in the project scenario as well as in the baseline scenario, due to the increasing trends natural gas prices are suffering in North America, including Mexico. Some price projections are shown in the table below. However, even if Petrotemex switched from heavy fuel oil to natural gas, the resulting emission reduction of GHG would still be lower than that of the project activity. Thus, the project activity is clearly a better alternative to reduce anthropogenic greenhouse gas emissions than merely switching fuels.

Table 14: Comparison between natural gas and heavy fuel oil prices in North America (US$/MMBtu)

year	USGC Natural gas*	USGC Heavy fuel oil+
2005	7.74	4.54
2006	6.88	4.39
2007	6.30	4.42
2008	5.94	4.42

*Source: NYMEX futures Nov 2, 2004
+Source: BNP PARIBAS, Nov 2004

Annex 4

MONITORING PLAN

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

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

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

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

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

The models contain a series of worksheets with different functions:

For Cosoleacaque plant

- Data entry sheets (*PTA production*, *fuel consumption, and electricity purchase*)
- Calculation sheets (*baseline emissions, project emissions*)
- Result sheet (*emission reductions*)

For Altamira plant

- Data entry sheets (*electricity generation*)
- Calculation sheets (*baseline emissions*)
- Result sheet (*emission reductions*)

There are worksheets where the user is allowed to enter data. Even in these sheets, only those cells where the staff of each plant is required to enter data have been left unblocked. All other cells contain model fixed parameters or computed values that cannot be modified by the staff.

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

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

Other sheets are shown in subsequent pages. All fields in these sheets include fixed values, or values that are computed from data in the data entry sheets. The last sheet shows the results, comparing year-by-year GHG emissions with the project with baseline values in order to determine annual emissions reductions, shown in the last column.

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

- -

Annex 5

TECHNICAL CHARACTERISTIC OF CURRENT EQUIPMENT

Cosoleacaque plant

Technical characteristics of the compressor AC-101	
AC101	Type: centrifugal, horizontal, 4 stages
First body	Guarantee horsepower: 12,644 bhp ± 4 %
	Input to compress train: 14,000 bhp
	Casing design: succ/dis 2.81/9.49 kg/cm^2 x 218.3 °C
	Temperature (design/max. operating): 218.3/193.3 °C
	Impeller: (1016/1016/1016/ 991) mm ∅, ss, enclosed
AC 101	Type: centrifugal, horizontal, 2 stages
Second body	Input to compress train: 14,000 bhp
	Casing design: succ/dis 42.5/42.5 kg/cm^2 x 218.3 °c
	Impeller: (686/610/610/724/686/686/686) mm ∅ s.s, enclosed

Technical characteristics of the compressor AC-102	
AC 102	Type: turbo, horizontal, 4 stages
First body	Guarantee horsepower: 7,086 bhp
	Capacity: 40,521.4 m^3/hr
	Weight flow: 43,856 kg/hr
	Pressure (inlet/discharge): 0.97/9.01 kg/cm^2
	Temperature (inlet/discharge): 38.8/115 °C
	Motor: 8,000/4,000 hp, 4,160 v, 60 hz, 960/620 a, 4/8 p, 1,800/900 rpm
AC 102	Type: turbo, horizontal, 7 stages
Second body	Guarantee horsepower: 7,086 bhp
	Capacity: 4,179.5 m^3/hr
	Weight flow: 42,085 kg/hr
	Pressure (inlet/discharge): 8.87/23.8 kg/cm^2
	Temperature (inlet/discharge): 37.7/23.8 °C

Technical characteristics of the compressor AC-103	
AC 103 First body	Type: centrifugal, horizontal, 4 stages Capacity: 69,282.2 m^3/hr Pressure (inlet/discharge): 2.72/9.18 kg/cm^2 Temperature (design/maxim): 232.2/135 °C
AC 103 Second body	Type: centrifugal, horizontal, 8 stages Capacity: 8,867.13 m^3/hr Pressure (inlet/discharge): 42.51/42.51 kg/cm^2 Temperature (design/maxim): 260/193.3 °C

Technical characteristics of the compressor AC-104	
AC 104 First body	Type: centrifugal, horizontal, 4 stages (14,800 bhp) Capacity: 69,282.2 m^3/hr Pressure (inlet/discharge): 2.72/9.18 kg/cm^2 Temperature (design/maxim): 232.2/135 °C
AC 104 Second body	Type: centrifugal, horizontal, 8 stages Capacity: 8,867.13 m^3/hr Pressure (inlet/discharge): 42.51/42.51 kg/cm^2 Temperature (design/maxim): 260/193.3 °C

Technical characteristics of the boiler AB-301A	
Boiler type	Water tube
Capacity	90,720 kg/hr
Start-up year	1978
Remaining useful life of equipment	20 years
Current fuel	Heavy fuel oil/natural gas
HHV Fuel (F.O. No. 6)	39,970 Btu/Lt

Technical characteristics of the boiler AB-301B	
Boiler type	Water tube
Capacity	90,720 kg/hr
Start-up year	1978
Remaining useful life of equipment	20 years
Current fuel	Heavy fuel oil/natural gas
HHV Fuel (F.O. No. 6)	39,970 Btu/Lt

Technical characteristics of the boiler AB-301C	
Boiler type	Water tube
Capacity	81,647 kg/hr
Start-up year	1983
Remaining useful life of equipment	20 years
Current fuel	Natural gas
HHV Fuel (Nat. Gas)	36,510 Btu/M3 Std.

Technical characteristics of the boiler AB-301D	
Boiler type	Water tube
Capacity	90,000 kg/hr
Start-up year	1994
Remaining useful life of equipment	20 years
Current fuel	Heavy fuel oil/natural gas
HHV Fuel (F.O. No. 6)	39,970 Btu/Lt