CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Waste Energy Recovery Project at PEMEX TMDB.
Version: Version 8.0
Date: 10/04/2012

A.2. Description of the project activity:

Petroleos Mexicanos (PEMEX) is the biggest enterprise in Mexico and Latin America and the highest fiscal contributor to the country. It is one of the few oil companies in the world that develops all the productive chain of the industry, upstream, downstream and final product commercialization.

The enterprise business plan comprises the need to grow, strengthening productive and operations infrastructure; enhance operative performance on an integral way and harmonize efforts from the different business lines to maximize its economic value. PEMEX operates by means of a corporative and four subsidiary entities:

- PEMEX Exploration and Production (PEP)
- PEMEX Refining
- PEMEX Gas and Basic Petrochemicals (PGPB)
- PEMEX Petrochemical

The CDM project activity will be developed by PEMEX Exploration and Production (PEP) subsidiary. PEP's mission is to maximize the reserves of the country, both in crude and natural gas economic value, on long term basis, guaranteeing safety, both for personnel and facilities, in harmony with the community and the environment. Their main activities are oil and natural gas exploration and exploitation; conveyance, storage in terminals and first hand commercialization; these are carried out daily in four geographic regions comprising the total Mexican territory: North, South, Northeast Offshore and Southeast Offshore.

Currently the Dos Bocas Maritime Terminal (TMDB) is producing about 600,000 barrels per day of Maya crude oil. However, due to the exploitation levels that have been reached in the crude wells the crude oil water content has been increased and it is expected that a new dewatering system will be required in order to meet the crude oil's production quality standards. Up until today, TMDB does not use any dewatering system to separate the associated water from the Maya crude oil.

Pumped crude oil generally contains what is known as formation water. This water can originate from subterranean layers of water in the immediate vicinity of the oil sources. Or in some cases, primarily in the case of older wells, water or water vapor has to be injected to allow the oil still present to be pumped. This water then also flows out of the well together with the crude oil. The crude oil has to have the water and salts removed from it; otherwise it cannot be processed by the refineries.

Crude oil dewatering is a process in which the crude oil associated water is separated to obtain a reduction of water content up to 1% or lower. This low water and salt content is required in order to prevent damages and inefficiencies in the refinery facilities where the crude oil will be treated. If the crude oil produced does not fulfill this requirement an economical penalty is applied.

Due to the above, PEP is planning to install four natural gas kilns with a hot oil system in order to provide the heat requirements for the Maya crude oil dewatering and desalting process and to eliminate the economical penalties that would arise if the current crude oil production practice continues. However, considering the high amount of CO2 emissions that will arise from this process PEP is analyzing the feasibility of a waste heat recovery project developed under the Clean Development Mechanism (CDM).

The proposed CDM project activity would consist in dewatering the Maya crude oil produced by the Dos Bocas Maritime Terminal (TMDB) through the construction of a Waste Heat Recovery System (WHRS) that would take advantage of the waste heat energy of the exhaust gases generated by the power generators located on the TMDB site. The WHRS would provide all the energy requirements for the Maya oil dewatering process.

In the current situation the power generators exhaust gases, resulting from fossil fuels combustion, are vented to the atmosphere without being used for any energy generation of any kind (neither for electricity and/or thermal purposes). In absence of the project activity, the venting of the power generators exhaust gases will continue and the equivalent quantity of heat required for the Maya crude oil dewatering process would be generated through a series of natural gas kilns that would be located at the TMDB.

The implementation of the proposed project activity will result in a Maya crude oil production with lower related CO2 emissions by eliminating the consumption of natural gas for this purpose.

In addition to lower GHG emissions, the project activity will result in several positive social and environmental impacts that will contribute to the local sustainable development and the international efforts of climate change mitigation:

- Recovery and utilization of a waste resource for the purpose of thermal generation: Not only the project will be able to confront global warming, it will also provide an environmental and sustainable solution for the Maya crude oil production requirements representing a clean technology demonstration project, encouraging less dependency of fossil fuels.
- Conservation of the natural gas – a non-renewable resource: as a result of the waste heat recovery project, no natural gas would be required for heat production. Therefore, the project implementation will cover an operational need of PEP production process preserving the natural gas locally available and reducing the related upstream and downstream emissions of the natural gas exploitation and production.
- Job opportunities related to the engineering, civil and mechanical works as part of the construction phase, and at the operation and maintenance of the WHRS.

A.3. Project participants:

Name of Party involved (*). ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicates if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	PEMEX Exploración y Producción (public entity)	No
Mexico (host)	Carbon Solutions de México S.A. de C.V. (private entity)	No

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval.
At the time of requesting registration, the approval by the Party(ies) involved is required.

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.:

State of Tabasco.

A.4.1.3. City/Town/Community etc.:

Municipality of Paraiso.

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

The project will be implemented in the Dos Bocas Maritime Terminal (TMDB) which is located on Ranchería El Limón Street in the Municipality of Paraiso, in the State of Tabasco. The geographic coordinates of the area are 18°25’52.02” North Latitude (N.L.) and 93°10’46.31” West Latitude (W.L.)

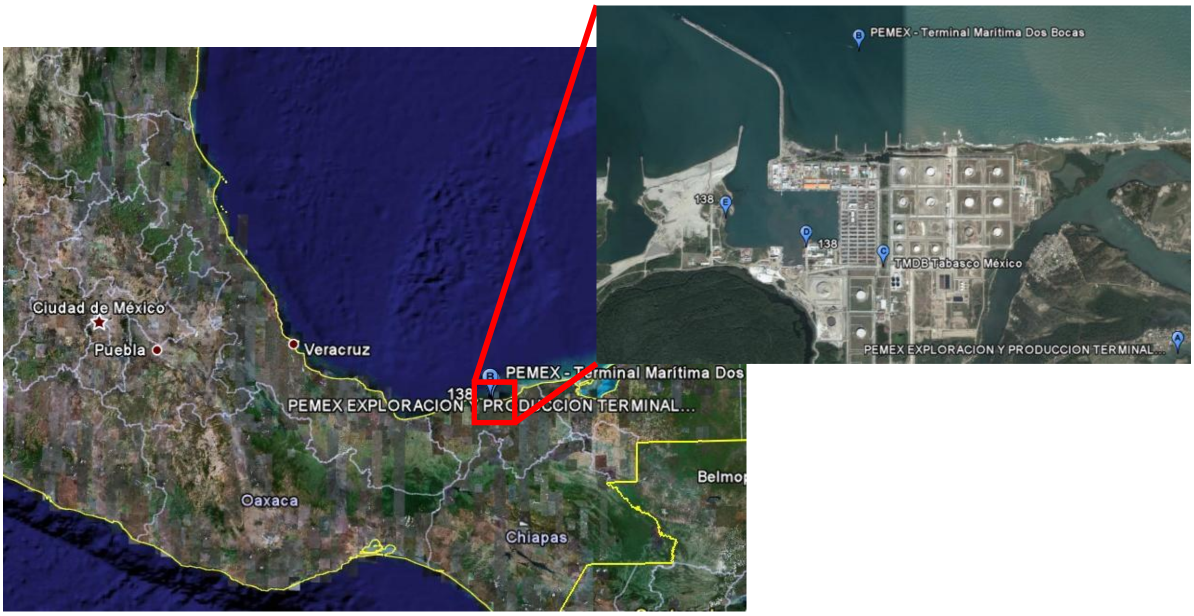


Figure 1. Project site location.

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

Type and Category
This project is categorized under the Sectoral Scope 1 and 4: "Energy Industries (Renewable/non – renewable sources)" and "Manufacturing Industries" for the purpose of heat generation from the waste energy.

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

Gun Barrels will be used for the dewatering/ desalting process. In these tanks the mixture of crude oil/water is injected and with the difference of density, the water is separated along with some of the salt contained (taking into account an adequate flocculants formulation, and a constant dosage in the offshore facilities). In the first tank, the primary function is to dewater the crude oil; in the second tank a large amount of water is injected as its primary function is the desalting process. To make this process possible continuously, water and crude oil should be heated in order to speed up the separation process.

In that case, the Gun Barrel tanks will operate with a serial configuration, in other words, the tank TV-5007 will function as a dewater/knock out (due to the water patches of approximately 50% in volume in very short times) during the dewatering process. The Maya crude oil will be supplied by the pump CB-5T and at the entrance of the TV-5007 tank it will have a maximum water content of 4% in volume, therefore hot water at 50°C and with a lower salinity (coming from the desalting process that will be carried out in the TV-5005 tank) will be injected to the Maya crude oil until a water content of 10% in volume is reached. During the dewatering process, in the TV-5007 tank, the water to be released from the Maya crude oil will be continuously drained and disposed of in the effluents treatment plant since it presents a considerable salt content.

Once the Maya crude oil has been dewatered in the TV-5007 tank, it will pass through a heating system in which it will be heated from 30°C to 60°C, and with a maximum water content of 1% in volume, it will be pumped out with the CB-2 pump to the TV-5005 tank.

The Maya crude oil heating system will be carried out through the utilization of a Waste Heat Recovery System (WHRS) that will recover the residual/waste energy from the power generator exhaust gases of the TMDB. The exhaust gases energy content will be transferred to a thermal fluid (Dowtherm), the heat recovered will be sent from the power generator area to the heat exchangers area by means of the thermal fluid in order to transfer it to the Maya crude oil.

At the exit of the heating system the Maya crude oil at 60°C will be pumped to feed the TV-5005 tank where fresh water will be injected until completing a 10% of water content in volume in order to carry out the desalting process. During the desalting process in the TV-5005 tank the water to be released from the Maya crude oil will be continuously drained and sent to the TV-5007 tank. The expected Maya crude oil's quality at the desalter's exit will be of 0.4% water content in volume and 30 PTB (Pounds per Thousand Barrels) of salts, the vapors produced from the Maya crude oil heating system will be sent to the lower pressure suction of the compression station.

Under its original design conditions, the dehydration system can process 600 MBPD, however, an additional study of the operation conditions was performed with the aim of changing the exit temperature of the processed crude oil to 45°C, obtaining the same quality and making possible to treat the double of flux per day with the current available heat, using the same hot oil with the same temperature reached in the original design but dividing the flow. Hence, it can be stated that for the current waste heat energy available the maximum capacity for the Maya crude oil dehydration system is of 1,200 MBPD. It is important to bear in mind that either this change will or will not be made the heat recovered from the exhaust gases in the turbo generators remains the same than with the original design.

In the current situation the power generators exhaust gases, resulting from fossil fuels combustion, are vented to the atmosphere without being used for any energy generation of any kind (neither for electricity and/or thermal purposes). The proposed project activity will recover the sensible heat from the power generators exhaust gases and utilize it to provide the heat requirements of the heating system used for the Maya crude oil dewatering process. In absence of the project activity, equivalent quantity of heat would be generated through a serial of natural gas kilns that would be located at the TMDB.

Turbogenerators data is shown in next table:

Turbogenerator	**TG2**	**TG3**	**TG4**
Compresor stages	17	17	17
Turbine stages	2	2	2
Inlet Temperature	15ºC	15ºC	15ºC
Inlet Pressure	760 mm Hg	760 mmHg	1.013bar

Current capacity of the turbogenerators is 12 MW for TG-2, 21.4 MW for TG-3 and 21.7 MW for TG-4. The last two were repowered and this capacity is the performance reached at test conditions.

For the implementation of the proposed project activity the following equipment will be required:

- Power generators (TG-2, TG-3 and TG-4; currently in operation), waste energy sources.
- Dewater, Gun Barrel tank TV-5007
- Desalter, Gun Barrel tank TV-5005
- Globe valves for mixing
- PROPURE valves for mixing
- Congenital water pumps (GA-3101 A-C/D)
- Recirculation pumps (GA-700 A/B/R)
- Crude oil pumps (GA-3100 A-B/C, CB2 & CB-5T)
- Demulsifiers' injection packages
- Elevated tank for gases recuperation
- Crude oil heating system (EA-3101 A/B/R T1 & EA-3101 A/B/R T2)
- Fresh water heating system (EA-3102)
- Hot oil cooler (EA-700)
- Heat recovers (BA 700 B/C/D)
- Blowers (GB-3100/R)
- AGAR antennas for the TV-5007 and TV-5005 interfaces control
- Instrumentation and control equipment
- Security Systems

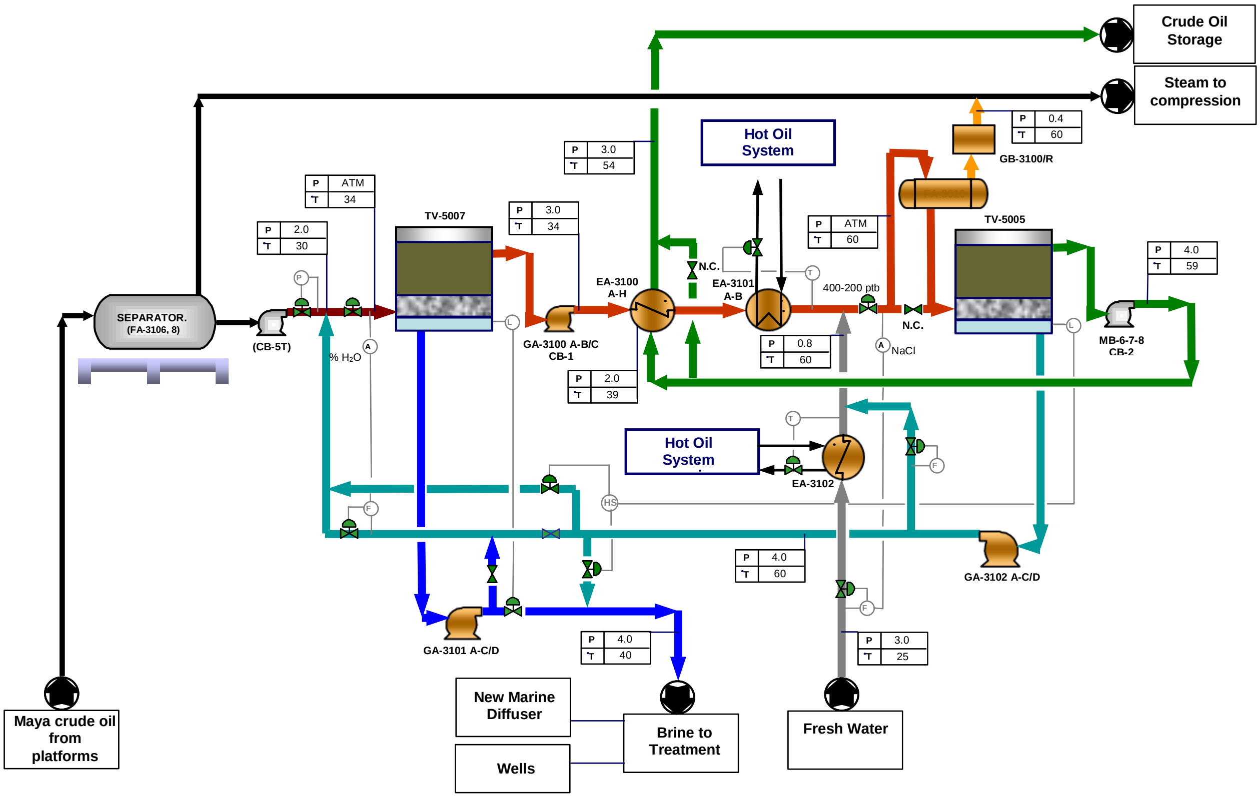


Figure 2. Technology and equipment that will be used for the project activity.

In PEMEX there are other dehydration systems, however, this project will be the first in using a residual heat recovery system. For this purpose, this will result in the development and transfer of new know-how for the operation and control of the waste heat recovery system to the project proponent and to the host country.

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

Year	Annual estimation of emission reduction in tonnes of CO2e
1/06/2012-31/05/2013	88,111
1/06/2013-31/05/2014	88,111
1/06/2014-31/05/2015	88,111
1/06/2015-31/05/2016	88,111
1/06/2016-31/05/2017	88,111
1/06/2017-31/05/2018	88,111
1/06/2018-31/05/2019	88,111
1/06/2019-31/05/2020	88,111
1/06/2020-31/05/2021	88,111
1/06/2021-31/05/2022	88,111

Total estimated reductions (tonnes of CO_2e)	881,110
Total number of crediting years	10
Annual average over the first crediting period of estimated reductions (tonnes Of CO_2e)	88,111

A.4.5. Public funding of the project activity:

There is no public funding involved in the proposed project activity.

SECTION B. Application of a baseline and monitoring methodology

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

The baseline and monitoring methodology used for the proposed project activity is the approved consolidated baseline methodology ACM0012, version 3.2, (EB44): *"Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects"*. Using the latest versions of the following tools:

- "Tool to calculate the emission factor for an electricity system". Version 2
  This tool is not used as the plant uses electricity from a captive system.
- "Tool for the demonstration and assessment of additionality". Version 5.2

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

As stated in the "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects":

"Type-1: All the waste energy in identified WECM stream/s that will be utilized in the project activity is, or would be flared or released to atmosphere in the absence of the project activity at the existing or new facility. The waste energy is an energy source for:

- *Cogeneration; or*
- *Generation of electricity; or*
- *Direct use as process heat source; or*
- *For generation of heat in element process (e.g. steam, hot water, hot oil, hot air); or*
- *For generation of mechanical energy."*

The project activity involves utilization of the waste heat energy contained at the exhaust gases coming from the power generators (where the waste energy is generated) at the TMDB, in order to displace the consumption of natural gas that would be required for the Maya crude oil dewatering and desalting process. Thus, this project activity utilizes waste gas as an energy source for generation of heat to produce hot oil. It should be noted that the project activity fall under the **Type-1 project activity** defined in the methodology.

Apart from the key applicability criteria stated above, the project activity is required to meet the following conditions in order to apply the baseline methodology:

"If project activity is use of waste pressure to generate electricity, electricity generated using waste gas pressure should be measurable."

This is not applicable to this project activity, since its purpose is not the generation of electricity, only the generation of heat.

"Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility;"

The energy generated in the project activity will be used within the industrial facility, the Dos Bocas Maritime Terminal (TMDB).

"The electricity generated in the project activity may be exported to the grid;"

This is not applicable to this project activity, since its purpose is not the generation of electricity, only the generation of heat.

"Energy in the project activity can be generated by the owner of the industrial facility producing the waste gas/heat or by a third party (e.g. ESCO) within the industrial facility."-

The energy in the project activity will be generated by the owner of the industrial facility producing the waste gas/heat.

"Regulations do not constrain the industrial facility generating waste gas from using the fossil fuels being used prior to the implementation of the project activity."

There are no such regulations which restrict the generation of the waste gas from fossil fuels before implementation of the project activity. This can be reviewed with the local and national established norms.

"The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity. If capacity expansion is planned, the added capacity must be treated as a new facility."-

For the project activity under consideration, the methodology is applicable to the existing capacity. In case there is any addition, added capacity will be treated as a completely new project activity.

"The emission reductions are claimed by the generator of energy using waste energy;"

PEMEX PEP is the owner of the industrial facility (TMDB) and will be the developer of the proposed project activity. PEMEX PEP will be the only entity claiming for the emission reductions. Carbon Solutions de Mexico (CSM) is included as a PP, as an ERPA was signed between PEMEX PEP and CSM. However this, ERPA establishes that CSM will buy CERs from PEMEX PEP, hence only PEMEX PEP will claim for the project's emission reductions.

"In cases where the energy is exported to other facilities, an official agreement exists between the owners of the project energy generation plant with the recipient plant(s) that the emission reductions would not be claimed by recipient plant(s) for using a zero-emission energy source;"

This is not applicable for the proposed project activity; the Dos Bocas Maritime Terminal (TMDB) is the waste gas/heat generator and it will be also consuming the energy produced from the waste gas/heat.

"For those facilities and recipients included in the project boundary, that prior to implementation of the project activity (current situation) generated energy on-site (sources of energy in the baseline), the credits can be claimed for minimum of the following time periods:

- *The remaining lifetime of equipments currently being used; and*
- *Credit period."*

Prior to the implementation of the proposed project activity no hot oil or any heat source has been used for the Maya crude oil dewatering and desalting process. All the equipment and infrastructure to be used in the project activity will be new. Therefore, emission reductions shall be claimed for the entire crediting period of 10 years.

"Waste energy that is released under abnormal operation (for example, emergencies, shut-down) of the plant shall not be accounted for".

Any waste energy released under abnormal operation of the plant, shall not been accounted for. This will be easily ensured as the maximum quantity of energy that the project can recover is already capped to the current capacity of the installation under normal conditions of operation, therefore any excessive waste energy would be released to the atmosphere and will not be accounted for emissions reductions for the project activity.

This methodology is not applicable to projects where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power.

The project activity is not waste gas/heat recovery in a single-cycle power plant, since its purpose is not to generate power.

"Demonstration of use of waste energy in absence of CDM project activity

*For **Type-1 project activities**: It shall be demonstrated that the waste energy utilized in the project activity was flared or released into the atmosphere (or wasted in case of project activity recovering waste pressure) in the absence of the project activity at the existing facility by either one of the following ways:*

- *By **direct measurements** of the energy content and amount of the waste energy produced for at least three years prior to the start of the project activity;*
- *Providing an **Energy balance** of the relevant sections of the plant to prove that the waste energy was not a source of energy before the implementation of the project activity. For the energy balance applicable process parameters are required. The energy balance must demonstrate that the waste energy was not used and also provide conservative estimations of the energy content and amount of waste energy released"*
- ***Energy bills** (electricity, fossil fuel) to demonstrate that all the energy required for the process (e.g. based on specific energy consumption specified by the manufacturer) has been procured*

commercially. Project participants are required to demonstrate through the financial documents (e.g. balance sheets, profit and loss statement) that no energy was generated by waste energy and sold to other facilities and/or the grid. The bills and financial statements should be audited by competent authorities;

- ***Process plant** manufacturer's original design specifications and layout diagrams from the facility could be used as an estimate of the quantity and energy content of the waste energy produced for the rated plant capacity/per unit of product produced;*
- *On site checks conducted by the DOE prior to project implementation can confirm that no equipment for waste energy recovery and utilization, on the WECM stream recovered under the project activity, had been installed prior to the implementation of the CDM project activity."*

To prove and to demonstrate that the waste energy utilized in the project activity was flared and released into the atmosphere, and also to prove that it was not utilized for any generation purposes prior to the implementation of the CDM project activity, **an Energy Balance** of the relevant sections of the plant (second bullet) will be provided. Also, during the site visit it will be confirmed by the DOE that no equipment for waste energy recovery and utilization, on the WECM stream recovered under the project activity, has been installed prior to the implementation of the CDM project activity (last bullet).

"For Type-1 project activities, in cases where waste energy recovery activities were already implemented in other streams of WECM prior to the implementation of the CDM project activity, the following should be demonstrated:

- *That there is no decrease in energy generated from the waste energy recovered previous to the implementation of the CDM project activity; or*
- *In the case where there is a decrease in energy generation from previously recovered waste energy, it can be demonstrated that the decrease is due to a decrease in generation of waste energy on account of the factors not related to the project activity;*
- *The conditions shall be confirmed by the verifying DOE for each issuance period."*

Another waste energy recovery activities already implemented in other streams of WECM prior to the implementation of the CDM project activity has not been detected. This condition will be verified by the DOE.

Based on the above, it may be concluded that the project activity meets all the applicability conditions required by methodology ACM0012 version 3.2 – "*Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects*".

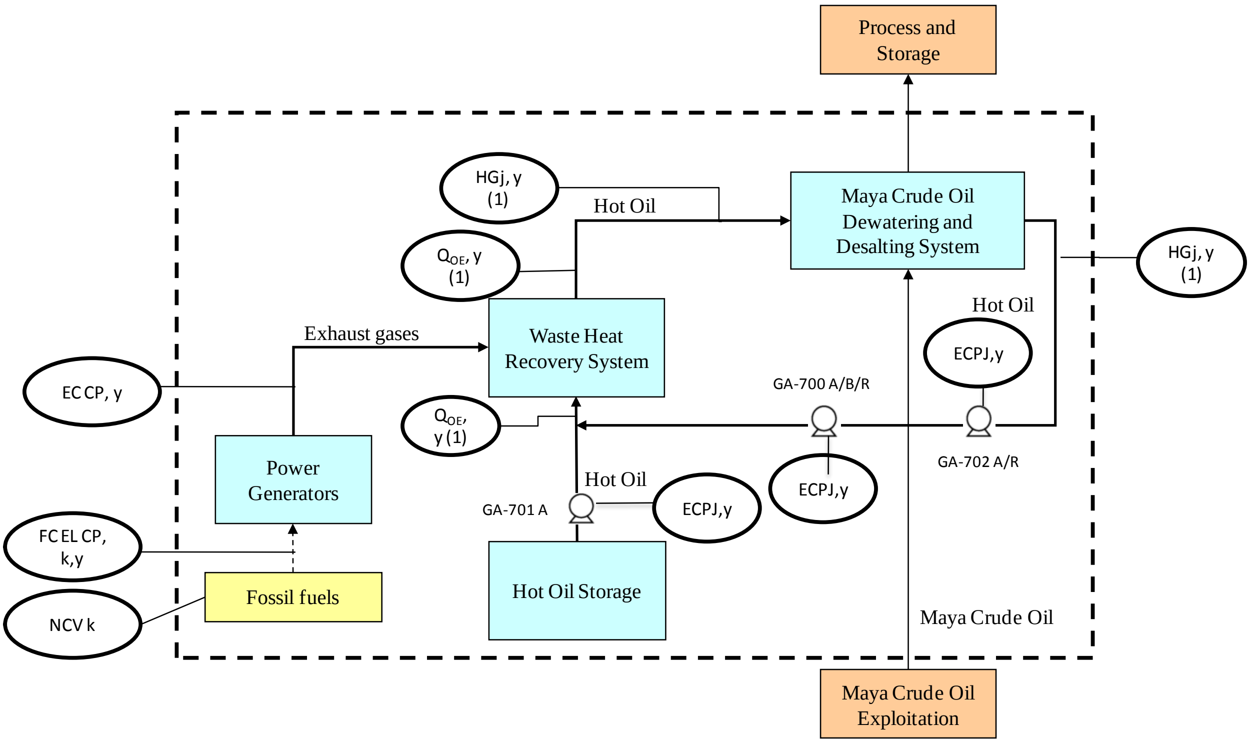
B.3. Description of the sources and gases included in the project boundary:

The definition of the project boundary states that the project boundary shall encompass all anthropogenic emissions by sources of greenhouses gases (GHG) under the control of the project participants that are significant and reasonably attributable to the CDM project activity.

As per ACM0012, it is identified that the gases involved in the project activity to determine GHG emissions sources, are as follows:

	Source	Gas	Included	Justification / Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Excluded	Excluded. Not applicable.
		CH_4	Excluded	Excluded. Not applicable.
		N_2O	Excluded	Excluded. Not applicable.
	Fossil fuel consumption in boilers for thermal energy	CO_2	Included	The major source of emissions in the baseline.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Excluded. Not applicable.
		CH_4	Excluded	Excluded. Not applicable.
		N_2O	Excluded	Excluded. Not applicable.
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	Excluded. Not applicable.
		CH_4	Excluded	Excluded. Not applicable.
		N_2O	Excluded	Excluded. Not applicable.
Project Activity	Supplemental fossil Fuel consumption at the project plant	CO_2	Included	An important emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplementary electricity consumption	CO_2	Included	An important emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Electricity import to replace captive electricity, which was generated using waste gas in absence of project activity	CO_2	Excluded	Excluded. Not applicable
		CH_4	Excluded	Excluded. Not applicable
		N_2O	Excluded	Excluded. Not applicable
	Project emissions from cleaning of the gas	CO_2	Excluded	Characteristics of the gases to be recovered allow to be directly used without any cleaning.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

The following chart represents the project boundary:



(1) This is calculated in base to the hot oil temperature and flow.

Figure 3: Flow chart of project boundaries (staggered line indicates boundaries)

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The methodology requires the project proponent to identify all the possible baseline alternatives in order to produce heat. An assessment of all these alternatives is required in order to identify at the baseline scenario: *i.e.* the most likely scenario in absence of the proposed project activity. The GHG performance of the proposed project activity and its associated emission reductions will be evaluated in respect to the identified baseline scenario.

Realistic and credible alternatives have been determined for*:

- Waste energy use in the absence of the project activity; and
- Steam/heat generation in the absence of the project activity.

Step 1: Define the most plausible baseline scenario for the generation of heat and electricity using the following baseline options and combinations

The baseline candidates should be considered for following facilities:

- For the industrial facility where the waste energy is generated; and

* Note: alternatives for the following have not been determined as the project is neither a power generation nor a mechanical energy generation activity:

- Power generation in the absence of the project activity; and
- Mechanical energy generation in the absence of the project activity

- For the facility where the energy is produced; and
- For the facility where the energy is consumed.

For the use of waste gas, the following alternatives have been identified as described in the methodology:

Alternative	Alternatives for use of waste gas	Conclusion (Yes/No)	Explanation
W1	WECM is directly vented to atmosphere without incineration or waste heat is released to the atmosphere or waste pressure energy is not utilized.	No	The residual energy contained in the exhaust gases at the exit of the TMDB power generators are not being utilized for any energy generation purposes, neither for electricity, nor heat, nor pressure.
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released to the atmosphere or waste pressure energy is not utilized.	Yes	The exhaust gases come from combustion process at the TMDB power generators units. Later, these gases are released to the atmosphere. This is currently the actual practice. This is in compliance with statutory requirements and was also the status quo of the project proponent in pre-project scenario. This is a credible alternative for baseline selection.
W3	Waste energy is sold as an energy source.	No	PEMEX PEP has not considered finding any possible buyers. The only possible user of the energy source is PEMEX PEP itself, as there are no other industrial installations nearby to the plant.
W4	Waste energy is used for meeting energy demand	Yes	Waste energy could be used to cover the energy demand of dehydrating the crude oil in the terminal.
W5	A portion of the waste gas produced at the facility is captured and used for captive electricity generation, while the rest of the waste gas produced at the facility is vented/flared.	No	Entire waste gas produced at the facility was being vented in the baseline scenario. The utilization of a portion of the waste gas produced will require investment and the development of infrastructure in order to be able to use it for electricity generation. However, this scenario would face similar investment and technological barriers as the proposed project activity itself. In absence of any alternative this option cannot be the baseline scenario. No use has been given to any of the waste gas realized for the power generators.
W6	All the waste gas produced at the industrial facility is	No	There is not energy generation at the project site using waste gas. The

Alternative	Alternatives for use of waste gas	Conclusion (Yes/No)	Explanation
	captured and used for export electricity generation.		purpose of the project activity is not to produce electricity to be consumed, and certainly not to export the power, but in the case that PEMEX PEP decides to use the waste gas for export electricity generation a considerable investment amount and infrastructure will be required in order to be able to generate electricity and send it to the grid. However, this scenario would face similar investment and technological barriers as the proposed project activity itself. Currently PEMEX PEP produces electricity through the utilization of Gas Turbine power generators. The electricity produced by the power generators is used only for internal consumption. Currently TMDB facilities have not any kind of installations to export electricity to the grid. Hence, in absence of any alternative this option cannot be the baseline scenario

Therefore, the plausible baseline alternatives scenarios are **W2** and **W4.**

For heat generation, the following alternatives have been identified as described in the methodology:

Alternative	Alternatives for heat generation	Conclusion (Yes/No)	Explanation
H1	Proposed project activity is not undertaken as a CDM project activity;	Yes	The project activity not undertaken as a CDM project activity is a credible alternative for baseline selection. This alternative also is in compliance with all legal and regulatory requirements.
H2	On-site or off-site existing/new fossil fuel based cogeneration plant	No	Since the proposed project activity involves the installation of a new facility for the crude oil dewatering and desalting process, currently there is no a cogeneration plant at the site location that satisfies the demand of heat required to dewatering the crude oil particularly. A new cogeneration plant cannot be considered as the baseline scenario, even when this alternative is in

Alternative	Alternatives for heat generation	Conclusion (Yes/No)	Explanation
			compliance with all existing legal and regulatory requirements. It should be noted that setting a new fossil fuel cogeneration plant (i.e. coal based) would require a substantial investment and probably a higher GHG emissions. Therefore, it is not the best alternative that can represent the most accurate baseline scenario and situation for the plant.
H3	On-site or off-site existing/new renewable energy based cogeneration plant;	No	Local conditions and regional nature would not allow to provide renewable energy enough to fulfill the require energy as the exhaust gases can do. Even when this alternative is in compliance with all existing legal and regulatory requirements, it is not a credible alternative for a baseline selection that can represent the most accurate option for the plant.
H4	An existing or new fossil fuel based boilers;	Yes	Due to the natural gas availability at the project location PEMEX PEP would provide the heat requirements for the crude oil dewatering and desalting process in TMDB through the installation of new natural gas based kilns. This alternative is in compliance with all existing legal and regulatory requirements. The proposed waste heat recovery project will only be implemented if the CDM registration is obtained. Therefore, this can be considered as the most plausible alternative.
H5	An existing or new renewable energy or other waste energy based generators;	No	Unavailability of renewable resources and unattractiveness of suitable technology for the project proponent makes this option unviable.
H6	Any other source such as district heat;	No	No other source of heat such as district heat is available. Thus this option is unviable.
H7	Other heat generation technologies (e.g. heat pumps or solar energy);	No	Considering the local conditions and nature, unattractiveness of suitable technology for the project proponent makes this option unviable.
H8	Steam/Process heat generation from waste energy, but with lower	No	This is a credible alternative as the hot oil might have been heated by the utilization of the exhaust gases with a

Alternative	Alternatives for heat generation	Conclusion (Yes/No)	Explanation
	efficiency;		lower efficiency technology. However, this scenario will face similar barriers as the proposed project activity., and additionally, the operating cost for running an inefficient system would be very high, making this alternative economically unfeasible. Besides, due to the heat recovery requirements, it is necessary to have the efficiency that has been projected for the CDM project. Also, the utilization of a lower efficiency system would imply that fossil fuels (natural gas) consumption might be required to supply the required process heat, this will considerably increase the operational cost and the project emissions rate, this is against PEMEX PEP policies for choosing the most economic and sustainable project option. Hence this alternative cannot be considered the baseline scenario.
H9	Cogeneration with waste energy, but at a lower efficiency.	No	This is a credible alternative as the heat requirement may have been met by the utilization of the exhaust gases with a technology having lower efficiency. However, a cogeneration system implies a higher investment and as the TMDB facilities have not installations to deliver electricity to the grid, electricity exportations would imply higher costs, making this option economically unfeasible. Hence this alternative cannot be a part of the baseline.

Therefore, the plausible baselines alternative scenarios are **H1** and **H4**.

From the analysis above, the following plausible baseline alternatives are resumed below for the proposed project activity:

- Alternative 1: Proposed project activity not undertaken as a CDM project activity, i.e. the installation of a WHRS using the residual energy coming from the exhaust gases from TMDB power generators to provide the Maya crude oil dewatering and desalting process heat requirements.
  This would imply the alternatives W4 and H1 where the waste energy would be used for meeting energy demand and where the heat energy required for the Maya crude oil dewatering and desalting process is provided from the waste heat recovery system.

- Alternative 2: The residual energy from the exhaust gases being released to atmosphere after their incineration at TMDB power generators, and a new fossil fuel (natural gas) based kilns are used to generate the heat requirements for the Maya crude oil dewatering and desalting process.
  This would imply the alternatives W2 and H4 where the waste energy is released to the atmosphere (after incineration, for example) and where the heat energy required for the Maya crude oil dewatering and desalting process is provided from new fossil fuel (natural gas) based kilns.

All these scenarios are in compliance with the regulations and policies from the country.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable

Mexico is known for abundant oil and natural gas availability. The natural gas consumption records and projections at the TMDB are on an annual basis and are estimated based on the expected production levels and the fuel demand according to its historical records. This will be applicable for both Alternatives 1 and 2.

Also it is important to remark that PEMEX PEP produces natural gas, therefore it is currently its own fuel supplier and will provide all the fuel requirements during the implementation of the proposed project activity.

Hence, based on the procedures established in this Step, the baseline fuel choice of energy source is Natural Gas.

Step 3: Step 2 and/or Step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality"

To identify the most plausible baseline scenario, both Step 2 and Step 3 of the "Tool for the demonstration and assessment of additionality" have been used for the alternatives identified in Step 1 above. The economic attractiveness of each option is evaluated with respect to the current situation and each option is evaluated for a common set of barriers. The outcome of this analysis is:

Alternative 1: Proposed project activity not undertaken as a CDM project activity.
In this alternative a substantial investment is required, which is considerably higher than the one required for Alternative 2. The feasibility of this option, i.e. implementation of the project activity without registration as a CDM project activity, is described in detail in Section B.5 below. The option is not considered to be the most plausible baseline scenario, and the reader is referred to Section B.5 for documented evidence supporting this assessment. Hence options H1 and W4 should not be considered as a plausible scenario.

Alternative 2: The residual energy from the exhaust gases being released to atmosphere after their incineration at TMDB power generators, and a new fossil fuel (natural gas) based kilns are used to generate the heat requirements for the Maya crude oil dewatering and desalting process
The utilization of new fossil fuel based kilns faces no prohibitive barriers since it employs natural gas which is a highly available fuel in the project location and with the lowest GHG emission factor, the

proposed technology to be used is commonly applied for this purpose and even if this alternative also requires a substantial investment it is highly economically feasible (see section B.5.).

Step 4: If more than one credible and plausible alternative scenario remain, the alternative with the lowest baseline emissions shall be considered as the most likely baseline scenario.

From the previous analysis and taking into account that the natural gas is the baseline fuel choice with the lowest baseline emissions, the most plausible alternative identified to generate the required heat in absence of the proposed project activity would have been Alternative 2 i.e; new fossil fuel (natural gas) based kilns.

A matrix can be defined to select the proper baseline scenario, which it would be the scenario 1 indicated in the table 1 of the ACM0012 version 3.2 methodology:

Project Scenario: Generation of Electricity or Heat only			
Scenario	Baseline options		Description of the situation
	Waste energy	Heat energy	
1	W2	H4	*"(…) The heat is obtained from new fossil fuel based kiln (s)."*

B.5. 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 (assessment and demonstration of additionality):

PEMEX PEP has been working in the analysis of the CDM project feasibility since July, 2008. Below, a description of how the project was conceived is given along with the different events that have occurred to decide the project's development under the Clean Development Mechanism:

- On July 30th 2008, a workshop about the mitigation of Greenhouse Gases and the Kyoto Protocol Mechanisms was given at the TMDB facilities. As a part of the workshop, identification of possible MDL was carried out. During this activity, the potential of a heat recovery project for the dewatering process was seriously analyzed considering that the CDM incentive could make this project possible.
- On August 12th 2008, the No Objection Letter was obtained.
- On September 22nd 2008, a contract was signed to develop the WHRS for the dewatering of the crude oil process. On October 7th 2008, a Letter of Understanding was signed between PEMEX PEP and Carbon Solutions de México (CSM) to formalize the previous verbal agreement of working in the development of the CDM project.
- On December 10th 2008, the local stakeholders consultation was carried out.
- On February 20th 2009, the PDD was published on the UNFCCC site, no comments were received.
- On March 9th 2009, the letter of approval from National Authority was obtained.
- On March 24th and 25th 2009, the site visit was carried out.

As required in the selected methodology, the additionality of the project activity is determined by applying the EB approved "Tool for the Demonstration and Assessment of Additionality (version 05.2)".

Step 1: Identification of alternatives to the project activity:

From the Alternative analysis described in B.4, the more realistic and credible alternative scenario to the project activity, with the lowest baseline emissions, that is in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations is alternative scenario 2 described above. Therefore it will be proceed to Step 2 (investment analysis) to determine the financial attractiveness of the project activity.

Step 2: Investment analysis

Sub-step 2a. Determine appropriate analysis method

The project activity generates the economic benefits due to energy saving (i.e.; saving from reduction in natural gas consumption) and avoiding future Maya crude oil production penalties. Therefore the simple cost analysis will not be appropriate for assessing investment analysis of this project. The investment comparison analysis will be utilized.

Another alternative to the proposed project considered seriously by the Project Proponent is to make a substantial investment to supply the required heat for the Maya crude oil dewatering and desalting process based on natural gas kilns. This consideration was made taking into account the situation of the fossil fuel market at the time.

The purpose of an investment analysis in the context of the CDM is to determine whether the project is less financially attractive than at least one alternative in which the project participants could have invested.

The investment requirements for the alternatives are described as follows:

- *Alternative 1: Proposed project activity not undertaken as a CDM project activity, i.e. the installation of a WHRS using the residual energy coming from the exhaust gases from TMDB power generators to provide the Maya crude oil dewatering and desalting process heat requirements.*
  In this alternative, a substantial and significant investment is required. This alternative is not the best economically attractive to be accomplished without the incentive of the carbon credits (as it will be described in this section).

- *Alternative 2: The residual energy from the exhaust gases being released to atmosphere after their incineration at TMDB power generators, and a new fossil fuel (natural gas) based kilns are used to generate the heat requirements for the Maya crude oil dewatering and desalting process*
  In this alternative, a substantial and significant investment is required, and it is the best economically attractive option to be implemented (as it will be described in this section).

Sub-step 2b: Option II - Investment comparison analysis

According to the methodology for determination of additionality, when the alternatives to the CDM project activity include investments of comparable scale to the project, then Option II can be used.

For the evaluations of the a) Natural Gas kilns scenario (Alternative 2); and b) WHRS scenario (Alternative 1, the proposed project activity), the Project Proponent takes the NPV as the main financial indicator but the IRR is used as a complement in order to evaluate the economical benefits for both scenarios.

As per the Guidelines for the Investment Projects Approval for PEMEX and its subsidiaries "Lineamientos para los proyectos de inversion de Petróleos Mexicanos y sus Organismos Subsidiarios" it is essential to have an optimum assignation of financial resources those investment opportunities that allow to the achievement of institutional objectives.

The investment analysis in PEMEX is not made in a project by project basis but for each group of investment programs or project denominated integral projects.

Depending on the strategic goals, specific needs and the financial resources availability, priorities will be established and the investment opportunities will be ranked. PEMEX delivers annually the planning document to the Federal Government.

PEMEX has to justify the technical, legal and environmental feasibility as well as the economical viability of the integral projects through a benefit-cost analysis as a requirement for their approval.

The cost-benefit analysis, according to the Guidelines for the Cost-Benefit Analysis development "Lineamientos para la elaboración y presentación de los análisis costo-beneficio de los programas y proyectos de inversión" published by the Treasury Ministry should include:

- Situation without the project and possible solutions
- Project description (Objective, Purpose, Location, Lifetime of the project, benefits, incomes or savings derived from the project, technical description)
- Situation with the project
- Project appraisal (taking into account financial indicators such as NPV and IRR)
- Sensitivity analysis (Taking into account the deviations that the profitability of the project will have when aspects such as initial investment, operation and maintenance, product prices, etc varies)

The economic appraisal that has to be presented and justified before the treasury ministry should include the reasons to choose the choice presented. The different alternatives to the choice selected have to be explained including the advantages and disadvantages of them, it should be explained from a technical and economical point of view the reasons why the choice was selected.

As per the Guidelines for the Investment Projects Approval for PEMEX and its subsidiaries "Lineamientos para los proyectos de inversion de Petróleos Mexicanos y sus Organismos Subsidiarios", the first financial indicator is the NPV, but this is often supported by the IRR, among other indicators.

Both indicators are presented and evaluated in this document.

Sub-step 2c: Calculation and comparison of financial indicators.

The calculation of the financial indicator for the project activity includes the initial investments costs, the operation and maintenance cost, and incomes associated with the savings in fossil fuel. The timeline includes the crediting period plus five year (2011-2025) considering the lifetime of the involved equipments in the Project Activity.

Investment needed for both scenarios (Alternatives 2 and 1)

Variable	Value	Source
Engineering (000 USD)	340.77	WHRS Contract with manufacturer
Hot oil and crude oil system (000 USD)	2,619.02	WHRS Contract with manufacturer
Mec, Elec, Inst and Ctrl Installation (000 USD)	1,439.10	WHRS Contract with manufacturer
Total common costs (000 USD)	**4,398.89**	

Table 1. Common costs for Natural gas kilns scenario and WHR system scenario

Natural Gas kilns scenario (Alternative 2)
For this scenario, a complete breakdown of investments and associated costs is given in the Table B.5.2

Variable	Value	Source
Equipment for natural gas kilns scenario (000 USD)	7,088.64	Kiln manufaturer (Proposal)
Common costs for both scenarios (000 USD)	4,398.89	WHRS Contract with manufacturer
Total Investment (000 USD)	**11,487**	
Cost of natural gas fuel, 2011 (US$ / MMBTU)	5.61	2008 PEMEX premises
Expected Maya crude oil treated in the dewatering system (M Barrels/year)	219,000	Technical Analysis by WHRS manufacturer
Excess salt content penalty (USD$/pound) †	6.4	Contract between PEMEX PEP and PEMEX PR.

† Salt penalty was included based in the contract with PEMEX PR, contract with PEMEX PPQ will be provided to the DOE. As the penalty in contract with PEMEX PR is higher it will be use in a conservative approach. PEMEX subsidiaries can make contracts and impose penalties because each subsidiary is a decentralized public entity of the Federal Government of Mexico, and is a legal entity empowered to own property and carry on business in its own name (Petróleos Mexicanos 20-F Form, page 5. http://www.ri.pemex.com/files/content/PEMEX_2010_Form_20-F_as_filed_June_30_2011.pdf [27/03/2012]; http://www.ri.pemex.com/index.cfm?action=content&sectionid=17&catid=12160 [27/03/2012]). The contract between PEMEX Exploración y Producción and PEMEX Refinación, establishes in Annex 1, section 2, page 98, the penalty PEMEX Exploración y Producción must pay in case there is an excess in the salt content of the crude oil sold. Such contract is in accordance to article 73 of the Petróleos Mexicanos Law (Ley de Petróleos Mexicanos, Article 73 (page 33) http://www.pemex.com/files/dca/LEYES/LeyPemex.pdf [30/03/2012]) which states that contracts between subsidiary agencies must include an adjustment to the price of the goods to be traded, in

Salt content reduction (pounds/M Barrel)	70	Historic data of salt content.
Average penalty savings per year (000 US$)	119,368	Calculated
Maintenance costs (000 US$)	958.02	Maintenance costs for the dewatering system for the light oil in TMDB. Since PEMEX PEP is already operating a similar system in TMDB for light crude oil, the same personnel is able to handle the supplementary kilns.
Average Natural gas costs per year (000 US$)	10,690	2008 PEMEX premises
IRP taxes (%)	70 %	Taxes paid for PEMEX PEP in 2008
Discount Rate	**12%**	PEMEX Premises
Lifetime of equipments	100,000 hrs	Kiln manufacturer
IRR (%)	**239.3%**	Calculated
NPV (000 USD)	**179,065**	Calculated

Table 2. Data used and IRR results for the evaluation of the Natural gas kilns scenario.

WHRS scenario (Alternative 1)

In this scenario, a complete breakdown of investments and associated costs is given in the Table B.5.3

Variable	Value	Source
Equipment for WHR scenario (000 USD)	26,961.05	WHRS Contract
Equipment integration (000 USD)	8,578.05	WHRS Contract
Site conditioning (000 USD)	2,952.23	WHRS Contract
Pipe supporting (000 USD)	994.67	WHRS Contract
Common costs for both scenarios (000 USD)	4,398.89	WHRS Contract
Total Investment (000 USD)	**43,885**	Calculated
Expected Maya crude oil treated in the dewatering system (M Barrels/year)	219,000	Technical Analysis by WHRS manufacturer
Turbogenerators failure Index	1.73%	Turbogenerators operational data
Excess salt content penalty (USD$/pound)	6.4	Contract between PEMEX PEP and PEMEX PR.
Salt content reduction (pounds/M Barrel)	70	Historic data of salt content.
Average penalty savings per year (000 US$)	117,305	
Annual maintenance costs (000 US$)	761.57	Spare parts for one year of operation: Letter referring to WHRS contract
Annual operation costs (000 US$)	634.57	Manpower costs: PEMEX estimations
IRP taxes (%)	70 %	Taxes paid for PEMEX PEP (RMSO) in 2008

accordance to international quality standards, if it were to be required, in order to represent the real price of the products exchanged.

Discount Rate	**12%**	PEMEX Premises
Lifetime of equipments	100,000 hrs	WHRS Contract
CERs price (USD)	20	Platts Emissions Daily October 10, 2008
IRR without CERs (%)	**74.63 %**	Calculated
IRR with CERs (%)	**78.52 %**	Calculated
NPV without CERs (000 USD)	**176,118**	Calculated
NPV with CERs (000 USD)	**185,008**	Calculated

Table 3. Data value used for the evaluation of the WHRS scenario.

Turbogenerators failure index has been included as in the project activity the waste heat recovery system depends upon them to work.

The waste heat recovery system of the project scenario itself would have a failure index as well as the kilns used in the baseline scenario, both failure indexes are unknown and it could be supposed that would be similar (both are new equipment to be installed), hence they are not taken into account. However, the turbogenerators failure is an external factor which will determine the availability of residual heat for the waste heat recovery system, so it must be taken into account as the project activity has to assume the additional risk generated for this additional equipment.

The CER price of 20 USD has been chosen based on Platts's quotes for secondary CERs that have been consistently around 20 EUR (aprox. 25 USD) over the last quarter of 2008; it was assumed that 80% of this price is a realistic value given the intrinsic uncertainty and the transaction costs (verification, etc.).

In this scenario, two options can be obtained in order to evaluate the project activity with and without the carbon credits:

- The NPV obtained for the WHRS scenario, without the incentive of the carbon credits, is 176.118 million USD a IRR of 74.63%
- The NPV obtained for the WHRS scenario, with the incentive of the carbon credits, is 185.008 million USD and a IRR of 78.52%

Scenario	Investment (000 USD)	IRR	NPV (000 USD)
Baseline Scenario	11,487	239.3%	179,065
Project Activity without CDM	43,885	74.63%	176,118
Project Activity with CDM	43,885	78.52%	185,008

Besides the fact that the project Activity has a NPV and IRR lower than the ones for the Baseline Scenario, it is also very important to bear in mind that the investment for the project Activity is more than 3 times the baseline scenario investment. PEMEX has a limited budget, and the projects are approved, as explained before, after a detailed appraisal from technical and economical point of view, showing that are the better alternative from all the possible solutions for a specific problem or situation. To approve a project with an investment more than 3 times the investment of an alternative solution, leaving aside the fact that the alternative solution has a higher NPV, implies that other projects would not have their investment approved to be carry on.

The results of the financial analysis of all the scenarios were made with highly conservative assumptions, trying to show the best IRR scenario.

Based on the above analysis, it can be concluded that the NPV for the proposed CDM project activity (176,118 million USD) and the IRR (74.63%). NPV without the income from the CER's sale remain less attractive than the NPV (179,065 Million USD) and IRR (239.3%) of Alternative 2, natural gas kilns for heat generation.

As it can be seen, the project activity for dewatering and desalting the Maya crude oil is very economically attractive and feasible due to the prevention of the excess salt content penalties from the crude oil produced. The proposed CDM project activity for waste heat recovery cannot be compared to the conventional operation of natural gas kilns (baseline scenario) because the fuel savings derived from the WHRS are not as high as the salt content penalties savings. Therefore, the natural gas savings are not high enough to justify the additional investment required (more than 3 times the baseline scenario investment) for the installation and operation of the Waste Heat Recovery System.

Due to the current economical situation of the company, where the CAPEX (Capital Expenditure) available for project development is highly limited, PEMEX has instructions to invest in project activities with the highest return value independently of the technology type required.

In the case the CDM registration is obtained, and taking into account the income from the CER's sales, the NPV of the proposed project activity will be up to 185,008 Million USD, which is higher than the NPV of Alternative 2 (the baseline scenario), i.e. 179,065 Million USD. Also, the environmental and sustainable development contribution to the country, the image and economical benefits that the Project Proponent will acquire with the project activity registration as a CDM project activity is a substantial and important incentive for the project implementation because all of the above mentioned will represent an additional economical, social and environmental value for the WHRS project activity.

Also if the CDM registration is obtained, PEMEX PEP would continue analyzing other opportunities for the applicability of the same type of technology for waste heat recovery and efficiency project in the rest of its crude oil production facilities in the country, resulting in the contribution and development of a more efficient and low carbon emission oil production and exploitation sector.

For this reason, the Project Proponent will assume the risk that represents the implementation of a CDM project activity because it considers that the proposed project activity will contribute to a cleaner energy generation development contributing to the social, economical and environmental sustainable development. However, this will be done only if the CDM registration is obtained.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by varying the following parameters:

- Increasing and decreasing the total investment cost.
- Increasing and decreasing the operating and maintenance cost.
- Increasing and decreasing the penalty cost
- Increasing and decreasing the salt content
- Increasing and decreasing the crude oil processed
- Increasing and decreasing the Turbogenerators failure index
- Increasing and decreasing the Petrol Income Tax

Variation in the carbon credit prices was not considered. The recovery system is expected to treat in the beginning up to 600 MBPD, however the expected production capacity of the TMDB is 1,200 MBPD, hence a decrease in the flow treated is not likely to happen, anyway a variation in the amount of crude oil to be treated was considered to evaluate the impact in the project analysis. Financial analyses were performed varying the parameters 10%, and assessing what the impact on the project IRR would be.

Without the carbon credits, the results obtained for the project scenario are the following:

	Variation			
	(+10%)		**(-10%)**	
	IRR	**NPV (000 USD)**	**IRR**	**NPV (000 USD)**
Investment cost	68.65%	173,749	81.92%	178,487
O&M costs	74.53%	175,826	74.73%	176,410
Penalty Costs	81.29%	196,390	67.96 %	155,845
Salt Content	86.04%	210,871	63.18 %	141,365
Production	81.29%	196,390	67.96 %	155,845

The results, varying the same parameters, obtained for the baseline scenario are the following:

	Variation			
	(+10%)		**(-10%)**	
	IRR	**NPV (000 USD)**	**IRR**	**NPV (000 USD)**
Investment cost	218.14%	177,932	264.8%	179,685
O&M costs	239.05%	178,864	239.55%	179,265
Penalty Costs	265.02%	199,694	213.59 %	158,436
Salt Content	283.39%	214,429	195.22 %	143,701
Production	265.02%	199,694	213.59 %	158,436
Natural Gas Cost	236.79%	177,163	241.82%	180,967

Turbogenerators Failure INDEX					
(0%)		**(1.73%)**		**(3%)**	
IRR	**NPV (000 USD)**	**IRR**	**NPV (000 USD)**	**IRR**	**NPV (000 USD)**
75.80%	179,683	74.63%	176,118	73.77%	173,495

Petrol Income Tax	80%	70%	60%	50%	40%	30%
Project IRR	53.57%	74.63%	95.50%	116.31%	137.10%	157.88%
Baseline IRR	163.75%	239.3%	314.81%	390.3%	465.78%	541.25%
Project NPV (000 USD)	111,731	176,118	240,505	304,892	369,280	433,667
Baseline NPV (000 USD)	117,889	179,065	240,240	301,416	362,592	423,767

Table 4. Sensitivity analysis.

As it is shown in the sensitivity analysis, the variables that would make the project activity to reach the same levels of NPV than the baseline scenario are: penalty costs, salt content and production when increasing by 10%. However, those variables also impact the baseline scenario NPV changing to 199,694; 214,429 and 199,694 kUSD respectively.

For the very unlikely scenario of having a 100% of availability of the heat source for the project scenario, the NPV is higher than the baseline scenario, 179,683 and 179,065 kUSD respectively, however, as explained before the investments for both scenarios are 43,885 and 11,487 kUSD respectively. The NPV, like any financial indicator is not enough by itself to make and investment decision as other aspects have to be considered. For the scenario of 0% of failure for the turbogenerators, the difference of 618 kUSD in the NPV is not enough to justify an investment more than three times higher.

A Petrol Income tax of 30% would imply a higher NPV than the Baseline Scenario; however, the difference presented is not enough to justify an investment three times higher. Besides petrol income tax of 30% is very unlikely to happen according to the historic records of percentages paid by PEMEX PEP.

Also, since NPV values obtained for both scenarios are similar, a simulation was made to know under what conditions IRR values would be equivalent for both scenarios. In order for that to happen, the baseline scenario investment would have to be increased by more than a 252% of its current value, baseline operation and maintenance costs would have to be increased by more than 6,500% of its current value or natural gas costs would have to be increased by more than 665% of its current value. For the case of penalty costs, they would have to be around 87% lower than their current value, salt content around 50% lower than its current value and production would have to be around 87% lower than its current value. Petrol income tax would have to be increased by more than 42% of its current value (to a point where none of the scenarios would be convenient).

It is important to remark that the increase of production (process up to 1,200 MBPD) would need the installation of a second train of dehydration and desalting. However, this train would be common for both scenarios and would not have an impact in the amount of waste heat recovered since it will be the same as in the baseline scenario.

The above remarks the high importance of the CDM registration, because obtaining the project approval as a Clean Development Mechanism is the only reason for which PEMEX PEP will reject the implementation of the crude oil dewatering and desalting process with natural gas kilns, even if this scenario is considerable more economically feasible than the proposed project activity.

Therefore, it can be concluded that the proposed CDM project activity is unlikely to be the most economically attractive.

Step 3: Barrier analysis:

Even though there are several technical and prevailing barriers that would prevent the proposed project activity from being carried out, these step will not be carried out because the additionality of the project has been already being proved with the investment analysis.

Step 4. Common practice analysis.

Sub-step 4a. Analyse other activities similar to the proposed project activity.

In Mexico, there are only two facilities both in PEMEX PEP, where the dewatering and desalting process for the crude oil is being carried out and those processes are made using fossil fuels.

Around the country, similar technology is used, but mainly, in cogeneration plants. Most of these types of plants have as main purpose to generate electricity. However, this is not related with the specific context involved in the project activity, since the purpose is only the generation of heat, and not generation of electricity.

Mexico is considered appropriate as geographical scope since the region of the project is the national market. Other countries in Central or North America are not included in the Geographical scope since the petroleum processing and commercialization activities are so different in each country due to government legislation and national market regulations. The practices in different countries cannot be compared since they are not in similar conditions.

Considering a similar socio-economic environment, geographic conditions and technological circumstances, the proposed project activity is unique in utilizing the exhaust gases from the power generators at the TMDB for heat generation in order to reduce GHG emissions and avail the revenues through the sale of carbon emission reductions.

The project activity so far, has achieved very limited penetration in the region because of its major risk factors, which have been previously mentioned at Steps 2 and 3. There was not identified any other source of WHRS similar projects currently operating around the region.

Sub-step 4b: Discuss any similar options that are occurring.

This sub-step does not apply since no similar activities are widely observed nor commonly carried out in the region.

As a result of applying the “Tool for the demonstration and assessment of additionality” ver. 5.2 it is concluded that based on conservative approaches and assumptions the proposed project activity fulfills all the additionality requirements demonstrating that the CDM registration is required and fundamental for its implementation

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Methodology requires accounting for:

Baseline Emissions

The baseline emissions for the year *y* shall be determined as follows:

$$BE_y = BE_{EN,y} + BE_{flst,y} \qquad \textbf{(1)}$$

Where:

BE y	The total baseline emissions during the year *y* in tons of CO2
BE En, y	The baseline emissions from energy generated by project activity during the year *y* in tons of CO2

BE flst, y Baseline emissions from generation of steam, if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (tCO2e per year), calculated as per equation 1c. This is relevant for those project activities where in the baseline steam is used to flare the waste gas.

Since at the baseline there is not any steam used to flare the waste gas, then *BE flst, y* = 0

Baseline emissions for Scenario 1

Scenario 1 represents the situation where the electricity is obtained from a specific existing power plant or from the grid, mechanical energy (displaced waste energy based mechanical turbines in project) is obtained by electric motors and heat from a fossil fuel based element process (e.g. steam generator, hot water generator, hot air generator, hot oil generator).

$$BE_{EN,y} = BE_{Elec,y} + BE_{Ther,y} \qquad \textbf{(2)}$$

Where:

$BE_{Elec,y}$ Baseline emissions from electricity during the year *y* in tons of CO2

$BE_{Ther,y}$ Baseline emissions from thermal energy (due to heat generation by element process) during the year *y* in tons of CO2

<u>Baseline emissions from electricity (BEElec,,y):</u>

Since the project activity would be the generation of heat component only, there is not baseline emissions from electricity, then *BE Elec, y*=0

<u>Baseline emissions from thermal energy (BEther,y):</u>

$$BE_{Ther,y} = f_{cap} * f_{wcm} * \sum_i \sum_j \left(\left(HG_{j,y} \right) + \left(MG_{i,j,y,tur} / \eta_{mech,tur} \right) \right) * EF_{heat,j,y} \qquad \textbf{(3)}$$

Where:

$BE_{Ther,y}$ Baseline emissions from thermal energy (as steam) during the year y in tons of CO_2

$HG_{j,y}$ Net quantity of heat (enthalpy) supplied to the recipient plant j by the project activity during the year y in TJ (In case of hot oil generator this is expressed as difference in energy content between the hot oil supplied to and returned by the recipient plant(s) to element process of cogeneration plant). This includes steam supplied to recipients that may be used for generating mechanical energy.

f_{wcm} Fraction of total heat generated by the project activity using waste energy. This fraction is 1 if the heat generation is purely from use of waste energy. If the element process providing heat uses both waste and fossil fuels, this factor is estimated using equation (1d/1e).

f_{cap} Energy that would have been produced in project year *y* using waste energy generated in base year expressed as a fraction of total energy produced using waste source in year *y*. The ratio is 1 if the waste energy generated in project year *y* is same or less than that generated in base year. The value is estimated using equations (1f), or (1f-1) or (1f-2), or (1g), (1g-1) or (1h)

$EF_{heat,j,y}$	The CO2 emission factor of the element process supplying heat that would have supplied the recipient plant j in absence of the project activity, expressed in tCO2/TJ.
$MG_{i,j,y,tur}$	Mechanical energy generated and supplied to the recipient j, which in the absence of the project activity would receive power from a steam turbine *i*, driven by steam generated in a fossil fuel generator . Refer monitoring table for the guidance to estimate this parameter
$\eta_{mech,tur}$	The efficiency of the baseline equipment (steam turbine) that would provide mechanical power in the absence of the project activity

Since the purpose of the project is not considering any generation of mechanical energy, $MG_{i,j,y,tur}$ = $\eta_{mech,tur}$ = 0. Therefore, equation 3 can be simplified as follows:

$$BE_{Ther,y} = f_{cap} * f_{wcm} * \sum_i \sum_j \left(\left(HG_{J,Y}\right)\right) * EF_{heat,j,y} \quad \textbf{(4)}$$

Respect the *EFheat,j,y* is calculated as follows:

$$EF_{heat,j,y} = \sum_i ws_{i,j} \frac{EF_{CO2,i,j}}{\eta_{EP,i,j}} \quad \textbf{(5)}$$

Where

$EF_{CO2,i,j}$	The CO2 emission factor per unit of energy of the baseline fuel used in i^{th} kiln used by recipient j, in tCO2/TJ, in absence of the project activity
$\eta_{EP,i,j}$	Efficiency of the i^{th} element process that would have been supplied heat to j^{th} recipient in the absence of the project activity
$ws_{i,j}$	Fraction of total heat that is used by the recipient j in the project that in absence of the project activity would have been supplied by the i^{th} kiln

Efficiency of the element process *($\eta_{EP,i,j}$)* shall be one of the following:

(i) Assume a constant efficiency of the element process and determine the efficiency, as a conservative approach, for optimal operation conditions i.e. design fuel, optimal load, optimal oxygen content in flue gases, adequate fuel conditioning (temperature, viscosity, moisture, size/mesh etc), representative or favorable ambient conditions (ambient temperature and humidity); or

(ii) Highest of the efficiency values provided by two or more manufacturers for element process with specifications similar to that would have been required to supply the recipient with heat that it receives from the project activity; or

(iii) Maximum efficiency of 100%;

(iv) Estimated from load v/s efficiency curve(s) established for each element process(es) through measurement and described in Annex 1. Follow international standards for estimation of efficiency of individual element process.

Manufacturers' information about the conditions of the natural gas kilns has been used for this purpose. The highest value of two manufacturers: Foster Wheeler and Thermal Fluid Systems will be used.

<u>Calculation of the energy generated (heat) in units supplied by WHRS and other fuels -- f_{WCM}</u>

The proposed project activity will provide all the heat requirements for the crude oil dewatering and desalting process through the utilization of the WHRS. Therefore the fraction of total heat generated by the project activity using waste energy will be 1 since the heat generation is purely from use of waste energy.

Capping of baseline emissions -- f_{cap}

The methodology requires that baseline emissions should be capped irrespective of planned/unplanned or actual increase in output of plant, change in operational parameters and practices, change in fuels type and quantity resulting into increase in generation of waste energy. In case of planned expansion a separate CDM project should be registered for additional capacity.

The cap can be estimated using the three Methods described below, it shall be used Method-1 to estimate the cap if historical data on energy released by the waste energy carrying medium is available. In case of project activities implemented in a new facility, or in facilities where three-year data on production is unavailable, Method-2 shall be used. In case the project proponents demonstrate technical limitations in direct monitoring of waste heat / pressure of waste energy carrying medium (WECM), then Method-3 is used.

Since there is not available historic data of the exhaust gases and the TMDB facility has technical limitations in the direct monitoring of the waste heat energy carrying medium (WECM), neither Method-1 nor Method-2 cannot be implemented.

Technical limitations in direct monitoring of the waste heat energy are due principally to the width/height relation of the howl; meters manufacturer has specified a howl height of 1.5 diameters before and after the measurement point, this because the evaluated meters use as operation principle the differential pressure and they require those distances to get an adequate velocity profile. Another fact that increases the uncertainty of the measurement is a bifurcation designed to use only the quantity of heat needed, which makes gas flow unstable.

Method-3:
In some cases, it may not be possible to measure the waste energy (heat, sensible heat, heat of reaction, heat of combustion etc.), enthalpy or pressure content of WECM. Therefore there is no historic data available for these cases. According the methodology there are two cases, Case 2 was selected because the waste energy will be recovered through the utilization of hot oil as an intermediate source.

Case 2: The energy is recovered from WECM in intermediate energy recovery equipment using an intermediate source. For example, an intermediate source to carry energy from primary WECM may include the sources such as water, oil or air to extract waste energy entrapped in chemicals (heat of reaction) or solids (sensible heat). This intermediate energy source is finally used to generate the output energy in the final waste heat recovery equipment. For these cases f_{cap} is the ratio of maximum theoretical intermediate energy recoverable from intermediate waste heat recovery equipment and actual intermediate energy recovered under the project activity (using direct measurement) For estimating the theoretical energy, manufacturer’s specifications can be used. Alternatively, technical assessment can be carried out by independent qualified/certified external process experts such as chartered engineers.

Following equation should be used to determine fcap:

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} \quad \textbf{(6)}$$

Where:

$Q_{OE,BL}$ Output/intermediate energy that can be theoretically produced (in appropriate unit), to be determined on the basis of maximum recoverable energy from the WECM, which would have been released (or WECM would have been flared or energy content of WECM would have been wasted) in the absence of CDM project activity.

$Q_{OE,y}$ Quantity of actual output/intermediate energy during year y (in appropriate unit)

Analyses made for the design of the heat recovery system were used to estimate the capped value and the proper justification used for ex-ante purposes.

Project Emissions

Project Emissions include emissions due to (1) combustion of auxiliary fuel to supplement waste gas/heat and (2) electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption; and (3) emissions due to consumption of imported electricity that in the absence of project activity would have been supplied by captive electricity generated (only for Type-2 project activities).

$$PE_y = PE_{AF,y} + PE_{EL,y} + PE_{EL,\mathrm{Im}\,port,y} \quad \textbf{(7)}$$

Where:

PE_y Project emissions due to project activity

$PE_{AF,y}$ Project activity emissions from on-site consumption of fossil fuels by the cogeneration plant(s), in case they are used as supplementary fuels, due to non-availability of waste energy to the project activity or due to any other reason

$PE_{EL,y}$ Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (as per Table 1: Summary of gases and sources included in the project boundary)

$PE_{EL,Import,y}$ Project activity emissions from import of electricity replacing captive electricity generated in the absence of the project activity for Type-2 project activities

Since the project activity is Type-1 activity, $PE_{EL,\mathrm{Im}\,port,y} = 0$

(1) Project emissions due to auxiliary fossil fuel

These emissions are calculated by multiplying the quantity of fossil fuels *(FFi,y)* used by the recipient plant(s) with the CO2 emission factor of the fuel type *i (EFCO2,i)*, as follows:

$$PE_{AF,y} = \sum FF_{i,y} * NCV_i * EF_{CO2,i} \quad \textbf{(8)}$$

Where:

$PE_{AF,y}$	Emissions from the project activity in year *y* due to combustion of auxiliary fuel in tonnes of CO2
$FF_{i,y}$	Quantity of fossil fuel type i combusted to supplement waste energy in the project activity during the year *y*, in energy or mass units
NCV_i	Net calorific value of the fossil fuel type i combusted as supplementary fuel, in TJ per unit of energy or mass units, obtained from reliable local or national data, if available, otherwise taken from the country specific IPCC default factors
$EF_{CO2,i}$	CO2 emission factor per unit of energy or mass of the fuel type i in tons CO2 obtained from reliable local or national data, if available, otherwise taken from the country specific IPCC default factors

Since all the heat requirements for the crude oil dewatering and desalting process will be provided by the WHRS, none auxiliary fossil fuels will be consumed during the project implementation. Therefore, $PE_{AF,y}$ = 0. The waste gas flux is guaranteed since calculation of heat requirements has been made considering two power generators working, in case of failure, there is a third power generator included in the design that can start to work as backup. Besides, in case of need of maintenance of the WHRS, the dewatering and desalting process can continue working up to 24 hours only with the increasing of flocculants content.

(2) <u>Project emissions due to electricity consumption of gas cleaning equipment or other supplementary electricity consumption</u>

Project emissions are calculated by multiplying the CO2 emission factor for electricity ($EF_{CO2,EL}$) by the total amount of electricity used as a result of the project activity ($EC_{PJ,y}$). The source of electricity may be the grid or a captive power plant. Project emissions from consumption of additional electricity by the project are determined as follows:

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,EL,y} \qquad \textbf{(9)}$$

Where:

$PE_{EL,y}$	Project emissions from consumption of electricity in gas cleaning equipment of project activity or other supplementary project electricity consumption (t CO2/yr)
$EC_{PJ,y}$	Additional electricity consumed in year *y* as a result of the implementation of the project activity (MWh)
$EF_{CO2,EL,y}$	CO2 emission factor for electricity consumed by the project activity in year *y* (t CO2/MWh)

For the CO_2 emission factor, it will be considered that it will be provided from an on-site captive power plant (TMDB power generators). The CO2 emission factor for electricity (*EFCO2,EL,y*) will be determined based on the fuel consumption and electricity generation in year *y*, as follows:

$$EF_{CO2,EL,y} = \frac{\sum_k FC_{EL,CP,k,y} \times NCV_k \times EF_{CO2,k}}{EC_{CP,y}} \qquad \textbf{(10)}$$

Where:

$EF_{CO2,EL,y}$	CO2 emission factor for electricity consumed by the project activity in year *y* (t CO2/MWh)
$FC_{EL,CP,k,y}$	Quantity of fuel type *k* combusted in the captive power plant at the project site in year *y* (mass or volume unit)
NCV_k	Net calorific value of fuel type *k* (GJ/mass or volume unit)
$EF_{CO2,k}$	Emission factor of fuel type *k* (t CO2/GJ)
$EC_{CP,y}$	Quantity of electricity generated in the captive power plant at the project site in year *y* (MWh)
k	Fuel types fired in the captive power plant at the project site in year *y*

Leakage

No leakage is applicable under this methodology.

Emission Reductions

Emission reductions due to the project activity during the year *y* are calculated as follows:

$$ER_y = BE_y - PE_y \qquad \textbf{(11)}$$

Where:

ER_y	Total emissions reductions during the year *y* in tons of CO2
PE_y	Emissions from the project activity during the year *y* in tons of CO2
BE_y	Baseline emissions for the project activity during the year *y* in tons of CO2.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	η_{BL} ($\eta_{EP,i,j}$,)
Data unit:	(%)
Description:	Baseline efficiency of the element process equipment.
Source of data used:	Manufacturer's data.
Value applied:	90.2% for natural gas kilns .
Justification of the choice of data or description of measurement methods and procedures actually applied :	Highest of the efficiency figure provided by natural gas kilns manufacturers. The highest value of two manufacturers: Foster Wheeler and Thermal Fluid Systems will be used.
Any comment:	These values will remain constant throughout the crediting period.

Data / Parameter:	$Q_{OE,\ BL}$
Data unit:	TJ/year
Description:	Quantity of heat that can be theoretically recovered by the hot oil in the process
Source of data used:	LIPSA design data.
Value applied:	According to the technical design up to 1,628 TJ/year can be processed
Justification of the choice of data or description of	Energy balance from technical designer

measurement methods and procedures actually applied :	
Any comment:	These values will remain constant throughout the crediting period.

B.6.3. Ex-ante calculation of emission reductions:

According to information provided by the power generators suppliers, those will not have an important reduction of their efficiency. The power drop expected depends of the pressure drop caused by the installation of the heat recovery system. According to the design pressure drop for the recovery heat system the power drop forecasted is 1.1%. Being this value that small it will be considered negligible for the ex-ante calculation of emission reductions.

In order to follow the requirements of the methodology ACM0012, version 3, it will be provided an ex-ante estimation of the emission reduction of the project activity.

Baseline Emissions

As it was described before, and according to the proposed activity, the only component for the scenario 1 will be baseline emissions coming from thermal energy. This leads to the equation (4) described before:

$$BE_{Ther,y} = f_{cap} * f_{wcm} * \sum_i \sum_j ((HG_{J,Y})) * EF_{heat,j,y}$$

Clarifications will be described:

<u>The CO_2 emission factor per unit of energy of the baseline fuel used in ith generator used by recipient j (*EFCO2,i,j*)</u>

$$EF_{heat,j,y} = \sum_i ws_{i,j} \frac{EF_{CO2,i,j}}{\eta_{EP,i,j}}$$

In the baseline scenario for the crude oil dewatering and desalting process at the TMDB, four natural gas kilns will produce the required need of heat for the process.

The destination of the heat produced by the project activity will be directed to this same crude oil dewatering and desalting process, which it would mean that *wsi,j* will be 0.25 considering that there are the same four kilns that would have been supplied the heat required, in the absence of the project activity. Also, the four kilns would use a common hot oil system where the quantity of hot oil and its temperature would be continuously recorded.

The four kilns would use the same type of fossil fuel (natural gas). Since there is no information from the project and country data, 2006 IPCC data will be used for the emission factor of natural gas, therefore, it will be used 56.1 tCO_2/ TJ.

The efficiency of these kilns (90.2%) was given based on the highest value of two manufacturers' data. $EF_{heat,j,y}$ result is 62.20 tCO_2/ TJ, for ex-ante purposes.

Net quantity of heat supplied to the recipient plant j by the project activity during the year *y* in TJ ($HG_{j,y}$)

$HG_{j,y}$ = Energy of hot oil supplied to the crude oil dewatering and desalting process – Energy of hot oil returned to element process.

This value can be obtained from the design variables used by WHRS supplier in the design of the heat exchangers. Three heat exchangers will be installed to recover the heat from the waste gas.

Heat Recovers BA-700B/C/D (Source: Technical Analysis by WHRS supplier	
Heat supplied in each Heat Exchanger (kcal/hr)	22,581,705
Heat Exchangers (HX with normal operation)	2
Spare Heat Exchangers	1
Turbogenerators Failure INDEX	1.73%

Table 5. Specifications for the Heat Exchangers.

$$HG_{j,y} = (22{,}581{,}705 kcal/hr - HX)*(2HX)*(4.187kJ/kcal)*(1TJ/1{,}000{,}000{,}000kJ)*$$
$$(24hr/day)*(365day/year)*(100-1.73)\%$$

$$HG_{j,y} = 1628 TJ/year$$

Fraction of total heat generated by project activity using waste gas (f_{WCM})

The proposed project activity will provide all the heat requirements for the crude oil dewatering and desalting process through the utilization of the WHRS. Therefore the fraction of total heat generated by the project activity using waste energy will be one, f_{WCM} =1, since the heat generation is purely from use of waste energy.

Capping of baseline emissions -- f_{cap}

Since there is not available historic data of the exhaust gases and there are technical limitations in direct monitoring of waste heat / pressure of waste energy carrying medium (WECM), Method-3 will be implemented.

f_{cap} has been calculated by using the maximum heat that can be recovered by the hot oil, the Energy Balance elaborated by the recovery system manufacturer, shows that each heat exchanger can recover up to 22,581,705 kcal/hr, as there will be two heat exchangers operating the maximum heat recoverable by the hot oil would be 1,628 TJ/year

Ratio will be 1 since the energy recovered in the project will be the same than the energy available prior to the start of the project activity.

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} = 1$$

The following table resumes the baseline emissions results:

f_{cap} (fraction)	f_{WCM} (fraction)	$HG_{i,y}$ (TJ/yr)	$EF_{heat,y}$ (tCO2/TJ)	**BE $_{therm}$ (tCO_2/ year)**
1	1.00	1,628	62.20	101,246

Table 6. Baseline emissions summary.

Total Baseline Emissions: 101,246 tCO2/year

Project Emissions

As it was described before, and according to the proposed activity, the only component for project emissions, for ex-ante purposes, will be the consumption of electricity from a captive power plant as PEMEX TMDB consumes electricity from its own power generators.

$$PE_y = PE_{AF,y} + PE_{EL,y} + PE_{EL,\mathrm{Im}\,port,y} \quad ; \quad PE_{EL,\mathrm{Im}\,port,y} = 0$$

<u>Project emissions due to auxiliary fossil fuel ($PE_{AF,y}$)</u>

$$PE_{AF,y} = \sum FF_{i,y} * NCV_i * EF_{CO2,i}$$

Since all the heat requirements for the crude oil dewatering and desalting process will be provided by the WHRS, none auxiliary fossil fuels will be consumed during the project implementation. Therefore, $PE_{AF,y}$ = 0.

<u>Project emissions due to electricity consumption of other supplementary electricity consumption ($PE_{EL,y}$)</u>

For the project activity, the main consumption of electricity will come from the pumping system required for the hot oil that will be used as the intermediate energy source in the WHRS, in MWh/year:

Hot Oil Pumping (MWh/yr)	9,802.44
Cooler Pump (MWh/yr)	653.50
Hot Oil Reposition Pump (MWh/yr)	49.01

Table 7. Electricity consumption assumptions. Source: Heat recovery system technical design.

<u>Electricity emission factor.</u>

The on-site power generators from the Dos Bocas Maritime Terminal will provide the required electricity consumption for the project activity. The electricity emission factor was calculated based on historical electricity generation and fuel consumption as follows:

$$EF_{CO2,EL,y} = \frac{\sum_k FC_{EL,CP,k,y} \times NCV_k \times EF_{CO2,k}}{EC_{CP,y}}$$

		Source
Power generation (MWh)	202,017.75	Plant Records
Natural gas		
Consumption (ft3/year)	2,266,387,011	Plant Records

NCV (BTU/ft3)	1,313.6	Gas Cromatography
Emission factor (Ton CO2/TJ)	56.1	IPCC
Diesel		
Consumption (barrels/year)	158,664.245	Plant Records
NCV (kcal/kg)	11,680	Industrial cost report
Diesel density (kg/l)	0.837	Units and conversion fact sheet
Emission factor (Ton CO2/TJ)	74.1	IPCC
Electricity Emission factor (TonCO2/MWh)	1.25	

Table 8. Electricity emission factor data.

The following table resumes the project emissions results:

Hot Oil Pumping (MWh/yr)	**Cooler Pump** (MWh/yr)	**Hot Oil Reposition Pump**(MWh/yr)	**$PE_{AF,y}$ (tCO2/yr)**
9,802.44	653.50	49.01	13,135

Table 9. Project emissions summary.

Total Project Emissions: 13,135 tCO_2/year

Leakage Emissions

No leakage is applicable under this methodology.

Emissions Reductions

Emission reductions due to the project activity during the year y are calculated as per equation (11)

$$ER_y = BE_y - PE_y$$
$$ER_y = 101{,}246 - 13{,}135 = 88{,}111$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	**Estimation of project activity emissions (tonnes of CO_2 e)**	**Estimation of baseline emissions (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of overall emission reductions (tonnes of CO_2 e)**
1/06/2012-31/05/2013	13,135	101,246	0	88,111
1/06/2013-31/05/2014	13,135	101,246	0	88,111
1/06/2014-31/05/2015	13,135	101,246	0	88,111

1/06/2015-31/05/2016	13,135	101,246	0	88,111
1/06/2016-31/05/2017	13,135	101,246	0	88,111
1/06/2017-31/05/2018	13,135	101,246	0	88,111
1/06/2018-31/05/2019	13,135	101,246	0	88,111
1/06/2019-31/05/2020	13,135	101,246	0	88,111
1/06/2020-31/05/2021	13,135	101,246	0	88,111
1/06/2021-31/05/2022	13,135	101,246	0	88,111
Total (tonnes of CO2 e)	**131,351**	**1,012,461**	**0**	**881,110**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	$ws_{i,j}$
Data unit:	-
Description:	Fraction of total heat that is used by the recipient j in the project activity that in absence of the project activity would have been supplied by the i^{th} kiln .
Source of data to be used:	Estimated from data on expected heat consumption given by the Project Proponent,
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$ws_{1,j}$ = 0.25 $ws_{2,j}$ = 0.25 $ws_{3,j}$ = 0.25 $ws_{4,j}$ = 0.25
Description of measurement methods and procedures to be applied:	Proper advice and information of changes will be given by TMDB facility. Monitoring frequency: yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$Q_{OE, y}$
Data unit:	TJ/yr
Description:	Heat recovered by the hot oil.
Source of data to be used:	Direct measurements by project participant.
Value of data applied	

for the purpose of calculating expected emission reductions in section B.5	1,628 TJ/yr
Description of measurement methods and procedures to be applied:	Heat recovered by the oil is determined as the difference of the enthalpy of the hot oil generated by the WHRS minus the enthalpy of the feed-hot oil. The respective enthalpies should be determined based on the mass (or volume) flows and the temperatures. Hot oil tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature. Monitoring frequency: Continuously Length of Archiving: 2 years after the end of the crediting period. Measurement of thermal oil flow will be made with a plate orifice meter at the exit of the Heat Recovers BA-700 B/C/D Measurement of temperature is made with digital thermometer Rosemount
QA/QC procedures to be applied:	Measuring equipment should be calibrated annually on regular equipment. During the time of calibration and maintenance, alternative equipment should be used for monitoring.
Any comment:	

Data / Parameter:	*HGj,y*
Data unit:	TJ / year
Description:	Net quantity of heat supplied to the recipient plant j by the project activity during the year *y* in TJ. For the case of the heat by the WHRS this is expressed as difference of energy content between the hot oil supplied to the crude oil dewatering and desalting process and the hot oil returned to the WHRS.
Source of data to be used:	Project Proponent measurement records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,628 TJ/yr
Description of measurement methods and procedures to be applied:	Heat recovery is determined as the difference of the enthalpy of the hot oil supplied to and returned by the recipient plant. The respective enthalpies should be determined based on the mass (or volume) flows and the temperatures. Hot oil tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature. Monitoring frequency: Continuously Length of Archiving: 2 years after the end of the crediting period. Measurement of thermal oil flow will be made with a plate orifice meter at the exit of the Heat Recovers BA-700 B/C/D Measurement of temperature is made with digital thermometer Rosemount
QA/QC procedures to be applied:	Measuring equipment should be calibrated annually on regular equipment. During the time of calibration and maintenance, alternative equipment should be used for monitoring.
Any comment:	Expressed as the difference between the hot oil supplied and the hot oil returned, both in energy units.

Data / Parameter:	$EF_{CO2,natural\ gas,kiln}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO2 emission factor per unit of energy of natural gas used in the kilns in absence of the project activity.
Source of data to be used:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	56.1
Description of measurement methods and procedures to be applied:	Monitoring Frequency: Yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	No QA/QC necessary for this data item
Any comment:	IPCC guidelines/Good practice guidance provide for default values where local data is not available.

Data / Parameter:	$EF_{heat,j,y}$
Data unit:	Tonnes CO_2 / TJ
Description:	The CO2 emission factor of the element process supplying heat that would have supplied the recipient plant j in absence of the project activity.
Source of data to be used:	Based on values of other data items described above.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	62.20
Description of measurement methods and procedures to be applied:	Monitoring Frequency: Yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	No QA/QC necessary for this data item
Any comment:	This data item is a calculated value using other data items. No QA/QC required.

Data / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year *y*, for any other project related equipment, as a result of the implementation of the project activity.
Source of data to be	Actual measurements, plant operational records

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10,505
Description of measurement methods and procedures to be applied:	Measurements of pumps consumption will be done with watt-hour meter Monitoring Frequency: continuously, aggregated monthly/yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Self-registration records. Calibration frequency: Annually.
Any comment:	This value includes pumps electricity consumption.

Data / Parameter:	$EF_{CO2,EL,y}$
Data unit:	t CO2/MWh
Description:	CO2 emission factor for electricity consumed by the project activity in year *y*
Source of data used:	Plant operational records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.250
Description of measurement methods and procedures to be applied:	Monitoring Frequency: yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	None
Any comment:	Only applicable if electricity is consumed from the on-site power generators.

Data / Parameter:	$FC_{EL,CP,k,y}$
Data unit:	ft3 and liters
Description:	Quantity of fuel type k combusted in the captive power plant at the project site in year y where k are the fuel types fired in the captive power plant at the project site in year y
Source of data used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Natural Gas Consumption: 2,266,387,011 ft^3/year Diesel Consumption: 25,222,379 liters/year
Description of measurement methods and procedures to be	- Use weight or volume meters Monitoring Frequency: Continuously, aggregated at least annually Length of Archiving: 2 years after the end of the crediting period.

applied:	Gas consumption will be measured using a mass flow sensor, Micromotion, Gas flow accuracy: +/- 0.75% of flow rate. Location: Before the turbogenerators.
QA/QC procedures to be applied:	Cross-checked measurement results with the quantity of heat generated and fuel purchase receipts. Calibration frecuency: Anually
Any comment:	Only applicable if electricity is generated on-site

Data / Parameter:	NCV_k
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of fuel type k where k are the fuel types fired in the captive power plant at the project site in year y
Source of data used:	Measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Natural Gas: 1313.6 BTU/ft3 Diesel: 11,680 kcal/kg
Description of measurement methods and procedures to be applied:	-For the gas, measurements will be carried on using chromatograph model PLGC - For diesel, Measurements shall be carried out at reputed laboratories and according to relevant international standards - In case of measurements: At least every six months, taking at least three samples for each measurement.
QA/QC procedures to be applied:	
Any comment:	Only applicable if electricity is generated on-site

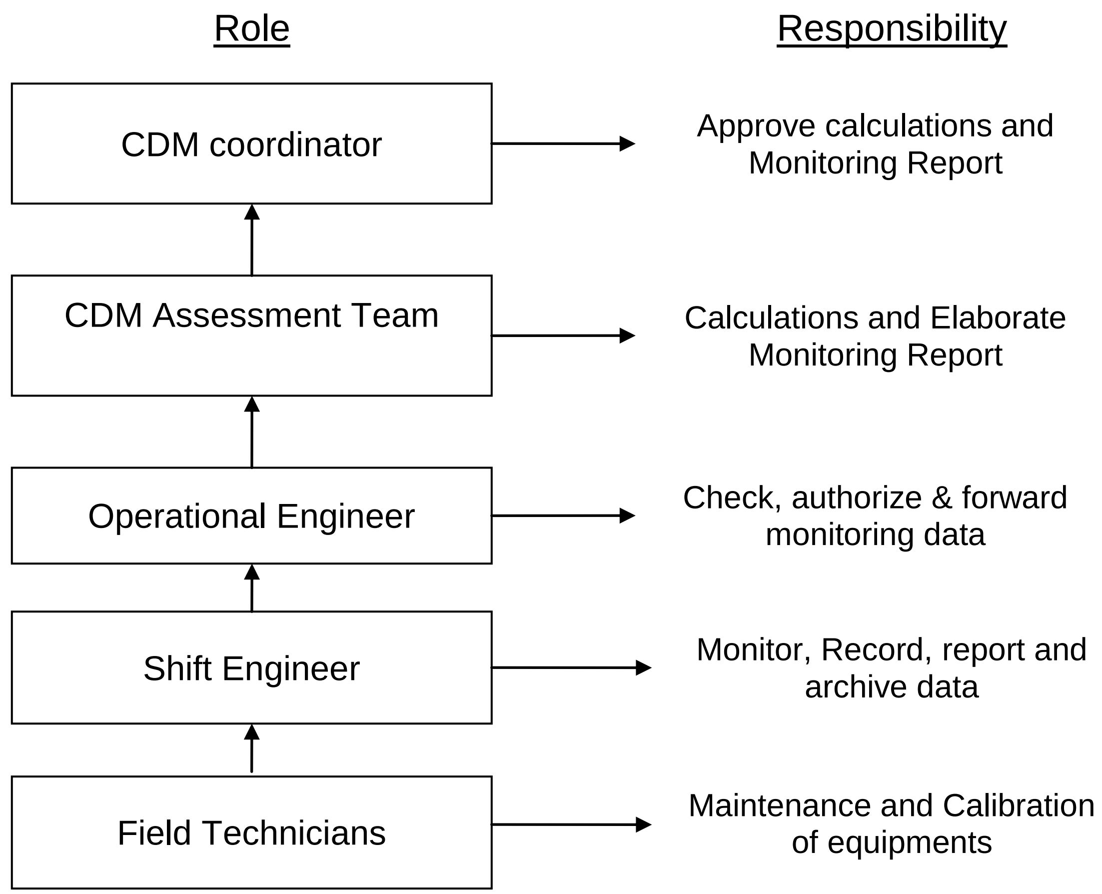
Data / Parameter:	$EF_{CO2,k}$
Data unit:	tCO_2/GJ
Description:	Emission factor of fuel type k where k are the fuel types fired in the captive power plant at the project site in year y
Source of data used:	IPCC default values.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Natural Gas: 0.0561 TonCO2/GJ Diesel: 0.0741 TonCO2/GJ
Description of measurement methods and procedures to be applied:	Monitoring Frequency: Yearly Length of Archiving: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	No QA/QC necessary for this data item
Any comment:	IPCC guidelines/Good practice guidance provide for default values where local data is not available.

Data / Parameter:	$EC_{CP,y}$
Data unit:	MWh
Description:	Quantity of electricity generated in the captive power plant at the project site in year y
Source of data used:	Use electricity meters
Value of data applied for the purpose of calculating expected emission reductions in section B.5	202,017.75 MWh/year
Description of measurement methods and procedures to be applied:	Monitoring Frequency: Continuously, aggregated anually Length of Archiving: 2 years after the end of the crediting period. For TG-1 and TG-2: • Watt-hour meter For TG-3 and TG-4: • GE Protective Relay • Following specifications: ENERGY METERING Description: continuous total of +watthours and ±varhours Range: 0.000 to 4000000.000 Mvarh Timing accuracy: ±0.5% Update Rate: 50 ms POWER METERING Range: -2000.000 to 2000.000 MW, –2000.000 to 2000.000 Mvar, 0 to 2000.000 MVA Accuracy at Iavg < 2 × CT: ±1% of × 2 × CT × VTratio × VTfull-scale Accuracy at Iavg > 2 × CT: ±1.5% of × 20 × CT × VTratio × VTfull-scale
QA/QC procedures to be applied:	Meters will be calibrated annually.
Any comment:	Only applicable if electricity is generated on-site

B.7.2. Description of the monitoring plan:

The responsible entity for the monitoring system is PEMEX PEP personnel.

Next figure describes the operational and management structure that will monitor emissions reductions generated by the project activity.



Maintenance Plan: The following aspects are the focus on the maintenance of the monitoring system in order to assure the data monitoring during the project:

- Equipment preventive maintenance; and
- Equipment calibration.

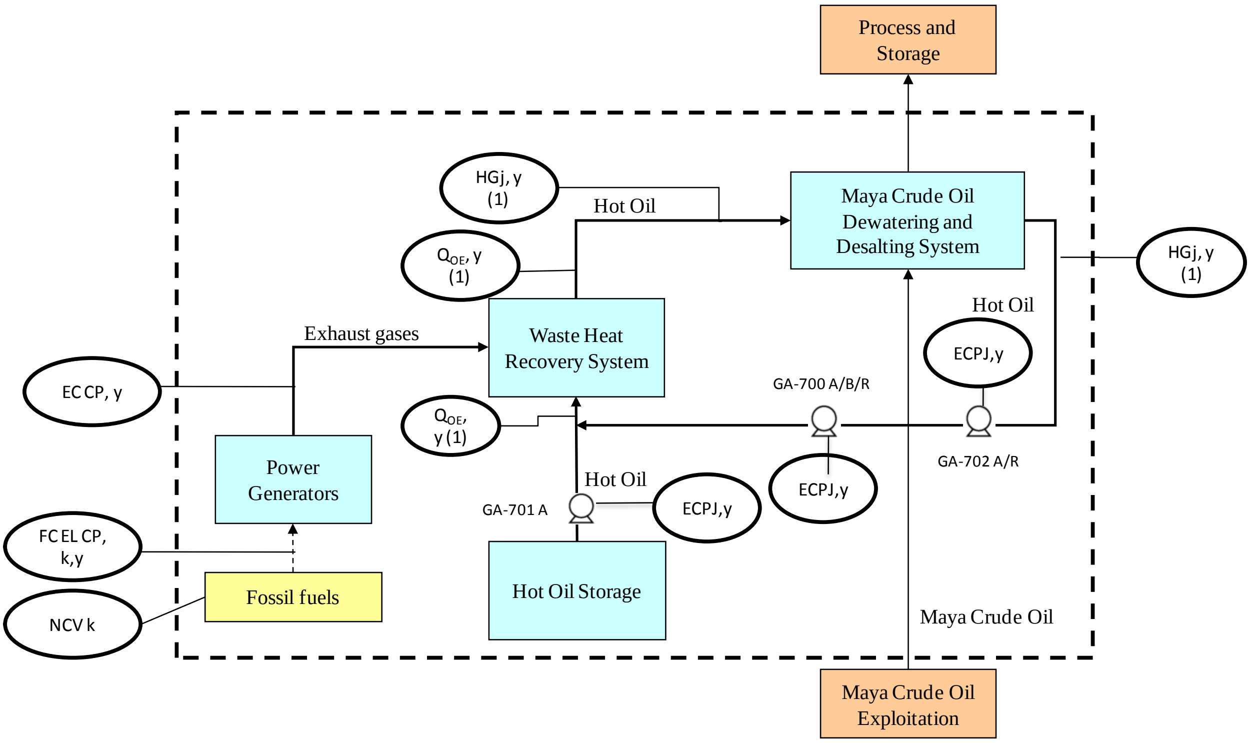
Register of Field Monitoring: The monitoring of the variables of the process indicated on B.7.1 item will be carried out electronically on a automated system in order to ensure the behavior of the activities of the project in all time, this will allow the verification and corrections to any irregularities in the process and the development of preventive actions in time to eliminate its causes.

Backup: All the monitoring data will be daily backed up to ensure a minimum loss of data.

Calibration of the measurement equipment: The calibration of the measurement equipment and/or monitoring will be done periodically, considering the date of validity of an official calibration document from, whenever applicable, and from qualified companies/entities.

Periodical Inspection: Inspections will be carried out by the responsible ones in the involved technical team, related to the: accompaniment of the operation; inspection of the equipment and analysis of the data collected and indexes of maintenance and regularity of the functioning of the equipment.

Next, it is presented the project boundary chart including the variables to measure:



(1) This is calculated in base to the hot oil temperature and flow.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completion of the baseline study: 15/12/2008.

Alfonso Lanseros Valdés
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This entity is not a project participant.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

01/06/2012. Which is the expected date for registration.

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

10 years

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

C.2.1. Renewable crediting period:

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

Not applicable

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/06/2012, but not earlier than registration.

C.2.2.2. Length:

10 years.

SECTION D. Environmental impacts

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

The Host party regulatory authority does not require to the TMDB facility of PEME PEP to conduct an Environment Impact Assessment (EIA) as per the statutory requirements for the project activity. For this project, which involves an operability modification by introducing a WHRS to take advantage of the heat content of the power generators exhaust gases, EIA study was not mandatory. The project activity will introduce a cleaner process for heat generation at the TMDB.

The TMDB facility of PEMEX PEP counts with the environmental permit LAU-09/00467-2003, from the National Ecology Institute, that allows PEME PEP the operation of the Dos Bocas Maritime Terminal (TMDB). This permit authorizes PEMEX PEP to carry out the activities for crude oil and other oil products storage, management and exportation. Since the proposed project activity will be developed within the boundary and limits of the TMDB facility no additional permits or licenses are required by the local or national authority. However the impact of the activity on the environment has been meticulously examined by the project proponent.

- **Impact on Ambient Air Quality:** The displacement of natural gas consumption by the utilization of the residual energy contained in the power generators exhaust gases will helps in the reduction of a substantial amount of CO_2 emissions. Reduction of GHG emission contributes largely to the improvement of air quality of the surrounding environment. The heat will be generated without using fossil fuel and thus minimizing greenhouse gas emissions.
- **Impact on Biodiversity:** The project activity itself does not have any negative impact on biodiversity of the surrounding environment. Reduction in the GHG emission only helps in the improvement of the ecological balance of the environment.
- **Impact on water quality**: The project activity does not provide any scope for the degradation of water quality inside and outside the plant premises.

Therefore, the positive environment impacts from the project activity can be represented as:

- The project activity has resulted in savings of GHG emission, which in the baseline scenario would have been caused due to the exclusive use of natural gas for heat generation in the TMDB.
- The project activity results in a reduction of natural gas consumption in the TMDB and other associated emissions, which include carbon dioxide, sulphur oxides and nitrogen oxides (at the natural gas kilns that would be installed in the absence of the project activity). The improvement in the ambient air-quality after the implementation of the project activity is worth noticeable.
- All types of waste generation due to transportation, handling, and utilization of natural gas in the TMDB will be minimized.

These aspects contribute to the regional and global benefits.

There are no negative environmental impacts from the installation of technologically instrumentation work. The technologies and installation does not require any major construction equipment.

D.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:

Not applicable.

SECTION E. Stakeholders' comments

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

On the 10th of December 2008 PEMEX PEP invited different stakeholders and neighbors, representing the local community near to the project activity site, in order to explain them that PEMEX PEP is working on the identification, documentation and execution of different project activities to reduce greenhouse gas emissions. One of these initiatives is the development and implementation of the Waste Energy Recovery Project at the Dos Bocas Maritime Terminal (TMDB).

The stakeholders' consultation took place in the Conference Room of the Boulevard Hotel in the city of Paraiso at 11:00 hrs, where several representatives of the fishing, health, education, agricultural, legislative, environmental and industrial sector participated. The consultation consisted in an explanation of the proposed CDM project activity which consists in the reduction of fossil fuels consumption through the recovery of the waste heat content of the power generators exhaust gases to use it as heat source for the Maya crude oil dewatering process. During the stakeholders consultation process the following topics about the project were discussed:

- Greenhouse effect, Global warming and the Kyoto Protocol
- Main activities of PEMEX PEP and the TMDB
- Description of the proposed project activity
- Expected benefits

During the project presentation, questions and comments were clarified and then PEMEX PEP asked each participant to answer a questionnaire in order to know their opinions and concerns about the project and confirm if they agreed or not with the project implementation.

At the end of the presentation the guest signed an Assistance registry. Also photos were taken from the presentation as evidence for the project approval.

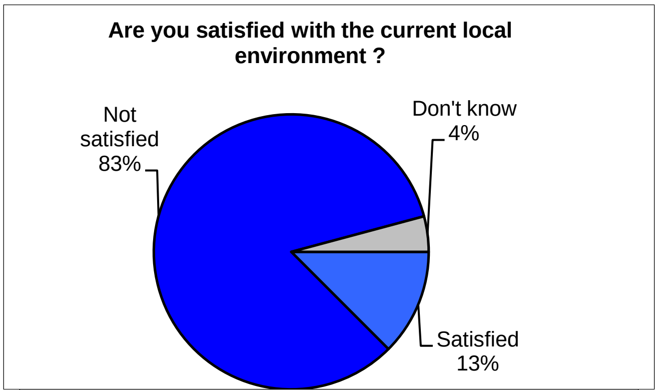
Figure 4. Local stakeholders consultation

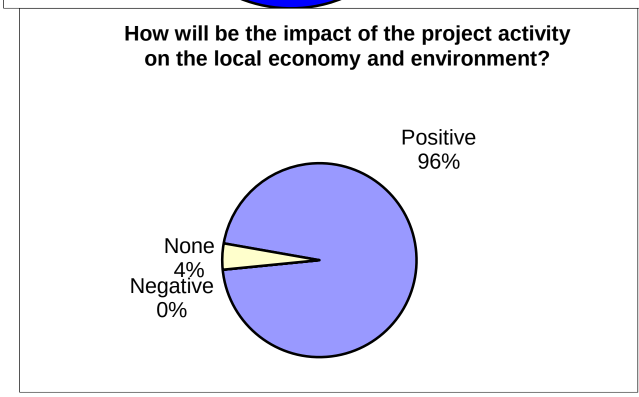
The stakeholders that participated in the consultation process were the following:

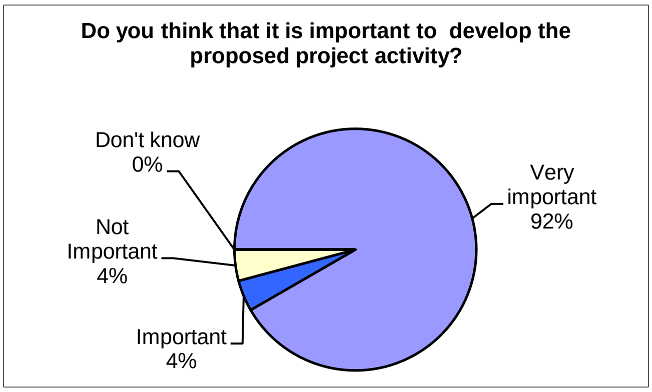
Name	Position /Labor
Luis Manuel Perez Madrigal	Fishermen Representative
Jorge Márquez Méndez	Government employee
Jose Luis Hidalgo Sanchez	University employee (Tabasco University)
Teodoro Wilson Gallegos	Fishermen Representative
Gonzalo Ortíz León	University employee (Chontalpa University)
Jorge Sastre Hernández	Health Verifier
Jose Castellano Cordova	Doctor

Name	Position /Labor
Exiovio Flores Fuentes	Farmer (Rural National Confederation)
Alfredo Cuevas	Natural Resources and Environmental Protection State Secretary (SERNAPAM)
Favio F. Aguirre Rueda	PEMEX
David Gustavo Minaya Pérez	Teacher
Bruno Marzo Degollado	Natural Resources and Environmental Protection State Secretary (SERNAPAM)
Ramón Bagza Romoro	Professional
Leticia Rodríguez	Natural Resources and Environmental Protection State Secretary (SERNAPAM)
Pedro Ricardo Castro Palomeque	Government employee
Benjamin Santos López	Government employee
Teodoro Perez Garcia	Government employee
Carmen Colorado Galmiche	Treasury Department Trustee
Carlos Mario Hernández Madrigal	Engineer
Arnulfo Cordova Perez	Agronomical Engineer
Deyanira Perez Magaña	Teacher
Pedro M. Cavepa	Doctor
Jose Luis Perez Angulo	Architect
Gilberto Beristain Maria	Engineer
Franklin Oyosa Ortiz	City Council
Candelario Olán Gomez	City Council

The following figures summarize the local community perception about the waste heat recovery project activity proposed by PEMEX PEP.







The local stakeholders concluded that the proposed CDM project activity will contribute to Mexico and the local community's sustainable development because through its implementation the local community will obtain several benefits such as the generation of new employment sources during the construction phase, the introduction of new technology for the development of similar projects and the improvement of the health and life quality in the zone.

E.2. Summary of the comments received:

All questions from the stakeholders were answered during the consultation sessions. Among the comments received are:

- Apply the project activity in other element process.
- To keep informed the local community about the implementation and status of the project activity.
- Carry out similar activities/projects in the TMDB burners to avoid/reduce emissions.
- The local stakeholders congratulated and appreciated the information given by PEMEX PEP about the project activity

Received comments show that stakeholders agree with the project. They understand that the project generates benefits to the local communities, and to the general environmental protection.

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

All comments received by the stakeholders were positive. No suggestions concerning the proposed project activity were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in this project

Annex 3

BASELINE INFORMATION

See Section B 6.3. A Detailed calculation spreadsheet will be provided to the DOE.

Annex 4

MONITORING INFORMATION

Discussed in Section B.7.2