Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Panuco Bagasse Cogeneration Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	07
Completion date of the PDD	05/02/2021
Project participants	Ingenio Panuco Sapi de CV (Private entity)
Host Party	Mexico
Applied methodologies and standardized baselines	ACM0006: Consolidated methodology for electricity and heat generation from biomass - version 12.1.1
Sectoral scopes	1: Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	97,660

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The proposed project is a new bagasse cogeneration project in México, located in the Panuco municipality basin in the Veracruz State which belongs to Pantaleon Group. The new cogeneration plant will be part of the existing sugar mill that process approximately 1,500,000 tonnes of sugar cane per year[1].

The project aims replace the actual cogeneration plant with installed capacity around of 17.2 MW to increase the installed capacity of a sugar mill around 122.666 MW[2].

Prior to the project activity, steam demand for cogeneration purposes is covered by 5 boilers that totalizing an installed capacity of 210 t/h of superheated steam at 23 bar and 331°C. Part of the steam produced by these boilers is delivered to the process and another part to feed 5 steam turbines that totalize an installed capacity of 17.2 MW[3]. All electricity produced is consumed by the plant processes and there is no surplus of electricity to be exported to the national grid.

Therefore, the purpose of the project activity is to supply electricity and heat to the various processes of the Panuco sugar mill by replacing fossil fuel (Bunker) by biomass combustion only. In addition, the project will also export excess electricity to the grid, further contributing to reduction of greenhouse gas emissions.

The CDM project activity is composed by two phases:

1st Phase: (2016 to 2019)
This phase involves the installation of a new boiler with operational conditions around 83 bar and 538ºC and a new back- pressure steam turbine with 45.466 MW of installed capacity, which will substitute the current turbines, totalizing an installed capacity of 62.666 MW (17.2 MW back-up and 45.466 MW new back-pressure turbine). As a result, the site will continue to cover its entire energy consumption and will export around 29.0 MW to the national power grid, which represents about 165,792 MWh per year of net electricity[4].

2nd Phase (2020)
This phase involves the installation of another new boiler with operational conditions around 83 bar and 538ºC and a new condensing steam turbine of around 60.0 MW totalizing 122.666 MW of installed capacity in the cogeneration plant. As a result, the site will continue to cover its entire energy consumption and will export to the national power grid around 110,334 MWh per year of net electricity.[5]

---

[1] *Desarrollo operativo* report developed by project developer (Panuco Sapi de CV). 2012.

[2] Cogeneration and extension plant study developed by *Consultores de Ingenios Azucareros S.A.* 2012.

[3] Installed capacity report developed by project developer (Panuco Sapi de CV). 2012

[4] Mass and energy balance of new cogeneration plant developed by project developer (Panuco Sapi de CV). 2012

[5] Mass and energy balance of new cogeneration plant developed by project developer (Panuco Sapi de CV). 2012

The estimate of emission reductions has been calculated according to the methodology ACM0006[6], version 12.1.1:

- Annual average is 97,660 tCO_2e;
- Total GHG emission reduction is 683,622 tCO_2e.

Contribution of the Project Activity to Sustainable Development:

The project will make a strong contribution to sustainable development in México. In addition to reducing emissions of GHGs and generating clean electricity, the Project will provide other sustainable development benefits as follows:

a) Contribution to the environment:

Electrical generation in the project will displace electricity generated by fossil fuel-fired power plants. Biomass energy is a renewable energy source, and unlike fossil fuels, it does not reduce the availability of energy for future generations contributing to reduction of greenhouse gas emissions and other pollutants in Mexico by replacing electricity otherwise generated by the Mexican national grid, which has a large share of fossil fuel power generation.

Moreover, the project activity setting an example for the sugar industry in Mexico, accelerating its transformation to high efficiency technologies and contributing to the technology transfer through import, implementation and utilization of high efficiency cogeneration system.

The project is innovator in the sugar sector of México due several reasons as, installed capacity is the double that the second largest biomass cogeneration project in México[7] [8] and because the boilers that will be installed have characteristics do not used in México in comparison to the all projects that using biomass to cogeneration of energy[9].

Furthermore, each boiler that will be installed includes an electrostatic separator that meets the atmospheric patterns of World Bank regarding particulate emissions, and all cooling systems operate in close circuit to reduce and minimize the consume of water.

b) Contribution to the improvement of working conditions and employment creation:

During the operational phase, there will be new jobs created locally for duties related to construction, operations and maintenance, monitoring and security personnel. These people will be fully trained by Panuco Plant on their duties and tasks. Local manpower will be used preferentially in the project implementation and operation of the project activity.

c) Contribution to income generation:

In addition to the local jobs created during its implementation and operation, the project will pay taxes to the government. The new workers that will be contracted preferentially of the region, therefore, the local commerce around this workers will be affected positively, contributing to the increment of local consume in the region, creating a distribution chain that would affect directly and indirectly to the local population.

---

[6] https://cdm.unfccc.int/methodologies/DB/U3THXNPFFSPP2WO1MFB20DXU1444S5

[7] Energy Regulatory Commission: http://www.cre.gob.mx/articulo.aspx?id=171 accessed on 09/02/2013

[8] UNFCCC: https://cdm.unfccc.int/Projects/DB/ERM-CVS1351604450.65/view accessed on 09/02/2013

[9] Boiler manufacturer technical proposal, Isgec Heavy Engineering Limited (ISGEC), January 2013.

A.2. Location of project activity

>>

Host Party:

- México

Region/State/Province etc:

- Huasteca Alta Region/Veracruz de Ignacio de la Llave State

City/Town/Community etc:

- Panuco Municipality

Physical/Geographical location:

- The cogeneration plant is located at coordinates: Latitude:22.050000° and Longitude:-98.183333°.

Figure 1- Physical/Geographical location of Panuco Municipality/Veracruz State

A.3. Technologies/measures

>>

a) The scenario existing prior to the start of the implementation of the Project Activity is as presented in the Figure below:

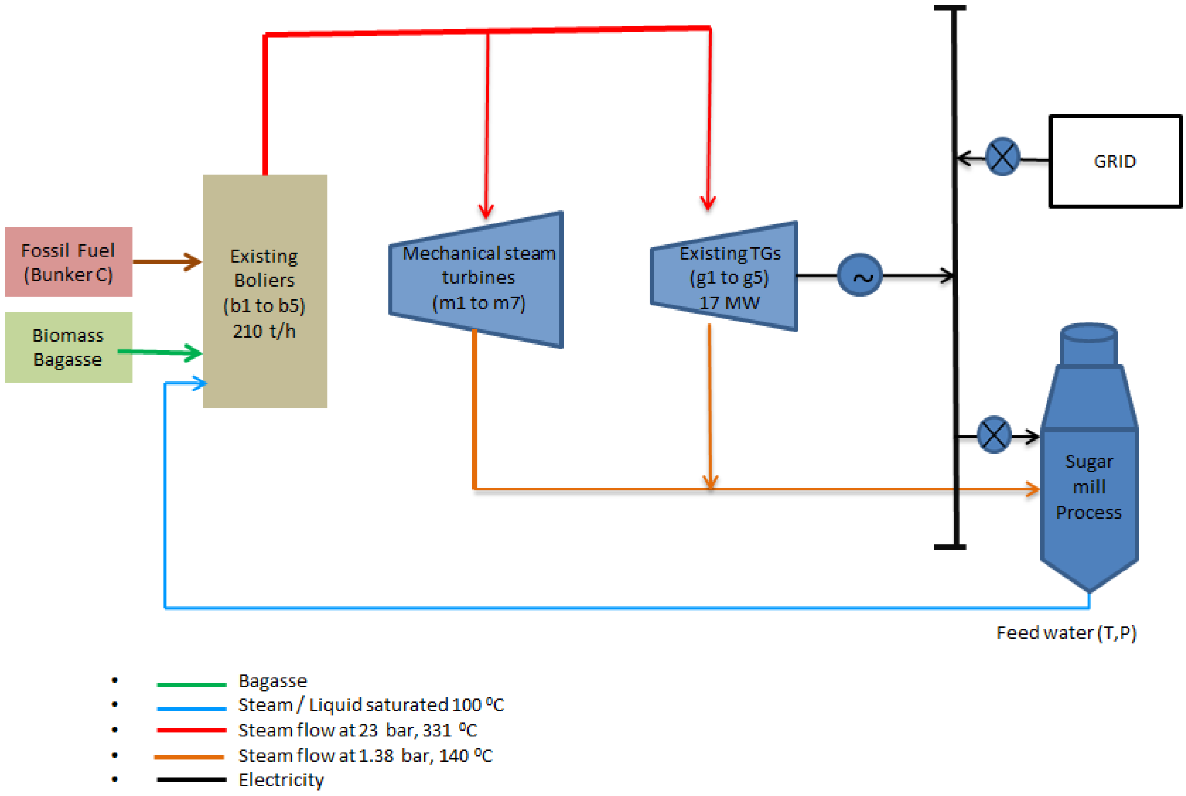


Figure 2- Scenario existing prior to the start of the implementation of the Project Activity

The scenario existing prior to the implementation of the project activity consisted of 5 low-pressure heat generators using bagasse and bunker C fuel oil as their fuels (around 7% of fuel oil is to co-firing). They have an installed capacity to supply 210 tonnes/hour of steam each at 23 bar and 331°C. The steam is used to run 3 cogeneration steam turbines with 17.2 MW of installed capacity and to mechanical applications of the sugar mill process. The thermal energy provided to the sugar mill was supplied both directly from the heat generators to the steam turbines feeding the mechanical applications (shredding, cutter and milling) requiring medium pressure steam and indirectly by the turbo generators' exhaust. The cogeneration plant and the mechanical steam turbines provided the whole process heat required for the sugar mill process. The steam turbines provided the most of its electricity demand, but it was necessary import electricity of the grid.

The table below shows the electricity consumed by the sugar mill and for the next years is:

Year	Electricity consumed (kWh)
2011	764,490
2012	808,355
2013	494,468
2014*	500,000
2015*	500,000
2016*	0
2017*	0
2018*	0
2019*	0
2020*	0
2021*	0

2022*	0
2023*	0

* Estimated

The main equipment that compounds the scenario existing prior to the implementation of the project activity is listed below:

1. Heat Generators

Boiler 1 and 2 (b1 and b2)

Type/Manufacturer	Springfield
Units Number	2
Capacity	20 t/h
Steam Pressure	260 lb/in^2
Steam Temperature	320 ^oC
Efficiency	50%
Fuel	Bagasse/bunker
Remaining lifetime	25 years[10]
Load Factor	76 %[11]

Boiler 3 (b3)

Type/Manufacturer	Herry bogt
Units Number	1
Capacity	55 t/h
Steam Pressure	260 lb/in^2
Steam Temperature	320 ^oC
Efficiency	50%
Fuel	Bagasse
Remaining lifetime	25 years
Load Factor	76 %[11]

Boiler 4 (b4)

Type/Manufacturer	Dallas Boiler
Units Number	1
Capacity	60 t/h
Steam Pressure	300 lb/in^2
Steam Temperature	320 ^oC
Efficiency	50%
Fuel	Bagasse/bunker
Remaining lifetime	25 years
Load Factor	76 %[11]

Boiler 5 (b5)

Type/Manufacturer	Fymisa
Units Number	1
Capacity	55 t/h
Steam Pressure	300 lb/in^2
Steam Temperature	320 ^oC
Efficiency	50%
Fuel	Bagasse/bunker
Remaining lifetime	25 years
Load Factor	76 %[11]

2. Heat Engine and Electrical Generator

Heat Engine TG 1 (g1)

Type/Manufacturer	Worthington
Units Number	1
Capacity	2000 kW
Voltage	2400 V
Input steam pressure	200 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	253.3 ^oC
Output steam temperature	148 ^oC
Plant load Factor	48 %
Remaining lifetime	28 years[12]

Heat Engine TG 2 (g2)

Type/Manufacturer	Acec
Units Number	1
Capacity	2600 kW
Voltage	4160 V
Input steam pressure	250 lb/in^2
Output steam pressure	22 lb/in^2
Input steam temperature	240 ^oC
Output steam temperature	148 ^oC
Plant load Factor	48 %
Remaining lifetime	25 years

[10]Expert evaluation report: The remaining lifetime of heat generators have been evaluated according to the "Tool to determine the remaining lifetime of equipment" by the company Delran Electromecanica S. A de C. V. on 20/12/2013. The report has been presented to the DOE in a folder "vida útil restante calderas" composed of 8 files.

[11] The average plant load factor of all heat generators were calculated using the historical data (operational hours and electricity generation) of years 2011, 2012 and 2013. The spreadsheet ("Panuco Load factor calculation prior the CDM Project 2015 03 17 FES.xlsx") showing this calculation was made available to DOE in validation process.

Heat Engine TG 3 (g3)

Type/Manufacturer	Shinko
Units Number	1
Capacity	3000 kW
Voltage	4160
Input steam pressure	250 lb/in^2
Output steam pressure	22 lb/in^2
Input steam temperature	254 ^oC
Output steam temperature	148 ^oC
Plant load Factor	48 %
Remaining lifetime	30 years

Heat Engine TG 4 (g4)

Type/Manufacturer	Worthinton
Units Number	1
Capacity	2500 kW
Voltage	4080
Input steam pressure	300 lb/in^2
Output steam pressure	15 lb/in^2
Input steam temperature	246.1 ^oC
Output steam temperature	148 ^oC
Plant load Factor	48 %
Remaining lifetime	27 years

Heat Engine TG 5 (g5)

Type/Manufacturer	Worthinton
Units Number	1
Capacity	7100 kW
Voltage	11000 V
Input steam pressure	560 lb/in^2
Output steam pressure	150 lb/in^2
Input steam temperature	382,2 ^oC
Output steam temperature	148 ^oC
Plant load Factor	48 %
Remaining lifetime	30 years

3. Process Steam Turbines

Mills (m1, m2, m3 and m4**)**

Type/Manufacturer	Worthinton
Units Number	4
Capacity	1000 HP
Input steam pressure	250 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	150 ^0C
Remaining lifetime	25 years

Mill (m5)

Type/Manufacturer	Murray
Units Number	1
Capacity	900 HP
Input steam pressure	250 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	150 ^oC
Remaining lifetime	30 years

[12] The remaining lifetime of the turbogenerators has been developed by the company *"Balanceos y Maquinados de Presición S.A. de C.V"* on 20/12/2012 to the turbogenerators TG1, TG2 and TG3 and on 31/03/2014 to the turbogenerators TG4 and TG5. The report has been presented to the DOE in a folder *"vida útil restante turbogeneradores"* composed of 19 files.

Fiberizer/Steam Turbine (m6)

Type/Manufacturer	TGM
Units Number	1
Capacity	3000 HP
Input steam pressure	300 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	150 ^{0}C
Remaining lifetime	35 years

Knives/Steam Turbine (m7)

Type/Manufacturer	Worthinton
Units Number	1
Capacity	700 HP
Input steam pressure	250 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	150 ^{0}C
Remaining lifetime	27 years[13]

Knives/Steam Turbine (m8)

Type/Manufacturer	Elliot
Units Number	1
Capacity	1500 HP
Input steam pressure	250 lb/in^2
Output steam pressure	25 lb/in^2
Input steam temperature	150 ^{0}C
Remaining lifetime	30 years

[13] Expert evaluation report: The remaining lifetime of mechanical steam turbines have been evaluated according to the “Tool to determine the remaining lifetime of equipment” by the company Balanceos y Maquinados de Presición S.A. de C.V on on 07/04/2014 to the mechanical steam turbines m1 to m8. The report has been presented to the DOE in a folder “vida útil restante turbinas mecánicas” composed of 5 files.

b) Project Activity Scenario

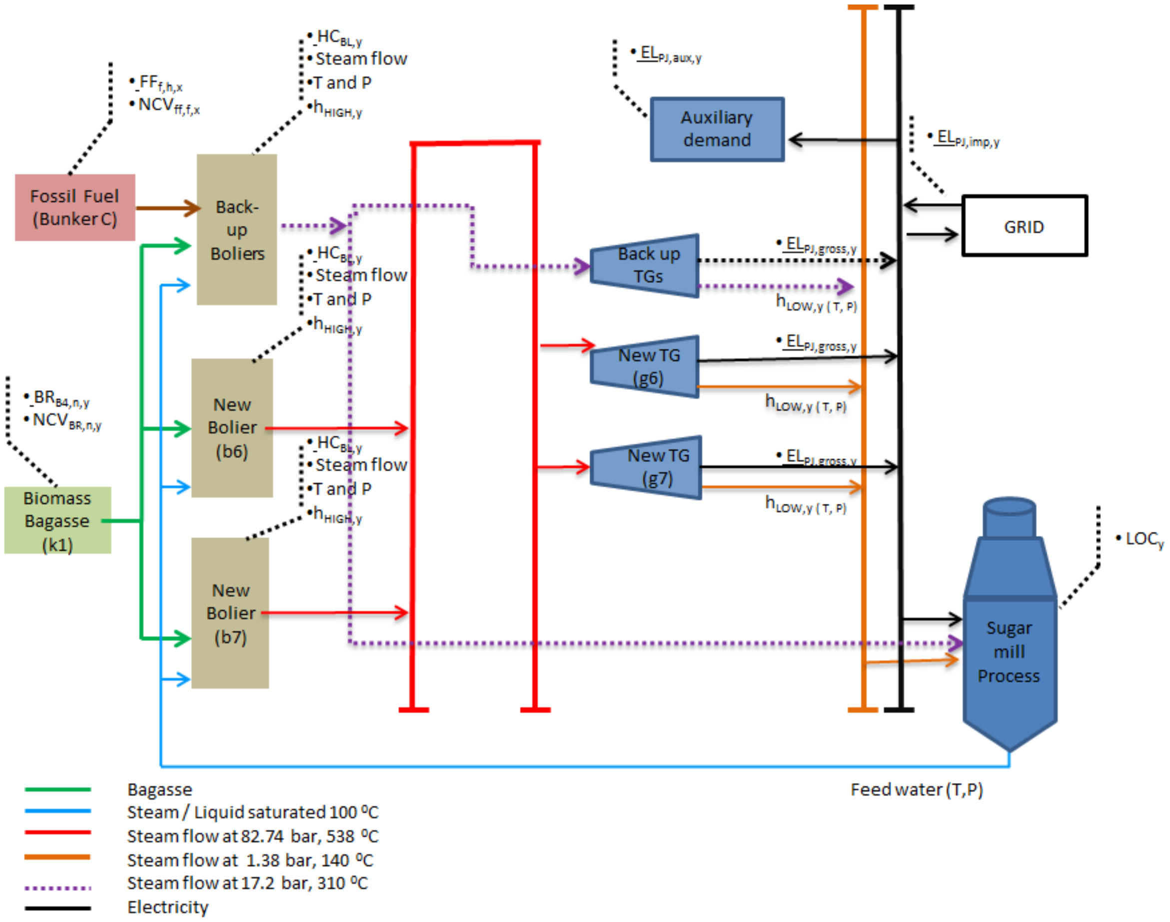


Figure 3- Project Activity Scenario

The project activity involves the installation of a new cogeneration plant. It consists in the installation of a high-pressure boiler that produces 200 tonnes/hour of superheated steam each and a power plant of 122.666 MW.

The boilers produce 200 t/h of steam at 82.7 bar and 538 ºC and it will utilize exclusively bagasse from on-site production.

The project activity provides all the heat and all the electricity required by the sugar mill. The turbo generators will have an output, of 255 tonnes steam per hour at 1,38 bar and 140 ºC[14] which is used at the sugar mill for various mechanical applications such as cutting, shredding and milling.

The output steam of the mechanical applications is used for sugar cane juice evaporation, then, it is condensed and used as feed water for the steam boiler.

The annual average electricity generation of the project is estimated to be 277,734 MWh and the electricity consumption of auxiliary plant is around 33,085 MWh, considering that during the project activity the steam turbines used in the mechanical applications will be replaced by electrical transmission motors.

In addition, the mill consumption after the implementation of second stage will be around 164,571 MWh and, it is estimated that around 110,334 MWh of electricity is directly fed to the grid[15].

---

[14] *According to the project cash flow.*

[15] *Forecast electricity.xlsx*

The old thermal boilers and old turbo-generators will remain on-site as backup to complement the thermal energy supplied to the sugar mill if required and are not expected to be used during normal operation

The main equipment that compounds the new plant (project activity) is listed below:

Boiler 1 (b6)

Type/Manufacturer	Bidrum/ ISGEC
Units Number	1
Capacity	200 t/h
Steam Pressure	1,200 lb/in^2
Steam Temperature	540 ^oC
Efficiency	85%
Fuel	Biomass
Lifetime	25 years[16]

Boiler 2 (b7)

Type/Manufacturer	Bidrum/ ISGEC
Units Number	1
Capacity	200 t/h
Steam Pressure	1,200 lb/in^2
Steam Temperature	540 ^oC
Efficiency	85%
Fuel	Biomass
Lifetime	25 years

Back-Pressure Steam Turbine 1 (g6)

Type/Manufacturer	TGM/RENK
Units Number	1
Capacity	45.466 MW
Input steam pressure	1200 lb/in^2
Output steam pressure	26 lb/in^2
Input steam temperature	540 ^oC
Output steam temperature	140 ^oC
Efficiency	75%
Lifetime	25 years

Condensing Steam Turbine 2 (g7)

Type/Manufacturer	TGM/RENK
Units Number	1
Capacity	60
Input steam pressure	1200 lb/in^2
Output steam pressure	28.5 lb/in^2
Input steam temperature	540 ^oC
Output steam temperature	140 ^oC

[16] Default values: technical lifetime of all equipment of the project activity based on: *Tool to determine the remaining lifetime of equipment.pdf*

Output steam temperature 2	140 ºC
Efficiency	75%
Lifetime	25 years

Electrical Generator (e1)

Type/Manufacturer	GE
Units Number	1
voltage	13.8
Apparent power	53.012 kVA
Active Power	45.466 MW
Power factor	0.83
Speed	1800 rpm
Frequency	60 Hz
Efficiency	100 %
Lifetime	25 years

Electrical Generator (e2)

Type/Manufacturer	GE
Units Number	1
voltage	13.8
Apparent power	53.012 kVA
Active Power	60 MW
Power factor	0.83
Speed	3600 rpm
Frequency	60 Hz
Efficiency	100 %
Lifetime	25 years

Additionally, the equipment which compounds the scenario existing prior to the implementation of the project activity will be kept as backup (boilers from b1 to b5 and turbo generators from g1 to g5). The total installed capacity will totalize 122.666 MW, being that 105.466 MW in operation and 17.2 MW in stand-by.

The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity as demonstrated in section B.4.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	Ingenio Panuco Sapi de CV (Private entity)	No

A.5. Public funding of project activity

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

A.6. History of project activity

>>
The proposed CDM project activity is not a project activity that has been deregistered, nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).

The proposed CDM project activity was not a CPA that has been excluded from a registered CDM PoA neither a registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) or exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

>>
Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

>>
Approved consolidated baseline methodology ACM0006: Consolidated methodology for electricity and heat generation from biomass - version 12.1.1

The following tools have been used:

- TOOL01 “Tool for the demonstration and assessment of additionality”, version 7.0.0[17]
- TOOL05 “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, version 01[18]
- TOOL07 “Tool to calculate the emission factor for an electricity system”, version 04.0[19]
- TOOL10 “Tool to determine the remaining lifetime of equipment”, version 01[20]
- TOOL12 “Tool for Project and leakage emissions from transportation of freight”, version 01.1.0[21]
- TOOL03 “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”, version 02[22]
- TOOL09“Tool to determine the baseline efficiency of thermal or electric energy generation systems”, version 01[23]

No standardized baseline was applied in this project activity.

B.2. Applicability of methodologies and standardized baselines

>>
This methodology is applicable to project activities that operate biomass (co-)fired power-and-heat plants. The CDM project activity may include the following activities or, where applicable, combinations of these activities:

- The installation of new plants at a site where currently no power and heat generation occurs (Greenfield projects);

- The installation of new plants at a site where currently power or heat generation occurs. The new plant replaces or is operated next to existing plants (capacity expansion projects);

---

[17] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

[18] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf

[19] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

[20] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf

[21] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

[22] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

[23] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf

- The improvement of energy efficiency of existing plants (energy efficiency improvement projects), which can also lead to a capacity expansion, e.g. by retrofitting the existing plant;

- The total or partial replacement of fossil fuels by biomass in existing plants or in new plants that would have been built in the absence of the project (fuel switch projects), e.g. by increasing the share of biomass use as compared to the baseline, by retrofitting an existing plant to use biomass, etc.

The project activity includes the installation of a new biomass cogeneration plant at a site where currently power and heat generation occurs (capacity expansion project). The old cogeneration system will be retained as backup.

Additional requirements of the Methodology are also met by the proposed project activity:

Condition	Applicability
No biomass types other than biomass residues and/or biomass from dedicated plantations are used in the project plant	The biomass residues from sugar mill plant production will be the only fuel for the power and heat plant, and no other biomass residues from elsewhere will be used[24]. The cane plantation provides raw material to the sugar mill process and this is the main business of the Panuco company. Therefore, no biomass types other than biomass residues and/or biomass from dedicated plantations are used in the project plant.
Fossil fuels may be co-fired in the project plant. However, the amount of fossil fuels co-fired does not exceed 80% of the total fuel fired on an energy basis.	No fossil fuel is co-fired during normal operation of the project's cogeneration plant. The cogeneration plant is designed to use biomass as fuel and it is not designed to co-fired fossil fuels. Even if the existing heat generators were used, their historical co-firing rate is only 7%[25].
The implementation of the project does not result in an increase of the processing capacity of raw input or in other substantial changes in the process;	The biomass residues come from a sugar mill production process and the implementation of the project does not result in an increase of the processing capacity of raw input or in other substantial changes in this process. The core business activity of the sugar mill not depend of the bagasse utilization because bagasse is a residue generated during sugar mill processes[26].
The biomass used by the project facility are not stored for more than one year	The cane bagasse will be consumed continuously throughout the crop season. In case a remaining amount to be stored in the end of the crop season, this bagasse will be consumed in the post crop operation or in the beginning of the following season,

[24] Panuco's internal report: "proyección de superficies.xlsx".

[25] The value is based on historical values of the three recent seasons of fossil fuel (Bunker C), bagasse consumption
and amount of steam generated. The information is available in the excel spreadsheet (Panuco CERs calculation).

[26] Founding instrument of the Panuco Company verified during validation visit on 11/02/2014.

	approximately 6 months later.
The biomass used by the project facility is not obtained from chemically processed biomass prior to combustion. Moreover, the preparation of biomass-derived fuel does not involve significant energy quantities, except from transportation or mechanical treatment so as not to cause significant GHG emissions.	The biomass used by the project facility is not obtained from chemically processed biomass prior to combustion. No significant energy, except for the transportation or mechanical treatment of the biomass residues, is required to prepare the biomass residues for fuel combustion.
In the case of fuel switch project activities, the use of biomass or the increase in the use of biomass as compared to the baseline scenario is technically not possible at the project site without a capital investment in: a. The retrofit or replacement of existing heat generators/boilers; or b. The installation of new heat generators/boilers; or c. A new dedicated biomass residues supply chain established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes); or d. Equipment for preparation and feeding of biomass.	The project is not a fuel switch project. The project consists in the installation of new plant at a site where currently power or heat generation occurs. The new plant replaces the existing plant (capacity expansion projects).
In the case that biogas is used in power and/or heat generation, this methodology is applicable under the following conditions: a. The biogas is generated by anaerobic digestion of wastewater (to be) registered as a CDM project activity and the details of the registered CDM project activity must be included in the PDD. Any CERs from biogas energy generation should be claimed under the proposed project activity registered under this methodology; b. The biogas is generated by anaerobic digestion of wastewater that is not (and will not) be registered as a CDM project activity. The amount of biogas does not exceed 50% of the total fuel fired on an energy basis.	Biogas is not used in power and/or heat generation in the project activity.
In the case of biomass from dedicated plantations: a. The cultivated land can be clearly identified and used only for dedicated energy biomass plantations; b. The CDM project activity does not lead to a shift of pre-project activities outside the project	The project activity does not use dedicated plantations that are newly established as part of the CDM Project activity. The project activity will use biomass residues from the sugar cane milling process as established prior the implementation of the project activity.[27]

[27] Panuco internal report: “proyección de superficies.xlsx”.

boundary, i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project; c. The plantations are established: - On land which was, at the start of the project implementation, classified as degraded or degrading; or - On a land area that is included in the project boundary of one or several registered A/R CDM project activities; d. The plantations are not established on organic soil (notably peatlands); e. The land area of the dedicated plantations will be planted by direct planting and/or seeding; f. After harvest, regeneration will occur either by direct planting, seeding or natural sprouting; g. Grazing will not occur within the plantation; h. No irrigation is undertaken for the biomass plantations; i. The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the CDM project activity would have not been used for any other agricultural or forestry activity; j. Only perennial plantations are eligible.	

Finally, the methodology is applicable because is according to the most plausible baseline scenario, as identified in the Section B.4 per the "Selection of the baseline scenario and demonstration of additionality" section here under, is:

- For power generation: Scenarios P2 to P7, or a combination of any of those scenarios;
- For heat generation: Scenarios H2 to H7, or a combination of any of those scenarios;
- If some of the heat generated by the CDM project activity is converted to mechanical power through steam turbines, for mechanical power generation: Scenarios M2 to M5:
  - In the case of M2 and M3, if the steam turbine(s) are used for mechanical power in the project, the turbine(s) used in the baseline shall be at least as efficient as the steam turbine(s) used for mechanical power in the project;
  - In the case of M4 and M5, steam turbine(s) for mechanical power are not allowed for the same purpose in the project.

- For biomass residue use: Scenarios B1 to B8, or any combination of those scenarios. For scenarios B5 to B8 leakage emissions should be accounted for as per the procedures of the methodology.

B.3. Project boundary, sources and greenhouse gases (GHGs)

>>

According to ACM0006, the spatial extent of the project boundary encompasses:

- All plants generating power and/or heat located at the project site, whether fired with biomass fossil fuels or a combination of both;

- All power plants connected physically to the electricity system (grid) that the project plant is connected to;
- Where possible, all off-site heat sources that supply heat to the site where the CDM project activity is located (either directly or via a district heating system);
- The means of transportation of biomass to the project site;
- If the feedstock is biomass residues, the site where the biomass residues would have been left for decay or dumped;
- If the feedstock is biomass produced in dedicated plantations: the geographic boundaries of the dedicated plantations;
- The wastewater treatment facilities used to treat the wastewater produced from the treatment of biomass;
- In case biogas is included, the site of the anaerobic digester.

Additionally, the methodology states that:

the project boundary encompasses not only the plants generating power and/or heat that are directly affected by the CDM project activity (e.g. retrofitted or installed) but also all other plants generating power and/or heat located at the same site as the CDM project activity, whether fired with biomass, fossil fuels or a combination of both.

For this purpose, project participants should document in the CDM-PDD:

- For each plant generating power and/or heat that has been operated at the project site within the most recent three years prior to the start of the CDM project activity: the type and capacity of the heat generators, the types and quantities of fuels which have been used in the heat generators, the type and capacity of heat engines, and whether the equipment continues operation after the start of the CDM project activity;
- For each plant generating power and/or heat installed under the CDM project activity: the type and capacity of the heat generators, the types and quantities of fuels used in the heat generators, the type and capacity of heat engines and direct heat extractions;
- For each plant generating power and/or heat that would be installed in the absence of the CDM project activity: the type and capacity of the plant, including the type and capacity of the heat generators, heat engines and electric power generators used and the types and quantities of fuels which would be used in each heat generator;
- The average amounts of electricity and heat import from off-site sources that would happen in the absence of the CDM project activity on an yearly basis and the forecast for the project scenario. A schematic diagram of the CDM project activity and the baseline scenario is presented in figure below.

The figure below is a simplified representation of the equipment and system of the project activity in the project boundary.

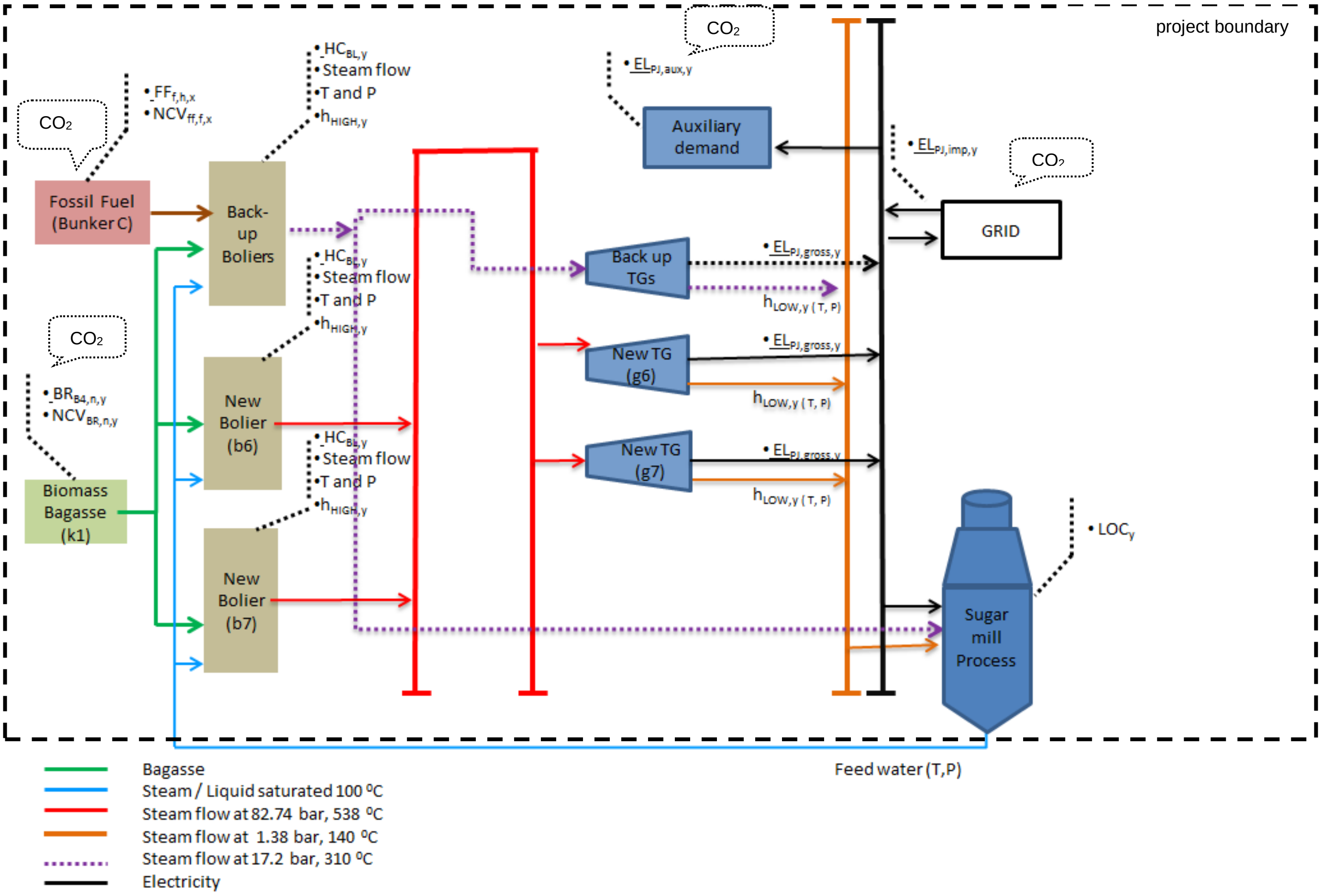


Table below illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

Source		GHGs	Included?	Justification/Explanation
Baseline	Electricity and heat generation	CO_2	Yes	Main emission source. CO_2 emissions from fossil fuel-fired power plants connected to the grid have been considered.
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Uncontrolled burning or decay of surplus biomass residues	CO_2	No	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources.
Project activity	On-site fossil fuel consumption	CO_2	Yes	May be an important emission source. No fossil fuel is expected to be used during regular operation. Fossil fuel consumption during start-up and by auxiliary equipment is relevant.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Off-site transportation of biomass	CO_2	Yes	May be an important emission source. There is no fossil fuel consumption for offsite transportation as the project activity would be utilizing the biomass residues available on-site.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Combustion of biomass for electricity and heat	CO_2	Yes	May be an important emission source. No fossil fuel is expected to be used during regular operation. Fossil fuel consumption during start-up and by auxiliary equipment is relevant.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Storage of biomass	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	No	Excluded for simplification. Since biomass are stored for not longer than one year, this emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emissions source is assumed to be very small
	Wastewater from the treatment of biomass	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	No	No waste water is treated (partly) under anaerobic conditions
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Cultivation of land to	CO_2	No	No biomass from dedicated plantation is used
		CH_4	No	No biomass from dedicated plantation is used

	produce biomass feedstock	N_2O	No	No biomass from dedicated plantation is used

B.4. Establishment and description of baseline scenario

>>
The selection of the baseline scenario and demonstration of additionality should be conducted by applying the following steps:

Step 1: Identification of alternative scenarios

This step serves to identify alternative scenarios to the proposed CDM project activity(s) that can be the baseline scenario through the following sub-steps:

Step 1a: Definition of alternative scenarios to the proposed CDM project activity

Identify realistic alternative scenarios that are available to the project participants and that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity.

The identified alternatives scenarios for electricity power are:

Table 1 - Alternative scenarios for electricity power

	Alternative Scenarios	Justification	This scenario is realistic?
P1	The proposed project activity not undertaken as a CDM project activity	This scenario is realistic	Yes
P2	If applicable, the continuation of power generation in existing power plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the starting date of the CDM project activity	This scenario is realistic	Yes
P3	If applicable, the continuation of power generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project CDM activity	The existing power plant is compound by 5 turbo-generators of MW each totalizing an installed capacity around of 17.2 MW. All turbo-generators are functioning with maximum capacity according manufacturer´s specifications and therefore the existing power plant would not operate with different conditions as for example the new project plant (project activity) with installed capacity of 122.666MW.	No
P4	If applicable, the retrofitting of existing power plants at the project site. The retrofitting may or may not include a change in fuel mix.	This scenario is not applicable because the existing power plant 17.2 MW) operate within proper historical efficiencies. The retrofitting would include an installation of high-pressure boilers, but this scenario is the project activity (122.666MW).	No

P5	The installation of new power plants at the project site different from those installed under the CDM project activity.	The PP has a cogeneration plant that operates with low pressure boilers to generate steam and electricity to self-consumption. The only possibility for the PP to be able to export electricity to the grid and/or to other stakeholders is by installing a more economic and efficient cogeneration (high pressure boilers and new turbo-generators) system than actual cogeneration plant. In the sugar mill sector the most energetically and economically efficient solution is a bagasse cogeneration plant as the fuel (bagasse) is readily available without cost. Hence, the installation of a new power plant of 122.666MW at the project site different than a bagasse cogeneration does not fulfil the criteria of the current legislation (Law of Public Service of Electricity art. 36)[28].	No
P6	The generation of power in specific off-site plants, excluding the power grid	This scenario is not plausible because actually exist a cogeneration plant to supply energy and heat for the sugar mill process and when is necessary additional energy, it is consumed from the grid. The construction a specific offsite plant to attend the missing energy would not be technical and economical feasible because the quantity consumed by the plant is 18,458 MWh per year (Prior scenario). The scenario that considers the CDM project activity will export energy to the grid and therefore an off-site plant is not necessary.	No
P7	The generation of power in the power grid.	This scenario is realistic	Yes

The lifetime of the existing power plant has been determined according to the “Tool to determine the remaining lifetime of equipment” version 1, option (b). In December 2012 and March 2014, a specialized company “Balanceos y Maquinados de Presición S.A. de C.V.” evaluated the operational history of the turbo-generators, the current operation and maintenance practices of these equipment[29]. The company conducted tests on the equipment to estimate their remaining

[28] http://www.diputados.gob.mx/LeyesBiblio/pdf/99.pdf

[29] The expert evaluation report of remaining lifetime of the turbo-generators developed by the company called “*Balanceos y Maquinados de Presición S.A. de C.V*” has been presented to the DOE in a folder “*vida útil restante turbo-generadores*” composed of 19 files.

lifetime. The conclusion obtained by the expert evaluation about the remaining lifetime of the five turbo-generators that totalizing 17.2 MW was an average of 28 years, if the current operation and maintenance practices in Panuco plant are maintained. Hence, they are expected to be operational as minimum up to the 2038 year. After this date, it is uncertain which power generation plant would have been installed at the baseline scenario. However, this period of years cover the last year (2037) of the three crediting period of the CDM project activity (21 years) and bears no consequence on the baseline evaluation.

For heat generation, the realistic and credible alternatives may include:

Table 2 - Alternative scenarios for heat generation

	Alternative Scenarios	Justification	This scenario is realistic?
H1	The proposed project activity not undertaken as a CDM project activity	This scenario is realistic	Yes
H2	If applicable, the continuation of heat generation in existing plants at the project site. The existing plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and equipment configuration) as those observed in the most recent three years prior to the CDM project activity	This scenario is realistic	Yes
H3	If applicable, the continuation of heat generation in existing power plants at the project site. The existing plants would operate with different conditions from those observed in the most recent three years prior to the starting date of the project CDM activity	The existing power plant is compound by 5 boilers that totalizing an installed capacity of 210 t/h of superheated steam at 17 bar and 250 °C. All boilers are functioning with maximum capacity according manufacturer´s specifications and therefore the existing power plant would not operate with different conditions as for example the new project plant (project activity) with capacity of 400 t/h of superheated steam at 83 bar and 538 °C.	No
H4	If applicable, the retrofitting of existing power plants at the project site. The retrofitting may or may not include a change in fuel mix.	This scenario is not applicable because the existing boilers of cogeneration plant that totalizing an installed capacity of 210 t/h of superheated steam at 17 bar and 250 °C are functioning with maximum capacity and proper efficiencies according manufacturer´s specifications. The retrofitting would include an installation of high pressure boilers, but this scenario is the new project plant (project activity) with capacity of 400 t/h of superheated steam at 83 bar and 538 °C.	No
H5	The installation of new power plants at the project site different from those installed under the CDM project activity	This scenario is not plausible because the CDM project activity considers biomass cogeneration that use bagasse as fuel without cost because is available in the farm. In	No

		the sugar mill the bagasse cogeneration is the most energetic and economical solution to provide heat and electricity in comparison to other power plants that would use other commercial fuel as natural gas or carbon with associated costs.	
H6	The generation of heat in specific off-site plants	This scenario is no plausible because the heat requirement is only necessary during operation plant (crop season) therefore don´t justify the generation of heat in specific offsite plant. Moreover, the sugar mill plant is located in rural area away of cities or industries that could have offsite plants.	No
H7	The production of heat from district heating.	This scenario is no plausible because the heat requirement is only necessary during operation plant (crop season) therefore don´t justify the generation of heat from district heating. Moreover, the sugar mill plant is located in rural area away of cities or industries that could have district heating. This scenario is unlikely because in México the average temperature in the Veracruz region is 23 ^{o}C[30].	No

The lifetime of the existing heat generators have been determined according to the “Tool to determine the remaining lifetime of equipment” version 1, option (b). In report of December 2013 a specialized company “Delran Electromecanica S. A de C. V.” evaluated the operational history of the heat generators, the current operation and maintenance practices of these equipment[31]. The company conducted tests on the equipment to estimate their remaining lifetime. The conclusion obtained by the expert evaluation about the remaining lifetime of the five boilers was an average of 25 years, if the current operation and maintenance practices in Panuco plant are maintained. Hence, they are expected to be operational as minimum up to the 2038 year. After this date, it is uncertain boilers would have been installed at the baseline scenario. However, this period of years cover the last year (2037) of the three crediting period of the CDM project activity (21 years) and bears no consequence on the baseline evaluation.

The alternative scenarios for the mechanical power generation are (This table is only presented in indicative manner, because all scenarios were disregarded but justified properly):

[30] National Institute of Statistics and Geography of Mexico (INEGI) http://cuentame.inegi.org.mx/monografias/informacion/ver/territorio/clima.aspx?tema=me&e=30

[31] The expert evaluation report of remaining lifetime of heat generators developed by the company “*Delran Electromecanica S. A de C. V*”. has been presented to the DOE in a folder “*vida útil restante calderas*” composed of 8 files.

Table 3 - Alternative scenarios for mechanical power

	Alternative Scenarios	Justification	This scenario is realistic?
M1	The proposed project activity not undertaken as a CDM project activity	This scenario is not realistic Since; The project activity considers replace all steam turbines by electrical equipment.	No
M2	If applicable, the continuation of mechanical power generation from the same steam turbines in existing plants at the project site.	Actually, there are 7 steam turbines operating in the sugar plant. These turbines will be electrified progressively during the first stage of the project (2016-2022), but meanwhile part of them will be operating as mechanical steam turbines only as back up. For this reason, this scenario is not realistic.	No
M3	The installation of new steam turbines at the project site	The current installed capacity of the steam turbines covers the sugar mill requirements adequately and efficiently, the efficiency of the steam turbines (64%[32]) is at is optimum, compared to new ones (60-70%)[33]. Hence, it is not credible to add new steam turbines to the project site. This scenario is no plausible, because the project activity considers replace the actual steam turbines by more efficient electrical motors, considering that with the project activity implementation there will be available energy to supply this equipment.	No
M4	If applicable, the continuation of mechanical power generation from electrical motors in existing plants at the project site.	This scenario is no plausible, because currently there are 7 steam turbines and no electrical motor has been used.	No
M5	The installation of new electrical motors at the project site	The installation of new electrical motors at the project site is not a realistic or credible scenario. Since, the installation of new motors will involve the electricity purchase from the grid, while currently steam is available for this application. The project activity considers replace all steam turbines by electrical equipment, but only after project activity implementation when there will be available energy to supply these equipment.	No

[32] Panuco sugar mill plant internal report.

[33] Efficiencies of steam turbines for mills, available at http://www.procknor.com.br/articles/acionamentos-para-moendas-%e2%80%93-stab-janfev-2004/ (accessed on 25/11/2013)

The lifetime of the existing power plant has been determined according to the "Tool to determine the remaining lifetime of equipment" version 1, option (b). In Abril 2014, a specialized company *"Balanceos y Maquinados de Presición S.A. de C.V."* evaluated the operational history of the mechanical steam turbines, the current operation and maintenance practices of these equipment[34]. The company conducted tests on the equipment to estimate their remaining lifetime. The conclusion obtained by the expert evaluation about the remaining lifetime of the eight mechanical steam turbines was the average of 28 years, if the current operation and maintenance practices in Panuco plant are maintained. Hence, they are expected to be operational as minimum up to the 2042 year. After this date, it is uncertain which power generation plant would have been installed at the baseline scenario. However, this period of years cover the last year (2037) of the three crediting period of the CDM project activity (21 years) and bears no consequence on the baseline evaluation.

The alternative scenarios for the use of biomass residues are:

Table 4 - Alternative scenarios for biomass residues use

	Alternative Scenarios	Justification	This scenario is realistic?
B1	The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.	This scenario is no plausible, because the biomass residues are used as fuel in the existing cogeneration plant during the crop season and therefore the biomass residues are not dumped or left to decay mainly under aerobic conditions. This practice is common for sugar mills in Mexico[35].	No
B2	The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to landfills which are deeper than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.	This scenario is no plausible, because the biomass residues are used as fuel in the existing cogeneration plant during the crop season and therefore the biomass residues are not dumped or left to decay under clearly anaerobic conditions. During the operation the biomass residues are temporarily stored in piles before to be delivered to the cogeneration plant and the piles are lower than 5 meters. This practice is common in Mexico.	No
B3	The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes.	This scenario is no plausible, because the biomass residues are used as fuel in the existing cogeneration plant during the crop season.	No

[34] Expert evaluation report: The remaining lifetime of mechanical steam turbines have been evaluated according to the "Tool to determine the remaining lifetime of equipment" by the company *Balanceos y Maquinados de Presición S.A. de C.V* on on 07/04/2014 to the mechanical steam turbines m1 to m8. The report has been presented to the DOE in a folder "*vida útil restante turbinas mecánicas*" composed of 5 files.

[35] Common practice for bagasse in sugar plants in Mexico: http://www.energia.gob.mx/webSener/res/0/D121122%20Iniciativa%20Renovable%20SENER_Cogeneraci%C3%B3n.pdf

		This practice is common in the sugar mills due to properties and commercial value of bagasse as fuel[36].	
B4	The biomass residues are used for power or heat generation at the project site in new and/or existing plants.	This scenario is realistic. This practice is common in Mexico; since sugar mills are replacing their steam mechanical power by electrical motors because there are more efficient in sugar production; however these systems require more electricity. In Mexico, the electricity price has been increasing in the last years as could be conferred in the cash flow of the CDM project, for this reason the own electricity generation and the selling of surplus to the grid seems to be a realistic option.	Yes
B5	The biomass residues are used for power or heat generation at other sites in new and/or existing plants	This scenario is no plausible, because the only option is the use of biomass residues in the existing cogeneration plant to supply the requirements of heat and energy of sugar mill process due to the deficiency of bagasse quantity to burn in the boilers of the existing cogeneration plant. The deficiency in biomass residues for the existing plant has been covered by the fossil fuel consumption. In spite having a growth of biomass generation due to the increase of sugar cane processing, it is pretty clear for project developers at ex-ante conditions that all the biomass will be only used inside the project boundaries for heat and power generation. PP does not consider any alternative use for biomass or selling the biomass to other sugar mills, besides, the closer sugar mill is located at 52 km from Panuco (El Higo) so it represents an approximately 100 km round trip, so it is not economically feasible for no one to spend money for buying bagasse from Panuco to be used as fuel, it is better to them using fossil fuel to do this. In case of remnant of bagasse, the PP will continue with the power generation by using the bagasse storage in the courtyard. No bagasse will be storage for more than one year in the courtyard.	No

[36] Common practice for bagasse in sugar plants in Mexico: http://www.energia.gob.mx/webSen,er/res/0/D121122%20Iniciativa%20Renovable%20SENER_Cogeneraci%C3%B3n.pdf

B6	The biomass residues are used for other energy purposes, such as the generation of biofuels.	This scenario is no plausible, because the biomass residues are used in the existing cogeneration plant to supply the requirements of heat and energy of sugar mill process. This practice is common for sugar mills in Mexico.	No
B7	The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in the pulp and paper industry).	This scenario is no plausible, because the commercial value of biomass residues is used in the existing cogeneration plant to supply the requirements of heat and energy of sugar mill process. Moreover, the use of bagasse as fertilizer can be used by other farms that don´t have cogeneration plant, but in this case these farms use their own bagasse as fertilizer. Regarding to use as feedstock in process of pulp or paper industry, this scenario is no plausible because, there are not similar industries in the region.	No
B8	Biomass residues are purchased from a market, or biomass residues retailers, or the primary source of the biomass residues and/or their fate in the absence of the CDM project activity cannot be clearly identified.	This scenario is no plausible because the biomass residues that will be used in the CDM project activity (new cogeneration plan) are only from sugar mill plant. In the absence of the CDM project activity these biomass residues are used in the existing cogeneration plant to supply the requirements of heat and energy of sugar mill process.	No

The following biomass categories are relevant to the project activity:

Table 5 - Biomass categories identified

	Biomass residue type	**Source**	**Baseline Scenario Use**	**Project Scenario Use**	**Quantity** (t/year)
K_1	Bagasse	On-site production	Electricity generation on-site (B4:)	Electricity generation on-site (biomass-only boiler)	255,992.63

The biomass residues utilized is the category k_1, bagasse from the on-site sugar mill. Other categories might arise during the project activity, however is expected that only biomass residues k_1 will be used during the project activity.

As the methodology requires, if additional biomass categories are identified in the future, they will be evaluated upon verification of the relevant monitoring period.

The CDM project activity does not involve the use of biogas; thus no biogas alternatives are discussed.

Outcome of Step 1a: List of plausible alternative scenarios to the CDM project activity.

The most credible and plausible alternatives scenarios that could represent the baseline and the project implementation are:

Electricity power: P1, P2 and P7
Heat generation: H1 and H2
Biomass residues: B4

The possible combinations of these alternative scenarios are:

Alternative Scenario 1, combining:
Power generation: P1, P7
Heat generation: H1
Bagasse: B4

Alternative 1 is to implement the project activity not undertaken as a CDM project activity.

Alternative Scenario 2, combining:
Power generation: P2, P7
Heat generation: H2
Bagasse: B4

Alternative 2 is to continue with the power, heat and mechanical power generation in existing plants at the project site. The heat requirements are supplied using fossil fuel and biomass heat generators. The power requirements, if insufficient, are supplied by imports of electricity from the grid. All on-site produced biomass is combusted. A total of 5% of fossil fuel is co-combusted.

Sub-step 1b: Consistency with mandatory applicable laws and regulations

For simplification, the alternative scenarios identified are:
P1, H1: The proposed activity not undertaken under the CDM.
P2, H2: The continuation of power and heat generation in existing power plants at the project site
P7: The generation of power in the power grid.
B4: The biomass residues are used for power or heat generation at the project site in new and/or existing plants.

All alternatives scenarios listed above are related to existing or new cogeneration plant to generate power, heat and mechanical power generation and to obtain operational permit this activity has to be consistency with mandatory applicable laws and regulations listed below.

- Law for the Use of Renewable Sources of Energy and Financing of the Energetic Transition (LAERFTE)[37]
- Bioenergetic promotion and development law[38]
- Service Public Law of Electricity (LSPEE)[39]
- General Law of Ecological Equilibrium and the Protection of the Environment[40]
- Energy Regulatory Commission Law[41]

***Outcome of Step 1b*:** All alternative scenarios identified in Step 1a are in compliance with mandatory legislation and regulations taking into account the enforcement in the Mexico.

---

[37] http://www.diputados.gob.mx/LeyesBiblio/regley/Reg_LAERFTE.pdf

[38] http://www.diputados.gob.mx/LeyesBiblio/pdf/LPDB.pdf

[39] http://www.diputados.gob.mx/LeyesBiblio/pdf/99.pdf

[40] http://www.diputados.gob.mx/LeyesBiblio/pdf/148.pdf

[41] http://www.ordenjuridico.gob.mx/Federal/Combo/L-44.pdf

B.5. Demonstration of additionality

>>

The following table shows the timeline of the project activity showing that the CDM benefits were taken into account to implement it.

Key Events	Date
Prior Consideration of the CDM to UNFCCC and Mexican DNA	01/08/2013
Contract between Designed Operational Entity (DOE) and the PP (Project Participant) for the validation process.	January/2014
Period of the Global Stakeholder Consultation (GSC)	22/01/2014 to 17/02/2014
The starting date of the project activity will be the purchase of the first relevant equipment[42].	12/02/2013
Start-up – Phase I[43] (start of the crop season)	September/2016
Commercial operation – Phase II* (start of the crop season)	September/2020

Step 2: Barrier analysis

Not applicable. Proceed to Step 3 directly.

Step 3: Investment analysis

The objective of Step 3 is to compare the economic or financial attractiveness of the alternative scenarios by conducting an investment analysis.

For this purpose, an investment analysis is conducted for the remaining alternative scenarios after the previous step. If the investment analysis is conclusive, the economically or financially most attractive alternative scenario is considered as the baseline scenario. Three options can be applied for the investment analysis: the simple cost analysis, the investment comparison analysis and the benchmark analysis.

Sub-step 3a. Determine appropriate analysis method

The investment analysis will be performed applying Option II (i.e. comparison analysis) as indicated in the latest version of "Tool for demonstration and assessment of additionality". This method is applicable because:

- Option I: Simple cost analysis does not apply as the project generates economic benefits other than CDM-related income, through the sales of electric and heat power.
- Option II: Investment comparison analysis is appropriate as, there are two realistic alternative scenarios to be compared.
- Option III: Benchmark analysis is not appropriate. There are two realistic alternative scenarios to be compared.

---

[42] Electrical generator purchase order.pdf

[43] Panuco internal report: *Balance de massa y energia_projeto nuevo.xlsx*

Output of Sub-step 3a:

Option II, was selected.

Sub-step 3b. Option II. Apply comparison analysis

For the purpose of assessing the financial/economic attractiveness, the indicator used was the Net Present Value (NPV).

The discount rate used for this analysis was the value pointed out in Appendix A (Group 1 - México) of the "Guidelines on the assessment of investment analysis" - version 05. The value was 11.20 %.

Sub-step 3c. Calculation and comparison of financial indicators

The following assumptions were taken for the purpose of the calculation of the financial indicator in all alternatives:

All numbers in the cash flow are in United States of America (USD) dollar hereinafter represented by the symbol $.

	PANUCO Bagasse Cogeneration Project			
	Assumptions			
	Parameter	Value	Unit	Reference
Assumptions	Discount rate	11.20%	%	Guidelines on the assessment of investment analysis - version 05, Group 1 (Mexico).
	Asset's Life time	25	years	The option c of the "Tool to determine the remaining lifetime of equipment" - version 1 (Electric Generators, air cooled)
	Total installed capacity	122.666	MW	Determined in CERs spreadsheet
	Price per MW installed	1,098.66	k$/MWe	Calculated in cashflow
	Total investment in the CDM project	109,865.72	k$	Calculated in cashflow
	O&M costs of electricity generation	11.48	$/MWh	Calculated as the average of the whole period
	Electricity price	90	$/MWh	Calculated in electricity price tab
	Income tax	30.0%	%	See the law of income tax (Ley de Impuesto Sobre la Renta 2012.pdf), page 10
	Depreciation	20	years	(http://www.dof.gob.mx/nota_detalle.php?codigo=5264340&fecha=15/08/2012)
	Long-term debt interest tax	3.94%	%	Calculated by Pantaleon group (3% Banamex tax + 0.94% Libor tax). Libor tax: http://www.banxico.org.mx/
	Leverage	50.00%	%	Default Share of the project value as per "Guidelines on investment analysis", version 5
	Debt term	5	years	Panuco loan from Banamex (Internal document of Pantaleon Group). http://www.banamex.com/
	Salvage value	3,532.1	k$	Calculated in cashflow
	Aggregated Value Tax (IVA)	16%	%	See law of aggregated value tax (LIVA_071209.pdf)

The price of electricity in Mexico was determined by PP based on historical data of the last 3 previous years of the investment decision date (2011-2013); it means that depends of the point where the project activity will be connected to the interconnected grid (the spreadsheet with the price calculation was presented to the validation team and the information was taken from SENER's website)[44]. In Mexico, the Federal Electricity Commission (CFE)[45] uses a correction factor of 0.98 to this electrical price if the power plant relies on renewable energies, so as this project plant will use biomass and this a renewable energy fuel, the value was correctly applied.

Alternative Scenario 1:

For the alternative 1 – The project activity implemented (combining Power generation: P1; Grid electricity: P7; Heat generation: H1; Bagasse: B4) undertaken without CDM revenues, the estimated project cash flow[46] is presented below:

[44] Mexican Secretary of Energy: http://www.sener.gob.mx/portal/Default.aspx?id=1432

[45] Federal Electricity Commission: http://www.cfe.gob.mx/paginas/home.aspx

[46] The cash flow, in electronic spreadsheet, will be made available to DOE in validation process (sheet "Base case - Scenario 1").

PANUCO Bagasse Cogeneration Project - Cash Flow (Scenario 1)

CDM Project (83 bar Boiler and 122.666 MW	Year	1	2	3	4	5	6	7	8	9	10
		YEARLY INVESTIMENT ANALYSIS									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
INCOME x COSTS ANALYSIS											
Dispatched electricity (MWh/year)		0	0	0	163,726	172,760	168,271	141,831	77,402	84,861	103,652
Electricity Price ($/MWh)		0	0	0	90	90	90	90	90	90	90
Electricity revenues (k$)		0	0	0	14,792	15,608	15,202	12,814	6,993	7,667	9,364
Gross Revenues (k$)		0	0	0	14,792	15,608	15,202	12,814	6,993	7,667	9,364
O&M Costs - Electricity generation (k$)		0	0	0	-2,315	-2,661	-2,354	-2,604	-2,460	-2,997	-2,677
O&M Total Costs		0	0	0	-2,315	-2,661	-2,354	-2,604	-2,460	-2,997	-2,677
Operational Results - EBITDA		0	0	0	12,477	12,947	12,848	10,209	4,532	4,670	6,687
Single rate Business tax	0.0%	0	0	0	0	0	0	0	0	0	0
Depreciation		0	0	0	-1,961	-1,961	-1,961	-1,961	-1,961	-1,961	-5,493
EBIT		0	0	0	10,516	10,985	10,887	8,248	2,571	2,709	1,194
		0	-773	-630	-481	-327	-167	0	0	0	0
		0	0	0	0	0	0	-1,392	-1,134	-867	-589
Interests		0	-773	-630	-481	-327	-167	-1,392	-1,134	-867	-589
EBT		0	-773	-630	10,034	10,658	10,721	6,856	1,437	1,842	605
Income tax	30.0%	0	0	0	-3,010	-3,197	-3,216	-2,057	-431	-553	-181
Depreciation		0	0	0	1,961	1,961	1,961	1,961	1,961	1,961	5,493
Net operational profit		0	-773	-630	8,985	9,422	9,466	6,761	2,967	3,250	5,917
CapEx											
CapEx - Electricity Generation		-5,491	-18,043	-15,689	0	0	-21,405	-21,405	-27,833	0	0
Drawdown of debt		19,612	0	0	0	0	35,321	0	0	0	0
Debt repayment		0	-3,625	-3,768	-3,916	-4,071	-4,231	0	0	0	0
		0	0	0	0	0	0	-6,529	-6,786	-7,054	-7,332
Debt Repayment		0	-3,625	-3,768	-3,916	-4,071	-4,231	-6,529	-6,786	-7,054	-7,332
Net Cash Flow Equity		14,120	-22,440	-20,087	5,069	5,351	19,151	-21,173	-31,653	-3,803	-1,415

Note: All numbers are in k$)

Benchmark	11.20%

NPV (25 years)	-16,936.69

Continues in the next page…

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2023	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
119,005	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334	110,334
90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
10,751	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968
10,751	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968	9,968
-3,084	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589
-3,084	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589	-2,789	-3,189	-2,789	-3,589
7,667	7,179	6,379	7,179	6,779	7,179	6,379	7,179	6,779	7,179	6,379	7,179	6,779	7,179	6,379
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-5,493	-3,532	-3,532
2,174	1,686	886	1,686	1,286	1,686	886	1,686	1,286	1,686	886	1,686	1,286	3,647	2,847
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,874	1,686	886	1,686	1,286	1,686	886	1,686	1,286	1,686	886	1,686	1,286	3,647	2,847
-562	-506	-266	-506	-386	-506	-266	-506	-386	-506	-266	-506	-386	-1,094	-854
5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	5,493	3,532	3,532
6,805	6,673	6,113	6,673	6,393	6,673	6,113	6,673	6,393	6,673	6,113	6,673	6,393	6,085	5,525
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-7,621	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-7,621	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-816	6,673	6,113	6,673	6,393	6,673	6,113	6,673	6,393	6,673	6,113	6,673	6,393	6,085	9,057

According to the cash flow, the NPV of scenario 1 is k$ -16,936.69.

Alternative Scenario 2[47]:

The scenario 2 combining (Power generation: P2; Grid electricity: P7; Heat generation: H2; Bagasse: B4) is the continuation of the current practice, which is in compliance with all applicable regulations and policies.

The continuation of the scenario 2 of the current practice involves expenses for operation and maintenance (O&M costs) for the continued use of the existing boilers and costs due to purchase of the imported electricity from the grid. The estimated project cash flow[48] is presented below:

[47] In order to clarify possible doubts: the scenario 2 in this PDD reflects scenario S3 according to terminology in the "Combined tool to identify the baseline scenario and demonstrate additionality.

[48] The cash flow, in electronic spreadsheet, was made available to DOE in validation process (sheet "Base case - Scenario 2").

PANUCO Bagasse Cogeneration Project - Cash Flow (Scenario 2)

Common practice (32 bar boiler and and 17 MW)	Year	1	2	3	4	5	6	7	8	9	10
		YEARLY INVESTIMENT ANALYSIS									
		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
INCOME x COSTS ANALYSIS											
Dispatched electricity (MWh/year)		0	0	0	0	0	0	0	0	0	0
Electricity Price ($/MWh)		0	0	0	0	0	0	0	0	0	0
Electricity revenues (k$)		0	0	0	0	0	0	0	0	0	0
Gross Revenues (k$)		0	0	0	0	0	0	0	0	0	0
O&M Costs - Electricity generation (k$)		0	0	0	-314	-314	-314	-314	-314	-321	-321
O&M Total Costs		0	0	0	-314	-314	-314	-314	-314	-321	-321
Operational Results - EBITDA		0	0	0	-314	-314	-314	-314	-314	-321	-321
Single rate Business tax	0.0%	0	0	0	0	0	0	0	0	0	0
Depreciation		0	0	0	0	0	0	0	0	0	0
EBIT		0	0	0	-314	-314	-314	-314	-314	-321	-321
			0	0	0	0	0	0	0	0	0
								0	0	0	0
Interests		0	0	0	0	0	0	0	0	0	0
EBT		0	0	0	-314	-314	-314	-314	-314	-321	-321
Income tax	30.0%	0	0	0	0	0	0	0	0	0	0
Depreciation		0	0	0	0	0	0	0	0	0	0
Net operational profit		0	0	0	-314	-314	-314	-314	-314	-321	-321
CapEx											
CapEx - Electricity Generation		0	0	0	0	0	0	0	0	0	0
Drawdown of debt		0	0	0	0	0	0	0	0	0	0
Debt repayment			0	0	0	0	0	0	0	0	0
								0	0	0	0
Debt Repayment		0	0	0	0	0	0	0	0	0	0
Net Cash Flow Equity		0	0	0	-314	-314	-314	-314	-314	-321	-321

Note: All numbers are in k$)

Benchmark	11.20%

NPV (25 years)	-2,090.11

Continues in the next page…

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2023	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-321	-321	-321	-327	-327	-327	-327	-327	-334	-334	-334	-334	-334	-340	-340

According to the cash flow, the NPV of scenario 1 is k$ - 2,090.11.

A short list showing the scenarios of the project activity is presented below according to the NPV (financial indicator).

Table 6 - Financial indicator comparison

Scenario	NPV @ 11.20% (k$)
Scenario 1	-16,936.69
Scenario 2	-2,090.11

As a result, the sensitivity analysis was conclusive and the most financially attractive alternative scenario is Scenario 2, the continuation of the current practice.

Sub-step 3c. **Sensitivity analysis**

The sensitivity analysis was performed varying the electricity tariff (revenues), the capital expenses (CapEx) and operational and maintenance costs (O&M) for the alternatives. All parameters ranging from -10% to +10%, as the result presented below:

		NPV (k$)	
	Variation	**Alternative scenario 1 (CDM Project)**	**Alternative scenario 2 (the continuation of the current practice)**
CapEx	-10%	-10,569	0
	10%	-23,305	0
Revenues	-10%	-22,204	0
	10%	-11,727	0
O&M	-10%	-15,669	-1,881
	10%	-18,205	-2,299
Base Case	0.0%	-16,937	-2,090

As presented above, in scenario 2 the project NPV values for CapEx and Revenues are always 0 due to the fact that there are no investment and revenues in the common practice scenario (scenario 2). The graphics below show the sensitivity analyses for every scenario.

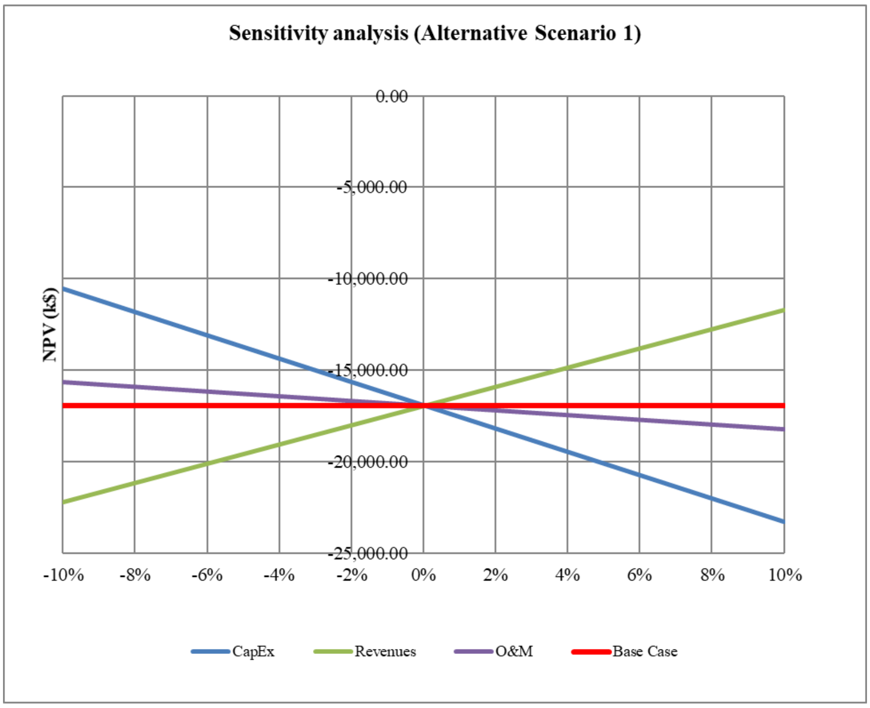


Figure 4 - Sensitivity analysis – Scenario 1

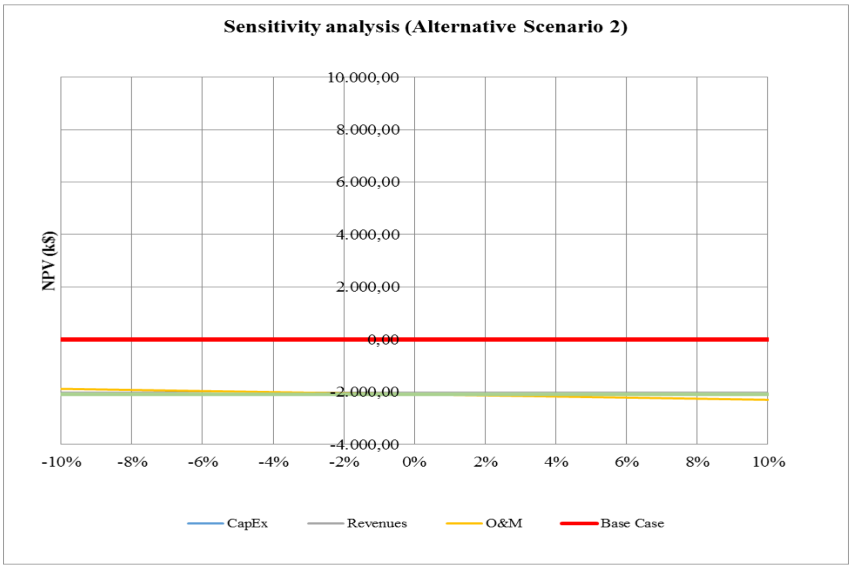


Figure 5 - Sensitivity analysis – Scenario 2

Breakeven point

To ensure the additionality of this project activity, the project proponents varied the three identified parameters (CapEx, Revenues and O&M) until each of them reached the most financially attractive scenario (NPV=0). The results are presented below and the spreadsheet[49] will be provided to the audit team:

[49] File: "*Panuco cash flow.xlsx*".

Capital Expenditures (CapEx) – To reach the NPV=0, the Capital Expenditures should be reduced in 26.6%. This result is extremely unlikely to happen in the future, as this reduction is too large for any kind of project which has a reliable investment estimate and as usually the CapEx increases during the project implementation.

Revenues – This electricity tariff or electricity generation increased in 32.5% to reach the NPV=0. This means that the electricity tariff should reach USD $119.71 or the maximum annual electricity generated reaches 368,018 MWh, deemed unrealistic as this value is far superior to the average values from the electricity statistics of the market in Mexico[50].

O&M – Also, to reach the benchmark, the O&M shall be reduced in 133.6%. This means that PPs should reduce all O&M costs, practically. Consequently, this scenario is unreal. Thus, the PPs deemed this situation to be unlikely to happen in the future.

Outcome of Step 3

As a result, the sensitivity analysis was conclusive and the most financially attractive alternative scenario is Scenario 2, the continuation of the current practice.

Therefore, it seems reasonable to conclude that the project activity (Scenario 1) is unlikely to be the most financially attractive scenario.

Step 4. Common practice analysis

The “Tool for the demonstration and assessment of additionality” clearly states that the latest version of the “Guidelines on common practice” available on the UNFCCC website shall be applied

According to “Guidelines on common practice” version 02 (EB 69 - Annex 08), the common practice analysis establishes the following items below:

1. **Applicable geographical area:** México is the fifth largest country in America and the world's fourteenth largest country in the world. Therefore, the entire host country (México) is considered suitable for this analysis;
2. **Measure:** Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energy (power generation and heat based on renewable energy);
3. **Output:** the service delivered by the project are heat and electricity (MWh);
4. **Different technologies:** the technology used in the project is the biomass cogeneration to produce heat and electricity.

The common practice analysis consists of the following steps:

Step 1: *Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.*

The installed capacity of the project is 122.666 MW[51]. Then, the output range of the project activity is from 61.333 to 183.999 MW.

Step 2: *Identify similar projects (both CDM and non-CDM) which fulfill all of the following conditions:*
(a)The projects are located in the applicable geographical area;
(b)The projects apply the same measure as the proposed project activity;

[50] Based on the average prices of electricity in Mexico, this information was published by Mexican Secretary of Energy: http://www.sener.gob.mx/portal/Default.aspx?id=1432.

[51] Consultancy study for the new cogeneration plant developed by “*Consultores de Ingenios Azucareros, S.A.*”

(c)The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
(d)The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
(e)The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(f)The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity

It was developed a search in the Mexican Energy Regulatory Commission[52] and there are not plants in México *(both CDM and non-CDM)* that uses that same fuel and technology within the calculated output range (from 61.333 MW to 183.999 MW) that considers the conditions established above[53][54].

Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

The total of the power plants identified in step 2 excluding the ones that are registered project activities, submitted or under validation and the total value is 0. Then, so then N_{all} =.

Therefore, $N_{all} = 0$.

Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}.

As $N_{all}=0$, then $N_{diff.} = 0$. $N_{all} = N_{diff}$.

Step 5: Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

$$F = 1 - \left(\frac{N_{diff}}{N_{all}}\right)$$

Therefore, $F = 0$ and $N_{all} - N_{diff} = 0$.

According to Guidelines on common practice: "*the proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and Nall-Ndiff is greater than 3".*

<u>Outcome of common practice analysis.</u>

The project activity is not a common practice because the factor $F < 0.2$ and the $N_{all} - N_{diff} < 3$.

Therefore, since no similar activities were observed, the proposed project activity is additional.

[52] Mexican Energy Regulatory Commission: http://www.cre.gob.mx/

[53] http://www.cre.gob.mx/articulo.aspx?id=171

[54] *Common practice analysis.xlsx.*

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad \textbf{(1)}$$

Where:

ER_y	=	Emissions reductions in year *y* (t CO_2)
BE_y	=	Baseline emissions in year *y* (t CO_2)
PE_y	=	Project emissions in year *y* (t CO_2)
LE_y	=	Leakage emissions in year *y* (t CO_2)

A schematic diagram of the CDM project activity is presented in Section B.3

Baseline emissions

Baseline emissions are calculated based on the most plausible baseline scenario identified in the section "Selection of the baseline scenario and demonstration of additionality", above in this methodology, taking into account how power and heat would be generated, and how the biomass would be used, in the absence of the CDM project activity.

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_f FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min(EF_{EG,GR,y}, EF_{EG,FF,y}) + BE_{BR,y}$$

(2)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$EL_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year *y* (MWh)
$EF_{EG,GR,y}$	=	Grid emission factor in year *y* (t CO_2/MWh)
$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year *y* (GJ)
$EF_{FF,y,f}$	=	CO_2 emission factor for fossil fuel type f in year *y* (t CO_2/GJ)
$EL_{BL,FF/GR,y}$	=	Baseline uncertain electricity generation in the grid or on-site in year *y* (MWh)
$EF_{EG,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year *y* (t CO_2/MWh)
$BE_{BR,y}$	=	Baseline emissions due to disposal of biomass residues in year *y* (t CO_2e)
y	=	Year of the crediting period
f	=	Fossil fuel type

Step 1: Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors in the baseline

Step 1.1: Determine total baseline process heat generation

The amount of process heat that would be generated in the baseline in year *y* ($HC_{BL,y}$) is determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the CDM project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure[55]. The process heat should be calculated net of any parasitic heat used for drying of biomass. This methodology assumes for the sake of simplicity that the proposed CDM project activity consumes steam from the same quality as in baseline process transported through one steam header.

Step 1.2: Determine total baseline electricity generation

The amount of electricity that would be generated in the baseline in year *y* is calculated as follows:

$$EL_{BL,y} = EL_{PJ,gross,y} + EL_{PJ,imp,y} - EL_{PJ,aux,y} \quad (3)$$

Where:

$EL_{BL,y}$	=	Baseline electricity generation in year *y* (MWh)
$EL_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year *y* (MWh)
$EL_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year *y* (MWh)
y	=	Year of the crediting period

$EL_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass(e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power or heat generating plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.).

For this methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the CDM project activity and are therefore not accounted for.

Step 1.3: Determine baseline capacity of electricity generation

The total capacity of electricity generation available in the baseline should be calculated using the equation below. The heat engines *i* should be obtained from the baseline scenario identified using the "Selection of the baseline scenario and demonstration of additionality" and the load factors should take into account seasonal operational constraints as well as other technical constraints in the system (e.g. availability of heat to drive heat engines).

$$CAP_{EG,total,y} = LOC_y \cdot \left[\sum_i \left(CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) \right] \quad (4)$$

Where:

[55] Heat supplied during the CDM project activity to a mechanical steam turbine shall count as process heat and be included in the process heat.

$CAP_{EG,total,y}$ = Baseline electricity generation capacity in year *y* (MWh)

$CAP_{EG,CG,i}$ = Baseline electricity generation capacity of heat engine *i* (MW)

$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio)

LOC_y = Length of the operational campaign in year *y* (hour)

i = Cogeneration-type heat engine in the baseline scenario

y = Year of the crediting period

Step 1.4: Determine the baseline availability of biomass residues

Where the baseline scenario includes the use of biomass residues for the generation of power and/or heat, the amount of biomass residues of category *n* that would be available in the baseline in year *y* (BRB4,n,y) has to be determined.

The determination of this parameter shall be based on the monitored amounts of biomass residues used for power and/or heat generation in the project boundary for which B4 has been identified as the most plausible baseline scenario in the CDM-PDD. The biomass residues quantities used should be monitored separately for (a) each type of biomass residue (e.g. sugarcane bagasse, rice husks, empty fruit bunches, etc.) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.). To the present project activity only own bagasse from the Panuco sugar mill plant will be used.

Where the whole amount of biomass residues of one particular type and from one particular source would be used in the baseline in clearly identifiable baseline heat generators, the monitored quantities of biomass residues used in the project can be directly allocated to those heat generators in the baseline scenario.

However, the following situations require particular attention:

- One biomass residue type from one particular source could be used in the baseline in two or more heat generators. In this case, the use of this biomass residue type from this source has to be allocated to the different heat generators should they have different efficiencies: This situation is not considered because, the existing plants would operate at the same conditions (e.g., average load factors, or average energy efficiencies,) as those observed in the most recent three years prior to the starting date of the CDM project activity.
- One biomass residue type from one particular source could have two different fates in the baseline scenario. In this case, it is necessary to allocate the biomass residue quantity used under the project to the following fates in the baseline scenario:
  - (a) Power or heat generation (B4), or
  - (b) Dumping, leaving to decay or burning (B1, B2 and/or B3), or
  - (c) Scenarios required for the purpose of calculating leakage effects: other fates (B5-B8).

In the project activity will be used only biomass residues from an on-site production process (category k1 of the Table 5), it is assumed that this type of biomass is entirely used for power and heat generation.

In doing so, the following allocation rules are met:

- The sum of biomass residues used in the baseline of Panuco for power and heat generation in all boilers (heat generators) shall be equal to the total amount of biomass residues which are used under the CDM project activity and for which the baseline scenario

is B4 as determined in tables 4 and 5. The produced biomass would be only used inside the boundaries of Panuco cogeneration plant;

- In spite having a growth of biomass generation due to the increase of sugar cane processing, it is pretty clear for project developers at ex-ante conditions that all the biomass will be only used inside the project boundaries for heat and power generation. PP does not consider any alternative use for biomass or selling the biomass to other sugar mills, because in case of remnant of bagasse, the PP will continue with the power generation by using the bagasse storage in the courtyard. No bagasse will be storage for more than one year in the courtyard;

- The allocation of biomass residues should be undertaken in a conservative manner. This means that in case of uncertainty an allocation rule should be applied that tends to result in lower emission reductions.

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

The efficiencies of heat generators and heat engines should be calculated using one of the following options:

Option 3: This option is only applicable to heat generators and heat engines that were operated at the project site for at least three calendar years prior the date of submission of the PDD for validation of the CDM project activity. The efficiencies of heat generators and heat engines are determined based on the historical records, as follows:

Efficiency for heat generators

The efficiency for heat generators should be calculated using the following equation:

$$\eta_{BL,HG,BR,h} = MAX\left\{\frac{HG_{BR,h,x}}{\sum_{n} BR_{n,h,x} \cdot NCV_{BR,n,x}};\frac{HG_{BR,h,x-1}}{\sum_{n} BR_{n,h,x-1} \cdot NCV_{BR,n,x-1}};\frac{HG_{BR,h,x-2}}{\sum_{n} BR_{n,h,x-2} \cdot NCV_{BR,n,x-2}}\right\} \quad (5)$$

$$\eta_{BL,HG,FF,h} = MAX\left\{\frac{HG_{FF,h,x}}{\sum_{n} FF_{f,h,x} \cdot NCV_{FF,f,x}};\frac{HG_{FF,h,x-1}}{\sum_{n} FF_{f,h,x-1} \cdot NCV_{FF,f,x-1}};\frac{HG_{FF,h,x-2}}{\sum_{n} FF_{f,h,x-2} \cdot NCV_{FF,f,x-2}}\right\} \quad (6)$$

Where:

$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator *h* (ratio)
$\eta_{BL,HG,FF,h}$	=	Baseline fossil-based heat generation efficiency of heat generator *h* (ratio)
$HG_{BR,h,x}$	=	Net quantity of heat generated from using biomass residues in heat generator *h* in year *x* (GJ/yr)
$HG_{FF,h,x}$	=	Net quantity of heat generated from using fossil fuels in heat generator *h* in year *x* (GJ/yr)
$BR_{n,h,x}$	=	Quantity of biomass residues of category n used in heat generator *h* in year *x* (tonnes on dry-basis)
$FF_{f,h,x}$	=	Quantity of fossil fuel type f fired in heat generator *h* in year *x* (mass or volume unit/yr)
$NCV_{BR,n,x}$	=	Net calorific value of biomass residues of category *n* in year

		x (GJ/tonnes on dry-basis)
$NCV_{FF,f,x}$	=	Net calorific value of fossil fuel type *f* in year *x* (GJ/mass or volume unit)
x	=	Last calendar year prior to the start of the crediting period
n	=	Biomass residue category
f	=	Fossil fuel type
h	=	Heat generator in the baseline scenario

If fossil fuels and biomass residues were used for heat generation in the heat generator h prior to the implementation of the CDM project activity, then $HG_{BR,h,x}$, $HG_{BR,h,x-1}$ and $HG_{BR,h,x-2}$, as well as $HG_{FF,h,x}$, $HG_{FF,h,x-1}$ and $HG_{FF,h,x-2}$, are determined as follows:

$$HG_{BR,h,x} = HG_{h,x} \cdot \frac{\sum_{n} BR_{n,h,x} \cdot NCV_{BR,n,x}}{\sum_{n} BR_{n,h,x} \cdot NCV_{BR,n,x} + \sum_{f} FF_{f,h,x} \cdot NCV_{FF,f,x}} \quad (7)$$

$$HG_{FF,h,x} = HG_{h,x} \cdot \frac{\sum_{n} FF_{f,h,x} \cdot NCV_{FF,f,x}}{\sum_{n} BR_{n,h,x} \cdot NCV_{BR,n,x} + \sum_{f} FF_{f,h,x} \cdot NCV_{FF,f,x}} \quad (8)$$

Where:

$HG_{BR,h,x}$	=	Net quantity of heat generated from using biomass residues in heat generator *h* in year *x* (GJ/yr)
$HG_{FF,h,x}$	=	Net quantity of heat generated from using fossil fuels in heat generator *h* in year *x* (GJ/yr)
$HG_{h,x}$	=	Net quantity of heat generated in heat generator *h* in year x (GJ/yr)
$BR_{n,h,x}$	=	Quantity of biomass residues of category *n* used in heat generator *h* in year *x* (tonnes on dry-basis)
$FF_{f,h,x}$	=	Quantity of fossil fuel type *f* fired in heat generator *h* in year *x* (mass or volume unit/yr)
$NCV_{BR,n,x}$	=	Net calorific value of biomass residues of category *n* in year *x* (GJ/tonnes on dry-basis)
$NCV_{FF,f,x}$	=	Net calorific value of fossil fuel type *f* in year *x* (GJ/mass or volume unit)

Efficiency for heat engines

The efficiency for heat engines should be calculated using the following equation:

$$\eta_{BL,EG,CG,i/j} = MAX\left\{\frac{EL_{BR,CG,x,i/j}}{HG_{BR,CG,x,i/j}};\frac{EL_{BR,CG,x-1,i/j}}{HG_{BR,CG,x-1,i/j}};\frac{EL_{BR,CG,x-2,i/j}}{HG_{BR,CG,x-2,i/j}}\right\} \quad (9)$$

Where:

$\eta_{BL,EG,CG,i}$	=	Baseline electricity generation efficiency of heat engine *i* (MWh/GJ)
$EL_{BR,CG,x,i/j}$	=	Quantity of electricity generated in heat engine *i/j* in year *x*

		(MWh)
$HG_{BR,CG,x,i/j}$	=	Quantity of heat used in heat engine *i/j* in year *x* (GJ)
x	=	Last calendar year prior to the start of the crediting period
i	=	Cogeneration-type heat engine in the baseline scenario
j	=	Power-only-type heat engine in the baseline scenario

The heat-to-power ratio of cogeneration-type heat engines (e.g. backpressure and heat-extraction steam turbines) should be calculated as follows.

Case 1: For existing heat engines with a minimum three-year operational history prior to the CDM project activity:

$$HPR_{BL,EG,CG,i} = \frac{1}{3.6} \cdot MAX\left\{\frac{HC_{BR,CG,x,i}}{EL_{BR,CG,x,i}};\frac{HC_{BR,CG,x-1,i}}{EL_{BR,CG,x-1,i}};\frac{HC_{BR,CG,x-2,i}}{EL_{BR,CG,x-2,i}}\right\} \quad \textbf{(10)}$$

Where:

$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine *i* (ratio)
$HC_{BR,CG,x,i}$	=	Quantity of process heat extracted from the heat engine *i/j* in year *x* (GJ)
$EL_{BR,CG,x,i}$	=	Quantity of electricity generated in heat engine *i/j* in year *x* (MWh)
x	=	Last calendar year prior to the start of the crediting period
i	=	Cogeneration-type heat engine in the baseline scenario

Step 1.6: Determine the emission factor of on-site electricity generation with fossil fuels

As fossil fuel based power generation was identified as part of the baseline scenario, but all capacity of power generation based on fossil fuels is used in the cogeneration mode, then:

$EF_{EG,FF,y} = EF_{EG,GR,y}$.

For the CDM project activity it is assumed that the heat engines will use only biomass-based heat. Therefore, there is no power generation capacity based on fossil fuels:

Step 1.7: Determine the emission factor of grid electricity generation

The parameter $EF_{EG,GR,y}$ should be determined as the combined margin CO_2 emission factor for grid to which the CDM project activity is connected in year *y*, calculated using the latest approved version of the “Tool to calculate the emission factor for an electricity system, version 04.0”.
The build margin CO_2 emission factor and operating margin CO_2 emission factor will be *ex-ante*. Therefore, the combined margin CO_2 emission factor will be *ex-ante*.

A detail explanation of calculation is presented in the Section B.6.3 of this document.

Step 2: Determine the minimum baseline electricity generation in the grid

The calculation of the minimum amount of electricity that would be generated in the grid in the baseline is based on the assumption that the amount of electricity generated on-site in the baseline cannot be higher than the installed capacity of power generation available in the baseline scenario.

Therefore, the following equation should be used:

$$EL_{BL,GR,y} = \max\left(0, EL_{BL,y} - CAP_{EG,total,y}\right) \quad \textbf{(11)}$$

Where:

$EL_{BL,GR,y}$	=	Baseline minimum electricity generation in the grid in year *y* (MWh)
$EL_{BL,y}$	=	Baseline electricity generation in year *y* (MWh)
$CAP_{EG,total,y}$	=	Baseline electricity generation capacity in year *y* (MWh)
y	=	Year of the crediting period

Step 3: Determine the baseline biomass-based heat and power generation

Step 3.1: Determine the baseline biomass-based heat generation

It is assumed that the use of biomass residues for which scenario B4: has been identified as the baseline scenario ($BR_{B4,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. From that assumption, the equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) should be determined.

Considering that the several heat generators and different categories of biomass residues might be identified as part of the baseline scenario, the prioritization of heat generators use and the allocation of biomass residues to different heat generators may be challenging and much dependent on specific site conditions. For that reason, the methodology proposes general principles that should be adhered to in order to determine the prioritization and allocation, which still leave room for technical constraints to be reflected given specific site conditions[56].

In order to do that, follow the procedure below:

- Prepare a list of all heat generators that would use biomass residues in the baseline scenario The list should include both biomass-based and co-fired heat generators;

The baseline scenario includes five heat generators (b1, b2, b3, b4, and b5) using bagasse and fossil fuel (Bunker C):

- Allocate the biomass types and quantities for which B4 has been identified as the baseline scenario ($BR_{B4,n,y}$) to the different heat generators ($BR_{B4,n,h,y}$). In doing so, the following principles should be adhered to:

- Where a biomass residue type can technically be used in more than one heat generator, it should be assumed that it is allocated from the most efficient to the less efficient heat generators to the maximum extent possible, taking into account any technical and operational constraints;

- Where a biomass residue type can technically be used in both heat generators which do not require co-firing fossil fuels and heat generators which require co-firing fossil fuels, it should be assumed that it is to the maximum extent possible used in the heat generator which does not require co-firing fossil fuels, taking into account any technical and operational constraints. Any remaining biomass residue quantities are then allocated to the subsequent heat generators which require co-firing fossil fuels;

[56] An example of a technical constraint is the case where the baseline includes multiple steam headers. In such cases the project participant may: a) Identify and rank process steam demand from process according to different enthalpies from highest to lowest; b) Rank steam headers according to different enthalpies from highest to lowest; c) Apply the guidance in this and the following step for each steam header starting with the steam demand with the highest enthalpy.

- In both cases, if different types of biomass residues result in different levels of heat generation efficiency, the allocation of biomass residues should be guided by the principle that the biomass residues would be allocated so as to maximize the heat generation efficiency of the set of heat generators;

The quantity of biomass residue identified as the baseline scenario ($\mathrm{BR}_{\mathrm{B4,n,y}}$) is allocated to the different heat generators (b1to b5) equally. Since, all heat generators have an similar efficiency and capacity, biomass is assumed divided evenly between the heat generators (b1 to b5).

Moreover, in the baseline scenario there is only one type of biomass residue (bagasse) for heat generation.

Project Activity Implementation

During monitoring, two new heat generators will be used (b6 and b7) and two new steam turbines (g6 and g7). The equipment which compounds the scenario existing prior to the implementation of the project activity (old cogeneration system) will be kept as backup (boilers from b1 to b5 and turbo generators from g1 to g5).

It is assumed that all biomass falling under scenario B4 will be firstly allocated to the biomass-based heat generator, which is more efficient (Efficiency: 85%)[57]. If the back-up is used, biomass will be then allocated to it.

Document and justify in the CDM-PDD in a transparent manner how the allocation of biomass residue types and quantities to heat generators will be performed during monitoring.

- Calculate the amount of heat generated with biomass residues based on the allocation rules established in the CDM-PDD using the following equations:

$$\mathrm{HG}_{\mathrm{BL,BR,y}} = \sum_{h}\sum_{n}\left(\mathrm{BR}_{\mathrm{B4,n,h,y}} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h}\right) \quad \textbf{(12)}$$

Subject to,

$\sum_{h}\sum_{\mathrm{n}}\mathrm{BR}_{\mathrm{B4,n,h,y}} = \sum_{n}\mathrm{BR}_{\mathrm{B4,n,y}}$, i.e. the biomass residues used in each heat generator should not exceed the total amount of biomass residues available. **(13)**

$\sum_{\mathrm{n}}\left(\mathrm{BR}_{\mathrm{B4,n,h,y}} \cdot \mathrm{NCV}_{\mathrm{BR,n,y}} \cdot \eta_{\mathrm{BL,HG,BR,h}}\right) \leq \mathrm{LOC}_{\mathrm{y}} \cdot \mathrm{CAP}_{\mathrm{HG,h}} \cdot \mathrm{LFC}_{\mathrm{HG,h}}$, i.e. the heat generation in each heat generator should not exceed the total capacity of the heat generator; **(14)**

Where:

$\mathrm{HG}_{\mathrm{BL,BR,y}}$	=	Baseline biomass-based heat generation in year *y* (GJ)
$\mathrm{BR}_{\mathrm{B4,n,h,y}}$	=	Quantity of biomass residues of category n used in heat generator h in year *y* with baseline scenario B4 (tonne on dry-basis)
$\mathrm{NCV}_{\mathrm{BR,n,y}}$	=	Net calorific value of biomass residue of category n in year *y* (GJ/tonne on dry-basis)

[57] Manufacturer technical proposal ISGEC: *Revised Technical Proposal - 200 TPH,1200 psig, 1000F.pdf*

$\eta_{BL,HG,BR,h}$	=	Baseline biomass-based heat generation efficiency of heat generator *h* (ratio)
$BR_{B4,n,y}$	=	Quantity of biomass residues of category n used in the CDM project activity in year *y* for which the baseline scenario is B4 (tonne on dry-basis)
LOC_y	=	Length of the operational campaign in year *y* (hour)
$CAP_{HG,h}$	=	Baseline capacity of heat generator *h* (GJ/h)
$LFC_{HG,h}$	=	Baseline load factor of heat generator *h* (ratio)
y	=	Year of the crediting period
h	=	Heat generator in the baseline scenario

Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction

It is assumed that cogeneration of process heat and power using biomass-based heat ($HG_{BL,BR,y}$) would be prioritized over the use of fossil fuels for the generation of process heat and power on-site. From that assumption the equivalent amount of electricity ($EL_{BL,BR,CG,y}$) and process heat ($HC_{BL,BR,CG,y}$) that would be generated are determined.

Considering that the several heat engines of different types might be identified as part of the baseline scenario, the prioritization of heat engines use may be challenging and much dependent on specific site conditions. For that reason, the methodology proposes general principles that should be adhered to in order to determine the prioritization of use, which still leave room for technical constraints to be reflected given specific site conditions.

In order to do that follow the procedure below:

- Prepare a list containing the heat engines identified in the baseline scenario for which heat and power can be cogenerated. The list should contain, in case of steam cycles, only back-pressure and heat-extraction steam turbines. Condensing steam turbines should not be considered at this stage;

The baseline scenario composes of five backpressure steam turbines (g1, g2, g3, g4, and g5).

- Allocate the total biomass-based heat ($HG_{BL,BR,y}$) to the different heat engines ($HG_{BL,BR,CG,y,i}$). In doing so, the following principles should be adhered to:
  - Where heat can technically be used in more than one heat engine type, it should be assumed that it is allocated so as to maximize the cogeneration of process heat. For instance, in case of steam cycles, if both back-pressure and heat-extraction steam turbines are identified in the baseline, heat should be first allocated to back-pressure turbines and then to heat-extraction turbines to the maximum extent possible, taking into account any technical and operational constraints;
  - The baseline scenario composes of five backpressure steam turbines (g1, g2, g3, g4, and g5) and for this reason there are not preferences for allocation of any steam turbine.
  - Subject to the allocation rule above, it should be assumed that heat is allocated from the most efficient to the less efficient heat engines to the maximum extent possible, taking into account any technical and operational constraints;
  - The quantity of total biomass-based heat (HGBL,BR,y) is allocated to the heat engines (g1 to g5) equally. All units are back-pressure turbines, hence no specific unit has

priority allocation of biomass heat, and the biomass-based heat is assumed divided evenly between the engines.

Project Activity Implementation

During monitoring, all biomass-heat generated will be allocated to the new heat engines (g6 and g7) following the procedure explained above.

- Calculate the amount of electricity and process heat generation based on the allocation above using the following equations:

$$EL_{BL,BR,CG,y} = \frac{1}{3.6} \cdot \sum_{i} \left(\frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \quad \textbf{(15)}$$

$$HC_{BL,BR,CG,y} = \sum_{i} \left(\frac{HPR_{BL,i}}{(HPR_{BL,i} + 1 + GGL_{default})} \cdot HG_{BL,BR,CG,y,i} \right) \quad \textbf{(16)}$$

Subject to,

$\sum_{i} HG_{BL,BR,CG,y,i} \leq HG_{BL,BR,y}$, i.e. the biomass-based heat used in cogeneration mode should not exceed the total biomass-based heat generated; **(17)**

$HC_{BL,BR,CG,y} \leq HC_{BL,y}$, i.e. the process heat cogenerated should not exceed the total process heat demand; **(18)**

$(\eta_{BL,EG,CG,i} \cdot HG_{BL,BR,CG,y,i}) \leq LOC_{y} \cdot CAP_{EG,CG,i} \cdot LFC_{EG,CG,i}$, i.e. the electricity generation in each heat engine should not exceed the total capacity of the heat engine. **(19)**

Where:

$EL_{BL,BR,CG,y}$	=	Baseline biomass-based cogenerated electricity in year *y* (MWh)
$\eta_{BL,EG,CG,i}$	=	Baseline electricity generation efficiency of heat engine *i* (MWh/GJ)
$HG_{BL,BR,CG,y,i}$	=	Baseline biomass-based heat used in heat engine *i* in year *y* (GJ)
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year *y* (GJ)
$HPR_{BL,i}$	=	Baseline heat-to-power ratio of the heat engine *i* (ratio)
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio)
$HG_{BL,BR,y}$	=	Baseline biomass-based heat generation in year *y* (GJ)
$HC_{BL,y}$	=	Baseline process heat generation in year *y* (GJ)
LOC_{y}	=	Length of the operational campaign in year *y* (hour)
$CAP_{EG,CG,i}$	=	Baseline electricity generation capacity of heat engine *i* (MW)
$LFC_{EG,CG,i}$	=	Baseline load factor of heat engine *i* (ratio)
i	=	Cogeneration-type heat engine in the baseline scenario
y	=	Year of the crediting period

The next step to be followed depends on the outcomes of the calculations above. Four cases are possible:

Case 3.2.1: If $HG_{BL,BR,y} = \sum_{i} HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$, then all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines and would suffice to serve all process heat demand. It is assumed then that the use of fossil fuels on-site in the baseline scenario would be uncertain (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology, particularly on the relative prices of on-site electricity generation using fossil fuels and the electricity price in the grid. In order to estimate the baseline parameters that result project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, $EL_{PJ,offset,y}$ = 0, $FF_{BL,HG,y,f}$ = 0, and,
- Proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

Case 3.2.2: If $HG_{BL,BR,y} = \sum_{i} HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} > HC_{BL,BR,CG,y}$, then all the heat that would be generated using biomass residues in the baseline would be used in cogeneration-type heat engines but still some process heat demand would remain to be met. It is assumed then that the process heat balance that remains to be met would be met by using fossil fuels. In order to estimate the baseline parameters that result, project participants should:

- Define $HC_{balance,FF,y} = HC_{BL,y} - HC_{BL,BR,CG,y}$, $EL_{balance,FF,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and,
- Proceed to Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation.

Case 3.2.3: If $HG_{BL,BR,y} > \sum_{i} HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} = HC_{BL,BR,CG,y}$, then all process heat demand would be met with biomass-based heat in the baseline and still there would be some biomass-based heat to be used. It is assumed then that this heat would be used for generation of power in power-only mode, i.e. without cogeneration of process heat. In order to estimate the baseline parameters that result project participants should:

- Define $HG_{balance,BR,PO,y} = HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i}$,
  $EL_{balance,PO,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and,

Proceed to Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode.

Case 3.2.4: If $HG_{BL,BR,y} > \sum_{i} HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} > HC_{BL,BR,CG,y}$, then there would be biomass-based heat in the baseline that could still be used and process heat demand to be met. It is assumed then that this balance of biomass-based heat would be extracted from the heat header and used to meet the process heat demand without cogeneration of power.

Three cases should thus be considered (refer to the monitoring tables for a definitions of $h_{LOW,y}$ and $h_{HIGH,y}$ used in the equations below):

Case 3.2.4.1: If $HC_{BL,y} - HC_{BL,BR,CG,y} = \frac{h_{LOW,y}}{h_{HIGH,y}} \cdot \left(HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i} \right)$, i.e. the balance of biomass-based heat (right-hand side of the equation) equals the remaining demand for process heat (left-hand side of the equation). Then there is no more biomass-based heat available and the demand for process heat has been met. It is assumed then that the use of fossil fuels on-site would be uncertain in the baseline scenario (except for the amount required due to technical constraints) because it would depend on a number of factors that are not taken into account in this methodology, particularly on the relative prices of on-site electricity generation using fossil fuels and the electricity price in the grid. In order to estimate the baseline parameters that result project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, $EL_{PJ,offset,y} = 0$, $FF_{BL,HG,y,f} = 0$, and,
- Proceed to Step 5 Determine the baseline emissions due to uncontrolled burning or decay of biomass residues.

Case 3.2.4.2: If $HC_{BL,y} - HC_{BL,BR,CG,y} > \frac{h_{LOW,y}}{h_{HIGH,y}} \cdot \left(HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i} \right)$, i.e. the balance of biomass-based heat (right-hand side of the equation) is less than the remaining demand for process heat (left-hand side of the equation). Then all biomass-based heat was used and there still remains process heat demand to be met. It is assumed then that this process heat demand would be met by using fossil fuels in the baseline. In order to estimate the baseline parameters that result project participants should:

- Define $HC_{balance,FF,y} = \left(HC_{BL,y} - HC_{BL,BR,CG,y} \right) - \frac{h_{LOW}}{h_{HIGH}} \cdot \left(HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i} \right)$, $EL_{balance,FF,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and,
- Proceed to Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation

Case 3.2.4.3: If $HC_{BL,y} - HC_{BL,BR,CG,y} < \frac{h_{LOW}}{h_{HIGH}} \cdot \left(HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i} \right)$, i.e. the balance of biomass-based heat (right-hand side of the equation) is greater than the remaining demand for process heat (left-hand side of the equation). Then the balance of heat produced with biomass residues is greater than the balance of process heat demand, meaning that there remains some biomass-based heat to be used after the demand for process heat was met. It is assumed then that this heat would be used to generate electricity in power-only mode, i.e. without cogeneration of process heat. In order to estimate the baseline parameters that result project participants should:

- Define $HG_{balance,BR,PO,y} = \left(HG_{BL,BR,y} - \sum_{i} HG_{BL,BR,CG,y,i} \right) - \frac{h_{HIGH}}{h_{LOW}} \cdot \left(HC_{BL,y} - HC_{BL,BR,CG,y} \right)$, $EL_{balance,PO,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and,
- Proceed to Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode.

Step 3.3: Determine the baseline biomass-based electricity generated in power-only mode

It is not applicable

Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation

Step 4.1: Determine the baseline fossil fuel based cogeneration of process heat and electricity and the remaining process heat demand

In many cases the amount of biomass residues available is not enough to generate the heat required to meet the process heat demand. In such cases, and if fossil-fuel-based heat generators have been identified in the baseline scenario, it is assumed that the balance of process heat is met using fossil fuels, resulting in related fossil fuel baseline emissions.

In order to determine the amount of heat and electricity that would be cogenerated using fossil fuels, the procedure below should be followed:

- Prepare a list containing the cogeneration heat engines identified in the baseline scenario for which heat and power can be cogenerated.

The baseline scenario includes five back-pressure steam turbines (g1, g2, g3, g4, and g5).

- Allocate the process heat balance ($HC_{balance,FF,y}$) to the different cogeneration heat engines that still have capacity to cogenerate heat and power, up to the level required for meeting the balance of process heat demand. In doing so, the following principles should be adhered to:
    - Where heat can technically be used in more than one cogeneration heat engine type, it should be assumed that it is allocated so as to maximize the cogeneration of process heat. For instance, in case of steam cycles, if both back-pressure and heat-extraction steam turbines are identified in the baseline, the process heat balance should be first allocated to back-pressure turbines and then to heat-extraction turbines to the maximum extent possible, taking into account any technical and operational constraints, including partial use of the heat engine in previous steps;
    - Subject to the allocation rule above, it should be assumed that the process heat is allocated from the most efficient to the less efficient heat engines to the maximum extent possible, taking into account any technical and operational constraints;

The quantity of total fossil-based heat ($HG_{BL,FF,y,i}$) is allocated to the heat engines (g1 to g5) equally.

All units are back-pressure turbines, hence no specific unit has priority allocation of fossil heat, and the fossil-based heat is assumed divided evenly between the engines.

Project Implantation

During the project activity, all biomass-heat generated will be allocated to the heat engines (g6 and g7).

Calculate for each cogeneration heat engine *i* the amount of cogenerated electricity and the amount of heat that would need to be generated by fossil fuels in heat generators in order to supply the cogeneration heat engine, as follows:

$$\mathrm{HG}_{\mathrm{BL,FF,CG,y,i}} = \frac{(HPR_{BL,i} + 1 + GGL_{default})}{HPR_{BL,i}} \cdot HC_{\mathrm{BL,FF,CG,y,i}}$$

, i.e. the amount of fossil fuel based heat required to supply the cogeneration heat engine *i* **(**20**)**

$$\mathrm{EL}_{\mathrm{BL,FF,y}} = \sum_{\mathrm{i}} \frac{\mathrm{HC}_{\mathrm{BL,FF,CG,y,i}}}{\mathrm{HPR}_{\mathrm{BL,i}}}$$

, i.e the amount of fossil fuel based electricity cogenerated by cogeneration heat engine i **(21)**

$$HG_{BL,FF,CG,y} = \sum_i HG_{BL,FF,CG,y,i} \quad (22)$$

Subject to,

$\sum_i HC_{BL,FF,CG,y,i} \leq HC_{balance,FF,y}$, i.e. the fossil fuel based cogenerated process heat should not exceed the balance of process heat demand, **(23)**

$$\frac{1}{3.6} \cdot \left((HG_{BL,FF,CG,y,i} + HG_{BL,BR,CG,y,i}) \cdot \frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \right) \leq LOC_y \cdot CAP_{EG,CG,i} \cdot LFC_{EG,CG,i}$$

(24)

Where:

$HG_{BL,FF,y,i}$	=	Baseline fossil-based heat used in heat engine *i* in year *y* (GJ)
$HC_{BL,BR,CG,y}$	=	Baseline biomass-based process heat cogenerated in year *y* (GJ)
$GGL_{default}$	=	The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio)
$HPR_{BL,i}$	=	Baseline Heat Power Ratio of heat engine *i* (ratio)
$EL_{BL,FF,y}$	=	Baseline fossil-based electricity generation in year *y* (MWh)
$HG_{BL,FF,y,h}$	=	Baseline fossil-based heat generation in heat generator h in year *y* (GJ)
$HC_{balance,FF,y}$	=	Balance of process heat demand after cogeneration in year *y* (GJ)
$HG_{BL,FF,CG,y,i}$	=	Baseline fossil-fuel-based heat used in heat engine *i* in year *y* (GJ)
$HG_{BL,BR,CG,y,i}$	=	Baseline biomass-based heat used in heat engine *i* in year *y* (GJ)
LOC_y	=	Length of the operational campaign in year *y* (hour)
$CAP_{EG,CG,i}$	=	Baseline electricity generation capacity of heat engine *i* (MW)
$LFC_{EG,CG,i}$	=	Baseline load factor of heat engine *i* (ratio)
f	=	Fossil fuel type
y	=	Year of the crediting period
i	=	Cogeneration-type heat engine in the baseline scenario

In case after step 4.1 $HC_{balance,FF,y} > HC_{BL,FF,CG,y}$, then there would still be process heat demand to be met. It is assumed then that this balance of process heat would be generated with fossil fuels and extracted from the heat header and used to meet the process heat demand without cogeneration of power until all baseline process heat is met.

$$HG_{BL,FF,DHE,y} = (HC_{balance,FF,y} - HC_{BL,FF,CG,y}) \cdot \frac{h_{HIGH,y}}{h_{LOW,y}} \quad (25)$$

$$HG_{BL,FF,y} = HG_{BL,FF,CG,y} + HG_{BL,FF,DHE,y} \quad (26)$$

Where:

$HC_{balance,FF,y}$	=	Balance of process heat demand after cogeneration in year *y* (GJ)

$HC_{BL,FF,CG,y}$	=	Baseline fossil-fuel-based process heat cogenerated in year *y* (GJ)
$h_{LOW,y}$	=	Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)
$h_{HIGH,y}$	=	Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)
$HG_{BL,FF,y}$	=	Baseline fossil-based heat generation in year *y* (GJ)
$HG_{BL,FF,DHE,y}$	=	Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year *y* (GJ)
$HG_{BL,FF,CG,y}$	=	Baseline fossil-based heat cogeneration in year y (GJ)

The following cases are possible depending on the results of the calculations above:

Case 4.1.1: If $EL_{balance,FF,y} \geq EL_{BL,FF,y}$; the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario. In order to determine the resulting baseline emissions project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{balance,FF,y} - EL_{BL,FF,y}$, $EL_{PJ,offset,y}$ = 0, and,
- Proceed to Step 4.2 .

Case 4.1.2: If $EL_{balance,FF,y} < EL_{BL,FF,y}$, the amount of electricity generated on-site in the baseline exceeds the amount of electricity generated in the project scenario. If grid-export was available in the baseline, this result indicates that the CDM project activity results in a decrease of power output which is likely to be supplied by the grid. As a consequence, project emissions in the form of generation of electricity in the grid should be accounted for via the parameter $EL_{PJ,offset,y}$. In order to determine the resulting baseline emissions project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{balance,FF,y} - EL_{BL,FF,y}$, $EL_{PJ,offset,y}$ = 0, and,
- Proceed to Step 4.2 .

The calculations in the Section B.6.3 defined than Case 4.1.1 is possible, the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario.

Step 4.2: Determine the baseline heat generation to meet the fossil-based cogeneration of heat and power and the heat to meet the balance of process heat

Considering that several heat generators might be identified as part of the baseline scenario, the prioritization of heat generators use may be challenging and much dependent on specific site conditions.
In order to determine the amount of heat and electricity that would be cogenerated using fossil fuels, the
allocation procedure below is be followed:

- Prepare a list of all heat generators that would use fossil fuels in the baseline scenario.

The baseline scenario includes six heat generators (b1, b2, b3, b4 and b5) using bagasse and fossil fuel (Bunker C).

- Allocate the total heat generation required from fossil fuels ($HG_{BL,FF,y}$) to the different heat generators ($HG_{BL,FF,y,h}$), subject to the difference in heat content in the different heat carriers, up to the level required for meeting the balance of process heat demand. In doing so, the following principles should be adhered to:

- Where heat can technically be generated in more than one heat generator, it should be assumed that it is generated starting from the most efficient to the less efficient heat generators to the maximum extent possible, taking into account any technical and operational constraints, including co-firing and the partial use of the heat generator in the previous steps;
- If different types of fossil fuels can technically be used in the heat generators, the type of fossil fuel used should be guided by the principle that fossil fuels would be used so as to maximize the heat generation efficiency of the set of heat generators;

Since, all heat generators have an similar efficiency and capacity, the prioritization and allocation to the heat generators (b1 to b5) is done evenly.

Moreover, in the baseline scenario the fossil fuel (Bunker C) was used in the heat generators. There is no district heating system.

Project Implementation (This section was determined as the methodology recommends)

During monitoring, the allocation of fossil fuel and quantities to the new heat generators does not occur because, the project activity will not use fossil fuel.

In case, fossil fuel are used, estimate the total amount of fossil fuels required to generate the heat required for the cogeneration in Step 4.1 and the balance of process heat based on the allocation principles above using the following equations:

$$\sum_{h} HG_{BL,FF,y,h} = HG_{BL,FF,DHE,y} + HG_{BL,FF,CG,y} \quad \textbf{(27)}$$

$$FF_{BL,HG,y,f} = \sum_{h} \left(\frac{HG_{BL,FF,y,h}}{\eta_{BL,HG,FF,h}} \right) \quad \textbf{(28)}$$

Subject to:

$HG_{BL,FF,y,h} \leq LOC_{y} \cdot CAP_{HG,h} \cdot LFC_{HG,h}$, i.e. the heat generation in each heat generator should not exceed the total capacity of the heat generator; **(29)**

Where:

$FF_{BL,HG,y,f}$	=	Baseline fossil fuel demand for process heat in year *y* (GJ)
$HG_{BL,FF,y,h}$	=	Baseline fossil-based heat generation in heat generator *h* in year *y* (GJ)
$\eta_{BL,HG,FF,h}$	=	Baseline fossil-based heat generation efficiency of heat generator *h* (ratio)
LOC_{y}	=	Length of the operational campaign in year *y* (hour)
$CAP_{HG,h}$	=	Baseline capacity of heat generator *h* (GJ/h)
$LFC_{HG,h}$	=	Baseline load factor of heat generator *h* (ratio)
$HG_{BL,FF,DHE,y}$	=	Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year y (GJ)
$HG_{BL,FF,CG,y}$	=	Baseline fossil-based heat cogeneration in year y (GJ)

Proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

It is not applicable.

Step 6: Calculate baseline emissions

Calculate baseline emissions using equation (2) above.

<u>Project emissions</u>

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y} + PE_{BC,y} \quad \textbf{(30)}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2)
$PE_{FF,y}$	=	Emissions during the year y due to fossil fuel consumption at the project site (t CO_2)
$PE_{GR1,y}$	=	Emissions during the year y due to grid electricity imports to the project site (t CO_2)
$PE_{GR2,y}$	=	Emissions due to a reduction in electricity generation at the project site as compared to the baseline scenario in year *y* (t CO_2)
$PE_{TR,y}$	=	Emissions during the year y due to transport of biomass to the project plant (t CO_2)
$PE_{BR,y}$	=	Emissions from the combustion of biomass during the year *y* (t CO_2e)
$PE_{WW,y}$	=	Emissions from wastewater generated from the treatment of biomass in year *y* (t CO_2e)
$PE_{BG2,y}$	=	Emissions from the production of biogas in year *y* (t CO_2e)
$PE_{BC,y}$	=	Project emissions associated with the cultivation of land to produce biomass in year *y* (t CO_2)

For the purpose of determining GHG emissions of the project activity, the following emissions sources are excluded as explained in detailed below:

For the purpose of determining GHG emissions of the project activity, only the following emissions sources are included (explanation is detailed below):

- Emissions from fossil fuel consumption at the project site for the generation of electric power and heat and for auxiliary loads related to the generation of electric power and heat;
- CO2 emissions from grid-connected fossil fuel power plants in the electricity system for any electricity that is imported from the grid to the project site;

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GR1,y} \quad \textbf{(31)}$$

Determination of $PE_{FF,y}$

This parameter is included.

The following emission sources should be included in determining $PE_{FF,y}$:

- Emissions from on-site fossil fuel consumption for the generation of electric power and heat. This includes all fossil fuels used at the project site in heat generators (e.g. boilers) for the generation of electric power and heat; and
- Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power and heat. This includes fossil fuels required for the operation of auxiliary equipment related to the power and heat plants (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.) which are not accounted in the first bullet, and fossil fuels required for the operation of equipment related to the preparation, storage and transportation of fuels (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.).

Emissions due to fossil fuel combustion $PE_{FF,y}$ are calculated using the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", option B.

CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum FC_{i,j,y} \times CO_{EFi,y} \qquad \textbf{(32)}$$

Where:

$PE_{FC,j,y}$	=	Are the CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr);
$FC_{i,j,y}$	=	Is the quantity of fuel type i combusted in the back up turbines during the year y (mass or volume unit/yr);
$CO_{EFi,y}$	=	Is the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	=	Are the fuel types combusted in process j during the year y

The CO_2 emission coefficient $CO_{EFi,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

Option B: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$CO_{EFi,y} = NCV_{i,y} \times EF_{CO2,i,y} \qquad \textbf{(33)}$$

Where:

$CO_{EFi,y}$	=	Is the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)
i	=	Are the fuel types combusted in process j during the year y

Determination of $PE_{GR1,y}$

This parameter is included.

Regarding grid electricity imports, the co-generation plant is expected to be self-sufficient except for electricity consumption during start-up. Electricity imports from the grid $EL_{PJ,imp,y}$ is taken into account in
the calculation of $EL_{BL,y}$. $EL_{PJ,imp,y}$ will be monitored. For the ex-ante estimation, though, these are assumed negligible.

$$PE_{GR1,y} = EF_{EG,GR,y} \cdot EL_{PJ,imp,y} \qquad \textbf{(34)}$$

Where:

$PE_{GR1,y}$	=	Emissions during the year *y* due to grid electricity imports to the project site (t CO_2)
$EL_{PJ,imp,y}$	=	Project electricity imports from the grid in year *y* (MWh)
$EF_{EG,GR,y}$	=	Grid emission factor in year *y* (t CO_2/MWh)

Determination of $PE_{TR,y}$

This parameter is excluded.
Due to the project activity does not considers to use biomass residues from off-site sources. $PE_{TR,y}$ = 0 tCO2

Determination of $PE_{GR2,y}$

This parameter is excluded

$EL_{balance,PO,y} < EL_{BL,BR,PO,y}$ (Case 3.3.2) or $EL_{balance,FF,y} < EL_{BL,FF,y}$ (Case 4.2.2) are not possible. Therefore, the amount of electricity generated on-site in the baseline is equal or less than the amount of electricity generated in the project scenario. No electricity is expected to be supplied by the grid due to decrease of power output in the project activity.

No emission reductions are calculated for $PE_{GR2,y.}$

$PE_{GR2,y}$ = 0 tCO_2

Determination of $PE_{BR,y}$

This parameter is excluded

Since no baseline emissions due to uncontrolled burning or decay of biomass residues are included, no project emissions due to this source need to be included:

$PE_{BR,y}$ = 0 tCO_2

Determination of $PE_{WW,y}$

This parameter is excluded

No wastewater related emissions or biogas emissions are expected in the project activity.

Determination of $PE_{BG2,y}$

This parameter is excluded.
The project does not include biogas. No emissions are expected.

Determination of $PE_{BC,y}$

This parameter is excluded.
The project does not include emissions associated with the cultivation of lands to produce biomass, since heat and electricity are produced using biomass residues and not from biomass cultivated in dedicated plantations. No emissions are expected.

Leakage

The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the CDM project activity. Changes in carbon stocks in the LULUCF sector are expected to be insignificant for biomass residues prevent changes in carbon stock requires that the project activity does not lead to a shift of pre-project activities outside the project boundary, and thus no leakage emissions are expected.

The baseline scenarios for biomass residues for which this potential leakage is relevant are B5, B6, B7 and B8. The project activity will use only biomass residues from an on-site production process (category k1 of the Table 1), it is assumed that this type of biomass is entirely used for power and heat generation in the baseline scenario B4.

For biomass from dedicated plantations, the applicability conditions above require that the project activity is established on degraded or degrading lands and does not lead to a shift of pre-project activities outside the project boundary, and thus no leakage emissions are expected.

Changes required for methodology implementation in 2nd and 3rd crediting periods

At the start of the second and third crediting period for a project activity, the continued validity of the baseline scenario shall be assessed by applying the latest version of the tool “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”.

B.6.2. Data and parameters fixed ex-ante

The following are not monitored parameters

Data/Parameter	Biomass categories and quantities used for the selection of the baseline scenario selection and assessment of additionality
Data unit	tonnes on dry-basis
Description	- Type (i.e. bagasse, rice husks, empty fruit bunches, etc.); - Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, from dedicated plantations etc.); - Fate in the absence of the CDM project activity (scenarios B); - Use in the project scenario (scenarios P); - Quantity (tonnes on dry-basis)
Source of data	On-site historical use of biomass and purchase orders
Value(s) applied	(see table below)
Choice of data or measurement methods and procedures	The information is based on historical and current plant management experience. The bagasse data is based on historical records of the plant.
Purpose of data	Biomass categories and quantities is used for the selection of the baseline scenario selection and assessment of additionality
Additional comment	This parameter is related to the procedure for the selection of the baseline scenario selection and assessment of additionality (Table 1, Section B.4).

Value(s) applied:

Category (k)	**Biomass residue type**	**Source**	**Baseline Scenario Use**	**Project Scenario Use**	**Quantity** (t/year)
K_1	Bagasse	On-site production	Electricity generation on-site (B4:)	Electricity generation on-site (biomass-only boiler)	255,992.63

Data/Parameter	$BR_{HIST,K1,x}$
Data unit	tonnes on dry-basis
Description	Quantity of biomass residues of category $K_{1,}$ used for power or heat generation at the project site in year x prior the date of submission of the PDD for validation of the CDM project activity (tonnes on dry-basis) prior the time of submission of the PDD for validation of the CDM project activity
Source of data	The information is based on historical operation documentation of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013).
Value(s) applied	$BR_{HIST,K1,2013}$ 461,903 Tonnes $BR_{HIST,K1,2012}$ 362,920 Tonnes $BR_{HIST,K1,2011}$ 390,808 Tonnes
Choice of data or measurement methods and procedures	The information is based on historical operation documentation. Measurements were made in electronic road scale.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	

Data/Parameter	$BR_{K1,h,x}$
Data unit	tonnes on dry-basis

Description	Quantity of biomass residues of category k1 used in heat generators (b1 to b5) in year x (tonnes on dry-basis)
Source of data	On-site measurements of "Ingenio Panuco" and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	$BR_{K1,2013}$ 461,903 Tonnes $BR_{K1,2012}$ 362,920 Tonnes $BR_{K1,2011}$ 390,808 Tonnes
Choice of data or measurement methods and procedures	The information is based on historical operation documentation. Measurements were made in electronic road scale.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat generators are similar in capacity and efficiency, no preference can be identified or justified, and the biomass is assumed to be evenly distributed between the baseline heat generators

Data/Parameter	$FF_{f,h,x}$
Data unit	Liter/yr
Description	Quantity of fossil fuel type f fired in heat generator b1 to b5 in year *x* (mass or volume unit/yr)
Source of data	On-site measurements of "Ingenio Panuco" and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	$FF_{BunkerC,b1-b5,2013}$ 6,385,057 Liters $FF_{BunkerC,b1-b5,2012}$ 5,148,968 Liters $FF_{BunkerC,b1-b5,2011}$ 2,885,782 Liters
Choice of data or measurement methods and procedures	The information is based on historical operation documentation. The data has been estimated in based on purchase invoices.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat generators are similar in capacity and efficiency, no preference can be identified or justified, and the fossil fuel is assumed to be evenly distributed between the baseline heat generators

Data/Parameter	$HG_{h,x}$
Data unit	GJ
Description	Net quantity of heat generated in heat generators b1 to b5 in year x (GJ/yr)
Source of data	On-site measurements and calculations of "Ingenio Panuco" and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	HGb1-b5,2013 2,211,224 GJ/yr HGb1-b5,2012 1,364,437 GJ/yr HGb1-b5,2011 1,683,284 GJ/yr
Choice of data or measurement methods and procedures	The information is based on historical operation documentation (tonnes/hour) of steam produced, the operating hours per season and the enthalpy of the heat generated at 331 °C and 23 bar by the generators minus the enthalpy of feed water at 100 °C liquid saturated.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat generators are identical in capacity and efficiency, no preference can be identified or justified, and the heat generated is assumed to be evenly distributed between the baseline heat generators.

Data/Parameter	$HG_{BR,CG/x,i}$
Data unit	GJ
Description	Quantity of heat used in cogeneration heat engines (g1 to g5) in year x (GJ/yr)
Source of data	On-site measurements of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	$HG_{BR,CG,\ 2013}$ 136,145 GJ/yr $HG_{BR,CG,\ 2012}$ 84,008 GJ/yr $HG_{BR,CG,\ 2011}$ 103,640 GJ/yr
Choice of data or measurement methods and procedures	The information is based on: - Historical operation documentation from 2011 to 2013 seasons (tonnes/hour) of the steam generated minus the steam consumed by to the mechanical applications. - The enthalpy of the heat generated by the heat generators at 23 bar and 331 °C minus the enthalpy of feed water at 100 °C liquid saturated.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat engines are similar in capacity and efficiency, no preference can be identified or justified, and the heat used is assumed to be evenly distributed between the baseline heat engines

Data/Parameter	$HC_{BR,CG/x,i}$
Data unit	GJ
Description	Quantity of process heat extracted from the cogeneration type heat engines (g1 to g5) in year x
Source of data	On-site measurements of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	$HC_{BR,CG,2013}$ 947,953 GJ/yr $HC_{BR,CG,2012}$ 584,935 GJ/yr $HC_{BR,CG,2011}$ 721,625 GJ/yr
Choice of data or measurement methods and procedures	The information is based on: - Historical operation documentation of 2011 to 2013 seasons (tonnes/hour) of the steam generated by the heat generators minus the steam consumed by to the mechanical applications. - The enthalpy of the heat generated by the heat generators at 1.38 bar and 140 °C minus the enthalpy of feed water at 100 °C liquid saturated.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat engines are similar in capacity and efficiency, no preference can be identified or justified, and the heat used is assumed to be evenly distributed between the baseline heat engines

Data/Parameter	$EL_{BR,CG,x,i}$
Data unit	MWh
Description	Quantity of electricity generated in heat engines (g1 to g5) in year *x* (MWh)
Source of data	On-site measurements of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)

Value(s) applied	ELBR,CG,2013 20,067 MWh/yr ELBR,CG,2012 15,152 MWh/yr ELBR,CG,2011 19,057 MWh/yr
Choice of data or measurement methods and procedures	The information is based on historical data measured by the electricity meters
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	As all baseline heat engines are similar in capacity and efficiency, no preference can be identified or justified, and the electricity generated is assumed to be evenly distributed between the baseline heat engines

Data/Parameter	$CAP_{HG,b1-b5}$
Data unit	GJ/h
Description	Baseline capacity of heat generators (b1 to b5)
Source of data	On-site measurements of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	560.28
Choice of data or measurement methods and procedures	This parameter reflects the design maximum heat generation capacity (in GJ/h) of each baseline heat generator b1 through b5. It is based on the installed capacity of the heat generator, and is determined by the enthalpy difference of the steam and feed water and the capacity in tonne steam per hour: 210 tonnes/h steam produced at 23 bar and 331 °C, water feed is 100 °C at saturated steam conditions For the five heat generators: $CAP_{HG,b1-b5}$ = 560.28 GJ/h
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

Data/Parameter	$CAP_{EG,CG,g1-g5}$
Data unit	MW
Description	Baseline electricity generation capacity of heat engines (g1 to g5)
Source of data	On-site measurements or reference plant design parameters
Value(s) applied	17
Choice of data or measurement methods and procedures	This parameter reflects the design maximum electricity generation capacity of each baseline heat engine cg8 to cg11. It is based on the installed capacity of the heat engines, as stated by the technology provider. No type j (power only) heat engines exist in the baseline. For the five heat engines: CAPEG,CG, g1-g5 = 17.2 MW
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

Data/Parameter	$LFC_{HG,h}$
Data unit	Ratio
Description	Baseline load factor of heat generators b1 through b5

Source of data	On-site measurements or reference plant design parameters of "Ingenio Panuco" and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	76 %
Choice of data or measurement methods and procedures	This parameter is calculated based on: • The baseline (historical) steam production in the last three seasons Steam Production,2013,b1-b5 = 828,444 tonnes Steam Production,2012, b1-b5 = 511,912 tonnes Steam Production,2011, b1-b5 = 630,649 tonnes • The baseline (historical) steam production maximum capacity: 210 tonnes of steam per hour (Five heat generators, b1 through b5) • The operational hours of heat generators per season Steam Production capacity,2013,b1-b5 = 942,480 tonnes Steam Production capacity,2012,b1-b5 = 797,790 tonnes Steam Production capacity,2011,b1-b5 = 830,760 tonnes The value is based on the maximum value of three years of operation (2011-2013). $LFC_{HG,2011,2012,\ 2013}$ = 76% These data is based on the historical information in the most recent three years prior to the CDM project activity, and thus takes into account the actual required operation conditions such as downtime, maintenance and required operation pattern. The data used in the calculation was made available to the validating DOE.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

Data/Parameter	$HPR_{BL,i}$
Data unit	Ratio
Description	Baseline heat-to-power ratio of the heat engines (g1 through g5)
Source of data	Historical information from the recent three seasons of "Ingenio Panuco" and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	13.12

Choice of data or measurement methods and procedures	This parameter is calculated based on: $HC_{BR,CG,2013}$ 947,953 GJ/yr $HC_{BR,CG,2012}$ 584,935 GJ/yr $HC_{BR,CG,2011}$ 721,625 GJ/yr $EL_{BR,CG,2013}$ = 20,067.49 MWh /yr $EL_{BR,CG,2012}$ = 15,153.89 MWh/yr $EL_{BR,CG,2011}$ = 19,057.75 MWh yr The value of HPRBLi, is based on the maximum historical value of the three years: HPRBL,CG,MAX,2011-2013 = 13.12
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

Data/Parameter	$LFC_{EG,CG,i}$
Data unit	Ratio
Description	Baseline load factor of heats engines (g1 through g5)
Source of data	Historical information from the recent three seasons and reference plant design parameters of “Ingenio Panuco” and this data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)
Value(s) applied	48%
Choice of data or measurement methods and procedures	This parameter is calculated based in: • The electricity generation of the heat engines during the last three seasons $EL_{BR,CG,2013}$ = 20,067.49 MWh /yr $EL_{BR,CG,2012}$ = 15,153.89 MWh/yr $EL_{BR,CG,2011}$ = 19,057.75 MWh yr • The baseline heat engines design capacity: 17.2 MW (five heat engines) and the operational hours per season. Electricity generation capacity 2013 76,296 MWh /yr Electricity generation capacity 2012 37,990 MWh/yr Electricity generation capacity 2011 39,560 MWh yr The value is based on the maximum value of three years of operation: (48%). These data is based on historical information of the recent three seasons, and thus takes into account the actual required operation conditions such as downtime, maintenance and required operation pattern.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

Data/Parameter	$NCV_{BR,k1,x}$
Data unit	GJ/tonnes on dry-basis
Description	Net calorific value of biomass residues of category k1 in year *x*
Source of data	Measurements by certified laboratory contracted by “Ingenio Panuco” and that data was obtained after the end of the mentioned year crop season (2011, 2012 and 2013)

Value(s) applied	NCVBR,k1,2013 = 14.44 NCVBR,k1,2012 = 14.44 NCVBR,k1,2011 = 14.44
Choice of data or measurement methods and procedures	Measurements from 2012 carried out by an accredited laboratory following the relevant international standards. The NCV used was based on the boiler manufacturer technical specifications[58]
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	The NCV is to be calculated for wet biomass as used in the heat generator (i.e. deducting the energy used for the evaporation of the water contained in the biomass residues).

Data/Parameter	$NCV_{FF,fuel\ oil,x}$
Data unit	GJ/t
Description	Weighted average net calorific value of fossil fuel in year *y*
Source of data	National Energy Balance (Mexico governmental agency)
Value(s) applied	$NCV_{average}$ = 41.86 $NCV_{fuel\ oil,\ 2013}$= 41.86 NCVf$_{uel\ oil,\ 2012}$ = 41.86 $NCV_{fuel\ oil,\ 2011}$=41.86
Choice of data or measurement methods and procedures	The NCV used was based on the PEMEX (Mexico's state-owned petroleum company) technical publication.
Purpose of data	This parameter is used for the calculation of baseline emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

>>

Baseline emissions

The ex-ante baseline emissions estimate follows the steps described in section B.6.1.

Step 1: Determine biomass availability, generation and capacity constraints, efficiencies and power emission factors in the baseline

Step 1.1: Determine total baseline process heat generation

The ex-ante estimations the values are taken from the operation logs of the sugar mill for the three most recent seasons in years 2011, 2012 and 2013.

The amount of process heat is determined as the difference of the enthalpy process heat produced at 23 bar and 331 °C, minus the enthalpy of the feed-water which is condensate returned to the heat generators at 100 °C, at liquid saturated conditions.

	2013	**2012**	**2011**	**Source**
Harvest days	234	182	202	File: “Desarrollo operativo report.xlsx”
LOC_y: Length of the operational campaign in year y (hour)	5,616	4,368	4,848	Calculated
Steam flow to heat engines - Part 1	89.17			File: “Historical operational mass

[58] Manufacturer technical specifications: ISGEC Revised technical proposal.pdf

(t/h)		and energy balance of actual plant.xlsx".
Steam flow to mechanical steam turbines - Part 2 (t/h)	92.71	File: "Historical operational mass and energy balance of actual plant.xlsx".
Total baseline process heat generation Part 1 (GJ/h)	1,028,928.16	Calculated
Total baseline process heat generation heat generation Part 2 (GJ/h)	1,222,886.59	Calculated
HCBL,y Total baseline process heat generation (GJ)	**2,251,814.76**	

Project Implementation

This parameter is monitored ex-post.

Step 1.2: Determine total baseline electricity generation

- ELPJ,gross,y is estimated by the expected generation determined in the internal report of Panuco plant named *"forecast electricity.xlsx"* (122.666 MW[59][60])

  Project Implementation
  This parameter is monitored ex-post.

- ELPJ,imp,y is set to 0, as the project is an exporter of electricity, imports are expected during start-up.

  Project Implementation
  This parameter is monitored ex-post.

- ELPJ,aux,y.

ELPJ,aux,y shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power or heat generating plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.).

Total auxiliary electricity consumption is estimated in 33,085.25 MWh per hour of total electricity output during operation.

For this methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the CDM project activity and are therefore not accounted for.

Project Implementation

This parameter is monitored ex-post.

[59] Cogeneration and extension plant study developed by *Consultores de Ingenios Azucareros S.A.*

[60] Panuco internal report: *forecast electricity.xlsx*

Parameter	Rationale	Sources
$EL_{BL,\,y}$ (MWh)		Calculated
$EL_{PJ,\,GROSS}$ (MWh)		prevision de electricidad.xlsx.
$EL_{PJ,\,aux}$ (MWh)	From 2016 to 2019 (first phase) the consumption of auxiliary equipment used to calculate the parameter $EL_{PJ,\,aux}$ is 1898 kW based on the document mentioned in the next column	Consumo equipos auxiliares_1ra etapa.xlsx
	From 2020 on (second phase) the consumption of auxiliary equipment used to calculate the parameter $EL_{PJ,\,aux}$ will be increased in 4794 kW due to the 1200 lb/in^2 boiler. The 4794 kW value is the sum of 794 kW of the boiler water feeding pump capacity and 4000 kW of the consumption of the condensation tower. Please refer to the page 21 of the document mentioned in the next	Estudio Ampliacion y cogeneracion.pdf.pdf

Year	$EL_{BL,\,y}$ (MWh)	$EL_{PJ,\,GROSS}$ (MWh)	$EL_{PJ,\,IMP,\,Y}$ (MWh)	$EL_{PJ,\,aux}$ (MWh)
2016	190,540.88	199,925	-	9,383.71
2017	203,806.02	213,190	-	9,383.71
2018	208,002.14	217,386	-	9,383.71
2019	182,750.24	192,134	-	9,383.71
2020	172,244.40	205,330	-	33,085.25
2021	185,609.05	218,694	-	33,085.25
2022	213,110.36	246,196	-	33,085.25

Step 1.3: Determine baseline capacity of electricity generation

As described in the Section B.6.1 the $CAP_{EG,total,y}$ is calculated with the following equation:

$$CAP_{EG,total,y} = LOC_y \cdot \left[\sum_i \left(CAP_{EG,CG,i} \cdot LFC_{EG,CG,i} \right) + \sum_j \left(CAP_{EG,PO,j} \cdot LFC_{EG,PO,j} \right) \right]$$

LOC_y is estimated to be identical to previous years, taking the average of the last three years (4,553h).

$LFC_{EG,CG,i}$ is set to 0.61, which is the maximum load factor of three years (seasons) of operation (2011, 2012 and 2013)

$CAP_{EG,CG,i}$ is 17.2 MW for all 5 baseline heat engines.

Parameter	Value	Source
LOC_y: Length of the operational campaign in year y (hour)	4,944 hours	Calculated
$CAP_{EG,CG,i}$ Baseline electricity generation capacity of heat engine i (e1-e5)	17.200 MW	plant capacity.xlsx
$LFC_{EG,CG,i}$ = Baseline load factor of heat engine *i* (ratio) cogeneration mode	48%	Historical of heat and energy generation.xlsx.
$CAP_{EG,total,y}$ = Baseline electricity generation capacity in year y (MWh)	40,962.23 MWh	Calculated

<u>Project Implementation</u>

This parameter is monitored ex-post.

Step 1.4: Determine the baseline availability of biomass residues

Where the baseline scenario includes the use of biomass residues for the generation of power and/or heat, the amount of biomass residues of category *n* that would be available in the baseline in year *y* ($BR_{B4,n,y}$) has to be determined.

This is the amount is the availability of sugar cane bagasse. This biomass residue has been used for power and/or heat generation in the project boundary for which B4 has been identified as the most plausible baseline scenario in the CDM-PDD.

Biomass residues category (*k*)	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario	Biomass residues quantity (tonnes)			Moisture (%)			Source
					2011	2012	2013	2011	2012	2013	
1	Sugar cane Bagase	On-site production	Heat and electricity generation on-site (B4)	Heat and electricity generation on-site (biomass-only boiler)	390,808.60	362,920.68	461,903.57	49.9%	51.2%	52.3%	desarrollo operativo report.xlsx

Dry biomass residues (tonnes)	195,990.51	177,286.75	220,328.00	Calculated
Px sugar produced (tonnes)	152,274.85	122,089.30	176,290.45	desarrollo operativo report.xlsx
Py sugar produced average (tonnes)	176,290.45			Calculated

Parameter	Value		Source
$BR_{B4,n,h,y}$ = Quantity of biomass residues of category n used in the project activity in year y for which the baseline scenario is B4	255,992.63	tones of bagasse (on dry-basis)	Calculated

<u>Project Implementation</u>

$BR_{B4,n,y}$ is monitored ex-post.

Step 1.5: Determine the efficiencies of heat generators, and efficiencies and heat-to-power ratio of heat engines

The efficiency of the heat generators and heat engines is calculated using Option 3.

<u>*Efficiency for heat generators (b1-b5)*</u>
The efficiency of the heat generator is determined based on historical data of the last three years (2011, 2012 and 2013).

The efficiency for heat generators should be calculated using the following equation:

$$\eta_{BL,HG,BR,b1\text{-}b6} = MAX\left\{\frac{HG_{BR,h,2010}}{\sum_{n} BR_{k1,h,2010} \cdot NCV_{BR,k1,2010}};\frac{HG_{BR,h,2011}}{\sum_{n} BR_{k1,h,2011} \cdot NCV_{BR,k1,2011}};\frac{HG_{BR,h,2012}}{\sum_{n} BR_{k1,h,2012} \cdot NCV_{BR,k1,2012}}\right\}$$

$$\eta_{BL,HG,FF,b1\text{-}b6} = MAX\left\{\frac{HG_{FF,h,2010}}{\sum_{n} FF_{f,h,2010} \cdot NCV_{FF,f,2010}};\frac{HG_{FF,h,2011}}{\sum_{n} FF_{f,h,2011} \cdot NCV_{FF,f,2011}};\frac{HG_{FF,h,2012}}{\sum_{n} FF_{f,h,2012} \cdot NCV_{FF,f,2012}}\right\}$$

Option 3

Parameter	2011	2012	2013	Source
$FF_{f,h,x}$(L)	2,885,782	5,148,968	6,385,057	Desarrollo operativo report.xlsx
$EL_{BR,CG,x,i}$ (KWh)	19,057,751	15,152,894	20,067,487	Desarrollo operativo report.xlsx
NCVBR,n,x (GJ/t)	14.44			ISGEC Revised technical proposal.pdf
$NCV_{FF,f,x}$(GJ/t)	41.86			Bunker © properties PEMEX.pdf
$\rho_{fuel\ oil,x}$ (kg/L)	0.99			Bunker © properties PEMEX.pdf

Year	BRn,h,x (tonnes)	$FF_{f,h,x}$(L)	$FF_{f,h,x}$ (tonnes)	HG,h,x (GJ)	HGBR,h,x (GJ)	$HG_{FF,h,x}$ (GJ)	$n_{BL,HG,BR,h}$	$\eta_{BL,HG,FF,h}$
2013	220,328.00	6,385,057.00	6,321.21	2,211,224.73	2,041,439.90	169,784.84	0.64	0.64
2012	177,286.75	5,148,968.00	5,097.48	1,364,437.90	1,259,460.53	104,977.37	0.49	0.40
2011	194,818.09	2,885,782.00	2,856.92	1,683,284.17	1,614,644.01	68,640.16	0.57	0.26

Parameter	Value	Source
$\eta_{BL,HG,BR,h}$ = Baseline biomass-based heat generation efficiency of heat generator	0.64	Calculated
$\eta_{BL,HG,FF,h}$ = Baseline fossil-based heat generation efficiency of heat generator h (ratio)	0.64	Calculated

Efficiency for heat engines (g1-g5)

The efficiency of the heat generator is determined based on historical data of the last three years (2011, 2012 and 2013).

$$\eta_{BL,EG\,g1\text{-}g5} = MAX\left\{\frac{EL_{BR,2010g1\text{-}g5}}{HG_{BR,2010g1\text{-}g5}};\frac{EL_{BR,2011g1\text{-}g5}}{HG_{BR,2011g1\text{-}g5}};\frac{EL_{BR,2012g1\text{-}g5}}{HG_{BR,2012g1\text{-}g5}}\right\}$$

Case 1: For existing heat engines with a minimum three-year operational history prior to the project activity:

$$HPR_{BL,EG,CG/g1\text{-}g5} = \frac{1}{3.6}\cdot MAX\left\{\frac{HC_{BR,CG,2010g1\text{-}g5}}{EL_{BR,CG/2010g1\text{-}g5}};\frac{HC_{BR,CG,2011g1\text{-}g5}}{EL_{BR,CG/2011g1\text{-}g5}};\frac{HC_{BR,CG,2012g1\text{-}g5}}{EL_{BR,CG/2012g1\text{-}g5}}\right\}$$

$\eta_{BL,EG,CG,i}$	Baseline electricity generation efficiency of heat engine *i* (MWh/GJ)
$EL_{BR,CG,x,i}$	Quantity of electricity generated in heat engine *i* in year *x* (MWh)
$HG_{BR,CG,x,i}$	Quantity of heat used in heat engine *i* in year *x* (GJ)
$HPR_{BL,i}$	Baseline heat-to-power ratio of the heat engine *i* (ratio)
$HC_{BR,CG,x,i}$	Quantity of process heat extracted from the heat engine *i* in year *x* (GJ)
$EL_{BR,CG,x,i}$	Quantity of electricity generated in heat engine *i* in year *x* (MWh)
i	Cogeneration-type heat engine in the baseline scenario

Heat Engines	$EL_{BR,CG,x,i}$ (MWh)	$HG_{BR,CG,x,i}$ (GJ)	$\eta_{BL,EG,CG,i}$ (MWh/GJ)
2013	20,067.49	136,145.53	0.1474
2012	15,152.89	84,008.70	0.1804
2011	19,057.75	103,640.13	0.1462
$\eta_{BL,EG,CG,i}$	**0.1804**		

The heat-to-power ratio of cogeneration-type heat engines

Case 1:

Heat Engines	**$HC_{BR,CG,x,i}$ (GJ)**	**$EL_{BR,CG,x,i}$ (MWh)**
2013	947,953.84	20,067.49
2012	584,935.64	15,152.89
2011	721,625.29	19,057.75
$HPR_{BL,i}$	**13.12**	

Step 1.6: Determine the emission factor of on-site electricity generation with fossil fuels

Although the baseline turbo generators could operate also on heat produced by combusting fossil fuel (Bunker C), all the capacity of power generation in the project is used in cogeneration mode, and on top of that, consuming biomass residues.

Therefore, no fossil fuel based power generation is identified as part of the BE, $EF_{EG,FF,y}$ = $EF_{EG,GR,2012}$, which is discussed in step 1.7 and is detailed in Appendix 4.

Step 1.7: Determine the emission factor of grid electricity generation

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without signification transmission constraints.

The proposed project activity will be connected to the national grid of Mexico. The national grid emission factor is calculated based on data developed by the Mexican Secretary of Energy (SENER).

The generated electricity is to be used either in the sugar mill plant or injected into the national grid. Thus the project electricity system is the national electricity grid.

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

The calculation of the operating margin and build margin emission factor will use the **option I** of the tool: Only grid power plants are included in the calculation.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

The methodology tool states that the Simple Operating Margin method can be used where low-cost/ must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

The methodology tool further states that low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear, and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

Electricity generation in Mexico is dominated by thermal power plants. Thus, for this project activity, in the calculation of the operating margin emission factor, **option (a) the Simple Operating Margin method has been selected from the four options proposed in the methodology.**

The following Table presents the gross electricity generation in Mexico[61] by type:

Five year gross generation by energy type

National Electricity Sector – Gross Electricity Generation by type (GW-h)									
Years	Hydro	Thermal	Combined cycle	Dual fuel	Coal-fired	Nuclear	Geo-thermal	Wind	Total
2008	38,892	47,362	106,056	6,883	17,789	9,804	7,056	255	234,096
2009	26,445	48,322	112,029	12,299	16,886	10,501	6,740	249	233,472
2010	36,738	45,208	114,833	15,578	16,485	5,879	6,618	166	241,506
2011	35,796	53,126	118,455	15,396	18,158	10,089	6,507	358	257,884
2012	31,317	61,334	117,557	16,234	17,724	8,770	5,817	1744	260,497
Last 5-year Average	33,838	51,070	113,786	13,278	17,408	9,009	6,548	554	245,491
%	13.8%	20.8%	46.4%	5.4%	7.1%	3.7%	2.7%	0.2%	100.0%

Source: *Gross electricity generation by type developed.pdf* by the Mexican Secretary of Energy (SENER)

Based on the table above, the following table represents the electricity generation (GWh) for OM emission factor calculation with the low-cost/must-run sources for Mexico including hydro, geothermal, nuclear and wind and showing that the low-cost/must run resources in Mexico constitute less than 50% of the total grid generation in average of the five most recent years.

Comparison analysis of Low-cost/must-run

Years	Low-cost/must-run gross generation (GWh)	Total generation (GWh)	Percentage of total (%)	Comparison (<50%)
2008	56,007	234,096	24%	Lower than 50%
2009	43,935	233,472	19%	Lower than 50%
2010	49,401	241,506	20%	Lower than 50%
2011	52,750	257,884	20%	Lower than 50%
2012	47,648	260,497	18%	Lower than 50%

For the Simple OM method, the emissions factor can be calculated using either *ex ante* option or *ex post* option. We choose *ex ante* option given the accessibility of data and simplification with respect to project monitoring and further emission reduction verification.

[61] http://www.sener.gob.mx/webSener/res/476/Generation.pdf, available on 11/10/2012.

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

As explained in Step 3, the Simple OM emission factor has been calculated based on a 3-year vintage (2011-2013) and will be applied ex-ante. The OM is calculated as the generation-weighted emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants.

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated by one of the following two options, the option B has been chosen because the Mexican electricity grid accomplishes with the following things:

a) The necessary data for Option A is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

Option B - *Calculation based on total fuel consumption and electricity generation of the system*

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

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

Where:

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

For this approach (simple OM) to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant *m*.

According to the provisions in the monitoring tables of the Tool to Calculate the Emission Factor for an Electricity System (Version 03.0.0), $EG_{m,y}$ is determined once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (**ex ante option**).

The 3-year vintage OM was calculated using the data of all operational power fossil fuel fired plants supplying electricity to the grid for the years 2010, 2011 and 2012. The data of the plants used in the Operating Margin calculation were provided by SENER.

$EF_{grid,OMsimple,y}$ = 0.4869 tCO_2/MWh.

Step 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor should be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The *Option 1 ex-ante* was chosen for the proposed project.

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units)}$ and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20%) and determine their annual electricity generation (AEG_{SET}-≥20%, in MWh);
c) From $SET_{5-units}$ and SET≥20% select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

Otherwise:

d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET-sample-CDM}$, in MWh); If

the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times$ AEGtotal), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);
f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{-}>10yrs}$).

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

$EF_{grid,BM,2011}$ =0.3497 tCO_2/MWh

Step 6. Calculate the combined margin emissions factor

The option a) weighted average CM was used to calculate the combined margin (CM).

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$$

The default weights are as follows: w_{OM} = 0.5 and w_{BM} = 0.5, fixed for the first crediting period. That gives:

$$EF_{2011} = 0.4869 \times 0.5 + 0.3497 \times 0.5 = 0.4183\ tCO_2/MWh$$

The build margin CO_2 emission factor and operating margin CO_2 emission factor will be *ex-ante*.

Therefore, the combined margin CO_2 emission factor will be *ex-ante*.

Step 2: Determine the minimum baseline electricity generation in the grid

The calculation of the minimum amount of electricity that would be generated in the grid in the baseline is based on the assumption that the amount of electricity generated on-site in the baseline cannot be higher than the installed capacity of power generation available in the baseline scenario. Therefore, the following equation should be used:

$$EL_{BL,GR,y} = \max(0, EL_{BL,y} - CAP_{EG,total,y})$$

Parameter	Source
$EL_{BL,y}$ = Baseline electricity generation in year y (MWh)	See Step 1.2
$CAP_{EG,total,y}$ = baseline electricity generation capacity in year y (MWh)	See Step 1.3
$EL_{BL,GR,y}$ = Baseline minimum electricity generation in the grid in year y (MWh)	Calculated

Year	$EL_{BL,y}$(MWh)	$CAP_{EG,total,y}$(MWh)	$EL_{BL,GR,y}$(MWh)
2016	190,540.88	40,962.23	149,578.65
2017	203,806.02	40,962.23	162,843.79
2018	208,002.14	40,962.23	167,039.91
2019	182,750.24	40,962.23	141,788.02
2020	172,244.40	40,962.23	131,282.17
2021	185,609.05	40,962.23	144,646.82
2022	213,110.36	40,962.23	172,148.14

Step 3: Determine the baseline biomass-based heat and power generation

Step 3.1: Determine the baseline biomass-based heat generation

It is assumed that the use of biomass residues for which scenario B4 has been identified as the baseline scenario ($BR_{B4,n,y}$) would be prioritized over the use of any fossil fuels in the baseline. From that assumption, the equivalent amount of heat that would be generated with biomass residues ($HG_{BL,BR,y}$) should be determined.

Parameter	Value	Source
$BR_{B4,n,h,y}$ = Quantity of biomass residues of category n used in the heat generator in year y for which the baseline scenario is B4 tones of bagasse (on dry-basis)	255,993	See Step 1.4
$NCV_{BR,n,y}$ = Net calorific value of biomass residue of category n in year (GJ/t)	14.4	See Step 1.5
$\eta_{BL,HG,BR,h}$ = Baseline biomass-based heat generation efficiency of heat generator h (ratio)	64%	See Step 1.5
$HG_{BL,BR,y}$ = Baseline biomass-based heat generation in year y (GJ)	2,371,889.02	Calculated
LOC_y = Length of the operational campaign in year y (hour)	4,944	See Step 1.3
Capacity of heat generator (tonnes /h)	210	Plant capacity.xlsx
$CAP_{HG,h}$ = Baseline capacity of heat generator h (GJ/h)	560.28	Calculated
$LFC_{HG,h}$ = Baseline load factor of heat generator h (ratio)	0.760	Historical of heat and energy generation.xlsx.
LOC_y *$CAP_{HG,h}$ *$LFC_{HG,h}$ = total capacity of the heat generator (GJ)	2,105,218.48	Calculated
Then $\sum_n \left(BR_{B4,n,h,y} \cdot NCV_{BR,n,y} \cdot \eta_{BL,HG,BR,h}\right) \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$		

The heat generation of the heat generator does not exceed the total capacity of the heat generator.

Step 3.2: Determine the baseline biomass-based cogeneration of process heat and electricity and heat extraction.

Parameter	Value	Source
$HPR_{BL,i}$ = Baseline heat-to-power ratio of the heat engine i (ratio) .	13.122	See Step 1.5
$GGL_{default}$ = The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio)	0.05	According to Step 1.5 of the methodology ACM0006. The default value for the losses linked to the electricity generator group (i.e. turbine/engine, couplings and electricity generator),GGLdefault , is 5%.
$HG_{BL,BR,CG,y,i}$ = Baseline biomass-based heat used in heat engine i in year y (GJ)	127,255.40	See Step 1.5.
$HC_{BL,BR,CG,y}$ = Baseline biomass-based process heat cogenerated in year y (GJ)	117,826.91	Calculated
$HG_{BL,BR,y}$ = Baseline biomass-based heat generation in year y (GJ)	2,371,889.02	See step 3.1
$\sum_i HG_{BL,BR,CG,y,i} < HG_{BL,BR,y}$	TRUE	Calculated
$HC_{BL,y}$ =Baseline process heat generation in year y (GJ)	2,251,814.76	See step 1.1
$HC_{BL,BR,CG,y} < HC_{BL,y}$	TRUE	Calculated
EL$_{BL,BR,CG,y}$ = Baseline biomass-based cogenerated electricity in year y (MWh)	2,494	Calculated
$\eta_{BL,EG,CG,i}$ = Baseline electricity generation efficiency of heat engine i (MWh/GJ)	0.18037291	See Step 1.5
$\eta_{BL,EG,CG,i}$ * $HG_{BL,BR,CG,y,i}$	22,953.43	Calculated
LOC_y = Length of the operational campaign in year y (hour)	4,944	See Step 1.3
$CAP_{EG,CG,i}$ =Baseline electricity generation capacity of heat engine i (MW)	17.20	See Step 1.3
$LFC_{EG,CG,i}$ = Baseline load factor of heat engine i (ratio)	0.48	See Step 1.3
LOC_y * $CAP_{EG,CG,i}$*$LFC_{EG,CG,i}$ (MWh)	40,962	Calculated
$(\eta_{BL,EG,CG,i} \cdot HG_{BL,BR,CG,y,i}) \leq LOC_y \cdot CAP_{EG,CG,i} \cdot LFC_{EG,CG,i}$	TRUE	Calculated

Case 3.2.4: If $HG_{BL,BR,y} > \sum_i HG_{BL,BR,CG,y,i}$ and $HC_{BL,y} > HC_{BL,BR,CG,y}$, then there would be biomass-based heat in the baseline that could still be used and process heat demand to be met. It is assumed then that this balance of biomass-based heat would be extracted from the heat header and used to meet the process heat demand without cogeneration of power. Three cases should thus be considered (refer to the monitoring tables for a definitions of $h_{LOW,y}$ and $h_{HIGH,y}$ used in the equations below):

Parameter	Value	Source
$HG_{BL,BR,y}$ = Baseline biomass-based heat generation in year y (GJ)	2,371,889.02	See Step 3.1
$HG_{BL,BR,CG,y,i}$ = Baseline biomass-based heat used in heat engine i in year y (GJ)	127,255.40	See Step 3.2
$HC_{BL,y}$ =Baseline process heat generation in year y (GJ)	2,251,814.76	See Step 1.1
$HC_{BL,BR,CG,y}$ = Baseline biomass-based process heat cogenerated in year y (GJ)	117,826.91	See Step 3.2
$h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes).	3.088	See Step 1.1
$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)	2.75280	See Step 1.1
$HC_{BL,y}$ - $HC_{BL,BR,CG,y}$ (GJ)	2,133,988	Calculated
h_{LOW}/h_{HIGH}*($HG_{BL,BR,y}$ -∑ $HG_{BL,BR,CG,y,i}$) (GJ)	2,000,980	Calculated
TRUE		
Then this fit to case 3.2.4.2 $HC_{BL,y} - HC_{BL,BR,CG,y} > \frac{h_{LOW}}{h_{HIGH}} \cdot \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i} \right)$		

Case 3.2.4.2: If $HC_{BL,y} - HC_{BL,BR,CG,y} > \frac{h_{LOW,y}}{h_{HIGH,y}} \cdot \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i} \right)$, i.e. the balance of biomass-based heat (right-hand side of the equation) is less than the remaining demand for process heat (left-hand side of the equation). Then all biomass-based heat was used and there still remains process heat demand to be met. It is assumed then that this process heat demand would be met by using fossil fuels in the baseline. In order to estimate the baseline parameters that result project participants should:

- Define $HC_{balance,FF,y} = \left(HC_{BL,y} - HC_{BL,BR,CG,y} \right) - \frac{h_{LOW}}{h_{HIGH}} \cdot \left(HG_{BL,BR,y} - \sum_i HG_{BL,BR,CG,y,i} \right)$, $EL_{balance,FF,y} = EL_{BL,y} - EL_{BL,GR,y} - EL_{BL,BR,CG,y}$, and,
- Proceed to Step 4: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation

Parameter	Value	Source
$HG_{BL,BR,y}$ = Baseline biomass-based heat generation in year y (GJ)	2,371,889.02	See Step 3.1
$HG_{BL,BR,CG,y,i}$ = Baseline biomass-based heat used in heat engine i in year y (GJ)	127,255.40	See Step 3.2
$h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes)	3.088	See Step 1.1
$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes)	2.75280	See Step 3.2.4
$HC_{BL,y}$ =Baseline process heat generation in year y (GJ)	2,251,814.76	See Step 1.1
$HC_{BL,BR,CG,y}$ = Baseline biomass-based process heat cogenerated in year y (GJ)	117,826.91	See Step 3.2
$HC_{BL,y}$ - $HC_{BL,BR,CG,y}$	2,133,988	Calculated
$h_{HIGH}/h_{LOW}*(HG_{BL,BR,y} - \sum HG_{BL,BR,CG,y,i})$	2,000,980	Calculated
$HC_{balance,FF,y}$ Balance of process heat demand after cogeneration in year y (GJ)	133,007.46	Calculated
EL$_{BL,y}$ Baseline electricity generation in year y (MWh)	190,541	See Step 1.2
EL$_{BL,GR,y}$ = Baseline minimum electricity generation in the grid in year y (MWh)	149,579	See Step 2
$EL_{BL,BR,CG,y}$ = Baseline biomass-based cogenerated electricity in year y (MWh)	2,494	See Step 3.2
ELbalance,$_{FF,y}$= Balance electricity generation demand that would remain to be met by using fossil fuel in year y (MWh)	38,468	Calculated

Step 3.1: Determine the baseline biomass-based electricity generated in power-only mode

It is not applicable

Step 1: Determine the baseline demand for fossil fuels to meet the balance of process heat and the corresponding electricity generation

Step 4.3: Determine the baseline fossil fuel based cogeneration of process heat and electricity and the remaining process heat demand

Parameter	Value	Source
$HPR_{BL,i}$ = Baseline Heat Power Ratio of heat engine i (ratio)	13.12	See Step 1.5
$GGL_{default}$ = The default value for the losses linked to the electricity generator group (turbine, couplings and electricity generator. Set at 0.05) (ratio)	0.05	According to Step 1.5 of the methodology ACM0006. The default value for the losses linked to the electricity generator group (i.e. turbine/engine, couplings and electricity generator),GGLdefault , is 5%.
$HC_{BL,FF,CG,y}$ = Baseline fossil-fuel-based process heat cogenerated in year y	8,890	Calculated
$HG_{BL,FF,CG,y,i}$ = Baseline fossil-fuel-based heat used in heat engine i in year y (GJ)	9,602	Calculated
$EL_{BL,FF,y}$ =Baseline fossil-based electricity generation in year y (MWh)	677.51	Calculated
$HG_{BL,FF,CG,y}$ = Baseline fossil-fuel-based heat used in heat engine i in year y (GJ)	9,602	
$\sum_i HC_{BL,FF,CG,y,i} \leq HC_{balance,FF,y}$	YES	
$\frac{1}{3.6} \cdot \left((HG_{BL,FF,CG,y,i} + HG_{BL,BR,CG,y,i}) \cdot \frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \right)$	2,682.51	Calculated
$LOC_y \cdot CAP_{EG,CG,i} \cdot LFC_{EG,CG,i}$	40,962.23	Calculated
Then $\frac{1}{3.6} \cdot \left((HG_{BL,FF,CG,y,i} + HG_{BL,BR,CG,y,i}) \cdot \frac{1}{(HPR_{BL,i} + 1 + GGL_{default})} \right) \leq LOC_y \cdot CAP_{EG,CG,i} \cdot LFC_{EG,CG,i}$		
$HG_{BL,FF,DHE,y}$ = Baseline fossil-based heat used to meet baseline process heat demand via direct heat extraction in year y (GJ)	139,231	Calculated
$HG_{BL,FF,y}$ = Baseline fossil-based heat generation in year y (GJ)	148,832	Calculated
Case 4.1.1 $EL_{balance,FF,y} \geq EL_{BL,FF,y}$	TRUE	Calculated
Case 4.1.2 $EL_{balance,FF,y} < EL_{BL,FF,y}$	FALSE	Calculated
$EL_{BL,FF/GR,y}$ =Baseline uncertain electricity generation in the grid or on-site in year y (MWh) $EL_{PJ,offset,y} = 0$	37,790.41	Calculated

Case 4.1.1: If $EL_{balance,FF,y} \geq EL_{BL,FF,y}$, the amount of electricity generated on-site in the baseline is either equal to or less than the amount of electricity generated in the project scenario. In order to determine the resulting baseline emissions project participants should:

- Define $EL_{BL,FF/GR,y} = EL_{balance,FF,y} - EL_{BL,FF,y}$, $EL_{PJ,offset,y}$ = 0, and,
- Proceed to Step 4.2 .

Step 4.4: Determine the baseline heat generation to meet the fossil-based cogeneration of heat and power and the heat to meet the balance of process heat

Estimate the total amount of fossil fuels required to generate the heat required for the cogeneration in Step 4.1 and the balance of process heat based on the allocation principles above using the following equations:

$$\sum_h HG_{BL,FF,y,h} = HG_{BL,FF,DHE,y} + HG_{BL,FF,CG,y}$$

$$FF_{BL,HG,y,f} = \sum_{h} \left(\frac{HG_{BL,FF,y,h}}{\eta_{BL,HG,FF,h}} \right)$$

Subject to:
$HG_{BL,FF,y,h} \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$, i.e. the heat generation in each heat generator should not exceed the total capacity of the heat generator

Parameter	Value	Source
$HG_{BL,FF,y}$ = Baseline fossil-based heat generation in year y (GJ)	148,832 GJ	Calculated
$FF_{BL,HG,y,f}$ =Baseline fossil fuel demand for process heat in year y (GJ)	231,952 GJ	Step 3.3.
$LOC_{y}.CAP_{HG,h}.LF_{CHG,h}$	2,105,218 GJ	Calculated as formula of Step 3.3.1
Then: $HG_{BL,FF,y,h} \leq LOC_y \cdot CAP_{HG,h} \cdot LFC_{HG,h}$		

Proceed to Step 5: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

Step 2: Determine the baseline emissions due to uncontrolled burning or decay of biomass residues

It is not applicable

Step 3: Calculate baseline emissions

$$BE_y = EL_{BL,GR,y} \cdot EF_{EG,GR,y} + \sum_{f} FF_{BL,HG,y,f} \cdot EF_{FF,y,f} + EL_{BL,FF/GR,y} \cdot \min(EF_{EG,GR,y}, EF_{EG,FF,y}) + BE_{BR,y}$$

Data	Value	Source
$EL_{BL,GR,y}$ = Baseline minimum electricity generation in the grid in year y (MWh)	149,578.65 MWh	See step 2
$EF_{EG,GR,y}$ = Emission factor of grid electricity generation	0.42 tCO_2/MWh	See step 1.7
$FF_{BL,HG,y,f}$ = Baseline fossil fuel demand for process heat in year y (GJ)	231,952	See step 4.2
$EF_{FF,y,f}$ = Baseline fossil fuel demand for process heat in year y (GJ)	0.077 tCO2/GJ	IPCC: CO_2 emission factor for residual fuel oil (heavy fuel oil (bunker))
$EL_{BL,FF/GR,y}$ = Baseline uncertain electricity generation in the grid or on-site in year y (MWh)	37,790 MWh	Step 4.1
$EF_{EG,FF,y}$ = CO_2 emission factor for electricity generation with fossil fuels at the project site in the baseline in year y (tCO2/MWh)	0.42 tCO_2/MWh	Step 1.7
Then Min($EF_{EG,GR,y}$,$EF_{EG,FF,y}$) =	0.42 tCO_2/MWh	Calculated
$BE_{BR,y}$ = Baseline emissions due to disposal of biomass residues in year	0.00	Calculated
BE_y	96,330 tCO_2	Calculated

Harvest Year	ELBL,GR,y	ELBL,GR,y *EFEG,GR,y	$FF_{BL,HG,y,f}$ * EFFF,y,f	$EL_{BL,FF/GR,y}$*Min(EFEG,GR,y,EFEG,FF,y)	BE_y	BE_y
2016	149,578.65	62,568.75	17,953.05	15,807.73	96,329.53	27,392.13
2017	162,843.79	68,117.56	17,953.05	15,807.73	101,878.34	96,104.33
2018	167,039.91	69,872.79	17,953.05	15,807.73	103,633.57	106,114.47
2019	141,788.02	59,309.93	17,953.05	15,807.73	93,070.71	104,138.77
2020	131,282.17	54,915.33	17,953.05	15,807.73	88,676.11	92,642.89
2021	144,646.82	60,505.77	17,953.05	15,807.73	94,266.54	88,615.40
2022	172,148.14	72,009.57	17,953.05	15,807.73	105,770.34	98,100.67

Project emissions

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GR1,y} + PE_{GR2,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y} + PE_{BC,y} \quad \textbf{(35)}$$

For the purpose of determining GHG emissions of the project activity, only the following emissions sources are included (explanation is detailed below):

- Emissions from fossil fuel consumption at the project site for the generation of electric power and heat and for auxiliary loads related to the generation of electric power and heat;
- CO_2 emissions from grid-connected fossil fuel power plants in the electricity system for any electricity that is imported from the grid to the project site;

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GR1,y} \quad \textbf{(36)}$$

Determination of $PE_{FF,y}$

$$PE_{FF,y} = \sum FC_{i,j,y} \cdot COEF_{i,y}$$

$$COEF_{i,y} = NCV_{i,y} \cdot EF_{CO2,i,y}$$

$COEF_{i,y}$ = 0.0436 GJ/L * 0.0774 tCO_2/GJ = 0.0034 tCO_2/L

$PE_{FF,,y}$ = 0 * 0.0034 tCO_2/L = 0 tCO_2

Project Implementation

$FC_{i,j,y} = FF_{f,h,x}$

$FC_{i,j,y}$ and $NCV_{i,y}$ will be monitored ex-post.

Determination of $PE_{GR1,y}$

$PE_{GR1,y} = EF_{EG,GR,y} \cdot EL_{PJ,imp,y}$ = 0

$EL_{PJ,imp,y}$ is set to 0

Project Implementation
$EL_{PJ,imp,y}$ parameter will be monitored ex-post.

Determination of $PE_{TR,y}$

This parameter is excluded.
Due to the project activity does not considers to use biomass residues from off-site sources. Consequently no emissions regarding biomass transportation occurs.

$PE_{TR,y}$ = 0 tCO_2

Determination of $PE_{GR2,y}$

This parameter is excluded.

$EL_{balance,PO,y} < EL_{BL,BR,PO,y}$ (Case 3.3.2) or $EL_{balance,FF,y} < EL_{BL,FF,y}$ (Case 4.2.2) are not possible.
Therefore, the amount of electricity generated on-site in the baseline is equal or less than the amount of electricity generated in the project scenario. No electricity is expected to be supplied by the grid due to decrease of power output in the project activity.

No emission reductions are calculated for $PE_{GR2,y}$.

$PE_{GR2,y}$ = 0 tCO_2

Determination of $PE_{BR,y}$

This parameter is excluded.
Since no baseline emissions due to uncontrolled burning or decay of biomass residues are included, no project emissions due to this source need to be included

$PE_{BR,y}$ = 0 tCO_2

Determination of $PE_{WW,y}$

This parameter is excluded.

Since, no wastewater related emissions or biogas emissions are expected in the project activity.

$PE_{WW,y} = 0\ tCO_2$

Determination of $PE_{BG2,y}$

This parameter is excluded. The project does not include biogas. No emissions are expected.

$PE_{BG2,y} = 0\ tCO_2$

Determination of $PE_{BC,y}$

This parameter is excluded.

The project does not include emissions associated with the cultivation of lands to produce biomass, since heat and electricity are produced using biomass residues and not from biomass cultivated in dedicated plantations. No emissions are expected.

$PE_{BC,y} = 0\ tCO_2$

Leakage

The project activity will use only biomass residues from an on-site production process (category k1 of the Table 1), it is assumed that this type of biomass is entirely used for power and heat generation in the baseline scenario B4.

Therefore, emissions from leakage are considered as zero.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2016	27,392	0	0	27,392
2017	96,104	0	0	96,104
2018	106,114	0	0	106,114
2019	104,139	0	0	104,139
2020	92,643	0	0	92,643
2021	88,615	0	0	88,615
2022	98,101	0	0	98,101
2023	70,513	0	0	70,513
Total	683,622	-	-	683,622
Total number of crediting years	**7**			
Annual average over the crediting period	**97,660**	**0**	**0**	**97,660**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

<table>
<tr><td>Data/Parameter</td><td>Biomass categories and quantities used in the CDM project activity</td></tr>
<tr><td>Data unit</td><td>- Type (i.e. bagasse, rice husks, empty fruit bunches, tree bark etc.);
- Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, dedicated plantations etc.);
- Fate in the absence of the CDM project activity (scenarios B);
- Use in the project scenario (scenarios P and H);
- Quantity (tonnes on dry-basis)</td></tr>
<tr><td>Description</td><td>The last column of Table 1 of section B.4.corresponds to the quantity of biomass (tonnes on dry-basis). This quantity will be updated every year of the crediting period as part of the monitoring plan so as to reflect the actual use of biomass in the project scenario. These updated values are used for emissions reductions calculations.

Along the crediting period, new categories of biomass (i.e. new types, new sources, with different fate) can be used in the CDM project activity. In this case, a new line will be added to the table. If those new categories are of the type B1, B2 or B3, the baseline scenario for those types of biomass residues should be assessed using the procedures outlined in the guidance provided in the procedure for the selection of the baseline scenario and demonstration of additionality.</td></tr>
<tr><td>Source of data</td><td>On-site measurements</td></tr>
<tr><td>Value(s) applied</td><td><table>
<tr><th>Category(k)</th><th>Biomass residue type</th><th>Source</th><th>Baseline Scenario Use</th><th>Project Scenario Use</th><th>Quantity</th></tr>
<tr><td>K_1</td><td>Bagasse</td><td>On-site production</td><td>Cogeneration on-site (B4)</td><td>Cogeneration on-site(B4)</td><td>Measured ex-post</td></tr>
</table></td></tr>
<tr><td>Measurement methods and procedures</td><td>Use of weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass.

Data would be monitored continuously and aggregated at least seasonally, to calculate emissions reductions.</td></tr>
<tr><td>Monitoring frequency</td><td>The meters will measure data continuously and aggregated daily.</td></tr>
<tr><td>QA/QC procedures</td><td>The weight meters for bagasse are calibrated yearly according to national standards, and are reviewed by the sugar cane unions’ representatives.
Crosscheck the measurements with an annual energy balance that is based on purchased quantities, purchase invoices and stock changes.</td></tr>
<tr><td>Purpose of data</td><td>This parameter is used for the calculation of emissions reductions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data/Parameter	$BR_{PJ,n,y}$
Data unit	tonnes on dry-basis
Description	$BR_{PJ,n,y}$ = Quantity of biomass residues of category n used in the CDM project activity in year y (tonnes on dry-basis)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures	The weight meters for biomass residues are calibrated yearly according to national standards. In case of the absence of National Standards, the calibration of weight meters will be done as per recommendation from the equipment manufacturer.

Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	$BR_{B4,n,y}$
Data unit	tonnes on dry-basis
Description	Quantity of biomass residues of category n used in the CDM project activity in year *y* for which the baseline scenario is B4 (tonne on dry-basis)
Source of data	On-site measurements
Value(s) applied	<table><tr><th>Baseline scenario</th><th>Category(n)</th><th>Biomass residue type</th><th>Quantity (dry basis)</th></tr><tr><td>B4</td><td>k1</td><td>Bagasse</td><td>Measured ex-post</td></tr></table>
Measurement methods and procedures	Use weight bridges. Adjust for the moisture content in order to determine the quantity of dry biomass.
Monitoring frequency	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions.
QA/QC procedures	The weight meters for biomass residues are calibrated yearly according to national standards. In case of the absence of National Standars, the calibration of weight meters will be done as per recommendation from the equipment manufacturer.
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	$EF_{FF,y,f}$
Data unit	t CO_2/GJ
Description	CO_2 emission factor for fossil fuel type f in year y (t CO_2/GJ)
Source of data	Values provided by fuel supplier in invoices or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances.
Value(s) applied	n/a
Measurement methods and procedures	Choose the value in a conservative manner and justify the choice. In cases values provided by fuel supplier in invoices are not available, IPCC default values limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2. (Energy) of 2006 IPCC guidelines on National GHG Inventories. Any future revision of the IPCC guidelines should be taken into account.
Monitoring frequency	Review the appropriateness of the data annually
QA/QC procedures	Check consistency of measurements and local/national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	Applicable if back-up existing heat generator is used.

Data/Parameter	$FF_{f,h,x}$
Data unit	L/year
Description	Quantity of fossil fuel type f fired in heat generator *h* in year *x*
Source of data	On-site measurements
Value(s) applied	n/a

Measurement methods and procedures	The measurements will be made with appropriate volumetric meter
Monitoring frequency	Data monitored continuously and aggregated as appropriate
QA/QC procedures	
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	Applicable if back-up existing heat generator is used.

Data/Parameter	$HC_{BL,y}$
Data unit	GJ
Description	$HC_{BL,y}$ = Baseline process heat generation in year *y* (GJ)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	This parameter should be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the CDM project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The baseline process heat generation is determined based on: - Steam Production: measured continuously by a flow meter; - Temperature: measured continuously with a thermocouple; - Pressure: In in case of superheated steam measured continuously with a pressure meter. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency	The meters will measure data continuously and aggregated as appropriate
QA/QC procedures	The various meters used to measure flow, temperature and pressure will be maintained and calibrated yearly according to the requirements of the technology provider. The data aggregation and calculations will be automatic where possible, and under strict quality control where manual data aggregation is required.
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	$EL_{PJ,gross,y}$
Data unit	MWh
Description	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	The data will be collected continuously using an electricity meter. Data monitored continuously and aggregated at least seasonally. The data will be archived throughout the crediting period and two years thereafter.
Monitoring frequency	The meters will measure data continuously and aggregated as appropriate

QA/QC procedures	The consistency of metered electricity generation will be cross-checked with the invoices for sold electricity, record of electricity internal consumption and quantity of biomass combusted. The electricity generated by the project will be measured with a calibrated electricity meter installed at the outlet of the heat engine following the rules established by the Energy Regulatory Comision (CRE) in the resolution *"Resolución por la que la Comisión Reguladora de Energía expide las Reglas Generales de Interconexión al Sistema Eléctrico Nacional para generadores o permisionarios con fuentes de energías renovables o cogeneración eficiente*[62]
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	$EL_{PJ,imp,y}$
Data unit	MWh
Description	Project electricity imports from the grid in year *y* (MWh)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	The data will be collected continuously using a bidirectional electrical meter. Data monitored continuously and aggregated at least seasonally. The data will be archived throughout the crediting period and two years thereafter.
Monitoring frequency	The meters will measure data continuously and aggregated as appropriate
QA/QC procedures	The calibration methods, as well as, the calibration frequency will be done in line with manufacturer specifications. The consistency of metered electricity should be cross-checked with receipts from electricity purchases.
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	$EL_{PJ,aux,y}$
Data unit	MWh
Description	Total auxiliary electricity consumption required for the operation of the power plants at the project site in year y (MWh)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	Use calibrated electricity meters. The data will be archived throughout the crediting period and two years thereafter.
Monitoring frequency	The meters will measure data continuously and aggregated as appropriate
QA/QC procedures	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years). The calibration methods, as well as, the calibration frequency will be done in line with manufacturer specifications.
Purpose of data	This parameter is used for the calculation of emissions reductions

[62] Energy regulatory commission: http://www.cre.gob.mx/documento/2195.pdf

Additional comment	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.). In case steam turbines are used for mechanical power in the baseline situation and electric motors for the same purpose in the project situation, the electricity used to run these electric motors shall be included in $EL_{PJ,aux,y}$

Data/Parameter	$NCV_{BR,n,y}$
Data unit	GJ/tonnes of dry matter
Description	Net calorific value of biomass residue of category n in year y (GJ/tonnes on dry-basis)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV on dry-basis.
Monitoring frequency	At least every six months, taking at least three samples for each measurement.
QA/QC procedures	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Purpose of data	This parameter is used for the calculation of emissions reductions.
Additional comment	-

Data/Parameter	$NCV_{FF,f,x}$
Data unit	GJ/L
Description	Net calorific value of fossil fuel type *f* in year *x*.
Source of data	Values provided by fuel supplier in invoices or national data where available.
Value(s) applied	n/a
Measurement methods and procedures	Values should be undertaken in line with national or international fuel standards.
Monitoring frequency	At least every six months.
QA/QC procedures	Verify if the values of NCV is within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC guidelines. If the values fall below this range, additional information will be provided to justify the outcome.
Purpose of data	This parameter is used for the calculation of emissions reductions.
Additional comment	Applicable if back-up existing heat generator is used.

Data/Parameter	$h_{LOW,y}$ $h_{HIGH,y}$
Data unit	GJ/tonnes
Description	$h_{LOW,y}$ = Specific enthalpy of the heat carrier at the process heat demand side (GJ/tonnes); $h_{HIGH,y}$ = Specific enthalpy of the heat carrier at the heat generator side (GJ/tonnes).
Source of data	On-site measurements
Value(s) applied	n/a

Measurement methods and procedures	The specific enthalpies should be determined based on the temperatures and, in case of superheated steam, the pressure. Temperature will be measured with a thermocouple and pressure with a pressure meter. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency	Data monitored continuously and aggregated as appropriate.
QA/QC procedures	The various meters used to measure temperature and pressure are be maintained and calibrated yearly according to the requirements of the technology provider.
Purpose of data	This parameter is used for the calculation of emissions reductions.
Additional comment	The process heat demand side refers to where heat is finally used for heating purposes by end-users and the heat generator side refers to where heat is generated

Data/Parameter	Moisture content of the biomass residues
Data unit	% Water content in mass basis in wet biomass residues.
Description	Moisture content of each biomass residues type *k*.
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	Measurements shall be carried out at reputed laboratories and according to relevant international standards. The weighted average should be calculated for each monitoring period and used in the calculations
Monitoring frequency	The moisture content should be monitored for each batch of biomass of homogeneous quality.
QA/QC procedures	Check the consistency of the measurements by comparing the measurement results with measurements from previous years or relevant data sources.
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

Data/Parameter	LOC_y
Data unit	Hour
Description	Length of the operational campaign in year *y* (hour)
Source of data	On-site measurements
Value(s) applied	n/a
Measurement methods and procedures	Record and sum the hours of operation of the CDM project activity facilities during year *y*.
Monitoring frequency	Yearly
QA/QC procedures	This parameter is measured as part of the established operation procedures of Ingenio Panuco, and it required for the sugar mill's seasonal reports.
Purpose of data	This parameter is used for the calculation of emissions reductions
Additional comment	-

B.7.2. Sampling plan

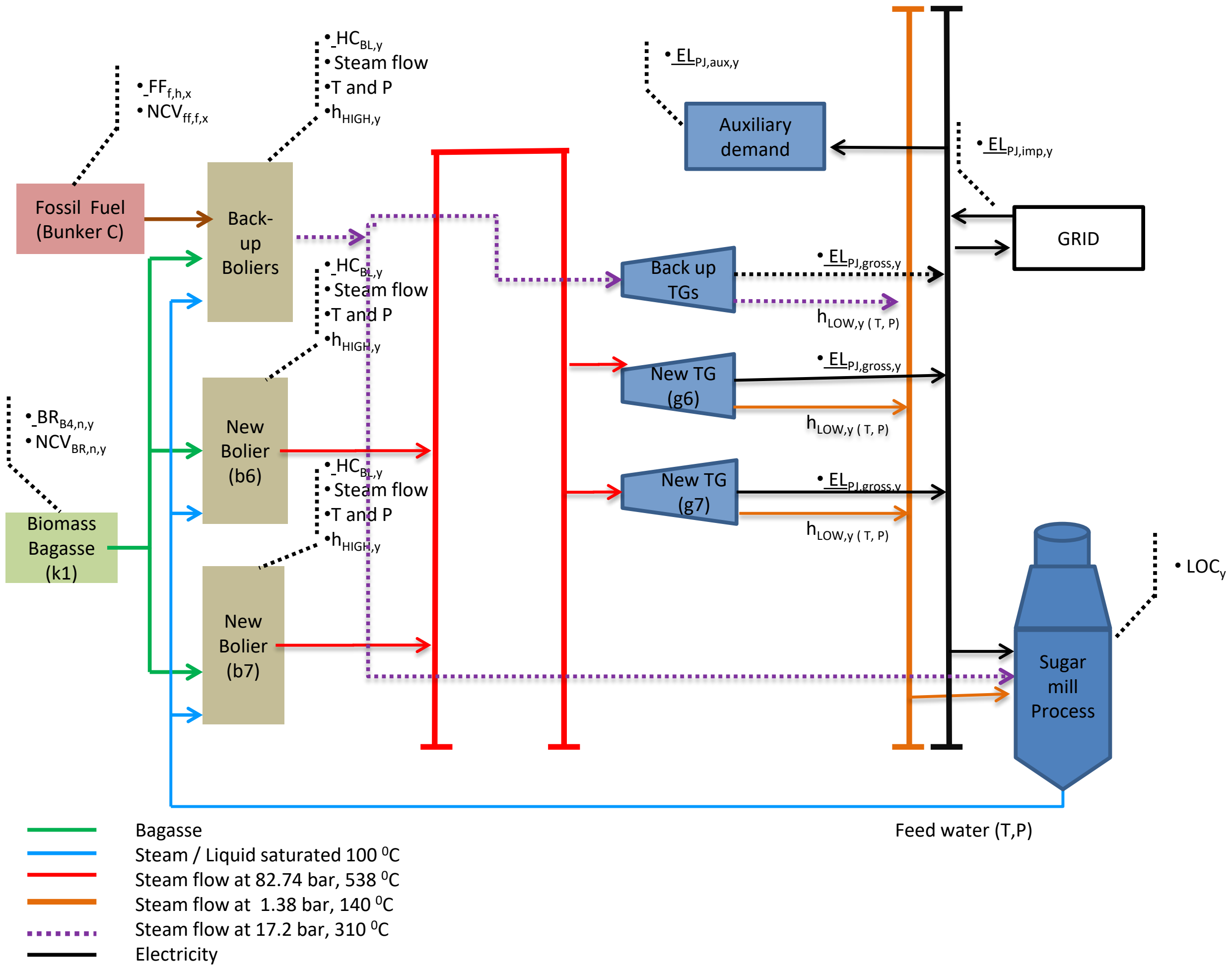
>>

All parameters of the project with exception of $NCV_{BR,n,y}$, $NCV_{FF,f,x}$ and $EF_{FF,y,f}$, will be monitored continuously and aggregated as appropriate, to calculate emissions reductions.

B.7.3. Other elements of monitoring plan

>>

All monitoring procedures and requirements of Panuco Bagasse Cogeneration Project are in accordance with the methodology ACM0006 “Consolidated methodology for electricity and heat generation from biomass” and are representing in the figure below.



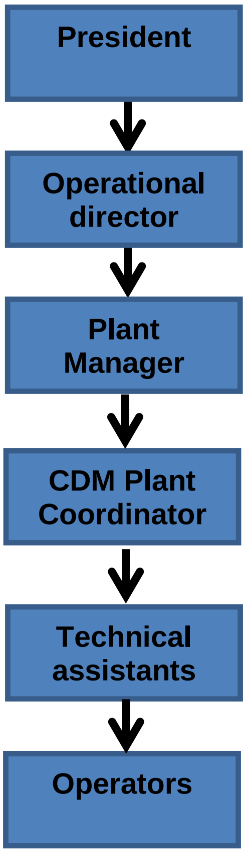
All continuously measured parameters will be recorded electronically via a datalogger, located inside the site boundary which will have the capability to aggregate and print the collected data in the frequencies range specified above. It will be the site operator responsibility to provide all requested data logs which will be stored during the reporting period at the Site office. The data logs will be summarized into emission reduction calculations prior to each verification. This task will be completed by Project Participant and reported directly to the DOE. These logs will be available to the DOE when requested in order to prove the operational integrity of the Project.

1. Management Structure

The collected operational data will be used to support the periodic verification report requiring CER auditing. The herein discussed monitoring plan has been designed to meet or conservatively exceed the UNFCCC requirements (approved monitoring methodology ACM0006 version 12.1.1).

The monitoring program routine system required to determine emission reductions is discussed in section 2 below, while the additional system data collected to ensure the safe, correct, and efficient operation of the management system is discussed in section 3.

1.1 Responsibility of the personnel involved:



Plant Manager and CDM Plant Coordinator are responsible:

i. To ensure proper operation and maintenance of the plant by the operators, with the support from the own Technical Team;
ii. to check the completeness and errors of data recorded;
iii. to prepare the monthly monitoring report with the integration of all data, with the support from CDM consultant;
iv. to execute fast and accurate repair/replacement of any failure equipment;
v. to ensure proper calibration and maintenance of monitoring equipment has been carried out as scheduled in the monitoring plan; and
vi. to make direct communication with the management board.

The overall monitoring procedure will be undertaken by the Plant Manager with the support received from the CDM consultant.

The Operators are responsible:

i. To run the plant as according to the operation manual with the support from technology provider;
ii. to record all the raw data and build them into spreadsheet; and
iii. to do the backup of all data into server and external hard drive.

The Operators have to report immediately to the Plant Manager upon any failure in plant operation and data recording for immediate remedy actions.

The Technicians are mainly responsible to execute the calibration and maintenance of monitoring equipment. They have to report immediately to the Plant Manager upon any failure in monitoring equipment for immediate repair and/or replacement of monitoring equipment to be done.

1.2. Installation of meters

All meters described in the Section B.7.1 will be installed in order to fulfill the proposed monitoring plan.

2. Monitoring Work Program

2.1. Monitoring Procedures:

Ingenio Panuco follows strict monitoring procedures, including maintenance, calibration and data security. These procedures follow the CDM requirements and the recommendations of the technology providers of the various meters within the project activity. Ingenio Panuco is responsible for the implementation of these procedures as well as their update as required.

The electricity generated by the project will be measured with a calibrated electricity meter installed at the outlet of the heat engine following the rules established by the Energy Regulatory Commission (CRE) in the resolution called as *"Resolution Energy Regulatory Commission, which issues the General Rules of the National Electrical Interconnection System for generators or permit holders with renewable energy or efficient cogeneration"*[63]

Biomass will be measured using calibrated weight bridges. For bagasse consumption quantities will be cross-checked with logbooks. The steam flow, temperature and pressure will be measure with calibrated meters.

The CDM developer will design a Monitoring Manual for operatives to follow with CDM monitoring instructions. Ingenio Panuco will coordinate information gathering and be in charge of guaranteeing high quality data.

The procedures for data collection and monitoring management will include:

- Assigning a monitoring team;
- Capacity building of the monitoring team;
- Implementation of emission calculations spreadsheets;
- Data collection for the implementation of monitoring plan;
- Data record and storage;
- Emission reduction calculations;
- Monitoring procedures;
- Calibration procedures;
- Monitoring reporting;
- Regular manual update;
- Back-up and emergency case procedures.

In case of emergency of malfunctions in monitoring equipment, proper conservative approach should be taken to measure the emission reductions if the major monitored data cannot be measured.

2.2. Internal Auditing

Procedures for internal auditing will be implemented in order to ensure that the monitoring methodology is applied in the correct manner, describing the non-conformities and proposing correctives measures when needed. The person in charge of following these auditing procedures

---

[63] Original name of the resolution in Spanish: *"Resolución por la que la Comisión Reguladora de Energía expide las Reglas Generales de Interconexión al Sistema Eléctrico Nacional para generadores o permisionarios con fuentes de energías renovables o cogeneración eficiente".* The regulatory information is available in the Energy regulatory commission website: http://www.cre.gob.mx/documento/2195.pdf

will be determined with the monitoring team. Specific training for the Monitoring Team will be provided prior to power plant's operation.

2.3. Data storage

Data will be stored electronically, during the crediting period and at least two years after the last issuance of CER credits for the project activity in the concerning crediting period. Ingenio Panuco will be responsible for storage of data received from the measuring devices, the calibration certificates and the relevant receipts.

2.4. Quality assurance and quality control

A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment and due to strict compliance with the recommendations for calibration frequency of the equipment provider. All metering devices will be calibrated. The specification of the meters will be in compliance with the requirements of the host country.

Several key monitoring parameters can be quality-checked with external information. Regarding electricity exports, it is the incentive of Ingenio Panuco and the customers of the company to keep the meters accurate and non-tampered.

The amounts of sugarcane weighed upon arrival to the project site are the base for the invoicing for the sugarcane farmers and self-control. The both the farmers and the project participants have high incentive to keep these measurements accurate.

Most of the monitoring parameters are required by Ingenio Panuco for the orderly and efficient operation of the sugar mill, and therefore high operation standards are applied. Moreover, the plant is certified by ISO 9001 quality system and various other quality standards.

3. Corrective actions

The staff will log all corrective actions and will report these in the monitoring report. In case when the corrective actions are considered necessary, these actions will be implemented according to internal procedures.

4. Procedures for monitoring personnel training

The Project Participant will conduct a training and quality control program to ensure that the good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action.

5. Emergency procedures

As a precautionary measure, regularly backups will be carried out to avoid data loss due to power outages. The CMD plant coordinator will check daily the records. In addition, an emergency plan will be developed including other types of emergencies such as fire and work accidents.

6. Calibration

All the measurement instruments will be subject to regular calibration as per manufacturer's specifications or, in the absence of official standards and when applicable, the calibration frequency will be defined by the Project Participants based on good practices in the market. Regular cross-check and calibration will be made by the operators and all applicable procedures will be supervised by Ingenio Panuco internal audit.

The CMD plant coordinator will be responsible for checking the equipment's proper working conditions, as well as checking and storing up the calibration certificates and records. The calibration frequencies for the measuring equipment are presented in section B.7.1. Calibration certificates will be kept for all the equipment during the crediting period and two years after.

This PDD was developed by:

BENG Engenharia Ltda
Phone: + 55 11 2614-9383
www.beng.eng.br

Project Coordinators:
Francisco Santo (francisco.santo@beng.eng.br)
João Sprovieri (joao.sprovieri@beng.eng.br)

BENG Engenharia Ltda is not a project participant.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
The start date of the project activity is 12/02/2013[64].

C.2. Expected operational lifetime of project activity

>>
21 years and 0 months.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable (3 x 7 years)

C.3.2. Start date of crediting period

>>
The crediting period will start on the date of the registration of the CDM project activity on 17/04/2015.

C.3.3. Duration of crediting period

>>
7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The new generation plant is the extension of the actual cogeneration plant and it will be located in the same site of the actual cogeneration plant. The actual cogeneration plant has the

[64] This date correspond to the proof of early payment to electric generator supplier.

Environmental Registry Number FAG2D3012311[65] and as the new cogeneration plant will be located in the Panuco plant site it is cover by the actual environmental license and ratified by the SEMARNAT *(Secretaría de Medio Ambiente y Recursos Naturales) letter* .No. SGPARN.02.IRA.515413[66]

However, an analysis of environmental impacts of the project was developed considering the applicable environmental laws of the country.

In Mexico, the environmental legislation is analyzed at federal and state level. SEMARNAT is the federal organ and the responsible authority for the evaluation and approval of the laws and regulations applicable to the proposed project. According to the "General law on the ecological equilibrium and environmental protection" ("*Ley General del Equilibrio Ecológico y la Protección al Ambiente*", the proposed project is subject to laws concerning levels of atmospheric emissions, sound levels, hazardous wastes, impact on endangered flora and fauna, and emission levels of contaminating gases from permanent sources.

In accordance to prevailing regulations, the project considers preventive actions during its implementation and operation.

The following paragraphs summarize the identified impacts and the preventive actions of the proposed project:

Flora and fauna

The works that are carried out in preparation of the site have direct impact on the fauna and flora, through the generation of sound and smoke and the movement of soil. The flora is not endangered though and the fauna is already adapted to the industrial surroundings. A potential impact could be the deposit of soil residues in environments with the presence of natural fauna. Care and supervision will ensure that the demolition material and soil are deposited correctly, or used as much as possible in the construction.

Surface water

Due to excavation and construction works, the surface water is not expected to be impacted significantly.

Mitigation measures on soil and waste management will be taken according to applicable legislation.

Ground water

There is a potential risk that the ground water can be contaminated during the cleaning and maintenance of the fuel tanks. In addition, fuel leaks can occur, although the risks are low.

Air

During the site preparation and construction, the emission levels of pollutants from the exhaust gas of the machines will be high. In addition, the noise levels will be high. This is a temporary impact. The noise levels will comply with applicable legislation.

In the operational phase, the proposed project has a positive impact in terms of air, in comparison to the current situation. Due to the increased efficiency of the new facility, the emissions of pollutants and greenhouse gases to the air are minimized.

---

[65] Registry date of Annual Operation Official Report (COA), SEMARNAT 2012.

[66] Environmental impact assessment (EIA) exemption emitted by SEMARNAT, 2013.

Soil

The soil at the site will be affected by excavation and construction works. This is seen as an insignificant impact though, as site is located on industrial grounds. A rigorous control of the wastes will be made, in accordance with the applicable legislation.

D.2. Environmental impact assessment

>>
The project activity does not involve relevant environment impacts in the project location area and therefore does not require environment impact assessment. Indeed, the current environmental license obtained by the sugar mill considers the installation and operation of a cogeneration plant, which overall operations, inputs and products are unchanged.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
The local stakeholder consultation took place on 23/10/2013 in the Plaza Hotel of the Panuco City. The stakeholders were invited personally through letters, poster located in strategic places of the city and announcements in daily newspapers. [67] Furthermore, after the local stakeholder consultation it was published on 27/10/2013 for other newspaper[68]. The stakeholder groups invited were: representatives from the municipality, local businesses, schools, farmers, associations and farm worker unions, and all of them was invited to attend a presentation about Panuco bagasse cogeneration project for producing electricity and explaining about the benefits of the implementation of a CDM project. The Project Participant confirmed the reception of the invitations by means of a registry of reception and additionally controlled the name of the attendants to the event using other format; which contains the name and signature of all the event participants.

MÉXICO » Los electores castigaron al PAN por sus divisiones en los comicios de 2012, reconoce Vázquez Mota P. 20

MILENIO 23 Aniversario

TAMAULIPAS
MARTES
22 de octubre de 2013
www.milenio.com

DIARIO® » PERIODISMOCONCARÁCTER — AÑO 23 » NÚM. 364

Pantaleon
Ingenio Panuco

Ingenio Pánuco invita a la **Consulta Pública del Proyecto "Cogeneración con Bagazo de Caña"**, que consiste en aprovechar el bagazo de caña, un subproducto del proceso de elaboración de azúcar, mejorando la eficiencia energética en un 200 % para la producción del vapor y electricidad necesarios para la operación del ingenio.

Por ser un proyecto que reduce gases de efecto invernadero (GEI), y pretende aplicar al mercado de carbono en el marco del Protocolo de Kioto, y así reclamar los certificados de reducción de emisiones que emanen del mismo.

La Consulta Pública del Proyecto de Cogeneración con Bagazo de Caña, será llevada a cabo el día Miércoles 23

MARÍA GUADALUPE ACUÑA MARTÍNEZ
Sala 3 / Suc. Madero

JOSÉ MACÍAS GUTIERREZ
Sala 1 / Suc. Ejército Mexicano

FUNERALES ALTAMIRA
213-38-38 217-07-00

---

[67] El milenio newspaper published on 22/10/2013:

[68] Frente y vuelta newspaper published on 27/10/2013

During this presentation the attendees received complete and clear information about the Panuco bagasse cogeneration project by Panuco employees.

E.2. Summary of comments received

>>
No comment or criticism was received, but recognition of the work being done by the PP and have emphasized the environmental benefits that the project will bring to the region.

E.3. Consideration of comments received

>>
No comment or criticism was received, but recognition of the work being done by the PP and have emphasized the environmental benefits that the project will bring to the region.

SECTION F. Approval and authorization

>>
The Letter of Approval (LoA) from the Party was issued on 28/02/2014 by the Interministerial Commission on Climate Change, in its capacity as Designated National Authority of Mexico to the Executive Board of the Clean Development Mechanism outlined in the Article 12 of the Kyoto Protocol.

Appendix 1. Contact information of project participants

Organization name	Ingenio Panuco Sapi de CV
Country	Mexico
Address	Alto del Estero Street
Telephone	00 521 846 2661672
Fax	00 521 846 2661672
E-mail	jespel@pantaleon.com
Website	www.pantaleon.com
Contact person	Mr. Juan Carlos Espel

Organization name	Econergy Brasil Ltda.
Country	Brazil
Address	Av. Angelica 2530, cj.35
Telephone	+55 11 3555-5700
Fax	+55 11 3555-5735
E-mail	francisco.santo@econergy.com.br
Website	www.econergy.com.br
Contact person	Mr. Francisco Santo

Appendix 2. Affirmation regarding public funding

Not applicable. There is no public funding involved in the project activity

Appendix 3. Applicability of methodologies and standardized baselines

All the information about the applicability of selected methodology is described in Section B.2. above.

Appendix 4. Further background information on ex ante calculation of emission reductions

1- Combined Margin CO_2 Emission Factor Calculation

<u>Operating Margin</u>

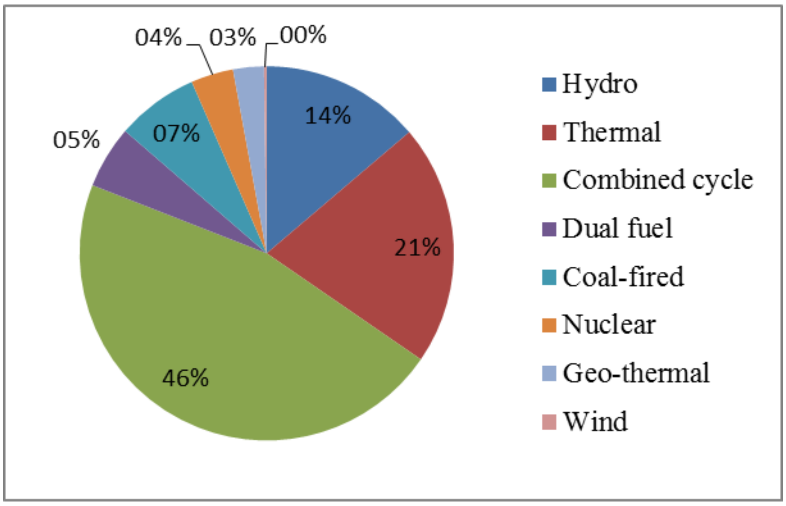


Figure 6 - Last 5-year Average National Electricity Sector – Gross Electricity Generation by type (GW-h)[69]

Option (a) the Simple Operating Margin method has been selected from the four options proposed in the methodology, because the low-cost/must run resources in Mexico constitute less than 50% of the total grid generation in average of the five most recent years, as showed in the Figure 6 above.

Table 1 - Gross Electricity generation by source (2010-2012)[70]

Year	I/2010 (MWh)	I/2011 (MWh)	I/2012 (MWh)
Thermal	160,025,505.80	171,580,247.82	178,890,728.86
• Steam	40,569,621.98	47,868,928.08	53,917,755.54
• Combined Cycle	114,817,553.00	118,454,541.52	117,606,004.17
• CFE	36,375,560.55	34,448,790.26	37,431,016.67
• PIE	78,441,992.46	84,005,751.26	80,174,987.50
• Open cycle with Natural gas	3,396,011.62	4,125,470.12	6,216,616.47
• Internal Combustion Engines	1,242,319.21	1,131,308.10	1,150,352.68
Dual fuel	15,577,758.08	15,395,878.87	16,233,964.03
Coal-fired	16,485,075.95	18,158,430.52	17,724,103.15
Nuclear	6,618,460.16	6,506,614.33	5,816,642.18
Geo-thermal	5,879,240.64	10,089,195.03	8,769,598.82
Wind	166,391.98	357,282.68	1,744,144.41
CFE	166,391.98	105,680.83	187,956.07

69 http://www.sener.gob.mx/webSener/res/476/Generation.pdf

70 http://sie.energia.gob.mx

The net electricity generation by source has been calculated considering the loss transmission:

PIE	-	251,601.85	1,556,188.35
Hydro	36,738,462.23	35,795,896.24	31,316,574.26
Photovoltaic	-	-	2,076.42
Total (MWh)	241,490,894.83	257,883,545.49	260,497,832.13

Table 2 - Transmission losses 2006, 2010 and 2011[71]

Transmission losses 2006	10.90%
Transmission losses 2010	11.00%
Transmission losses 2011	11.30%

For 2012 year where used the value of 2011 year, considering the increasing tendency.

Table 3 - Net Electricity generation by source (2010 - 2012)

Year	I/2010	I/2011	I/2012
Thermal	142,422,700.17	152,191,679.81	158,676,076.50
• Steam	36,106,963.56	42,459,739.20	47,825,049.16
• Combined Cycle	102,187,622.17	105,069,178.33	104,316,525.70
• CFE	32,374,248.89	30,556,076.96	33,201,311.78
• PIE	69,813,373.28	74,513,101.37	71,115,213.91
• Open cycle with Natural gas	3,022,450.34	3,659,292.00	5,514,138.81
• Internal Combustion Engines	1,105,664.10	1,003,470.28	1,020,362.83
Dual fuel	13,864,204.69	13,656,144.56	14,399,526.10
Coal-fired	14,671,717.59	16,106,527.87	15,721,279.49
Nuclear	5,890,429.54	5,771,366.91	5,159,361.62
Geo-thermal	5,232,524.17	8,949,115.99	7,778,634.15
Wind	148,088.86	316,909.73	1,547,056.09
CFE	148,088.86	93,738.90	166,717.03
PIE	-	223,170.84	1,380,339.06
Hydro	32,697,231.39	31,750,959.97	27,777,801.37
Photovoltaic	-	-	1,841.79
Total (MWh)	215,168,387.30	229,516,355.48	231,061,577.10

Table 4 - Yearly fuel consumption for electricity generation (2010 - 2012)[72]

Year	2010	2011	2012
Fuel oil (kbarrels)	57,170.09	64,564.09	73,537.35
Diesel (kbarrels)	2,401.54	2,964.13	4,565.41
Coal (ktons)	14,694.09	15,521.05	15,453.17
Natural gas (MMfeet^3)	378,228.68	390,854.40	417,913.98

[71] http://sie.energia.gob.mx

[72] http://www.sener.gob.mx/portal/Mobil.aspx?id=1430

Table 5 - IPCC 2006 Net Calorific Values (NCV)[73]

Year	Lower Limit (95% confidence) GJ/Gg or GJ/t
Fuel oil	39.80
Diesel	41.40
Coal	21.60
Gas Natural	46.50

Table 6 - IPCC 2006 CO2 Emission Factor (EFCO2)[74]

Year	Lower Limit (95% confidence) kg CO2/TJ	Lower Limit (95% confidence) kg tCO2/GJ
Fuel oil	75,500.00	0.0755
Diesel	72,600.00	0.0726
Coal	94,600.00	0.0946
Natural Gas	54,300.00	0.0543

Table 7 - Fuels density[75]

Fuels density (kg/m3)	
Fuel oil	959.5
Diesel	959.5
Coal	850
Natural Gas	0.9

The weighted OM (tCO_2/MWh) is:

OM_{2010} (tCO_2/MWh)	0.4778
OM_{2011} (tCO_2/MWh)	0.4827
OM_{2012} (tCO_2/MWh)	0.4994
$OM_{2010-2012}$ (tCO_2/MWh)	**0.4869**

[73] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

[74] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

[75] http://www.engineeringtoolbox.com/fuels-densities-specific-volumes-d_166.html

Building Margin

Name	Capacity MW	Unit	Technology	$EG_{m,y}$ Generation MWh	Productio n (%)	Accumulat e (%)	$n_{m,y}$ Efficiency	$EF_{CO2i,m,y}$ Emission Factor of power unit	$EG_{m,y}*EF_{EL,m,y}$
2012 additions [7]									
Manzanillo I (Manuel Alvarez Moreno)	157.6	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Manzanillo I (Manuel Alvarez Moreno)	157.6	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Manzanillo I (Manuel Alvarez Moreno)	157.6	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
2011 additions [7]									
2010 additions [7]									
2009 adittions [7]									
San Lorenzo Potencia	116.1	1	CC	235	0.00%	0.00%	60%	0.326	76.6
San Lorenzo Potencia	133.0	4	CC	0	0.00%	0.00%	60%	0.326	0.0
San Lorenzo Potencia	133.0	3	CC	0	0.00%	0.00%	60%	0.326	0.0
Magdalena	32.0	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Santa Cruz	32.0	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Coapa	32.0	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Iztapalapa	32.0	1	TG	0	0.00%	0.00%	39.50%	0.495	0.0
2008 adittions [7]									
Ciudad del Carmen	16.0	2	TG	0	0.00%	0.00%	39.50%	0.495	0.0
Ciudad del Carmen	17.0	3	TG	0	0.00%	0.00%	39.50%	0.495	0.0
2007 adittions [7]									
Tamazunchale (PIE)	1,135.0	1	CC	8086000	3.91%	3.91%	60%	0.326	2634418.8
Rio Bravo (Emilio Portes Gil)	33.0	1	CC	0	0.00%	3.91%	60%	0.326	0.0
Rio Bravo (Emilio Portes Gil)	33.0	2	CC	0	0.00%	3.91%	60%	0.326	0.0
Rio Bravo (Emilio Portes Gil)	145.1	4	CC	264000	0.13%	4.04%	60%	0.326	86011.2
Ecatepec (LFC) - CDM	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Remedios (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Victoria (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Villa de Flores (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Cuautitlan (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Coyotepec (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Coyotepec (LFC)	32.0	2	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Vallejo (LFC)	32.0	1	TG	0	0.00%	4.04%	39.50%	0.495	0.0
Holbox	0.8	8	CI	0	0.00%	4.04%	39.50%	0.495	0.0
Holbox	0.8	9	CI	0	0.00%	4.04%	39.50%	0.495	0.0
2006 adittions [7]									
Tuxpan V (PIE)	495.0	1	CC	3,961,000	1.92%	5.96%	60%	0.326	1290493.8
Valladolid III (PIE)	525.0	1	CC	3,737,000	1.81%	7.76%	60%	0.326	1217514.6
Altamira V (PIE)	1,121.0	1	CC	8,214,000	3.97%	11.74%	60%	0.326	2676121.2
Chihuahua II (El Encino)	65.3	5	CC	4,541,000	2.20%	13.93%	60%	0.326	1479457.8
Atenco (LFC)	32.0	1	TG	0	0.00%	13.93%	39.50%	0.495	0.0
2005 adittions [7]									
Hermosillo	93.3	2	CC	2,025,000	0.98%	14.91%	60%	0.326	659745.0
Rio Bravo IV	500.0	1	CC	2,725,000	1.32%	16.23%	60%	0.326	887805.0
La Laguna II	498.0	1	CC	3,767,000	1.82%	18.06%	60%	0.326	1227288.6
Yécora	0.7	4	CI	0	0.00%	18.06%	39.50%	0.495	0.0
Hol Box	0.8	7	CI	0	0.00%	18.06%	39.50%	0.495	0.0
2004 adittions [7]									
Rio Bravo III (PIE)	495.0	1	CC	2,194,000	1.06%	19.12%	60%	0.326	714805.2
El Sauz	128.0	7	CC	4,260,000	2.06%	21.18%	60%	0.326	1387908.0
Tuxpan	163.0	7	TG	7,220,000	3.49%	24.67%	39.50%	0.495	3573077.5

Sources for new plants installed (SENER - Mexico's Secretariat of Energy):
Forecast of the electrical sector 2013-2027:
http://sener.gob.mx/res/PE_y_DT/pub/2013/Prospectiva_del_Sector_Electrico_2013-2027.pdf
Forecast of the electrical sector 2012-2026:
http://www.sener.gob.mx/res/PE_y_DT/pub/2012/PSE_2012_2026.pdf
Forecast of the electrical sector 2010-2025:
http://www.energia.gob.mx/res/PE_y_DT/pub/SECTOR_ELECTRICO.pdf
Forecast of the electrical sector 2009-2024:
http://www.sener.gob.mx/res/PE_y_DT/pub/Prospectiva_electricidad%20_2009-2024.pdf
Forecast of the electrical sector 2008-2017:
http://www.sener.gob.mx/res/PE_y_DT/pub/Prospectiva%20SE%202008-2017.pdf
Forecast of the electrical sector 2007-2016:
http://www.sener.gob.mx/res/PE_y_DT/pub/Prospectiva%20Sector%20Electrico%20FINAS.pdf
Forecast of the electrical sector 2006-2015:
http://www.sener.gob.mx/res/PE_y_DT/pub/prospsectelec2006.pdf
Forecast of the electrical sector 2005-2014:
http://www.sener.gob.mx/res/PE_y_DT/pub/Electrico_2005_2014.pdf
Forecast of the electrical sector 2004-2013:
http://www.sener.gob.mx/res/PE_y_DT/pub/prospec_elec_04_13.pdf

$EF_{grid,BM,2012}$ = 0.3497 tCO2/MWh

Finally, the option:
a) weighted average CM was used to calculate the combined margin (CM).

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y}$$

The default weights are as follows: w_{OM} = 0.5 and w_{BM} = 0.5, fixed for the first crediting period. That gives:

$$EF_{2012} = 0.4869 \times 0.5 + 0.3497 \times 0.5 = 0.4183\ tCO_2/MWh$$

The build margin CO_2 emission factor and operating margin CO_2 emission factor will be *ex-ante*.

Therefore, the combined margin CO_2 emission factor will be *ex-ante*

Appendix 5. Further background information on monitoring plan

All the information about the monitoring plan were described in section B.7.1 and B.7.2

Appendix 6. Summary report of comments received from local stakeholders

Presented in section E.2.

Appendix 7. Summary of post-registration changes

A typo mistake	1. The initial installed capacity changed from 17.0 MW to 17.2 MW due to a mistake in not considering the accurate sum of the equipment installed capacity. The sum of the electrical generators from g1 to g5 have been reassessed. This typo mistake correction was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and only item impacted is (d) the additionality of the project activity. The additionality has been reassessed and it was confirmed the project remains additional.
	2. The outlet pressure of the back-pressure steam turbine (g6) has been changed from 28.5 lb/in2 (described in the registered PDD) to 26 lb/in2 (nameplate of the installed equipment) which provides the same value of enthalpy to a common temperature. In addition, all the calculations of enthalpy are based on real site measurements of pressure and temperature. This typo mistake correction was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and there is no impacted in any item.
	3. The rotation speed of electrical generator (e1) has been changed from 3600 to 1800 rpm. This typo mistake correction was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and there is no impacted in any item.
Change to project design	4. In 1st phase, the installed capacity of the additional electrical generator (e1) changed from 40.0 MW to 45.466 MW. At the time of the registration of the project activity in 2015, the installed capacity values declared in the PDD for (g6) and (e1) were based on the purchasing invoices dated from 2013. Those invoices states that the installed capacity would be 40 MW (g6) and

	44 MW (e1). However, the PP has clarified that the installed capacity defined at the project plant operational reality after tests and commissioning (equipment nameplate) usually range from the technical nominal data defined in the invoices. Thus, the PP was not aware of the correct nameplate installed capacity at the time of registration of the PDD (2015) since the commissioning of those equipment, event when tests and technical adjustments including installed capacity definition in the nameplate are carried out, occurred only in April/2016. So, the intention of the PRC is to be transparent and correct a technical value that was incorrectly declared at the time of the registration of the PDD. Such change impacted the total installed capacity of this phase from 57.0 MW to 62.666 MW. Subsequently, changing the exported electricity from 147,207 MWh/yr to 165,792 MWh/yr. This change to project design was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and only item impacted is (d) the additionality of the project activity. The additionality has been reassessed and it was confirmed the project remains additional.
	5. The changes in 1st phase impacted the total installed capacity of the 2nd phase from 117.0 MW to 122.666 MW. This change to project design was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and only item impacted is (d) the additionality of the project activity. The additionality has been reassessed and it was confirmed the project remains additional.
	6. As a consequence, to the change in the installed capacity, the calculation emission reduction was amended accordingly.
Change to the monitoring plan	7. Changes to the QA/QC procedures. The monitored parameters accuracy class definitions have been removed since those are not necessary according to the CDM-PDD-FORM, version 11.0 and ACM0006, version 12.1.1. The error and accuracy class for the scales of parameters $BR_{PJ,n,y}$ and $BR_{B4,n,y}$ was defined (Class IV) at registration time, nonetheless nor the authorities neither the CDM board require such classes; so in absence of National standards the manufacturer recommendation will be followed. The error, uncertainty and accuracy of meters for parameters $EL_{PJ,gross,y}$ and $EL_{PJ,imp,y}$ was defined at registration (up to 1.5%), nonetheless nor the authorities neither the CDM board require such classes. So the meters classes will be defined as per the Energy Regulatory Commission (CRE) rules or manufacturer recommendation will be followed. This change was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and only item impacted is “(b)The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines documents”. The monitoring plan was adjusted accordingly in compliance with methodology and tools.
Correction	8. The harvest days were corrected since the information in the original cashflow was incorrect according to PP. Thus, it has been changed this key parameter in line with this corrected information provided. It was observed that the additionality of the project is maintained. This change was evaluated under the criteria of PS §242 of the Project Standard items a) to e) and only item impacted is (d) the additionality of the project activity. The additionality has been reassessed and it was confirmed the project remains additional.

As the installed capacity change (from 117 MW to 122.666 MW) did not represent an increase of more than 20%, no discount in the overall emission reduction should be applied in accordance with

paragraph #241 of the CDM project standard for project activities (Version 02.0). It was observed that the additionality of the project is maintained, when proposed changes are carried out.

- - - - -

Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.

Version	*Date*	*Description*
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document