CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scaleproject activity

A.1 Title of the small-scale project activity:

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COPASA MG Small Thermoelectric Plant at ETE Arrudas Project
Version: 7
Date: 06/12/2011

A.2. Description of the small-scale project activity:

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Companhia de Saneamento de Minas Gerais COPASA MG (from now on referred as Copasa) is a Brazilian enterprise, which provides services related to water supply and sanitary sewage in the Minas Gerais State, Brazil. On December 31, 2008 Copasa had concession contracts to provide water supply services in 611 municipalities, serving 12.4 million customers connected to the distribution network, in addition to concession contracts to provide sanitary sewage services in 192 cities, totaling 6.8 million customers connected to the collection network[1].

One of Copasa's wastewater treatment facilities (ETE – *Estação de Tratamento de Esgoto*) is ETE Arrudas. Located in the municipality of Sabará (Minas Gerais), ETE Arrudas is one of the largest and most modern facilities of its kind in the country. It occupies 63.84 ha and serves 1 million users, which corresponds to a 2.25 m^3/s wastewater inflow. It is noteworthy that its capacity can be further expanded for up to 1.6 million users (4.5 m^3/s wastewater inflow). The installed treatment process allows the reduction of up to 93% of the solids and organic load of the wastewater. Figure 1 depicts the aerial view of ETE Arrudas and its main component processes.

Figure 1. Aerial view of ETE Arrudas (Date of the image: 12/05/2007). A) Main entrance B) Control and support facilities C) Anaerobic digesters D) Biogas flares E) Primary decanters F) Aerobic reactors G) Secondary decanters.

[1] Copasa's sustainability report, 2008. Available at http://www.copasa.com.br/relatorioanual/. Accession date: 21/07/2009.

During the anaerobic digestion treatment step (Anaerobic digesters, Figure 1C), biogas is produced. Despite its significant energy content, prior to the project activity, the biogas was flared without any energetic use. Moreover, prior to the project activity the entire electricity supply of ETE Arrudas was taken from the National Interconnected System (*Sistema Interligado Nacional* - SIN).

The project activity consists in the implementation and operation of a small thermoelectric plant (PCT – *Pequena Central Termoelétrica*), which will generate renewable electricity by means of a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step. No electricity (nor heat) generation equipment existed in ETE Arrudas prior to the project activity.

The renewable electricity produced by the project activity will be consumed within ETE Arrudas' facilities, which would otherwise consume electricity from SIN. The nominal electricity generation capacity of the PCT will be 2.4 MW, which is below the eligibility maximum threshold for Type-I small-scale CDM project activities (15 MW of total installed electrical energy generation capacity).

The electricity produced by the project activity will be entirely consumed by ETE Arrudas (i.e. electricity will not be exported to SIN during the crediting period). The expected yearly average net electricity production of the project activity equates to 12,334 MWh, which represents 36.9 % of the total electricity consumption of ETE Arrudas in the year 2010. The remainder of the electricity demand of ETE Arrudas will continue to by met by purchasing it from the state electricity utility. The project activity does not encompass the installation of additional generation capacity (i.e. beyond 2.4 MW) during the crediting period. Average gross yearly electricity production and average plant load factor, during the crediting period: 14,348 MWh and 68%, respectively.

The electricity produced by the project activity would otherwise be generated by the operation and implementation of new sources connected to SIN, as reflected in its combined margin (CM). SIN is partly supplied by fossil fuel-based thermoelectric resources whose generation will be offset by the renewable electricity produced by the project activity, thus reducing GHG emissions (26,723 tCO_2e during the first crediting period).

The project activity contributes the host country's sustainable development in the following ways:

- **Contribution to local environmental sustainability**: besides diminishing GHG emissions, the project activity will reduce emissions of mercaptans and H_2S, improving the air quality of the vicinities of ETE Arrudas.
- **Contribution to the net workplace generation and improvement of labor conditions**: the project activity creates new positions during its implementation and operation of the PCT, besides improving the working conditions at ETE Arrudas (odor reductions).
- **Contribution to technological learning and technological development**: the project activity may act as benchmark for other industries in which the same type of project could be replicated across Brazil.

A.3. Project participants:

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Table 1. Project Participants

Name of Party involved ((host) indicates a host party)	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Federative Republic of Brazil (host)	Companhia de Saneamento de Minas Gerais – COPASA MG	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the small-scaleproject activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

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Federative Republic of Brazil

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

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Minas Gerais

A.4.1.3. City/Town/Community etc:

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A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

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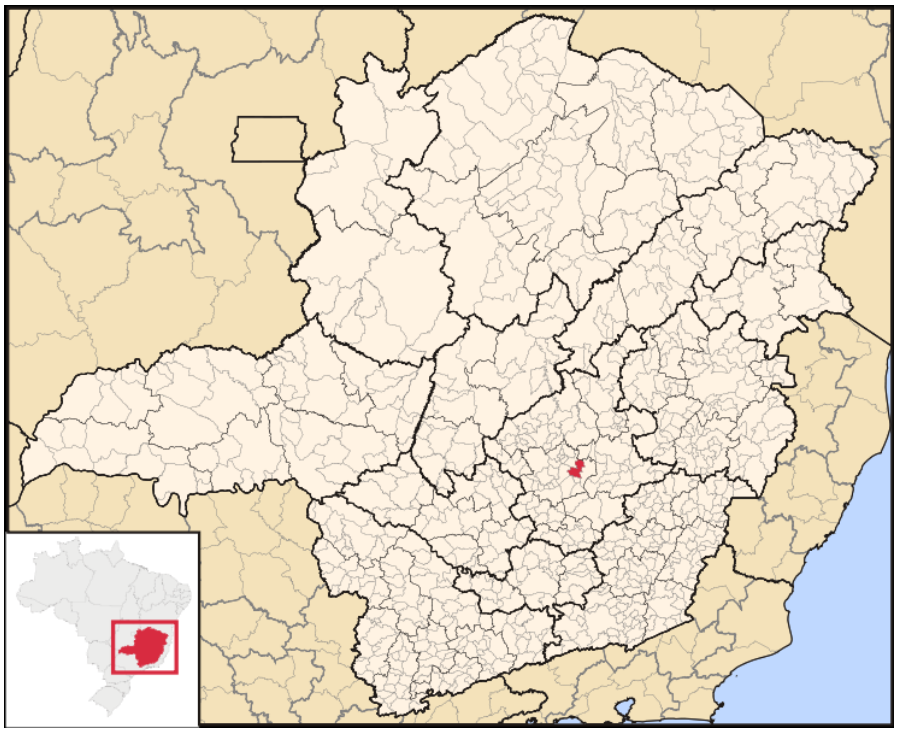

Figure 2. Geographical location of the project activity. Bottom-left panel: depicts the position of the state of Minas Gerais in the Federative Republic of Brazil. Main panel: depicts the municipality of Sabará within Minas Gerais.

Access: Avenida dos Andradas, 8805 – Bairro Caetano Furquim. Belo Horizonte/MG. Brazil.

Reference coordinates: -19.89714 °S and -43.87909 °W (19 °53'49.70"S and 43 °52'44.74"W).

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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As previously stated, the project activity consists in the implementation and operation of a PCT, which will produce renewable electricity by means of a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step in ETE Arrudas. Before being admitted to the electricity generation facility the biogas will be kept under pressure in a set of gasholders leading to a gas treatment system.

The project activity will produce renewable electricity that would otherwise be generated by the operation and implementation of new electricity generation resources connected to SIN. Considering the above, according to the Appendix B to the simplified modalities and procedures for small-scale CDM project activities, the project activity falls under the following type and category:

- Type: I (Renewable Energy Projects)
- Category: I-F (Renewable electricity generation for captive use and mini-grid)

The nominal electricity generation capacity of the PCT will be 2.4 MW, which is below the eligibility

maximum threshold for Type-I small-scale CDM project activities (15 MW of installed electricity generation capacity). The project activity consists in the following major components (please refer to section B.3): gasholders, biogas treatment system, energy generation module, electricity transformation system and supervisory control and data acquisition system.

The project will employ both indigenous and imported environmentally safe and sound technology. This fact is demonstrated bellow, along with the general description of its individual major components. Importantly, the existing biogas flares will remain commissioned during the project activity. This is a measure that seeks preparedness for cases where emergencies can cause unintended emissions. For instance, if for any reason during a given moment the biogas could not be stored in the gasholder or combusted in the PCT, it will be combusted in the existing open flares.

Gasholders:

The biogas produced in the anaerobic digesters shall be stored and pressurized in double-layer gasholders, in order to allow, by means of supporting infrastructure, a steady biogas supply to the electricity generation module.

The gasholders' internal and external layers consist in polyester membranes, with internal and external polyvinyl chloride (PCV) covering. Membrane sections shall be united by means of sewing and welding. Additionally, a strap of the same material will cover the membrane junctions. The membrane shall be resistant to abrasion, bacterial action and ultraviolet radiation. Moreover, the following characteristics shall be met:

- Resistance to impact-driven ruptures: ≈ 5,500 N/5 cm;
- Resistance to heat: as per DIN EN ISO 105-B04;
- Bending resistance: as per DIN 53359, degree 0 (scale from 0 – 4; 0 = no damage);
- Resistance to low temperatures: as per DIN 53361, degree 0 (scale from 0 – 4; 0 = no damage);
- Resistance to fire: as per ÖN B 3800 class B1.

Each gasholder will possess an inflation blower with anti-deflagrating protection as per VDMA 24169. An anti-return valve will be installed between the inflation blower and the gasholder, in order to keep a constant pressure in the gasholder in the cases of failure or stop in the inflation blowers.

Biogas treatment system

The biogas treatment system will be composed of two conditioning units. These units will operate in a parallel fashion during normal operation or in an isolated fashion during the maintenance of one of the units, without the necessity of halting the electricity generation system. This system shall ensure the necessary conditions for the biogas combustion in the set of microturbines. The main equipments/processes in the conditioning system are depicted below:

- Pre-refrigeration and filtering:
    - Electric butterfly-valve;
    - Pre-refrigeration in gas/glycol exchanger;
    - Compressor's suction scrubber with filtering system.

- Biogas compression module:
    - Screw-type compressor;
    - Gas/oil separator.

- Drying system:
    - Glycol chiller;
    - Heater;
    - Humidity separator.

Electricity generation modules

At the 'core' of the PCT, three modules will generate electricity with nominal electricity generation capacity equivalent to 800 kW, each. Each module is composed of four 4 microturbines with nominal electricity generation capacity equivalent to 200 kW. In total, the nominal electricity generation capacity of to be installed under the project activity is 2.4 MW.

The microturbines employed in the project activity are manufactured by Capstone Turbine Corporation (United States). The characteristics of this technology include[2]:

- High electrical efficiency over a very wide operating range;
- Low maintenance air bearings require no lube oil or coolant;
- Ultra-low emissions;
- High availability;
- Proven technology.

The key mechanical components that make up the Capstone microturbine are shown in Figure 3.

[2] See the manufacture's webpage. http://www.microturbine.com

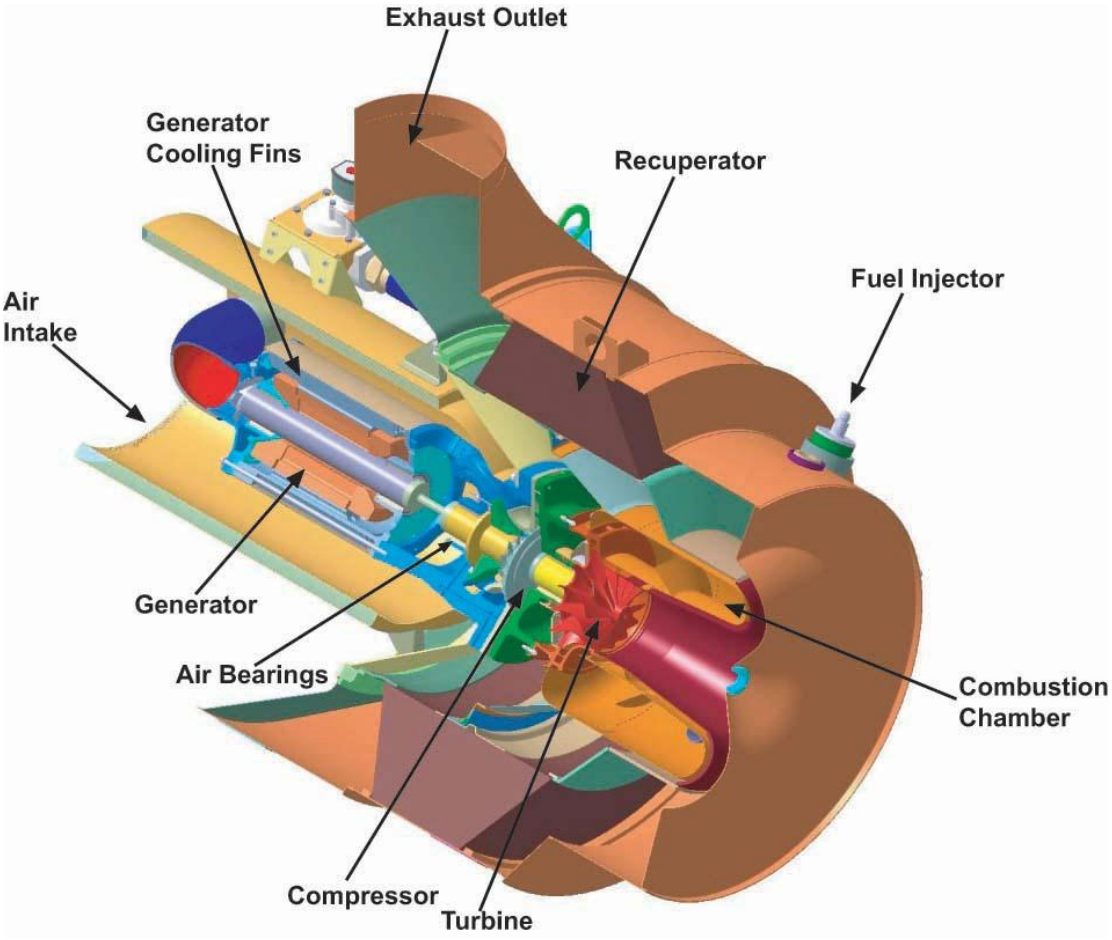

Figure 3. Typical Capstone Turbogenerator Construction (Source: http://www.microturbine.com).

In order to cinch the continuity of the supply of electricity, even during eventual oscillations in the quality of the biogas, the microturbines shall be able to operate in following operational conditions:

- Low methane concentration: down to 35%
- High H_2S concentration: up to 5,000 ppm

The control system and interconnection to the electric installations shall be individual to each of the generation module, increasing the availability of the electricity generation system since, even with the failure of one of the modules, the remaining units will be able to continue their operation.

Electricity transformation system

In order to allow the interconnection of the electricity generation module with the existing electric installations, an electricity transformation system will be implemented. This system will consist in installations and equipments destined to the receivership, measurement and transformation to 13.8 kV of the electricity generated at 440 V at 60 Hz. Three 1,000 kVA transformers will be installed.

Supervisory Control and Data Acquisition

All processes in the project activity will be controlled by the Supervisory Control and Data Acquisition (SCADA) system, which utilizes software and hardware resources in order to perform data collection and storage, local and remote control of operations, signalize abnormal situations and making available historical and real-time process' data. SCADA employs the 'Hot Standby' concept.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Table 2. Estimated amount of emission reductions over the chosen crediting period:

Years	Estimation of annual emission reductions in tonnes of CO_2e
2013(Including the last day of 2012)	3,561
2014	3,719
2015	3,889
2016	3,889
2017	3,889
2018	3,889
2019(excluding the last day of 2019)	3,889
Total estimated reductions (tonnes of CO_2e)	26,723
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period	3,818

A.4.4. Public funding of the small-scale project activity:

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The project will not receive any public funding from Parties included in Annex I.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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The project participant has NOT registered any other projects in the same project category and technology/measure within the previous 2 years within a 1km range from the current project activity's boundary. Therefore, according to the criteria established in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, the proposed project activity CANNOT be deemed to be a debundled component of another CDM project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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AMS.I-F. Renewable electricity generation for captive use and mini-grid. Version 02/EB 61. Sectoral Scope: 01.

This Project Design Document (PDD) also draws upon the following tool and methodology:

Title: Grid connected renewable electricity generation.

Ref.: AMS.I-D. Version 17/EB 61. Sectoral Scope: 01

Title: Tool to calculate the emission factor for an electricity system

Ref.: Version 2.2.1, EB 63

Title: Tool to calculate baseline, project and/or leakage emissions from electricity consumption

Ref.: Version 1, EB 39

B.2 Justification of the choice of the project category:

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The project activity consists in the implementation and operation of a PCT, which will be composed by a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step in ETE Arrudas. Prior to the project activity, the biogas was flared without any energetic use.

As previously mentioned, the PCT will generate renewable electricity, which will be entirely consumed within ETE Arrudas. Prior to the project activity the electricity utilized in ETE Arrudas was entirely sourced by SIN and no power generation equipment existed in ETE Arrudas.

The emissions reduction of the project activity will accrue from electricity generation for onsite consumption. The biogas used for electricity generation in this project activity would otherwise be flared without energetic use.

The installed capacity of the PCT will be 2.4 MW

Considering the facts above, as per Appendix B of the simplified modalities and procedures for small-scale project activities, the project activity falls under the type I project category. The project activity qualifies as a small-scale project activity since its capacity will not exceed 15 MW of installed electricity generation capacity and it will remain under the limits of small-scale project activity types during every year of the crediting period.

AMS.I-F/Version 02 was selected for the application into the present project activity. This selection was based on the analysis conducted in the table below.

Table 3. Analysis of the applicability conditions of AMS.I-F/Version 02

Applicability condition	Comment
1. This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to user(s). The project activity will displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit i.e., in the absence of the project activity, the users would have been supplied electricity from one or more sources listed below: (a) A national or a regional grid (grid hereafter); (a) Fossil fuel fired captive power plant; (b) A carbon intensive mini-grid.	The project activity consists in the implementation and operation of a small thermoelectric plant (PCT – *Pequena Central Termoelétrica*), which will generate renewable electricity by means of a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step in ETE Arrudas. The renewable electricity produced by the project activity will be consumed within ETE Arrudas' facilities, which would otherwise consume electricity from the National Interconnected System (*Sistema Interligado Nacional* - SIN). The installed capacity of the PCT will be 2.4 MW.
2. For the purpose of this methodology, a mini-grid is defined as small-scale power system with a total capacity not exceeding 15 MW (i.e., the sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW), which is not connected to a national or a regional grid.	Not pertinent to the project activity. The renewable electricity produced by the project activity will be consumed within ETE Arrudas' facilities, which would otherwise consume electricity from SIN.
3. Project activities or project activity components supplying electricity to a grid shall apply AMS-I.D. Project activities for standalone off-the-grid power systems supplying electricity to households/users included in the boundary are eligible under AMS-I.A.	As previously, mentioned, the renewable electricity produced by the project activity will be consumed within ETE Arrudas' facilities, which would otherwise consume electricity from SIN.
4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	Not pertinent to the project activity. The project activity does encompass hydropower technology/measures.
5. For biomass power plants, no other biomass other than renewable biomass are to be used in the project plant.	The project activity encompasses electricity generation from the biogas generated in the anaerobic stage of wastewater treatment in ETE Arrudas. Otherwise, the biogas would be flared without any energetic use. Hence, the biogas used in the project activity may be

	defined as a biomass residue. Moreover, the use of that biogas in the project activity does not involve a decrease of carbon pools. Hence, as per Annex 18, EB 23 for the definition of renewable biomass, the biogas used in the project activity may be deemed as renewable biomass.
6. This methodology is applicable for project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition, (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	There was no renewable energy power plant operating in ETE Arrudas prior to the implementation of the project activity (option (a)).
7. In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not pertinent to the project activity. The project activity installs a new power plant at a site where there was no renewable energy power plant operating prior to its implementation (Greenfield plant).
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Not pertinent to the project activity. The project activity installs a new power plant at a site where there was no renewable energy power plant operating prior to its implementation (Greenfield plant).
9. If the unit added has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel , the capacity of the entire unit shall not exceed the limit of 15 MW.	Not pertinent to the project activity. The PCT will be solely fired by biogas. Nonetheless, the installed capacity of the PCT will be 2.4 MW.
10. Combined heat and power (co-generation) systems are not eligible under this category.	The project activity does not encompass co-generation (heat exchangers not included in the project boundary).
11. In case electricity produced by the project activity is delivered to another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the electricity will have to be entered into specifying that only the facility generating the electricity can claim emission reductions from the electricity displaced.	Not pertinent to the project activity. As previously mentioned the renewable electricity produced by the project activity will be entirely consumed within ETE Arrudas' facilities, which would otherwise consume electricity from SIN.

B.3. Description of the project boundary:

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As per AMS.I-F/Version 02, "the spatial extent of the project boundary includes industrial (…) facilities consuming energy generated by the system. (…) The boundary also extends to the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to".

Considering the above, the boundary includes the facilities of ETE Arrudas, which will consume the electricity produced by the project plant (please refer to Figure 1). Moreover, the boundary includes the project plant, i.e. the site where the renewable electricity will take place[3], which is represented by Figure 4.

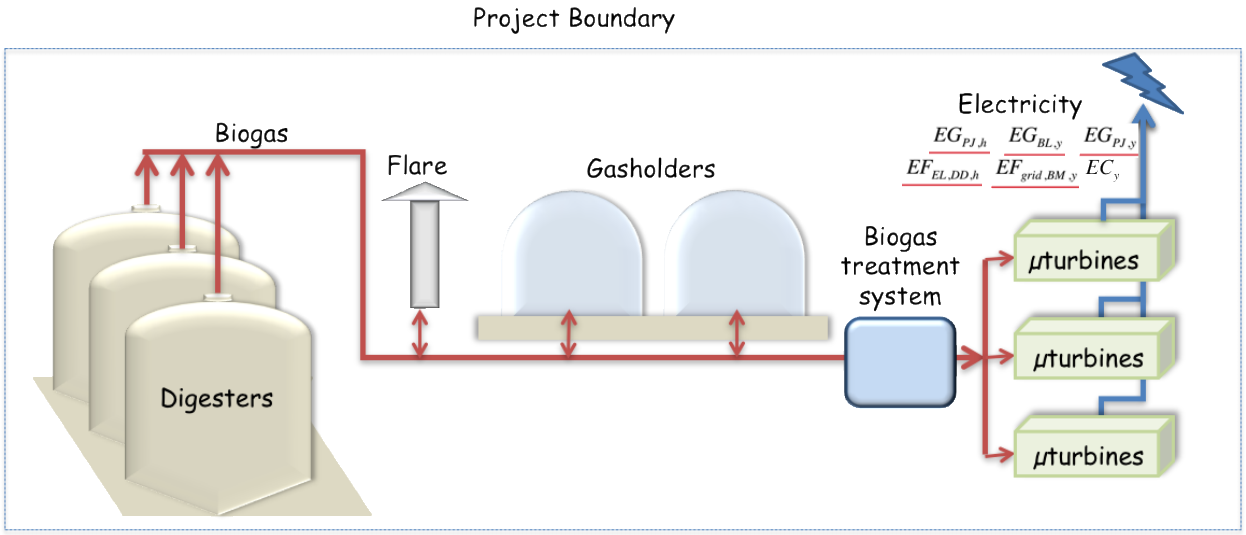

Figure 4. Equipment and processes included in the project boundary. The variables to be monitored for emissions reductions calculations are also depicted. $EG_{PJ,h}$, $EG_{BL,y}$, $EG_{PL,y}$ consist of the net electricity production by the project activity (total electricity production minus internal loads). $FE_{EL,DD,h}$ is theCO_2 emission factor for power units in the top of the dispatch order**.** $EF_{grid,BM,y}$ is the build margin CO_2 emission factor**.** EC_y is the yearly grid electricity consumption by the project activity (in account for the exceptional cases in which the project plant's internal loads exceed electricity generation).

The plants physically connected to SIN (i.e. the system from which the electricity consumption will be displaced by the project activity) are also included in the project boundary.

[3] Heat exchangers are not included in the project boundary.

Emission sources and gases included in the project boundary are depicted in the table below.

Table 4. Emissions sources included in the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.
Project	Power plants supplying energy to SIN (Grid electricity *consumption*)	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.

As per Resolution N°8 of the Brazilian DNA, the electric grid considered in this project activity is considered as a single system consisted by the sub-markets of SIN as the definition of the electric system of the project.

B.4. Description of baseline and its development:

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The project activity falls under Project Category Type I – Renewable Energy Projects (I.F Renewable electricity generation for captive use and mini-grid) and consists in the implementation and operation of a PCT, which will be composed by a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step in ETE Arrudas.

Prior to the project activity, the biogas was flared without any energetic use.

As previously mentioned, the PCT will generate renewable electricity, which will be entirely consumed within ETE Arrudas. Prior to he project activity the electricity utilized in ETE Arrudas was entirely sourced by SIN and no power generation equipment existed in ETE Arrudas.

The emissions reduction of the project activity will accrue from electricity production for onsite consumption. The biogas used for electricity generation in this project activity would otherwise be flared without energetic use.

As per AMS-I.F/Version 02, paragraph 14, "baseline emissions (…) are the product of amount of electricity produced by the renewable generating unit and an emission factor". Moreover, AMS-I.F/Version 02, paragraph 14, states "emission factor of a grid shall be calculated as per the procedures provided in AMS-I.D".

According to AMS-I.D/Version 17, paragraph 12 "the emission factor can be calculated in a conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the Emission Factor for an electricity system'.

OR

(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used".

Taking the guidance above into account, since the project plant displaces electricity that would otherwise be supplied by SIN, baseline emissions will be calculated as the product of the net electricity generation (total electricity generation minus parasitic loads) and SIN's combined margin (CM) emission factor.

Table 5 illustrates in a transparent manner all data and parameters used to determined the baseline emissions:

Table 5. Parameters used for the determination of Baseline emissions

Data / Parameter	Description	Value
BE_y	Baseline Emissions in year y (tCO_2e); "the baseline emissions is the product of electrical energy baseline $EG_{BL,y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor". (Average yearly value during first crediting period). Data source: Calculated.	3,818
$EG_{BL,y}$	Quantity of net electricity produced as a result of the CDM project activity in year y (MWh); Since the project consists in the installation of a new electricity generation facility, this parameter corresponds to the renewable electricity production by the project activity in the year "y". Data source: study elaborated by Instituto Bioterra (*Estudo de viabilidade técnica econômica de cogeração de energia na estação de tratamento de esgoto do Arrudas*)	12,334
$EF_{CO2,grid,y}$	CO_2 Emission Factor in year y (tCO_2e/MWh). Since the project plant displaces electricity that would otherwise be generated by plants connected to the National Interconnected System (SIN), $EF_{CO2,grid,y}$ will be calculated as the Combined margin CO_2 emission factor for power generation connected to SIN using the latest version of the "Tool to calculate the emission factor for an electricity system" (AMS.I-D/Version 17, paragraph 12, option (a)). For the purposes of ex ante estimations, the value corresponding to the average value for the year 2010, considering a constant hourly electricity production, was used (published by the Interministerial Commission for Climate Change–www.mct.gov.br/clima). Despite the fact that $EF_{CO2,grid,y}$ will be monitored *ex-post*, for the purposes of the *ex-ante*	0.3095

emission reduction calculations it has been assumed that this parameter would remain constant throughout the crediting period as a simplicity measure. This assumption is supported by data from the Operation Plan (2008) of the National Interconnected System elaborated by the National Electric System Operator (ONS). According to this plan, for the years 2008 – 2012, 45% of new electricity offers would come from renewable sources (42% from hydro resources and 3% from wind) and the remaining 55% would come from thermoelectric sources. These fairly symmetric capacity additions render a low impact in the grid emission factor.

Average operating margin (2010) (tCO_2/MWh)		Build margin (2010) (tCO_2/MWh)
Jan	0.2111	0.1404
Feb	0.2798	
Mar	0.2428	
Apr	0.2379	
May	0.3405	
Jun	0.4809	
Jul	0.4347	
Aug	0.6848	
Sep	0.7306	
Oct	0.7320	
Nov	0.7341	
Dec	0.6348	

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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The project activity consists in the implementation and operation of a PCT, which will be composed by a set of microturbines sourced by the biogas proceeding from the anaerobic wastewater treatment step in ETE Arrudas. Prior to the project activity, the biogas was flared without any energetic use.

As previously mentioned, the PCT will generate renewable electricity, which will be entirely consumed within ETE Arrudas. Prior to he project activity the electricity utilized in ETE Arrudas was entirely sourced by SIN and no power generation equipment existed in ETE Arrudas.

The emissions reduction of the project activity will accrue from electricity generation for onsite consumption. The biogas used for electricity generation in this project activity would otherwise be flared without energetic use.

The fact that the project activity without the CDM incentives would not have occurred anyway is demonstrated as per the **Attachment A to Appendix B of the simplified modalities and procedures for**

small-scale CDM project activities. Moreover, the steps and provisions outlined in the '*Non-binding best practice examples to demonstrate additionality for SSC project activities*' (EB 35) are followed.

The barrier due to which the project activity would not have occurred anyway is discussed below:

Barrier due to prevailing practice

The corollary of the fact that all municipal wastewater treatment facilities in Minas Gerais are operated by Copasa, considered along with the statement that Copasa has no previous experience in the operation of electricity generation systems, is the project activity being the first biogas-sourced electricity generation system in municipal wastewater treatment facilities in the state. Corroborating to that conclusion, one may mention the written statement of the Research and Development Director of the Environmental Foundation of the Minas Gerais State (*Fundação Estadual do Meio Ambiente* - FEAM), declaring that the project activity is the first of its kind in Minas Gerais State according to the Environmental Data Integrated System (*Sistema Integrado de Informações Ambientais* - SIAM) of the Environmental and Sustainable Development Secretariat of Minas Gerais State (*Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável* - SEMAD).

Furthermore, in Brazil only two such operating entrepreneurships could be identified amongst the *operating* thermoelectric plants listed by the National Electric Energy Agency (*Agência Nacional de Energia Elétrica* - ANEEL)[4]. Moreover, *no* such other entrepreneurships could be identified amongst the thermoelectric plants *under construction* listed by ANEEL[4].

The two biogas-sourced electricity generation systems in municipal wastewater treatment facilities operating in Brazil are ETE Ouro Verde[5] and Energ-Biog[6], owned and operated by the Sanitation Company of Paraná (*Companhia de Saneamento do Paraná* – SANEPAR) (Paraná State) and by the *Biomass Users Network do Brasil* (São Paulo State), respectively. Regarding these plants, a few facts should be noted. Firstly, besides the fact that the installed electricity generation capacity installed in Energ-Biog is 30 kW (capacity to be installed in ETE Arrudas: 2.4 MW), this unit is a pilot plant, aiming at the testing of two distinct technologies for the generation of electricity from the biogas generated in wastewater facilities (Otto-cycle engines and microturbines)[7]. Similarly, employing Otto-cycle engines, the installed electricity generation capacity at ETE Ouro Verde is 20 kW. Considering the arguments

[4] Generation Database (*Banco de Informações de Geração* – BIG). Available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp. Accession date: 23/07/2009.

[5] Summary of the entrepreneurship "ETE Ouro Verde" (Empreendimento de nome "ETE Ouro Verde"). Available at: http://www.aneel.gov.br/aplicacoes/Empreendimento/ResumoUsina.asp?lbxUsina=29968:ETE%20Ouro%20Verde. Accession date: 23/07/2009.

[6] Summary of the entrepreneurship "Energ-Biog" (*Resumo do Empreendimento de nome "Energ-Biog"*). Available at:

http://www.aneel.gov.br/aplicacoes/Empreendimento/ResumoUsina.asp?lbxUsina=28686:Energ-Biog. Accession date: 23/07/2009.

[7] Biomass National Reference Center (*Centro Nacional de Referência em Biomassa* - CENBIO). Installation and testing of a unit for the demonstration of electricity generation from biogas proceeding from wastewater treatment. (*Instalação e Testes de uma Unidade de Demonstração de Geração de Energia Elétrica a partir de Biogás de Tratamento de Esgoto*). Available at: http://cenbio.iee.usp.br/projetos/energ_biog/energ_biog.htm. Accession date: 23/07/2009.

above, it can be stated that the present project activity is the *first of its kind*, in terms of technology, geography and sector.

Summary of national policies and circumstances relevant to the baseline of the proposed project activity

The Decennial Plan of Electricity Expansion 2008/2017 (*Plano Decenal de Expansão de Energia*)[8], highlights that there is an expressive potential for the generation of electricity from biomass. Yet, the Atlas of Electric Energy of Brazil (*Atlas de Energia Elétrica do Brasil*)[9] defines biomass-driven electricity as one of the main alternatives for the diversification of the Brazilian energetic matrix and its consequent reduction of the dependence upon fossil fuels. Both documents recognize the potential for GHG emissions reductions by the utilization of this energetic potential. Moreover, the Atlas points that biogas-based electricity generation is one of the most favorable to the environment, since its application allows the mitigation of CH_4 emissions and of soil and underground water contamination, due to the fact that biogas is usually derived from solid waste (urban, industrial and agro-industrial) wastewater. Nonetheless, both documents state that the most preponderant source of the so-called 'bio-electricity' is derived from the residues of the sugar industry, whereas biogas-based electricity corresponds only to a minute share of the biomass-based electricity. Moreover, biogas-based electricity is almost entirely sourced by landfill gas.

Contrastingly, despite pointing the "expressive potential for the generation of electricity from biomass", the Decennial Plan (See volume 1, item 3.4.2, graph 11) foresees that the growth in thermoelectricity during the 2008-2017 period will be mainly based on fossil fuel-fired sources (e.g. fuel oil and natural plants), whereas biomass-based sources will have limited participation in the foreseen growth.

With the objective of increasing the participation of electricity produced from wind and biomass sources and from small hydroelectric plants (*Pequenas Centrais Hidroelétricas* - PCHs) in the National Interconnected System (SIN), the Program of Incentive to Alternative Sources of Electric Energy (*Programa de Incentivo às Fontes Alternativas de Energia Elétrica* - PROINFA[10]) was launched.

PROINFA is based on feed in tariffs. When launched in 2002, it was designed to have 2 phases. The first phase initially set a quota of 3.3 GW of new generation capacity equally distributed among wind, biomass and small hydro. After the program was launched, part of the quota of biomass was transferred to wind projects. Projects developed under PROINFA have a 20-year Power Purchase Agreement signed with the state-owned electricity utility Eletrobrás with prices much higher than the market price. Besides, there is a guarantee of 70% of the contractual revenues during the period of the financing contract of the entrepreneurship.

The program foresees the implementation of 144 plants, totaling 3,299.40 MW of installed capacity, being 1,191.24 MW from 63 PCHs, 1,422.92 MW from 54 wind plants and 685.24 MW from 27 biomass

[8] Brasil, Ministério de Minas e Energia, Empresa de Pesquisa Energética. Plano Decenal de Expansão de Energia 2008/2017 / Ministério de Minas e Energia. Empresa de Pesquisa Energética. Rio de Janeiro: EPE, 2009. Available at: http://www.epe.gov.br/PDEE/Forms/EPEEstudo.aspx. Accession date: 21/05/2010.

[9] Brasil, Agência Nacional de Energia Elétrica. Atlas de energia elétrica do Brasil / Agência Nacional de Energia Elétrica. ed. – Brasília : Aneel, 2008. Available at: http://www.aneel.gov.br/biblioteca/EdicaoLivros2009atlas.cfm. Accession date: 21/05/2010.

[10] Programa de Incentivo às Fontes Alternativas de Energia Elétrica . Available at: http://www.mme.gov.br/programas/proinfa. Accession date: 21/05/2010.

plants. It is estimated that till the end of 2010, 68 (1,591.77 MW) entrepreneurships will start operation, being 23 PCHs (414.30MW), 2 biomass plants (66.50MW) and 43 wind plants (1,110.97MW).

Besides PROINFA, another incentive mechanism for biomass-based electricity generation is the Reserve Energy Auction (*Leilão de Energia de Reserva* - LER)[8], which is organized for the purchase of electricity from wind and biomass sources and PCHs. Biomass plants under LER and PROINFA mainly consist in sugar cane bagasse-fired plants. Limited examples include landfill gas-fired plants, being wastewater treatment biogas-fired completely absent from the list of those bestowed with the incentives from LER and PROINFA. Hence, despite significant governmental incentives entrepreneurships such as the present project activity are not observed in Brazil.

Demonstration and assessment of prior consideration of the CDM

Prior consideration of the CDM by the project activity has been demonstrated according to guidance provided in Annex 13 of EB62 ("Guidance on the demonstration and assessment of prior consideration of the CDM", Version 4). Project participants have informed the Brazilian DNA and the UNFCCC secretariat of the commencement of the project activity and of their intention in seeking the CDM status. Such notification was made within six months of the project activity and contained a brief description of the project activity and the precise geographical location of the project plant. Documental evidences of these notifications have been made available to DOE during validation.

The project activity implementation timeline, including events and actions, which have been taken to achieve CDM registration, with description of the evidence used to support these actions is depicted below:

Table 6. Project activity timeline

Date	Event	Documental Evidence
31/01/2009	End of the public tender pertaining to design and implementation of improvements in ETE Arrudas including the construction of the PCT. Deemed as the starting date of the project activity (Refer to section C.1.1).	Publication of the final result of the public tender at the Official Journal of the Government of the State of Minas Gerais (*Imprensa Oficial do Governo do Estado de Minas Gerais* - IOF). Available at: http://pesquisa.iof.mg.gov.br/pesquisa/abrehtmlNew.asp?url=/iodiario/exec/31012009/1.asp&busca=1020080410&exata=True - ancor1 (Reference: DVLI. 1020080410)
05/05/2009	End of the public tender pertaining to CDM consultancy services regarding the implementation of the PCT at ETE Arrudas.	Publication of the final result of the public tender at the Official Journal of the Government of the State of Minas Gerais (*Imprensa Oficial do Governo do Estado de Minas Gerais* - IOF). Available at: http://pesquisa.iof.mg.gov.br/pesquisa/abrehtmlNew.asp?url=/iodiario/exec/05052009/1.a

		sp&busca=munduscarbo&exata=True#ancor1(Reference: DVLI. 0820090086)
13/05/2009	Communication of the project starting date to UNFCCC and Brazilian DNA	Letters of communication and confirmations of receipt.
19/06/2009	Start of the physical implementation of the PCT.	Job order #4600028401, pertaining to, *inter alia*, the implementation of the PCT.
15/12/2010	Start of the operation of the PCT	

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Baseline emissions

As per AMS-I.F/Version 02, paragraph 14:

(1) $BE_y = EG_{BL,y} \cdot EF_{CO2,grid,y}$

Where:

BE_y = Baseline Emissions in year y (tCO_2e);

$EG_{BL,y}$ = Quantity of net electricity produced as a result of the CDM project activity in year y (MWh);

$EF_{CO2,grid,y}$ = CO_2 Emission Factor in year y (tCO_2e/MWh).

Moreover, AMS-I.F/Version 02, paragraph 14, states "emission factor of a grid shall be calculated as per the procedures provided in AMS-I.D". Hence, $EF_{CO2,grid,y}$ will be calculated as the Combined Margin CO_2 emission factor for power generation connected to SIN using the latest version of the "Tool to calculate the emission factor for an electricity system" (AMS.I-D/Version 17, paragraph 12, option (a)). The following formulae apply:

(2) $EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$

Where:

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year y (tCO_2/MWh);

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh);

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh);

w_{OM} = Weighting of operating margin emissions factor (50%);

w_{BM} = Weighting of build margin emissions factor (50%).

The Brazilian DNA has published the delineation of SIN to be adopted for the purposes of CDM projects. As per Resolution N°8 of the Brazilian DNA, the electric grid considered in this project activity is considered as a single system consisted by the sub-markets of SIN as the definition of the electric system of the project. Off-grid plants will not be included in the calculation of $EF_{CO2,grid,y}$.

The weighting factors for build and operating margin were selected according to guidance provided in the "Tool to calculate the emission factor for an electricity system".

$EF_{grid,OM,y}$ will be calculated according to the *dispatch data analysis*. As per this method OM emission factor is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is producing electricity, as follows:

$$(3) \qquad EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	= Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh);
$EG_{PJ,h}$	= Electricity generation by the project activity in hour h of year y (MWh);
$EF_{EL,DD,h}$	= CO_2 emission factor for grid power units in the top of the dispatch order in hour h in year y (tCO_2/MWh);
$EG_{PJ,y}$	= Total generated by the project activity in year y (MWh);
h	= Hours in year y in which the project activity is generating electricity.

For the first crediting period, the build margin emission factor will 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.

The parameters $EF_{EL,DD,h}$ and $EF_{grid,BM,y}$ are calculated and published by the Inter-ministerial Commission for Global Climate Change, the Brazilian Designated National Authority, according to the most recent version of the "Tool to calculate the emission factor for an electricity system". By using these published values and the hourly electricity generatingit will be possible to calculate the associated baseline emissions.

Project emissions

In exceptional cases, the project's electricity production can be lower than the internal loads (parasitic loads). This would imply in electricity consumption from the grid, which will result in project CO_2 emissions. Hence, for accounting such project emissions the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) will be used.

The situation described above corresponds to scenario A of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

The approach provided by the tool applicable to scenario A is the "Generic approach": project emissions from electricity consumption are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$(4) \qquad PE_{EC,y} = EC_{PJ,y} \cdot EF_{EL,y} \cdot (1 + TDL_y)$$

Where:

$PE_{EC,y}$ = Project emissions from grid electricity consumption in year y (tCO_2);

$EC_{PJ,y}$ = Quantity of grid electricity consumed by the project activity in year y (MWh);

$EF_{EL,y}$ = Emission factor for grid electricity generation in year y (tCO_2/MWh);

TDL_y = Average technical transmission and distribution losses for providing grid electricity in year y.

$EF_{EL,y}$ is equivalent to $EF_{CO2,grid,y}$, which will be calculated as the Combined Margin CO_2 emission factor for power generation connected to SIN using the latest version of the "Tool to calculate the emission factor for an electricity system" (AMS.I-D/Version 17, paragraph 12, option (a)), as explained above.

The appropriate TDL_y default value was selected accordingly the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption":

"In case of (…) scenario A (…), use as default values of 20% for project or leakage electricity consumption sources".

Leakage emissions

According to AMS.I-F/Version 02, leakage (LE_y) is not expected in this project activity, since the electricity generating equipment will not be transferred from another activity.

Emission reductions

Emission reductions will be calculated as follows:

(5) $ER_y = BE_y – PE_y – LE_y$

Where:

ER_y = Emission reductions in year y (tCO_2e);

BE_y = Baseline Emissions in year y (tCO_2e);

PE_y Project emissions in year y (tCO_2e);

LE_y = Leakage emissions in year y (tCO_2e).

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

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Data / Parameter:	w_{OM}
Data unit:	%
Description:	Weighting of operating margin emissions factor
Source of data used:	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1).
Value applied:	50
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value was selected because the project activity does not consist on wind or solar energy generation.
Any comment:	The value to be adopted in the second and third crediting period for this parameter is 25%, unless other default value is specified in the most recent version of the "Tool to calculate the emission factor for an electricity system"

Data / Parameter:	w_{BM}
Data unit:	%
Description:	Weighting of build margin emissions factor
Source of data used:	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1).
Value applied:	50
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value was selected because the project activity does not consist on wind or solar energy generation.
Any comment:	The value to be adopted in the second and third crediting period for this parameter is 75%, unless other default value is specified in the most recent version of the "Tool to calculate the emission factor for an electricity system"

Data / Parameter:	TDL_y
Data unit:	%
Description:	Average technical transmission and distribution losses for providing grid electricity in year y
Source of data used:	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01/EB39).
Value applied:	20
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the applicable default value for project electricity consumption sources.
Any comment:	-

Data / Parameter:	$\eta_{m,y}$

Data unit:	Ratio
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data used:	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1)
Value applied:	

Generation Technology	Old units (before and in 2000)	New units (after 2000)
Coal	-	-
Subcritical	37%	39%
Supercritical	-	45%
Ultra-upercritical	-	50%
IGCC	-	50%
FBS	35.5%	-
CFBS	36.5%	40%
PFBS	-	41.5%
Oil	-	-
Steam turbine	37.5%	39%
Open cycle	30%	39.5%
Combined cycle	46%	46%
Naural gas	-	-
Steam turbine	37.5%	37.5%
Open cycle	30%	39.5%
Combined cycle	46%	60%

Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value.
Any comment:	This parameter may used for the calculation of $EF_{EL,DD,h}$ and $EF_{grid,BM,y}$. As previously stated $EF_{EL,DD,h}$ and $EF_{grid,BM,y}$ are calculated and published by the Brazilian DNA. Hence, depending of the DNA's option of calculation $\eta_{m,y}$ may or may not be used. Future updates in $\eta_{m,y}$ default values will be taken into account.

B.6.3 Ex-ante calculation of emission reductions:

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Emission reductions were *ex-ante* estimated as follows:

(1) $BE_y = EG_{BL,y} \cdot EF_{CO2,grid,y}$

Where:

BE_y = Baseline emission in the year "y" (tCO_2e);

$EG_{BL,y}$ = Quantity of net electricity produced as a result of the CDM project activity in year y (MWh);

$EF_{CO2,grid,y}$ = Emission factor for National Interconnected System (SIN) in year y (0.3095 tCO_2/MWh). The value corresponding to the average value for the year 2010, considering a constant hourly electricity production, was used (published by the Inter-Ministerial Commission for Climate Change).

Despite the fact that $EF_{CO2,grid,y}$ will be monitored *ex-post*, for the purposes of the *ex-ante* emission reduction calculations it has been assumed that this parameter would remain constant throughout the crediting period as a simplicity measure. This assumption is supported by data from the Operation Plan (2009) of the National Electric System from National Electric System Operator (ONS). According to this plan, for the years 2008 – 2012, 45% of new electricity offers would come from renewable sources (42%

from hydro resources and 3% from wind) and the remaining 55% would come from thermoelectric sources. These fairly symmetric capacity additions render a low impact in the grid emission factor.

Since, no fossil-fuel consuming equipments will be used by the project activity, since the electricity to be used in the project activity will be self-sourced, and since other significant emissions associated with the project activity cannot be identified, it is expected that project activity emissions will be null for this project activity.

For the purpose of *ex-ante* calculations, project emission ($PE_{EC,y}$) will be considered zero, since it is expected that electricity generation will be higher than the parasitic loads at any time in the project activity.
According to AMS.I-F/Version 02, leakage (LE_y) is not expected in this project activity, since the electricity generating equipment will not be transferred from another activity.

Emission reductions will be calculated as follows:

(2) $ER_y = BE_y - PE_y - LE_y$

Where:
ER_y = Emission reductions in year y (tCO_2e);

BE_y = Baseline Emissions in year y (tCO_2e);

PE_y Project emissions in year y (tCO_2e);

LE_y = Leakage emissions in year y (tCO_2e).

See detailed ex-ante calculation in the annex spreadsheet “ex_ante_calculation_COPASA.xls”.

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

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Table 7. Summary of the ex-ante estimation of emission reductions

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2013(including 31/12/2012)	-	3,561	-	3,561
2014	-	3,719	-	3,719
2015	-	3,889	-	3,889
2016	-	3,889	-	3,889
2017	-	3,889	-	3,889
2018	-	3,889	-	3,889
2019(excluding 31/12/2019)	-	3,889	-	3,889
Total (tonnes of CO_2e)	-	26,723	-	26,723

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

B.7.1 Data and parameters monitored:

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Parameter:	$EG_{PJ,h}$
Unit:	MWh
Description:	Electricity generation by the project activity in hour h of year y
Source of data:	Project participants
Value of data	1.41
Brief description of measurement methods and procedures to be applied:	This parameter will be continuously analyzed. Hourly integration and monthly recording. Consists of the net electricity production by the project activity (total electricity production minus internal loads). A single meter (ION 7300 - Power Measurement, or similar) will measure the total electricity generation, after transformation. Internal loads will be measured by a second meter (ION 7300 - Power Measurement, or similar), which will determine the electricity consumption of the equipments included in the project boundary.
QA/QC procedures to be applied (if any):	Meters will be calibrated as per manufacture's recommendations. Total electricity generation and project electricity consumption will automatically monitored and stored by SCADA.
Any comment:	---

Parameter:	$EG_{BL,y}$ and $EG_{PJ,y}$
Unit:	MWh
Description:	Total electricity displaced by the project activity in year y
Source of data:	Project participants
Value of data	12,334
Brief description of	This parameter will be continuously analyzed. Hourly integration and monthly

measurement methods and procedures to be applied:	recording. Consists of the net electricity production by the project activity (total electricity production minus internal loads). A single meter will measure the total electricity generation, after transformation. Internal loads will be measured by a second meter, which will determine the electricity consumption of the equipment included in the project boundary. Consists in the yearly consolidation of $EG_{PJ,h}$.
QA/QC procedures to be applied (if any):	Meters will be calibrated as per manufacture's recommendations. Total electricity generation and project electricity consumption will automatically monitored and stored by SCADA.
Any comment:	---

Parameter:	$EF_{EL,DD,h}$
Unit:	tCO_2/MWh
Description:	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y
Source of data:	Interministerial Commission on Global Climate Change
Value of data	(0.4787 tCO_2e/MWh) as published by the Interministerial Commission on Global Climate Change (Brazilian DNA) for the year 2010. Average, considering constant hourly dispatch.
Brief description of measurement methods and procedures to be applied:	Hourly values will be used. As per the most recent version of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures to be applied (if any):	As per the most recent version of the "Tool to calculate the emission factor for an electricity system".
Any comment:	--

Parameter:	$EF_{grid,BM,y}$
Unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor in year y
Source of data:	Interministerial Commission on Global Climate Change
Value of data	(0.1404 tCO_2e/MWh) as published by the Brazilian Interministerial Commission on Global Climate Change (Brazilian DNA) for the year 2010
Brief description of measurement methods and procedures to be applied:	As per the most recent version of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures to be applied (if any):	As per the most recent version of the "Tool to calculate the emission factor for an electricity system".
Any comment:	For the first crediting period, the build margin emission factor will 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.

Parameter:	$EC_{PJ,y}$
Unit:	MWh

Description:	Quantity of grid electricity consumed by the project activity in year y
Source of data:	Project participants
Value of data	0.00
Brief description of measurement methods and procedures to be applied:	This parameter will be continuously analyzed. Hourly integration and monthly recording. Consists of the grid electricity consumed by the project activity in points of time when the project's electricity production is lower than the parasitic loads (internal loads minus total electricity production). A single meter (ION 7300 - Power Measurement, or similar) will measure the total electricity generation, after transformation. Internal loads will be measured by a second meter (ION 7300 - Power Measurement, or similar), which will determine the electricity consumption of the equipment included in the project boundary.
QA/QC procedures to be applied (if any):	Should be crosschecked with the electricity purchase records. Meters will be calibrated as per manufacture's recommendations. Project electricity consumption will automatically monitored and stored by SCADA.
Any comment:	---

Parameter:	-
Unit:	Nm^3
Description:	Quantity of biomass (biogas) consumed in year y
Source of data:	Project participants
Value of data	9,315,889
Brief description of measurement methods and procedures to be applied:	To be measured continuously or estimated using annual mass/energy balance. Adjust for the moisture content in order to determine the quantity of dry biomass.
QA/QC procedures to be applied (if any):	---
Any comment:	---

B.7.2 Description of the monitoring plan:

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Monitoring consists of metering the net electricity generated by the project activity. Net electricity generation will be determined as the total electricity generation minus internal loads. Total electricity generation and project electricity consumption will automatically monitored and stored by SCADA (further discussed below.)

The monitoring plan also includes parameters CO_2 emission factor for power units in the top of the dispatch order and Build margin CO_2 emission factor. These parameters will be obtained from the Interministerial Commission for Climate Change, which calculates and publishes the parameters $EF_{EL,DD,h}$ and $EF_{grid,BM,y}$, according to the "Tool to calculate the emission factor for an electricity system". These published parameters will be used for $EF_{grid,CM,y}$ calculation.

Metering of the Net Electricity Production

Net electricity generation will be determined as the total electricity generation minus internal loads. The measurement of the total production of electricity will be performed by means of a meter connected to the secondary of the current and tension transformers of the measurement cubicle. Internal loads will be

determined by second meter, which will determine the electricity consumption of the equipments included in the project boundary.

The electricity meters should meet relevant local standards at the time of installation. The meter shall comply, *inter alia*, with Brazilian standards the following Brazilian standards:

- NBR 14519 – (Static) Electronic Electricity Meters – Specification

Grid emission factor

The Interministerial Commission for Climate Change calculates and publishes the $EF_{EL,DD,h}$ and $EF_{grid,BM,y}$, according to the "Tool to calculate the emission factor for an electricity system". These published parameters will be used for $EF_{grid,CM,y}$ calculation.

Quality Control and Quality Assurance

Quality control and quality assurance procedures will guarantee the quality of data collected.

All processes in the project activity will be controlled by the Supervisory Control and Data Acquisition (SCADA) system, which utilizes software and hardware resources in order to perform data collection and storage, local and remote control of operations, signalize abnormal situations and making available historical and real-time process' data. SCADA employs the 'Hot Standby' concept[11].

Monitored data will be kept for at least 2 years after the end of the crediting period in electronic and paper media. Besides, the electricity purchase invoices and documentation pertaining to the type, model, maintenance and calibration of the meters employed in the project activity will likewise be kept in electronic and paper media for at least 2 years after the end of the crediting period.

Meters will undergo maintenance procedures according to manufactures' specification. Yet, meters' re-calibration procedures will be performed according to the manufacturer's instructions or, at least, every three years. For the monitoring of the electricity generation by the project activity and its internal loads, two ION7300 meters (or similar) will be used. The accuracy specifications of ION7300 comply with IEC 687 Class 0.5 specification and ANSI 12.20 Class 0.5 at 25 ℃ (77 ℉) (0.5% accuracy in readings).

A complete set of procedures and an Operations and Maintenance Plan will be implemented to ensure accurate measurement electricity produced and proper operation of the energy generation unit. The Operation and Maintenance Plan will be compiled during the assisted operation (see below) of the project plant. The plan will be available for inspection on site during project verification. The O&M Manual will be provided (work instructions) to individuals that collect and/or process data. At the project site a trained operator will ensure the appropriate operation of the project. An external staff, which will be responsible for the PCT's pre-operation and operation, will be contracted for *at least* one year. During this period ETE Arrudas's staff will acquire new skills and know-how for the proper operation of the PCT.

The roles and responsibilities within the structure outlined in Figure 5 are described in detail in the paragraphs below.

[11] **Hot Standby**: A method of redundancy in which the primary and secondary (i.e., backup) systems run simultaneously. The data is mirrored to the secondary server in real time so that both systems contain identical information.

DVGE's (*Divisão de Co-geração e Auto-produção de Energia* – Division of cogeneration and energy self-production) staff: Responsible for data backup, for emission reductions calculations, for the compilation of monitoring reports and for the general management of the project activity.

ETE Arrudas managing team: Responsible for the record keeping of the information collected by the PCT's operational staff, and of the electricity purchase invoices and documentation pertaining to the type, model, maintenance and calibration of the meters employed in the project activity. ETE Arrudas' managing staff will report to DVGE's (*Divisão de Co-geração e Auto-produção de Energia* – Division of Co-generation and energy self-production) staff.

PCT's operational team**:** Responsible for the operation of the plants and acquisition of the raw data (net electricity generation) to be monitored under the project activity. The operational staff will report to ETE Arrudas' managing staff.

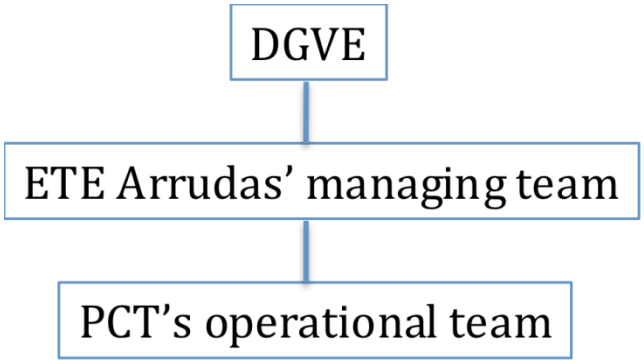

Figure 5. Project activity's managing structure

The energy generating equipment will not be transferred from another activity; therefore, leakage effects do not need to be accounted for.

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

>>

Date of completion of the application of the baseline and monitoring methodology: 27/05/2011.

Responsible person:	Breno Rates (Not a project participant)
Responsible entity:	WayCarbon Soluções Ambientais e Projetos de Carbono LTDA. (Not a project participant)
Contact info.:	Av. Paulista, 37 - 10 ºandar | 01311-000 Bela Vista | São Paulo | SP | +55.11.3372.9595. brates@waycarbon.com

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

31/01/2009.

Copasa is a mixed-capital company[12]. In that sense, as of December 31st 2010, the Government of the State of Minas Gerais held 53.07% of the capital stocks of the company[13]. Due to this fact, Copasa is subjected to the Law #8,666 of June 21st of 1993[14], which *inter alia* establishes norms for tenders and contracts of the Public Administration regarding civil works, services, purchases, ownership transfers and rentals.

As per 8,666's 2nd article, "construction works (and) services (…) of the Public Administration, when commissioned to third parties, are necessarily preceded by tender (…)". Moreover, 8,666's 61th article establishes: "The publication of the summary of the instrument of contract (…) in the official press, which is indispensable condition for its efficacy, shall be arranged by the Administration (…)".

In this context, and considering the definitions of CDM, the starting date of the project activity consists of the date of the publication at the Official Journal of the Government of the State of Minas Gerais (*Imprensa Oficial do Governo do Estado de Minas Gerais* - IOF) of the summary of the instrument of contract pertaining to the design and implementation of the improvements in ETE Arrudas, including the construction of the PCT[15].

[12] *Estatuto social* (Corporate by-laws) – *Companhia de Saneamento de Minas Gerais COPASA MG.* http://www.mzweb.com.br/copasa/web/arquivos/Copasa_Estatuto_Social_28032011_port.pdf. Accession date: 05/04/2011.

[13] COPASA MG. Investor Relations/Corporate Governance/Ownership Breakdown. http://www.copasa.com.br/ir/. Accession date: 05/04/2011.

[14] LEI N º8.666, DE 21 DE JUNHO DE 1993. http://www.planalto.gov.br/ccivil_03/Leis/L8666cons.htm. Accession date: 05/04/2011.

[15] Publication of the final result of the public tender at the Official Journal of the Government of the State of Minas Gerais (*Imprensa Oficial do Governo do Estado de Minas Gerais* - IOF). Available at:

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

>>
20 (twenty) years and 0 (zero) months.

[Refers to the useful life of Captone Microturbines ("20+ years provided all maintenance has been performed according the Capstone Turbine Maintenance Schedules"), as indicated in a letter issued by Captone Turbine Corporation, which was provided to DOE during validation]

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

C.2.1. Renewable crediting period

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

>>
31/12/2012

C.2.1.2. Length of the first crediting period:

>>
7 (seven) years and 0 (zero) months.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not applicable.

C.2.2.2. Length:

>>
Not applicable.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
Environmental Licensing is the major tool to implement environmental policies in Brazil. The main objective is to standardize environmental impacts assessments and to establish control plans for polluting enterprises. The National Council for the Environment (CONAMA) Normative Deliberations numbers 01/1990 and 237/1997 state that environmental impact assessments must be undertaken before the installation of new entrepreneurships or before the expansion/modification of existing activities. The construction and operation of these entrepreneurships are not allowed until the issuance of environmental permits. According to Federal Regulation 9.433/1997, article 52nd, the state-level or municipal-level

http://pesquisa.iof.mg.gov.br/pesquisa/abrehtmlNew.asp?url=/iodiario/exec/31012009/1.asp&busca=1020080410&exata=True - ancor1. (Reference: DVLI. 1020080410)

environmental agencies are the authority in charge to issue Environmental Permits within each Federative Unit (States or Municipalities), or by the Federal environment agency (IBAMA) depending on the scope, scale and boundaries of the activity. For the proposed project activity, which encompasses the installation of a new small thermoelectric plant within the metropolitan region of Belo Horizonte, on the border limits of Belo Horizonte and Sabará Municipalities, licensing procedures were carried under the State-level agency.

In Minas Gerais State, the Secretary of Environment and Sustainable Development (SEMAD) is the entity responsible inside the government, through its agencies FEAM (State Environmental Foundation), IGAM (State Water Institute) and IEF (State Forestry Institute), to carry out the technical assessments and to issue environmental permits (through the Environmental Policy Committee – COPAM) for new or existing entrepreneurships. Depending on the scale of the entrepreneurship, a comprehensive Environmental Impact Assessment (EIA) and a correspondent Environmental Impact Report – Action Plan (RIMA) are required if the activity is considered as large scale. For small- and medium-scale enterprises, a directed Environmental Assessment Report (RCA) and a correspondent Environmental Control Plan (PCA) suffice to meet legal requirements.

COPASA-MG has an Operation Permit issued by COPAM to treat domestic wastewater at ETE Arrudas. For the installation of the new small thermoelectric power plant, another environmental permit had to be requested. Following legal regulations, COPASA-MG requested the power plant construction permit through the document FCEI R240481/2009. At that occasion, the small thermoelectric power plant was classified under Class 3 by COPAM's Normative Deliberation n.° 74/2004, which corresponds to a small-scale enterprise (less than 10 MW installed capacity) with high potential to cause environmental impacts (due to thermoelectric power generation). In face of that, COPASA-MG was requested, through the document FOBI 332892/2009 dated of 09th July 2009, to present the following documents in order to evaluate the project's impacts and compliance to other legal requirements:

a) Documentation on the Environmental License Request (original signed forms)

b) Authorization from the National Agency for Electric Energy (ANEEL) to explore and build a power plant;

c) Geographic coordinates of the project activity;

d) Statement from Sabará Municipality with regards to compliance with local regulations;

e) Invoice of payment of licensing procedures fees;

f) Environmental Assessment Report (RCA);

g) Environmental Control Plan (PCA); and

h) Published communication, through relevant local or regional newspaper, of the License request.

The documents above were presented to COPAM, and at April 5th 2010,the preliminary and installation license (Reference: LP + LI N° 057 SUPRAM CM) was issued, thus, granting COPASA the permission to implement the project activity.

Afterwards, at October 26th 2010, the operating license (Reference: LO n° 250 – SUPRAM CM) was issued, thus, granting COPASA the permission to operate the project activity.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

Not applicable.

SECTION E. Stakeholders' comments

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

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Stakeholders' comments were invited following the Designated National Authority procedures for such purpose, defined by Resolution number 07 of the Interministerial Comission for Global Climate Change (*Comissão Interministerial de Mudança Global do Clima* - CIMGC), of March 5th 2008.

Accordingly, the relevant stakeholders were mapped and invited by letter to visit a website (http://www.munduscarbo.com/projetos.htm) in order to access the project documentation, which includes the SSC-CDM-PDD and a correspondent version in Portuguese. This documentation will be accessible via the above-mentioned electronic address throughout the registration period.

Invitation letters were sent in September 8th 2009, and were received within September 09th to September 11th 2009.

The following stakeholders received letters communicating the CDM project activity:

- Mayor of Sabará Municipality;
- Sabará's Municipal Secretary of Environment;
- President of Sabará's Municipal Legislative Chamber;
- Brazilian Forum of NGOs and Social Movements for the Environment;
- Environmental Secretariat of the Minas Gerais State (*Secretaria Estadual de Meio Ambiente*);
- Environmental Foundation of the Minas Gerais State (*Fundação Estadual do Meio Ambiente* - FEAM);
- Water Management Institute of the Minas Gerais State (*Instituto Mineiro de Gestão das Águas* - IGAM);
- State Environmental Prosecutor;
- Federal Environmental Prosecutor;
- Manuelzão Project (*Projeto Manuelzão*);
- Community Association 'January 5th' of the Housing State Mariano de Abreu (*Associação Comunitária e Habitacional 5 de Janeiro do Conjunto Mariano de Abreu*);
- 'Esperança' Communitarian Association (*Associação Comunitária Esperança*);
- 'Baluarte da Verdade' Communitarian Association (Associação Comunitária Baluarte da Verdade)

E.2. Summary of the comments received:

>>

The President of FEAM, Mr. José Cláudio Junqueira Ribeiro, by means of an official communication (*Ofício* N°. 140/2009/PRE/SISEMA, 20/10/2009), highlighted that the project activity coadunates with the expectations of the Environmental Secretariat of the Minas Gerais State and of FEAM in regards to its adherence to the principles of the Climate Change State Policy. Furthermore, the President informed that the entrepreneurship in reference had not yet provided the documents requested in FOBI 332892/2009 (Listed in section D.1). How due account was taken of this comment is described in section E.3.

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

>>

In regards to how due account was taken of the comment provided by Mr. José Cláudio Junqueira Ribeiro, as mentioned in section D.1, shortly after the receipt of *Ofício* N°. 140/2009/PRE/SISEMA, the documents requested by FOBI 332892/2009 were presented to COPAM, and at April 5th 2010, the preliminary and installation license (Reference: LP + LI N^{o} 057 SUPRAM CM) was issued, thus, granting COPASA with the permission to implement the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Companhia de Saneamento de Minas Gerais – COPASA MG
Street/P.O.Box:	Rua Mar de Espanha, 453 – Santo Antônio
Building:	--
City:	Belo Horizonte
State/Region:	Minas Gerais
Postfix/ZIP:	30330-900
Country:	Brazil
Telephone:	+55-31-3250-2037
FAX:	--
E-Mail:	--
URL:	www.copasa.com.br
Represented by:	Ricardo Negri Coelho
Title:	--
Salutation:	Mr.
Last Name:	Coelho
Middle Name:	
First Name:	Ricardo
Department:	Divisão de Co-Geração e Auto-Produção de Energia
Mobile:	--
Direct FAX:	--
Direct tel:	--
Personal E-Mail:	ricardo.negri@copasa.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Not applicable.

Annex 3

BASELINE INFORMATION

The parameters used in ex-ante emission reduction calculations are listed in the table below. DATA SOURCE: Electricity generation estimation obtained from the study elaborated by Instituto Bioterra (Estudo de viabilidade técnica econômica de cogeração de energia na estação de tratamento de esgoto do Arrudas – provided to the DOE, along with its "Annotation of Technical Responsibility").

Date	Biogas production (Nm3)	Gross generation (kW)	Net electricity generation		
			off-peak	peak	total
			kWh	kWh	kWh
jan/11	657,351	1,387	794,283	76,001	870,284
feb/11	657,351	1,387	794,283	76,001	870,284
mar/11	657,351	1,387	794,283	76,001	870,284
apr/11	657,351	1,387	794,283	76,001	870,284
may/11	657,351	1,387	794,283	76,001	870,284
jun/11	657,351	1,387	794,283	76,001	870,284
jul/11	657,351	1,387	794,283	76,001	870,284
aug/11	657,351	1,387	794,283	76,001	870,284
sep/11	657,351	1,387	794,283	76,001	870,284
oct/11	657,351	1,387	794,283	76,001	870,284
nov/11	657,351	1,387	794,283	76,001	870,284
dec/11	657,351	1,387	794,283	76,001	870,284
jan/12	691,949	1,460	836,087	80,001	916,088
feb/12	691,949	1,460	836,087	80,001	916,088
mar/12	691,949	1,460	836,087	80,001	916,088
apr/12	691,949	1,460	836,087	80,001	916,088
may/12	691,949	1,460	836,087	80,001	916,088
jun/12	691,949	1,460	836,087	80,001	916,088
jul/12	691,949	1,460	836,087	80,001	916,088
aug/12	691,949	1,460	836,087	80,001	916,088
sep/12	691,949	1,460	836,087	80,001	916,088
oct/12	691,949	1,460	836,087	80,001	916,088
nov/12	691,949	1,460	836,087	80,001	916,088
dec/12	691,949	1,460	836,087	80,001	916,088
jan/13	724,075	1,528	874,906	83,715	958,621
feb/13	724,075	1,528	874,906	83,715	958,621
mar/13	724,075	1,528	874,906	83,715	958,621
apr/13	724,075	1,528	874,906	83,715	958,621
may/13	724,075	1,528	874,906	83,715	958,621
jun/13	724,075	1,528	874,906	83,715	958,621
jul/13	724,075	1,528	874,906	83,715	958,621

aug/13	724,075	1,528	874,906	83,715	958,621
sep/13	724,075	1,528	874,906	83,715	958,621
oct/13	724,075	1,528	874,906	83,715	958,621
nov/13	724,075	1,528	874,906	83,715	958,621
dec/13	724,075	1,528	874,906	83,715	958,621
jan/14	756,201	1,595	913,724	87,429	1,001,153
Onwards	756,201	1,595	913,724	87,429	1,001,153

Summary:

Average yearly gross electricity production during the crediting period (MWh)	14,348
Average plant load factor during the crediting perid (%)	68%
Average yearly net electricity production during the crediting pediod (MWh)	12,334
Average hourly net electricity production during the crediting petid (MWh)	1.41
Quantity of biomass (biogas) consumed in year y (Nm3)	9,315,889

Ex-ante estimation $EF_{CO2,grid,y}$. Since the project plants displaces electricity that would otherwise be generated by plants connected to the Brazilian Interconnected System (SIN), $EF_{CO2,grid,y}$ will be calculated as the Combined margin CO_2 emission factor for power generation connected to SIN using the latest version of the "Tool to calculate the emission factor for an electricity system". For the purposes of ex ante estimations, the value corresponding to the average value for the year 2010, considering a constant hourly electricity production, was used (published by the Brazilian Inter-Ministerial Commission for Climate Change - http://www.mct.gov.br/index.php/content/view/327118.html#ancora)

EF_{OM}		EF_{BM}	$EF_{CO2,grid,y}$
jan/10	0.2111	0.1404	0.3095
feb/10	0.2798		
mar/10	0.2428		
apr/10	0.2379		
may/10	0.3405		
jun/10	0.4809		
jul/10	0.4347		
aug/10	0.6848		
sep/10	0.7306		
oct/10	0.7320		
nov/10	0.7341		
dec/10	0.6348		
Average	0.4787		

Annex 4

MONITORING INFORMATION

All pertinent information has been provided throughout the text, especially in section B.7.1 and B.7.2.

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