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

CONTENTS

Annexes

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-scale project activity

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

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JOSAPAR Itaqui Biomass Co-generation Project

Version 8
Date: 16/07/2007

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

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Purpose

The Josapar Itaqui Biomass Co-generation Project developed by JOSAPAR is a project for installation in the Itaqui city, Rio Grande do Sul state, Brazil. Josapar is a rice mill company, of which the core business is the production of paddy and parboiled rice to internal and exporting markets. Josapar is placed 2nd company in the ranking of rice companies in Brazil (Brazilian Rice Year Book 2005, pg. 59)[1].
The project eliminates Josapar's electricity demand from the grid, will sell the small surplus generated electricity to the grid and provide process steam to the rice mill.

Project description

The main activity in the region where the project will be located is rice production and industrialization. Rice mills generate huge amounts of biomass residues (rice husks), and the Brazilian and local state legislation prohibits the unlicensed displacement and/or uncontrolled burning of rice husks, and restricts the land filling of it, allowing the displacement only in previously licensed areas. As a result, the rice mills have huge amounts of biomass that are left for decay.

The Josapar project will be the solution for the high costs associated to electricity consumption in rice production. A better quality and control of the steam supplied to the process is targeted with the project implementation.

The Josapar's project consists of a turn-key biomass electricity co-generation unit, with 6 MWe and 15.5 $MW_{thermal}$ of installed capacity using only rice husks as fuel, complying with all the Josapar's demand and exporting the surplus power to the grid. With this new thermal power plant, Josapar will deactivate the old boiler used only to produce process steam. This old boiler already uses biomass as fuel but it does not generate electricity.

The only biomass that Josapar is going to use are its own rice mill residues as fuel for the boiler. The amount of biomass used by third suppliers is null, once the company doesn't depend on external sources

[1] Rosa, Gilson R. Da Et. Al., Anuário Brasileiro do Arroz 2005, Gazeta Santa Cruz, Santa Cruz do Sul, Brasil, 2005, pg 59

of biomass to maintain the power plant fully operational. Internal transportation of the fuel is facilitated by electrical screws, conveyors and elevators.

At the present time a considerable amount of rice husks, around 31,878 t/years, is generated in the Josapar rice mills. A furnace is used to burn 38% of the biomass production. The resulting amount of 19,827 tonnes per year of biomass is disposed in legal landfills outside the location where the project activity will be placed.

Contribution of the project to sustainable development
The project is promoting sustainable development to the Host Country, providing:

- Increases in employment in the area where the plant is located;
- Diversification in the sources of electricity generation;
- Uses of clean and efficient technologies, and conserving natural resources, thus the project will be meeting the Agenda 21 and Sustainable Development Criteria of Brazil;
- Actions as a clean technology demonstration project, encouraging development of modern and more efficient generation of electricity and thermal energy using biomass fuel throughout the Country;
- Optimisation in the use of natural resources, avoid new uncontrolled waste disposal places, using a large amount of rice residues from region.

A.3. Project participants:

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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)
Brazil (host)	JOSAPAR – Joaquim Oliveira Participações S.A.	No
Brazil (host)	PTZ Bioenergy Fontes Alternativas de Energia Indústria, Comércio e Serviços Ltda.	No
The Netherlands	Bioheat International B.V.	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-scale project activity:

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

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A.4.1.1. Host Party(ies):

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Brazil

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

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Rio Grande do Sul State

A.4.1.3. City/Town/Community etc:

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Itaqui

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

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JOSAPAR-Itaqui rice mill is located in Itaqui City, in the western region of Rio Grande do Sul State. Address: Rua Sesmaria Rocha, s/nº, 720 km from Porto Alegre, the capital city of the state.

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

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As per appendix B of the simplified modalities and procedures for small-scale CDM project activities, the project activity falls under the following two categories:

Type I; Category I.D.: Grid connected renewable electricity generation

Type III; Category III.E.: Avoidance of methane production from biomass decay through controlled combustion.

Reference: version 10: of Appendix B of the simplified modalities and procedures for small scale CDM project activities.

Justification of how the proposed CDM project adheres to the applicability criteria of the selected project categories.

Type I; Category I.D.: Grid connected renewable electricity generation

Type I project activities are defined as renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (or an appropriate equivalent) (decision 17/CP.7, paragraph 6 (c) (i)). The project comprises combustion of renewable rice husks in a biomass boiler for electricity generation. The nominal capacity of the installation is 6.0 MWe, which is below the limit of 15 MW for type I projects.

Type III; Category III.E.: Avoidance of methane production from biomass decay through controlled combustion.

Type III project activities are defined as other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually (decision 17/CP.7, paragraph 6 (c) (iii) over the entire crediting period.

The project activity emissions of category III.E. consist of:
a. CO_2 emissions related to the combustion of the non-biomass carbon content of the waste (plastics, rubber and fossil derived carbon) and auxiliary fuels used in the combustion facility.
b. Incremental CO_2 emissions due to incremental distances between the collection points to the controlled combustion site and to the baseline disposal site as well as transportation of combustion residues and final waste from controlled burning site to disposal site.
c. CO2 emissions related to the power used by the project activity facilities, including the equipments for air pollution control required by regulations. In case the project activity consumes grid based electricity, the grid emission factor (kg CO_2e / kWh is used, or it is assumed that diesel generator would have provided a similar amount of electric power, calculated as described in category I.D.

Ad a. Emissions through combustion of non-biomass carbon are null once the waste composition is 100% rice husks.
Ad. b. The emissions related to the biomass transportation are zero because all the rice husks are generated in the rice mill, where the project will be implemented. The project emissions will result just from the ash transportation, which is maximally 5 tonnes of carbon dioxide equivalent annually.
Ad c. The emissions through electricity or diesel consumption are zero, once the Biomass Power Plant will be fully supplied by a renewable source.
Therefore, project emissions leads to direct carbon emissions of less than 15 kilo tonnes of carbon dioxide equivalent annually.

It is concluded that the project is eligible as small-scale and that it will remain under the limits for small-scale project activities types every year over the crediting period.

Use of environmentally sound technologies and transfer of know how
The JOSAPAR project will operate using state of art conventional Rankine steam cycle technology. The combustion of the fuel will be performed with proven technologies like a high pressured boiler (65 bar). The power plant control is supervised by a high standard automation set of LPCs and computers.

A condensing steam turbine drives an electrical generator. The system is managed by control panels and devices that keep a steady condition of voltage, frequency and load. Under current operational conditions, the boiler produces up to 30,000 kg/h of steam at 65 bar and 500°C while it consumes 5.8 t/h of rice husks. The boiler will operate with an utilization factor of 62% due to the fact of the limitation of the rice husks supply. The steam feeds a multistage steam condensing turbine at 0.09 bar. Before the turbine inlet, up to 50% of total steam generated is deviated to process heat. The steam turbine drives a 3 phase synchronous generator producing up to 6,000 kWe at 13,800 V and 60 Hz.

An integration panel allows synchronicity and full load control for the auxiliary power plant services, rice mill and export to the grid. Electricity is sent to the utility distribution lines through a transformer of 13.8 kV. The project will complies with the Brazilian and State environmental standards, mainly regarding to the control flue gas emissions and wastes. The ash from the plant can be sold as a beneficial by-product, however it was not considered in the feasibility study aiming a conservative scenario.

The project uses the above described environmentally safe and sound technology, which leads to utilization of husks otherwise left for decay and replacement of carbon based electricity generation. PTZ Bioenergy Fontes Alternativas de Energia Indústria, Comércio e Serviços Ltda. already has accumulated a large experience in engineering, projecting and constructing power plants at rice industries with conventional high pressure boilers in co-generation, with a similar concept of process engineering.

Similar technology has been used by PTZ Bioenergy Fontes Alternativas de Energia Indústria, Comércio e Serviços Ltda to combust rice husks at the CAMIL rice mill project (2001), a 4.2 MWe power plant in Itaqui-RS, Brazil, and a 3.0 MWe project at the URBANO rice mill Project (1999) in Jaraguá do Sul city, Santa Catarina State, Brazil, differing only in the equipment's scale.

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

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Table 1: Net emission reduction by the bundle of projects (tonnes CO_2 equivalent)

Year	Estimation of annual emission reductions in tonnes of CO_2 e
1 Mar - 31 Dec 2010	**18,222**
2011	**28,801**
2012	**34,989**
2013	**39,137**
2014	**41,917**
2015	**43,781**
2016	**45,030**
1 Jan - 28 Feb 2017	**7,644**
Total estimated reductions (tonnes of of CO_2 e)	**259,521**
Total number of crediting years	**7**

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

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There will be no public funding to the project.

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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According to paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities, a small-scale project is considered a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

There is no other small-scale activity that meets the above mentioned criteria. Accordingly, the proposed project activity is not a debundled component of a larger 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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Type I; Category I.D.: Grid connected renewable electricity generation (Version 10)

Type III; Category III.E.: Avoidance of methane production from biomass decay through controlled combustion (Version 11)

Reference: Appendix B of the simplified modalities and procedures for small-scale CDM project activities (version 10).

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

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The applicability criteria of the Category I.D. 'Grid connected renewable electricity generation' are:

Technology/measure

1. This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.
2. If the unit added has both renewable and non-renewable components (e.g.. a wind/diesel unit), the eligibility limit of 15MW 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 15MW.
3. Biomass combined heat and power (co-generation) systems that supply electricity to and/or displace electricity from a grid are included in this category. To qualify under this category, the sum of all forms of energy output shall not exceed 45 $MW_{thermal}$. E.g., for a biomass based co-generating system the rating for all the boilers combined shall not exceed 45 $MW_{thermal}$.
4. In the case of project activities that involve the 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[1] from the existing units.
5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW

[1] Physically distinct units are those that are capable of generating electricity without the operation of existing units, and that do not directly affect the mechanical, thermal, or electrical characteristics of the existing facility. For example, the addition of a steam turbine to an existing combustion turbine to create a combined cycle unit would not be considered “physically distinct”.

The project conforms to the above mentioned conditions in the following ways:
Ad. 1. The project comprises the use of rice husks, which is a renewable biomass to be used to supply electricity to and/or displace electricity from the south-southeast Brazilian electricity distribution system. Rio Grande do Sul and Santa Catarina States are the only two states in Brazil who presents coal fired

power plants complementing the energy demand in the integrated electrical south-southeast Brazilian grid. Thus the project activity replaces the use of at least one fossil fuel.
Ad. 2. The unit uses only rice husks, which is renewable biomass.
Ad. 3. The plant has a maximum output of heat (15.5 MWth) and power (6.0 MWe). The sum of these outputs is below the limit of 45 MWthermal.
Ad. 4. The biomass power plant is the first one to be installed in JOSAPAR Itaqui. The maximum output power of 6.0 MWe is below the limit of 15 MW established to be qualified as a small scale CDM project activity.
Ad. 5. The project is not a retrofitted or modified facility. The biomass power plant will be a new facility that will produce a maximum of 6.0 MWe that is below the limit of 15 MW.

It is concluded that category AMS I.D. is applicable to the small-scale project activity.

Type III; Category III.E.: Avoidance of methane production from biomass decay through controlled combustion.
Type III project activities are defined as other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually (decision 17/CP.7, paragraph 6 (c) (iii).

The applicability criteria of the Category III.E. 'Avoidance of methane production from biomass decay through controlled combustion' are:

Technology/measure

1. This project category comprises measures that avoid the production of methane from biomass or other organic matter that:

> (a) Would have otherwise been left to decay under clearly anaerobic conditions throughout the crediting period[1] in a solid waste disposal site without methane recovery, or
>
> (b) Is already deposited in a waste disposal site without methane recovery.

Due to the project activity, decay is prevented through controlled combustion of the wastes of type referred to in paragraph 1(a) and/or 1(b) above. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually.

2. For the case of stockpile of wastes where in the baseline usually there is a reduction in the amount of waste through regular open burning the use of the FOD model will have to be adjusted to take account of this burning in order to estimate correctly the baseline emission.

3. The project activity does not recover or combust methane unlike AMS III.G. Nevertheless, the location and characteristics of the disposal site in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions.

4. If the project activity involves combustion of partially decayed waste mined (i.e. removed) from a solid waste disposal site, the project participants shall:

i) Provide justifications for not using methane recovery and combustion as a technology/measure to achieve emission reductions; and

ii) If fresh wastes are generated during the crediting period, demonstrate that there is adequate capacity of the combustion facility to treat the newly generated wastes in addition to the partially decayed wastes removed from the disposal site or alternately justify the reasons for combusting the partially decayed wastes instead of the newly generated wastes.

5. If the combustion facility is used for heat and electricity generation, that component of the project activity shall use a corresponding methodology under type I project activities.

[1] Further work is undertaken to investigate to which extent and in which cases methane emissions may occur from stockpiling biomass residues. Subject to further insights on this issue the methodology may be revised.

Decay is prevented through controlled combustion of rice husks and less methane is produced and emitted to the atmosphere. Emissions through combustion of non-biomass carbon are null once the waste composition is 100% rice husks. The emissions through electricity or diesel consumption are zero, once the Biomass Power Plant will be fully supplied by a renewable source. The emissions related to the biomass transportation are zero because all the rice husks are generated in the rice mill, where the project will be implemented. The project emissions will result just from the ash transportation, which is maximally 5 tonnes of carbon dioxide equivalent annually. Therefore, project emissions leads to direct carbon emissions of less than 15 kilo tonnes of carbon dioxide equivalent annually. The maximum emission reductions for this project activity are 36,930 tCO_2-eq annually, which is under the established limit of 60 $ktCO_2$-eq per year.

It is concluded that category AMS III.E. is applicable to the small scale project activity.

Assumptions of the baseline methodology

To estimate the baseline emissions related to grid connected renewable electricity generation the baseline calculations as indicated under category I.D. of Appendix B are applied. The combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM), was calculated according to the procedures prescribed in the approved methodology ACM0002. The option for the ex-ante estimation of the Simple Adjusted OM and the Build Margin (BM) was chosen.

To estimate the baseline emissions related to the avoidance of methane production from biomass decay through controlled combustion, the baseline is calculated using the first order decay model based on the discrete time estimate method of the IPCC Guidelines, as referred to in category AMS IIIE and described in category AMS III-G.

B.3. Description of the project boundary:

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According to category I.D. the project boundary encompasses the physical, geographical site of the renewable generation source.

According to category III.E. the project boundary is the physical, geographical sites where:

a. where the solid waste would have been disposed and the avoided methane emission occurs in absence of the proposed project activity,
b. where the treatment of biomass through controlled combustion takes place,
c. and in the itineraries between them, where the transportation of wastes and combustion residues occurs.

The rice husks are combusted for electricity generation at the site of the rice mill. This is also the location where the rice husks are produced from the rice milling process. So, there will be no itinerary between the biomass landfill and where combustion of the residues occur .The physical, geographical site of the rice mill is indicated in paragraph A.4.1.The solid waste would have been disposed in a legalized landfill by the local Environmental Authority in the absence of the proposed project activity.

Landfill location: Rio Grande do Sul State
Itaqui City
Granja Sementeiro – Horto Florestal

B.4. Description of baseline and its development:

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This scenario represents continuation of the current practices. Rice husks are left for decay, and because no electricity is produced with rice husks, all needed -fossil fuel based- electricity is delivered by the grid.

Category I.D.

The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in a transparent and conservative manner.

The baseline emissions (*BEy*) resulting from the electricity supplied and/or not consumed from the grid is calculated as follows, where *EGy* is the annual net electricity generated from the Project.

$$BEy = EGy * EFy$$

The baseline emissions factor (*EFy*) is a weighted average of the *EF_OMy* and *EF_BMy*:

$$EFy = (\omega_{OM} * EF\_OMy) + (\omega_{BM} * EF\_BMy)$$

where the weights ω_{OM} and ω_{BM} are by default 0.5.

The Operating Margin emission factor (*EF_OMy*) is calculated according to the procedures prescribed in the approved methodology ACM0002 – option (b):

Simple Adjusted OM:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\cdot\frac{\sum_{(i,j)} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{i,j}} + \lambda_y\cdot\frac{\sum_{(i,k)} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$

Where:

k	low-cost/must-run power sources;
j	power sources delivering electricity to the grid, not including low-operating cost and mustrun power plants, and including imports to the grid;
$F_{i,j,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*;
$F_{i,k,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *k* in year(s) *y*;
$COEF_{i,j,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;
$COEF_{i,k,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *k* and the percent oxidation of the fuel in year(s) *y*;
$GEN_{j.y}$	is the electricity (MWh) delivered to the grid by source *j*.
$GEN_{k.y}$	is the electricity (MWh) delivered to the grid by source *k*.

$$\lambda_y = \frac{\text{"number of hours per year for which low - cost / must - run souces are on margin"}}{\text{"8760 hours per year"}}$$

Lambda (λy) should be calculated as follows:

Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. *ΣkGENk,y*).

Step iii) Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from lowcost/must-run resources (i.e. *ΣkGENk,y*).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that lowcost/must-run sources do not appear on the margin and λy is equal to zero. Lambda (λy) is the calculated number of hours divided by 8760.

The CO_2 emission coefficient *COEFi* is obtained as:

$COEF_i = NCV_i \,.\, EF_{CO2,i} \,.\, OXID_i$

where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values);

$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

The *Simple Adjusted* OM was calculated using the following data vintage:

(Ex-ante) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission

The Build Margin emission factor (EF_BM_y) is the weighted average emission factor of a sample of power plants *m*:

$$EF\_BM_y(tCO_2/MWh) = \frac{\left[\sum_{i,m} F_{i,m,y} * COEF_{i,m}\right]}{\left[\sum_m GEN_{m,y}\right]}$$

where $F_{i.m,y}$, $COEF_{i,m}$ *and* GEN_m are analogous to the *OM* calculation above.

The option 1 was selected to calculate the Build Margin emission factor:

Ex-ante based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Additional Formulae

$F_{i,y} = GEN_{j\,y} / (\eta_i \,.\, NCV_i)$

where:

$GEN_{j.y}$ is the electricity (MWh) delivered to the grid by source *i*

η_I is the fossil fuel conversion efficiency for the source *i*

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*

As recommended by the Executive Board, the fossil fuel conversion efficiency provided by national sources, where available, was used to calculate the Build Margin parameters once it provides a more conservative emission factor.

$EF_{CO2,I} = EF_{C,i} * 44/12$

where:

$EF_{C,i}$ is the carbon emission factor

44/12 is the carbon to carbon dioxide conversion factor

Assumption

The evaluation of the Operating Margin emission factor was conduced in a conservative way using the following consideration:

$COEF_k = 0$.:

$$\frac{\sum_{(i,k)} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0$$

Table 2: Emission reduction by grid connected renewable electricity generation

Indicator	Abbreviation	Value	Unit	Source of data
Low-cost/must-run power sources	k	See annex 3	Dimensionless	ONS
Power sources delivering electricity to the grid exluding low cost/must run power plants	j	See annex 3	Dimensionless	ONS
Amount of fuel i consumed by relevant power sources j in year(s) y	$F_{i,j,y}$	See annex 3	t/ year	Calculated
Amount of fuel i consumed by relevant power sources k in year(s) y	$F_{i,k,y}$	See annex 3	t/ year	Calculated
Net calorific value of a fuel i	NCV_i	See annex 3	TJ/kt	IPCC and Brazilian Ministry of Mine and Energy[2]
Oxidation factor of the fuel i	$OXID_i$	See annex 3	Dimensionless	IPCC default values
CO_2 emission factor of the fuel i	$EF_{CO2,i}$	See annex 3	Dimensionless	Calculated
CO_2 emission coefficient of fuel i	$COEF_{i,j,y}$	See annex 3	tCO_2/t	Calculated
electricity delivered to the grid by source j	$GEN_{j,y}$	See annex 3	MWh/year	ONS
electricity delivered to the grid by source k	$GEN_{k,y}$	See annex 3	MWh/year	ONS
Fossil fuel conversion efficiency for the source i to calculate EF_OM	η_{i_OM}	See annex 3	Dimensionless	IPCC
Fossil fuel conversion efficiency for the source i to calculate EF_BM	η_{i_BM}	See annex 3	Dimensionless	IPCC, Eletrobrás[3] and CIMGC[4]
Carbon emission factor	$EF_{C,i}$	See annex 3	Dimensionless	IPCC
Carbon to carbon dioxide conversion factor	-	44/12	Dimensionless	IPCC
Lambda at 2003	λ_{2003}	0,531	Dimensionless fraction	Calculated
Lambda at 2004	λ_{2004}	0.506	Dimensionless fraction	Calculated
Lambda at 2005	λ_{2005}	0.513	Dimensionless fraction	Calculated
Operating margin weight	ω_{OM}	0.5	Dimensionless	IPCC default value
Build margin weight	ω_{BM}	0.5	Dimensionless	IPCC default value
Operating margin emission factor	EF_OMy	0.404	tonnes CO_2/MWh	Calculated
Build margin emission factor	EF_BMy	0.092	tonnes CO_2/MWh	Calculated
Baseline emission factor	EFy	0.248	tonnes CO_2/MWh	Calculated
Annual net electricity generated by the Project	EGy	32,663	MWh	Calculated
Baseline emissions	BEel	8,100	tonnes CO_2/year	Calculated

[2] Ministério de Minas e Energia - Balanço Energético Nacional 2007: www.mme.gov.br

[3] Eletrobrás – http://www.eletrobras.gov.br/EM_atuacao_ccc/default.asp

[4] Comissão Interministerial de Mudança Global do Clima – CIMGC; Análise sobre o Setor Energético na Região Sul: www.mct.gov.br/clima/comunic_old/energi41.htm#index

Category III.E.

The baseline scenario is the situation where, in the absence of the project activity, organic waste matter is left to decay within the project boundary and methane is emitted to the atmosphere. The yearly baseline emissions are the amount of methane that would have been emitted from the decay of the freshly generated wastes, calculated as the methane generation potential using the first order decay model (FOD) described in AMS III.G.

Baseline emissions

$BEy = BE_{CH4,SWDS,y} - MD_{y,reg} * GWP\_CH_4$

where,

BEy	Baseline emissions at year "y" during crediting period (tCO2e)
$BE_{CH4,SWDS,y}$	Yearly Methane Generation Potential of the wastes diverted to be disposed in the landfill from the beginning of the project (x=1) up to the year "y", calculated according to AMS III.G (tCO2e).
$MD_{y,reg}$	methane that would be destroyed or removed in the year "y" for safety or legal regulation
GWP_CH_4	GWP for CH4 (value of 21 is used for the first commitment period)

The estimation of the methane emission potential of a solid waste disposal site ($BE_{CH4,SWDS,y}$, in tCO_2e) shall be undertaken using the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", found on the CDM website. The tool may be used with the oxidation factor (OX = 0.0), assuming no oxidation of methane in the covering layers, and the factor "f=0.0" assuming that no methane is captured and flared.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

where:

$BE_{CH4,SWDS,y}$	= Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	= Model correction factor to account for model uncertainties (0.9)
f	= Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	= Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	= Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	= Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	= Fraction of degradable organic carbon (DOC) that can decompose
MCF	= Methane correction factor
$W_{j,x}$	= Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	= Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	= Decay rate for the waste type *j*
j	= Waste type category (index)

x = Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)

y = Year for which methane emissions are calculated

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Waste type j	**DOC_i (% wet waste)**	**DOC_i (% dry waste)**
A. Wood and wood products	43	50
B. Pulp, paper and cardboard (other than sludge)	40	44
C. Food, food waste, beverages and tobacco (other than sludge)	15	38
D. Textiles	24	30
E. Garden, yard and park waste	20	49
F. Glass, plastic, metal, other inert waste	0	0

Waste type j		**Boreal and Temperate (MAT≤20ºC)**	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,04	0,06
	Wood, wood products and straw	0,02	0,03
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,05	0,1
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,06	0,185
Waste type j		**Tropical (MAT>20ºC)**	
		Dry (MAP<1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,045	0,07
	Wood, wood products and straw	0,025	0,035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,065	0,17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,085	0,4

MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

As the biomass combust in the project is 100% rice husks, the following parameters are chosen:

1. Fraction of degradable organic carbon (DOC) that can decompose:

DOC = 38 %

Considering:

a. Waste Type: food waste
b. Condition: dry waste

$Q_{biomass} = Q_{biomass\_total} - Q_{biomass\_baseline}$

where:

$Q_{biomass}$	Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)
$Q_{biomass\_total}$	Total amount of biomass consumed in the project activity and registered by the weight measuring system in the year *x* (tons, wet basis)
$Q_{biomass\_baseline}$	Amount of biomass consumed during the baseline scenario (tons/year)

$W_{j,x} = Q_{biomass} \cdot (1 - MC)$

Where:

$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons, dry basis)
$Q_{biomass}$	Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)
MC	Moisture Content (12% by weight)

2. Decay rate:

k = 0,4

Considering:

a. MAT = 20,1ºC > 20ºC
b. MAP = 1860.7 mm > 1000mm

Source: City Hall website http://www.itaqui.rs.gov.br/noticia.php?detalhar=33

Table 3: Emission reduction by avoidance of methane production from biomass decay through controlled combustion

Indicator	Abbreviation	Value	Unit	Source of data
methane correction factor	MCF	1.0	dimensionless fraction	IPCC
Fraction of degradable organic carbon (by weight) in the waste	DOC_j	0.38	dimensionless fraction	IPCC
Fraction of DOC that can decompose	DOC_F	0.5	dimensionless fraction	IPCC
fraction of CH_4 in landfill gas	F	0.5	dimensionless fraction	IPCC default value
decay rate for the rice husk	k	0.4	$year^{-1}$	IPCC
Oxidation factor	OX	0.0	dimensionless fraction	IPCC default value
Fraction of methane captured at the SWDS and flared, combusted or used in another manner	f	0.0	dimensionless fraction	IPCC default value
Model correction factor to account for model uncertainties	φ	0.9	dimensionless fraction	IPCC default value
Quantity of biomass treated under the project activity	$Q_{biomass}$	19,827	tonnes/year (wet basis)	Measurements by project participants
Biomass moisture content	MC	0.12	dimensionless fraction	CIENTEC[5]
Amount of organic waste prevented from disposal in the SWDS	Wj,x	17,448	tonnes/year (dry basis)	Calculated
GWP for CH_4	CH_4_GWP	21	tonnes of CO_2 equivalent/tonne of CH4	IPCC default value
Baseline methane emissions from biomass decay	BEy	28,979	tonnes of CO_2 equivalent/year	Calculated

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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Attachment A to Appendix B indicated that project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;
(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The first step in the process is to list the likely future scenarios. Two scenarios were considered:
Scenario 1 - Continuation of current activities

[5] CIENTEC, 1986. Programa Energia: Aproveitamento Energético da Casca de Arroz. Relatório do Projeto de Pesquisa. Porto Alegre, Fundação de Ciência e Tecnologia.

This scenario represents continuation of the current practices. Rice husks are left for decay, and because no electricity is produced with rice husks, all needed -fossil fuel based- electricity is delivered by the grid.

Scenario 2 - Construction of a renewable energy plant
In this scenario, the JOSAPAR biomass electricity generation plant is established. Rice husks will be used to produce heat and power. The power replaces fossil fuel based power formerly delivered by the grid. In addition surplus power will be delivered to the grid, thereby replacing fossil fuel based electricity. Methane emissions from the decay of biomass residues will be interrupted.

With respect to the **investment** barrier:
- The continuation of current practices (Scenario 1) does not pose any financial/economical barrier to the project developer, and requires no further financing.
- The construction of a renewable energy plant (Scenario 2) faces specific financial/economic barriers due to the fact that the capital costs related to biomass units are very high. The capital costs involved in the project pose a barrier, especially considering the high interest rates prevalent in developing countries. It is worth noting that there are no direct subsides or promotional support for the implementation of independent renewable energy plants.

The financial barrier is demonstrated through a financial analysis, which the results are presented in table 4 below. The carbon revenues increase the returns of the project transforming this into an attractive investment for the company and financial agents.

Table 4: Financial Analysis Results

	With Carbon	Without Carbon
Net Present Value (US$)	138,883.50	-1,585,570.42
IRR	10.4%	2.4%
Discount Rate	9.75%	9.75%
Present Value of carbon sold (7 years) US$	2,595,210.00	

The Internal rate return and the Net Present Value were obtained based on the power plant cash flow presented in Table 5 below.

Table 5: Cash Flow

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1. REVENUES										
Electricity revenue price to the grid (USD/MWh)	-	50.00	53.50	57.25	61.25	65.54	70.13	75.04	80.29	85.91
Electricity revenues to the grid (MWh/year)	-	19,872	23,846	23,846	23,846	23,846	23,846	23,846	23,846	23,846
2. RESULTS										
(+) Electricity renues	-	993,600	1,275,782	1,365,087	1,460,643	1,562,888	1,672,290	1,789,351	1,914,605	2,048,628
(-) Variable Costs	-	189,891	250,656	275,722	303,294	333,623	366,985	403,684	444,052	488,458
(-) Taxes	-	37,260	57,410	61,429	65,729	70,330	75,253	80,521	86,157	92,188
(-) Fixed Costs	-	148,215	195,644	215,208	236,729	260,402	286,442	315,086	346,595	381,254
(=) Gross profit	-	618,234	772,072	812,728	854,892	898,533	943,610	990,060	1,037,801	1,086,727
(-) Interest	765,324	1,290,400	1,137,517	932,251	726,985	521,719	316,452	111,186	0	0
(-) Depreciation	-	378,567	454,280	454,280	454,280	454,280	454,280	454,280	454,280	454,280
(=) Profit before income tax	-	-1,050,732	-819,725	-573,803	-326,374	-77,466	172,877	424,594	583,521	632,447
(-) Income tax	-	0	0	0	0	0	58,778	144,362	198,397	215,032
(+) Biomass transportation save	-	85,000	107,100	112,455	118,078	123,982	130,181	136,690	143,524	150,700
(+) Electricity save	-	556,573	714,640	764,665	818,191	875,465	936,747	1,002,319	1,072,482	1,147,556
(+) Carbon Credits	-	182,220	288,010	349,890	391,370	419,170	437,810	450,300	76,440	0
(=) Net profit	**-**	**-226,939**	**290,025**	**653,207**	**1,001,265**	**1,341,151**	**1,618,837**	**1,869,541**	**1,677,570**	**1,715,671**
(+) Depreciation	-	378,567	454,280	454,280	454,280	454,280	454,280	454,280	454,280	454,280
(=) Incomes generated	-	**151,628**	**744,305**	**1,107,487**	**1,455,546**	**1,795,431**	**2,073,117**	**2,323,821**	**2,131,850**	**2,169,951**
(-) Loan repayments	-	437,099	1,311,298	1,311,298	1,311,298	1,311,298	1,311,298	1,311,298	0	0
(-) JOSAPAR equity	2,035,301	40,920	0	0	0	0	0	0	0	0
(-) Working Capital	338,106	0	0	0	0	0	0	0	0	0
(+) Current Asset applications	460,700	460,700	0	0	0	0	0	0	0	0
(=) Cash Flow	**-2,678,032**	**134,308**	**-566,993**	**-203,811**	**144,248**	**484,133**	**761,820**	**1,012,524**	**2,131,850**	**2,169,951**

*All presented values are in US$

With respect to the **technological** barrier:

- In the case of Scenario 1 (continuation), there are no technical/technological issues as this simply represents a continuation of current practices and does not involve any new technology or innovation. Indeed, in this scenario there are no technical/technological implications as the scenario calls for continued use of electricity from the grid.
- In the case of Scenario 2, there are no significant technical/technological barriers. All the technologies involved in this scenario are available in the market and commercially proven, and have been used effectively in the Host Country.

With respect to the analysis of **prevailing business practice**:

- The continuation of current practices (Scenario 1) presents no particular obstacles. This practice has been used effectively in the past with good results, and the continued operation of existing facilities and actual practices presents no real barriers. Moreover, Brazil has a huge rice industry, with more than 350 rice mills. A considerable fraction, about 60%, of rice production is located in the south region (IRGA 2004)[5]. The south Brazilian region, i.e. the states of Rio Grande do Sul, Santa Catarina and Paraná, have no recorded problems with power supply, even along the electricity crisis observed at 2001. Environmental agencies have been approving new areas for disposing the industrial residues, as rice husks, with clear and effective rules, in such a way that only the distance, and by consequence the costs, will represent obstacles for taking the residues into consideration as a pressure to perform future projects.

- The Brazilian technologies in rice mills are very updated with global technologies employed, representing the state of art on rice mills technology. The efficiency of the process reaches around 98% of the commercial matter in the grain. Usually 78% of the rice is transformed in products. The other 22-23% are rice residues. Given the large number of rice mills in the south region the biomass residue generation is concentrated in the south region, creating an excess of biomass residues that the market cannot absorb. According to CIENTEC[5] more than 59,60 % of residues are not used or sold. Currently only 6 small-scale power plants operate at the south region of Brazil. From 2002, no new plants were build, mainly due to the lack of feasibility. Thus, there are many large biomass piles that are left for decay, generating methane during this process.

- The construction of a new renewable energy plant (Scenario 2) doesn't represent a deviation from the company's core business (rice production) once the energy costs avoided will be utilized to sell beneficed rice for a lower price or to increment the profit margin of the product. Therefore, the steam generated by the boiler will be used to achieve a higher quality in the rice process. Currently JOSAPAR has a great amount of rice husks that guaranties the supply for the future plant.

With respect to the analysis of **other barriers**

- In case of scenario 1, no other barriers were identified.
- In case of scenario 2, no other barriers were identified.

Table 6 below summarises the results of the analysis regarding the barriers faced by each of the plausible scenarios. As the table indicates, Scenario 1 faces no barriers, whereas Scenario 2 faces the financial/economic barrier.

Table 6: Summary of Barriers Analysis

Barrier Evaluated	Scenario 1 Continuation of Current Activities	Scenario 2 Construction of a new plant
1. Investment barrier	No	Yes
2. Technological barrier	No	No
3. Prevailing practice	No	No
4. Other barriers	No	No

Because the investment barrier would prevent that the project would have occurred anyway, it is concluded that the project is additional.

The implementation of the project will eliminate the amount of biomass disposed in the landfills as well as the energy consumed from the grid, consequently reducing the CO_2 emissions, as shown in the following analysis:

- The Baseline Scenario presents the discharge of 19,827 t/year of rice husks in the landfills. The amount 12,051 tonnes of rice husks per year is already prevented to be land filled through the combustion in furnaces. All electricity is delivered by the grid, which is partly based on fossil fuels, mainly in the south region that has a considerable concentration of coal Thermo power plants, and consequently has associated CO_2 emission.

- The Project Scenario is represented by the construction of a new renewable energy plant of 6,0 MW. This implementation will provide steam for the drying rice process, process heat and electricity. The amount of rice husks consumed will be 31,878 tonnes per year. The methane emissions due to biomass decay will be eliminated. The electricity imported from the grid, which is partly generated by fossil fuel, will be displaced, contributing to GHG emission reductions.

The Project Scenario is environmentally additional in comparison to the baseline scenario, and therefore eligible to receive Certified Emissions Reductions (CERs) under the CDM.

B.6. Emission reductions:

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B.6.1. Explanation of methodological choices:

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<u>**Category I.D.**</u>

Emission reductions

Emission reduction by grid connected renewable electricity production during a given period equals:

$ER_{ID} = BE_{el}$

where,
ER_{ID} = emission reduction due to grid connected renewable electricity production (tonnes CO_2equ)
BE_{el} = Baseline Emissions of electricity generation (tonnes CO_{2eq})

No formula is provided to quantify the emission reduction of electricity generation in the Baseline of category I.D. of appendix B. In words it is described that:

Baseline emissions
(…) the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The option (a) was chosen to calculate the emission factor.

The baseline emissions (*BEy*) resulting from the electricity supplied and/or not consumed from the grid is calculated as follows, where *EGy* is the annual net electricity generated from the Project.

$$BEy = EGy * EFy$$

The baseline emissions factor (*EFy)* is a weighted average of the *EF_OMy* and *EF_BMy:*

$$EFy = (\omega_{OM} * EF\_OMy) + (\omega_{BM} * EF\_BMy)$$

where the weights ω_{OM} and ω_{BM} are by default 0.5.

The Operating Margin emission factor (*EF_OMy*) is calculated according to the procedures prescribed in the approved methodology ACM0002 – option (b): Simple Adjusted OM.

Option (b) – Simple Adjusted OM – was chosen once low cost/must run resources constitute more than 50% of total grid generation, excluding option (a); not enough data was available to perform option (c) Dispatch Data Analysis, but sufficient data was available to apply the Simple Adjusted OM as recommended in the ACM0002 methodology.

Simple Adjusted OM:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\cdot\frac{\sum_{(i,j)} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{i,j}} + \lambda_y\cdot\frac{\sum_{(i,k)} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$

Where:

k	low-cost/must-run power sources;
j	power sources delivering electricity to the grid, not including low-operating cost and mustrun power plants, and including imports to the grid;
$F_{i,j,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*;
$F_{i,k,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *k* in year(s) *y*;
$COEF_{i,j,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;
$COEF_{i,k,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *k* and the percent oxidation of the fuel in year(s) *y*;
$GEN_{j.y}$	is the electricity (MWh) delivered to the grid by source *j*.
$GEN_{k.y}$	is the electricity (MWh) delivered to the grid by source *k*.

$$\lambda_y = \frac{\text{"number of hours per year for which low - cost / must - run souces are on margin"}}{\text{"8760 hours per year"}}$$

Lambda (λy) should be calculated as follows:

Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma kGENk,y$).

Step iii) Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from lowcost/must-run resources (i.e. $\Sigma kGENk,y$).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that lowcost/must-run sources do not appear on the margin and λy is equal to zero. Lambda (λy) is the calculated number of hours divided by 8760.

The CO_2 emission coefficient *COEFi* is obtained as:

$COEF_i = NCV_i \,.\, EF_{CO2,i} \,.\, OXID_i$

where:

NCV_i	is the net calorific value (energy content) per mass or volume unit of a fuel *I*;
$OXID_i$	is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values);
$EF_{CO2,i}$	is the CO_2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

The Simple Adjusted OM was calculated using the following data vintage:

Ex-ante: full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission.

The Build Margin emission factor (EF_BM_y) is the weighted average emission factor of a sample of power plants *m*:

$$EF\_BM_y\left(tCO_2 / MWh\right) = \frac{\left[\sum_{i,m} F_{i,m,y} * COEF_{i,m}\right]}{\left[\sum_m GEN_{m,y}\right]}$$

where $F_{i.m,y}$, $COEF_{i,m}$ *and* GEN_m are analogous to the *OM* calculation above.
The option 1 was selected to calculate the Build Margin emission factor:

Ex-ante based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Additional Formulae

$F_{i,y} = GEN_{j\,y} / (\eta_i \, . \, NCV_i)$

where:

$GEN_{j.y}$	is the electricity (MWh) delivered to the grid by source *i*
η_I	is the fossil fuel conversion efficiency for the source *i*
NCV_i	is the net calorific value (energy content) per mass or volume unit of a fuel *i*

As recommended by the Executive Board, the fossil fuel conversion efficiency provided by national sources, where available, was used to calculate the Build Margin parameters once it provides a more conservative emission factor.

$EF_{CO2,I} = EF_{C,i} * 44/12$

where:

$EF_{C,i}$	is the carbon emission factor
44/12	is the carbon to carbon dioxide conversion factor

Assumption

The evaluation of the Operating Margin emission factor was conduced in a conservative way using the following consideration:

$COEF_k = 0$.:

$$\frac{\sum_{(i,k)} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0$$

Project emissions

The project emissions are negligible.

Leakage

No leakage calculation is required, as the renewable energy technology used is not equipment transferred from another activity.

Category III.E.

Emission reductions

Emission reduction by avoidance of methane production from biomass decay through controlled combustion equals:

$ER_{IIIE} = BEy – (PEy + Leakagey)$

where,

ER_{IIIE}	Emission reduction by the avoidance of methane production from biomass decay through controlled combustion (tonnes of CO_2 equivalent)
PE_y	Project activity emissions (tonnes of CO_2 equivalent)
BE_y	Baseline methane emissions from biomass decay (tonnes of CO_2 equivalent)

Baseline emissions

$BEy = BE_{CH4,SWDS,y} – MD_{y,reg} * GWP\_CH_4$

where,

BEy	Baseline emissions at year "y" during crediting period (tCO2e)
$BE_{CH4,SWDS,y}$	Yearly Methane Generation Potential of the wastes diverted to be disposed in the landfill from the beginning of the project (x=1) up to the year "y", calculated according to AMS III.G (tCO2e).
$MD_{y,reg}$	methane that would be destroyed or removed in the year "y" for safety or legal regulation
GWP_CH_4	GWP for CH4 (value of 21 is used for the first commitment period)

The estimation of the methane emission potential of a solid waste disposal site ($BE_{CH4,SWDS,y}$, in tCO_2e) shall be undertaken using the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", found on the CDM website. The tool may be used with the oxidation factor (OX = 0.0), assuming no oxidation of methane in the covering layers, and the factor "f=0.0" assuming that no methane is captured and flared.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

where:

$BE_{CH4,SWDS,y}$	= Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	= Model correction factor to account for model uncertainties (0.9)
f	= Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	= Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	= Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	= Fraction of methane in the SWDS gas (volume fraction) (0.5)

DOC_f	= Fraction of degradable organic carbon (DOC) that can decompose
MCF	= Methane correction factor
$W_{j,x}$	= Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	= Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	= Decay rate for the waste type *j*
j	= Waste type category (index)
x	= Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	= Year for which methane emissions are calculated

The Methane correction factor (MCF) value is 1.0 once the rice husks are sent to a controlled landfill where the waste is leveled.

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Waste type j	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
A. Wood and wood products	43	50
B. Pulp, paper and cardboard (other than sludge)	40	44
C. Food, food waste, beverages and tobacco (other than sludge)	15	38
D. Textiles	24	30
E. Garden, yard and park waste	20	49
F. Glass, plastic, metal, other inert waste	0	0

Waste type j		Boreal and Temperate (MAT≤20ºC)	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,04	0,06
	Wood, wood products and straw	0,02	0,03
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,05	0,1
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,06	0,185
Waste type j		**Tropical (MAT>20ºC)**	
		Dry (MAP<1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,045	0,07
	Wood, wood products and straw	0,025	0,035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,065	0,17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,085	0,4

MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

As the biomass combust in the project is 100% rice husks, the following parameters are chosen:

1. Fraction of degradable organic carbon (DOC) that can decompose:

DOC = 38 %

Considering:

a. Waste Type: food waste
b. Condition: dry waste

$Q_{biomass} = Q_{biomass\_total} - Q_{biomass\_baseline}$

where:

$Q_{biomass}$ Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)

$Q_{biomass\_total}$ Total amount of biomass consumed in the project activity and registered by the weight measuring system in the year *x* (tons, wet basis)

$Q_{biomass\_baseline}$ Amount of biomass consumed during the baseline scenario (tons/year)

$W_{j,x} = Q_{biomass} \cdot (1 - MC)$

Where:

$W_{j,x}$ Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons, dry basis)

$Q_{biomass}$ Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)

MC Moisture Content (12% by weight)

2. Decay rate:

k = 0,4

Considering:

a. MAT = 20,1ºC > 20ºC
b. MAP = 1860.7 mm > 1000mm

Source: City Hall website http://www.itaqui.rs.gov.br/noticia.php?detalhar=33

Project emissions

According to the same guidelines for type III. E., the project emissions are calculated using the following formula:

$PE_y = PE_{y,comb} + PE_{y,transp} + PE_{y,power}$

where:

PE_y project activity direct emissions in the year "y" (tonnes of CO2 equivalent)
$PE_{y,comb}$ emissions through combustion of non-biomass carbon in the year "y"
$PE_{y,transp}$ emissions through incremental transportation in the year "y"
$PE_{y,power}$ emissions through electricity or diesel consumption in the year "y"

(i) Emissions through combustion of non-biomass carbon in the year "y":

$PE_{y,comb} = Q_{y,non\text{-}biomass} * 44/12 + Q_{y,fuel} * E_{y,fuel}$

where:

$Q_{y,non\text{-}biomass}$ Non-biomass carbon of the waste combusted in the year "y" (tonnes of Carbon)
$Q_{y,fuel}$ Quantity of auxiliary fuel used in the year "y" (tonnes)
$E_{y,fuel}$ CO_2 emission factor for the combustion of the auxiliary fuel (tonnes CO2 per tonne fuel, according to IPCC Guidelines)

(ii) Emissions through incremental transportation in the year "y":

$PE_{y,transp} = (Q_y/CT_y) * DAF_w * EF_{CO2} + (Q_{y,ash}/CT_{y,ash}) * DAF_{ash} * EF_{CO2}$

where:

Q_y	quantity of waste combusted in the year "y" (tonnes)
CT_y	average truck capacity for waste transportation (tonnes/truck)
DAF_w	average incremental distance for waste transportation (km/truck)
EF_{CO2}	CO2 emission factor from fuel use due to transportation (kgCO2/km, IPCC default values or local values can be used.
$Q_{y,ash}$	quantity of combustion residues produced in the year "y" (tonnes)
$CT_{y,ash}$	average truck capacity for combustion residues transportation (tonnes/truck)
DAF_{ash}	average distance for combustion residues transportation (km/truck)

(iii) Emissions through electricity or diesel consumption in the year "y":

In case the project activity consumes grid-based electricity, the grid emission factor (kg_{CO2e}/kWh) is used, or it is assumed that diesel generators would have provided a similar amount of electric power, calculated as described in category I.D.

The CO_2 emissions related to combustion of non-biomass carbon content of the waste are zero because the project only combust rice husks, which is 100% biomass.
Only ash is transported as a result of the project activity.
All electricity needed to run the rice husk power plant produced by the same power plant. So the used electricity is renewable and the emissions through electricity or diesel consumption are zero.

The formulae used to calculate the project emissions will only consider the parcel related to the ash transportation emissions as follows:

$$PE_{y,transp} = (Q_{y,ash}/CT_{y,ash}) * DAF_{ash} * EF_{CO2}$$

where:

EF_{CO2}	CO_2 emission factor from fuel use due to transportation (kgCO_2/km, IPCC default values or local values can be used.
$Q_{y,ash}$	quantity of combustion residues produced in the year "y" (tonnes)
$CT_{y,ash}$	average truck capacity for combustion residues transportation (tonnes/truck)
DAF_{ash}	average distance for combustion residues transportation (km/truck)

The quantity of combustion residues produced can be determined by a weight measuring system or estimating by a literature value about the ash content in the biomass. The truck capacity is determined once a standard truck with a fixed volume is used. The average distance between the project and the ash displacement can be registered with the kilometer counter of a truck or car.

Formulae to supplement equations presented in category III.E of annex B.

The amount of combustion residues produced is determined in the following way:

$$Q_{ash} = AC*Q_{biomass}$$

Where,

Q_{ash}	quantity of combustion residues produced (tonnes/year)
AC	ash content in rice husks (18% weight)

$Q_{biomass}$ quantity of biomass treated under the project activity (tonnes/year)

Leakage

The controlled combustion technology is not equipment transferred from/to another activity. Therefore leakage effects do not need to be considered.

Combined Emission Reductions

The total combined emission reduction of the bundle of project activities of type I.D. and III.E are:

$ER_{total} = ER_{ID} + ER_{IIIE}$

ER_{total} Total net emission reduction by the bundle of project activities (tonnes CO_2 equivalent)
ER_{ID} Emission reduction due to grid connected renewable electricity production (tonnes CO_2equ)
ER_{IIIE} Emission reduction by the avoidance of methane production from biomass decay through controlled combustion (tonnes of CO_2 equivalent)

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

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Category I.D.

Data / Parameter:	NCV_i
Data unit:	TJ/kt
Description:	Net calorific value of a fuel *i*
Source of data used:	IPCC and Brazilian Ministry of Mine and Energy
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Where available, specific NCV was used based in the brazilian fuel characteristics. This data was obtained from Brazilian Ministry of Mine and Energy. Where not available, IPCC default values were used.
Any comment:	

Data / Parameter:	*$GEN_{j,2003}$*
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *j* at 2003
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	*$GEN_{j,2004}$*
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *j* at 2004
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	*$GEN_{j,2005}$*
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *j* at 2005
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	$GEN_{k,2003}$
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *k* at 2003
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	$GEN_{k,2004}$
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *k* at 2004
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	$GEN_{k,2005}$
Data unit:	MWh/year
Description:	Electricity delivered to the grid by source *k* at 2005
Source of data used:	ONS
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Dispatch data.
Any comment:	

Data / Parameter:	η_{i_OM}
Data unit:	Dimensionless
Description:	Fossil fuel conversion efficiency for the source *i* to calculate EF_OM
Source of data used:	IPCC
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative values were used as recommend by the Executive Board.
Any comment:	

Data / Parameter:	η_{i_BM}
Data unit:	Dimensionless
Description:	Fossil fuel conversion efficiency for the source *i* to calculate EF_BM
Source of data used:	IPCC, Eletrobrás and CIMGC
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative values were used. Dispatched data was used where available.
Any comment:	The fossil fuel conversion efficiency based on national data, where available, was used to obtain a more conservative emission factor as recommended by the Executive Board.

Data / Parameter:	$EF_{C,i}$
Data unit:	Dimensionless
Description:	Carbon emission factor
Source of data used:	IPCC
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative values stated by IPCC were used.
Any comment:	

Data / Parameter:	-
Data unit:	Dimensionless
Description:	Carbon to carbon dioxide conversion factor
Source of data used:	IPCC
Value applied:	44/12
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conversion factor stated by IPCC.
Any comment:	

Data / Parameter:	λ_{2003}
Data unit:	Dimensionless fraction
Description:	Lambda at 2003
Source of data used:	Calculated
Value applied:	0.531
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	λ_{2004}
Data unit:	Dimensionless fraction
Description:	Lambda at 2003
Source of data used:	Calculated
Value applied:	0.506
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	λ_{2005}
Data unit:	Dimensionless fraction
Description:	Lambda at 2003
Source of data used:	Calculated
Value applied:	0.513
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	λ
Data unit:	Dimensionless fraction
Description:	Average between Lambda 2003, 2004 and 2005
Source of data used:	Calculated
Value applied:	0.517
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	ω_{OM}
Data unit:	Dimensionless
Description:	Operating margin weight
Source of data used:	IPCC default value
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value for biomass power plants.
Any comment:	

Data / Parameter:	ω_{BM}
Data unit:	Dimensionless
Description:	Build margin weight
Source of data used:	IPCC default value
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value for biomass power plants.
Any comment:	

Data / Parameter:	EF_OMy
Data unit:	tonnes CO_2/MWh
Description:	Operating margin emission factor
Source of data used:	Calculated
Value applied:	0.404
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	EF_BMy
Data unit:	tonnes CO_2/MWh
Description:	Build margin emission factor
Source of data used:	Calculated
Value applied:	0.092
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Data / Parameter:	EFy
Data unit:	tonnes CO_2/MWh
Description:	Baseline emission factor
Source of data used:	Calculated
Value applied:	0.248
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as described in ACM0002.
Any comment:	

Category III.E.

Data / Parameter:	MCF
Data unit:	Dimensionless
Description:	Methane correction factor
Source of data used:	IPCC
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Methane correction factor (MCF) value is 1.0 once the rice husks are sent to a controlled landfill where the waste is leveled.
Any comment:	

Data / Parameter:	DOC_j
Data unit:	Dimensionless
Description:	Fraction of degradable organic carbon (by weight) in the waste
Source of data used:	IPCC
Value applied:	0.38
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considering: a. Waste Type: food waste b. Condition: dry waste
Any comment:	

Data / Parameter:	DOC_F
Data unit:	Dimensionless
Description:	Fraction of DOC that can decompose
Source of data used:	IPCC
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value.
Any comment:	

Data / Parameter:	k
Data unit:	$year^{-1}$
Description:	Decay rate for the rice husk
Source of data used:	IPCC
Value applied:	0.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considering: a. MAT = 20,1ºC > 20ºC b. MAP = 1860.7 mm > 1000mm Source: City Hall website http://www.itaqui.rs.gov.br/noticia.php?detalhar=33
Any comment:	

Data / Parameter:	MC
Data unit:	Dimensionless
Description:	Rice husk moisture content
Source of data used:	CIENTEC[5]
Value applied:	0.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	Value based on the local rice husk analysis developed by CIENTEC.
Any comment:	

Data / Parameter:	$Q_{biomass\_baseline}$
Data unit:	t/year
Description:	Amount of biomass combust in the baseline scenario
Source of data used:	Proprietary (JOSAPAR) data
Value applied:	12,051
Justification of the choice of data or description of measurement methods and procedures actually applied :	The amount of rice husk combust in the baseline scenario was obtained in the following way: 1. Rice husk inlet: Amount of rice with husk received per year by the rice mill times the husk content (22 % w/w) obtained from laboratory analysis. 2. Rice husk outlet: Amount of trucks loaded with rice husks per year leaving the rice mill times the truck capacity (tonnes / truck). The number of trucks leaving the rice mill is obtained from the truck bills. The truck has a fixed volume, which multiplied by the rice husk specific mass will result in the amount of rice husk (tonnes/truck) removed from the rice mill. 3. Rice husk combust: The rice husk combust in the baseline scenario is the difference between the amount of rice husk inlet and rice husk outlet.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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<u>Category I.D.</u>

Emission reductions

Emission reduction by grid connected renewable electricity production during a given period equals:

$ER_{ID} = BE_{el}$

where,
ER_{ID} = emission reduction due to grid connected renewable electricity production (tonnes CO_2equ)
BE_{el} = Baseline Emissions of electricity generation (tonnes CO_{2eq})

No formula is provided to quantify the emission reduction of electricity generation in the Baseline of category I.D. of appendix B. In words it is described that:

Baseline emissions

(…) the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The baseline emissions (*BEy*) resulting from the electricity supplied and/or not consumed from the grid is calculated as follows, where *EGy* is the annual net electricity generated from the Project.

$$BEy = EGy * EFy$$

The baseline emissions factor (*EFy)* is a weighted average of the *EF_OMy* and *EF_BMy:*

$$EFy = (\omega_{OM} * EF\_OMy) + (\omega_{BM} * EF\_BMy)$$

where the weights ω_{OM} and ω_{BM} are by default 0.5.

The Operating Margin emission factor (*EF_OMy*) is calculated according to the procedures prescribed in the approved methodology ACM0002 – option (b):

Simple Adjusted OM:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\cdot\frac{\sum_{(i,j)} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{i,j}} + \lambda_y\cdot\frac{\sum_{(i,k)} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$

where:

k	low-cost/must-run power sources;
j	power sources delivering electricity to the grid, not including low-operating cost and mustrun power plants, and including imports to the grid;
$F_{i,j,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*;
$F_{i,k,y}$	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *k* in year(s) *y*;
$COEF_{i,j,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;

$COEF_{i,k,y}$	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *k* and the percent oxidation of the fuel in year(s) *y*;
$GEN_{j,y}$	is the electricity (MWh) delivered to the grid by source *j*.
$GEN_{k,y}$	is the electricity (MWh) delivered to the grid by source *k*.

$$\lambda_y = \frac{\text{"number of hours per year for which low - cost / must - run souces are on margin"}}{\text{"8760 hours per year"}}$$

Lambda (λy) should be calculated as follows:

Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma kGENk,y$).

Step iii) Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from lowcost/must-run resources (i.e. $\Sigma kGENk,y$).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that lowcost/must-run sources do not appear on the margin and λy is equal to zero. Lambda (λy) is the calculated number of hours divided by 8760.

The CO_2 emission coefficient *COEFi* is obtained as:

$$COEF_i = NCV_i \,.\, EF_{CO2,i} \,.\, OXID_i$$

where:

NCV_i	is the net calorific value (energy content) per mass or volume unit of a fuel *I*;
$OXID_i$	is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values);
$EF_{CO2,i}$	is the CO_2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

The *Simple Adjusted* OM was calculated using the following data vintage:

(Ex-ante) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission

The Build Margin emission factor (EF_BM_y) is the weighted average emission factor of a sample of power plants *m*:

$$EF\_BM_y(tCO_2 / MWh) = \frac{\left[\sum_{i,m} F_{i,m,y} * COEF_{i,m}\right]}{\left[\sum_m GEN_{m,y}\right]}$$

where $F_{i.m,y}$, $COEF_{i,m}$ *and* GEN_m are analogous to the *OM* calculation above.

The option 1 was selected to calculate the Build Margin emission factor:

Ex-ante based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Additional Formulae

$F_{i,y} = GEN_{j\,y} / (\eta_i \,.\, NCV_i)$

where:

$GEN_{j.y}$	is the electricity (MWh) delivered to the grid by source *i*
η_I	is the fossil fuel conversion efficiency for the source *i*
NCV_i	is the net calorific value (energy content) per mass or volume unit of a fuel *i*

As recommended by the Executive Board, the fossil fuel conversion efficiency provided by national sources, where available, was used to calculate the Build Margin parameters once it provides a more conservative emission factor.

$EF_{CO2,I} = EF_{C,i} * 44/12$

where:

$EF_{C,i}$	is the carbon emission factor
44/12	is the carbon to carbon dioxide conversion factor

Assumption

The evaluation of the Operating Margin emission factor was conduced in a conservative way using the following consideration:

$COEF_k = 0$.:

$$\frac{\sum_{(i,k)} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} = 0$$

Project emissions

The project emissions are negligible.

Leakage

No leakage calculation is required, as the renewable energy technology used is not equipment transferred from another activity.

Category III.E.

Emission reductions

Emission reduction by avoidance of methane production from biomass decay through controlled combustion equals:

$ER_{IIIE} = BEy – (PEy + Leakagey)$

where,

ER_{IIIE} Emission reduction by the avoidance of methane production from biomass decay through controlled combustion (tonnes of CO_2 equivalent)

PE_y Project activity emissions (tonnes of CO_2 equivalent)

BE_y Baseline methane emissions from biomass decay (tonnes of CO_2 equivalent)

Baseline emissions

$BEy = BE_{CH4,SWDS,y} – MD_{y,reg} * GWP\_CH_4$

where,

BEy	Baseline emissions at year "y" during crediting period (tCO2e)
$BE_{CH4,SWDS,y}$	Yearly Methane Generation Potential of the wastes diverted to be disposed in the landfill from the beginning of the project (x=1) up to the year "y", calculated according to AMS III.G (tCO2e).
$MD_{y,reg}$	methane that would be destroyed or removed in the year "y" for safety or legal regulation
GWP_CH_4	GWP for CH4 (value of 21 is used for the first commitment period)

The estimation of the methane emission potential of a solid waste disposal site ($BE_{CH4,SWDS,y}$, in tCO_2e) shall be undertaken using the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", found on the CDM website. The tool may be used with the oxidation factor (OX = 0.0), assuming no oxidation of methane in the covering layers, and the factor "f=0.0" assuming that no methane is captured and flared.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

where:

$BE_{CH4,SWDS,y}$	= Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	= Model correction factor to account for model uncertainties (0.9)
f	= Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	= Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	= Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	= Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	= Fraction of degradable organic carbon (DOC) that can decompose
MCF	= Methane correction factor
$W_{j,x}$	= Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	= Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	= Decay rate for the waste type *j*
j	= Waste type category (index)
x	= Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	= Year for which methane emissions are calculated

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Waste type j	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
A. Wood and wood products	43	50
B. Pulp, paper and cardboard (other than sludge)	40	44
C. Food, food waste, beverages and tobacco (other than sludge)	15	38
D. Textiles	24	30
E. Garden, yard and park waste	20	49
F. Glass, plastic, metal, other inert waste	0	0

Waste type j		**Boreal and Temperate (MAT≤20ºC)**	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,04	0,06
	Wood, wood products and straw	0,02	0,03
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,05	0,1
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,06	0,185
Waste type j		**Tropical (MAT>20ºC)**	
		Dry (MAP<1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0,045	0,07
	Wood, wood products and straw	0,025	0,035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0,065	0,17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0,085	0,4

MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

As the biomass combust in the project is 100% rice husks, the following parameters are chosen:

1. Fraction of degradable organic carbon (DOC) that can decompose:

DOC = 38 %

Considering:

a. Waste Type: food waste
b. Condition: dry waste

$Q_{biomass} = Q_{biomass\_total} - Q_{biomass\_baseline}$

where:

$Q_{biomass}$ Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)

$Q_{biomass\_total}$ Total amount of biomass consumed in the project activity and registered by the weight measuring system in the year *x* (tons, wet basis)

$Q_{biomass\_baseline}$ Amount of biomass consumed during the baseline scenario (tons/year)

$W_{j,x} = Q_{biomass} \cdot (1 - MC)$

Where:

$W_{j,x}$ Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons, dry basis)

$Q_{biomass}$ Amount of rice husks prevented from disposal in the SWDS in the year *x* (tons, wet basis)

MC Moisture Content (12% by weight)

2. Decay rate:

k = 0,4

Considering:

a. MAT = 20,1ºC > 20ºC
b. MAP = 1860.7 mm > 1000mm

Source: City Hall website http://www.itaqui.rs.gov.br/noticia.php?detalhar=33

Project emissions

According to the same guidelines for type III. E., the project emissions are calculated using the following formula:

$PE_y = PE_{y,comb} + PE_{y,transp} + PE_{y,power}$

where:

PE_y	project activity direct emissions in the year "y" (tonnes of CO2 equivalent)
$PE_{y,comb}$	emissions through combustion of non-biomass carbon in the year "y"
$PE_{y,transp}$	emissions through incremental transportation in the year "y"
$PE_{y,power}$	emissions through electricity or diesel consumption in the year "y"

(i) Emissions through combustion of non-biomass carbon in the year "y":

$PE_{y,comb} = Q_{y,non\text{-}biomass} * 44/12 + Q_{y,fuel} * E_{y,fuel}$

where:

$Q_{y,non\text{-}biomass}$	Non-biomass carbon of the waste combusted in the year "y" (tonnes of Carbon)
$Q_{y,fuel}$	Quantity of auxiliary fuel used in the year "y" (tonnes)
$E_{y,fuel}$	CO_2 emission factor for the combustion of the auxiliary fuel (tonnes CO2 per tonne fuel, according to IPCC Guidelines)

(ii) Emissions through incremental transportation in the year "y":

$PE_{y,transp} = (Q_y/CT_y) * DAF_w * EF_{CO2} + (Q_{y,ash}/CT_{y,ash}) * DAF_{ash} * EF_{CO2}$

where:

Q_y	quantity of waste combusted in the year "y" (tonnes)
CT_y	average truck capacity for waste transportation (tonnes/truck)
DAF_w	average incremental distance for waste transportation (km/truck)
EF_{CO2}	CO2 emission factor from fuel use due to transportation (kgCO2/km, IPCC default values or local values can be used.
$Q_{y,ash}$	quantity of combustion residues produced in the year "y" (tonnes)
$CT_{y,ash}$	average truck capacity for combustion residues transportation (tonnes/truck)
DAF_{ash}	average distance for combustion residues transportation (km/truck)

(iii) Emissions through electricity or diesel consumption in the year "y":

In case the project activity consumes grid-based electricity, the grid emission factor (kg_{CO2e}/kWh) is used, or it is assumed that diesel generators would have provided a similar amount of electric power, calculated as described in category I.D.

Formulae to supplement equations presented in category III.E of annex B.

The amount of combustion residues produced is determined in the following way:

$Q_{ash} = AC*Q_{biomass}$

Where,

Q_{ash}	quantity of combustion residues produced (tonnes/year)
AC	ash content in rice husks (18% weight)
$Q_{biomass}$	Quantity of biomass treated under the project activity (tonnes/year)

Leakage

The controlled combustion technology is not equipment transferred from/to another activity. Therefore leakage effects do not need to be considered.

<u>Combined Emission Reductions</u>

The total combined emission reduction of the bundle of project activities of type I.D. and III.E are:

$ER_{total} = ER_{ID} + ER_{IIIE}$

ER_{total}	Total net emission reduction by the bundle of project activities (tonnes CO_2 equivalent)
ER_{ID}	Emission reduction due to grid connected renewable electricity production (tonnes CO_2equ)
ER_{IIIE}	Emission reduction by the avoidance of methane production from biomass decay through controlled combustion (tonnes of CO_2 equivalent)

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

>>

Table 7: Emission reduction by grid connected renewable electricity generation

Year	Estimation of project activity emissions (tCO2 e)	Estimation of baseline emissions (tCO2 e)	Estimation of leakage (tCO2 e)	Estimation of overall emission reductions (tCO2 e)
1 Mar - 31 Dec 2010	0	6,750	0	6,750
2011	0	8,100	0	8,100
2012	0	8,100	0	8,100
2013	0	8,100	0	8,100
2014	0	8,100	0	8,100
2015	0	8,100	0	8,100
2016	0	8,100	0	8,100
1 Jan - 28 Feb 2017	0	1,350	0	1,350
Total (tonnes of CO2 e)	0	56,700	0	56,700

Table 8: Emission reduction by avoidance of methane production from biomass decay through controlled combustion

Year	Estimation of project activity emissions (tCO2 e)	Estimation of baseline emissions (tCO2 e)	Estimation of leakage (tCO2 e)	Estimation of overall emission reductions (tCO2 e)
1 Mar - 31 Dec 2010	4	11,476	0	11,472
2011	5	20,706	0	20,701
2012	5	26,894	0	26,889
2013	5	31,042	0	31,037
2014	5	33,822	0	33,817
2015	5	35,686	0	35,681
2016	5	36,935	0	36,930
1 Jan - 28 Feb 2017	1	6,295	0	6,294
Total (tonnes of CO2 e)	35	202,856	0	202,821

Table 9: Net emission reduction by the bundle of projects (tonnes CO_2 equivalent per year)

Year	Type I.D grid connected renewable electricity generation			Type III.E Avoidance of methane production			Total net emission reduction
	Baseline emissions (A)	Project emissions (B)	Net emission reduction (A-B)	Baseline emissions (C)	Project emissions (D)	Net emission reduction (C-D)	(A-B) + (C-D)
1 Mar - 31 Dec 2010	**6,750**	**0**	**6,750**	**11,476**	**4**	**11,472**	**18,222**
2011	**8,100**	**0**	**8,100**	**20,706**	**5**	**20,701**	**28,801**
2012	**8,100**	**0**	**8,100**	**26,894**	**5**	**26,889**	**34,989**
2013	**8,100**	**0**	**8,100**	**31,042**	**5**	**31,037**	**39,137**
2014	**8,100**	**0**	**8,100**	**33,822**	**5**	**33,817**	**41,917**
2015	**8,100**	**0**	**8,100**	**35,686**	**5**	**35,681**	**43,781**
2016	**8,100**	**0**	**8,100**	**36,935**	**5**	**36,930**	**45,030**
1 Jan - 28 Feb 2017	**1,350**	**0**	**1,350**	**6,295**	**1**	**6,294**	**7,644**
Total estimated reductions	**56,700**	**0**	**56,700**	**202,856**	**35**	**202,821**	**259,521**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**EGy**
Data unit:	MWh/year
Description:	Annual net electricity generated from the project activity
Source of data to be used:	Power plants supervisory system
Value of data	32,663
Description of measurement methods and procedures to be applied:	The electricity generated by the project activity will be continuously measured and integrated by the biomass power plant supervisory system. The electricity generated will be electronic registered in a monthly basis. For more details, please refer to section B.7.2.
QA/QC procedures to be applied:	The biomass power plant will be provided by two additional electricity measurement devices which will allows to check the output numbers consistency.
Any comment:	

Data / Parameter:	**$Q_{biomass\_total}$**
Data unit:	t/year
Description:	Total amount of biomass consumed by the power plant
Source of data to be used:	Biomass weigh measuring system
Value of data	31,878
Description of measurement methods and procedures to be applied:	The biomass consumption will be continuously measured/integrated and will be electronic recorded in a monthly basis.
QA/QC procedures to be applied:	The amount of biomass consumed could be double checked by the difference between the rice husk inlet and the rice husk transported to the outside of the rice mill, in case of surplus biomass, during the project activity. The rice husk inlet will be the rice *in natura* (rice with husk) multiplied by the husk content (22 % w/w). The husk content results from the analysis performed by CIENTEC[5] laboratory. The outlet rice husk is obtained through the truck bills related to the biomass transportation.
Any comment:	

B.7.2 Description of the monitoring plan:

>>

ROLES AND RESPONSIBILITIES

Joaquim Oliveira S.A. Participações (JOSAPAR), PTZ Bioenergy Ltda (fully and exclusively authorized to act on the behalf of JOSAPAR regarding this CDM project) and BioHeat International (exclusively authorized to sell the carbon credits from the JOSAPAR project) are all project participants.

JOSAPAR operates the plant that is part of the project and will measure the required monitoring data related to the project and is qualified to do so.

PTZ is responsible for interpretation of the monitoring data, and leakage effects, preparation of the monitoring reports and quality assurance. PTZ will provide instructions and training to operators of JOSAPAR and operates as the Project Manager regarding monitoring.

BioHeat International serves as focal point for communication with the UNFCCC and is available as back office to support PTZ.

MONITORING PROCEDURES

Category I.D.

Figure 1 shows the location of the three electricity measurement systems (M1,M2 and M3) that will be placed at biomass power plant.

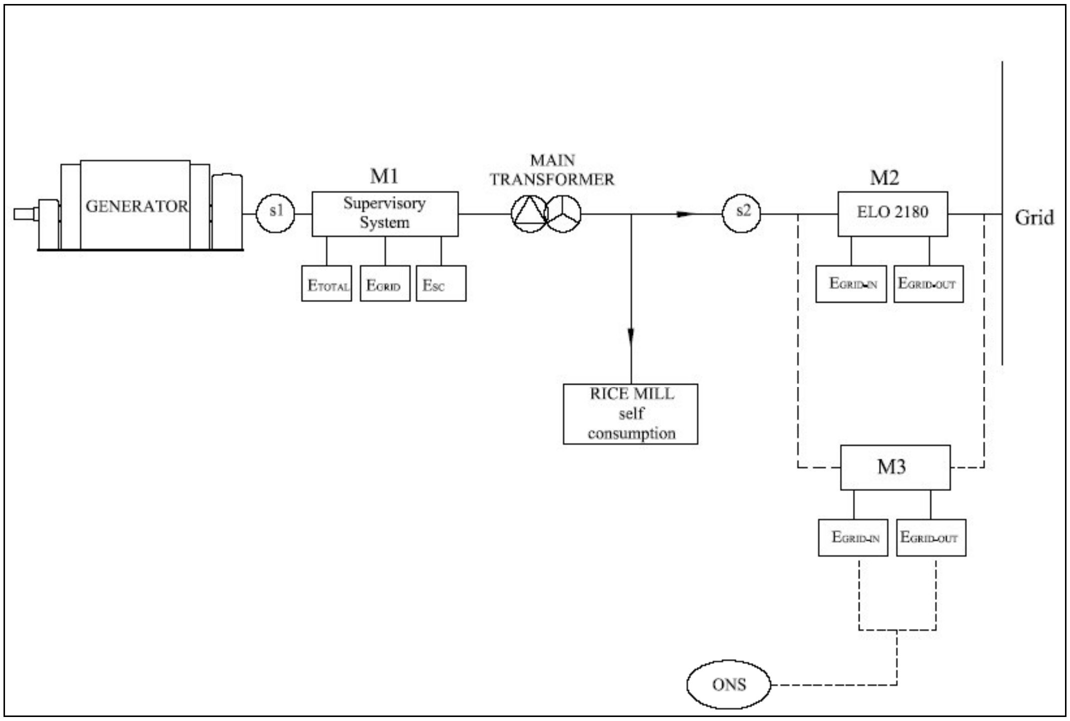

Figure 1. Diagram of the electricity measurement systems

M1

The first electricity measurement system (M1) is located right at the exit of the generator and constantly records the gross (E_{TOTAL}) and grid (E_{GRID}) electricity generated. It has two sensors, one placed just after the generator (s1) and one placed just before the grid (s2). By determination the difference between E_{TOTAL} and E_{GRID}, the electricity provided for JOSAPAR self-consumption (E_{SC}) is obtained. E_{TOTAL} is the displaced electricity and equals EG_y (Electricity production by the project activity. The other parameters are used for quality control and quality assurance. The gross electricity generated is continuously integrated and registered in a monthly basis.

M2

The second electricity measure system (M2) registers the electricity exported ($E_{GRID-OUT}$) to and imported ($E_{GRID-IN}$) from the grid. This device is identified as ELO 2180 and is actually installed at the measurement cabin. The information generated by M2 is monthly read by the electricity concessionaire, which is responsible to submit the electricity bills. The electrical grid company owns the system.

M3

The third electricity measure system (M3) will measure the same data as M2. However, unlike M2, the measured values will be uploaded in real time through internet to ONS, the Brazilian national authority responsible to collect the data about electricity generation/consumption in the country.

Category III.E.

The biomass treated under the project activity $Q_{biomass}$ will be measured through a weight measuring system. This system will register the biomass consumption monthly.

It is important to note that $Q_{biomass}$ will be the total amount of biomass registered by the weight measuring system ($Q_{biomass\_total}$) discounted the amount of biomass combust in the baseline scenario ($Q_{biomass\_baseline}$) as specified in Annex 3.

COMMUNICATION

The project manager will instruct the project owner in how to collect the monitoring data. For this purpose a Monitoring Protocol will be established.

- The monitoring protocol (MP) consists of a (1) data registration form and (2) detailed instructions on the monitoring procedures. The data registration form is used by the monitoring personnel of the project owner to report all project information needed to calculate the avoided greenhouse emissions and other relevant project information to the project manager on a yearly base.
- The project owner can contact the project manager by telephone, email or fax for additional information on the MP.
- The project owner sends the monitoring protocol with monitoring data back to the project manager, covering monitoring data on the previous calendar year.
- Every year the project manager will evaluate the MP. If necessary, the MP will be updated as to reflect:
  (1) changes as indicated in the verification report of the previous verification;
  (2) changes initiated by the project manager as to improve data collection quality and communication toward the project owners.
  The project manager sends the updated MP as soon as possible to the project owners.
- Beside information supply through the data registration form, which is submitted on a yearly base, the project owner will inform the project manager within two weeks in case:
  (1) technical problems occur with the installation that could lead to substantial lower electricity production or methane reduction than foreseen.
  (2) problems occur that could endanger the monitoring data collection (broken measurement equipment, problems with data registration form, etc).
  (3) the project owner introduces a new contact person for the communication with the project manager.
- In case the project owner introduces a new contact person, the project manager will contact the new contact person and take care that he or she is fully informed about the monitoring procedures. In addition the project manager will advise on the need for training (data collection, processing, and interpretation, knowledge of measurement equipment).
- In case problems occur that could endanger proper monitoring, the troubleshooting procedures will be applied.

DATA PROCESSING & QUALITY MANAGEMENT

The procedures below are related to the activities of the project manager. Detailed instructions on data collection and processing for the project owner is formulated in the Monitoring Protocol.

- The project manager stores and keeps the contracts, filled in data sheets and additional documentation (for instance confidentially agreements with project owners) in an orderly way, organised either by document type or by subproject.
- The project manager keeps all paper and electronic documents at a safe place during the CDM-project period, and longer if so required according to CDM-regulations.
- The monitoring data collected from the project owners is processed in the following way:
    1. Data is checked on completeness. If the data is not complete, the project manager contacts the project owner by phone, email or fax to ask for additional information.
    2. Data is checked on calculation errors. If calculation errors occur, the project owner is contacted by phone, email or fax and asked for clarification, and if necessary additional explanation is given. This type of errors is noted, and taken into account in the evaluation of the MP.
    3. If uncertainty exists on the monitoring data, a conservative approach will be applied in the interpretation of this data.
    4. Data is entered into the central database, an excel sheet that contains all necessary calculation rules and procedures.
    5. Consistency checks are carried out. If significant inconsistencies are observed, the project owner is asked for clarification. The project owner and project manager will jointly formulate a plausible explanation for the inconsistencies. If this approach does not work, the trouble shooting procedures will be followed.
    6. The calculated emission reductions and other relevant information are reported in the monitoring report and offered to the verification body.

- The project manager carries out corrective actions as stated in validation and/or verification reports, and/or otherwise as requested by the DOE. If appropriate, the project manager takes care that the project owner implements the corrective actions. The results of corrective actions will be described in the monitoring report of the subsequent period, or will be immediately send to the DOE, depending on its urgency.
- The project manager prepares the concept monitoring report and internally checks the report on completeness and quality of data. The concept monitoring report is sent to the project advisor. The project advisor checks the concept monitoring report and the calculations and returns open questions to the project manager. After both project manager and project advisor are fully satisfied with the content of the final monitoring report, the external verification institute (DOE) is requested to verify the monitoring report.

TROUBLESHOOTING

If problems occur related to the monitoring of the project performance, for instance data collection, measurement equipment, the data registration form, etc. The project manager will execute the following actions if problems are directly related to the monitoring of projects:

(1) The project manager will try to explain and indicate solutions for problems by phone, email or fax.

(2) If necessary and if it is contributing to the solution of the problem, the project manager will pay a visit to the project site, or the project owner will visit the office of the project manager.

(3) In case of problems that cannot be easily solved, the project manager will contact the project advisor. They will jointly formulate an approach to solve the problem.

(4) All disputes that might arise from the contract between Bioheat International B.V. and the project owner will be settled as described in the contract between Bioheat International B.V. and the project owners.

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

16/07/2007

Name of person/entity determining the baseline and monitoring methodology:

- Ricardo Pretz and Diego Silveira from PTZ Bioenergy Fontes Alternativas de Energia Indústria, Comércio e Serviços Ltda. and;
- Martijn Vis from Bioheat International B.V.

Contact details are listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

01/08/2008

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

>>

30 years

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

C.2.1. Renewable crediting period

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

>>

01/03/2010

C.2.1.2. Length of the first crediting period:

>>

7 years, 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

>>

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

>>

Documentation

The renewable energy plant will receive permit for construction from ANEEL, the Brazilian electricity energy National Agency.

The environmental permit for operation from the Environmental Agency of Rio Grande do Sul State (FEPAM – Fundação Estadual de Proteção Ambiental) also will be acquired for the project implementation.

Renewable electricity generation

The project will contribute to displace more carbon-intensive electricity generation sources from the South-Southeast-Midwest grid, promoting the use of renewable fuels (biomass) for electricity generation.

Rice husks

The project will improve the local environmental condition due to the adequate treatment of rice husks residues. Currently these residues are a problem because they are left decomposing in landfills, releasing methane emissions to the atmosphere.

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:

>>

Environmental impacts are not significant.

SECTION E. Stakeholders' comments

>>

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

>>

According to the Resolution nº 1 dated on 2nd December 2003, from the Brazilian Inter-Ministerial Commission of Climate Change - CIMGC, decreed on 7th July 1999, any CDM projects must send a letter with description of the project and an invitation for comments by local stakeholders. In this case, letters were sent to the following local stakeholders:

- City Hall of Itaqui;
- Chamber of Itaqui;
- Environment agencies from the state and Local Authority;

- Brazilian Forum of NGOs;
- District Attorney (known in Portuguese as Ministério Público, i.e. the permanent institution essential for legal functions responsible for defending the legal order, democracy and social/individual interests) and;
- Local communities associations.

Local stakeholders were invited to raise their concerns and provide comments on the project activity for a period of 30 days after receiving the letter of invitation. PTZ Bioenergy Fontes Alternativas de Energia Indústria, Comércio e Serviços Ltda. and the project developer addressed questions raised by stakeholders during this period.

E.2. Summary of the comments received:

>>

1. City Hall of Itaqui.
2. Local communities associations

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

>>

1. The City Hall of Itaqui congratulated the project initiative.
2. The local communities associations congratulated the project initiative and suggest destining the surplus of electricity generated to social institutions.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project participants

Organization:	JOSAPAR – Joaquim Oliveira S.A. Participações
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Salutation:	
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Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funds.

Annex 3

BASELINE INFORMATION

Summary Table

Ex-ante estimation

Year	2003	2004	2005	**Average**
Electricity generated (MWh)	303,759,363	307,901,911	324,700,347	**312,120,540**
Electricity generated excluding low cost/must-run power sources (MWh)	14,262,645	18,157,904	17,842,905	**16,754,485**
Emissons (tCO_2)	12,086,653	14,922,077	14,919,154	**13,975,961**
λ	0.531	0.506	0.513	**0.517**
EF_OM (tCO_2/MWh)	0.397	0.406	0.407	**0.404**
20% of Total generated (MWh)	60,751,873	61,580,382	64,940,069	**62,424,108**
Total generated by the last 5 plants built (MWh)	1,177,754	2,605,422	777,845	**1,520,340**
EF_BM (tCO_2/MWh)	0.077	0.102	0.097	**0.092**
w_OM	0.5	0.5	0.5	**0.5**
w_BM	0.5	0.5	0.5	**0.5**
EF (tCO_2/MWh)	0.237	0.254	0.252	**0.248**

Biomass and electricity aspects in the JOSAPAR Biomass Co-generation Project

Year	Electricity generated/year (MWh)	Amount of rice husks produced (kg/year)	Amount of rice husks consumed (kg/year)	Amount of rice husks consumed in the Project Activity (kg/year)	Amount of rice husks to the landfill (kg/year)	% Consumed
2009	-	31,878,000	12,051,000	0	19,827,000	38%
2010	27,219	31,878,000	26,565,000	14,514,000	5,313,000	83%
2011	32,663	31,878,000	31,878,000	19,827,000	0	100%
2012	32,663	31,878,000	31,878,000	19,827,000	0	100%
2013	32,663	31,878,000	31,878,000	19,827,000	0	100%
2014	32,663	31,878,000	31,878,000	19,827,000	0	100%
2015	32,663	31,878,000	31,878,000	19,827,000	0	100%
2016	32,663	31,878,000	31,878,000	19,827,000	0	100%
2017	32,663	31,878,000	31,878,000	19,827,000	0	100%
2018	32,663	31,878,000	31,878,000	19,827,000	0	100%
2019	32,663	31,878,000	31,878,000	19,827,000	0	100%
2020	32,663	31,878,000	31,878,000	19,827,000	0	100%
2021	32,663	31,878,000	31,878,000	19,827,000	0	100%

BASELINE INFORMATION

The grid factor calculation was conduced with the following databases:

- Efficiency for thermal power plants:

Thermal Power Plant	Efficiency calculation sources
Jorge Lacerda A	Eletrobrás[1] and CIMGC[2]
Jorge Lacerda B	Eletrobrás and CIMGC
Jorge Lacerda C	Eletrobrás and CIMC
Charqueadas	Eletrobrás and CIMGC
P.Medice A	Eletrobrás and CIMGC
P. Medice B	Eletrobrás and CIMGC
P. Medice (A+B)	Eletrobrás and CIMGC
São Jeronimo	Eletrobrás and CIMGC
Figueira	Eletrobrás and CIMGC
Santa Cruz	Eletrobrás and CIMGC
Igarapé	Eletrobrás and CIMGC
Piratininga	Eletrobrás and CIMGC
Nova Piratininga	Eletrobrás and CIMGC

For the other efficiency inputs the Executive Board recommended values were used just for the Build Margin calculation. For the Operating Margin the values adopted were the average as described in the OECD information paper (Bosi, 2002)[3].

- Electricity Generated at 2003, 2004, 2005:

National Operator from the Electricity System: www.ons.org.br

[1] Eletrobrás – http://www.eletrobras.gov.br/EM_atuacao_ccc/default.asp

[2] Comissão Interministerial de Mudança Global do Clima – CIMGC; Análise sobre o Setor Energético na Região Sul: www.mct.gov.br/clima/comunic_old/energi41.htm#index

[3] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. Road testing baselines for GHG mitigation projects in the electric power sector. OECD/IEA information paper, October 2002.

ONS Dispatched Data

Year: 2003

GRID	Fuel Source [1]	Power Plant [1]	Start date	GEN_y[2]	Fossil Fuel Conversion Eficiency [4]	BM_Fossil Fuel Conversion Eficiency [5]	NCV_i[6]	$F_{i,y}$_OM	$F_{i,y}$_BM	$OXID_i$	Carbon Emission Factor[3]	$EF_{CO2,i}$	$COEF_{i,y}$	$F_{i,j,y}*COEF_{i,j,y}$_OM	$F_{i,j,y}*COEF_{i,j,y}$_BM
				MWh/year			TJ/kt	t/year	t/year		tC/TJ	tCO_2/TJ	tCO_2/t	tCO_2/year	tCO_2/year
SE-CO	H	Jauru	Sep-2003	78,921	1	1	0	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Gauporé	Sep-2003	86,201	1	1	0	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Três Lagoas	Aug-2003	233,793	0.32	0.32	48.00	54,795	54,795	99.5%	15.3	56.10	2.68	146,815	146,815
SE-CO	H	Funil (MG)	jan/03	370,111	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Itiquira I	Sep-2002	408,728	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
S	G	Araucária	Sep-2002	22	0.32	0.32	48.00	5	5	99.5%	15.3	56.10	2.68	14	14
S	G	Canoas	Sep-2002	182,256	0.32	0.32	48.00	42,716	42,716	99.5%	15.3	56.10	2.68	114,451	114,451
SE-CO	H	Piraju	Sep-2002	417,894	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Nova Piratininga	jun/02	47,847	0.2197	0.32	52.00	15,077	10,352	99.5%	15.3	56.10	2.90	43,764	30,046
S	O	PCT CGTEE	jun/02	0	0.33	0.33	40.40	0	0	99.0%	20.7	75.90	3.04	0	0
SE-CO	H	Rosal	jun/02	316,262	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Ibirité	May-2002	530,761	0.32	0.32	48.00	124,397	124,397	99.5%	15.3	56.10	2.68	333,302	333,302
SE-CO	H	Cana Brava	May-2002	2,200,434	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Sta. Clara	jan/02	169,471	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Machadinho	jan/02	3,436,304	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Juiz de Fora	nov/01	5,845	0.32	0.32	48.00	1,370	1,370	99.5%	15.3	56.10	2.68	3,670	3,670
SE-CO	G	Macaé Merchant	nov/01	2,389,507	0.32	0.32	48.00	560,041	560,041	99.5%	15.3	56.10	2.68	1,500,537	1,500,537
SE-CO	H	Lajeado (ANEEL res. 402/2001)	nov/01	4,457,790	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Eletrobolt	Oct-2001	242,364	0.32	0.32	48.00	56,804	56,804	99.5%	15.3	56.10	2.68	152,197	152,197
SE-CO	H	Porto Estrela	Sep-2001	410,136	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	2,228,109	0.32	0.32	48.00	522,213	522,213	99.5%	15.3	56.10	2.68	1,399,184	1,399,184
SE-CO	G	W. Arjona	jan/01	549,729	0.32	0.32	48.00	128,843	128,843	99.5%	15.3	56.10	2.68	345,213	345,213
S	G	Uruguaiana	jan/00	1,751,486	0.5	0.5	48.00	262,723	262,723	99.5%	15.3	56.10	2.68	703,923	703,923
S	H	S. Caxias	jan/99	5,556,125	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Canoas I	jan/99	594,298	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Canoas II	jan/99	507,843	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Igarapava	jan/99	1,140,260	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Porto Primavera	jan/99	9,059,670	1	1	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	0	0.32	0.33	43.00	0	0	99.0%	20.2	74.07	3.15	0	0
SE-CO	H	Sobragi	Sep-1998	341,073	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH EMAE	jan/98	103,188	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	PCH CEEE	jan/98	240,724	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	PCH ENERSUL	jan/98	119,405	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CEB	jan/98	76,857	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH ESCELSA	jan/98	260,910	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	PCH CELESC	jan/98	442,080	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CEMAT	jan/98	966,348	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CELG	jan/98	80,656	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CERJ	jan/98	256,284	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	PCH COPEL	jan/98	421,439	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CEMIG	jan/98	564,461	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH CPFL	jan/98	328,332	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	S. Mesa	jan/98	4,490,258	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	PCH EPAULO	jan/98	0	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Guilmam Amorim	jan/97	511,414	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Corumbá	jan/97	1,604,930	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Miranda	jan/97	1,778,457	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Noav Ponte	jan/94	2,208,901	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Segredo (Gov. Ney Braga)	jan/92	5,253,636	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Taquaruçu	jan/89	2,251,810	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Manso	jan/88	841,600	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	D. Francisca	jan/87	895,131	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Itá	jan/87	5,222,285	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Rosana	jan/87	2,029,045	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	N	Angra	jan/85	13,355,432	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	T. Irmãos	jan/85	2,493,761	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Itaipu 60 Hz	jan/83	46,309,279	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Itaipu 50 Hz	jan/83	36,692,448	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Emborcação	jan/82	3,928,062	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Nova Avanhandava	jan/82	1,377,657	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Gov. Bento Munhoz - GBM	jan/80	4,178,204	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	S.Santiago	jan/80	6,124,508	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Itumbiara	jan/80	7,342,183	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	O	Igarapé	jan/78	33,791	0.2938	-	40.40	10,249	0	99%	20.7	75.90	3.04	31,112	0
S	H	Itauba	jan/78	1,895,033	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	A. Vermelha (Jose E. Moraes)	jan/78	7,280,135	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	S.Simão	jan/78	10,850,060	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Capivara	jan/77	3,527,028	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	S.Osório	jan/75	4,305,490	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Marimbondo	jan/75	6,614,912	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Promissão	jan/75	998,520	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	C	Pres. Medici	jan/74	1,306,186	0.2085	-	13.82	#######	0	98%	26	95.33	1.29	2,107,038	0
SE-CO	H	Volta Grande	jan/74	1,892,826	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Porto Colombia	jun/73	1,849,042	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Passo Fundo	jan/73	1,176,518	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Passo Real	jan/73	771,223	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Ilha Solteira	jan/73	16,060,345	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Mascarenhas	jan/73	777,134	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Gov. Parigot de Souza - GPS	jan/71	1,001,495	1	-	0.00	0	0	0.0%	0.0	0	0	0	0

SE-CO	H	Chavantes	jan/71	2,026,711	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Jaguara	jan/71	2,649,364	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Sá Carvalho	Apr-1970	302,343	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Estreito (Luiz Carlos Barreto)	jan/69	3,084,368	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Ibitinga	jan/69	600,891	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Jupiá	jan/69	8,944,402	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	O	Alegrete	jan/68	0	0.26	-	40.40	0	0	99%	20.7	75.90	3.04	0	0
SE-CO	G	Campos (Roberto Silveira)	jan/68	0	0.24	-	48.00	0	0	99.5%	15.3	56.10	2.68	0	0
SE-CO	G	Santa Cruz (RJ)	jan/68	540,073	0.3314	-	48.00	122,225	0	99.5%	15.3	56.10	2.68	327,483	0
SE-CO	H	Paraibuna	jan/68	265,808	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Limoeiro (Armando Sal es de Oliviera)	jan/67	128,521	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Caconde	jan/66	340,046	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	C	J.Lacerda C	jan/65	1,985,975	0.3395	-	18.84	#######	0	98%	26	95.33	1.76	1,967,467	0
S	C	J.Lacerda B	jan/65	1,126,809	0.2771	-	18.84	777,026	0	98%	26	95.33	1.76	1,367,688	0
S	C	J.Lacerda A	jan/65	583,250	0.2635	-	18.84	422,957	0	98%	26	95.33	1.76	744,470	0
SE-CO	H	Bariri (Alvaro de Souza Lima)	jan/65	541,316	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Funil (RJ)	jan/65	619,432	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	C	Figueira	jan/63	54,554	0.166	-	23.86	49,585	0	98%	26	95.33	2.23	110,533	0
SE-CO	H	Furnas	jan/63	4,499,554	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Barra Bonita	jan/63	477,594	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	C	Charqueadas	jan/62	136,595	0.2011	-	12.98	188,387	0	98%	26	95.33	1.21	228,453	0
SE-CO	H	Jurumirim (Armando A. Laydner)	jan/62	439,132	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	H	Jacui	jan/62	1,419,402	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Pereira Passos	jan/62	326,708	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Tres Marias	jan/62	1,818,886	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Euclides da Cunha	jan/60	419,565	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Camargos	jan/60	157,100	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Santa Branca	jan/60	134,029	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Cachoeira Dourada	jan/59	2,959,147	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Salto Grande (Lucas N. Garcez)	jan/58	427,192	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Salto Grande (MG)	jan/56	513,869	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Mascarenhas de Moraes (Peixoto)	jan/56	2,207,257	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Itutinga	jan/55	210,152	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
S	C	S. Jerônimo	jan/54	43,993	0.114	-	17.58	79,025	0	98%	26	95.33	1.64	129,793	0
SE-CO	O	Carioba	jan/54	0	0.3	-	40.40	0	0	98%	20.7	75.90	3.01	0	0
SE-CO	O	Piratininga	jan/54	289,700	0.2378	-	40.19	109,124	0	99%	20.7	75.90	3.02	329,546	0
S	H	Canastra	jan/53	237,695	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Nilo Peçanha	jan/53	2,386,456	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Fontes Nova	jan/40	719,497	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Henry Borden Sub.	jan/26	63,638	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Henry Borden Ext.	jan/26	448,281	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	I. Pombos	jan/24	680,168	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
SE-CO	H	Jaguari	jan/17	54,835	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
Importação Internacional	H	-	-	360,234	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
Exportação Internacional	H	-	-	0	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
Importação NNE	H	-	-	99,532	1	-	0.00	0	0	0.0%	0.0	0	0	0	0
Exportação NNE	H	-	-	7,632,626	1	-	0.00	0	0	0.0%	0.0	0	0	0	0

Year: 2004

GRID	Fuel Source [1]	Power Plant [1]	Start date	GEN_y [2]	Fossil Fuel Conversion Eficiency [4]	BM_Fossil Fuel Conversion Eficiency [5]	NCV_i [6]	$F_{i,y}$_OM	$F_{i,y}$_BM	$OXID_i$	Carbon Emission Factor[3]	$EF_{CO2,i}$	$COEF_{i,y}$	$F_{i,j,y}$*$COEF_{i,j,y}$_OM	$F_{i,j,y}$*$COEF_{i,j,y}$_BM
				MWh/year			TJ/kt	t/year	t/year		tC/TJ	tCO_2/TJ	tCO_2/t	$tCO_2/year$	$tCO_2/year$
SE-CO	G	TermoRio	Nov-2004	120,326	0.32	0.32	48.00	28,201	28,201	99.5%	15.3	56.10	2.68	75,561	75,561
SE-CO	H	Candonga	Sep-2004	129,327	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Queimado	May-2004	360,952	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Norte Fluminense	Feb-2004	1,507,181	0.32	0.32	48.00	353,246	353,246	99.5%	15.3	56.10	2.68	946,464	946,464
SE-CO	H	Jauru	Sep-2003	487,636	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Gauporé	Sep-2003	335,127	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Três Lagoas	Aug-2003	1,419,067	0.32	0.32	48.00	332,594	332,594	99.5%	15.3	56.10	2.68	891,131	891,131
SE-CO	H	Funil (MG)	jan/03	667,597	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Itiquira I	Sep-2002	856,539	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	G	Araucária	Sep-2002	22	0.32	0.32	48.00	5	5	99.5%	15.3	56.10	2.68	14	14
S	G	Canoas	Sep-2002	527,587	0.32	0.32	48.00	123,653	123,653	99.5%	15.3	56.10	2.68	331,308	331,308
SE-CO	H	Piraju	Sep-2002	466,775	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Nova Piratininga	jun/02	13,820	0.2197	0.32	52.00	4,354	2,990	99.5%	15.3	56.10	2.90	12,638	8,679
S	O	PCT CGTEE	jun/02	0	0.33	0.33	40.40	0	0.00	99.0%	20.7	75.90	3.04	0	0
SE-CO	H	Rosal	jun/02	384,555	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Ibirité	May-2002	1,245,228	0.32	0.32	48.00	291,850	291,850	99.5%	15.3	56.10	2.68	781,965	781,965
SE-CO	H	Cana Brava	May-2002	2,214,839	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Sta. Clara	jan/02	345,880	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Machadinho	jan/02	4,337,016	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Juiz de Fora	nov/01	66,002	0.32	0.32	48.00	15,469	15,469	99.5%	15.3	56.10	2.68	41,447	41,447
SE-CO	G	Macaé Merchant	nov/01	740,098	0.32	0.32	48.00	173,460	173,460	99.5%	15.3	56.10	2.68	464,759	464,759
SE-CO	H	Lajeado (ANEEL res. 402/2001)	nov/01	4,331,991	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Eletrobolt	Oct-2001	1,324,501	0.32	0.32	48.00	310,430	310,430	99.5%	15.3	56.10	2.68	831,746	831,746
SE-CO	H	Porto Estrela	Sep-2001	554,865	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	1,659,230	0.32	0.32	48.00	388,882	388,882	99.5%	15.3	56.10	2.68	1,041,946	1,041,946
SE-CO	G	W. Arjona	jan/01	538,087	0.32	0.32	48.00	126,114	126,114	99.5%	15.3	56.10	2.68	337,902	337,902
S	G	Uruguaiana	jan/00	2,270,176	0.5	0.5	48.00	340,526	340,526	99.5%	15.3	56.10	2.68	912,385	912,385
S	H	S. Caxias	jan/99	6,015,459	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Canoas I	jan/99	578,928	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Canoas II	jan/99	486,299	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Igarapava	jan/99	1,090,945	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Porto Primavera	jan/99	9,472,700	1	1	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	0	0.32	0.33	43.00	0	0.00	99.0%	20.2	74.07	3.15	0	0.0
SE-CO	H	Sobragi	Sep-1998	395,652	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH EMAE	jan/98	137,132	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	PCH CEEE	jan/98	215,617	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	PCH ENERSUL	jan/98	174,892	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CEB	jan/98	109,606	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH ESCELSA	jan/98	353,471	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	PCH CELESC	jan/98	468,240	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CEMAT	jan/98	1,353,714	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CELG	jan/98	73,309	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CERJ	jan/98	297,264	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	PCH COPEL	jan/98	707,277	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CEMIG	jan/98	672,546	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH CPFL	jan/98	458,822	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	S. Mesa	jan/98	4,397,135	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	PCH EPAULO	jan/98	0	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Guilmam Amorim	jan/97	661,366	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Corumbá	jan/97	2,163,267	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Miranda	jan/97	1,069,831	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Noav Ponte	jan/94	1,302,583	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Segredo (Gov. Ney Braga)	jan/92	5,897,593	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Taquaruçu	jan/89	2,022,042	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Manso	jan/88	732,036	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	D. Francisca	jan/87	683,674	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Itá	jan/87	6,054,272	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Rosana	jan/87	1,864,543	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	N	Angra	jan/85	11,581,987	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	T. Irmãos	jan/85	2,058,733	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Itaipu 60 Hz	jan/83	46,853,256	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Itaipu 50 Hz	jan/83	36,935,778	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Emborcação	jan/82	4,312,481	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Nova Avanhandava	jan/82	1,406,957	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Gov. Bento Munhoz - GBM	jan/80	5,352,443	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	S.Santiago	jan/80	6,886,744	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Itumbiara	jan/80	7,854,963	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	O	Igarapé	jan/78	19,989	0.2938	-	40.40	6,063	0.00	99%	20.7	75.90	3.04	18,406	0.0
S	H	Itauba	jan/78	1,233,332	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	A. Vermelha (Jose E. Moraes)	jan/78	6,520,363	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	S.Simão	jan/78	12,205,751	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Capivara	jan/77	3,302,087	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	S.Osório	jan/75	484,648	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Marimbondo	jan/75	6,349,261	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Promissão	jan/75	1,048,625	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	C	Pres. Medici	jan/74	1,492,153	0.2178	-	13.82	1,784,555	0.00	98%	26.0	95.33	1.29	2,304,140	0.0
SE-CO	H	Volta Grande	jan/74	1,793,617	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Porto Colombia	jun/73	1,715,325	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Passo Fundo	jan/73	705,586	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Passo Real	jan/73	549,702	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Ilha Solteira	jan/73	15,868,207	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Mascarenhas	jan/73	786,812	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0

S	H	Gov. Parigot de Souza - GPS	jan/71	1,204,667	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Chavantes	jan/71	1,935,377	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Jaguara	jan/71	2,506,033	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Sá Carvalho	Apr-1970	464,819	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Estreito (Luiz Carlos Barreto)	jan/69	2,948,054	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Ibitinga	jan/69	712,124	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Jupiá	jan/69	8,790,288	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	O	Alegrete	jan/68	0	0.26	-	40.40	0	0.00	99%	20.7	75.90	3.04	0	0.0
SE-CO	G	Campos (Roberto Silveira)	jan/68	0	0.24	-	48.00	0	0.00	99.5%	15.3	56.10	2.68	0	0.0
SE-CO	G	Santa Cruz (RJ)	jan/68	199,124	0.3342	-	48.00	44,681	0.00	99.5%	15.3	56.10	2.68	119,714	0.0
SE-CO	H	Paraibuna	jan/68	199,289	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Limoeiro (Armando Sal es de Oliviera)	jan/67	165,483	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Caconde	jan/66	280,607	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	C	J.Lacerda C	jan/65	2,330,323	0.3400	-	18.84	1,309,745	0.00	98%	26.0	95.33	1.76	2,305,359	0.0
S	C	J.Lacerda B	jan/65	1,304,788	0.2781	-	18.84	896,387	0.00	98%	26.0	95.33	1.76	1,577,783	0.0
S	C	J.Lacerda A	jan/65	873,490	0.2663	-	18.84	626,682	0.00	98%	26.0	95.33	1.76	1,103,060	0.0
SE-CO	H	Bariri (Alvaro de Souza Lima)	jan/65	638,646	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Funil (RJ)	jan/65	685,740	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	C	Figueira	jan/63	73,448	0.1663	-	23.86	66,631	0.00	98%	26.0	95.33	2.23	148,530	0.0
SE-CO	H	Furnas	jan/63	4,288,104	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Barra Bonita	jan/63	567,300	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	C	Charqueadas	jan/62	239,467	0.2016	-	12.98	329,387	0.00	98%	26.0	95.33	1.21	399,441	0.0
SE-CO	H	Jurumirim (Armando A. Laydner)	jan/62	445,781	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	H	Jacui	jan/62	1,178,249	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Pereira Passos	jan/62	384,696	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Tres Marias	jan/62	1,892,922	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Euclides da Cunha	jan/60	561,413	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Camargos	jan/60	188,520	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Santa Branca	jan/60	99,619	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Cachoeira Dourada	jan/59	3,315,489	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Salto Grande (Lucas N. Garcez)	jan/58	484,648	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Salto Grande (MG)	jan/56	579,580	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Mascarenhas de Moraes (Peixoto)	jan/56	2,337,376	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Itutinga	jan/55	239,530	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
S	C	S. Jerônimo	jan/54	30,845	0.1140	-	17.58	55,421	0.00	98%	26.0	95.33	1.64	91,026	0.0
SE-CO	O	Carioba	jan/54	0	0.3	-	40.40	0	0.00	98%	20.7	75.90	3.01	0.0	0.0
SE-CO	O	Piratininga	jan/54	162,952	0.2378	-	40.19	61,376	0.00	99%	20.7	75.90	3.02	185,352	0.0
S	H	Canastra	jan/53	148,084	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Nilo Peçanha	jan/53	2,689,893	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Fontes Nova	jan/40	803,368	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Henry Borden Sub.	jan/26	5,393	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Henry Borden Ext.	jan/26	417,167	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	I. Pombos	jan/24	881,028	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
SE-CO	H	Jaguari	jan/17	35,455	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
Importação Internacional	H	-	-	189,847	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
Exportação Internacional	H	-	-	1,180,696	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
Importação NNE	H	-	-	1,278,428	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0
Exportação NNE	H	-	-	3,830,322	1	-	0.00	0.00	0.00	0.0%	0.0	0.0	0.0	0.0	0.0

Year: 2005

GRID	Fuel Source [1]	Power Plant [1]	Start date	GEN_y[2]	Fossil Fuel Conversion Eficiency [4]	BM_Fossil Fuel Conversion Eficiency [5]	NCV_i[6]	$F_{i,y}$_OM	$F_{i,y}$_BM	$OXID_i$	Carbon Emission Factor[3]	$EF_{CO2,i}$	$COEF_{i,y}$	$F_{i,j,y}*COEF_{i,j,y}$_OM	$F_{i,j,y}*COEF_{i,j,y}$_BM
				MWh/year			TJ/kt	t/year	t/year		tC/TJ	tCO_2/TJ	tCO_2/t	tCO_2/year	tCO_2/year
SE-CO	H	Quebra Queixo	Dec-2005	16,197	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Ourinhos	Nov-2005	25,167	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Barra Grande	Nov-2005	248,690	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Mimoso	Oct-2005	48,329	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Ponte de Pedra	Aug-2005	439,462	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Aimorés	Aug-2005	122,877	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Santa Clara PR	Aug-2005	321,818	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Monte Claro	Jan-2005	243,331	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	TermoRio	Nov-2004	1,150,380	0.32	0.32	48.0	269,620	269,620	99.5%	15.3	56.10	2.68	722,403	722,403
SE-CO	H	PCH CESP	Sep-2004	0	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Candonga	Sep-2004	565,935	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Queimado	May-2004	588,657	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Norte Fluminense	Feb-2004	3,635,646	0.32	0.32	48.0	852,105	852,105	99.5%	15.3	56.10	2.68	2,283,074	2,283,074
SE-CO	H	Jauru	Sep-2003	514,779	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Gauporé	Sep-2003	389,619	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Três Lagoas	Aug-2003	690,051	0.32	0.32	48.0	161,731	161,731	99.5%	15.3	56.10	2.68	433,331	433,331
SE-CO	H	Funil (MG)	jan/03	800,466	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Itiquira I	Sep-2002	1,104,190	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	G	Araucária	Sep-2002	0	0.32	0.32	48.0	0	0	99.5%	15.3	56.10	2.68	0	0
S	G	Canoas	Sep-2002	927,537	0.32	0.32	48.0	217,391	217,391	99.5%	15.3	56.10	2.68	582,465	582,465
SE-CO	H	Piraju	Sep-2002	446,366	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Nova Piratininga	jun/02	231,010	0.2197	0.32	52.0	72,782	49,978	99.5%	15.3	56.10	2.90	211,259	145,067
S	O	PCT CGTEE	jun/02	0	0.33	0.33	40.4	0	0	99.0%	20.7	75.90	3.04	0	0
SE-CO	H	Rosal	jun/02	421,691	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Ibirité	May-2002	490,201	0.32	0.32	48.0	114,891	114,891	99.5%	15.3	56.10	2.68	307,831	307,831
SE-CO	H	Cana Brava	May-2002	2,316,663	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Sta. Clara	jan/02	332,249	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Machadinho	jan/02	4,480,027	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Juiz de Fora	nov/01	232,477	0.32	0.32	48.0	54,487	54,487	99.5%	15.3	56.10	2.68	145,988	145,988
SE-CO	G	Macaé Merchant	nov/01	119,568	0.32	0.32	48.0	28,024	28,024	99.5%	15.3	56.10	2.68	75,085	75,085
SE-CO	H	Lajeado (ANEEL res. 402/2001)	nov/01	4,539,333	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Eletrobolt	Oct-2001	190,904	0.32	0.32	48.0	44,743	44,743	99.5%	15.3	56.10	2.68	119,882	119,882
SE-CO	H	Porto Estrela	Sep-2001	593,357	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	1,229,232	0.32	0.32	48.0	288,101	288,101	99.5%	15.3	56.10	2.68	771,920	771,920
SE-CO	G	W. Arjona	jan/01	728,835	0.32	0.32	48.0	170,821	170,821	99.5%	15.3	56.10	2.68	457,686	457,686
S	G	Uruguaiana	jan/00	1,733,424	0.5	0.5	48.0	260,014	260,014	99.5%	15.3	56.10	2.68	696,664	696,664
S	H	S. Caxias	jan/99	5,920,260	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Canoas I	jan/99	555,667	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Canoas II	jan/99	441,828	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Igarapava	jan/99	1,297,196	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Porto Primavera	jan/99	9,686,480	1	1	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Sobragi	Sep-1998	385,988	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH EMAE	jan/98	149,526	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	PCH CEEE	jan/98	173,917	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	PCH ENERSUL	jan/98	162,165	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CEB	jan/98	114,097	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH ESCELSA	jan/98	500,563	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	PCH CELESC	jan/98	481,799	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CEMAT	jan/98	1,515,897	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CELG	jan/98	72,592	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CERJ	jan/98	311,762	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	PCH COPEL	jan/98	578,787	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CEMIG	jan/98	619,029	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH CPFL	jan/98	461,440	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	S. Mesa	jan/98	4,731,322	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	PCH EPAULO	jan/98	0	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Guilmam Amorim	jan/97	632,333	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Corumbá	jan/97	1,923,111	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Miranda	jan/97	1,480,071	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Nova Ponte	jan/94	2,015,019	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Segredo (Gov. Ney Braga)	jan/92	5,587,794	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Taquaruçu	jan/89	2,032,597	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Manso	jan/88	616,312	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	D. Francisca	jan/87	761,279	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Itá	jan/87	5,940,371	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Rosana	jan/87	1,880,873	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	N	Angra	jan/85	9,854,879	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	T. Irmãos	jan/85	2,030,080	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Itaipu 60 Hz	jan/83	43,263,219	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Itaipu 50 Hz	jan/83	38,437,460	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Emborcação	jan/82	5,428,696	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Nova Avanhandava	jan/82	1,424,680	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Gov. Bento Munhoz - GBM	jan/80	5,264,925	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	S.Santiago	jan/80	6,337,245	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Itumbiara	jan/80	8,818,284	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	O	Igarapé	jan/78	13,604	0.2938	-	40.4	4,126	-	99%	20.7	75.90	3.04	12,527	-
S	H	Itauba	jan/78	1,725,629	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	A. Vermelha (Jose E. Moraes)	jan/78	7,426,577	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	S.Simão	jan/78	11,878,356	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Capivara	jan/77	3,445,003	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	S.Osório	jan/75	4,404,318	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Marimbondo	jan/75	6,694,731	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000

SE-CO	H	Promissão	jan/75	1,022,782	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	C	Pres. Medici	jan/74	1,699,573	0.2178	-	13.82	2,032,621	-	98%	26	95.33	1.29	2,624,433	-
SE-CO	H	Volta Grande	jan/74	2,181,749	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Porto Colombia	jun/73	1,955,931	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Passo Fundo	jan/73	994,464	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Passo Real	jan/73	671,226	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Ilha Solteira	jan/73	16,814,478	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Mascarenhas	jan/73	795,700	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Gov. Parigot de Souza - GPS	jan/71	1,240,817	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Chavantes	jan/71	1,785,328	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Jaguara	jan/71	2,694,735	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Sá Carvalho	Apr-1970	478,444	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Estreito (Luiz Carlos Barreto)	jan/69	4,208,999	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Ibitinga	jan/69	688,094	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Jupiá	jan/69	9,114,514	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	O	Alegrete	jan/68	0	0.26	-	40.4	0	-	99%	20.7	75.90	3.04	0	-
SE-CO	G	Campos (Roberto Silveira)	jan/68	0	0.24	-	48.0	0	-	99.5%	15.3	56.10	2.68	0	-
SE-CO	G	Santa Cruz (RJ)	jan/68	176,628	0.3342	-	48.0	39,633	-	99.5%	15.3	56.10	2.68	106,190	-
SE-CO	H	Paraibuna	jan/68	272,422	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Limoeiro (Armando Sales de Oliviera)	jan/67	157,213	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Caconde	jan/66	400,542	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	C	J.Lacerda C	jan/65	2,012,313	0.3400	-	18.84	1,131,009	-	98%	26	95.33	1.76	1,990,755	-
S	C	J.Lacerda B	jan/65	1,188,746	0.2781	-	18.84	816,666	-	98%	26	95.33	1.76	1,437,462	-
S	C	J.Lacerda A	jan/65	877,032	0.2663	-	18.84	629,224	-	98%	26	95.33	1.76	1,107,533	-
SE-CO	H	Bariri (Alvaro de Souza Lima)	jan/65	603,788	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Funil (RJ)	jan/65	857,914	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	C	Figueira	jan/63	81,238	0.1663	-	23.86	73,698	-	98%	26	95.33	2.23	164,284	-
SE-CO	H	Furnas	jan/63	5,687,817	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Barra Bonita	jan/63	547,013	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	C	Charqueadas	jan/62	213,418	0.2016	-	12.98	293,557	-	98%	26	95.33	1.21	355,990	-
SE-CO	H	Jurumirim (Armando A. Laydner)	jan/62	454,698	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	H	Jacui	jan/62	1,174,695	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Pereira Passos	jan/62	397,305	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Tres Marias	jan/62	2,543,413	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Euclides da Cunha	jan/60	534,411	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Camargos	jan/60	200,117	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Santa Branca	jan/60	148,713	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Cachoeira Dourada	jan/59	3,604,388	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Salto Grande (Lucas N. Garcez)	jan/58	486,456	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Salto Grande (MG)	jan/56	632,393	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Mascarenhas de Moraes (Peixoto)	jan/56	2,781,338	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Itutinga	jan/55	251,290	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
S	C	S. Jerônimo	jan/54	33,587	0.1140	-	17.58	60,348	-	98%	26	95.33	1.64	99,117	-
SE-CO	O	Carioba	jan/54	0	0.3	-	40.4	0	-	98%	20.7	75.90	3.01	0	-
SE-CO	O	Piratininga	jan/54	187,501	0.2378	-	40.19	70,623	-	99%	20.7	75.90	3.02	213,275	-
S	H	Canastra	jan/53	213,576	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Nilo Peçanha	jan/53	2,818,325	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Fontes Nova	jan/40	748,752	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Henry Borden Sub.	jan/26	199,758	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Henry Borden Ext.	jan/26	551,061	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	I. Pombos	jan/24	874,876	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
SE-CO	H	Jaguari	jan/17	99,160	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
Importação Internacional	H	-	-	490,209	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
Exportação Internacional	H	-	-	620,561	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
Importação NNE	H	-	-	3,045,043	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000
Exportação NNE	H	-	-	4,789,574	1	-	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.000	0.000

Legend

S: South	SE: Southeast
CO: Midwest	NNE: Northeast
C: Coal	D: Diesel
N: Natural Gas	O: Fuel oil
H: Hydro	N: Nuclear

References

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[4] Roadtesting Baselines for GHG mitigation Projects in the Electric Power Sector, October 2002
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[6] Balanço Energético Nacional 2007 - Ministério de Minas e Energia: (www.mme.gov.br)

Assumption

The evaluation of the Operating Margin emission factor was conduced in a conservative way using the following consideration:

$COEF_k = 0$.:

$$\frac{\sum_{(i,k)} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0$$

Load Duration Curve

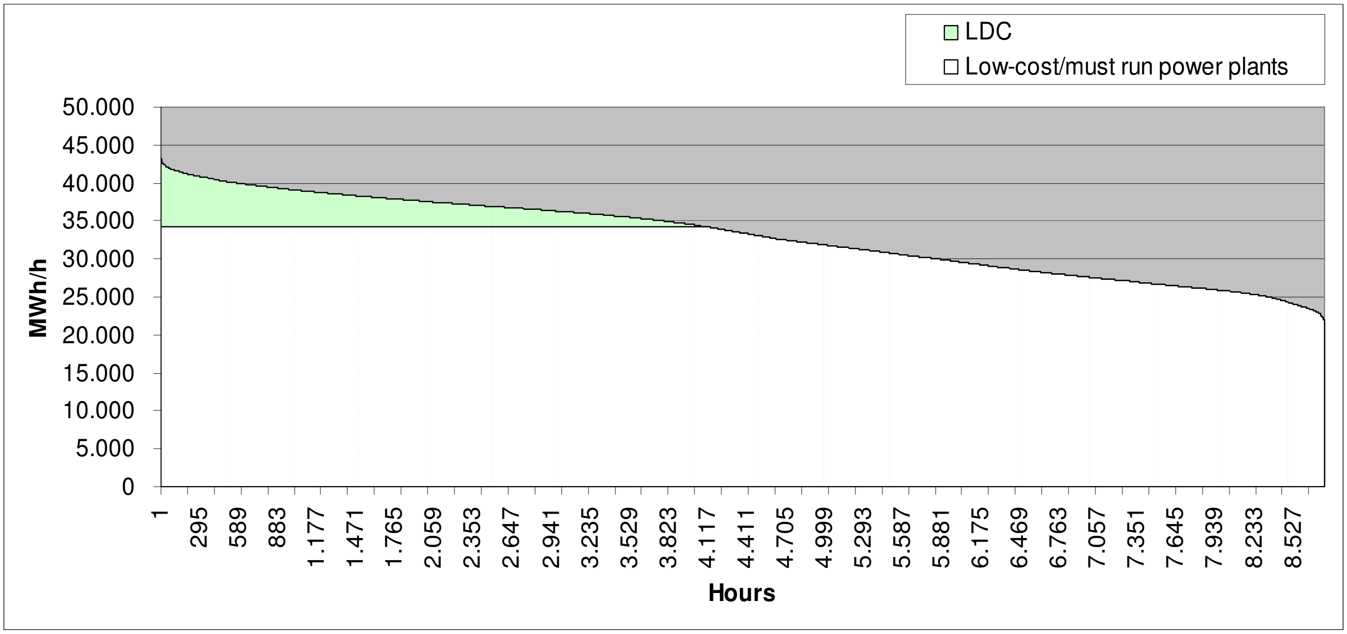

Figure 1. Load Duration Curve corresponding to the south-southeast-midwest Brazilian grid at 2003

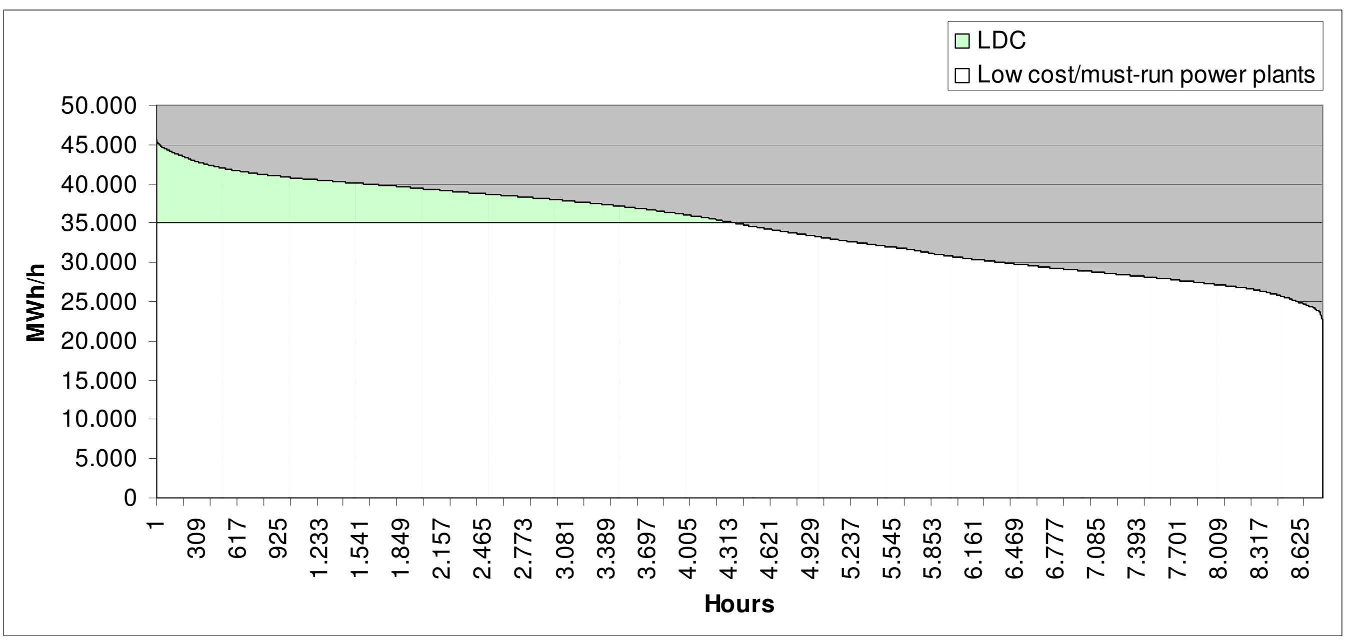

Figure 2. Load Duration Curve corresponding to the south-southeast-midwest Brazilian grid at 2004

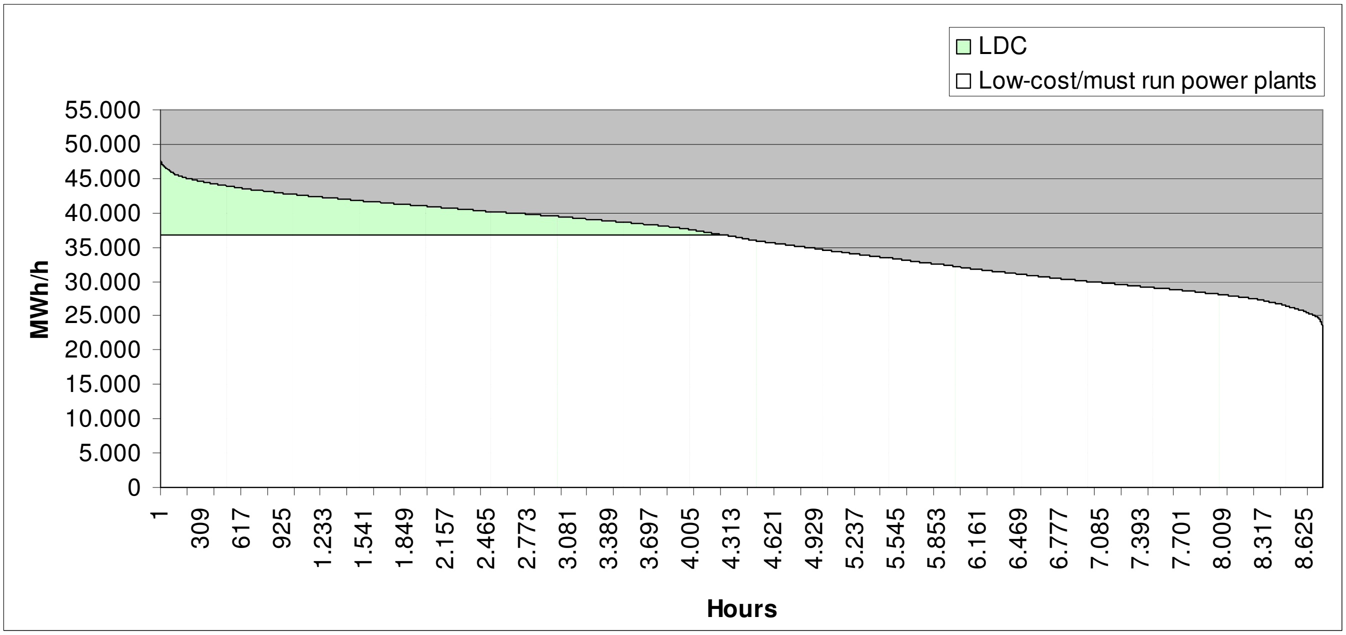

Figure 3. Load Duration Curve corresponding to the south-southeast-midwest Brazilian grid at 2005

Full details about the necessary data to plot the load duration curves were provided to DOE.

Annex 4

MONITORING INFORMATION

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