



Monitoring report form
(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT

Title of the project activity	Cristalino Small Hydroelectric Power Plant (hereafter referred to as "CristalSHP")
Reference number of the project activity	1800
Version number of the monitoring report	3
Completion date of the monitoring report	13/11/2014
Registration date of the project activity	15/12/2008
Monitoring period number and duration of this monitoring period	First monitoring period. 1,994 days. (15/12/2008 - 31/05/2014) (first and last days included)
Project participant(s)	Cristalino Energia Ltda (Private entity)
Host Party(ies)	Brazil
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral Scope 1 – Energy Industries (Renewable / Non-renewable Sources) Methodology AMS-I.D. ver. 12
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	34,496 tCO ₂ e ¹
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	30,402 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	22,734 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	7,668 tCO ₂ e

¹ Calculation demonstrated in the document "CERs 1st MR-rev2.xls"

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The present project activity consists in renewable sources electricity generation— hydro potential, through the construction of a Small Hydro Power plant (SHP) called Cristalino, developed by Cristalino Energia Ltda.

With an installed capacity of 4MW, the SHP is located on Barra Preta river in Manoel Ribas city, Parana State – south region, Brazil.

The electricity delivered to the National Interconnected Grid System (SIN) replaces fossil fuelled thermal generation that would have to be inputted in the system by renewable energy generation.

The project activity contributes to the environmental sustainability increasing the share of renewable energy in relation to the total electricity consumption in Brazil.

Considering that the project activity consists in a SHP with a small reservoir (880m² of area) – it represents a virtually zero environmental impact when compared to large hydroelectric plants. This fact is very important because the construction of Small Hydro Power plants can really contributes to efficient use of environmental and natural resources, avoiding the growth of environmental and social liabilities caused by new large hydroelectric power plants or fossil fuel thermal generation.

In this way, the investment in modern technology for small hydropower plants contributes for an efficient use of the water resources as a relevant factor to be emphasized, adding value to the natural resources (this is a run of river project activity).

The technology used in the enterprise is the Barra Preta River (Ivaí River Basin) hydro energy potential for electricity generation through the water gravitational energy, which is used to move the turbines and doing this, trigger generators that enable the electricity generation. This is a clean and renewable source of electricity that presents minimal impact over the environment.

The Cristalino SHP dispatches generated energy to the National Interconnected Grid (SIN - *Sistema Interligado Nacional*) through a COPEL 's Substation called Manoel Ribas (the power line extension has 14.5 Km from the SHP until Manoel Ribas substation).

The relevant dates for the project activity are described in Table 1 below.

Table 1: Timeline SHP Cristalino

18/07/2005	Authorization to start construction (ANEEL ² , Despatch N# 854 ³)
08/08/2005	Authorization to start commercial operations (ANEEL, Despatch N# 981 ⁴)
15/12/2008	CDM Project registration date and start date of crediting period
15/12/2008 - 31/05/2014	First monitoring period (both days included)

The total GHG emission reductions in this monitoring period (15 December 2008 until 31 May 2014) were 30,402 tCO₂.

² ANEEL, National Electricity Regulatory Agency (*Agência Nacional de Energia Elétrica*)

³ <http://www.aneel.gov.br/cedoc/dsp2005854.pdf>

⁴ <http://www.aneel.gov.br/cedoc/dsp2005981.pdf>

A.2. Location of project activity

The project activity is located in the City of Manoel Ribas, Paraná State, Southern Brazil.

The GPS coordinates are: 24° 34'19" S and 51°33'31" W.

The Figure 1 illustrates the location of the enterprise:

Figure 1: Geographical location of Manoel Ribas city.



Source: Wikipedia - pt.wikipedia.org

A.3. Parties and project participant(s)

Party involved (host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (Host Country)	Cristalino Energia Ltda. (Private entity)	No

A.4. Reference of applied methodology and standardized baseline

The methodology used was the AMS-I.D. version 12: "Grid connected renewable electricity generation" - version 12⁵ (valid from 10 August 2007 to 13 December 2007). This one already contains the standardized baseline.

A.5. Crediting period of project activity

15/12/2008 to 14/12/2015, 7 years, renewable.

A.6. Contact information of responsible persons/ entities

Carbotrader Assessoria e Consultoria em Energia Eireli is the entity responsible for the baseline calculation and MR description.

The person responsible in Carbotrader is Arthur Augusto Clessie de Moraes, telephone +55 (11) 4522-7180, e-mail: moraes.arthur@carbotrader.com.

⁵ http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_LPQNF2IC0HM1LAZCQGJPWLSGCP5BB8/AMS_I.D_rev_ver12.pdf?t=RzV8bjh0ODFkDALq4j3iV9N7HfRqMeqOZnw

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project activity Cristalino Small Hydroelectric Power Plant (hereafter referred to as “Cristalino” or “the Project”) has been implemented by Cristalino Energia Ltda. The Project involved the installation of two units of 2.0MW turbines matched with two units of 2.500MVA generators. The total installed capacity of the Project is 4.0MW, and the estimated annual system-connected electricity (EG_y) is 24,192MWh.

The Project provides renewable energy to the Brazilian Interconnected System. The emission reductions are achieved by displacing part of the fossil fuelled electricity from the Brazilian Interconnected System. The estimated average annual emission reductions as per the registered PDD are 6,317tCO₂e.

The Project is a run of river small hydroelectric plant with total installed capacity of 4.0MW (2.0MW x 2). The Project uses the hydro potential of Barra Preta River (which is part of the Ivaí River basin), and has a small reservoir with 880m² of area.

The Project facility contains a small dam, which stores water in order to generate electricity for short periods of time. It was designed to function as a run of river scheme. A typical run of river scheme involves a low-level diversion dam. According to Eletrobras⁶ definition, run of river projects are “the projects where the river’s dry season flow rate is the same or higher than the minimum required for the turbines”. A low-level diversion dam raises the river water level sufficiently to enable an intake structure to be located on the river side. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and as low level as possible to gain the maximum head on the turbine.

Figure 2 below shows the scheme of a run of the river power plant:

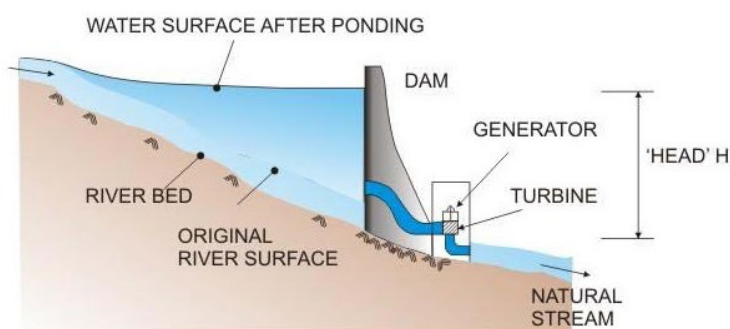


Figure 2 - Schematic view of a run of river power plant

The equipment and technology used in the Project have been successfully applied to similar projects in Brazil and around the world. The equipment used in the project was developed and manufactured locally.

The project was implemented according its technical specification.

There were stops mainly due to circuit breaker opening and predictive and preventive maintenance, but these did not cause alterations in the calculations of the project emission reductions. These occurrences are not considered significant by the project participants.

⁶ Brazil Electrical Company - <http://www.eletrobras.gov.br/elb/procel/main.asp?ViewID={D81425AF-257E-44E9-8B0F-1F885CD35D6D}>

There were delays in the meters calibration (from 15 December 2008 to 13 May 2009 and from 10 May 2013 to 9 June 2013), these delays have been reported in the calculations⁷ of the project emissions.

In 24 June 2013 there was a slip of the embankment on the left bank of the canal occurred due to heavy rains at the time. Then the SHP didn't produce energy until this problem was solved. The date that the SHP returned to operate was 9 August 2013. As it was not produced energy, no CERs were claimed for the period prescribed.

The main equipments of the Project include the following:

Table 2 - Turbine characteristics

General Characteristics	
Manufacturer	Möller
Type	Simple Horizontal Francis
Number of Turbines	2
Height Net Fall	86.9m
Unit Nominal Flow	2.62m ³ /s
Unit Power	2,043kW
Rotation	900rpm

Table 3 - Generators characteristics

General Characteristics	
Manufacturer	GEVISA
Type	Static Three Phase Generator
Number of Generators	1
Power	2,500 kVA
Rotation	900rpm
Nominal Tension	6.6kV
Power Factor	0.8

Manufacturer	ANSALDO
Type	Static Three Phase Generator
Number of Generators	1
Power per Unit	2,500 kVA
Rotation	900rpm
Nominal Tension	13kV
Power Factor	1.0

Table 4 – Transmission system characteristics

General Characteristics	
Primary Tension	34.5kV
Transmission Line	14.5km
Connection Point	Manoel Ribas Substation

⁷ Document "CERs 1st MR-rev2.xls".

In the generation energy values from 15/12/2008 to 13/05/2009 and 10/05/2013 to 09/06/2013 were discounted the imprecision of the meters (0.2%), since the calibration did not cover this period. It can be seen in the document annexed "CERs 1st MR-rev2.xls"(Tab Overview).

As described in the EB 52 annex 60, paragraph 4, the option applied was letter "a" because the errors from calibration were smaller than the maximum permissible error of the measuring equipments. Then, as the results of delayed calibration contain errors smaller than maximum permissible errors in measuring equipments, in the values from 15/12/2008 to 13/05/2009 and 10/05/2013 to 09/06/2013 were discounted the imprecision of the meter (0.2%).

See below the Table 3 with the calibration datas:

Table 5: Calibration datas

Nº	METERS IDENTIFICATION		NUMBER OF CALIBRATION CERTIFICATE	DATE OF ISSUE	VALIDITY
1	Serie number: 504455 Manufacturer: Landis+Gyr/SAGA1000	Main meter	CCR 282/05	09/06/2005	08/06/2007
2	Serie number: 504456 Manufacturer: Landis+Gyr/SAGA1000	Backup meter	CCR 283/05	09/06/2005	08/06/2007
3	Serie number: 504455 Manufacturer: Landis+Gyr/SAGA1000	Main meter	CCL 075/09	14/05/2009	13/05/2011
4	Serie number: 504456 Manufacturer: Landis+Gyr/SAGA1000	Backup meter	CCL 074/09	14/05/2009	13/05/2011
5	Serie number: 504455 Manufacturer: Landis+Gyr/SAGA1000	Main meter	504455	10/05/2011	09/05/2013
6	Serie number: 504456 Manufacturer: Landis+Gyr/SAGA1000	Backup meter	504456	10/05/2011	09/05/2013
7	Serie number: 504455 Manufacturer: Landis+Gyr/SAGA1000	Main meter	CCR 555/13	10/06/2013	09/06/2015
8	Serie number: 504456 Manufacturer: Landis+Gyr/SAGA1000	Backup meter	CCR 556/13	10/06/2013	09/06/2015

B.2. Post registration changes**B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline**

Not Applicable

B.2.2. Corrections

Not Applicable

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

Not applicable

B.2.4. Changes to project design of registered project activity

Not applicable.

B.2.5. Changes to start date of crediting period

Not Applicable

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not Applicable

SECTION C. Description of monitoring system

- **Monitoring system**

Cristalino has a supervision system manufactured which the electrical parameters are measured and the electricity generated is registered.

The electricity generated is transmitted to a panel inside the Manoel Ribas substation from COPEL (*Companhia Paranaense de Energia*, the local energy distribution company), where the meters are located (one main and a backup meter), through a transmission line of 14.5 km. The meters are connected to a gateway that transmits through cellular modem the electricity generation data to the energy trader company CCEE⁸ (*Câmara de Comercialização de Energia Elétrica*). These data are sent to the CCEE HTTP internet server on a frequency of every 15 minutes. Also, these data are available on a monthly basis for the electrical regulatory agencies CCEE, ANEEL, ONS⁹ (*Operador Nacional do Sistema Elétrico*), COPEL and daily for Cristalino Energia Ltda (that makes use of an own software called E-meter, for acquiring the copy of meters electricity readings).

- **Equipments involved**

Meters:

- Principal = Landis+Gyr, SAGA 1000, 3 phases, 60 Hz, Class 0.2, Reference Code 504455
- Backup = Landis+Gyr, SAGA 1000, 3 phases, 60 Hz, Class 0.2, Reference Code 504456

⁸ <http://www.ccee.org.br/>

⁹ <http://www.ons.org.br>

They are located in an exclusive panel for SHP Cristalino in the Manoel Ribas substation which belongs to COPEL Company.

Their readings are possible through the following systems:

- **E-meter** software (belongs to the PP) and
- **SINERCOM/Cliq CCEE** system (belongs to the CCEE with access through criptocard provided by the CCEE for COPEL monitoring centre, PP read only access or third party company contracted by the PP for this purpose).

- **Data collection and data archive**

The data is continuously monitored, recorded every 15 minutes and monthly aggregated. Spreadsheets are generated containing electricity dispatched to the grid. CCEE reports are made available and cross-checked with Emeter reports. After, these data are sent to Carbotrader (CDM consultant) and ER calculations are performed. The gathered data are kept for at least 2 years after last crediting period.

For the data applied to emission reductions calculation, the following table summarizes the monitoring parameter, monitoring equipment, location and the calibration frequency.

Table 6 – Monitoring parameter

Monitoring Parameter	Description	Source	Equipment Location	Equipment Brand	Calibration Frequency
EG_y (MWh)	Electricity generated by the renewable power plant in the year y	Cristalino Energia Ltda.	Electricity meter installed at Manoel Ribas substation	SAGA 1000	Every 2 years

- **Emergency procedures**

In the Small Hydroelectric Plant there is an Operation & Maintenance Manual, that contains the Emergency Plan.¹⁰ Some topics covered in the manual are the Emergency Plan at risk of fire and explosion, flood or landslide external and internal flooding (powerhouse), workplace safety and physical, chemical and biological hazards and preventive measures of protection, use of IPEs (Individual Protection Equipments), identification of risks (fire, electricity, noise, falls) and first aid measures, etc.

- **Accuracy and Calibration**

The accuracy and reliability of the electricity generation data were established through internal procedures for data collection and supervision system.

¹⁰ The name of the file is "Manual_O&M_Cristalino_rev3x".

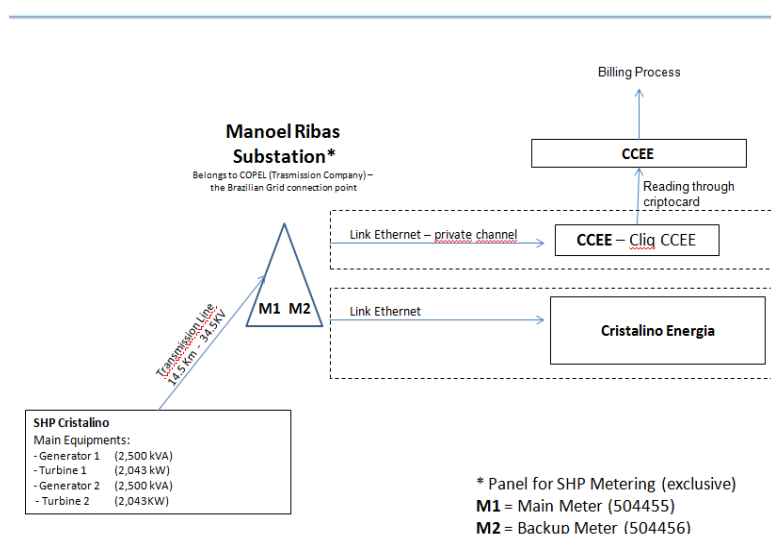
On a monthly basis, after the close of each month, the account manager performs the cross-checking of data between the total electricity generation recorded in Cristalino Energia Ltda with the total reported by the SINERCOM/Cliq CCEE.

The monitoring equipment SAGA 1000 has been installed at the substation COPEL, where the energy generated by Cristalino is transmitted. In accordance with the ONS¹¹ established regulations the monitoring equipment is calibrated every two years and is connected on line to the CCEE, which is responsible for the accounting of the supplied energy.

In summary:

- 1) In Manoel Ribas substation¹², which belongs to COPEL company, the electricity provided by Cristalino is dispatched to the Brazilian grid, there are an exclusive panel inside the substation with the meters (main and backup) for SHP Cristalino;
- 2) The electricity generated by SHP Cristalino is sent to CCEE (SINERCOM/Cliq CCEE) through their own metering channel (encrypted) over the meters placed in Manoel Ribas substation on a frequency of every 15 minutes;
- 3) At Cristalino's office, the electricity generation data are collected on a daily basis through own metering channel over the same meters located in Manoel Ribas substation (software E-meter that collects the electricity meters readings).

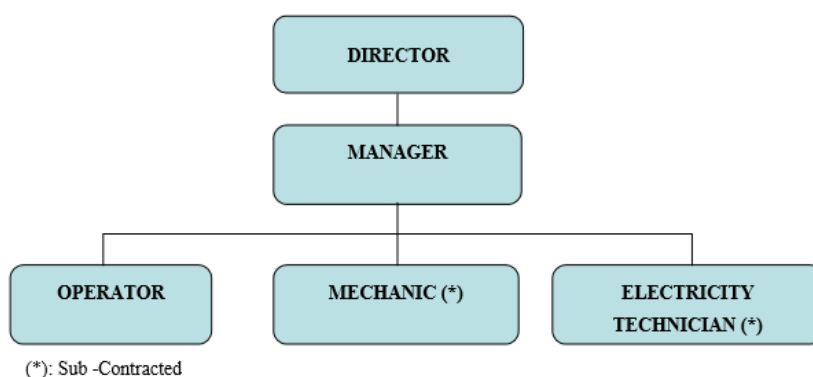
The following diagram explains the monitoring system of Cristalino SHP.



- **Organizational structure (Cristalino main staff):**

¹¹ *Operador Nacional do Sistema Elétrico* - http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.3_Rev_1.1.pdf [refer to Anexo 1 (b) and (d)]

¹² Manoel Ribas substation is the frontier point with the Brazilian National Interconnected Grid (SIN)



SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	EF_{grid}
Unit:	tCO₂e/MWh
Description:	Baseline emission factor of the Project
Source of data:	Registered PDD (version 05, 16 September 2008)
Value(s) applied:	0.2611
Purpose of data:	Baseline emission calculation
Additional comment:	Determined <i>ex-ante</i> and fixed for the first crediting period as per the registered PDD, Calculated as per ACM0002 version 6.

D.2. Data and parameters monitored

Data / Parameter:	EG _y								
Unit:	MWh								
Description:	Electricity generated by the renewable technology in the year <i>y</i>								
Measured/ Calculated / Default:	Measured								
Source of data:	Meters located at the Manoel Ribas substation (COPEL)								
Value(s) of monitored parameter:									
	Year	2008	2009	2010	2011	2012	2013	2014	TOTAL
	EG _y	1,233 .14	26,514.9 9	21,139.7 6	22,675.7 2	15,517.9 3	21,148.4 3	8,225.49	116,455. 45

Monitoring equipment:	<table> <tr> <td>Model</td><td>SAGA 1000</td></tr> <tr> <td>Accuracy</td><td>Class 0.2</td></tr> <tr> <td>Manufacturer</td><td>LANDIS+GYR</td></tr> <tr> <td>Serial number</td><td>504455 and 504456</td></tr> <tr> <td>Calibration frequency</td><td>Every two years</td></tr> <tr> <td>Validity</td><td>Two years</td></tr> <tr> <td>Location</td><td>Manoel Ribas Substation</td></tr> </table>	Model	SAGA 1000	Accuracy	Class 0.2	Manufacturer	LANDIS+GYR	Serial number	504455 and 504456	Calibration frequency	Every two years	Validity	Two years	Location	Manoel Ribas Substation
Model	SAGA 1000														
Accuracy	Class 0.2														
Manufacturer	LANDIS+GYR														
Serial number	504455 and 504456														
Calibration frequency	Every two years														
Validity	Two years														
Location	Manoel Ribas Substation														
Measuring/ Reading/ Recording frequency:	The electricity generation data are continuously monitored, recorded every 15 minutes and monthly aggregated. Data will be kept archived electronically until two years after finishing the crediting period.														
Calculation method (if applicable):	The electricity delivered to the SIN is monitored by Cristalino and by the electricity agents through meter connected to the SIN.														
QA/QC procedures:	The uncertainty level of the data is low, and the equipment are calibrated every 2 years.														
Purpose of data:	Baseline emission calculation														
Additional comment:	The data preservation is the Vetorlog data bank.														

D.3. Implementation of sampling plan

Not applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The baseline emissions (BE_y) are calculated by using the following formula:

$$BE_y = EG_y * EF_{grid,CM,y}$$

Where:

BE_y	Baseline emissions in year y (tCO ₂ /year).
EG_y	Net electricity supplied by the Project activity to the grid (MWh).
$EF_{grid,CM,y}$	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the methodology ACM0002 version 6.

The *ex-ante* emission factor as per the registered PDD (version 05, 16 September 2008) is 0.2611 tCO₂e/MWh.

The following table provides the calculation of the baseline emissions during the monitoring period.

Table 8 – Baseline emissions

EG _y	EF _y		BE _y
	OM	BM	
Total	0.4349	0.0872	

Year	MWh	tCO ₂ e/MWh	tCO ₂ e
2008*	1,233.14	0.2611	321
2009	26,514.99		6,923
2010	21,139.76		5,519
2011	22,675.72		5,920
2012	15,517.93		4,051
2013	21,148.43		5,521
2014**	8,225.49		2,147
Total	116,455.45	0.2611	30,402

*From 15 to 31 December 2008

** Until 31 May 2014

Baseline emissions calculation is available in the following spreadsheet: "CERs 1st MR-rev2.xls"

E.2. Calculation of project emissions or actual net GHG removals by sinks

According to the project category and the corresponding methodology, project emissions are zero.

E.3. Calculation of leakage

There is no leakage associated with this project activity.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
Total	30,402	0	0	30,402

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	34,496	30,402

E.6. Remarks on difference from estimated value in registered PDD

The difference between the estimations of CERs stated in PDD and CERs generated during this monitoring period is due to the plant underperformance caused by a drought period in Southern region of Brazil where the project is located (so, influence of the climate on project activity hydrological conditions over the period considered for carbon credits).

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO ₂ e)	22,734	7,668

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Cristalino Energia Ltda.
Street/P.O. Box	St. Capitão João A David, 230 - Centro – Prudentópolis
Building	
City	Manoel Ribas
State/Region	Paraná
Postcode	89834-000
Country	Brazil
Telephone	55 42 3446 2359
Fax	
E-mail	correcto@br10.com.br
Website	
Contact person	Walter Camargo
Title	Director
Salutation	Mr.
Last name	Camargo
Middle name	
First name	Walter
Department	
Mobile	
Direct fax	
Direct tel.	55 42 3446 2359
Personal e-mail	correcto@br10.com.br

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
04.0	25 June 2014	<p>Revisions to:</p> <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		