

4TH VERIFICATION

SALTO PILÃO HYDROPOWER PLANT PROJECT ACTIVITY

Document Prepared By Ecopart Assessoria em Negócios Empresariais Ltda.

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Table of Contents

1	Project Details	3
1.1	Summary Description of the Implementation Status of the Project	3
1.2	Sectoral Scope and Project Type	4
1.3	Project Proponent.....	4
1.4	Other Entities Involved in the Project	4
1.5	Project Start Date	4
1.6	Project Crediting Period	4
1.7	Project Location	5
1.8	Title and Reference of Methodology.....	5
1.9	Other Programs.....	5
1.10	Sustainable Development	6
2	Implementation Status.....	7
2.1	Implementation Status of the Project Activity	7
2.2	Deviations	8
2.2.1	Methodology Deviations	8
2.2.2	Project Description Deviations.....	8
2.3	Grouped Project	8
2.4	Safeguards.....	8
2.4.1	No Net Harm	8
2.4.2	Local Stakeholder Consultation.....	9
3	Data and Parameters	11
3.1	Data and Parameters Available at Validation	11
3.2	Data and Parameters Monitored	11
3.3	Monitoring Plan	14
4	Quantification of GHG Emission Reductions and Removals	19
4.1	Baseline Emissions	19
4.2	Project Emissions.....	21
4.3	Leakage	22
4.4	Net GHG Emission Reductions and Removals	22
APPENDIX 1: Remarks on difference from estimated values		23

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Salto Pilão project activity consists of the implementation of a hydropower plant with 191.88 MW¹ installed capacity and 0.15 km²² reservoir area. The plant is located between the cities of Lontras, Ibirama and Apiúna, state of Santa Catarina, Southern region of Brazil.



Figure 1 – Salto Pilão Hydropower Plant (source: CESAP’s website)

Salto Pilão hydropower plant (*from Portuguese Usina Hidrelétrica Salto Pilão - UHESP*) is owned by an association of several companies called *Consórcio Empresarial Salto Pilão*. The current consortium structure is as follows³:

- Companhia Brasileira de Alumínio (CBA): 60%;
- Companhia Geração de Energia de Pilão (CGEP): 20%; and
- DME Energética Ltda. (DMEE): 20%.

The renewable electricity generated by the project has important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the Project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO₂ emissions), which would be generated (and emitted) in its absence. This monitoring report presents information related to the **fourth** verification of the project activity, which covers the period of August 1st, 2013 to December, 31st 2017. The total emission reductions by the project activity over the monitored period are **1,980,116 tCO₂e**.

¹ Equipment tag following the definitions for “installed power generation capacity” of ACM0002 (version 11).

² Operation License # 4055/2012, issued on May 31st, 2012 by the environmental agency of Santa Catarina State (Fundação do Meio Ambiente – FATMA).

³ Information available at CESAP’s website: <<http://www.usinasaltopilao.com.br/institucional>>.

1.2 Sectoral Scope and Project Type

Sectoral Scopes: 1 - Energy industries (renewable - / non-renewable sources).

The project consists in a hydroelectricity power plant presented as a single project, *i.e.* it is not a grouped project

1.3 Project Proponent

Organization name	Consórcio Empresarial Salto Pilão - CESAP
Contact person	Luís Cláudio Ribeiro
Title	Manager
Address	Av. Desembargador Vitor Lima, nº. 260 – ático, 88040-400, Florianópolis, SC, Brazil
Telephone	+55 (47) 3353-9116
Email	luis@usinasaltopilao.com.br

1.4 Other Entities Involved in the Project

Organization name	Ecopart Assessoria em Negócios Empresariais Ltda.
Role in the project	Advisory company for the project development under the VCS
Contact person	A. Ricardo J. Esparta
Title	Technical director
Address	R. Padre João Manuel, 222, 01411-000, São Paulo, SP, Brazil
Telephone	+55 (11) 3063-9068
Email	ricardo.esparta@eqao.com.br

1.5 Project Start Date

According to the VCS Standard Version 3.2, the project starting date is the “*is the date on which the project began generating GHG emission reductions or removal*”. Therefore, the UHESP starting date is December 11th, 2009⁴, when the first generating unit started operation.

1.6 Project Crediting Period

According to the VCS Standard, the project crediting period for non-AFOLU projects shall be a maximum of ten years which may be renewed at most twice. Therefore, the duration of the project crediting period is 10 years renewable.

1st crediting period: 19-January-2010⁵ to 18-January-2020.

⁴ ANEEL Ordinance nr. 4,597 issued on December 10th, 2009. Available at ANEEL's website: <<http://www.aneel.gov.br/>>.

1.7 Project Location

The project is located in Itajaí-Açu River, between the cities of Lontras, Ibirama and Apiúna, Santa Catarina State, Southern region of Brazil.



Figure 2 - Physical location of the cities involved in the project activity

Source: GOOGLE EARTH (2009)⁶

According to the project license⁷, the geographic coordinates of the project activity are 27°06' S and 49°28' W.

1.8 Title and Reference of Methodology

ACM0002 – “*Consolidated methodology for grid-connected electricity generation from renewable sources*” (version 11).

1.9 Other Programs

Not applicable. The project does participate in other GHG Program, other forms of environmental credit or emission trading program and other binding limits.

⁵ ANEEL Ordinance nr. 102 issued on January 18th, 2010. Available at ANEEL's website: <<http://www.aneel.gov.br/cedoc/dsp2010102.pdf>>.

⁶ GOOGLE EARTH (2009). Brazil's map. Available at: <<http://earth.google.com/>>. Accessed on 12 Nov 2009.

⁷ Operation License # 4055/2012, issued on May 31st, 2012 by the environmental agency of Santa Catarina State (Fundação do Meio Ambiente – FATMA).

1.10 Sustainable Development

The project contributes to achieve the Host Country's development priorities regarding renewable energy generation, local development, employment and income generation, and reduction of greenhouse gases.

The project is in line with the Brazilian government initiatives to increase the renewable energy share in the electric matrix. Through Law # 10,438/2002⁸, the Brazilian government created PROINFA (Program for Alternative Energy Sources) for promoting the renewable electricity generation by celebrating long-term power purchase agreements (20-year period) at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. More recently, the government is promoting micro-scale renewable electricity generation, which consumers can generate its own electricity and dispatch electricity surplus to the grid⁹.

The project also contributes for achieving the 37% emission reduction goal of Brazil up to 2025 year as established in its Intended Nationally Determined Contribution (iNDC)¹⁰. The Brazilian iNDC is under Law # 12,187 issued on 29-December-2009, which establishes the National Policy on Climate Change.

In conclusion, the project activity contributes to the national sustainable priorities of the Host Country.

⁸ Available at: <http://www.planalto.gov.br/ccivil_03/leis/2002/L10438.htm>

⁹ ANEEL Resolution # 482 issued on 17-April-2012. Available at: <<http://www2.aneel.gov.br/cedoc/ren2012482.pdf>>

¹⁰ Available at:
<http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf>

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

UHESP project started commercial operations on December 11th, 2009¹¹ (first generating unit). The second generating unit started commercial operations on January 19th, 2010¹². The equipment and technology used in UHESP has been successfully applied to similar projects in Brazil and around the world.

As indicated in the Monitoring Report from the previous periods, the project has lower loss load than estimated due to an expansion of the headrace tunnel during the construction period. It causes a decrease in the pressure drop and, consequently, an increase in the net head, allowing the increase in the electricity generation and, consequently, in installed capacity and assured energy. Additionally, specifications of the equipment installed in the plant allowed this power increase.

Therefore, the installed capacity of the project increased from 182.3 MW to 191.88 MW and assured energy increased from 106.7MW-ave to 114.1MW-ave. Both changes were addressed in in PD, version 7.1, dated 22/05/2019.

However, no equipment has been modified or retrofitted since the plant became operational. Any equipment modification or retrofit has to be authorized by the Brazilian Power Regulatory Agency (“ANEEL” from the Portuguese Agência Nacional de Energia Elétrica) and shall be publicly available. Since no ANEEL authorizations are available, it can be demonstrated that equipment has not been modified. Additionally, there was no modification in the reservoir area. Equipment specifications are presented in Table 1 below.

Table 1 - Technical configuration of UHESP

Description		Salto Pilão HPP
Turbines	Type	Francis
	Quantity	2
	Power (MW)	97.65
	Nominal flow (m ³ /s)	55.5
	Water head (meters)	194
	Manufacturer	Voith Siemens
Generators	Type	Vertical-shaft
	Quantity	2
	Nominal Power (MVA)	106.6 (95.94 MW)
	Tension (kV)	13.8
	Frequency (Hz)	60
	Manufacturer	Voith Siemens

¹¹ As per ANEEL Ordinance #4,597 dated on 10/12/2009. Available at: <http://www.aneel.gov.br/cedoc/dsp20094597.pdf>

¹² As per ANEEL Ordinance # 102 dated on 19/01/2010. Available at: <http://www.aneel.gov.br/cedoc/dsp2010102.pdf>

No special events - such as overhaul times, downtimes of equipment, exchange of equipment – occurred during the monitored period. Therefore, there were no events or situations that could have impacted the GHG emission reductions during the monitoring period.

2.2 Deviations

2.2.1 Methodology Deviations

Not applicable, since no methodology deviations are applied.

2.2.2 Project Description Deviations

During the 4th verification of the project the DOE has requested the revision of the PD in order to reflect changes occurred in the project design:

- Increase in the installed capacity from 182.3MW to 191.88MW according to generators' tag and;
- Increase in the assured energy from 106.7MW-ave to 114.1MW-ave due to underestimated historic of river flow rate at the time of the project conception.

In addition, the following corrections were made in the PD:

- Equipment specification according to its nameplate and;
- Frequency of calibration according to updated ONS procedures¹³ valid on 01/01/2017 onwards;

Applicability of the methodology, additionality and the appropriateness of the baseline scenario were assessed in PD, version 7.1, dated 22/05/2019.

2.3 Grouped Project

Not applicable.

2.4 Safeguards

2.4.1 No Net Harm

As described in the registered PD, the Project Environmental Impact Study was prepared by Ambiental Consultoria e Planejamento Ltda. in September 1997 – Environmental impact assessment and environmental impact report (EIA/RIMA)¹⁴.

¹³ ONS procedures. "Sub-module 12.3 Maintenance of the metering system for invoicing" (in a free translation from the Portuguese *Submódulo 12.3. Manutenção do sistema de medição para faturamento*). Available at ONS's website: <<http://ons.org.br/pt/paginas/sobre-o-ons/procedimentos-de-rede/vigentes>>

¹⁴ "EIA/RIMA" from the Portuguese "Estudo de Impacto Ambiental – EIA" and "Relatório de Impacto Ambiental – RIMA".

Considering the results of the EIA/RIMA conclusions, Environmental Basic Project (“PBA” from the Portuguese Projeto Básico Ambiental) was prepared in order to reduce the negative impacts and potentiate the positive ones identified during the project planning, construction and operation. The project PBA was prepared based on the Reference Term of the project EIA and conditionings established by the environmental agency.

Under PBA, the following plans have been implemented in order to reduce the impacts of the project construction, raised in the environmental study analysis:

I) Environmental control. It involves 17 (seventeen) programs, which includes: climates conditioning observations, water quality monitoring, monitoring and conservation of local fauna, reservoir cleaning, geological impacts monitoring, environmental control of the engineering works, degraded areas recuperation, ecological station implementation, terrestrial fauna monitoring and conservation, population resettlement, social communication, infrastructure improvement, workers training, public health control, support of the municipalities, landscape memory conservation, archeological rescue.

II) Expropriation. The expropriation plan was chosen to ensure a fair compensatory condition for the local community and a fair value to the areas involved in the project boundaries.

III) Multiple use of the reservoir. This plan involves the conservation and protection of the reservoir and other areas direct and indirect affected. The plan is divided in 2 (two) main programs: a) utilization program and; b) multiple use of the reservoir.

Regarding environmental licenses, CONAMA Resolution # 237 dated 19/12/1997 establishes licenses required for the licensing process:

- The Preliminary License (“LP” from the Portuguese Licença Prévia);
- The Construction License (“LI” from the Portuguese Licença de Instalação);
- The Operating License (“LO” from the Portuguese Licença de Operação).

During the project implementation, all licenses mentioned above were issued by the environmental agency of Santa Catarina State. The current LO valid is LO # 4055/2012 issued on 31/05/2012 and it is valid for 96 months.

2.4.2 Local Stakeholder Consultation

There is no local nor national requirement to conduct the local stakeholder consultation prior to the project verification. According to national requirements¹⁵, when applicable, public hearings shall be conducted before the project implementation and always conducted by a representative from the environmental agency responsible for the licensing process of the referred project.

¹⁵ CONAMA Resolution nr. 9/1987

In the case of the project activity, local stakeholder consultation was conducted before the project implementation through the public hearing held by the environmental agency in September 2002. Detailed description of the local stakeholder consultation is presented in the registered PD.

No major concerns were raised during the public hearing regarding the project implementation. All suggestions and comments raised during the licensing process were taken into account while executing the environmental plans and programs with the environmental agency supervision.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

All data and parameters for emission reduction calculation is monitored during the credit period. For details, please refer to the section 3.2 below.

3.2 Data and Parameters Monitored

Data / Parameter	$EG_{\text{facility},y}$														
Data unit	MWh/year														
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y .														
Source of data	Project sponsor and the power utility/CCEE.														
Description of measurement methods and procedures to be applied	Electricity supplied by the project activity to the grid. Double checked by Project Sponsors internal control and sales receipt or documents from the power utility/CCEE. CCEE is a Brazilian government entity, which monitors the electricity on the national interconnected grid.														
Frequency of monitoring/recording	Hourly measurement and monthly recording.														
Value monitored	<table border="1"> <thead> <tr> <th>Period</th> <th>$EG_{\text{facility},y}$ (MWh)</th> </tr> </thead> <tbody> <tr> <td>01-Aug-2013 – 31-Dec-2013</td> <td>481,736</td> </tr> <tr> <td>01-Jan-2014 – 31 Dec 2014</td> <td>1,157,972</td> </tr> <tr> <td>01-Jan-2015 – 31 Dec 2015</td> <td>1,310,327</td> </tr> <tr> <td>01-Jan-2016 – 31 Dec 2016</td> <td>1,247,996</td> </tr> <tr> <td>01-Jan-2017 – 31-Dec-2017</td> <td>827,062</td> </tr> <tr> <td>Total</td> <td>5,025,094</td> </tr> </tbody> </table>	Period	$EG_{\text{facility},y}$ (MWh)	01-Aug-2013 – 31-Dec-2013	481,736	01-Jan-2014 – 31 Dec 2014	1,157,972	01-Jan-2015 – 31 Dec 2015	1,310,327	01-Jan-2016 – 31 Dec 2016	1,247,996	01-Jan-2017 – 31-Dec-2017	827,062	Total	5,025,094
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Total	5,025,094														
Monitoring equipment	There are six energy meters (principal and backup): 2 installed at the power plants and 4 installed at the local substation, which continuously monitor the electricity generated by the plant and delivered to the grid. Their specification is detailed below in section 3.3. Calibration follows recommendations of the Electric System National Operator.														
QA/QC procedures to be applied	Equipment used have by legal requirements extremely low level of uncertainty.														
Purpose of the data	Calculation of baseline emissions.														
Calculation method	Not applicable.														
Comments	-														

Data / Parameter	Cap_{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Project site and official data source.

Description of measurement methods and procedures to be applied	Installed capacity determined by official entities and can be confirmed during on-site visit verifications.
Frequency of monitoring/recording	Data will be archived in paper format and will be monitored yearly.
Value monitored	191,880,000
Monitoring equipment	Not applicable.
QA/QC procedures to be applied	Determined based on recognized standards with no possibility of uncertainty.
Purpose of the data	Calculation of project emissions.
Calculation method	Not applicable.
Comments	A deviation from the Project Description was applied to the project activity due the increase in the installed capacity of the plant. For more details, please refer to the section 2.2.

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Project site and official data source.
Description of measurement methods and procedures to be applied	Measured from topographical surveys, maps, satellite pictures, etc. (once at the time of the project conception) and water levels (during the project crediting period).
Frequency of monitoring/recording	Monthly measurement and recording.
Value monitored	150,000
Monitoring equipment	-
QA/QC procedures to be applied	Determined based on recognized standards with extremely low level of uncertainty.
Purpose of the data	Calculation of project emissions.
Calculation method	Not applicable.
Comments	-

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at: < http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html >.
Description of measurement	Since option C) for the calculation of the operating

methods and procedures to be applied	margin was chosen, this value is up-dated annually according to data from the Brazilian DNA and following the prescription of the emission factor tool.												
Frequency of monitoring/recording	-												
Value monitored	<table border="1"> <thead> <tr> <th>Period</th> <th>EF_{grid,CM,y} (tCO₂e/MWh)</th> </tr> </thead> <tbody> <tr> <td>01-Aug-2013 – 31-Dec-2013</td> <td>0.4290</td> </tr> <tr> <td>01-Jan-2014 – 31 Dec 2014</td> <td>0.4395</td> </tr> <tr> <td>01-Jan-2015 – 31 Dec 2015</td> <td>0.4079</td> </tr> <tr> <td>01-Jan-2016 – 31 Dec 2016</td> <td>0.3904</td> </tr> <tr> <td>01-Jan-2017 – 31-Dec-2017</td> <td>0.2937</td> </tr> </tbody> </table>	Period	EF _{grid,CM,y} (tCO ₂ e/MWh)	01-Aug-2013 – 31-Dec-2013	0.4290	01-Jan-2014 – 31 Dec 2014	0.4395	01-Jan-2015 – 31 Dec 2015	0.4079	01-Jan-2016 – 31 Dec 2016	0.3904	01-Jan-2017 – 31-Dec-2017	0.2937
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01-Jan-2017 – 31-Dec-2017	0.2937												
Monitoring equipment	-												
QA/QC procedures to be applied	Official source of data.												
Purpose of the data	Calculation of baseline emissions.												
Calculation method	-												
Comments	-												

Data / Parameter	EF _{grid,OM,y}												
Data unit	tCO ₂ /MWh												
Description	Operating Margin CO ₂ emission factor for grid connected power generation in year <i>y</i> calculated using the latest version of the “ <i>Tool to calculate the emission factor for an electricity system</i> ”.												
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at: < http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html >.												
Description of measurement methods and procedures to be applied	Option C) was chosen to calculate the operating margin. This option does not permit the <i>ex-ante</i> vintage for the calculation of the emission factor. Therefore, the emission factor is calculated ex-post applying the numbers provided by the Brazilian DNA.												
Frequency of monitoring/recording	Hourly and aggregated as appropriate.												
Value monitored	<table border="1"> <thead> <tr> <th>Period</th> <th>EF_{grid,OM,y} (tCO₂e/MWh)</th> </tr> </thead> <tbody> <tr> <td>01-Aug-2013 – 31-Dec-2013</td> <td>0.5868</td> </tr> <tr> <td>01-Jan-2014 – 31 Dec 2014</td> <td>0.5826</td> </tr> <tr> <td>01-Jan-2015 – 31 Dec 2015</td> <td>0.5604</td> </tr> <tr> <td>01-Jan-2016 – 31 Dec 2016</td> <td>0.6226</td> </tr> <tr> <td>01-Jan-2017 – 31-Dec-2017</td> <td>0.5846</td> </tr> </tbody> </table>	Period	EF _{grid,OM,y} (tCO ₂ e/MWh)	01-Aug-2013 – 31-Dec-2013	0.5868	01-Jan-2014 – 31 Dec 2014	0.5826	01-Jan-2015 – 31 Dec 2015	0.5604	01-Jan-2016 – 31 Dec 2016	0.6226	01-Jan-2017 – 31-Dec-2017	0.5846
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Monitoring equipment	-												
QA/QC procedures to be applied	Official source of data.												
Purpose of the data	Calculation of baseline emissions.												
Calculation method	-												
Comments	-												

Data / Parameter	$EF_{grid,BM,y}$												
Data unit	tCO ₂ /MWh												
Description	Build margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “ <i>Tool to calculate the emission factor for an electricity system</i> ”.												
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at: < http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html >.												
Description of measurement methods and procedures to be applied	Option 2 was chosen to calculate the build margin. Therefore, the emission factor is calculated ex-post applying the numbers provided by the Brazilian DNA. Numbers provided by the Brazilian DNA is applied during the project verification.												
Frequency of monitoring/recording	Yearly												
Value monitored	<table border="1"> <thead> <tr> <th>Period</th> <th>$EF_{grid,BM,y}$ (tCO₂e/MWh)</th> </tr> </thead> <tbody> <tr> <td>01-Aug-2013 – 31-Dec-2013</td> <td>0.2713</td> </tr> <tr> <td>01-Jan-2014 – 31 Dec 2014</td> <td>0.2963</td> </tr> <tr> <td>01-Jan-2015 – 31 Dec 2015</td> <td>0.2553</td> </tr> <tr> <td>01-Jan-2016 – 31 Dec 2016</td> <td>0.1581</td> </tr> <tr> <td>01-Jan-2017 – 31-Dec-2017</td> <td>0.0028</td> </tr> </tbody> </table>	Period	$EF_{grid,BM,y}$ (tCO ₂ e/MWh)	01-Aug-2013 – 31-Dec-2013	0.2713	01-Jan-2014 – 31 Dec 2014	0.2963	01-Jan-2015 – 31 Dec 2015	0.2553	01-Jan-2016 – 31 Dec 2016	0.1581	01-Jan-2017 – 31-Dec-2017	0.0028
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01-Jan-2017 – 31-Dec-2017	0.0028												
Monitoring equipment	N/A												
QA/QC procedures to be applied	Official source of data.												
Purpose of the data	Calculation of baseline emissions.												
Calculation method	-												
Comments	-												

3.3 Monitoring Plan

The project sponsor proceeded with the necessary measures for the power control and monitoring. Together with the information produced by both project sponsor and the power utility/Electric Energy Commercialization Chamber (CCEE), it is possible to monitor the power generation of the project (in MWh/year). CCEE makes feasible and regulates the electricity energy commercialization in Brazil.

There are six energy meters (principal and backup) specified by CCEE: 1 principal meter installed at each one of the generating units (total of 2 principal meters), which measure the gross energy, and 4 meters (2 principal meters and 2 backup meters) installed at the local substation, which measure the net energy. CCEE has on-line access to the energy readings from meters located at the substation.

Energy data is measured by the meters in real time. Monthly, consolidations are made for payment purposes. Cross check is made between reports from CCEE/power utility and power plant. However, energy data from meters located at the power plant is higher than data from meters at the substation, considering transmission losses from the power plant to the substation.

The table below presents the meters description used at UHE Salto Pilão.

Table 2 - Meters description

Model	Manufacturer	Quantity	Location
ION 8600B	Schneider Electric	2	Power plant
ION 8600A		4	Substation

The diagram below presents the relevant monitoring points:

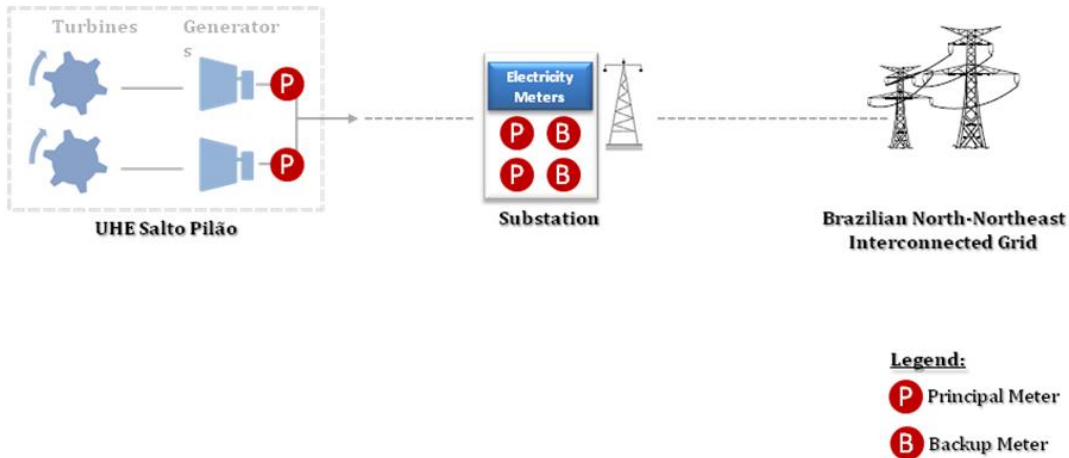


Figure 3 - Diagram of the relevant monitoring points

Previous to 2017 year, calibration should be conducted each 2 years. However, according to updated ONS procedures¹⁶ valid on 01/01/2017 onwards, energy meter calibration shall be conducted in a 5-year period.

The following table presents the dates in which the meters were calibrated according to calibration certificates. All of the meters possess a precision class D (0.2% accuracy class).

Table 3 - Calibration dates of the energy meters

Location		Number	Calibration Dates		Calibration Dates	
			Date	Reference	Date	Reference
Power Plant	Principal	PT-0812A276-01 installed on 17/04/2013	02/06/2011 [†]	Progressul Report	14/04/2015	CC-0082-15
	Principal	PT-0811A790-01	04/03/2013	CC-0033-13	22/05/2015	CC-0081-15
Substation	Principal	PT-0902A536-01	04/03/2013	CC-0031-13	14/04/2015	CC-0085-15
	Backup	PT-0903A301-01	04/03/2013	CC-0032-13	14/04/2015	CC-0087-15
	Principal	PT-0903A335-01	04/03/2013	CC-0029-13	14/04/2015	CC-0084-15
	Backup	PT-0903A346-01	04/03/2013	CC-0030-13	14/04/2015	CC-0086-15

[†]Energy meter was calibrated in 2011, but it was installed and put in operation on 17/04/2013 only.

¹⁶ ONS procedures. "Sub-module 12.3 Maintenance of the metering system for invoicing" (in a free translation from the Portuguese *Submódulo 12.3. Manutenção do sistema de medição para faturamento*). Available at ONS's website: <<http://ons.org.br/pt/paginas/sobre-o-ons/procedimentos-de-rede/vigentes>>

While considering the 2-year period for calibration frequency of energy meters located at the substation (which measures net electricity), there is a period uncovered by calibration¹⁷; the last calibrations were conducted on 14/04/2015, but it should be conducted on 04/03/2015 as the ONS procedures are valid on 01/01/2017 onwards only. Results of the last calibration are presented below:

Table 4 - Calibration dates of the energy meters

Measurement	% Error (+/-)			
	PT-0902A536-01	PT-0903A301-01	PT-0903A335-01	PT-0903A346-01
1	-0.069	-0.035	-0.089	-0.013
2	-0.077	-0.036	-0.096	-0.026
3	-0.076	-0.047	-0.096	-0.025
4	-0.101	-0.043	-0.102	-0.030
5	-0.072	-0.037	-0.091	-0.019
6	-0.084	-0.044	-0.101	-0.033
7	-0.08	-0.051	-0.101	-0.027
8	-0.101	-0.032	-0.102	-0.025
The highest diversion	-0.101	-0.051	-0.102	-0.033

As can be seen in the table above, error of the delayed calibration test is lower than the maximum permissible error of equipment (0.2%). For a conservative approach, the maximum accuracy of equipment (0.2%) was applied in the measured values of the uncovered period of calibration (04/03/2015 – 14/04/2015).

Electricity from CCEE/power utility reports is considered for emission reduction purposes. Therefore, these monthly reports were available during the project verification (estimated to happen yearly) as well as the calibration certificates from meters involved in the project activity. It is important to mention that the measurement of the electricity generation is done automatically by meters (principal and back-up) and it is controlled and stored by CCEE. Through CCEE system, the O&M team has access to the electricity generation data whenever necessary.

Salto Pilão Consortium is responsible for the maintenance of the monitoring equipments, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Salto Pilão Consortium is also responsible for the project management, as well as for organizing and training of the staff in the appropriate monitoring, measurement and reporting techniques.

The chart below represents Salto Pilão Consortium organizational structure.

¹⁷ The updated ONS procedures, which consider a 5-year calibration frequency, are valid on 01/01/2017 onwards only. Before this date, the previous ONS procedures are valid, which consider a 2-year calibration frequency.

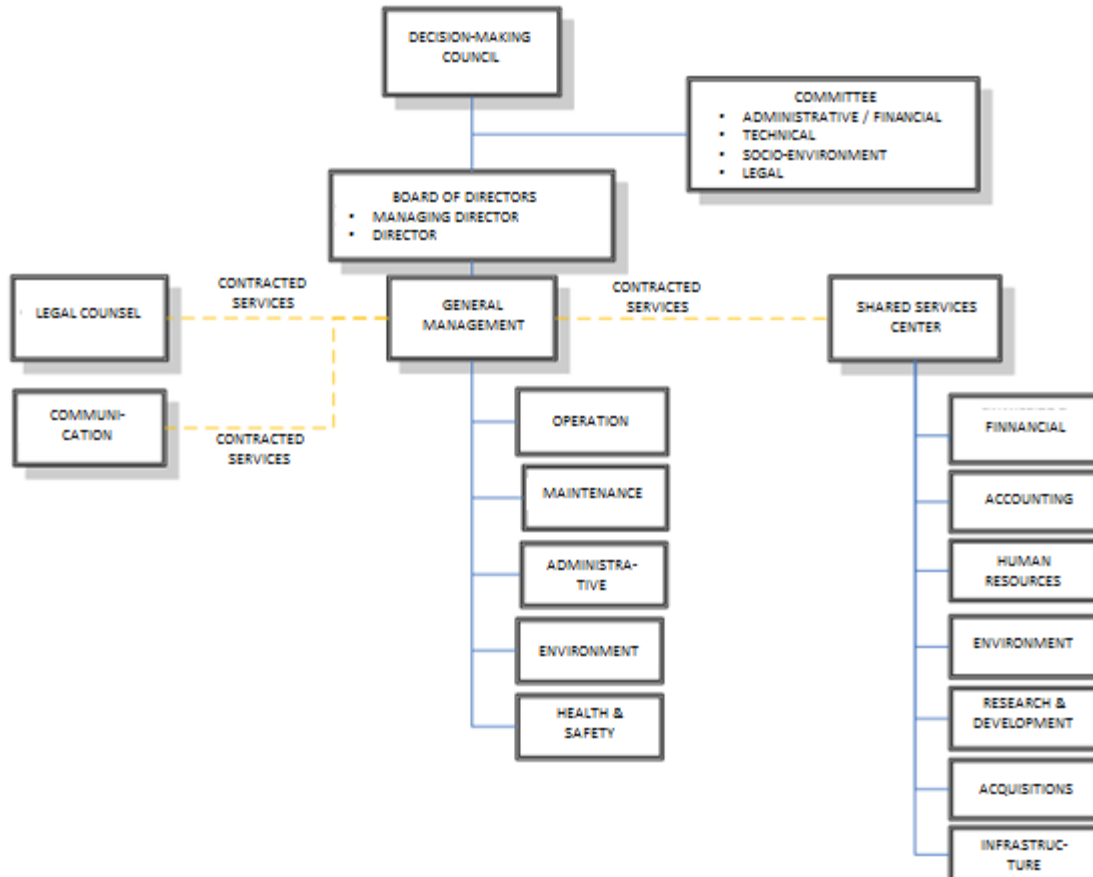


Figure 4 - Salto Pilão Consortium organizational structure

It is noteworthy that the directors of Salto Pilão Consortium, as well as those responsible for O&M indicated above and directly involved in the activities, have over 30 years of experience in the Brazilian electricity sector, with extensive qualification and have worked on several projects in Brazil and abroad.

Furthermore, all employees of the plant undergo periodic training and recycling process, which includes all training provided in the safety of the work force in Brazil. The plant operators also have specific training and accreditation to meet the requirements of the Brazilian Power Regulatory Agency (ANEEL). Additionally, since 2012, Salto Pilão has the ISO 9001:2008 certification.

In addition, the Brazilian Power Regulatory Agency (ANEEL) can visit the plant to inspect the operation and maintenance of the facility assuring that project sponsors are carrying out the necessary procedures for the project operation.

Salto Pilão Consortium has hired expert companies to execute their environmental programs. After the beginning of the commercial operations, renovation of degraded areas and of permanent preservation areas are being carried out according to the regulations of the environmental agencies, through a team of environment experts, who are also monitoring the compliance with the environmental agencies' regulations. Studies done during the design phase of the project activities have shown the environmental impacts and the interference on the social development in the region of the plant, indicating the mitigation measures adopted during the construction

phase. These measures have been taken seriously. Data about environmental impact are being archived by the hydropower plant and the environmental agency.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Emission reductions (ER_y)

According to the selected approved methodology ACM0002, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation 1}$$

Where:

ER_y = Emission reductions in year y (tCO₂e/yr);

BE_y = Baseline emissions in year y (tCO₂/yr);

PE_y = Project emissions in year y (tCO₂e/yr).

Baseline emissions (BE_y)

Baseline emissions are calculated using the annual electricity dispatched to the grid ($EG_{\text{facility},y}$) times the CO₂ baseline emission factor (EF_y), as follows:

$$BE_y = EG_{P,J,y} \cdot EF_{\text{grid},CM,y} \quad \text{Equation 2}$$

Where:

BE_y = Baseline emissions in year y (tCO₂/yr);

$EG_{P,J,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);

$EF_{\text{grid},CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the “*Tool to calculate the emission factor for an electricity system*” (tCO₂/MWh).

For Greenfield projects installed at a site where no electricity generation occurred previously, as it is the case of the proposed project activity, the calculation of $EG_{P,J,y}$ is as follows:

$$EG_{P,J,y} = EG_{\text{facility},y} \quad \text{Equation 3}$$

Where:

$EG_{P,J,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);

$EG_{\text{facility},y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr).

Electricity generation of the project delivered to the grid ($EG_{facility,y}$)

The period of this project VCS verification is from August 1st 2013 to October 31th, 2017. Energy exported to the grid in the above mentioned period is as follows:

Table 5 - Energy exported to the grid during the monitored period (in MWh)

Month	2013	2014	2015*	2016	2017
January	-	128,516	134,545	107,998	117,370
February	-	55,730	124,808	123,244	80,186
March	-	111,165	83,928	134,750	68,380
April	-	50,050	74,623	110,051	36,736
May	-	79,639	58,314	108,879	70,142
June	-	127,354	98,511	103,332	114,293
July	-	114,856	131,911	86,128	42,601
August	126,227	91,350	73,786	112,325	71,281
September	115,317	104,218	121,146	80,139	20,969
October	119,268	121,143	137,529	106,812	76,518
November	52,201	92,029	133,462	64,165	81,149
December	68,723	81,924	137,763	110,174	47,437
Total	481,736	1,157,972	1,310,327	1,247,996	827,062

*Data already considers discounts for the uncovered period of calibration (04/03/2015 – 14/04/2015), as discussed in section 3.3

CO₂ emission factor of the grid (EF_y)

The CO₂ emission factor of the grid is the result of a weighted average of two emission factors pertaining to the electricity system: the “operating margin” (OM) and the “build margin” (BM). In the case of this project activity, parameters were calculated in accordance with the “Tool to calculate the emission factor for an electricity system” and were determined *ex-post*, as presented in the registered PD.

The Brazilian DNA made available the emission factor calculation based on information of the grid power plants only. More information of the methods applied can be obtained in the DNA’s website (<http://www.mct.gov.br/index.php/content/view/4016.html>).

Considering 0.5 as the weights for OM and BM emission factors available for renewable energy projects, excluding solar and wind power projects, the CO₂ emission factors considered in this monitoring period are as follows:

Table 6 – The CO₂ emission factor of the grid (in tCO₂e/MWh)

Year	$EF_{grid.OM.y}$	$EF_{grid.BM.y}$	$EF_{grid.CM.y}$
2013	0.5868	0.2713	0.4290
2014	0.5826	0.2963	0.4395
2015	0.5604	0.2553	0.4079

Year	EF _{grid.OM.y}	EF _{grid.BM.y}	EF _{grid.CM.y}
2016	0.6226	0.1581	0.3904
2017	0.5846	0.0028	0.2937

Considering Equation 2, the baseline emissions are as follow:

Table 7 – Baseline emissions during the monitored period (in tCO₂e)

Month	2013	2014	2015	2016	2017
January	-	56,479	54,877	42,159	34,473
February	-	24,492	50,905	48,111	23,552
March	-	48,854	34,232	52,602	20,084
April	-	21,995	30,436	42,961	10,790
May	-	34,999	23,784	42,503	20,602
June	-	55,968	40,179	40,338	33,569
July	-	50,476	53,803	33,622	12,513
August	54,155	40,146	30,095	43,848	20,936
September	49,474	45,801	49,412	31,284	6,159
October	51,169	53,239	56,094	41,696	22,474
November	22,396	40,444	54,435	25,048	23,834
December	29,484	36,003	56,189	43,009	13,933
Total	206,679	508,895	534,441	487,181	242,920

4.2 Project Emissions

New hydroelectric power projects resulting in new reservoirs, shall account for CH₄ and CO₂ emissions from reservoirs, estimated as follows:

- a) If the power density (*PD*) of power plant is greater than 4 W/m² and less than or equal to 10 W/m²:

$$PE_y = \frac{EF_{Res} \times TEG_y}{1000} \quad \text{Equation 4}$$

Where:

PE_y = Emission from reservoir expressed as tCO₂e/year;

EF_{Res} = Default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO₂e/MWh;

TEG_y = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh).

- b) If power density (*PD*) of the project is greater than 10W/m², *PE_y* = 0.

The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \text{Equation 5}$$

Where:

PD = Power density of the project activity, in W/m^2 .

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W).

Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).

A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

For Salto Pilão HPP:

Capacity of the project = 191.89 MW

Reservoir area = 0.15 km^2

Power density = $191.88 / 0.15 = 1,279.20 W/m^2$, so $PE_y = 0$.

4.3 Leakage

There is no leakage emissions involved in the project.

4.4 Net GHG Emission Reductions and Removals

Since there are no project emissions or leakage involved in the project activity, emission reductions are equal to baseline emissions. *i.e.* $ER_y = BE_y$.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2013	206,679	0.0	0.0	206,679
2014	508,895	0.0	0.0	508,895
2015	534,441	0.0	0.0	534,441
2016	487,181	0.0	0.0	487,181
2017	242,920	0.0	0.0	242,920
Total	1,980,116	0.0	0.0	1,980,116

APPENDIX 1: REMARKS ON DIFFERENCE FROM ESTIMATED VALUES

The emission reductions reached during this monitoring period is higher than estimated in the registered PD. Considering the 44.1% increase in the emission reductions of the project activity during the monitored period when comparing to the estimated ones, the Project Proponent analyzed the monitored parameters that may have impacted the emission reductions of the project activity, as described below.

→ **Electricity generation of the project delivered to grid (EG_{facility,y})**

While analyzing the net electricity generated by UHE Salto Pilão, it can be observed that electricity increase in all years, except for 2017 year.

Table 8 – Net electricity generated by the project activity: estimated Vs. monitored

Period	Net Energy Generated		
	Estimated (MWh)	Monitored (MWh)	Diff
01/08/2013 - 31/12/2013	418,975	481,736	15.0%
01/01/2014 - 31/12/2014	999,516	1,157,972	15.9%
01/01/2015 - 31/12/2015	999,516	1,310,327	31.1%
01/01/2016 - 31/12/2016	999,516	1,247,996	24.9%
01/01/2017 - 31/12/2017	999,516	827,062	-17.3%
TOTAL	4,417,039	5,025,094	13.8%

The estimated electricity considered in the registered PD is based on the assured energy of the Salto Pilão. The methodological calculation of assured energy is established by the MME and shall be approved by ANEEL for each power utility. Furthermore, according to ANEEL (2005) “...the assured energy is established independently of the real electricity generation; energy assured is associated to the estimated long-term operational conditions of power plants, assuming a specific risk of electricity supply (deficit) mainly when electricity generation is related to hydrologic variability whose hydropower plants are subjected to”.

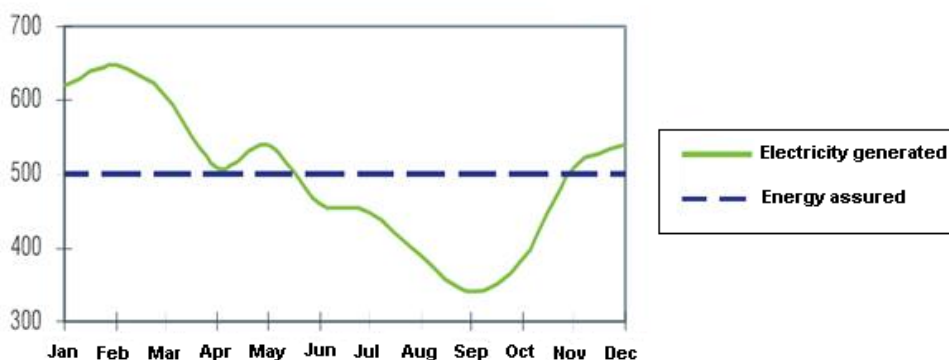


Figure 5 - Exemplification of electricity generation and energy assured of a hydropower plant

Source: ANEEL (2005)¹⁸

¹⁸ ANEEL (2005). ANEEL thematic notes (in a free translation from the Portuguese *Cadernos Temáticos ANEEL*). Assured energy. April, 2005. Available at: <<http://www.aneel.gov.br/arquivos/pdf/caderno3capa.pdf>>.

Therefore, electricity generated can be lower, higher or the same of the assured energy. In reality, it is not uncommon that hydropower plants generate electricity higher than assured energy. Furthermore, Itajaí-Açú river flow significantly changed during the monitored period as can be seen in the figure below from the ONS.

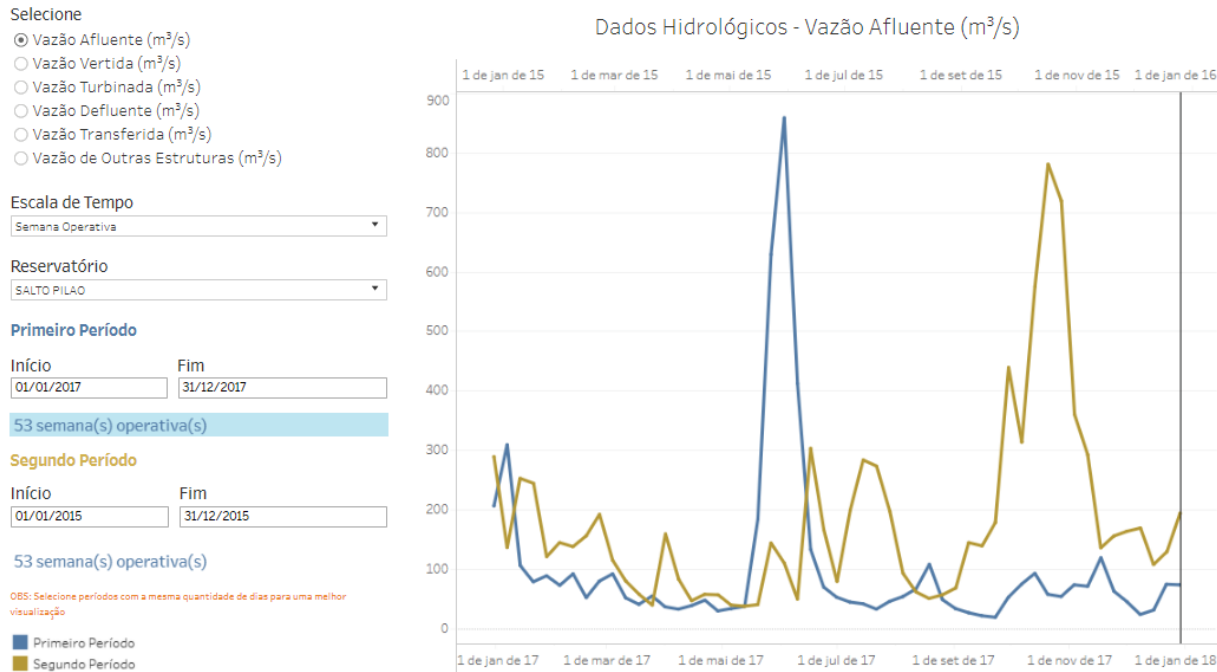


Figure 6 – Comparison between Salto Pilão river flow during 2015 and 2017 years

Source: ONS (2018)¹⁹

This unusual behavior of electricity generation certainly impacts in the emission reductions generated by the project activity.

→ **Combined margin CO₂ emission factor for grid connected power generation (EF_{grid,CM,y})**

The CO₂ emission factor of the grid increased in all years when compared to the value considered in the registered PD.

Table 9 – CO₂ emission factor of the grid (estimated Vs. monitored)

Period	Emission Factor of the Grid (EF)		
	Estimated (tCO ₂ /MWh)	Monitored (tCO ₂ /MWh)	Diff
01/08/2013 - 31/12/2013	0.3112	0.4290	37.9%
01/01/2014 - 31/12/2014	0.3112	0.4395	41.2%
01/01/2015 - 31/12/2015	0.3112	0.4079	31.1%
01/01/2016 - 31/12/2016	0.3112	0.3904	25.4%

¹⁹ Information available at: http://ons.org.br/Paginas/resultados-da-operacao/historico-da-operacao/dados_hidrologicos_vazoes.aspx

Period	Emission Factor of the Grid (EF)		
	Estimated (tCO ₂ /MWh)	Monitored (tCO ₂ /MWh)	Diff
01/01/2017 - 31/12/2017	0.3112	0.2937	-5.6%
AVERAGE	0.3112	0.3921	26.0%

The increase in the CO₂ emission factor of the grid is due to an increase in fossil fuel power plants. Brazil possesses a large share of hydroelectricity and, for this reason, it presents a low CO₂ emission factor of the grid when comparing to other Latin American countries. However, during the years when an atypical short rainy season is observed, the generation of electricity by the thermal power plants fuelled with fossil fuels rises. This can be evident in the year of 2014, when the calculated emission factor was significantly higher when compared to those considered in the registered PD (2008 year).

In spite of the increase of reservoir levels in the Southern region²⁰, which impacted the electricity generated by Salto Pilão, the CO₂ emission factor of the grid boundaries include the five macro-regions of the Host Country (North, Northeast, South, Southeast and Midwest) (Figure 7). Then, the volume of Brazilian reservoirs reduced although the volume of Southern reservoir increases and, for this reason, the CO₂ emission factor of the grid and the electricity generated by Salto Pilão increase.

²⁰ Information available at:

<https://www.canalenergia.com.br/noticias/53048751/subsistema-sul-tem-elevacao-de-09-e-leva-reservatorios-a-volume-acima-de-66>

<https://www.canalenergia.com.br/noticias/53048051/subsistema-sul-tem-elevacao-e-leva-reservatorios-a-volume-de-628>

<https://g1.globo.com/economia/noticia/reservatorios-de-hidreletricas-do-sudeste-e-centro-oeste-tem-o-pior-outubro-desde-2000.ghtml>

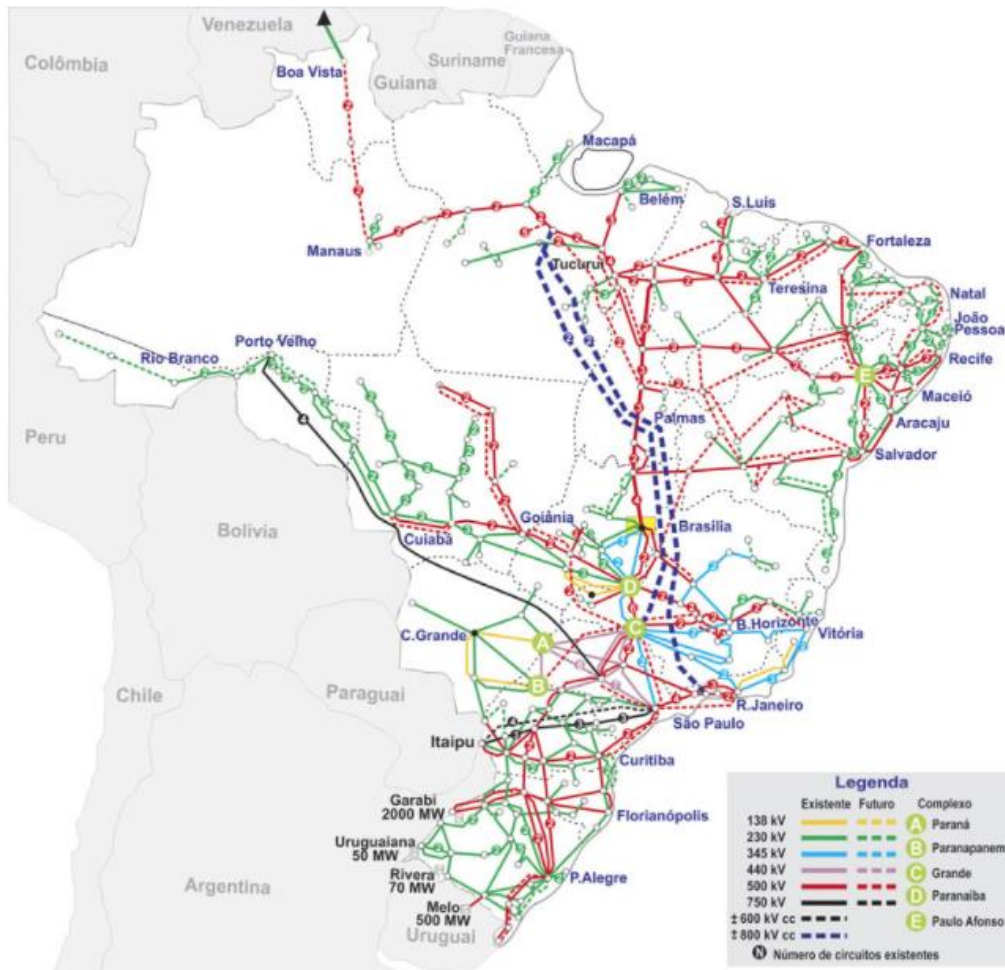


Figure 7 – Brazilian Interconnected System

Source: ONS (2018)²¹

Considering the explanations above, there was a significantly increase in the CO₂ emission factor of the grid during the monitored period when compared to the estimated value and, therefore, this increase undeniable impacted the emission reductions generated by the project activity.

Conclusion

Considering the discussion presented above, the parameter that increase the emission reductions of the project activity in comparison to the estimated value presented in the registered PDD is due to a higher river flow at Salto Pilão reservoir and the increase of the combined margin CO₂ emission factor of the grid (EF_{grid,CM,y}). Therefore, this increase impacted the baseline emissions/emission reductions of the project activity.

²¹ Available at: <<http://ons.org.br/pt/paginas/sobre-o-sin/mapas>>