SALTO PILÃO HYDROPOWER PLANT PROJECT ACTIVITY

Document Prepared by Ecopart Assessoria em Negócios Empresariais Ltda.

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Prepared By	*Ecopart Assessoria em Negócios Empresariais Ltda.*
Contact	*Rua Padre João Manoel, 222* *01411-000* *São Paulo - SP - Brazil* *Telephone: +55 11 3063-9068* *E-mail: focalpoint@eqao.com.br* *Website: www.eqao.com.br*

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The primary objective of Salto Pilão hydropower plant ("UHESP" from Portuguese Usina Hidrelétrica Salto Pilão) is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental (run-of-river power plant), social (job creation about 1000 workers in the construction phase, and infra-structure enhancements in surrounded municipalities), and economic sustainability by increasing the share of renewable energy in total electricity consumption for Brazil (and for the region of Latin America[1]).

UHESP consists of the construction of a hydropower plant[2] with a reservoir of 0.15 km^2 under 319m water level[3] and an installed capacity of 191.88 MW[4], located between the cities of Lontras, Ibirama and Apiúna, state of Santa Catarina, Southern region of Brazil. In the absence of the project, electricity would be generated by the operation of grid-connected power plants, including fossil fuel power plants and hydropower plants with large reservoirs. With an estimated annual average of 186,810 tCO_2e, for the entire 2nd crediting period (19/01/2020 – 18/01/2030) it is estimated an emission reduction of **1,868,095 tCO_2e.**

UHESP is owned by an association of several companies called Consórcio Empresarial Salto Pilão. The current consortium structure is as follows[5]:

- Companhia Brasileira de Alumínio (CBA): 60%*;*
- Camargo Côrrea Geração de Energia S/A (CCGE): 20%; and
- DME Energética Ltda. (DMEE): 20%.

The timeline of the project is as follows:

- EPC (Engineering Procurement and Construction) contracts signature: 23 December 2003;

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[1] Brazil exports electricity for some countries of the Latin America region. Therefore, the project contributes for the increasing the share of renewable energy consumption in Brazil and, indirectly, for some countries in the Latin America region.

[2] "UHE" from the Portuguese Usina Hidrelétrica de Energia.

[3] The operational environmental license (LO) for the monitored period is not yet available, but it has been in the process of renewal since 01/30/2020 (Protocol No. 542535). Available at: https://consultas.ima.sc.gov.br/consulta/consultar#

[4] Generator tag: 106,600kVA x 0.9 = 95,940 kW x 2 generating units = 191.88MW.

[5] 1st Addedum of the Concession Contract signed July 23rd, 2004 and ANEEL Resolution nr. 1,391 issued on June 3rd, 2008.

- Feasibility study for emissions reductions revenues: May 2006;
- Board Decision to re-start the UHESP project: 06 July 2006;
- Addendum EPC contract signing: 12 August 2006;
- Contract closure for carbon consultancy: 1 December 2007;
- Financial closure: 12 and 13 April 2007;
- Construction license issuance: 31 July 2007 / 22 October 2007;
- Operations starting: 11 December 2009.

Although the intent to construct the power plant had begun in 2003, it never took place until now and the construction never started. After a feasibility assessment for carbon revenues in May 2006, the project owner decided in a Meeting of the Consortium Board of Directors in July 2006 to re-start investment, and therefore, the addendum of the EPC contract was signed in August 2006 and project proponents started all procedures to construct the project, as obtaining the construction license and financing.

Additionally, the installed capacity of the project increased from 182.3 MW to 191.88 MW and assured energy increased from 106.7MW-ave to 109MW-ave and, later, to 114.1MW-ave due to underestimated historic of river flow rate.

Assured Energy	Legislation
106.7MW-ave	Concession contract # 15/2002
109MW-ave	MME Ordinance #35 issued on 22/05/2012
114.1MW-ave	MME Ordinance #178 issued on 3/05/2017

Detailed description on project changes is presented in CNEC Technical Report which was presented to ANEEL. ANEEL approved the project changes, including installed capacity, as can be seen in ANEEL Resolution #3,303 issued on 17/01/2012. Regarding the revision of assured energy, it was approved by the Brazilian Mines and Energy Ministry ("MME" from the Portuguese Ministério de Minas e Energia) as can be seen in MME Ordinance #35 issued on 22/05/2012 (109MW-ave) and MME Ordinance #178 issued on 03/05/2017 (114.1MW-ave).

Although UHESP does not have alone a major relevant impact in the Host Country given its electric system size, it is undoubtedly part of a greater idea. The project activity contributes to sustainable development since it meets the needs of the present without compromising the ability of future generations to meet their own needs, as defined by the Brundtland Commission (1987). In other words, the implementation of hydroelectric power plants ensures renewable energy generation, reduces the national electric system demand, avoids negative social and environmental impacts caused by the construction of large hydropower plants with large reservoirs and fossil fuel thermo power plants, and drives the regional economy, increasing quality *of life in local communities.*

Therefore, it is indisputable that the project has reduced negative environmental impacts and has developed the regional economy, resulting, consequently, in better quality of life. In other words, environmental sustainability associated to social and economic justice, definitely contributes for the host country's sustainable development.

1.2 Sectoral Scope and Project Type

Salto Pilão Project Activity is not a grouped project. It falls in the *Sectoral Scope 1 – Energy industries* (renewable/non- renewable sources), and the project type is *I – Renewable Energy Projects*, as established by the Clean Development Mechanism (CDM). Methodologies approved under CDM are also approved under Voluntary Carbon Standard (VCS) as demonstrated at the VCS website: < https://verra.org/methodologies/>.

1.3 Project Eligibility

The project applies scope as per the version 4.3 of the VCS Standard[6].

The project reduces CO_2 emission which is the six Kyoto Protocol greenhouse gases.

The project activities supported by CDM methodology ACM0002 which is a methodology approved under a VCS approved GHG program.

Hence, the project is eligible under VCS standard v4.3

1.4 Project Design

The project is a single installation of an activity.

Eligibility Criteria

Not applicable, since the project is not a grouped project.

1.5 Project Proponent

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

[6] https://verra.org/wp-content/uploads/2022/06/VCS-Standard_v4.3.pdf

Email	luis@usinasaltopilao.com.br

1.6 Other Entities Involved in the Project

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

1.7 Ownership

Consócio Empresarial Salto Pilão is the owner of Salto Pilão project. This can be evidenced by contracts and governmental authorizations to explore the hydro potential of Salto Pilão project. All documents was presented to DOE during the on-site visit.

1.8 Project Start Date

The UHESP starting date is December 11th, 2009[7], when the first generating unit started operation.

1.9 Project Crediting Period

The 1st crediting period was from: 19-January-2010 to 18-January-2020. And now, this validation report for the **2nd crediting period from: 19-January-2020 to 18-January-2030.**

UHESP has a 10 years of crediting period (which can be renewed two times), with a total duration of 30 years.

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

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
From 19/01/2020 to 31/12/2020	177,597
Year 2021	186,810
Year 2022	186,810
Year 2023	186,810
Year 2024	186,810
Year 2025	186,810
Year 2026	186,810
Year 2027	186,810
Year 2028	186,810
Year 2029	186,810
From 01/01/2030 to18/01/2030	9,213
Total estimated ERs	**1,868,095**
Total number of crediting years	10
Average annual ERs	186,810

1.11 Description of the Project Activity

(i) UHESP is a run-of-river hydropower plant

Run-of-river projects do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams (Figure 1).

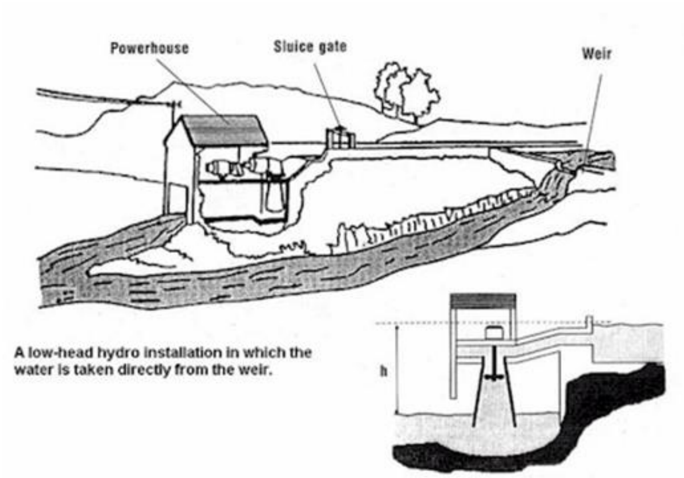

Figure 1 - Schematic view of run-of-river power plant

According to the World Commission of Dams[8], run-of-river projects are defined as:

"Dams that create a hydraulic head in the river to divert some portion of the river flows to a canal or power station… Often (they) have no storage reservoir or limited daily pondage. Within these general classifications there is considerable diversity in scale, design, operation and potential for adverse impacts".

In the case of UHESP[9]:

- Maximum volume of the reservoir: 1,582,827 m^3;
- Average volume of the reservoir: 21,520 m^3;
- Days of pondage at maximum volume of the reservoir (residence time): 0.16 day;
- Days of pondage at average volume of the reservoir (residence time): 0.002 day.

Considering data above, water in UHESP's reservoir has limited daily pondage; it remains in the reservoir less than 1 day. Therefore, the project can be considered a run-of-river power plant according to the presented criteria.

[8] WCD (2000). Dams and Development: a new framework for decision-making. World Commision on Dams. UK and USA: Earthscan Publications Ltd. Available at <http://www.unep.org/dams/WCD/report.asp>.

[9] Information was taken from the Consolidated Project Design (from the Portuguese Projeto Básico Consolidado) prepared by CNEC Engenharia S/A in May 2008 (chapters 7.2 2 and 11).

In addition, the Operation License of the project nr. 202/2009 issued on July 13th, 2009 by the Environmental Agency of Santa Catarina State (Fundação do Meio Ambiente – FATMA) states that since the project dam has 206 meters and the reservoir has no purpose of water storage for the water flow regularization, the project is classified as a run-of-river project. The operational environmental license (LO) for the monitored period is not yet available, but it has been in the process of renewal since 30/01/2020 (Protocol No. 542535). Available at: (https://consultas.ima.sc.gov.br/consulta/consultar#). All documented evidence was presented to DOE during validation.

(ii) Turbine Technology

The technology employed at UHESP project is established in the industry. The Francis turbine (Figure 2) is the most widely used among water turbines. This turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through the penstock and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

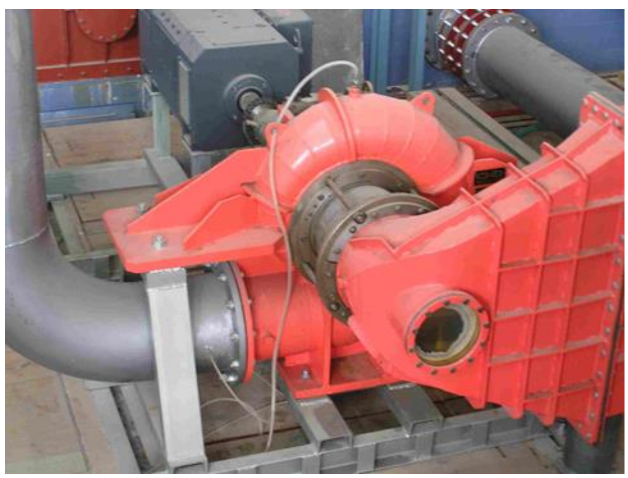

Figure 2 - Example of a Francis turbine

Source: NTUA (2009)[10]

The technology and equipment used in the project were developed and manufactured locally and has been successfully applied to similar projects in Brazil and around the world. The lifetime of

[10] NTUA (2009). Department of mechanical engineering. Fluids section. National Technical University of Athens. Available at: <http://www.fluid.mech.ntua.gr/lht/PB0303011.JPG>. Accessed on 30 Apr 2009.

the main equipment (turbines and generators) is 30 years, according to technical literature[11]. Specifications and equipments used in UHESP are presented in Table 1 below.

Table 1- Specifications of the equipment used at UHESP[12]

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

UHESP reservoir's size is 0.15 km^2 and gross power density of 1,279.2 W/m^2. As a matter of comparison, the average power density of the Brazilian hydropower plants, totalizing 74,442 MW of installed capacity, is 2.03 W/m^2[13].

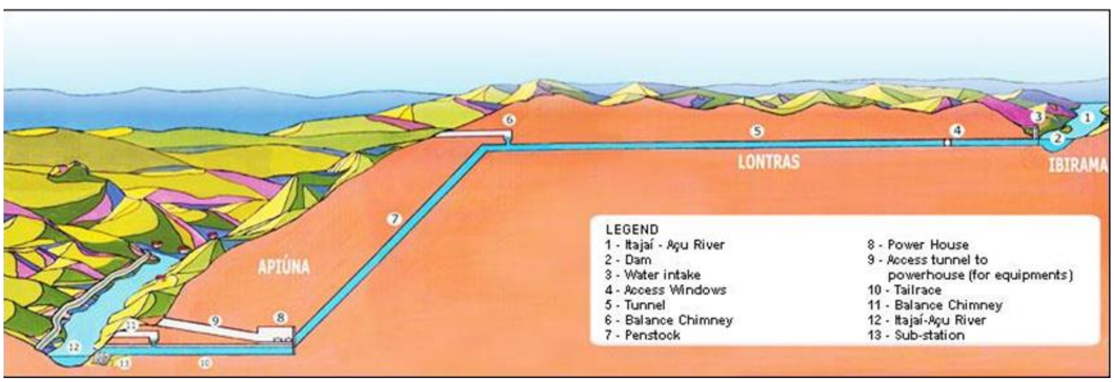

Figure 3 – Simplified Diagram of the UHESP

Source: UHESP (2009)[14]

[11] Following specifications of ANEEL Normative Resolution number 367, June 2nd 2009 that establishes depreciation annual taxes for equipment in the electricity sector in Brazil for turbo-generator.

[12] Equipment tag verified during the site visit.

[13] MME (2009). Plano Decenal de Expansão de Energia Elétrica: 2008-2017 / Ministério de Minas e Energia; colaboração Empresa de Pesquisa Energética. – Brasília: MME: EPE, 2009.

[14] UHESP. Desenho técnico. Consórcio Empresarial Salto Pilão. Available at: <http://www.usinasaltopilao.com.br/>. Accessed on 12 Nov 2009.

Figure 4 - Physical location of the Dam (left) and the Power House (right).

Source: GOOGLE EARTH (2021)

1.12 Project Location

The project is located in Itajaí-Açú River, between the cities of Lontras, Ibirama and Apiúna, Santa Catarina State, Southern region of Brazil[15].

Table 2 - Geographic coordinates of the project activity16

Location at the project site	Latitude	Longitude
Power House	27º06' S	49°28' W
Dam	27°08' S	49°31' W

1.13 Conditions Prior to Project Initiation

Prior to the project activity implementation, there was no hydropower plant or other project activity been implemented in the location of the UHESP project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation from fossil fuel sources (and CO_2 emissions), which would be generated (and emitted) in the absence of the project (see explanations related to the baseline scenario in section 3.4). In conclusion, the baseline scenario and the scenario without the project activity are the same.

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

[16] Operation License nr. 202/2009, issued on July 13th, 2009 by the Environmental Agency of Santa Catarina State (FATMA).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity is in compliance with all laws and regulations, on the contrary, permissions and licenses would not be issued. The relevant local law and regulations are mentioned below:

Table 2 – Main applicable legislation

Date	Regulation	Regulator	Description
17/11/2016	Law nr. 13,360	Federal	It establishes financial compensations for water use.
21/01/2014	Law nr. 16,342	Santa Catarina States	It establishes the Environmental Code of the State.
11/01/2013	Law nr. 12,783	Federal	It establishes for electricity generation, transmission and distribution concessions.
09/09/2010	Resolution nr. 414	National Environmental Council	It establishes general rules on the supply of electricity.
10/09/1996	Decree nr. 2,003	Federal	It regulates the electric energy generation.
07/07/1995	Law nr. 9,074	Federal	It establishes regulations for concessions and permissions for public services.
19/12/1997	Resolution nr. 237	National Environmental Council	Revision of the procedures and criteria used in the licensing process as a tool for environmental management.
16/09/1987	Resolution nr. 6	National Environmental Council	It establishes the publication default for licensing request, in any other modalities, renewal and concession of licenses
23/01/1986	Resolution nr. 1	National Environmental Council	It establishes general criteria and guidelines for the use and implementation of environmental impact assessment.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project did/does not participate nor seek registration under any other GHG Programs.

1.15.2 Projects Rejected by Other GHG Programs

UHESP project was not rejected by any other GHG program. The VCS Program is the only GHG program that the project participates.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.16.2 Other Forms of Environmental Credit

Not Applicable.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

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 # 10,438/2002[17], 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 grid[18].

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). 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.

1.17.2 Sustainable Development Contributions Activity Monitoring

As described in table 1 below, the project has contributed at least 3 SDGs[19] since the beginning of its operation.

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

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

[19] Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. https://unstats.un.org/sdgs/indicators/indicators-list/

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	7.2.1 Renewable energy share in the total final energy consumption	Implemented activities to increase	During this monitoring period (19/01/2020 to 31/10/2021) an amount of 1,071,926 MW of renewable energy was generated and delivered to the national interconnected system.	Considering the entire life of the project (total of 30 years) it is estimated a renewable energy generation of 30,166,540 MW[20] delivered to the national interconnected system. In this way, preventing that same amount from being generated by non-renewable sources,
2)	8.5	8.5.2 Unemployment rate, by sex, age and persons with disabilities	Implemented activities to decrease	During the years 2020 and 2021 (monitoring period) the project generated approximately 45 direct and 67 indirect jobs, regardless of sex, age, color and disability.	The project employed around 1,000 workers, in the construction phase, infrastructure improvements in surrounding municipalities, regardless of sex, age, color and disability.
3)	13.2	13.2.2 Total greenhouse gas emissions per year	Implemented activities to decrease	For this monitoring period (19/01/2020 to 31/10/2021), there was a reduction of 229,534 tonnes of carbon release into the atmosphere.	A decrease of 7,193,549 tonnes[21] of carbon into the atmosphere is estimated, considering the total duration of the project (30 years).

[20] Considering the amount of energy generated that was monitored in the first crediting period, and the estimated value for this entire second period, also applied to the presumed third period.

[21] Considering the amount of emissions reductions generated that was monitored in the first crediting period, and the estimated value for this entire second period, also applied to the presumed third period.

1.18 Additional Information Relevant to the Project

Leakage Management

Not Applicable.

Commercially Sensitive Information

Not Applicable.

Further Information

Not Applicable.

2 SAFEGUARDS

2.1 No Net Harm

Accordingly to article 3 of this Resolution and Complementary Law nr. 38 dated November 21st, 1995, in order to issue licenses, the Environmental Impact Study (from the Portuguese Estudo de Impacto Ambiental – EIA) and the Environmental Impact Report (from the Portuguese Relatório de Impacto Ambiental – RIMA) are required for hydropower projects with installed capacity greater than 10 MW.

The UHESP Environmental Impact Study was prepared by Ambiental Consultoria e Planejamento Ltda. in September 1997 and is composed by three volumes:

I. Methodological aspects and information related to the project;

   a) General description of the project (identification, objectives, preferential area of installation and justifications for the project implementation);

   b) Technical description of the project (project alternative locations studies: introduction, basic types of hydro projects, inventory, preliminary feasibility study, feasibility study, UHESP general description, datasheet, costs and schedule);

   c) Environmental legislation (introduction, environmental licensing and environment impact study, issues related to environmental juridical aspects of the electrical sector);

   d) Methodology (methodological references, study limits, research techniques and source of information).

II. Diagnosis of the current situation;

a) Occupation history;

b) Recent trends and current situation of the physical and biotic medium (hydro resources, soil, flora and vegetation, geology, geomorphology and landscape, terrestrial fauna, ictus fauna);

c) Recent trends and current situation of the socio-economic-cultural environment (area of influence and directly affected area).

III. Impact analysis and mitigation measures proposals, as well as programs and plans;

a) Qualification of the main Works and Actions of the project;

b) Interactions matrix between the project actions and associated impacts;

c) Interaction network of the associated impacts of the main project actions;

d) Impacts characterization (physical, biotic and socio-economic);

e) Classification of the associated impacts of the works and actions related to the project.

The main concerns of the community and technicians were presented in the environmental study and were related to the possibility of flooding in the municipalities of Lontras and Rio do Sul, possibility of drying the river between the dam and the power house, the quality of the water (for bathing and fishing), blockade of the fishes immigration, deforestation, fauna impact, resettlement, consequences in the activities of ecotourism in Ilha das Cotias, impacts on Archeological sites and cultural heritages, job creation and financial compensation.

The following plans are been implemented in order to reduce the impacts of the project construction, raised in the environmental study analysis:

I) <u>Environmental control</u>. 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) <u>Expropriation.</u> 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) <u>Multiple use of the reservoir</u>. 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.

Besides of the above mentioned plans, there are several actions that are been implemented, which includes river flow maintenance, complementary environmental studies for the project monitoring, maintenance and monitoring of Ilha das Cotias (with hunters surveillance), treatment of the residues generated by the project construction, and others. All information related to the environmental programs and plans is presented in the project PBA (as mentioned below) and conditioning licenses. All information related to the licensing process is available with the project sponsors and the environmental agency of Santa Catarina State.

Environmental Impact Study and report were made publicly available to local stakeholders and public entities. Furthermore, according to the CONAMA Resolution nr. 1 dated January 23rd, 1986, the environmental agency – State or National – is responsible to issue licenses and decide the necessity in making public consultations and forums for the project implementation. When public consultation is required, it usually happens in parallel with the Preliminary License issuance. In the case of UHESP, the stakeholder forum was held on September 25th, 2002 together with the environmental agency of Santa Catarina. Considering the positive contribution of UHESP for the region, the public forum resulted in the Preliminary License issuance on July 24th, 2003.

After the Preliminary License issuance, the environmental agency requires a report containing environmental and social programs to be implemented aiming the mitigation of impacts caused by the project construction (from the Portuguese "Projeto Básico Ambiental – PBA"), which shall contain:

- Archeological rescue program;
- Reservoir cleaning and conservation program;
- Fauna rescue, conservation and monitoring;
- Water quality monitoring;
- Degraded area recuperation program;
- Erosion control program.

The PBA of UHESP was prepared by ECSA Engenharia Sócio-Ambiental S/C Ltda. in November 2003, which presented 24 programs. The UHESP PBA was approved by the environmental agency and, therefore the Construction License was issued on December 11th, 2003.

In parallel with the power plant construction, programs described in the PBA were implemented and, when the power plant construction finished, the Operating License was issued.

In order to keep the Operating License valid, many social and environmental requirements have to be quarterly assessed, thus this license is constantly revalidated during the project's lifetime. This ensures that the project continuously meets its environmental obligations and the goals that are established in the project PBA.

The necessary documents and requirements for the licensing process are presented in the CONAMA Resolution nr. 6. All licenses and environmental studies are available with the project sponsor and the environmental agency of Santa Catarina State (FATMA).

In spite of the installed capacity change of UHESP from 182.3MW to 198.88MW, a new environmental impact study was not required as impacts identified in the report remained the same.

For the second period the project developer understands that the implementation of the Salto Pilão Hydroelectric Power Plant, combines the socioeconomic development with environmental preservation, indispensable factors for the future, these two goals can be achieved harmoniously, from that each action or project is guided by values that prioritize nature and being human.

To this end, in order to preserve the region's natural wealth, it develops its actions and the programs contained in the Basic Environmental Project ("PBA" from Portuguese – Plano Básico Ambiental), which deal with both aspects of the physical environment (soil, air, water) and the biotic environment (fauna and flora) and social (people and communities), in an interrelated and complementary way, sought to prevent, mitigate and control interference in the environment, resulting from of the construction of the enterprise, as well as developing actions and projects that contribute to raising the quality of life and development indices sustainable development in the region where it operates.

All programs are permanently maintained and monitored by a team Internal Environmental Management, and also by the IMA – Instituto do Meio Ambiente de Santa Catarina, through semi-annual periodic reports, in addition to ANEEL as an agency regulator. The population, employees, Consortium members and other interested audiences are permanently informed through the maintenance of an extensive program of Social Communication, a strong relationship channel between the entrepreneur and the various audiences involved, who, through informational materials, program visits, meetings, among other actions, has disseminated information, and clarifying the community on the actions and measures adopted for their mitigation, as well as the facilitating the process of integrating the population to the new conditions created with the plant implantation.

2.2 Local Stakeholder Consultation

As mentioned in section 2.1, in order to issue licenses, the Environmental Impact Study (from the Portuguese Estudo de Impacto Ambiental – EIA) and the Environmental Impact Report (from the Portuguese Relatório de Impacto Ambiental – RIMA) are required for hydropower projects with installed capacity greater than 10 MW.

Both studies shall be made publicly available to local stakeholders and public entities. Furthermore, according to the CONAMA Resolution nr. 1 dated January 23rd, 1986, the environmental agency – State or National – is responsible to issue licenses and decide the necessity in making public consultations and forums for the project implementation. When public consultation is required, it usually happens in parallel with the Preliminary License issuance.

In the case of Salto Pilão project, the public forum was held by the environmental agency of Santa Catarina State (FATMA) on September 25th, 2002. Considering the positive contribution of Salto Pilão implementation, no concerns were raised in this meeting and the Preliminary License was issued on July 24th, 2003.

Seeking to constantly interact with communities and authorities, aiming disseminate information on the operation of the project and on the implementation of environmental programs, CESAP seeks to inform the population, employees, Consortium members and other stakeholders permanently interested in their actions through the maintenance of a broad Social Communication program.

A strong relationship channel between the entrepreneur and the various audiences involved, that through the website, informational materials, visiting program, meetings, among other actions, it has been spreading information, and clarifying the community about the actions and measures adopted for its mitigation, as well as the facilitation of the process of integrating the population to the new conditions created with the implementation of the power plant.

2.3 Environmental Impact

The growing global concern on sustainable use of resources is driving a requirement for more sensitive environmental management practices. Increasingly this is being reflected in countries' policies and legislation. In Brazil the situation is not different. Environmental rules and licensing policies are very demanding in line with the best international practices.

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation of any polluting or potentially polluting activity or any other capable to cause environmental degradation is obliged to secure a series of permits from the relevant environmental agency (federal and/or local, depending on the project).

The PPs interest in preserving the region's natural wealth can be measured for the environmental actions developed. The 24 programs contained in the Basic Project Environmental (PBA) for the implementation phase, for example, are projects that deal with both aspects of the physical environment (soil, air, water) and the biotic environment (fauna and flora) and social.

Together, these programs interrelate and complement each other, seeking to prevent, mitigate and control possible interferences in the environment, caused by implementation of the enterprise. Thus, in 2009, CESAP received the first Environmental Operating License (LAO), valid for three years, and in 2012 the first renewal of the LAO, valid for eight years.

Project sponsors have to obtain all licenses required by the Brazilian environmental regulation (National Environmental Council Resolution "Conselho Nacional do Meio Ambiente - CONAMA" nr. 6/87):

- The preliminary license (Licença Prévia or LP),
- The construction license (Licença de Instalação or LI); and
- The operating license (Licenca de Operação or LO).

The project activity has all above mentioned licenses, which are available with the project sponsor and the environmental agency of Santa Catarina State (FATMA).

Table 3 – History of UHESP licenses issued by FATMA

Type	Number	Date of issuance
Preliminary License	228/03	24/07/2003
Construction License	076/03	11/12/2003
	076/05	30/11/2005
	063/GELAO/07	31/07/2007
	085/07	22/10/2007
Operation License	202/09	13/07/2009
	4055/12	31/05/2012
	542535*	30/01/2020

* Protocol number of the renewal process of the operational environmental license (LO).

It is noteworthy that was filed the request for renewal of LAO in January/2020 4055/2012, whose validity was until 31/05/2020. The LAO renewal process together the IMA is under technical analysis by the Institute.

CESAP periodically presents the actions and results of the implementation of the environmental programs provided for in the Environmental Operating License, appointed in accordance with the commitments assumed with the Environmental Agency, with the programs below all in service status.

2.4 Public Comments

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 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project uses the Clean Development Mechanism (CDM) methodology: ACM0002 – “Grid-connected electricity generation from renewable sources” (version 20.0), also approved by the VCS Program.

The ACM0002 also refers to the following tools:

- “TOOL01: Tool for the demonstration and assessment of additionality” (version 07.0.0);
- “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality” (version 07.0);

- "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 03.0);
- "TOOL07: Tool to calculate the emission factor for an electricity system" (version 07.0);
- "TOOL10: Tool to determine the remaining lifetime of equipment" (Version 01);
- "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1).

The "TOOL02: combined tool to identify the baseline scenario and demonstrate additionality" and the "TOOL03: tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" are not applicable to the project activity, and therefore, they are not used.

3.2 Applicability of Methodology

ACM0002 methodology is applicable to grid-connected renewable power generation project activities that (a) install a Greenfield power plant; (b) involve a capacity addition to a existing plant; (c) involve a retrofit of (an) existing plant(s)/units(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) involve a replacement of (an) existing plant(s).

The proposed project activity comprises the installation of a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant) corresponding to option (a).

The methodology also provides the following conditions:

- The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;

The proposed project activity is the installation of a hydro power plant.

- In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;

Not applicable. The proposed project activity does not correspond to a capacity addition, retrofit or replacement.

In the case of hydropower plants, at least one of the following conditions must apply:

- The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or
- The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (7), is greater than 4 W/m^2; or
- The project activity results in new single or multiple reservoirs and the power density, calculated using equation (7), is greater than 4 W/m^2;

Considering the applicability conditions, UHESP can use ACM0002 methodology as it is a new hydropower plant with a power density greater than 4 W/m^2.

In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply:

- The power density calculated using the total installed capacity of the integrated project, as per equation (8), is greater than 4 W/m^2;
- Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity;
- Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be;
    - Lower than or equal to 15 MW; and
    - Less than 10 per cent of the total installed capacity of integrated hydro power project.

Not applicable. The implementation of the proposed project activity will result in a new single reservoir.

Finally, the methodology has the following restrictions – i.e. project activities may not be applicable in the following cases:

- Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;
- Biomass fired power plants;

The project is still applicable for the use of ACM0002 since it does not correspond to any of the restrictions listed above. In addition to the applicability conditions of the ACM0002 methodology, the applicability conditions of the tools used must also be assessed.

In order to estimate the baseline emissions occurring after the implementation of the proposed project activity the “Tool to calculate the emission factor for an electricity system” is used. This tool provides the steps required to estimate the CO2 emission factor, which consists of a “combined margin”, for the displacement of electricity generated by plants connected to an electric grid.

As further described below in section B.6.1, off-grid power plants are not considered. Hence, the requirements of Annex 2 of the tool, referring to the applicability conditions that shall be met when this kind of plants are considered, is not applicable. Besides, the Brazilian Electric System is neither partially nor totally located in any Annex-I country.

In this sense, it can be concluded that there are no applicability conditions preventing the use of this tool to estimate the CO_2 emission factor of the Brazilian Electricity System in the context of the proposed project activity.

3.3 Project Boundary

According to ACM0002, baseline determination shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activity. GHG and emission sources included in or excluded from the project boundary are shown in the table below.

Table 4 – GHG emissions and sources in the baseline and project activity

Source		Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the Project Activity.	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.
Project	Emission of CH_4 from the reservoir.	CO_2	No	Minor emission source.
		CH_4	No	No significant emission from reservoir is identified in the project activity, according to the power density calculation.
		N_2O	No	Minor emission source.

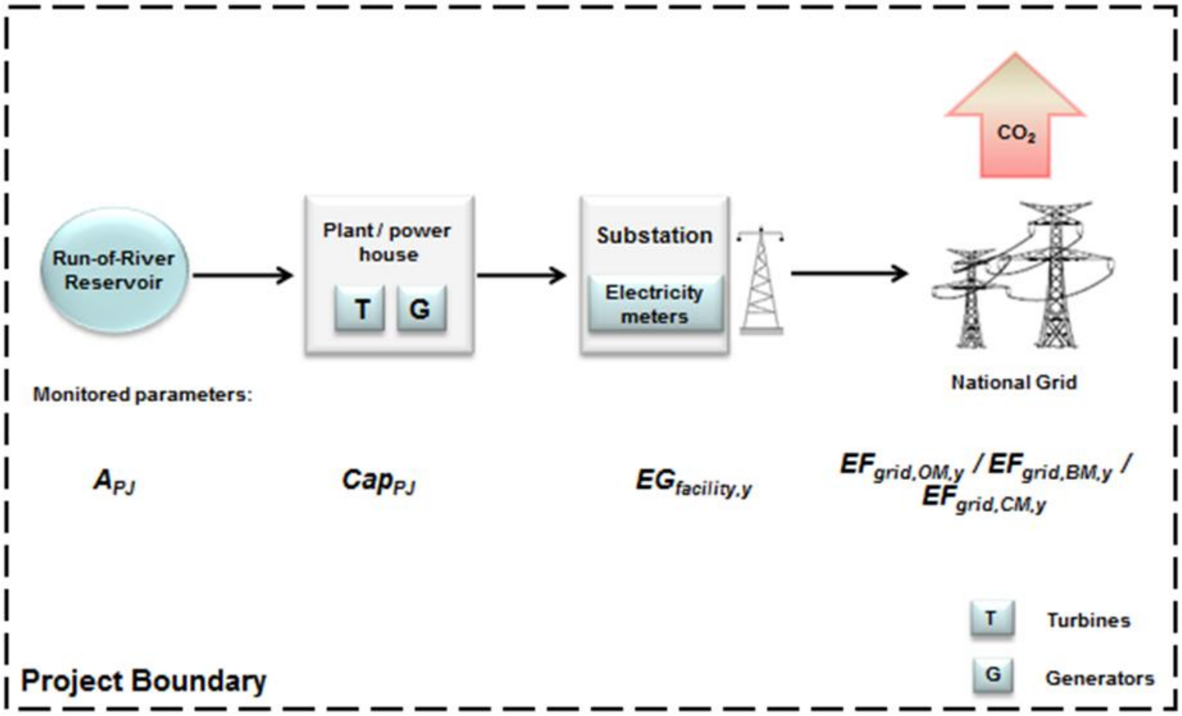

Figure 2 – Flow diagram of the project boundary

3.4 Baseline Scenario

The project activity is the installation of a new grid-connected renewable power plant. Hence, accordingly to ACM0002 the baseline scenario is the following:

“If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in “TOOL07: Tool to calculate the emission factor for an electricity system”.

Steps of the methodological “TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” were applied as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

There are no new relevant national and/or sectoral policies and/or circumstances in the electricity generation sector applicable to the project activity in comparison to the time of the submission of the project activity for validation, which would affect the compliance of the current baseline scenario.

Regarding baseline emissions, there are no changes in the electricity system delineation of the project activity. According to Resolution #8 issued by the Brazilian DNA on May 26th, 2008, the project electricity system for projects connected to the National Interconnected System ("SIN" from the Portuguese "Sistema Interligado Nacional") shall cover all five macro geographical regions of the country (North, Northeast, South, Southeast and Midwest).

Since the project activity applied the ex-post option for the CO_2 emission factor of the grid in the first crediting period, this parameter continued to be calculated by the project participants using the ex-post data vintage. The CO_2 emission factor of the grid was updated based on the most recent information available by the Brazilian DNA for emission reductions calculation purposes.

Therefore, the current baseline complies with national and sectoral policies which have come into effect after the submission of the project for registration and subsequent renewals.

Step 1.2: Assess the impact of circumstances

There are no new relevant national and/or sectoral policies and/or circumstances in the electricity sector applicable to the project activity in comparison to the time of the submission of the project activity for validation, which could impact the validity of the current baseline for the next crediting period. Also, there are no new fuels or raw materials involved in the project activity.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

In the absence of the project, the electricity would be generated by grid connected power plants. Thus, this step does not apply, since the whole system would continue to supply energy independently of the lifetime of individual equipment.

Step 1.4: Assessment of the validity of the data and parameters

Circumstances related to CO_2 emission factor of the grid have changed due to the delineation of the grid as discussed in Step 1.1 and, therefore, the CO_2 EF was revised in this PDD. The CO_2 EF of the grid reflects the GHG emissions of existing and the prospective power plants connected to the electricity system. In the case of Brazil, it possesses a large share of hydroelectricity and, for this reason, it presents a low CO_2 emission factor of the grid when comparing to other countries.

Furthermore, the weights established in the CO_2 EF tool also impacted the $EF_{CM,y}$ results at the time of the 2nd crediting period, since 0.25 for OM and 0.75 for BM shall be considered for the 2nd and subsequent crediting periods (and no more 0.5 for OM and BM as in the 1st crediting period). Also, the CAP_{BL} and A_{BL} parameters were fixed according to the applied methodology, where the monitoring frequency must be only once at the beginning of the crediting period. Detailed description of methods applied for the calculation of emission reductions are presented in section 4.1.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The current scenario still valid, thus there is no need to be updated. Detailed description of data and parameters applied for the calculation of emission reductions are presented in sections 4.1.

Step 2.2: Update the data and parameters

Considering changes in the Brazilian grid delineation, the CO_2 emission factor of the grid has to be updated to reflect the current delineation and matrix, following the latest version of TOOL07. Also, according to the methodology applied, the CAP_{BL} and A_{BL} parameters were fixed, where the monitoring frequency is only once at the beginning of the credit period. Detailed description on how the emission factor was determined is presented in sections 4.1.

3.5 Additionality

It should be noted that for this second crediting period, there was no change in the country's regulatory legislation regarding the hydroelectric activity and once the project has achieved regulatory surplus, in other words, that the project is not mandated by any law, statute or other regulatory framework, and that the energy generated by the project activity is not used to meet governmental goals, laws or legal mandates of the country. Therefore, the project activity continues to be additional in accordance with the country's specific legislation for this activity.

This section remained unchanged, it is the reproduction of the registered PD.

The description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity is demonstrated through the "Tool for the demonstration and assessment of additionality", as referred in ACM0002 used in this project, which is very similar to VCS 2007.1 (Test 1 – project test).

Step 1. Identification of alternatives to the project activity consistent with current laws and regulation

Sub-step 1a. Define alternatives to the project activity:

The project is not mandated by any enforced law, statute or other regulatory framework.

Alternatives to the proposed project activity are:

Alternative 1: Continuation of the present scenario, with the supply of electricity from the Brazilian interconnected grid;

Alternative 2: The implementation of the project without incentives/revenues from voluntary carbon markets.

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

Both alternatives, the project activity and the alternative scenarios, are in compliance with all regulations in accordance with the following entities:

- The National Electric System Operator (ONS from the Portuguese Operador Nacional do Sistema Elétrico);
- The Electricity Regulatory Agency (ANEEL from the Portuguese Agência Nacional de Energia Elétrica);
- The Mines and Energy Ministry (MME from the Portuguese Ministério de Minas e Energia);
- The Chamber of Electric Energy Commercialization (CCEE from the Portuguese Câmara de Comercialização de Energia Elétrica);
- The Santa Catarina Environmental Agency (FATMA from the Portuguese Fundação do Meio Ambiente);
- The VCS Board.
- Relevant local law and regulations related to the project activity are presented in section 1.10 of this PD.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

The "Tool for the demonstration and assessment of additionality" refers to the "Guidelines on the assessment of investment analysis" and, therefore, these guidelines were used in the following analysis.

Sub-step 2a. Determine appropriate analysis method:

Once the project activity generates other financial benefit other than the carbon generation related income (sale of energy) Option I could not be chosen. Option III is more appropriate when compared to Option II because there are no other options of investment from the project owner perspective. Therefore, additionality is demonstrated through benchmark analysis (option III).

Sub-step 2b – Option III – Apply benchmark analysis:

According to the "Tool for the demonstration and assessment of additionality", discount rates and benchmarks shall be derived from:

a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;

b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects;

c) A company internal benchmark (weighted average capital cost of the company), only in the particular case referred to above in paragraph 5. The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark;

d) Government/official approved benchmark where such benchmarks are used for investment decisions;

e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified.

The benchmark used to be compared with the IRR of UHESP project is the Weighted Average Cost of Capital (WACC) calculated based on standard parameters well known and used in the electricity sector. Therefore, option (e) is chosen[22].

The financial indicator identified for the Salto Pilão project is the project Internal Rate of Return (IRR). The IRR here presented is compared to the appropriate benchmark, which is the Weighted Average Cost of Capital (WACC) as presented above.

Weighted Average Cost of Capital (WACC)

The weighted-average cost of capital (WACC) is a rate used to discount business cash flows and takes into consideration the cost of debt and the cost of equity of a typical investor in the sector of the project activity. The benchmark can be applied to the cash flow of the project as a discount rate when calculating the net present value (NPV) of the same, or simply by comparing its value to the internal rate of return (IRR) of the project. The WACC considers that shareholders expect compensation towards the projected risk of investing resources in a specific sector or industry in a particular country.

The WACC calculation is based on parameters that are standard in the market, considers the specific characteristics of the project type, and is not linked to the subjective profitability expectation or risk profile of this particular project developer. The WACC as of the project’s financial analysis decision date was of 9.36%. For the WACC calculation, the following equation was used:

$$WACC = Wd \times Kd + We \times Ke$$

Where:

We and **Wd** are, respectively, the weights of equity and debt typically observed at the sector. **We** is of 35%, and **Wd** of 65%. These numbers derive from the typical leverage of similar projects in the sector in Brazil, based on the rules for available long term loans from Brazilian Development Bank (from the Portuguese Banco Nacional de Desenvolvimento Econômico e Social - BNDES).

[22] Detailed information related to the option chosen is presented in the Validation Protocol (Project Participants response of CAR BQA 1).

Kd is the cost of debt, which is observed in the market related to the project activity, and which already accounts for the tax benefits of contracting debts. Kd is of 5.02%, and also derives from long term loans applied to the sector in Brazil, and therefore is based on BNDES financing endeavour credit line's interest rates.

Ke is the cost of equity, estimated through the Capital Asset Pricing Model (CAPM). Ke is of 17.43%. **Ke** derives from a risk free rate plus the market risk premium adjusted to the sector through Beta. The risk-free rate, the market risk premium, and the Beta have been calculated based on publicly available data and presented to the DOE.

Plugging these numbers into WACC formula:

$$WACC = 65\% \times 5.05\% + 35\% \times 17.43\% = 9.36\%$$

Each assumption made and all data used to estimate the benchmark have been presented to the DOE. The spreadsheet used for calculation of the WACC has also been provided to the DOE.

Internal Rate of Return (IRR)

The cash flow of the project activity, containing the calculation of the project IRR of the project activity have been presented to the DOE in a separate annex to this VCS-PD.

During the 4th verification of the project the DOE has requested to reflect changes in the installed capacity and assured energy occurred in the VCS-PD independently of previous verifications and Monitoring Reports, which already considered the change. In order to demonstrate that the project remains additional, the cash flow of the project was revised to reflect these changes. Therefore, three analyses are evaluated in this PD considering:

a) The original cash flow: all parameters considered at the time of investment decision as required by the "Guidelines on the assessment of investment analysis", which all documented evidence was made available at the time of the project validation and registration;
b) The revised cash flow – assured energy: all parameters considered at the time of the investment decision, changing the assured energy of the project only (the key parameter), based on the following legislation:

Table 5 – Assured energy of the project

Assured Energy	Applied Period	Legislation
106.7MW-ave	2010-2011	Concession contract # 15/2002
109MW-ave	2012-2017	MME Ordinance #35 issued on 22/05/2012
114.1MW-ave	2018 onwards	MME Ordinance #178 issued on 3/05/2017

c) The revised cash flow – monitored electricity generation: all parameters considered at the time of the investment decision, changing the electricity generated by the project according to previous verifications.

The analysis resulted in the following Internal Rates of Return:

Table 6– Project IRR analysis

Scenario	IRR (%)
a) Investment decision timing	7.25
b) Revision of assured energy	7.64
c) Monitored electricity	8.22

While reassessing additionality, scenario b) is applicable since it considers what would be the project IRR if the assured energy increase was considered since the conception of the project (at the time of the investment decision). In addition, the DOE has requested to present scenario c) in order to demonstrate that the project is still additional while considering electricity monitored during verifications.

Sub-step 2c: Calculation and comparison of financial indicators:

This number shows that the IRR of the project is lower than the benchmark. Hence, it is evident that the project activity is not financially attractive to the investor.

Table 7– Comparison between Project's IRR and investor's WACC

Project	IRR (%)	WACC (%)
a) Investment decision timing	7.25	9.36
b) Revision of assured energy	7.64	
c) Monitored electricity	8.22	

Sub-step 2d: Sensitivity analysis

The sensitivity analysis, as established by the "Guidelines on the Assessment of Investment Analysis", is to be conducted considering variables that constitute more than 20% of either total project costs or total project revenues, including initial investment costs. In addition, it suggests that variations should cover a range of +10% and -10%. Hence, variations were done increasing project's revenues (varying the energy price and plant load factor) and, reducing investment expenses and operation and maintenance costs. The results are presented below.

Table 8– Results of IRR while conducting a sensitivity analysis

Salto Pilão	Investment decision timing (%)	Revision of assured energy (%)	Monitored electricity(%)
Original	7.25	7.64	8.22
Price Sensitivity	8.94	9.36	10.07
PLF Sensitivity	8.14	8.54	8.65
Investment Sensitivity	8.24	8.64	9.29
Costs Sensitivity	8.08	8.48	9.12

Under scenarios analyzed above, the only scenario which IRR surpasses the benchmark is when the energy price increase 10% while considering the verified electricity generation during verifications. According to the "Guidelines on the assessment of investment analysis", the probability of the occurrence of scenario which IRR surpasses the benchmark shall be analyzed. However, as the project is already implemented, a reasonable approach is to analyze incurred revenues (energy generation and price), as well as incurred costs (investment and operational costs). Therefore, another analysis was conducted:

d) Realized cash flow: actual values incurred to the project (electricity monitored, capex, opex, operational costs, depreciation, etc) based on financial statements.

Table 9 – Project IRR analysis – incurred values

Scenario	IRR (%)	Benchmark (%)
d) Realized values	8.84	9.36

Up to 2017, realized investment and operating expenses considered in the cash flow revision are based on annual financial statements. Regarding the energy price, the companies commercialized electricity differently: Cia. Geração de Energia Pilão (CGEP) and DME Energética have signed power purchase agreements and CBA uses electricity for self-consumption. Therefore, the energy price of CGEP and DME is based on power purchase agreements adjusted to the Extended Consumer Price Index (IPCA). For the CBA energy price, 2019 DCIDE market curve is deflated for the previous period. From 2019 onwards, the expected inflation on average term from the Focus Bulletin is considered.

For 2018 and 2019, operating expenses consider the forecast budget approved on the 27th Minutes of Meeting of the Consortium Board. For the uncoming years, operating expenses were inflated based on the expected inflation on average term from the Focus Bulletin.

Regarding capex for the 2018 – 2023 period, the forecast budget approved on the 27th Minutes of Meeting of the Consortium Board is considered. From 2024 onwards, estimative is based on 0.3% of total assets[23]. All documented evidence was presented to DOE during validation.

While analyzing the realized scenario (operational project), the IRR remains lower to the benchmark. It can be concluded that, in spite of the assured energy revision and a higher energy price, investment and costs also increased.

Outcome: The IRR of the project at the time of the investment decision was 7.25%, which is lower than the benchmark of 9.36%. Even if the increase in the assured energy and installed capacity were considered at the time of the investment decision, the project attractiveness (7.64%) remains below the benchmark. Under the sensitivity analysis, the project is not financially attractive to the investor even when variables change in favor of the project; the only possible scenario which IRR is higher than then benchmark is when applying +10% in energy price for scenario c) monitored electricity above. However, while assessing the realized values incurred to the project, it can be concluded that the project remains financially not attractive to investor. Therefore, the assured energy

[23] Due to the forecast investment inclusion, the fair value of the project was included in the end of the assessment period following the "Guidelines on the assessment of investment analysis".

SATISFIED/PASS – Proceed to Step 3 or

increase does not change the initial conclusion of the project additionality. For this reason, the most plausible alternative to the project continues to be the electricity supply by other grid-connected power plants (alternative 1).

Step 3. Barrier analysis

Not applicable.

Step 4. Common practice analysis

For the common practice analysis, the GHG Protocol for Project Accounting (chapter 7) is used. All information required in the Additionality Tool is also required in the GHG Protocol, however the GHG Protocol has a more detailed/objective criteria than the "Tool for the demonstration and assessment of additionality". Therefore, the following steps are assessed:

(i) Define the product or service provided by the project activity

The product that will be provided by Salto Pilão project activity is the kilowatt-hours of electricity supplied to the interconnected grid.

(ii) Identify possible types of baseline candidates;

As mentioned above, alternatives to the project activity are: the continuation of the current situation (with electricity generated by large hydroelectric with large reservoirs and thermal power fossil fuel stations) or the implementation of the proposed project activity without carbon credits incentives. Therefore, both alternatives deliver the same product.

Considering explanations above, baseline candidates should be all the electricity-generating technologies connected to the grid.

In the Figure 6, it is presented Brazil's electricity matrix, which clearly demonstrates that the main source of electricity generation comes from hydropower plants.

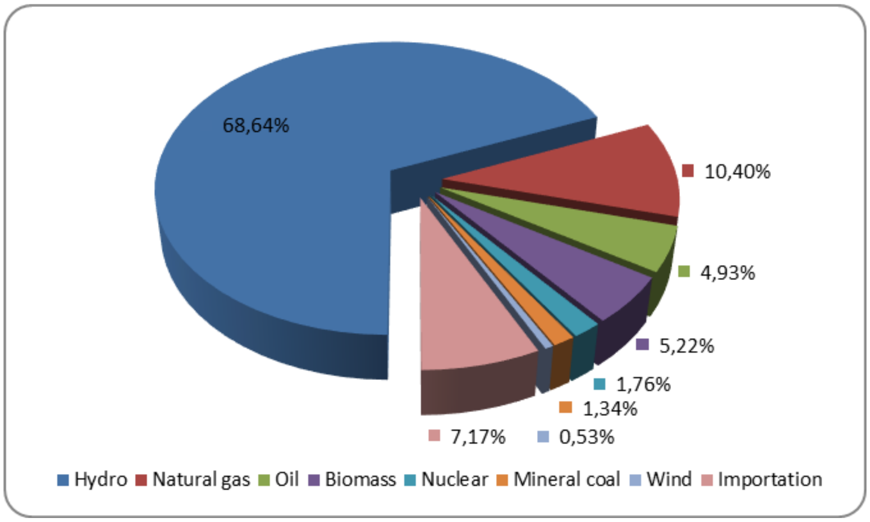

Figure 6 – Brazil's electricity matrix

Source: ANEEL (2009a)

However, as mentioned in the GHG Protocol for Project Accounting, the "availability and nature of substitute products or services for the project activity should be considered in identifying baseline candidates with the 'same' product or service". Therefore, since Salto Pilão is a hydropower plant project and, thus, generates renewable energy to the grid, the nature of electricity generation of a renewable energy project cannot be compared to the ones provided through fossil fuel consumption. Even among renewable generation technologies, differences are huge and it is not reasonable to compare a hydropower plant, as it is the case of Salto Pilão, with wind, solar or small hydro power plants[24] projects.

Considering explanations above, only **hydropower plants**, i.e., hydropower plant with installed capacity above 30 MW, were included in this common practice analysis. Furthermore, only plants with installed capacity 50% lower and 50% higher than Salto Pilão project were analyzed (i.e. between 95.94 and 287.82 MW).

(iii) Define and justify the geographic area and the temporal range used to identify baseline candidates;

- Geographic area

Brazil has an extension of 8,514,876.599 square kilometres[25] (with over 4,000 km distance in the north-south as well as in the east-west axis) and 6 distinct climate regions: sub-tropical, semi-arid, equatorial, tropical, highland-tropical and Atlantic-tropical (humid tropical). These varieties of

[24] According to the Brazilian legislation (ANEEL Resolution nr. 652 dated December 9th, 2003), small hydropower plant must have installed capacity between 1 MW and 30 MW, and have a reservoir area smaller than 3 km².

[25] Available at: http://www.ibge.gov.br/english/geociencias/cartografia/default_territ_area.shtm

climate obviously have strong influence in the technical aspects related to a hydropower plant implementation.

In addition, hydroelectric projects can differ significantly from each other considering the region to be implemented, climate, topography, availability of transmissions lines, river flow regularity, etc. For those reasons alone it is extremely difficult and not reasonable to compare different hydropower potential and plants. Moreover, hydro-power plants cannot be optimally placed (close to load centers and transmission lines) and easily transferred (moved to a new region where a better tariff is offered) as, for example, modular fossil-fuel-fired (diesel, natural gas) power plants. Differences may be even larger if no big water storage is possible.

Considering information above, only hydropower plants located in the same region of Salto Pilão project were analyzed – Southern region of Brazil, which is composed by Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RS) States.

It is important to mention that, as mentioned above, depending on the project location, differences related to the technical aspects have influence for hydropower plant projects implementation even if hydro projects are located in the same region. Considering that technical differences obviously have influence in the investment/financing of a project and that project sponsors have different investment capacity, financial information should be considered when hydro projects are analyzed. However, Project Participants decided to do their upmost in making a reasonable comparison for the purpose of common practice analysis even without investment information available.

- Temporal range

Until the beginning of the 1990's, the energy sector was composed almost exclusively of state-owned companies. From 1995 onwards, due to the increase in international interest rates and the lack of investment capacity of the State, the government started the privatization process. However, by the end of 2000 results were still modest. Further initiatives, aiming to improve electric generation in the country, were taken between the 1990's and 2003; however it did not attract new investment to the sector.

In 2003 the recently elected government decided to fully review the electricity market institutional framework in order to boost the investments in the electric energy sector. The market rules were changed and new institutions were created as Energetic Research Company (in a free translation from the Portuguese Empresa de Pesquisa Energética – EPE) – an institution that would become responsible for the long term planning of the electrical sector with role of evaluating, on a perennial basis, the safety of the supply of electric power – and Chamber for the Commercialization of Electric Power (in a free translation from the Portuguese Câmara de Comercialização de Energia Elétrica – CCEE) – an institution to manage the commercialization of electric power within the interconnected system. This new structure was approved by the House of Representatives and published in March of 2004[26]. Given the new regulatory framework and investment climate, Project Participants considered only projects starting after March of 2004.

(iv) Define and justify any other criteria used to identify baseline candidates;

Generally, hydropower plants constructed in Brazil have large reservoirs, conferring a low power density. Hydropower plants with large reservoirs are preferred from the government's point of view than those that have small reservoirs or run-of river plants since they have fewer risks of supply. Therefore, the average of power density of the Brazilian hydropower plants is 2.03 W/m2[27].

Considering explanations above, the technology used in Salto Pilão project - conferring a power density of 1,279.2 W/m^2 -, cannot be compared to the ones with large reservoirs. Thus, only hydropower plants with **power density greater than 4 W/m^2** (under ACM002 methodology eligibility criteria) were included in this common practice analysis.

(v) Identify a final list of baseline candidates;

According to the criteria mentioned above, only hydropower plants (i.e. between 95.94 and 287.82 MW) located in the Southern region of Brazil (Paraná, Santa Catarina and Rio Grande do Sul States) with operations started from March 2004 and under the ACM0002 eligibility criteria (power density greater than 4 W/m^2) were analyzed.

Considering information above, Project Participants researched about the generating units of hydropower plants from 2004 to 2008 (the most recent data available at the time of completing this document). Also, it can be identified the hydropower plants that received carbon credits incentives or not.

Table 10 - Projects considered for the common practice analysis

Year	Project	State	Total installed capacity (MW)	Reservoir area (km^2)	Power density	Incentive
2004	Monte Claro	RS	130.0	1.0	130.0	CDM
2005	Santa Clara	PR	120.0	20.1	6.0	CDM
2006	Fundão	PR	120.2	2.5	48.1	CDM
2007	-					

[26] http://www.planalto.gov.br/CCIVIL/_Ato2004-2006/2004/Lei/L10.848.htm

[27] MME (2009). Plano Decenal de Expansão de Energia Elétrica: 2008-2017 / Ministério de Minas e Energia; colaboração Empresa de Pesquisa Energética. – Brasília: MME: EPE, 2009.

2008	Castro Alves	RS	130.0	5.0	26.0	CDM
	14 de Julho	RS	100.0	5.0	20.0	CDM

Source: ANEEL (2009b)[28] and UNFCCC (2009)[29]

Considering Table , all hydropower plants that started operations in the Southern region received carbon credits incentives to be developed. In spite of the revision in the installed capacity of the project (from 182.3MW to 191.88MW), it does not change the results of the common practice analysis and no additional hydropower plant was found similar to UHESP. This result demonstrates that is required a strong incentive to develop renewable energy projects in Brazil. In the case of hydropower plants, large reservoirs are the common practice and the small ones require some kind of incentive to reduce risks related to the nature of this technology.

All projects included in this analysis are in accordance with legal requirements according to publicly available information.

(vi) Identify baseline candidates that are representative of common practice (for the project-specific baseline procedure).

Common practice in Brazil has been the construction of large-scale hydroelectric plants with large reservoirs – which present low risks for the energy supply and, therefore, are preferred from the government's point of view – and, more recently, of thermal fossil fuel plants, with natural gas, which also receive incentives from the government. As of January 2009 17.73% of the power generated in the country comes from thermal power plants, and this number tends to increase in the next years, once 37.47% of projects approved between 1998 and 2009 were thermal power plants[30].

In the most recent energy auctions, which took place on September 17th, 2008 and September 30th, 2008 34 plants negotiated their electricity to be sold from 2011 on (10 plants are expected to become operational on 2011 and the other 24 plants are scheduled to export energy from 2013 on), of which only one was a hydropower plant, one was a thermal plant fuelled with sugar cane bagasse, and the other 24 plants were fossil fuel thermal plants[31].

In summary, the proposed project activity cannot be considered as common practice and therefore is not a business as usual type scenario. And it is clear that, in the absence of the incentive created carbon credits incentives, this project would not be the most attractive scenario. Thus, the

[28] ANEEL (2009b). Fiscalização dos serviços de geração. Acompanhamento da expansão da oferta de geração de energia elétrica. Resumo geral do acompanhamento das usinas de geração elétrica - Versão fevereiro de 2009. Available at: <http://www.aneel.gov.br/area.cfm?idArea=37&idPerfil=2>. Accessed on 26 Feb 2009.

[29] UNFCCC. Project activities. Validation. Available at: <http://cdm.unfccc.int/Projects/Validation/index.html>. Accessed on 12 Nov 2009.

[30] ANEEL – Agência Nacional de Energia Elétrica (Brazilian power regulatory agency). Banco de informação de Geração. 2009. Available at <http://www.aneel.gov.br/area.cfm?idArea=15&idPerfil=2>.

[31] All information of the actions is publicly available at CCEE's website: <www.ccee.org.br>.

most plausible alternative would be the continuation of the present scenario, with the electricity supplied by other plants of the Brazilian interconnected grid (alternative 1).

SATISFIED/PASS – Project is additional

3.6 Methodology Deviations

No methodology deviations are applied to the project activity.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$ **Equation 1**

Where:

BE_y	Baseline emissions in year *y* (tCO_2/yr);
$EG_{PJ,y}$	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);
$EF_{grid,CM,y}$	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” (tCO_2/MWh).

<u>Calculation of $EG_{PJ,y}$</u>

The project activity is the installation of a new grid connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, thus $EG_{PJ,y}$ is calculated according to option (a) Greenfield renewable energy power plants as follows:

$$EG_{PJ,y} = EG_{facility} \quad \text{Equation 2}$$

Where:

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

Determination of $EF_{grid,CM,y}$

The Project Activity is connected to the Brazilian National Interconnected System (SIN). The grid emission factor is calculated by the Brazilian DNA, according to the "Tool to calculate the emission factor for an electricity system".

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, the project participants shall identify the relevant project electricity system. Project participants may delineate the project electricity system using any of the following options:

Option 1. A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies), In case a delineation is provided by a group of DNAs, the same delineation should be used by all the project participants applying the tool in these countries;

Option 2. A delineation of the project electricity system defined by the dispatch area of the dispatch centre responsible for scheduling and dispatching electricity generated by the project activity. Where the dispatch area is controlled by more than one dispatch centre, i.e. layered dispatch area, the higher level area shall be used as a delineation of the project electricity system (e.g. where regional dispatch centres are required to comply with dispatch orders of the national dispatch centre then area controlled by the national dispatch centre shall be used);

Option 3. A delineation of the project electricity system defined by more than one independent dispatch areas, e.g. multi-national power pools.

The option chosen is **Option1**, by means of the Resolution number 8, issued on May 26th, 2008, the Brazilian DNA, delineated the electricity system as the National Interconnected Grid (SIN) for CDM purposes. It covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest) as presented in the below.

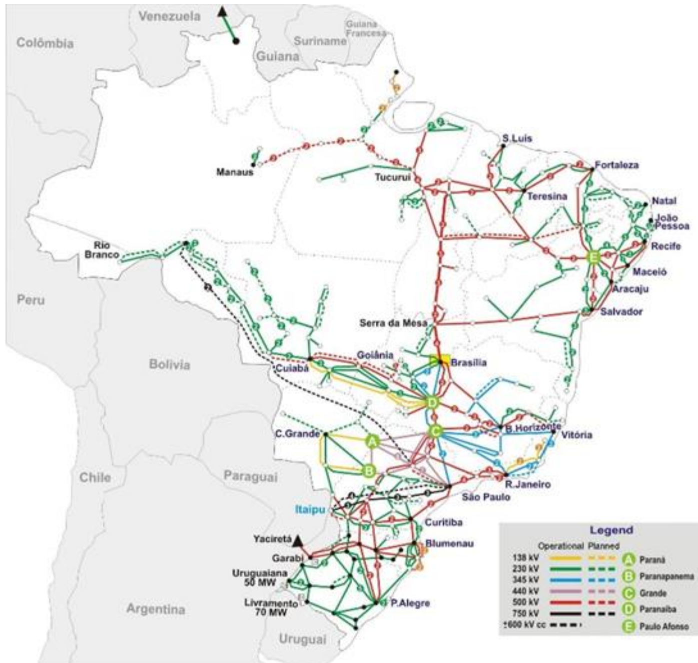

Figure 7 – Brazilian Interconnected System. (Source: ONS)

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option (i): only grid power plants are included in the calculation;

Option (ii): both grid power plants and off-grid power plants are included in the calculation

The Brazilian DNA made available the emission factor calculation based on information of the grid power plants only – **option (i)** – following the "Tool to calculate the emission factor for an electricity system". More information of the methods applied can be obtained in the DNA's website (https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao).

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

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

The Brazilian DNA made available the operating margin emission factor calculated using option c – Dispatch data analysis OM. Accordingly to the "Tool to calculate the emission factor for an electricity system", when this is the chosen option to calculate the operating margin the emission factor has to be up-dated annually. Hence, and the ex-post vintage will be used in the project activity.

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

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad \text{Equation 3}$$

Where:

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

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order for Project Participants to calculate the operating margin emission factor. Hence, this data will be updated annually applying the number published by the Brazilian DNA. For estimation purposes, the data of the most recent year available in the DNA website will be used.

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

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

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

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

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

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$ **Equation 4**

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$FE_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

Step 6: Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot \omega_{OM} + EF_{grid,BM,y} \cdot \omega_{BM}$$ **Equation 5**

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh
ω_{OM}	Weighting of operating margin emission factor (%)
ω_{BM}	Weighting of build margin emission factor (%)

According to the emission factor tool, wind and solar power generation project activities shall use the default values of w_{OM} = 0.75 and w_{BM} = 0.25 for the first crediting period and for subsequent crediting periods. All other projects shall use the default values of w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

For estimation purposes, the most recent available data (2020) from the hourly emission factor provided by the Brazilian DNA was applied. When applying the estimate figures in the formula presented above, the $EF_{grid,OM\text{-}DD,y}$ obtained is:

$$EF_{grid,OM\text{-}DD,\ 2020} = 0.4539\ tCO2e/MWh.$$

The average building margin for the considered years is:

$$EF_{BM,\ 2020} = 0.0979\ tCO_2e/MWh.$$

With these numbers, applying in the formula presented in step 6 above, we have:

$$EF_{2020} = 0.25 \times 0.4539 + 0.75 \times 0.0979$$

$$EF_{2020} = 0.1869\ tCO2e/MWh$$

Quantity of net electricity generation supplied by the project plant/unit to the grid ($EG_{facility,y}$).

Estimated electricity exported to the grid by the project is estimated based on the energy assured as established by the MME Ordinance #178 issued on 03/05/2017. Considering an energy assured of 114.1 MW-average and 8,760 hours of operation in a year, Salto Pilão is expected to export 999,516 MWh/year.

Table 11– Baseline emissions of Salto Pilão project during the second crediting period

Years	Net energy generation (MWh)	Baseline emissions (tCO_2e)
19/01/2020	950,225	177,597

2021	999,516	186,810
2022	999,516	186,810
2023	999,516	186,810
2024	999,516	186,810
2025	999,516	186,810
2026	999,516	186,810
2027	999,516	186,810
2028	999,516	186,810
2029	999,516	186,810
18/01/2030	49,291	9,213
TOTAL	**9,995,160**	**1,868,095**

4.2 Project Emissions

The project emissions are accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ **Equation 6**

Where:

PE_y Project emissions in year y (tCO_2e/yr)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO_2e/yr)

$PE_{GP,y}$ Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)

$PE_{HP,y}$ Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

According to the methodology, project emissions due to fossil fuel combustion and emissions of non-condensable gases from the operation of geothermal power plants are set to zero for hydropower projects ($PE_{GP,y}$ = $PE_{HP,y}$ = 0).

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

As per the ACM0002, for hydro power project activities that result in new single or multiple reservoirs:

- The methodology is not applicable if the power density (PD) of the project activity is less or equal to 4 W/m^2;
- CH_4 and CO_2 emissions from the reservoir shall be accounted if the power density of the project activity is greater than 4 W/m^2 and less than or equal to 10 W/m^2 and;
- Emissions from water reservoir are set to zero if the power density of the project activity is greater than 10 W/m^2.

Project emissions from water reservoirs are calculated as follows:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \quad \textbf{Equation 7}$$

Where:

$PE_{HP,y}$	Project emissions from reservoirs of hydropower plants in year y (tCO_2e);
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants, and the default value as per EB 23 is 90 kg CO_2e/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).

The power density of the project activity is determined as per the equation below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \textbf{Equation 8}$$

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 single or multiple reservoirs 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 single or multiple reservoirs 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.

Substituting the values in equation 8, we have:

$$PD = \frac{191{,}800\ W - 0}{150{,}000\ m^2 - 0} = 1{,}279.2\ W/m^2$$

As mentioned in section 4.1 above, the only GHG emissions applicable to Salto Pilão project is from water reservoirs of hydro power plants ($PE_{HP,y}$). However, considering that the project has a power density of 1,279.2 W/m^2, there are no project emissions involved in the project.

4.3 Leakage

According to the methodology, “no other leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected”.

4.4 Estimated Net GHG Emission Reductions and Removals

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

$$ER_y = BE_y - PE_y$$ **Equation 9**

Where:

ER_y	Emission reductions in year y (tCO_2e/yr);
BE_y	Baseline emissions in year y (tCO_2e/yr);
PE_y	Project emissions in year y (tCO_2e/yr).

Considering equation 1, estimated emission reductions of Salto Pilão project is presented in the table below.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
From 19/01/2020 to 31/12/2020	177,597	0	0	177,597
Year 2021	186,810	0	0	186,810
Year 2022	186,810	0	0	186,810
Year 2023	186,810	0	0	186,810

Year 2024	186,810	0	0	186,810
Year 2025	186,810	0	0	186,810
Year 2026	186,810	0	0	186,810
Year 2027	186,810	0	0	186,810
Year 2028	186,810	0	0	186,810
Year 2029	186,810	0	0	186,810
From 01/01/2030 to 18/01/2030	9,213	0	0	9,213
Total	**1,868,095**	**0**	**0**	**1,868,095**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	Cap_{BL}
Data unit	*W*
Description	*Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.*
Source of data	*Project site.*
Value applied:	*0*
Justification of choice of data or description of measurement methods and procedures applied	*Determination of installed capacity based on recognized standards. The installed capacity of the plant can also be evidenced by the nameplates of the equipment installed at the power plant.*
Purpose of Data	*Calculation of project emissions*
Comments	-

Data / Parameter	A_{BL}
Data unit	*m²*
Description	*Area of the single or multiple reservoirs 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.*
Source of data	*Project site.*
Value applied:	*0*
Justification of choice of data or description of measurement methods and procedures applied	*Measured from topographical surveys, maps, satellite pictures, etc.*
Purpose of Data	*Calculation of project emissions*
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 "Tool to calculate the emission factor for an electricity system".*
Source of data	*The Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC).*
Value applied:	*0.0979*
Justification of choice of data or description of measurement methods and procedures applied	*Option 2 was chosen to calculate the build margin. Therefore, the emission factor for the second credit period shall be calculated* ***ex-ante*** *applying the numbers provided by the Brazilian DNA. Numbers provided by the Brazilian DNA will be applied during the project verification.*
Purpose of Data	*Calculation of baseline emissions*

Comments	For the purpose of the emission reductions estimation 2020 data was used. This was the most recent publicly available information at the time the validation.

5.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$; SDG 7.1.2
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.*
Description of measurement methods and procedures applied	*Electricity supplied by the project activity to the grid. Double checked by Project Sponsors internal control and 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	*Continuous measurement and at least monthly recording.*
Value applied:	*999,516* *The estimated net electricity dispatched to the grid was calculated through the energy assured of the project 114.1 MW-ave (as established by the MME Ordinance #178 issued on 03/05/2017) and 8,760 hours of operation in a year (114.1MW-ave x 8,760 hours).*
Monitoring equipment	*Electricity meters. 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 5.3. Calibration follows recommendations of the Electric System National Operator.* Electricity meter(s):

Description	Main meter	Backup meter
Type	ION 8600	ION 8600
Accuracy	0.2	0.2

QA/QC procedures applied	*The equipments used have by legal requirements extremely low level of uncertainty*
Purpose of data	*Calculation of baseline emissions*
Calculation method	*N/A*
Comments	According to the VCS 4.1 template for Joint Description and Monitoring Report, project developers must report in the section "1.17 Sustainable Development Contributions", the monitoring of SDGs.

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.*
Description of measurement methods and procedures applied	*Determine the installed capacity based on manufacturer's specifications or commissioning data or recognized standards*
Frequency of monitoring/recording	*Once at the beginning of each crediting period.*
Value applied:	*191,880,000* *Based on generator tag: 106.600kVA x 0.9 = 95,940 kW x 2 generating units = 191.880MW.*
Monitoring equipment	*N/A*
QA/QC procedures applied	-
Purpose of data	*Calculation of project emissions*
Calculation method	*N/A*
Comments	-

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.*
Description of measurement methods and procedures applied	*Measured from topographical surveys, maps, satellite pictures, etc.*
Frequency of monitoring/recording	*Once at the beginning of each crediting period.*
Value applied:	*150,000*
Monitoring equipment	*Limnimetric rulers or sensors*
QA/QC procedures applied	*Determined based on recognized standards with extremely low level of uncertainty.*
Purpose of data	*Calculation of project emissions*
Calculation method	*Comparison between monitored water levels and reservoir studies of quota x volume x area curve*
Comments	*The project's reservoir area is determined from the value of the normal maximum water level of 319 m[32].*

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	*The Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)*

[32] According to Environmental License n°4055/2012, the normal maximum water level in the reservoir is 319 m, and this value is monitored according to the methodology.

Description of measurement methods and procedures applied	*Since option C) for the calculation of the operating margin was chosen, this value will be up-dated annually according to data from the Brazilian DNA and following the prescription of the emission factor tool.*
Frequency of monitoring/recording	*Yearly*
Value applied:	*0.1869* *Calculated based on an average of the operating and build margin emission factors for the year of 2020 published by the Brazilian DNA:* https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao
Monitoring equipment	*N/A*
QA/QC procedures applied	*Official source of data.*
Purpose of data	*Calculation of baseline emissions*
Calculation method	*N/A*
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 y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".*
Source of data	*The Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)*
Description of measurement methods and procedures applied	*Option C) was chosen to calculate the operating margin. This option does not permit the ex-ante vintage for the calculation of the emission factor. Therefore, the emission factor will be calculated* **ex-post** *applying the numbers provided by the Brazilian DNA.*
Frequency of monitoring/recording	*Yearly*
Value applied:	*0.4539*

	Calculated based on an average of the operating margin emission factors for the year of 2020 published by the Brazilian DNA: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao
Monitoring equipment	*N/A*
QA/QC procedures applied	*Official source of data.*
Purpose of data	*Calculation of baseline emissions*
Calculation method	*N/A*
Comments	-

Data / Parameter	SDG 8.5.2
Data unit	*Number of direct and indirect jobs per year.*
Description	Unemployment rate, by sex, age and persons with disabilities.
Source of data	Annual Report on Socio-Environmental Responsibility and Economic-Financial
Description of measurement methods and procedures applied	As per global indicator framework developed by the Interagency and Expert Group on SDG Indicators (IAEG-SDGs).
Frequency of monitoring/recording	-
Value applied:	*During this crediting period, it is estimated a generation of approximately 100 direct and indirect jobs per year.*
Monitoring equipment	*N/A*
QA/QC procedures applied	-
Purpose of data	-
Calculation method	*N/A*

Comments	According to the VCS 4.1 template for Joint Description and Monitoring Report, project developers must report in the section "1.17 Sustainable Development Contributions", the monitoring of SDGs.

Data / Parameter	SDG 13.2.2
Data unit	*tCO_2e/yr*
Description	Total greenhouse gas emissions per year.
Source of data	Calculated
Description of measurement methods and procedures applied	As per global indicator framework developed by the Interagency and Expert Group on SDG Indicators (IAEG-SDGs).
Frequency of monitoring/recording	*Annual*
Value applied:	**186,810 tCO_2e/yr**
Monitoring equipment	*N/A*
QA/QC procedures applied	-
Purpose of data	-
Calculation method	$EG_{facility}$ X $EF_{grid,CM}$
Comments	According to the VCS 4.1 template for Joint Description and Monitoring Report, project developers must report in the section "1.17 Sustainable Development Contributions", the monitoring of SDGs.

5.3 Monitoring Plan

The purpose of the project monitoring is to ensure transparency, validity and reliability of the emission reductions generated by UHESP. All information related to the project monitoring will be available at the time of the project verification and will be archived at least for 2 years after the end of the last crediting period with the project sponsor.

Salto Pilão project will proceed with the necessary requirements according to the ACM0002 –"Consolidated baseline methodology for grid-connected electricity generation from renewable sources". According to this methodology, the following parameters will be monitored:

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid ($EG_{facility,y}$);
(ii) Installed capacity of the hydro power plant after the implementation of the project activity (CAP_{PJ});
(iii) Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ});
(iv) All parameters to calculate the 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" ($EF_{grid.CM.y}$).

Procedures for the monitoring of parameters mentioned above are described as follows.

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid ($EG_{facility,y}$);

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 will be 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: 2 installed at the power plants (which measure the gross energy) and 4 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. In case of any failure or high discrepancy readings, meters will be displaced.

Table 12 – Meters description

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

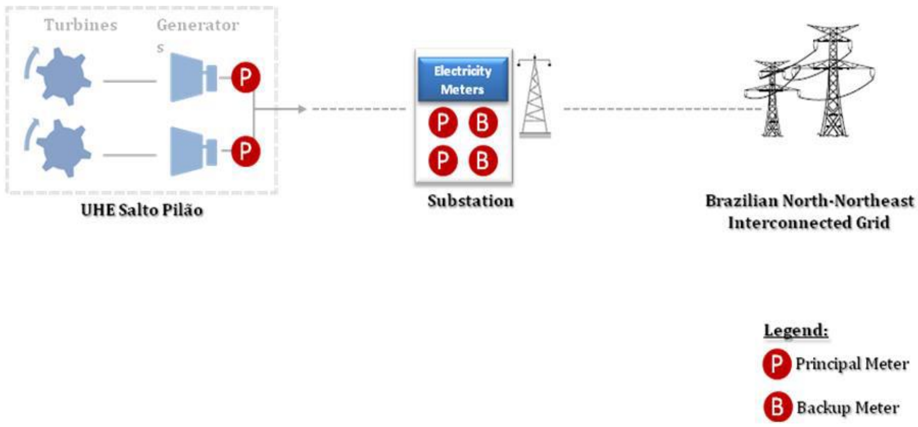

Figure 8 – Diagram of the relevant monitoring points

According to updated ONS procedures[33] valid on 01/01/2017 onwards, energy meter calibration shall be made following the necessary requirements and the established calibration frequency.

Electricity from CCEE/power utility reports will be considered for emission reduction purposes. Therefore, these monthly reports will be available during the project verification (estimated to happen yearly) as well as the calibration certificates from meters involved in the project activity.

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (CAP_{PJ});

The installed capacity of the power plant (W) will be checked by DOE through an on-site visit during verification (once at the beginning of each crediting period). And can be cross-checked with official documents, e.g. environmental license, ANEEL Resolutions, and others.

(iii) Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ});

Although the project reservoir is very small (150,000 m^2) and results in a power density of 1,279.2 W/m^2, project sponsors will monitor the reservoir area (in m^2) of the project through topographical data made once at the time of the project design conception (before the project construction) and monitoring of the water levels in the reservoir. This monitoring of water levels will be made by project sponsor and will be available during the project verification (once at the beginning of each crediting period).

[33] ONS. Grid Procedures – Module 6: Operation Assessment/Submodule 6.16 Installation of the measurement for billing (from the Portuguese Módulo 6: avaliação da operação / Submódulo 6.16: Manutenção do Sistema de Medição para Faturamento). Available at http://www.ons.org.br/paginas/sobre-o-ons/procedimentos-derede/vigentes.

(iv) All parameters to calculate the 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" ($EF_{grid.CM.y}$)

As mentioned in section 3 "Quantification of GHG Emission Reductions and Removals", the Brazilian DNA will made available the operating margin emission factor (tCO_2/MWh) yearly. And build margin, as option 2 was chosen to calculate the build margin, the EF_{BM} for the second credit period shall be calculated ex-ante applying the numbers provided by the Brazilian DNA. Numbers provided by the Brazilian DNA will be applied during the project verification. Thus, Project Participants will use data from the Brazilian DNA at the time of the project verification.

Salto Pilão Consortium is responsible for the maintenance of the equipments' monitoring, 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.

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 will be done according to the regulations of the environmental agencies, through a team of environment experts, who will also monitor 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 to be adopted during the construction phase. These measures are being taken seriously. Data about environmental impact are being archived by the hydropower plant and the environmental agency.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$; SDG 7.2.1
Data unit	MWh/year

Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*.
Value applied:	(see table below)

Month	*EG_{facility,y}* 2020	*EG_{facility,y}* 2021
January	5,935*	96,309
February	40.126	80,368
March	6,126	71,872
April	1,185	21,191
May	0	38,167
June	13,780	100,488
July	55,278	61,869
August	44,146	24,112
September	46,208	71,243
October	28,298	131,742
November	24,046	-
December	109,437	-
TOTAL	**347,565**	**697,361**

**from 19/01/2020 onwards.*

Comments

Electricity meters specification is detailed below:

UG1 meter at substation

Description	Main meter	Backup meter
Serial number	PT-0902A536-01	PT-0903A301-01
Type	ION 8600	ION 8600
Accuracy	0.2	0.2
Calib. Date	Preview date: 14/04/2015 Last calibration: 08/08/2020	Preview date: 14/04/2015 Last calibration: 08/08/2020
Calib.frequency	5 years	5 years

UG2 meter at substation

Description	Main meter	Backup meter

	Serial number	PT-0903A335-01	PT-0903A346-01
	Type	ION 8600	ION 8600
	Accuracy	0.2	0.2
	Calib. Date	Preview date: 14/04/2015 Last calibration: 07/08/2020	Preview date: 14/04/2015 Last calibration: 07/08/2020
	Calib.frequency	5 years	5 years

There are two internal meters used for double checking the electricity generated:

Meter at power plants:

Description	Generator 1	Generator 2
Serial number	PT-0812A276-01	PT-0811A790-01
Type	ION 8600	ION 8600
Accuracy	0.2	0.2
Calib. Date	Preview date: 22/05/2015 Last calibration: 07/08/2020	Preview date: 22/05/2015 Last calibration: 07/08/2020
Calib.frequency	5 years	5 years

– *Discount applied to generation (April to August 2020), due to being outside the calibration period. Applied 0.2% (equipment accuracy).*

– The year 2020 had a great drought, causing the plant to generate an amount of electricity much lower than expected, reaching zero as in the month of May. So when compared to the same months in the year 2021, there is a big difference in generation.

Data / Parameter	Cap_{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Value applied:	191,880,000 Based on generator tag: 106.600kVA x 0.9 = 95,940 kW x 2 generating units = 191.880MW.
Comments	-

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.
Value applied:	*150,000* m^2.
Comments	*The project's reservoir area is determined from the value of the normal maximum water level of 319 m*[34].

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*".
Value applied:	*Period* / $EF_{grid,CM,y}$: *19/01/2020 – 31/12/2020*: *0.1966* *01/01/2021 – 31/10/2021*: *0.2236*
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 *y* calculated using the latest version of the "*Tool to calculate the emission factor for an electricity system*".
Value applied:	*Period* / $EF_{grid,OM,y}$

[34] According to Environmental License n°4055/2012, the normal maximum water level in the reservoir is 319 m, and this value is monitored according to the methodology.

	19/01/2020 – 31/12/2020	*0.4926*
	01/01/2021 – 31/10/2021	*0.6005*
Comments	-	

Data / Parameter	SDG 8.5.2
Data unit	*Number of direct and indirect jobs per year.*
Description	Unemployment rate, by sex, age and persons with disabilities.
Value applied:	*During the years 2020 and 2021 the project generated 45 direct and 67 indirect jobs, regardless of sex, age, color and disability.*
Comments	According to the VCS 4.1 template for Joint Description and Monitoring Report, project developers must report in the section "1.17 Sustainable Development Contributions", the monitoring of SDGs.

Year	*Number of jobs*
From 19/01/2020 to 31/12/2020	56
From 01/01/2021 to 31/10/2021	56
TOTAL	112

Data / Parameter	SDG 13.2.2
Data unit	tCO_2e/yr
Description	Total greenhouse gas emissions per year.
Value applied:	
Comments	According to the VCS 4.1 template for Joint Description and Monitoring Report, project developers must report in the section "1.17 Sustainable Development Contributions", the monitoring of SDGs.

Year	*tCO_2e/yr*
From 19/01/2020 to 31/12/2020	73,633
From 01/01/2021 to 31/10/2021	155,901
TOTAL	229,534

6.2 Baseline Emissions

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

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2/yr);
$EG_{PJ,y}$	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);
$EF_{grid,CM,y}$	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" (tCO_2/MWh).

Calculation of $EG_{PJ,y}$

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 $EG_{PJ,y}$ is as follows:

$$EG_{PJ,y} = EG_{facility}$$

Where:

$EG_{PJ,y}$	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);
$EG_{facility,y}$	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 January 19th 2020 to October 31th, 2021. The net electricity generation exported to the grid in the above mentioned period is as follows:

Table 13 - Energy exported to the grid during the monitored period (in MWh)

Mount	2020	2021
January	5,935*	96,309

February	40,126	80,368
March	6,126	71,872
April	1,185	21,191
May	0	38,167
June	13,780	100,488
July	55,278	61,869
August	44,146	24,112
September	46,208	71,243
October	28,298	131,742
November	24,046	
December	109,437	
Total	**374,565**	**697,361**

**from 19/01/2020 onwards*

CO_2 emission factor of the grid (EF_y)

The CO_2 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 (https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao).

The weights considered for the emission factors are w_{OM} = 0.25 and w_{BM} = 0.75 available for renewable energy projects in the second crediting period,, excluding solar and wind power projects. The CO_2 emission factors considered in this monitoring period are as follows:

Table 14 – The CO_2 emission factor of the grid (in tCO_2e/MWh)

Year	$EF_{grid,OM,y}$	$EF_{grid,BM,y}$	$EF_{grid,CM,y}$
2020	0.4926	0.0979	0.1966
2021	0.6005	0.0979	0.2236

Considering Equation 2, the baseline emissions are as follow:

Table 15 – Baseline emissions during the monitoring period (in tCO_2e)

Year	2020	2021
January	1,167*	21,531
February	7,888	17,967
March	1,204	16,068
April	233	4,737
May	0	4,737
June	2,709	22,465
July	10,867	13,831
August	8,678	5,391
September	9,084	15,927
October	5,563	29,452
November	4,727	-
December	21,513	-
Total	**73,633**	**155,901**

*From 19/01/2020 onwards.

6.3 Project Emissions

No project emissions are expected as the project activity only involves renewable electricity generation from the wind power plant. Hence according to ACM0002 guidelines, for new hydroelectric power projects resulting in new reservoirs, there are no emissions from reservoirs if power density (PD) of the project is greater than 10W/m².

For Salto Pilão HPP:

Capacity of the project = 191.89 MW

Reservoir area = 0.15 km²

Power density = 191.89 / 0.15 = 1,279.20 W/m², so **PE_y = 0.**

6.4 Leakage

There is no leakage emissions involved in the project.

6.5 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_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
From 19/01/2020 to 31/12/2020	73,633	0	0	73,633
From 01/01/2021 to 31/10/2021	155,901	0	0	155,901
Total	**229,534**	**0**	**0**	**229,534**