MONITORING REPORT TEMPLATE[1]

MONITORING REPORT FOR RENEWABLE ENERGY PROJECT

Document prepared by South Pole Carbon Asset Management S.A.S.

Version 1.0 07/01/2025

Monitoring Report Template (Version 3.4)[2]	
Name of project	*Zeus Hydroelectric Power Plant*
BCR Project ID	*BCR-CO-173-1-003*
Registration date of the project activity	*06/06/2024*
Project holder	*Central Hidroeléctrica Zeus S.A.S. E.S.P.*
Contact	*Juan Felipe Posada Rojas* *Cr 43B 19-95 Oficina 1312 ED CCI, Medellín, Colombia* *juanposada@grupocolviva.com* *+57 604 4444 08 56*
Version number of the Project Document applicable to this monitoring report	*Version 1.0* *(11/06/2025)*

[1] This form is for the monitoring report of projects using the BCR Program.
[2] The instructions in this form are a guide. Do not represent an exhaustive list of the information the preparer shall provide under each section of the template.

Monitoring Report Template (Version 3.4)[2]	
Applied methodology(ies)	*AMS-I.D.: Grid connected renewable electricity generation --- Version 18.0*
Project location (Country, Region, City)	*Don Matias, Antioquia, Colombia*
Project starting date	*17/05/2022*
Quantification period of GHG reductions/removals	*17/05/2022 to 16/05/2029*
Monitoring period number	*First monitoring period.*
Monitoring period	17/05/2022 to 31/12/2024
Amount of emission reductions or removals achieved by the project in this monitoring period	*60,641 tCO_{2e}*
Contribution to Sustainable Development Goals	*7, 8, 13*
Special category, related to co-benefits	*NA*

Table of contents

1 General description of project

The proposed project consists of implementing a hydroelectric plant located in the municipality of Don Matias, which lies within the Antioquia department in Colombia. The implementation of the project ensures energy security, diversifies the grid's generation mix, and leads to the sustainable growth of the electricity sector. The project consists of installing two Francis turbines, provided by Wasserkraft Volk, with a total installed capacity of 9.88 MW based on a feed flow of 7 m3/s and an expected generation of 59,200 MWh per year of renewable energy.

The electricity is dispatched to the Colombian electricity grid. Prior to project implementation, no hydroelectric plant or other generation plants were installed at the site. In the baseline scenario, the energy delivered to the grid is generated by a mix of thermal and renewable power generation as reflected in the combined margin emission factor (as per the tool applied). Hence, the project will reduce thermal power generation and GHG emissions from fossil fuel-based generation in the grid by increasing the share of renewable energy.

The project contributes to sustainable development in the following ways:

- Decreases dependence on fossil fuels, which are non-renewable and limited resources, contributing to the achievement of SDG 7 (Affordable and Clean Energy), which aims to ensure access to affordable, secure, and sustainable energy.
- Ensures productive employment, decent work, and equal pay for all, including young people and those with disabilities, contributing to SDG 8 (Decent work and economic growth).
- Reduces emissions of sulfur oxides (SOx), nitrogen oxides (NOx), carbon monoxide, particulate matter, and other pollutants, as well as carbon dioxide (CO_2) associated with fossil fuel combustion; the project contributes to SDG 13 (Climate Action).

The project started operation on May 17, 2022. During the monitoring period from 19 May 2022 to 31 December 2024, the electricity generated was 134,497.75 MWh injected into the national grid, reducing GEI emissions by 60,641 tCO_2.

1.1 Sectoral scope and project type

Scope in the BCR Standard

The project is eligible under the scope of the BCR Standard by meeting one or more of the following conditions:

The scope of the BCR Standard is limited to:	
The following greenhouse gases, included in the Kyoto Protocol: Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O).	X
GHG projects using a methodology developed or approved by BioCarbon, applicable to GHG removal activities and REDD+ activities (AFOLU Sector).	
Quantifiable GHG emission reductions and/or removals generated through implementation of GHG removal activities and/or REDD+ activities (AFOLU Sector).	
GHG projects using a methodology developed or approved by BioCarbon, applicable to activities in the energy, transportation and waste sectors.	X
Quantifiable GHG emission reductions generated through implementation of activities in the energy, transportation and waste sectors.	

The Zeus Hydroelectric Plant project consists of a run-of-the-river power plant that uses the waters of the Rio Grande River at an elevation of 1,766 meters above sea level, with a design flow of 7 m^3/s and a gross head of 169.98 m. Although the two turbines have a total capacity of 10.196 MW, the real installed capacity of the power plant is 9.887 MW, calculated based on the maximum turbine flow of 7 m^3/s. This complies with the standard rule, which states that only small run-of-river hydropower plants between 500 and 20,000 kW of installed capacity are eligible.

Project Type

According to Section 11.1.3, "Activities in the Energy Sector," of the BioCarbon Standard version 3.4, the project activity corresponds to Non-Conventional and Renewable Energy Sources (NCRE) because the implemented activities are related to energy from a Small Hydroelectric Plant (PCH, for its acronym in Spanish) with an installed capacity of 9.887 MW.

1.2 Project start date

According to BCR Standard version 3.4, Section 11.5, the start date of GHG projects is when the activities that result in actual reductions/removals of GHG emissions begin. That is when the implementation, construction, or real action of a GHG Project begins.

The Zeus hydroelectric power plant was declared commercially operational on May 19, 2022. However, as part of the testing period, the plant began delivering energy to the grid on May 17, 2022. Therefore, the emission reductions started on May 17, 2022, which defines the project start date.

1.3 Project quantification period

Project length and quantification periods

According to BCR Standard version 3.4, Section 11.5, the quantification period for reductions/removals attributable to GHG Project is the period during which the project holder quantifies the GHG emission reductions or removals achieved by the project in comparison to the baseline scenario. The quantification periods shall not exceed the project length period of the project.

The Zeus hydroelectric power plant was declared commercially operational on May 19, 2022. However, as part of a testing period, the plant began delivering energy to the grid on May 17, 2022. Therefore, the emission reductions started on May 17, 2022. Then, the quantification periods for the project will be stated as:

Quantification period	***Dates***
First	*17/05/2022 – 16/05/2029*
Second	*17/05/2029 – 16/05/2036*
Third	*17/05/2036 – 29/09/2041*

1.3.1 Current Monitoring Report

With the current monitoring report, the aim is to record the results of the project's implementation from May 17, 2022, to December 31, 2024.

1.4 Project location and project boundaries

The Zeus Hydroelectric Power Plant is located in the Rio Grande River basin, in the north of the department of Antioquia, at an approximate distance of 60 km from Medellín. Up to the site where the Zeus project is located, the Rio Grande River basin covers territories in the Don Matías and Santa Rosa de Osos municipalities.

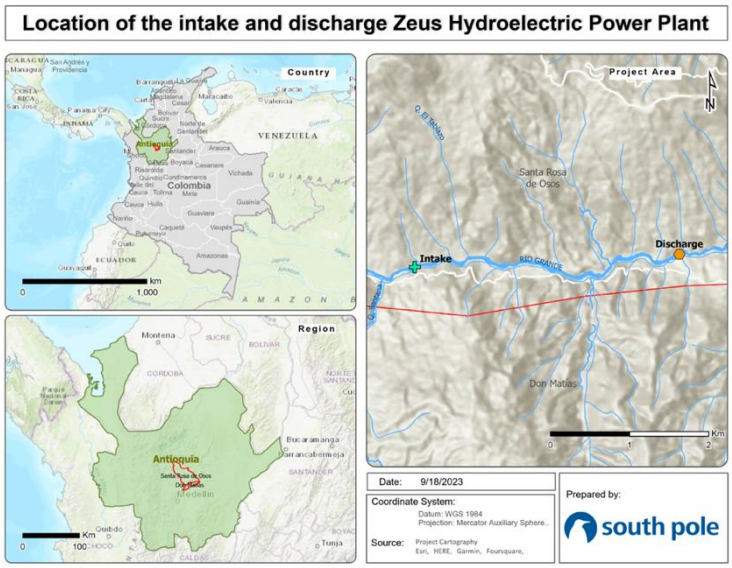

Figure 1. Map of the Project location

Table 1. Coordinates for intake and discharge sites.

	North (m)	*East (m)*
Intake	*1'215.734*	*858.301*
Discharge	*1'215.886*	*861.623*

According to the CDM methodology AMS-I.D version 18.0, the Project Boundary includes the project power plant and all power plants physically connected to the electricity system to which the mitigation project power plant is connected. Thus, the project power plant aims to reduce CO_2 emissions by displacing electricity generation from fossil fuel-fired power plants within Colombia's electricity grid.

1.5 Summary Description of the Implementation Status of the Project

For the construction of the project, the Project Owner obtained an Environmental License issued by the Regional Autonomous Corporation of the Center of Antioquia (CORANTIOQUIA, by its acronym in Spanish) through Resolution 160TH-RES1811-6435, dated November 21, 2018.

The Zeus Hydroelectric Power Plant was constructed and began commercial operations on May 19, 2022, as certified by XM (the grid operator and administrator).

The main equipment installed to project activity are listed below:

Table 2. Characteristics of Francis Turbines.

Main characteristics of the turbines	
Number of units	*2*
Brand	*WKV*
Type	*Francis Turbine*
Model	*2021*
Design flow per turbine	*3,500 l/s*
Design capacity per unit	*5.098 MW*
Nominal speed	*720 rpm*

Table 3. Characteristics of the Generators.

Main characteristics of the generators	
Number of units	*2*
Brand	*WKV*
Capacity per unit	*5,600 kVA*
Voltage	*6,900 V*
Frequency	*60 Hz*

Table 4. Characteristics of the Transformers

Main characteristics of the Auxiliary Transformer	
Number of units	*1*
Brand	*GBE*
Model	*2021*
Rated Power	*100 kVA*
Frequency	*60 Hz*

Main characteristics of the Main Transformer	
Number of units	*1*
Brand	*MACE*
Model	*2016*
Rated Power	*7,000 kVA*
Voltage	*44 kV*
Frequency	*60 Hz*

Since the start of commercial operations, the Zeus Hydroelectric Power Plant has been operating without major complications and has delivered a total of 134,546.15 MWh to the National Electricity System as follows:

Table 5. Annual Power Generation

Year	MWh
2022	44,180.46
2023	45,818.31
2024	44,498.98

With this power generation, the project has achieved a total reduction of 60,641 tCO_2 emissions during this first monitoring period.

During the monitoring period from 2022 to 2024, the Zeus Hydroelectric Power Plant experienced shutdowns mainly due to maintenance and natural events that affected operations. These shutdowns are listed in the following table:

Table 6. Shutdowns of the Zeus Plant During the Monitoring Period

Year	Month	Number of Shutdowns	Total Hours	Causes
2022	May	12	30	Intervention by the Equipment Manufacturer WKV
				Failure Due to Lightning Strikes in the Generators
	June	19	48	Intervention by the Equipment Manufacturer WKV
				Transmission Network Failure Due to Strong Winds

				Valve Failure in the Filtration System of Units 1 and 2
				Corrective Maintenance
	July	20	24	Corrective Maintenance
	August	3	5	Failure Due to Lightning Strikes
				Preventive Maintenance
	September	15	175	Major Failure Due to Lightning Strike
				Preventive Maintenance by Manufacturer WKV
				Preventive Maintenance
	October	16	11	Shutdown Due to Low Water Level
				Corrective Maintenance
	November	11	49	Shutdown Due to Low Water Level
				Corrective Maintenance in Unit 1
	December	10	18	Riverbed Maintenance
				Corrective Maintenance
				Corrective Maintenance
2023	January	3	5	Shutdown Due to Low Water Level
				Corrective Maintenance
	February	5	5	Shutdown Due to Low Water Level
				Failure Due to Lightning Strikes
				Preventive Maintenance
	March	11	2	Corrective Maintenance
	April	8	2	Corrective Maintenance
	May	6	10	Distribution Network Failure
				Corrective Maintenance
	June	11	2	Corrective Maintenance
	July	5	2	Corrective Maintenance
	August	10	3	Corrective Maintenance
	September	15	26	Preventive Maintenance
	October	17	4	Corrective Maintenance

	November	21	6	Corrective Maintenance
				Riverbed Maintenance
	December	0	0	-
2024	January	0	0	-
	February	4	0.083	Corrective Maintenance
	March	0	0	-
	April	1	0	Shutdown Due to Low Water Level
	May	8	4	Shutdown Due to Low Water Level
				Corrective Maintenance
	June	17	5	Preventive Maintenance
				Corrective Maintenance
	July	3	14	Corrective Maintenance
	August	8	7	Corrective Maintenance
				Preventive Maintenance
	September	8	12	Corrective Maintenance
	October	3	0.28	Corrective Maintenance
	November	0	0	-
	December	3	0.18	Corrective Maintenance

As observed in the table above, most of the shutdowns occur as a result of corrective maintenance related to the plant's operation, as well as due to the effects of adverse natural phenomena such as lightning strikes, strong winds, and rising river levels caused by heavy rainfall.

2 Title, reference and version of the baseline and monitoring methodology(ies) applied to the project

The project activity is developed in accordance with the approved consolidated CDM baseline methodology AMS-I.D.: "Grid-connected renewable electricity generation" Version 18.0. Available at: https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

Additionality demonstration is assessed by applying the latest versions of the CDM "Demonstration of additionality of small-scale project activities" Version 13.1. Available at: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-21-v13.1.pdf/history_view

The emission factor of the relevant power system is determined based on the CDM procedure " Tool to calculate the emission factor for an electricity system" (Version 7.0).

Available at: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf/history_view

3 Double Counting and Participation under Other GHG Programs.

The BCR Tool "Avoiding Double Counting (ADC)" sets out the principles and requirements for the BCR Program, to avoid double counting of emission reductions or removals. The Tool addresses the avoidance of double claiming as referred to in CORSIA Emissions Unit Eligibility (EUC) Criteria as well as that of Article 6.2 (Paris Agreement).

As per the requirements, a letter needs to be provided to ensure that the country where the project is being conducted acknowledges that the project is reducing emissions. Additionally, the focal point should state that the project is appropriately registered in the country's public registry system.

In Colombia, the National Registry for the Reduction of Greenhouse Gas Emissions (RENARE) was established through Resolution 1447 of 2018. It is responsible for managing initiatives aimed at mitigating GHG emissions at the national level.

The project has not been registered under any other GHG program, registry, or similar mechanisms, such as emission trading programs, the Paris Agreement, or I-RECs.

4 Contribution to Sustainable Development Goals (SGD)

Regarding the United Nations Sustainable Development Goals (SDGs), the project achieves the following:

SDG	SDG Target	SDG Indicator	Project Contribution
7 Affordable and Clean Energy	7.2. By 2030, increase substantially the share of renewable energy in the global energy mix.	7.2.1. Renewable energy share in the total final energy consumption.	Zeus Hydroelectric Plant supplied 134,497.75 MWh of renewable energy to the Colombian national grid during 2022–2024.
8 Decent work and economic growth	8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with	8.5.2 Unemployment rate, by sex, age, and persons with disabilities.	The project generated temporary jobs for both women and men during construction (235), as well as permanent jobs for the operation and maintenance

	disabilities, and equal pay for work of equal value.		(13) of the Zeus Hydroelectric Plant for local people in its area of direct influence, contributing to the region's economic growth.
13 Climate Action	13.2 Integrate climate change measures into national policies, strategies, and planning.	13.2.2 Total greenhouse gas emissions per year.	The Zeus Hydroelectric Plant supplied 48,832 MW per year of renewable energy to the Colombian national grid, reducing 66,641 tCO2 by displacing fossil-fuel-based power plants.

5 Compliance with Applicable Legislation

The structure of the Colombian energy market is based on Laws 142[3] (Public Services Law) and 143[4] (Electricity Law) of 1994, which represent the last major reform of the power sector and establish the current regulatory framework. Since their enactment, Colombia has had a liberalized energy market, which is characterized by an unbundled generation, transmission, distribution, and commercialization scheme to separate the power activities and the markets. An electricity spot market and the development of a long-term contract market for electricity sales are the core of new structure to introduce a more effective framework for competition and an independent regulatory system supervised by the CREG (Regulatory Commission for Energy and Gas), created by the Law 143. This Electricity Law specifically introduced rules regarding: (i) Power sector planning; (ii) power generation; (iii) transmission and distribution; (iv) grid operation; (v) grid access fees; (vi) regime for electricity sales; (vii) concessions and contracts; and (viii) environmental issues, among others.

Law 99 of 1993 establishes the general requirements for the issuance of environmental licenses and permits and defines the role of the Ministry of the Environment and the Regional Autonomous Corporations (CAR) in the licensing process. As per Article 52 of

[3] http://www.secretariasenado.gov.co/senado/basedoc/ley_0142_1994.html
[4] http://www.secretariasenado.gov.co/senado/basedoc/ley_0143_1994.html

Law 99[5] and Article 9 of Decree 2041[6], any projects smaller than 100 MW do not fall under the jurisdiction of the Ministry of Environment. Instead, they are the responsibility of the CAR, specifically for this case, the Tahamíes Territorial Office of the Regional Autonomous Corporation of the Center of Antioquia.

Per the above, on November 28, 2012, the company's legal representative presented the application to the CAR for an environmental license for the development of the Zeus Hydroelectric Power Plant, which was granted through resolution No. 1811-6435 of 2018.

As per the requirements of the Mining-Energy Planning Unit (UPME), the electricity generation project must submit a connection study report to include the plant in the National Interconnected System[7]. The Zeus Hydroelectric Power Plant commenced its testing phase on May 17, 2022, and after meeting all the necessary regulations, it was approved for commercial operation on May 19, 2022.

The project does not intersect or overlap with territory legally titled as Indigenous Reservations, nor with collective titles belonging to black or Afro-descendant or ethnic communities.

6 Climate change adaptation

Zeus Hydroelectric Plant play a role in climate change adaptation through various mechanisms:

1. Renewable energy source: Hydroelectric power is an energy source that relies on water flow to generate electricity. This means it does not deplete the water resource, making it a renewable energy source. Zeus Hydroelectric Plant reduces the reliance on fossil fuels, significantly contributing to greenhouse gas emissions. Hydroelectric plants provide a clean and sustainable energy source, essential in mitigating climate change impacts.
2. Reduced Reliance on Fossil Fuels: Zeus helps reduce the reliance on fossil fuels for electricity generation. Hydroelectricity can provide a stable and sustainable energy supply as Colombia transitions from fossil fuel-based power generation

[5] https://www.minambiente.gov.co/wp-content/uploads/2021/08/ley-99-1993.pdf
[6]https://archivo.minambiente.gov.co/images/normativa/app/decretos/7b-decreto_2041_oct_2014.pdf
[7] See folder “4- Estudio de conexión enviado para incorporación al SIN”

to cleaner alternatives. This transition helps decrease the overall carbon footprint of the energy sector.

3. Stabilizing Energy Supply: Zeus provides a stable and reliable source of electricity, helping to address the challenges associated with intermittent renewable energy sources like solar and wind. This stability is crucial for adapting to climate change, where extreme weather events and changing patterns can impact energy infrastructure. Hydroelectric plants serve as a dependable base-load power source.

Water Resource Management: Effective water resource management is essential for climate change adaptation. Zeus is designed to regulate and manage water flow, helping to control flooding during heavy rainfall and ensuring a steady water supply during periods of drought. This adaptive capacity is valuable in regions facing changing precipitation patterns and increased frequency of extreme weather events.

7 Carbon ownership and rights

Carbon Rights

Central Hidroeléctrica Zeus S.A.S. E.S.P. is constituted and certified by the existence and legal representation based on the registration and registrations made in the commercial registry of the Chamber of Commerce of Medellín for Antioquia on October 19, 2022. The company's main purpose is the promotion, development, and execution, either on its own behalf or on behalf of third parties of hydroelectric generation projects; as well as the administration, operation, and maintenance of the resulting hydroelectric plants for the generation and commercialization of electrical energy.

The Environmental License for the Zeus Hydroelectric Power Plant project was granted through resolution No. 1811-6435 of November 2018, and likewise, the concession of water, discharge permit, among other authorizations and responsibilities included therein.

All carbon rights will remain within Central Hidroeléctrica Zeus S.A.S. E.S.P for the project length from 30-September-2020 to 29-September-2041.

7.1 Project holder

Individual or organization	Central Hidroeléctrica Zeus S.A.S. E.S.P.
Contact person	Juan Felipe Posada Rojas
Job position	Generation Manager

Address	Cr 43B 19-95 Oficina 1312 ED CCI, Medellín, Colombia
Phone number	+57 604 444 08 56
Email	juanposada@grupocolviva.com

7.2 Other Project participants

Individual or organization	South Pole Carbon Asset Management S.A.S.
Contact person	Alexa Islas Escobar
Job position	Senior Specialist Technical, Sustainable Technologies, Climate Projects - Latam
Address	Carrera 46 # 7-59, Medellín, Colombia
Phone number	+57 302 461 57 68
Email	a.islas@southpole.com

The project owner complies with the directives specified in section 13 of the BCR Standard version 3.4.

8 Environmental Aspects

According to the Biocarbon Sustainable Development Safeguards Tool v1.1, the environmental impacts involved in the project implementation are shown in the table below:

Table 7. Aspects that indicated a potential risk according to the Biocarbon Sustainable Development Safeguards Tool.

Potential risk	***Project risk***	***Mitigation or preventive action[8]***

[8] See "EIA.pdf"

Land use: Resource Efficiency and pollution prevention management		
Land degradation or soil erosion, leading to the loss of productive land.	*The project will remove vegetation for construction activities and affect geotechnical and erosion stability.*	*PMA_MF_01_01 Study and analysis of geotechnical stability and erosive processes.* *PMA_MF_01_02 Control and management of erosion stability.* *PMA_MF_01_03 Management of uncovering and soil intervention by the project.*
Air and water pollution resulting from project-related emissions, discharges, or improper waste disposal practices.	*The project will generate air pollution due to construction activities.* *The project will generate wastewater from the construction and operation of the plant.*	*PMA_MF_07_01 Emissions of particulate matter, gases and vapors control and management.* *PMA_MF_07_02 Explosives and blasting management.* *PMA_MF_05_01 Management of domestic liquid waste.* *PMA_MF_05_02 Management of construction and industrial liquid waste.* *PMS_MF_04_01. Monitoring to water purification system.*

Inadequate waste management practices, leading to the improper disposal of project-related waste and potential environmental harm.	*The project will generate waste from the construction, operation, and closure activities.*	*PMA_MF_02. Construction materials management.* *PMA_MF_03. Fuels and oils waste management.* *PMA_MF_04. Comprehensive waste management plan (domestic solid waste, hazardous waste, surplus construction, and excavation waste)*
Deforestation or degradation of forested areas impacting carbon sequestration, biodiversity, and ecosystem services.	*The project will remove vegetation for construction activities and affect the nearby landscape.*	*PMA_MB_01:_01 Vegetation removal and forestry management.* *_02 Forrestal compensation, ecology restoration, and landscape management.*
Water		
Water pollution, including contamination of rivers, lakes, oceans, or aquifers as a result of project-related activities such as emissions, spills, or waste disposal.	*The project will generate wastewater from the construction and operation of the plant.*	*PMA_MF_05. Liquid waste management (domestic water waste, and construction water waste).* *PMS_MF_04_01. Monitoring to water purification system.*
Disrupting aquatic ecosystems, including marine life, river ecosystems, or wetlands due to the changes in	*The project might disrupt the RioGrande river ecosystem during the construction phase.*	*PMA_MB_03_01 Complementary studies of the aquatic fauna and its eating habits.*

water quality, temperature or flow patterns?		*PMA_MB_03_02 Ichthyofauna rescue plan.*
Biodiversity and ecosystems		
Negatively impacting endangered or threatened species within the project area, either directly or indirectly through habitat changes or other disturbances.	*The project might impact the local fauna.*	*No endangered or threatened species were found during the Environmental Impact Assessment; nevertheless, the project proposed the next management plans:* *PMA_MB_02_01 Management plan for endangered or threatened species.* *PMA_MB_02_02 Strategy for education campaign on environmental sensibilization and fauna protection.*
Climate Change		
The project didn't identify any potential risk to increase climate change. The project aims to contribute to climate change adaptation by generating electricity from a renewable source and reducing the Colombian's reliance on fossil fuels.		

9 Socioeconomic Aspects

According to the Biocarbon Sustainable Development Safeguards Tool v1.1, the social impacts must at least include the following aspects:

a. Labor and Working Conditions
b. Gender equality and Women empowerment
c. Land Acquisition, Restrictions on Land Use, Displacement, and Involuntary Resettlement
d. Indigenous Peoples and Cultural Heritage

e. Community health and safety
f. Corruption
g. Economic Impact
h. Governance and Compliance

During the construction phase and the operational period between 2022 and 2024, the project has complied with Colombian legislation, as well as respected human rights and its internal policies related to social aspects. Specifically:

a. Labor and working conditions.

The project complies with Colombia's labor and human rights laws and the practices established in Law No. 50 of 1990. It has an Internal Labor Regulation that ensures compliance with relevant laws prohibiting forced labor, human trafficking, and child labor practices. The Zeus Hydroelectric Plant applies the rule of social behavior, of not involving minors, established in the declaration of fundamental rights of the International Labor Organization. The staff and laborers are not asked to work in conditions that directly impact their health and safety. By signing the Employee Hiring Contract , the worker declares to know and is bound to comply with the obligations of the Internal Labor Regulations and the position profile .

The Zeus Internal Labor Regulations and the employee hiring contract clearly outline the employment rights, working hours, and health and safety protocols to be followed throughout the duration of the project activity. Employees are well-informed of their rights and responsibilities, ensuring a fair and safe working environment.

According to the Procedure for use, maintenance, and delivery of personal protection elements , the workers know how to use each personal protection element, the equipment, and the necessary recommendations for their conservation. The safety equipment includes security boots, hearing protection, gloves, respiratory protection, safety glasses, and overall.

b. Gender equality and Women empowerment

The Zeus Hydroelectric Power Plant protects the work activity of pregnant women, which is why during this period and breastfeeding, the mandates of the treating doctor are accepted; in the employment relationship, they will not carry out high-risk work, nor in dangerous, unhealthy, or activities that require efforts greater than their capacity, all by the occupational health and safety programs in force at the Hydroelectric Power Plant and ordered by the occupational risk administrator30.

The Internal Labor Regulation includes a mechanism for preventing workplace harassment behavior aimed at generating a collective coexistence conscience. This

promotes work with decent and fair conditions, harmony between those who share work life, and a good environment and protects the privacy, honor, mental health, and freedom of people at work.

c. Land acquisition, restriction on land use, displacement, and involuntary resettlement.

Zeus legally owns the land where the hydroelectric power plant is located. No local people were forcibly displaced by the project activity.

d. Indigenous peoples and cultural heritage

The project activity did not damage cultural heritage or harm indigenous people. Nevertheless, it established a Preventive archeology program28.

e. Community health and safety

The project ensures that hazardous and domestic wastes are disposed of properly according to Colombia's regulations and the PMA_MF_04 Waste Management Plan. This includes a comprehensive waste management plan covering domestic solid waste, hazardous waste, and surplus construction and excavation waste. Proper disposal is crucial to protecting the environment and the health of the local people.

f. Corruption

There is no misuse of funds, bribery to secure contracts or permits, nepotism or favoritism in the selection of contractors, fraudulent reporting, conflicts of interest, lack of transparency, weak regulatory oversight, lack of accountability mechanisms, environmental permitting corruption, and subcontractor corruption in project activities.

g. Economic impact

During the construction and operational phases, the project created employment opportunities for the local community. By providing sustainable energy resources, the project contributes to the economic development of the region.

h. Governance and compliance

The project has a strong governance structure, such as clear roles and responsibilities defined32. Zeus Hydroelectric Power Plant got the Environmental License, concession of water, discharge permit, among other authorizations and responsibilities included therein.

10 Stakeholders' Consultation

The stakeholder consultation processes have been devised to solicit input from local stakeholders prior to the initiation of project activities. In accordance with the regulations outlined by the Ministry of Environment and Sustainable Development, any hydroelectric project is required to conduct a consultation inviting local stakeholders to participate in a meeting where project information, such as a project description document, is provided and their feedback is obtained[9].

The consultation provided information on the technical information, project location, environmental impacts, project benefits, and social activities.

This section encompasses the government and community participation strategy employed in constructing the Environmental Impact Assessment (EIA). Additionally, we detail the information-gathering process utilized to characterize and survey the Project's baseline. This process allowed for the identification of potential impacts and management measures, considering the project's scope and areas of influence.

The meetings outlined in Table 13 were conducted, and field trips and visits to homes in the specific area of influence were carried out.

Table 8. Socialization meetings prior construction stage.

Activity	*Date*	*Place*
Socialization with local authorities: Santa Rosa de Osos and Donmatías	*January 26, 2015*	*Municipal Council Auditorium Mayor of Santa Rosa de Osos*
	January 29, 2015	*Donmatías Municipal Palace*
Socialization with ADI JAC Leaders. Santa Ana-San Isidro, San Isidro Parte Baja, Las Ánimas, Mocorongo and Sugar Loaf	*January 26, 2015*	*Municipal Council Auditorium Mayor of Santa Rosa de Osos*
	January 29, 2015	*Communal booth Vereda Pan de Azúcar, Donmatías*
Workshop on characterization, impacts and management measures in the ADI	*June 10, 2015*	*Communal booth Vereda Pan de Azúcar, Donmatías*
	June 11, 2015	*Township House of Culture of San Isidro*
	June 12, 2015	*School Village San Isidro Lower Part*

[9] Degree 2041 of 2014. Art. 9 and 15. https://archivo.minambiente.gov.co/images/normativa/app/decretos/7b-decreto_2041_oct_2014.pdf

Dissemination of EIA results with local authorities: Santa Rosa de Osos y Donmatías	*February 29, 2016*	*Donmatías Municipal Palace*
	March 1 and 2, 2016	*Santa Rosa de Osos Municipal Palace*
Dissemination of EIA results with ADI villages: Santa Ana-San Isidro, San Isidro Lower Part, Las Ánimas, Mocorongo and Sugar Loaf	*February 29, 2016*	*Township House of Culture of San Isidro*
	March 1, 2016	*Communal booth Vereda Pan de Azúcar, Donmatías*
	March 2, 2016	*School Village San Isidro Lower Part*

According to the activities to be carried out in the construction stage and in compliance with the Environmental Management Plan, a meeting was held in each village of the ADI and in each municipality of the AII, where the community and local authorities were informed about the progress of the construction phase, the execution of the EMPs, progress in the attention and resolution of PQRS and the results of environmental and social management, in addition to issues specific to this stage.

This call was made through an invitation letter and posters in strategic locations. Virtual invitations were also sent to promote the meeting. The meetings outlined in Table 14 were conducted.

Table 9. Socialization meetings during construction stage.

Municipality	***Location***	***Date***	***Assistants***	***Place***
Santa Rosa de Osos	*Vereda Las Ánimas*	*April 19, 2022*	*9*	*Communal booth Las Ánimas*
	Vereda Las Animas-Mocorongo	*April 25, 2022*	*2*	*Google Meet*
	Vereda San Isidro Lower Part	*April 19, 2022*	*12*	*CER San Isidro Lower Part*
	Vereda Santa Ana	*April 20, 2022*	*8*	*Santa Ana Chapel*
	Santa Rosa de Osos Town Hall	*May 5, 2022*	*1*	*Municipal Building*
Donmatías	*Vereda Mocorongo*	*Not Applicable*	*0*	*Not Applicable*
	Vereda Pan de Azúcar	*April 21, 2022*	*12*	*Communal booth Pan de Azúcar*
	Donmatías Town Hall	*May 6, 2022*	*2*	*Municipal Building*

Figure 2. Photographic record.

10.1 Summary of comments received

Table 10. Comments received during stakeholder consultations.

Comment/Questions	Date	Stakeholder	Response
What is the environmental entity that supervises and grants the operating permit for the project?	*June 10, 2015*	*Community Action Board, Vereda Pan de Azúcar, Donmatías. (Contact information 3206703320)*	*Corantioquia is the responsible authority.*
How has the company's experience been with communities in other projects?			*The response has been favorable and enriching since the contributions of people are vital to the project. Mechanisms for interaction and dynamization with the community are also established.*
How will the installation of the project pipelines affect us?	*January 26, 2015*	*Community Action Board, San Isidro*	*Zeus will install 6 km of pipeline that will be buried, it will not be possible to build in those areas, but the community can carry out*

		(Contact information 3196407334)	sowing, livestock and other agricultural activities.
Is the project related to any other in the area?			No, it is a new project of a company from Antioquia and whose characteristics and size are different from other hydroelectric projects.
Will the catchment works leave the river without water?	June 12, 2015	Community Action Board, San Isidro (Contact information 3166676708)	According to the environmental license granted, it is stipulated that the ecological flow of the river must be left, and the remainder must be added, which allows the conservation of the river.
What will the project do if they have polluted water?	April 19, 2022	Las Ánimas Community (Contact information 3207886575)	Zeus must do water treatment before releasing the project's industrial or domestic water. We could install septic tanks with the 1% of the investment, but only with the previous authorization.
How many community initiatives can be requested by the citizen oversight?			All the initiatives that you want, we will analyze all of them and prioritize.
Can the project introduce new species for fishing activities?	April 19, 2022	San Isidro Community (Contact information 3166676708)	No, introducing new species could damage the aquatic ecosystem.
What is the useful life of the project?	April 20, 2022	Santa Ana Community (Contact information 3196407334)	The project lifetime is 50 years.
Has the project finished the construction work?	April 25, 2022	Mocorongo Community (Contact information 3146827364)	Yes, the project will start a test period in the following days to begin with the operation.
One of the most relevant issues is associated to the roads. I consider that there should be a written commitment and invite other companies present in the area and municipal authorities to sum efforts to improve that road that we all use.			Zeus will prioritize actions for each principal road within the project's area of influence. Nevertheless, there cannot be a commitment because we cannot force other companies to participate and intervene on the roads. You, as a community, can request those companies.
Could Zeus share the meeting record and the	May 5, 2022	Santa Rosa Community	The information requested was sent by May 12, 2022.

technical description of the project with the community?	*May 6, 2022*	*(Contact information 3103527728)* *Don Matías Community (Contact information 6048666324)*	

10.2 Consideration of comments received

To assess the effectiveness of community consultation, Zeus conducted 37 satisfaction surveys. These surveys helped to evaluate the perception and satisfaction of social organizations, communities, and municipal officials. The satisfaction scale ranged from 1 (very dissatisfied) to 5 (very satisfied). Based on the results, 97.3% of the assistants stated that the given information was satisfactory.

The resolution of the comments received during the consultations are shown in Table 15. After submitting the project to the BCR Standard for registration, there will be a 30-day consultation period for comments. The received comments will be used to adjust the project design and resolve any issues.

11 REDD+ Safeguards

The project activity is not a REDD+ project; thus, this section is not applicable.

12 Special categories, related to co-benefits

The project does not intend to achieve one of the special categories: “co-benefits can be divided into three additional benefits: biodiversity conservation, community benefits, and gender equity”[10]; therefore, this section is not applicable.

[10] https://biocarbonstandard.com/wp-content/uploads/BCR_Standard.pdf (pp. 31)

13 Implementation of the project

13.1 Implementation status of the project

The implementation of the PCH Zeus was carried out in accordance with the required technical, economic, legal, and environmental studies, ensuring compliance with current regulations and the mitigation of potential environmental impacts.

PCH Zeus began commercial operation on May 19, 2022, under the management of Central Hidroeléctrica Zeus S.A.S. E.S.P., with an installed capacity of 9.887 MW. Its commissioning contributes to increasing hydroelectric generation capacity in the region, supplying the National Interconnected System (SIN), and strengthening the country's energy matrix.

In summary, PCH Zeus is fully operational, generating clean and renewable energy while contributing to the sustainable development of the municipality of Don Matías and Colombia as a whole.

13.2 Changes after the GHG project registration

13.2.1 Temporary deviations

There is no cany temporary deviation applied to the project; therefore, this section is not applicable.

13.2.2 Permanent Changes

13.2.2.1 Corrections

There is no correction applied to the project; therefore, this section is not applicable.

13.2.2.2 Permanent changes to the monitoring plan, BCR program methodologies in use, or other regulatory documents related to BCR program methodologies.

There is no change in the monitoring plan or the applied methodology; therefore, this section is not applicable

13.2.2.3 Changes to GHG project design

There is no change to the project design; therefore, this section is not applicable.

14 Grouped Projects

The project activity is not a grouped project; thus, this section is not applicable.

15 Monitoring system

15.1 Description of the monitoring plan

The Monitoring Plan consists of the procedures to measure the project's electricity generation delivered to the SIN (EG_{Zeus}) and monitor the combined margin CO_2 emission factor ($EF_{grid,CM}$) for the grid-connected power generation each year calculated using the CDM tool “Tool 07”. Since the construction margin CO_2 emission factor ($EF_{grid,BM}$) was set ex-ante for the first crediting period, the $EF_{grid,CM}$ will depend only on the variation expressed by the operating margin emission factor ($EF_{grid,OM}$). Therefore, the monitoring plan consists of the following:

Electricity generation from project activity.

Monitoring procedures are implemented onsite or remotely using tele-metering technology. A main and backup meters are installed at the interconnection point of the project with the SIN. The meters installed are bi-directional, considering both the quantity of electricity supplied by the project plant to the grid and the quantity of electricity delivered to the project plant from the grid. Meters are read remotely from the control center using PrimeRead version 10 reading software, which allows you to query the status of the meters, consult their logs, download data, and store their readings in the database. Metering data backups are made every 15 days to preserve border data. The operational team is in charge of taking the measurements and reporting to XM. The energy meters in the substation are read via dedicated software every 24 hours and the report is made within a maximum period of eight hours following the day of the operation.

If a communication failure occurs during the reading process or there are difficulties in consulting the meter records that cannot be corrected remotely, the border representative is informed and applies the established contingency plan. If communication with the border cannot be re-established, a technical visit with specialized personnel will be scheduled in order to solve the problem. Emission reductions cannot be claimed during that period until the meters are functioning correctly again and reliable data is available.

As noted, there is a main electricity meter and a backup meter, which ensures correct metering in the event of a main electricity meter failure. The information recorded by the meters will be verified through a cross-consultation of the values reported by the coordinator of the national electrical network in the SINERGOX virtual portal, and the lowest value will be chosen as a conservative measure.

The data is included in an Excel spreadsheet for emission reduction calculations on a monthly basis. All data collected as part of the monitoring process are archived electronically and kept for at least two years after the end of the last crediting period.

The following scheme shows the power plants, the substation, and the metering points:

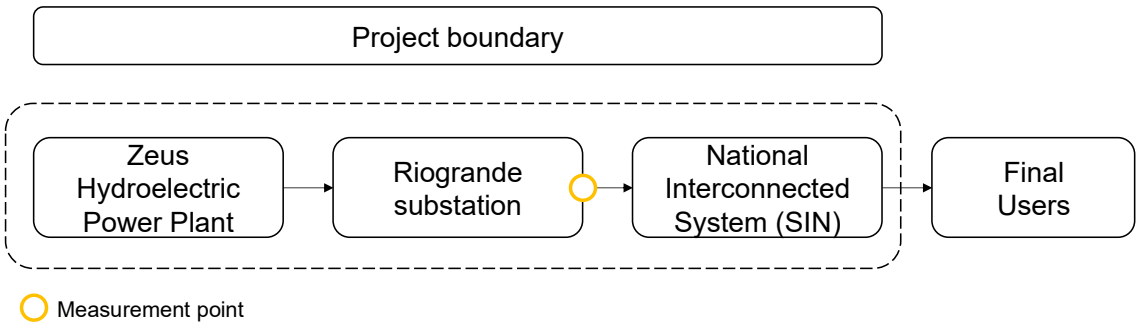

Figure 3. Simplified scheme of the monitoring boundary.

Operating margin emission factor ($EF_{grid,OM}$).

The $EF_{grid,OM}$ consists of accessing the fuel consumption and the electricity generation data from all the SIN registered plants. XM, as the Colombia Wholesale Energy Market administrator, attends the commercial transactions in the market that give the next services:

“Register the borders, that is, the energy consumption measurement systems, their location, and their representative. Settle and invoice the resulting energy exchanges between the generating and marketing agents of the market, who sell and buy on the Energy Exchange" (XM S.A. E.S.P., 2019).

Therefore, XM gives the necessary information to calculate the $EF_{grid,OM}$ for each year. It is available for the public in the XM Portal[11], a virtual platform in which data organized by SIN agents and generation units are stored. For the ex-post option, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

QA/QC measures.

[11] https://sinergox.xm.com.co/ntrcmb/Paginas/Historicos/Historicos.aspx

The energy measurement process is regulated under resolution CREG 038 of 2014[12], under which the guidelines that every energy-generating agent must comply with are established, in which, among others, it is established that the agent must have a Control Center Measurement Management (CGM in Spanish), for the provision of the telemetry service in each of the commercial borders for which it is responsible, guaranteeing compliance with the requirements established in CREG resolution 038 of 2014 and CNO agreement 1043 of 2018[13].

By Article 11 of that resolution, meters were calibrated prior to the operation start and will be calibrated after any repair or intervention. The calibration was and will be done by a laboratory accredited by the National Accreditation Body of Colombia (ONAC in Spanish) under the requirements of the NTC-ISO-IEC 17025 or the international equivalent. Article 28 defines that any plant whose generation is between 500 and 15,000 MWh/month or in the range of installed capacity between 1 and 30 MW must submit its measuring equipment to a maintenance process with a maximum periodicity of 4 years[14]. In case both meters fail, no emission reductions will be claimed during that period until having again data from the main or backup meter.

The CNO National Operation Council establishes in agreement CNO 981 that the maximum frequency of routine tests for current and voltage transformers to maintain measurement systems is every 12 years[15].

All activities that involve installing elements and maintenance work on the measurement system must be duly documented in the Energy Measurement Review and Installation Minutes (Circular 098 of 2014, Annex 2[16]). Personnel must make a photographic record and record the activities in the border resume. The work on the measurement chain must be carried out by qualified personnel with the respective professional registration, which must be included in the border documentation.

Personnel responsible for monitoring.

[12] https://gestornormativo.creg.gov.co/gestor/entorno/docs/resolucion_creg_0038_2014.htm
[13] https://www.cno.org.co/content/acuerdo-1043-por-el-cual-se-aprueba-la-modificacion-del-documento-de-condiciones-minimas-de
[14] CREG Resolution 038 of 2014. Art 6. Types of measurement points; Art 28. Maintenance of the measurement system.
[15] CNO Agreement 981 Annex 1: “Identification of interventions that require meter calibration tests or routine tests of TTs or TCs and the development of procedures for performing routine tests for TTs and TCs”. https://www.cno.org.co/content/acuerdo-981-por-el-cual-se-aprueba-la-modificacion-del-documento-de-identificacion-de-las
[16] http://www.cac.org.co/2016/html/codigo_doc_creg.html

- The BCR Coordinators supervise the monitoring process, compile the monitoring data in an Excel spreadsheet, and calculate the emission reductions of the monitoring period. They also develop the monitoring report in accordance with the BCR rules.
- The Plant Manager is responsible for verifying energy measurements. This task involves reviewing and validating the data recorded by the meters.
- Central Hidroeléctrica Zeus S.A.S. E.S.P. has an agreement with a Measurement Management Center (CGM) of Zeus Hydroelectric Power Plant for the provision of telemetry service at the commercial border, guaranteeing compliance with the requirements established in CREG resolution 038 of 2014 and CNO agreement 1043 of 2018. The CGM is responsible for reading the electricity generated by the project and processing the energy produced by the meters installed at the substation. The meter records are downloaded into a spreadsheet for measurement control. The data collected from the meter is stored electronically and then sent to XM.

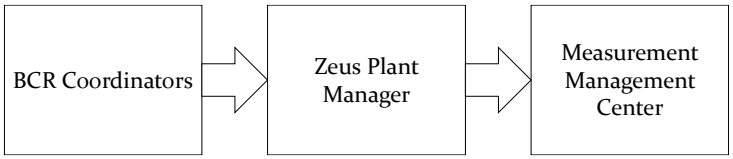

Figure 4. Operational structure of the monitoring plan.

Personnel who carry out monitoring tasks are familiar with the basic monitoring requirements and structures. New personnel must participate in basic training to get familiarized with the monitoring procedures.

Since the main monitoring tasks, i.e., the measurement of the energy production, the calibration of energy meters, and the reporting of the energy generation are carried out independently from the BCR as part of the daily operation, no specific training is required. Corrective actions are carried out if any inconsistency is identified.

15.2 Data and parameters to quantify the reduction of emissions

15.2.1 Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO2/MWh

Description	Built margin CO2 emission factor for grid-connected energy generation in the year and calculated with the latest version of the “TOOL07” of the CDM "Tool to calculate the emission factor for an electrical system".
Source of data used	Calculated based on information provided by the XM network administrator. See “Zeus Colombia Calculations.xlsx”
Value (s)	0.2369
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of baseline emissions.
Justification of choice of data or description of measurement methods and procedures applied	As per the most recent “TOOL07” of the CDM “Tool to calculate the emission factor for an electricity system”.
Additional comments	The emission factor is fixed ex-ante; thus, no monitoring and recalculation of the emissions factor during the crediting period is required. For new credit periods, it is necessary to review.

15.2.2 Data and parameters monitored

Data / Parameter	$EG_{Zeus,y}$
Data unit	MWh/year
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in the year y.
Measured /Calculated /Default:	Calculated
Source of data	Measurement in the power plant.
Value(s) of monitored parameter	

YEAR	MWh
May 17, 2022 – December 31, 2022	41,180.46
January 01, 2023 – December 31, 2023	45,818.31
January 01, 2023 – December 31, 2023	44,498.98

<table>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>A main and a backup meter are used for monitoring:
<table>
<tr><th>Meter</th><th>Serial</th><th>Model</th><th>Brand</th><th>Calibration date</th><th>Accuracy</th></tr>
<tr><td>Main</td><td>51386024</td><td>ZMD402CT44.0459 S3</td><td>LANDIS & GYR</td><td>16/Nov/2021</td><td>0.2 S</td></tr>
<tr><td>Backup</td><td>51386022</td><td>ZMD402CT44.0459 S3</td><td>LANDIS & GYR</td><td>16/Nov/2021</td><td>0.2 S</td></tr>
</table></td></tr>
<tr><td>Measuring/ Reading/ Recording frequency</td><td>Electricity delivered to the National Grid is measured continuously with daily reports. Invoices are issued on a monthly basis</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Not applicable.</td></tr>
<tr><td>QA/QC procedures applied</td><td>Calibration tasks are in accordance with Colombian regulations for electricity measurement devices17.
The meters will be calibrated a maximum of every four years according to the requirements of national regulations18.
The information recorded by the meters will be verified through a cross-consultation of the reporting values to the coordinator of the national electrical network available in the SINERGOX virtual portal, and the lowest value will be chosen as a conservative measure.</td></tr>
</table>

Data / Parameter	$EG_{m,y}, EG_{k,y}$
Data unit	MWh/y

[17] https://gestornormativo.creg.gov.co/gestor/entorno/docs/resolucion_creg_0038_2014.htm

[18] Degree 2041 of 2014. Art. 9 and 15. https://archivo.minambiente.gov.co/images/normativa/app/decretos/7b-decreto_2041_oct_2014.pdf

Description	Net electricity generated by power plant/unit m or k in year y.
Measured /Calculated /Default:	Measured
Source of data	SINERGOX XM Portal: https://sinergox.xm.com.co/oferta/Paginas/Historicos/Historicos.aspx
Value(s) of monitored parameter	Electricity delivered by each power plant connected to the National Grid, see “ER calculations_120125.xlsx”.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment required for electricity metering in the Colombian context is described in Article 9 of Resolution 038, issued by the Energy and Gas Regulation Commission (CREG, by its acronym in Spanish) in 2014. On the other hand, the calibration frequencies of metering systems connected to the National Grid in Colombia are listed in Article 28 of Resolution 038, issued by CREG in 2014.
Measuring/ Reading/ Recording frequency	The amount of energy generated by power plants during the year is recorded in the SINERGOX portal as "Generation". This system will be accessed once a year to download the data, which will be stored in an electronic spreadsheet. Each year, the project will take into account the addition of new power plants and their typology.
Calculation method (if applicable)	Not applicable.
QA/QC procedures applied	The data organized and delivered to the XM network coordinator is supervised by multiple public and private entities responsible for guaranteeing the information's transparency and quality.

Data / Parameter	$FC_{i,m,y}, FC_{i,k,y}$
Data unit	MBTU

Description	Amount of fuel type i consumed by power plant/unit m or k in year y.
Measured /Calculated /Default:	Measured
Source of data	The data available for the respective monitoring period will be consulted in the SINERGOX portal of the national XM network coordinator.
Value(s) of monitored parameter	Fossil fuel consumption by each power plant connected to the National Grid, see “ER calculations_120125.xlsx”.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	No applicable.
Measuring/ Reading/ Recording frequency	The amount of fossil fuel consumed for energy generation in fuel-based power plants during the year is recorded in the SINERGOX portal as "Fuel Consumption." This system will be accessed once a year to download the data, which will then be stored in an electronic spreadsheet.
Calculation method (if applicable)	No applicable.
QA/QC procedures applied	The data organized and delivered to the XM network coordinator is supervised by multiple public and private entities responsible for guaranteeing the information's transparency and quality.

Data / Parameter	$EF_{tCO_2,i,y}; EF_{CO_2,m,i,y}$
Data unit	tCO2/TJ
Description	CO2 emission factor of fuel type i used in power unit m in year y.

<table>
<tr><td>Measured /Calculated /Default:</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>National default values registered by the Mining and Energy Planning Unit (UPME, by its acronym in Spanish)19.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td><table>
<tr><td>Fuel</td><td>tCO2/TJ</td></tr>
<tr><td>Gas</td><td>55.539</td></tr>
<tr><td>Fuel oil</td><td>80.460</td></tr>
<tr><td>Natural gas</td><td>55.539</td></tr>
<tr><td>Diesel (ACPM in Colombia)</td><td>74.233</td></tr>
<tr><td>Carbon</td><td>88.136</td></tr>
<tr><td>Kerosene</td><td>73.940</td></tr>
<tr><td>Crude oil</td><td>77.842</td></tr>
</table></td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>No applicable.</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency</td><td>a) For Simple adjusted OM (ex-post): Annually during the crediting period for the relevant year, following the guidance in Step 3 (see Section 3.7.3).
b) For BM (ex-ante): for the first crediting period once, following guidance in Step 5 (see Section 3.7.3)</td></tr>
<tr><td>Calculation method (if applicable)</td><td>No applicable.</td></tr>
<tr><td>QA/QC procedures applied</td><td>As per the most recent “TOOL07” of the CDM “Tool to calculate the emission factor for an electricity system”.</td></tr>
</table>

[19] https://app.upme.gov.co/Calculadora_Emisiones1/new/calculadora.html

Data / Parameter	$EF_{grid,\ OM,y}$
Data unit	t CO2/ MWh
Description	Operating margin CO2 emission factor of the grid electricity in year y.
Measured /Calculated /Default:	Calculated.
Source of data	Calculated according to the CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0
Value(s) of monitored parameter	Year: $EF_{grid,\ OM,y}$ 2022: 0.5954 2023: 0.7005 2024: 0.6971
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calculated according to the CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0 and data taken from SINERGOX portal of the national XM network coordinator.
Measuring/ Reading/ Recording frequency	Annually during the crediting period for the relevant year, following the guidance in CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0.
Calculation method (if applicable)	CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0.
QA/QC procedures applied	As per the most recent “TOOL07” of the CDM “Tool to calculate the emission factor for an electricity system”.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO2/MWh
Description	Combined margin CO2 emission factor of the grid electricity in year y.

Measured /Calculated /Default:	Calculated
Source of data	Calculated according to the CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0
Value(s) of monitored parameter	Year: 2022 — $EF_{grid,CM,y}$: 0.4161 Year: 2023 — $EF_{grid,CM,y}$: 0.4687 Year: 2024 — $EF_{grid,CM,y}$: 0.4670
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calculated according to the CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0 and data taken from SINERGOX portal of the national XM network coordinator.
Measuring/ Reading/ Recording frequency	Annually during the crediting period for the relevant year, following the guidance in CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0.
Calculation method (if applicable)	CDM Tool 07 - Tool to calculate the emission factor for an electricity system. Version 07.0.
QA/QC procedures applied	As per the most recent “TOOL07” of the CDM “Tool to calculate the emission factor for an electricity system”.

16 Quantification of GHG emission reduction / removals

16.1 Baseline emissions

The detailed calculations and data of the baseline emissions are presented in the Excel file “ER Calculations_120125.xlsx”. The following section presents the relevant methodological approaches and equations.

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

Equation 1 (Equation 1 AMS-I.D)

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 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 CDM "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

According to Equation (2) of AMS-I.D. (version 18.0), if the project activity is the installation of a greenfield power plant, then:

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

Equation 2 (Equation 2 AMS-I.D)

Where:

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

The combined margin emission factor (EFgrid,CM,y) is calculated following the guidance in the "Tool to calculate the emission factor for an electricity system" (version 7.0) by applying the following steps:

STEP 1. Identify the relevant electricity systems.

To determine the electricity emission factors, the project activity shall identify the relevant project electricity system. Similarly, it shall identify any connected electricity systems. The project activity delineates the project electricity system using the Option 1 for this step on the tool:

<< Option 2. A delineation of the project electricity system defined by the dispatch area of the dispatch center responsible for scheduling and dispatching electricity generated by the project activity. Where the dispatch area is controlled by more than one dispatch center, 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 centers are required to comply with dispatch orders of the national dispatch center then area controlled by the national dispatch center shall be used).>>

For determining the electricity emission factors, the project electricity system is defined by the spatial extent of the power plants physically connected through transmission and distribution lines to the project activity (i.e., Zeus Hydroelectric Project), and that can be

dispatched without significant transmission constraints. In this case, the project electricity system is given as the National Interconnected System (SIN) of Colombia, including the imports from Ecuador 230 and Ecuador 138.

For the purpose of determining the operating margin emission factor, the CO2 emission factor(s) for net electricity imports is chosen as zero t CO2/MWh.

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

In accordance with the tool, this step is optional. For the proposed project activity, off-grid power plants are not included in the project electricity system (Option 1).

STEP 3. Select a method to determine the operating margin (OM).

In accordance with the tool, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM

For the project activity, the simple adjusted OM is applied, using the ex-post data vintage:

<<Ex-post option: if the ex-post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the proceeding the previous year y-2 may be used. The same data vintage (y,y-1.y-2) should be used throughout all crediting periods.>>

All power plants connected to the SIN are included. Power plants registered as CDM project activities are also included as suggested by the tool. Historical data of the year in which the project activity displaces grid electricity is available from XM (grid operator and administrator) and will be updated annually during monitoring.

STEP 4. Calculate the operating margin emission factor according to the selected method.

The simple adjusted operating margin emission factor EFgrid,OM-adj,y (tCO2e/MWh) is a variation of the simple operating margin emission factor, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (m), as follows:

$$EF_{grid,OM-adj,y} = (1 - \lambda_y) \times \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \times \frac{\sum_k EG_{k,y} \times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Equation 3 (Equation 10 CDM Tool 7)

Where:

$EF_{grid,OM-adj,y}$	=	*Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh)*
λ_y	=	*Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y*
$EG_{m,y}$	=	*Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)*
$EG_{k,y}$	=	*Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh)*
$EF_{EL,m,y}$	=	*CO_2 emission factor of power unit m in year y (tCO_2/MWh)*
$EF_{EL,k,y}$	=	*CO_2 emission factor of power unit k in year y (tCO_2/MWh)*
m	=	*All grid power units serving the grid in year y except low-cost/must-run power units*
k	=	*All low-cost/must run grid power units serving the grid in year y*
y	=	*The relevant year as per the data vintage chosen in Step 3: in which the project activity displaces grid electricity.*

The lambda factor (λ_y) is determined as:

$$\lambda_y(per\ cent) = \frac{Number\ of\ hours\ low - \frac{cost}{must} - run\ are\ on\ the\ margin\ in\ year\ y}{8760\ hours\ per\ year}$$

Equation 4 (Equation 11 CDM Tool 7)

There are two approaches to determine lambda (λ_y):

Approach 1. Use default values of lambda from Table 1 Appendix 2 (Tool 07) based on the share of electricity generation from low-cost/must-run in total generation derived using 1) the average of the five most recent years or 2) based on long-term averages for hydroelectricity production. Approach 1 can only be applied if the LASL is not less than

one-third of the HASL in a project electricity/ grid system demonstrated based on the yearly data for the years used to determine the OM emission factor.

Approach 2. Lambda (λ_y) should be determined by applying the step-wise procedure provided in Appendix 3 (Tool 07).

According to the approach 2, the steps required to calculate λ_y are:

- Step i: The total hourly generation data of the year are presented, from high to low, in comparison to the total 8,760 hours of the year.
- Step ii: Calculate the total annual generation of low-cost/must-run plants $(\sum_k EG_{k,y})$.
- Step iii: Draw a horizontal line that crosses the line represented, so that the area under the curve represents the total generation of low-cost/must-run plants $(\sum_k EG_{k,y})$.
- Step iv: Determine value λ_y, taking into account that λ_y is calculated as X/8,760, where X represents the hours on the right of the point of intersection.

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m is determined as follows (power units k are not included since the low-cost/must-run units have zero emissions and thus do not require calculating the emission factor).

The selected option for calculating the emission factor of each plant is based on the available fuel consumption and electricity generation information (option A1, Tool 07 CDM) of the different plants of the Colombian Interconnected System, with the following expression:

$$EF_{EL,m,y} = \frac{FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Equation 5 (Equation 4 CDM Tool 7)

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2/MWh

$FC_{i,m,y}$ = Amount of fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type i in year y (t CO_2/GJ)

$EG_{m,y}$	= *Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)*
m	= *All power units serving the grid in year y except low-cost/must-run power units*
i	= *All fuel types combusted in power unit m in year y*
y	= *The relevant year as per the data vintage chosen in Step 3: in which the project activity displaces grid electricity*

However, for the calculation of the emission factor of each power unit m, the following options should be considered as well according to the availability of information:

<<Option A2. If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows:>>

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m.y}}$$

Equation 6 (Equation 5 CDM Tool 7)

Where:

$EF_{EL,m,y}$	= *CO_2 emission factor of power unit m in year y (t CO_2/MWh*
$EF_{CO2,m,i,y}$	= *Average CO_2 emission factor of fuel type i used in power unit m in year y (t CO_2/GJ)*
$\eta_{m.y}$	= *Average net energy conversion efficiency of power unit m in year y (ratio)*
m	= *All power units serving the grid in year y except low-cost/must-run power units*
y	= *The relevant year as per the data vintage chosen in Step 3: in which the project activity displaces grid electricity*
3.6	= *Conversion factor (GJ/MWh)*

If for a power unit m only data on electricity generation is available, Option A3 has been used as a simple and conservative approach with an emission factor of zero tCO2/MWh.

To be conservative, the power plants without fuel consumption reports are considered in the low cost-must run generation, to be consistent with the Option A3 mentioned before.

By applying Equation 5 to determine the emission factor of each power plant, the results from the lambda calculation and the main Equation 3 for the OM emission factor, and the corresponding generation weights of each year, OM emission factor is determined as shown in the table below.

Table 11. Characteristics of the Colombian national electrical system.

	2022	2023	2024
EF No LC/MR	0.7134	0.7137	0.6975
EF LC/MR	0.0000	0.0000	0.0000
Lambda	0.1654	0.0184	0.0006
Total Generation [MWh]	76,030,405	80,231,797	82,144,297
$EF_{OM\ Simple\ adjusted\ 2022}$ (tCO_2/MWh)	0.5954	0.7005	0.6971

STEP 5. Calculate the build margin (BM) emission factor.

As in the Validated PDD, the procedure applied to the Build Margin emission factor followed Option 1 of Paragraph 72 of CDM Tool 07 – Tool to Calculate the Emission Factor for an Electricity System, Version 07.0:

<<For the first crediting period, calculate the build margin emission factor ex-ante.>>

The procedure of the $EF_{grid,BM,y}$ are described in section *3.7.3 GHG baseline emissions* of the validated PDD. The resulting BM emission factor set for the first credit period is:

$EF_{BM,2023}$	**0.2369 tCO2/MWh**

STEP 6. Calculate the combined margin (CM) emissions factor.

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Equation 7 (Equation 16 CDM Tool 7)

Where:

$EF_{grid,OM,y}$ = *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)*
w_{OM} = *Weighting of operating margin emissions factor (%)*
w_{BM} = *Weighting of build margin emissions factor (%)*

For hydroelectric projects the weighting of operating and build margin is done as indicated in the tool for the first crediting period, i.e. $w_{OM} = 0.5$and $w_{BM} = 0.5$.

Once calculated the CO_2 OM emission factor with Equation 3 and BM emission factor calculated ex ante, the combined margin emission factor for each year since the start of commercial operation is presented in the next table:

Year	$EF_{grid,CM,y}$	Unit
2022	0.4162	tCO_2/MWh
2023	0.4687	tCO_2/MWh
2024	0.4670	tCO_2/MWh

Finally, Equation 1 of this document is applied to calculate the baseline emissions for each year of the current Monitoring Report:

Table 12. Baseline emissions for 2022 – 2024 monitoring report.

Year	Baseline emissions (tCO_2)
17/05/2022—31/12/2022	18,405
01/01/2023 – 31/12/2023	21,475
01/01/2024 – 31/12/2024	20,781

16.2 Project emissions/removals

According to the methodology AMS-I.D Version 18.0, for most renewable energy project activities, $PE_y = 0$.

Since the project activity has no reservoir, the project emissions are zero:

$$PE_y = 0\ tCO_2$$

16.3 Leakages

According to the methodology, there is no risk of leakage.

16.4 Net GHG Emission Reductions / Removals

The following table displays the reduction of GHG emissions during the current quantification period of the project:

Year	*Baseline emissions (tCO_2e)*	*Project emissions (tCO_2e)*	*Leakage emissions (tCO_2e)*	*Net GHG emission reductions (tCO_2e)*
17-05-2022—31-12-2022	18,405	0	0	18,385

2023	21,475	0	0	21,475
2024	20,781	0	0	20,781
Total	60,661	0	0	60,641

16.5 Comparison of actual emission reductions with estimates in the project document

The comparison between the estimated ex-ante Net GHG Emission Reductions and the actual values of the emission reductions for this monitoring report is presented in the following table:

Year	*GHG emission reductions ex ante (tCO_2e)*	*GHG emission reductions Actual (tCO_2e)*	*Difference (%)*
17-05-2022—31-12-2022	*14,528*	18,385	26.68%
2023	*23,156*	21,475	-7.26%
2024	*23,156*	20,781	-10.26%
Total	***60,840***	**60,661**	**-0.2942%**

16.6 Remarks on difference from estimated value in the registered project document

There is no increase in the emission reductions calculated ex-ante during the project validation since the project has been operating as specified during its design phase and without major complications.