Project design document form

(Version 11.0)

BASIC INFORMATION	
Title of the project activity	Sogamoso Hydroelectric Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	09
Completion date of the PDD	12/08/2019
Project participants	ISAGEN S.A. E.S.P.
Host Party	Colombia
Applied methodologies and standardized baselines	The ACM0002- version 16.0 “Grid-connected electricity generation from renewable sources”
Sectoral scopes	Sectoral Scope 1: Energy industries (renewable - non-renewable sources)
Estimated amount of annual average GHG emission reductions	1,386,355 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Sogamoso Hydroelectric Project (hereafter referred to as the "Project") developed by ISAGEN S.A. E.S.P. (hereafter referred to as ISAGEN) is a reservoir based hydropower project located in the Santander Department of the Republic of Colombia (hereafter referred to as the "Host Country"). The maximum total installed capacity of the Project, based on the generators nameplate, will be 874.8 MW comprised of three Francis turbines. The estimated average electricity production supplied to the Colombian National Interconnected System (also referred to as "the National Grid" or simply "the Grid")[1] will be 5,056 GWh per year[2] .

The purpose of the Project is to utilize the hydrological resources of the Sogamoso River through the construction of a dam to generate low emissions electricity for the Grid.

In addition, the Project has received positive validation regarding its compliance of the WCD (World Commission on Dams) seven strategic priorities. The report concludes that the project ¨complies with all relevant requirements of the WCD and other criteria of the country in a satisfactory manner and in some respects in a higher than minimally required by Colombia national regulations.¨ (AENOR 2014/12/15).

The main source of the baseline greenhouse gases (GHG) emissions are the Grid connected plants that utilize fossil fuels for the energy generation. The electricity currently generated by the Grid is mainly composed of the hydropower plants nevertheless, it is characterized by the combined margin emission factor of 0.2742 tCO_2e/MWh for year 2008. The Project is therefore expected to reduce GHG emissions (CO_2 as a product of combustion) by displacing electricity, based on fossil fuels, from the Grid by an estimated 1,386,355 tCO_2e per year throughout the crediting period.

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the Grid by the Project would have otherwise been generated by the operation of Grid-connected power plants and by the addition of new generation sources.

The Project contributes to sustainable development of the Host Country, Colombia, specifically in the following aspects:

- **General Aspects**

  - The Project launches various investment programs and employment opportunities contributing to the socio-economic development of the nearby municipalities and the Department.
  - Through the "Community Information and Participation Program" the Project contributes to the formation of the participative and self-advocating communities.
  - ISAGEN follows the criteria and guidelines established by the "World Commission on Dams" about policies and corporate expressions of social responsibility.

[1] Under Colombian electric regulation, Colombian National Interconnected System is also known as SIN per its initials in Spanish (Sistema Interconectado Nacional)

[2] Power plant's design documentation: INGETEC S.A., Update of designs of tender and environmental impact study - Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, rev. 1 – June 9, 2008.

- Protection of natural environment as of the basin of Sogamoso river basin and the restoration, conservation and protection of the Natural National Park *Serrania de Los Yariguies*[3], among other programs.

- **Institutional Strengthening:** This program consists of supporting and strengthening in the provision of services such as health, education, basic sanitation, recreation, security and other aspects, which are direct competence of other entities.

- **Environmental Education:** This process aims to promote awareness, education and training processes for educational institutions and the population located in the area of influence of the Project, as well as to work's contractors, to establish conscious relationships and proper practices with the environment. Target groups of this program are made up of local governments, 26 educational centers in the area of influence, 18 environmental groups identified in the area, Project's contractors and workers. This program is carried out with "Fundación Natura" whose activities for this program are:
  i) Support and coordinate activities related to education and environmental management with programs of schools located in the area of influence by strengthening of PRAES (Proyectos Ambientales Escolares, in Spanish).
  ii) Promote through environmental education issues, the development of attitudes, skills and abilities for conservation, protection and proper utilization of natural resources in the communities, by promoting of PROCEDAS (Programas Ciudadanos de Educación Ambiental, in Spanish).

- **Improving of health:** Agreement with the Hospital San Juan de Dios, municipality of Betulia, to the adequacy and equipping of the Health Center, located in the area of Tienda Nueva.

- **Restitution of roads:** To replace the sections of roads and bridges that will be affected by the Project, there will be sections of roads that will be returned in better condition than they have at present.

A.2. Location of project activity

A.2.1. Host Party

Republic of Colombia.

A.2.2. Region/State/Province etc.

Department of Santander.

A.2.3. City/Town/Community etc.

The dam and its reservoir are located in jurisdiction of the municipalities of Girón, Betulia, Zapatoca, Los Santos and San Vicente de Chucurí, in the Department of Santander. The Project's area of influence extends until the Sogamoso River flows into the Magdalena River.

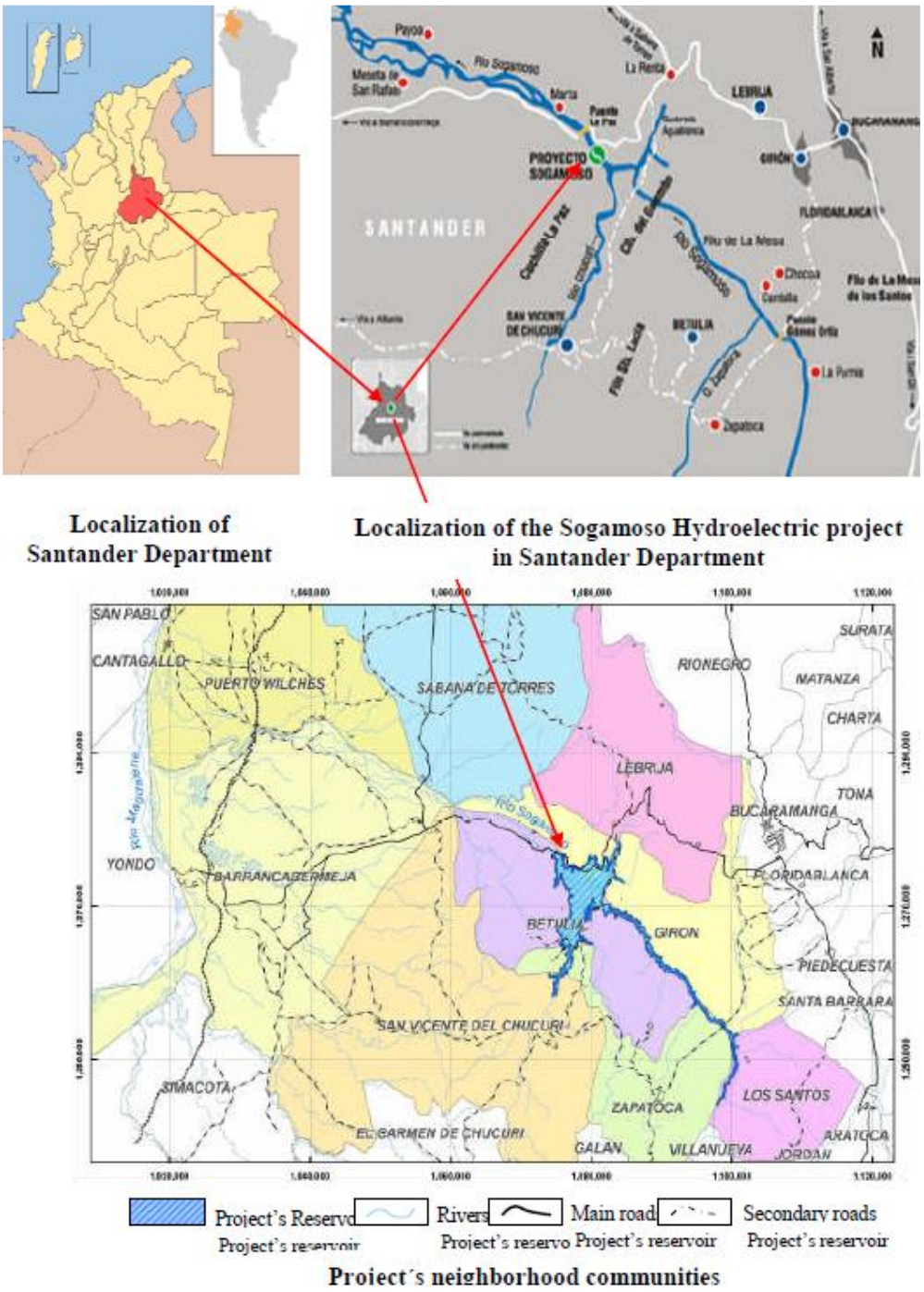
A.2.4. Physical/Geographical location

The works that comprise the Sogamoso Hydroelectric Project are located in the Department of Santander, in the canyon where the river Sogamoso crosses the mountain range of La Paz, 75 km upstream from its confluence with the Magdalena River and 62 km downstream of the confluence of Suarez and Chicamocha Rivers. The dam and the reservoir are located within the municipalities of Girón, Betulia, Zapatoca, Los Santos and San Vicente de Chucurí

The Project's coordinates according to Magna Sirgas system are: 7° 6' 0.427"N, 73° 24' 26.623"W

[3] *Yariguies* Mountain range is located in the jurisdiction of municipalities of *Betulia, Zapatoca, Galán, El Hato, Simacota, Chima, Contratación, Guacamayo, Santa Helena, Carmen de Chucuri and San Vicente de Chucuri, Cerro de Armas in muncipality of Landazuri; Cerro de la Paz and Cuchilla de Ramos* in the municipality of *Betulia* in the Department of Santander. This program is included in the Investment Plan of 1% approved by the Government.

Figure 1: Geographical localization of the project activity



A.3. Technologies/measures

The project activity consists of the generation of electric energy from the renewable hydro resources that will displace electricity based on fossil fuels from the Grid. The Project's baseline scenario, as per the provisions of the Consolidated baseline methodology for Grid connected electricity generation from renewable sources - ACM0002 - version 16.0, is the same as the scenario existing prior to the start of the implementation of the project activity, which is: in the absence of the project activity the electricity would have been delivered to the Grid by the operation of the Grid-connected power plants and by the addition of new generation sources to it.

The Sogamoso Hydroelectric Project has been developed considering an adequate implementation and operation of the power plant based on sound and safe technology and knowhow transfer from the other power plants owned by ISAGEN. The technology chosen

corresponds to the present time, providing the latest advances and state of art in each engineering specialty. At the same time the reliability of this Project corresponds to the power plants' of its kind existing in the world. This kind of technology and the continuous improvement of its know-how have permitted ISAGEN to be one of the most important electricity companies in Colombia with more than 35 years of experience in the energy sector.

Contractors involved in building and also the operation of Sogamoso hydropower plant will follow ISAGEN's policies in order to ensure sound and safe operation and maintenance of all the equipment implemented in the plant and will monitor the data collection related to operation and measurement of different activities developed daily. These processes will ensure environmental control, industrial safety and occupational health, including relevant protection in different areas and procedures for the staff to acquire proper experience and resources to operate the system in a sustainable way.

For preparing the engineering designs of the Project, ISAGEN contracted the company INGETEC S.A., which is a company of consultant engineers founded in 1947. This Company has more than 60 years of experience in consultancy and design of infrastructure projects in Colombia, Argentina, Bolivia, Costa Rica, Canada, Chile, Ecuador, El Salvador, Guatemala, Haiti, Mexico, Panama, Peru, Turkey and Venezuela.

ISAGEN sought the guarantee that the Sogamoso Project reflects the best practices in technical, environmental and social aspects under standards currently recognized in Colombia and overseas. This is why ISAGEN contracted a company with important knowledge and experience such as INGETEC S.A.

On the other hand, for the supply of the main electromechanical and control equipment, the manufacture will be in charge of recognized companies with international experience in this field. ISAGEN will have the advice from these companies for the assembly and the initial operation of the equipment.

Finally, the good practices implemented and perfected by ISAGEN through its experience of more than 35 years in the electric sector will be applied to the Project. ISAGEN has the certificates from ICONTEC (Instituto Colombiano de Normas Técnicas) related to the Quality Management System under the ISO 9001 standard version 2008; Environmental Management System under the ISO 14001 version 2004, Safety and Occupational Health Management System under the OHSAS 18001 standard version 2007. Moreover, ISAGEN received for the fourth time the Andesco (National Association of Public Service Companies) Prize of Corporate Responsibility in the large company category and received the honourable mention in the category of Best Application of Corporate Government and Environmental Management Performance.

The above reflects the following of good practices the Project has had and will have from the stage of initial studies to the stage of the operation of the Project.

The structuring of bidding processes for the Project and the compliance with it guarantee that the technology comes from well-known and the most important companies of the world and market leaders, which possess a large experience in the world electric industry and national electric sector. Additionally, during the construction of the Project and its early operation ISAGEN will count on manufacturers' technical direction in order to ensure Sogamoso hydropower plant an adequate operation.

All the facilities in the power plant will comply with the most recent version or revision of relevant national and international regulations or standards, especially the Technical Regulation of the Electric Installations (Reglamento Técnico de Instalaciones Eléctricas - RETIE per its initials in Spanish), which aims to guarantee people, animal and vegetal life safety and to preserve the environment by minimizing or eliminating risks of electric origin.

The Hydroelectric Sogamoso Project will supply 5,056 GWh-year to the National Interconnected System, which will permit the displacement of power generated by thermal power plants and to give support to the expansion of the Colombian Electric System. The Hydroelectric Sogamoso Project will have significantly better performance than the thermal technology to be replaced by the Project in the fields of efficiency and exploitation of natural, environmental and social resources, which represents a contribution to the sustainable development of the country.

According to the definition adopted by the United Nations Conference on Commerce and Development -UNCTAD-, "Technology Transfer" consists of the systematic knowledge transfer to the manufacture of a product, the application of a process or the provision of a service. For the implementation, operation and maintenance of the Project, ISAGEN considers different processes of technology transfer from companies of Annex I countries, which allows acquiring in a systematic way a high knowledge in the application of processes to generate electric energy and the provision of different services associated with this activity. In the specific case of Sogamoso Project, ISAGEN is developing the technology transfer in aspects such as civil works and equipment acquisition with companies of Annex I countries, as explained below.

The construction of diversion tunnels, the dam and generation works is in charge of the group ICT S.A.S., which is part of the Italian firm Impregilo and the Colombian construction companies Conalvías and Técnica Vial. The Italian firm Impregilo was established in 1906 and is Italy's leading General Contractor and one of the world's top-ranking construction groups. The Impregilo Group is an international specialist in major infrastructures and civil buildings of architectural prestige. It is also active in the concessions sector and in environmental engineering and plants. Roads, motorways, railways and subways, dams and hydroelectric plants, underground works, bridges, viaducts, ports and airports, desalination plants, waste-to-energy facilities, industrial emission treatment plants: the Group boasts extensive experience in Italy and around the world, coupled with a solid commitment to meeting contract schedules, safeguarding the environment and promoting technological innovation.

Manufacture, supply and installation of main electromechanical equipment are in charge of the companies Andritz, Toshiba, Mitsui&Co., Ltd. and Siemens. The crane bridge is to be constructed by the Colombian company Imocom with the support of the Taim Weser Company.

Andritz Company is in charge of the manufacture, supply and installation of Francis type turbines and associated equipment. Andritz has its origins in an iron foundry that was established in 1852. The Group is headquartered in Austria. It develops and makes its high-tech systems at production, service and sales sites all around the world. The Andritz group is a global market leader for customized plant, systems and services for hydropower, the pulp and paper, steel and other specialized industries (solid/liquid separation, feed and biofuel).

Toshiba and Mitsui&Co., Ltd. are in charge of the manufacture, supply and installation of power generator and associated equipment. The Japan-based Toshiba Corporation is a diversified manufacturer and marketer of advanced electronic and electrical products, spanning information and communications equipment and systems, Internet-based solutions and services, electronic components and materials, power systems, industrial and social infrastructure systems, and household appliances. Mitsui&Co., Ltd., founded in 1947 in Japan, is a multilaterally pursuing business that ranges from product sales, worldwide logistics and financing, through to the development of major international infrastructure and other projects in the following fields: Iron & Steel Products, Mineral & Metal Resources, Infrastructure Projects, Motor Vehicles, Marine & Aerospace, Chemicals, Energy, Foods & Retail, Consumer Services, Information, Electronics and Telecommunications, Financial Markets and Transportation Logistics.

Siemens Company, founded in 1847 in Germany, is in charge of manufacture, supply and installation of power transformers. It is a multinational company in the field of telecommunications, transportation, lighting, electric equipment, motors, automatization, industrial instrumentation among other engineering fields.

The Spanish Taim Weser Company, supporting Colombian Imocom Company in the construction of the Crane Bridge, is a company giving solutions in the business of: Bulk Material Handling, Heavy and Specialized Lifting Equipment, Waste Treatment and Renewable Energy, all over the world.

Countries where the companies mentioned above have their head offices (Italy, Germany, Austria, Japan and Spain) correspond to Annex I countries, which is evidence that 'Technology Transfer' from developed countries is being implemented because of the Sogamoso Project.

Electronic components of the meters to be used in the measurement system (and in the monitoring plan) will be manufactured with the latest technology so as to minimize meters electricity consumption and to provide to the devices electric safety and reliability. As the Project is new, the description presented below includes only the equipment to be used and civil works to be implemented in the project activity.

MAIN FEATURES OF THE POWER PLANT

The Dam will be gravel with face concrete type, 190 m high and 345 m crest length; the crest's level will correspond to 330 meters above sea level (masl). The dam will have the spillway on the left side; the spillway will be controlled by 4 gates and its discharge channel will end in a ski jumping for energy dissipation.

The deviation of the river to allow the construction of the dam is planned through two deviation tunnels dug on the left. This deviation will be done in compliance with environmental requirements in order to preserve the Basin of Sogamoso River and thus it will permit carry out works and actions for environmental recovery in influenced areas, minimizing affections to water sources.

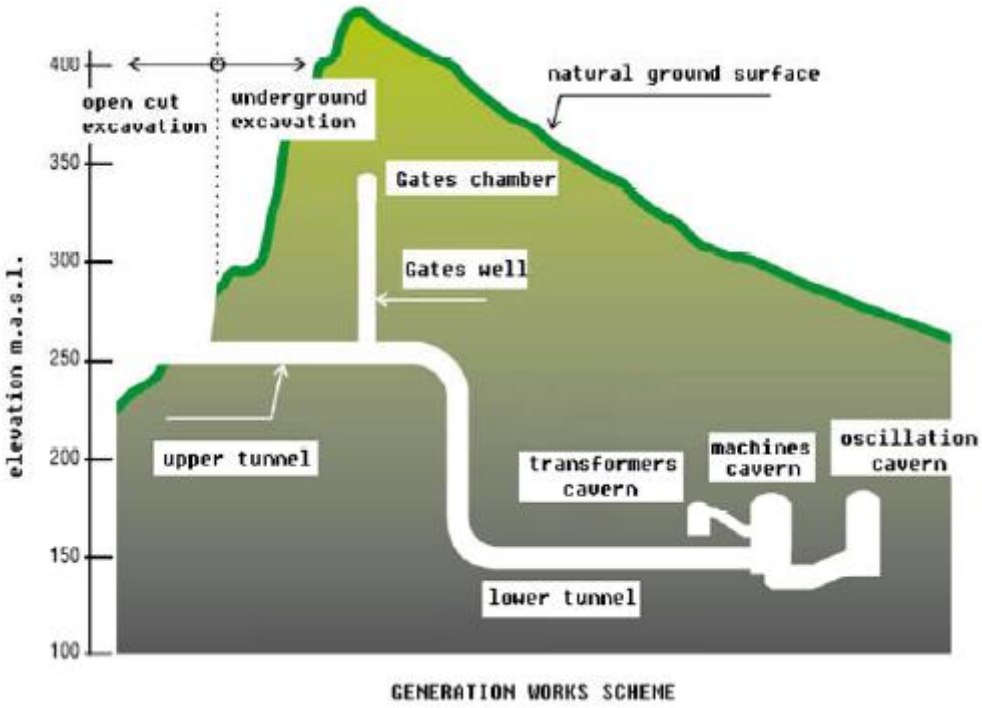
Activity Project will have a maximum total installed capacity of 874.8 MW (based on generators nameplate), using three generation units driven by Francis type turbines with a maximum flow of 665 m3/s, and rated flow of 630 m3/s. The reservoir will have a total volume of 4,717 million of m3, of which 2,802 million will correspond to useful reservoir; flooded area (water mirror) will be 7,590 ha.

Each of the turbines will have one three-phase synchronous generator adapted to its axis; the outgoing power from the three generators will pass to the three-pole switch-breaker through the isolated phase bar. Next, the power will pass to each of the power transformers, which will be located in an independent cavern. From the power transformers the power will be conducted through the power wires to the output porch on the surface.

The power wires will form a part of a set of three-phase circuits at 230 kV. They will be connected using aerial lines from the output porch on the surface to the connection substation of Sogamoso hydropower plant to National Transmission System. Finally, the produced energy in the power plant will be delivered to the Grid.

The generation works scheme is shown in the following figure (connection scheme can be seen in the monitoring plan).

Figure 2 Generation construction scheme



MAIN CIVIL WORKS

- Dam.
- Spillway.
- Background discharge.
- Collection, adduction and conduction.
- Subterranean Central: access tunnel to the central subterranean, machines caverns, transformers cavern, oscillation cave, and deviation tunnels.
- Gates system.

MAIN ELECTRO-MECHANIC EQUIPMENT (THREE GENERATION UNITS)

Hydraulic Turbine

Francis type, vertical axis, continuous operation
Speed: 163.64 rpm
Rated flow: 210 m^3/s
Rated Net Head: 145.53 m
Rated Power: 281.35 MW
Main associated equipment: - Admission cylinder valves of 6.7 m in diameter
- Speed Regulator

Electric Generator

Synchronous type, three-phase, vertical axis
Frecuency: 60 Hz
Air-cooling
Power: 324 MVA
Power factor: 0.9
Voltage: 16.5 kV
Main associated equipment: - Excitation system,
- Voltage regulation system,
- Grounding system,
- Lubrication system,
- Cooling system, among others.

Power Transformer
Three-phase, OFWF type
Transformer turns ratio: 16.5 kV to 230 kV
Power: 324 MVA.

Main additional electro-mechanic equipment:

i) Electric auxiliary services:
- AC power supply system
- DC power supply system
- Backup system
- Lighting system
- Electric power system

ii) Mechanic auxiliary services:
- Air-conditioning and ventilation system,
- Fire system,
- Compressed air system,
- General purpose water system
- Water-cooling system for equipment
- Drainage system

iii) Control, protection and telecommunications system

iv) Bridge-crane

v) Hydro-mechanic equipment

Monitoring equipment and their location in the systems

Directly measured by the metering systems (main and backup) installed at the approved commercial frontiers installed in the interconnection substation. The measurement will be conducted and recorded hourly and daily sent to the National Dispatch Center (CND, for its Spanish initials), according to the national regulations that govern the subject.

The parameters quantity of electricity supplied to the grid by the Project and quantity of electricity supplied to the Project by the grid will be measured.

AVERAGE ELECTRICITY PRODUCTION OF THE PROJECT AND 'PLANT LOAD FACTOR' CALCULATION

Average Electricity Production of the Project

As was mentioned in the section A.2., average electricity production supplied to the Colombian National Interconnected System by the Project will be 5,056 GWh per year. This value is indicated in the document 'Actualization of designs of tender and Environmental Impact Study for Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, revision 1 - June 9, 2008', prepared by INGETEC S.A.[4] as an independent consultant of the Project.

[4] Company founded in 1947 and with more than 60 years' experience, INGETEC SA participated in the development of major infrastructure projects in Colombia, and various engineering projects carried out in Argentina, Bolivia, Costa Rica, Canada, Chile, Ecuador, El Salvador, Guatemala, Haiti, Mexico, Panama, Peru, Turkey and Venezuela. The firm has extensive experience in design, consultancy and supervision of hydroelectric and thermoelectric projects, transmission lines and substations, transportation and disposal of sewage, irrigation districts, roads (tunnels, bridges and viaducts), mass transport (metro, articulated buses), environmental and social studies, industrial developments, among others, leadership in the design of dams, tunnels, caverns and deep wells of large diameter.

Analysis performed and results obtained by INGETEC S.A. are shown in that document for different options analyzed regarding the revision of the Project's scheme.

In order to determine the electricity production of the Project, a simulation model for diary operation of the reservoir was used, which starts from a premise of delivering Firm Energy committed for the reliability charge and obtains a guide curve which maximizes secondary energy, once delivering of firm energy is accomplished. The model was run solely for alternative 1 and the following procedure was applied to estimate additional benefits for other alternatives:

From the simulation of alternative 1 are obtained the days when overflow is presented and the amount of the overflow.

For other alternatives, for the days of overflow obtained from the simulation of alternative 1, it is calculated the additional energy that can be produced taking into account the greater maximum power producible in each alternative.

Data used for simulations correspond to the diary hydrology obtained from INGETEC S.A. in its study 'Actualization of designs of tender and Environmental Impact Study for Sogamoso Hydroelectric Project - Report of Verification and Actualization of flows and Sediments, revision 1 - May, 2008', and to the parameters of each alternative, which are:

- Reservoir level
- Maximum flow
- Net hydraulic head
- Efficiency of turbines and generators

With the simulations described above, the amount of secondary marginal energy for each alternative was obtained with regard to alternative 1. The selected alternative as optimum and recommended by INGETEC S.A. for the installation of Sogamoso Project corresponds to an annual average electricity production of 5,056 GWh, based on generators for a maximum power of 870 MW, which corresponds to the alternative 2 of the document 'Actualization of designs of tender and Environmental Impact Study for Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, revision 1 - June 9, 2008'.

'Plant Load Factor' of the Project

According to the guideline of annex 11 version 1 of EB 48 (Guidelines for the reporting and validation of plant load factors), since Sogamoso Project applies methodology ACM0002, this Project is required to explain the result of the 'Plant Load Factor' to the Designated Operational Entity in an ex-ante way.

The guideline has as one of its options for defining the 'Plant Load Factor' that this factor can be determined based on studies prepared by an external consultant different than the Company that develops the project. Therefore, the study 'Actualization of designs of tender and Environmental Impact Study for Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, revision 1 - June 9, 2008', from the engineering Company INGETEC S.A., was taken as a support of the 'Plant Load Factor'.

Subsequently, the 'Plant Load Factor' is calculated, which is the ratio between the electricity that the Project is in capacity to produce if it operated at the capacity of 870 MW (869.89 MW indeed) solely during the time permitted by technical, hydrological and dispatch conditions, and the electricity that the Project is in capacity to produce if it operated at the capacity of 870 MW (869.89 MW indeed) during all hours of the year without stopping.

It is important to mention that taking into account the occasions when the Project is in capacity to deliver 870 MW (869.89 MW indeed), the name plate data of generators indicates 874.8 MW,

which corresponds to the nearest design value above the Project´s maximum power, in order to avoid damage to the generators.

7,620.24 GWh-year would correspond to 100% of the electricity production of the Project operating at 870 MW (869.89 MW indeed) without stopping. As explained above, the annual average electricity production of the Project will be 5,056 GWh. Therefore, the following is the calculation of the 'Plant Load Factor':
(5,056 GWh-year) / (7,620.24 GWh-year) = 0.6635 (66.35%)

Another way to confirm the 'Plant Load Factor' is:
(5,056 GWh-year) / (869.89 MW*8,760 hours-year*(1/1,000)) = 0.6635 (66.35%)

In conclusion, according to INGETEC´s study ('Actualization of designs of tender and Environmental Impact Study for Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, revision 1 - June 9, 2008'), alternative 2 was selected because this alternative was recommended by INGETEC and this alternative is being implemented by ISAGEN. The average annual electricity production of this alternative corresponds to 5,056 GWh which is obtained from the analysis and simulations of hydrological factors of the water tributary to the Project, which leads to a result for the 'Plant Load Factor' of 0.6635 (66.35%).

It is important to mention that the economic studies were prepared with an average electricity production of 5,056 GWh based on the alternative recommended by INGETEC, according to that explained above and taking into account that it is the alternative that is being implemented by ISAGEN.

According to the experience of ISAGEN, the expected operational lifetime of project activity is:

- Main civil works and infrastructure - 50 years
- Generation equipment – 25 years
- Other assets – 5 years

About expected operational lifetime of civil works and infrastructure, it is the common practice to consider 50 years or more. As examples we can quote the following sources:

- National Society of Mining, Oil and Energy (www.reddeenergia.com): "Comparing the life shown by various renewable generation projects, we find that the hydro reach 50 years[5]."
- Technology to underwriter, Munich Re Group: "Hydroelectric plants have a high lifetime of 50 years[6]."

Additionally, it is important taking into account the operational lifetime actually observed in hydroelectric power plants constructed several or many years ago in Colombia that are still in operation. This is shown in the following table, where is possible to see different power plants in Colombia that use water resource and have been constructed since 1957. Hydropower plant Jaguas (1987 – 22 years in operation), Miel I (2002 – 7 years in operation) and San Carlos (1988 – 21 years in operation) are owned by ISAGEN.

[5] News published in the website Red de energía.com titled Renewable energy: advantages and disadvantages that should be meditated - National Society of Mining, Oil and Energy. (http://www.reddeenergia.com/mostrarnoticia.php?idnoticia=17314). Red de energía.com is a project that stems from the need of the professionals working in the Energy and Mining Sector to have a virtual platform in which to communicate, share knowledge and express critical opinions and techniques regarding energy development and mining.

[6] PDF Document from Munich Re Group (www.munichre.info/publications/302-06086_es.pdf), 2009, Münchener Rückversicherungs-Gesellschaft, Königinstrasse 107, 80802 München, Germany. Munich Re Group is an important reinsurance Company with international operation.

Table 1 Hydroelectric power plants constructed installed in Colombia

Power Plant	Installed Capacity (MW)	Year of commissioning	Location	
			Municipality	Department
ESMERALDA	30.0	1963	Chinchiná	Caldas
SAN FRANCISCO	135.0	1969	Chinchiná	Caldas
BAJO ANCHICAYÁ	74.0	1957	B/ventura	Valle
CHIVOR	1,000.0	1977	Santa María	Boyacá
LA GUACA	324.0	1987	La Mesa	Cundinamarca
GUAVIO	1,200.0	1992	Ubalá	Cundinamarca
PARAISO	276.0	1987	La Mesa	Cundinamarca
BETANIA	540.0	1987	Yaguará	Huila
ALTO ANCHICAYÁ	355.0	1973	Buenaventura	Valle
CALIMA	132.0	1967	Calima (Darien)	Valle
PRADO	46.0	1973	Prado	Tolima
SALVAJINA	285.0	1985	Silvia	Cauca
GUADALUPE III	270.0	1966	Gómez Plata	Antioquia
GUADALUPE IV	225.0	1985	Alejandría	Antioquia
GUATAPÉ	560.0	1980	Guatapé	Antioquia
LA TASAJERA	306.0	1994	Bello	Antioquia
PLAYAS	201.0	1988	San Carlos	Antioquia
PORCE II	405.0	2001	Amalfi	Antioquia
TRONERAS	42.0	1965	Carolina	Antioquia
JAGUAS	170.0	1987	San Rafael	Antioquia
MIEL I	396.0	2002	Norcasia	Caldas
SAN CARLOS	1,240.0	1988	San Carlos	Antioquia
URRÁ	338.0	2000	Tierralta	Córdoba

Source[7]: CND - XM - UPME, table by PwC

The above demonstrates that expected operational lifetime of Sogamoso Project goes above the duration of the crediting period and complies with the requirements of operational lifetime of the Project financial assessment and Project cash flow assessment.

In all cases, expected operational lifetime can be extended through adequate maintenance practices, as is the case of ISAGEN's policies.

In case the lifetime of some of the equipment happens to be shorter than the duration of the CDM project activity, the Project proponents will ensure their replacement (when necessary) with the equipment of equal or similar technical and operational specifications, therefore the characteristics

[7] Acronyms definitions:

CND per its initials in Spanish (Centro Nacional de Despacho) is the office of XM that plans, in short, medium and long term, generation resources (power plants in the SIN) and transmission resources in Colombia according to the demand.

XM Compañía de Expertos en Mercados S.A. E.S.P, affiliate of ISA, operates the SIN and manages the Colombian Wholesale Electricity Market.

Energy Mining Planning Unit (Unidad de Planeación Minero Energética - UPME per its initials in Spanish), entity of the Ministry of Mines and Energy (Minminas per its initials in Spanish) is in charge of planning of sustainable development of mining and energy sectors of Colombia.

ISA (Interconexión Eléctrica S.A. E.S.P) is the Colombian business group in charge of design, construction, management and operation of systems of linear infrastructure in electricity and telecommunications connectivity and infrastructure construction projects.

Colombian Wholesale Electricity Market (Mercado de Energía Mayorista - MEM per its initials in Spanish) consists in commercial transactions between agents (traders and generators) that buy and sell electricity in blocks.

Regulation Commission of Energy and Gas (Comisión de Regulación de Energía y Gas - CREG per its initials in Spanish).

considered for the CDM project will remain. This way it will be ensured that the amount of the emission reductions achieved by the CDM project during the crediting period will not increase due to replacements contrary or in different directions to the original features of the existing equipment of the mentioned above project activity.

On the other hand, all the Project equipment are included in the program of preventive and corrective maintenance (as will be explained in Appendix 5) which will keep ensuring its proper functioning. Furthermore, at the moment of its reparation or replacement (only when back up does not exist), the time of the installation of the substitute equipment will be reduced to minimum to avoid eventual interference with the continuity of the project activity.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia	Private Company: ISAGEN S.A. E.S.P.	No

A.5. Public funding of project activity

No public funding will be involved in financing of the proposed project activity.

A.6. History of project activity

1. We Confirm that:
   (a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
   (b) The proposed CDM project activity is not a project activity that has been deregistered.

2. We Declare that the following statement are not true:
   1. The proposed CDM project activity was a CPA that has been excluded from a registered CDM PoA;
   2. A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

The approved baseline and monitoring methodology applied to the project activity is: Consolidated baseline methodology for Grid-connected electricity generation from renewable sources, ACM0002, version 16.0.

The methodological tools that the above mentioned methodology draws upon are:
- Tool to calculate the emission factor for an electricity system, version 4.0
- Tool for the demonstration and assessment of additionality, version 7.0

B.2. Applicability of methodologies and standardized baselines

The proposed project activity conforms to the applicability requirements of the approved methodology ACM0002, version 16.0, paragraph 5 of section 2.2: (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m^2; due to the following facts:

(i) It consists of the installation of a new renewable power plant connected to the Grid and it will be situated at a site where no renewable power plant was operated prior to the implementation of the project activity;
(ii) It consists of the installation of the hydro power plant;
(iii) The project activity results in a new reservoir and the Power Density of the power plant (12.70 W/m^2), as per definitions given in the Project Emissions section, is greater than 4 W/m^2.
(iv) It does not involve switching from fossil fuels to renewable energy sources at the site of the project activity and the new plant is not a biomass fired power plant.

Therefore it is concluded that the methodology applicable to the proposed project activity is the approved methodology ACM0002, version 16.0.

By the other hand, the applicability of the mentioned methodological tools are demonstrated as follows:

Tool to calculate the emission factor for an electricity system, version 4.0.0. This tool is applicable due to:

- When calculating baseline emission for the project activity that substitutes grid electricity, that is where the project activity supplies electricity to a grid that results in savings of electricity that would have been provided by the grid.

- The project electricity system is not located partially or totally in an Annex I country. The national electricity system is totally located in Colombia, which is not an Annex I country.

Tool for the demonstration and assessment of additionality, version 7.0.0. This tool is applicable due to:

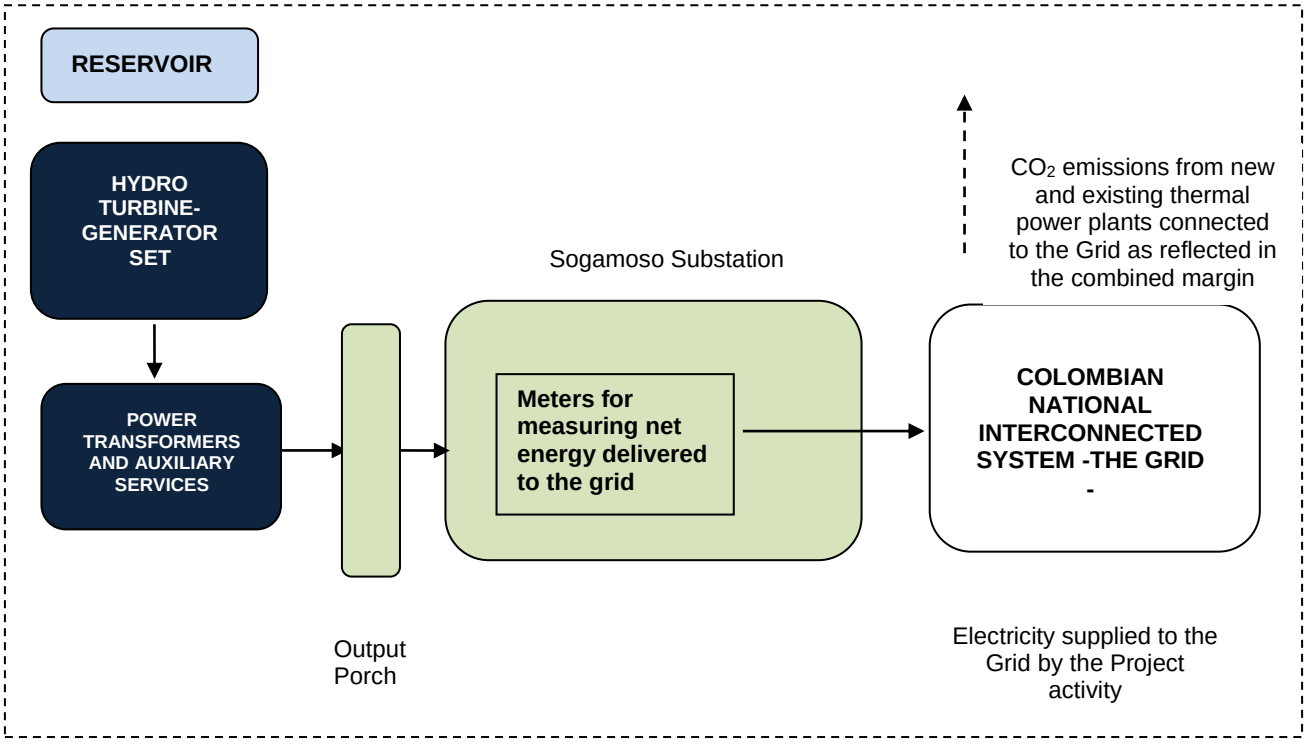
- Project Participants do not propose a new methodology and this tool is required by the methodology ACM0002, version 16.0.

- Therefore it is concluded that the methodological tools are applicable to the proposed project activity.

B.3. Project boundary, sources and greenhouse gases (GHGs)

The Project boundary for the proposed Project is represented by the Colombian National Interconnected System (SIN) and the physical and geographical site where the electric generation plant, dam and reservoir are located. See more information about the SIN included in Appendix 4.

Figure 3: Project boundaries and sources of GHG emission



According to the guidance of the approved methodology ACM0002, version 16.0 the only accountable source of the baseline greenhouse gasses emissions, that will take place within the borders of the proposed project activity, will be the emissions of the CO_2 from electricity generation in the fossil fuel fired power plants connected to the Grid mix that will be displaced due to the project activity. See the justification given in the Table.

Source		GHG	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 according to the methodology ACM0002, version 16.0
		CH_4	No	Minor emission source according to the methodology ACM0002, version 16.0
		N_2O	No	Minor emission source according to the methodology ACM0002, version 16.0
Project activity	Emissions of CH_4 from the reservoir	CO_2	No	According to the guidance of the methodology ACM0002, version 16.0, these emissions are not accounted for within Project boundaries as the Power Density of the hydroelectric plant is greater than 10 W/m^2 (the power density of the Project power plant is 12.70 W/m^2). See the calculation in part B.6.1.
		CH_4	No	
		N_2O	No	Minor emission source according to the methodology ACM0002, version 16.0.

B.4. Establishment and description of baseline scenario

According to the guidance of the approved methodology ACM0002, version 16.0 "Identification of the baseline scenario", the baseline for the proposed project activity 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 the "Tool to calculate the emission factor for an electricity system".*

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the Grid by the Project would have otherwise been generated by the operation of Grid-connected power plants and by the addition of new generation sources.

Baseline emissions of the proposed project activity were estimated taking into account the following parameters:

(a) Annual amount of the energy generated by the plant

The total amount of 5,056 GWh of the average electric energy to be generated annually by the Sogamoso Hydroelectric Project was taken from the power plant's design documentation:

INGETEC S.A., Update of designs of tender and environmental impact study – Sogamoso Hydroelectric Project - Recommendations of installation for the power plant, rev. 1 - June 9, 2008.

(b) Baseline emission factor for the Colombian electricity Grid.

The baseline combined margin emission factor (equalled to 0.2742 tCO_2e/MWh) was calculated conform to the "Tool to calculate the emission factor for an electricity system", version 4.0. For details on the calculation please refer to section B.6 and Appendix 4 of the current document.

B.5. Demonstration of additionality

Step 1: Identification of alternatives of the project activity consistent with current mandatory applicable laws and regulations

Definition of project activity

The project activity involves the construction of the hydroelectric power plant Sogamoso of 874.8 MW of maximum total installed capacity which will be dispatched within the Grid.

Substep 1a: Definition of alternatives to the project activity
According to the methodological tool "Tool for the demonstration and assessment of additionality", version 7.0.0, in step 1, it is mentioned that the identification of alternatives for the project activity should define realistic and credible alternatives. These alternatives can include a project activity without registration of CDM projects, or if applicable, the continuation of the current situation, that is, that the project or the alternatives are not carried out. For the analysis of alternatives, the project participants have followed the mentioned methodological tool according to realistic and credible alternatives to the situation, context and conditions of ISAGEN.

Therefore, for the reasons described previously, the alternatives selected are:

Alternative 1: Continuation of the current situation: Sogamoso power plant is not built and electricity continues being generated by the existing composition of the power plants of the Grid.

Alternative 2: Completing Sogamoso Project without CDM: Construction of the new renewable energy power plant connected to the Grid without considering it as a CDM activity.

Justification for the choice of baseline scenario for the project:

According to the Approved Consolidated Baseline and Monitoring Methodology ACM0002 “Consolidated baseline methodology for Grid-connected electricity generation from renewable sources” Version 16.0, in the case when the Project activity consists of building a new renewable energy power plant connected to the Grid, the Project Baseline is defined by the scenario as follows:

> *“Delivered electricity to the grid by the project activity that would have otherwise been generated by the operation of power plants connected to the grid and the additions of new power plants, as reflected in the calculation of the combined margin in the "Tool to calculate the emission factor for an electricity system”.*

Given that the project activity consists of building a renewable energy power plant, connected to the Grid, the Baseline scenario above is suitable for the project activity studied. Therefore, Alternative 1 defined above is the baseline of the Project.

Substep 1b: Consistency with current mandatory applicable laws and regulations

Alternative 1
At the time of drafting this document in Colombia there is no legislation which requires electricity generators entities for the National Interconnected System of Colombia to reduce emissions of greenhouse gases of the Grid nor the construction of power plants from renewable resources.

Therefore, alternative 1 complies with current regulations of the country.

Alternative 2
Environmental license is the permission granted by the competent environmental authority for the implementation of a project, work or activity that involves a process of environmental impact assessment whereby prevention, mitigation, management, correction and compensation are ensured. Environmental effects, process management and planning are implemented through an

administrative act in which the competent environmental authority authorizes the execution of works that benefit the development of the country.

The regulation on environmental licenses was established in the country since the Law 99 of 1993. According to the Article 49, the environmental license is defined as a license granted by the State for the execution of works or the implementation of projects or activities that may cause serious damage to the environment or natural resources or introduce a significant alteration to the landscape.

In this sense, the five laws that have regulated the procedure for granting environmental licenses are: Decree 1753 of 1994; Decree 1728, 2002; Decree 1180, 2003; Decree 1220 of 2005 and finally the 2820 Decree 2010 The last one, in Article 8, requires the competence of the Ministry of Environment, Housing and Territorial Development (now Ministry of Environment and Sustainable Development), to grant the environmental license to the following projects:

- The construction and operation of power plants with installed capacity equal to or greater than 100 MW,

- Exploration projects and uses of virtually pollutants power sources with installed capacity greater than 3MW.,and

- The construction of transmission lines of the SIN1, comprising the set of lines with their corresponding connection modules (substations), which are planned to operate at voltages equal to or greater than 220 kV.

According to Article 3 of the Decree mentioned above environmental license carries all permissions, authorizations and / or concessions for the use and / or production of renewable natural resources that are necessary for development and operation of the project, work or activity. Additionally, no project, work or activity will require more than one environmental license.

As indicated above, the Ministry of Environment, Housing and Territorial Development granted to ISAGEN, through Resolution 0206 of 2009, the environmental license for construction and operation of the Sogamoso Project.

As provided above, alternative 2 complies with current regulations of the country.

Additionally, at the time of drafting this document in Colombia there is no legislation which requires generating entities to reduce emissions of greenhouse gases of the Grid and on the other hand to build power plants from renewable resources to reduce emissions of greenhouse gases of the Grid.

Therefore alternative 2 is in addition to the requirements of current regulations of the country.

Results of the analysis in Step 1
The analysis of step 1 demonstrates compliance of identified project alternatives with the mandatory regulation and standards. The study allows advancing to the next step.

Step 2: Investment Analysis
According to the tool for demonstration and evaluation of additionality, version 7.0.0, project participants may use one of the two analyses: the investment analysis or barrier analysis, or both. In the present study we decided to introduce the two analyses: investment and barriers.

Substep 2a: Determine appropriate analysis method
According to the tool for demonstration and evaluation of additionality, version 7.0.0, following three options may be used for investment analysis:

I. Simple cost analysis

II. Investment comparison analysis
III. Benchmark analysis

Due to the project activity generates, by the sale of energy, economic and financial benefits different to the CDM ones, we choose as most appropriate for investment analysis the Option III – Benchmark Analysis. Through this analysis it will be demonstrated that the project activity is not the most economically or financially attractive in comparison with the benchmark of the electric sector[8].

Substep 2b Option III. Benchmark Analysis
The likelihood of developing the Project as opposed to continue with power generation by the existing composition of the power plants of the National Interconnected System (Alternative 1 - baseline of the Project) will be determined by comparing the Project Internal Return Rate (IRR) without CDM financing (Alternative 2) with the benchmark of the Colombian electric sector.

Determining the appropriate benchmark
When applying the option III, benchmark analysis, the economic/ finance analysis has been based on parameters that are standard in the electricity market, considering specific characteristics of the type of project and not the subjective expectation of profitability of project participant or the risk profile, in order to avoid the lack of veracity in the analysis.

Given that in Colombia there is not a benchmark for the evaluation of projects in the electric sector, this benchmark was calculated and it is the discount rate of the electric sector.

To calculate a discount rate comparable with the IRR of the Project, it is important to note that the Project was evaluated without considering debt for its financing. Thus, when evaluating the Project it was assumed that it would be financed with own resources.

The financial model of the Project considers its implementation without financing, because that was the way the project was evaluated by ISAGEN and that was the way ISAGEN decided to implement the project. “Guidance: Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant.” As can be seen, considering implementation of the project without financing corresponds to the way ISAGEN decided to implement the project and is consistent with the requirement of the Guidance related to the topics of the Methodological Tool.

The project started its implementation with ISAGEN’S own resources as explained below: The investment decision was approved by ISAGEN Board on November 27th 2008 as it is presented in the meeting memories (Meeting 176). The construction of access roads started on February 23, 2009 and the specifications for the construction of diversion tunnels were available since November 25, 2008 for a public tender which was closed on February 13, 2009. These events were previous to the authorization from the Ministry of Finance and Public Credit to ISAGEN for accessing financing, which was issued on August 20, 2009. It is important to say that the Ministry would have been able to deny the financing authorization (nonetheless the project could have continued its implementation only with ISAGEN´s equity, as was considered at the beginning of the Project). Furthermore, the starting date of the project (date on which the contract for the main construction services was signed), indicated in this PDD as July 27, 2009, is also previous to that authorization, which shows that the decision to initiate the project was previous to the authorization from the Ministry.

Additionally, the numeral 9 page 14 of the Methodological Tool mentions: “Guidance: The cost of financing expenditures (i.e. loan repayments and interest) should not be included in the calculation of the project IRR.” This is totally consistent with the IRR calculation made in the financial model of

[8] Benchmark of electric sector calculated by PricewaterhouseCoopers in accordance with established international methodology. The period used to calculate the risk free premium, was an average of 3 month for the period from March 2008 to May 2008. The reason for using an average for the period of 3 month is to eliminate any abrupt variation of the risk free rate near to the date of estimation.

the project (made by ISAGEN and presented to DOE) because the cost of financing expenditures is not considered in the IRR calculation, which is consistent with the way the project was evaluated and decided to be implemented by ISAGEN and is consistent with the Guidance of the Methodological Tool.

According to that mentioned above, and taking into account that the project did not have financing, likewise the benchmark was made without considering debt. When debt is not taken into account in determining the WACC, this rate is equivalent to the Cost of Equity. That's because the definition of the WACC is:

$$WACC = Ke * \frac{E}{D+E} + Kd * (1-Tx) * \frac{D}{D+E}$$

Where
Ke = Cost of equity
Kd = Cost of debt
E = Market value of equity
D= Market value of debt
Tx = Corporate Tax Rate

As noted, since it is not considered debt in Project financing (D = 0) given that ISAGEN evaluates its projects from the perspective of using own capital to finance, the equation is WACC = Ke, thus, this is the calculation of the discount rate. In other words, the Cost of Equity in the sector is the investor's discount rate for the electricity sector in Colombia.

Substep 2c: Calculation and comparison of financial indicators
The following table presents the result of the investment analysis made for the project activity:

Table 3 Summary of financial analysis of the Project with and without CDM financing

Financial Indicator	%
IRR of the Project without CDM	12,95%
IRR of the Project with CDM	13,32%
Benchmark sector	14.50%

As can be observed, Sogamoso Hydroelectric Project is not economic/financially viable without the income from the sale of CER's considering that the IRR is lower than the sector benchmark.

In the following analysis it will be demonstrated that the project activity is not economically/financially feasible for the investor without the revenue from the sale of Certified Emission Reductions.

For further information about the analysis of indicators presented, refer to the Annex 1 where the Project cash flow is shown.
Parameters considered for the financial analysis are presented in the following table:

Table 4 Primary parameters used in the investment analysis

Parameter	Value
Maximum Installed capacity (MW)	874.80
Average generation (GWh/year)	5,056
Time of construction (years)	5

Lifetime of Project (years)	50
Power Price (USD/MWh)	46.91*
Total investment (USD)	1.314.692.520 **
Operational costs AOM (USD/KW year)	15.72[9]

*Constant 2008
** The total investment amount in current COP is 2.904.137 millions. The calculation of the Budget in dollars takes into account the official yearly exchange rate as presented below.

INVESTMENTS - COP Mill

DESCRIPTION	2,008	2,009	2,01	2,011	2,012	2,013	2,014	TOTAL
INVESTMENT	**10.510**	**579.237**	**399.439**	**487.123**	**577.056**	**241.712**	**27.988**	**2.323.065**
Land	9.323	52.510	103	0	0	0	0	**61.935**
Civil works	0	425.616	323.759	368.308	361.265	62.734	15.785	**1.557.467**
Equipment	0	84.162	53.329	95.899	192.188	154.667	6.299	**586.544**
Studies	1.187	6.569	0	0	0	0	0	**7.757**
Engineering	0	10.380	22.248	22.916	23.603	24.311	5.905	**109.362**
EXPENSES	**5.950**	**36.900**	**39.623**	**196.979**	**254.894**	**45.451**	**1.276**	**581.072**
Replacemet works	0	2.078	1.249	157.526	213.748	98	0	**374.699**
Environmental	5.665	17.205	20.637	21.256	22.403	26.048	846	**114.059**
Other	285	17.617	17.737	18.197	18.743	19.305	430	**92.315**
TOTAL	**16.460**	**616.136**	**439.062**	**684.102**	**831.950**	**287.163**	**29.264**	**2.904.137**
TRM	1.946	2.069	2.218	2.203	2.287	2.324	2.339	

INVESTMENTS - USD

DESCRIPTION	2,008	2,009	2,010	2,011	2,012	2,013	2,014	TOTAL
INVESTMENT	**5.400.739**	**279.989.533**	**180.091.470**	**221.134.933**	**252.341.089**	**104.023.486**	**11.963.660**	**1.054.944.909**
Land	4.790.605	25.381.994	46.376	0	0	0	0	**30.218.975**
Civil works	0	205.732.708	145.970.429	167.197.503	157.977.875	26.998.199	6.747.368	**710.624.083**
Equipment	0	40.681.963	24.043.840	43.534.622	84.041.811	66.562.701	2.692.377	**261.557.315**
Studies	610.134	3.175.534	0	0	0	0	0	**3.785.668**
Engineering	0	5.017.334	10.030.826	10.402.807	10.321.402	10.462.585	2.523.915	**48.758.868**
EXPENSES	**3.057.586**	**17.836.477**	**17.864.273**	**89.420.845**	**111.462.586**	**19.560.265**	**545.579**	**259.747.611**
Replacemet works	0	1.004.462	563.191	71.510.767	93.469.915	42.064	0	**166.590.398**
Environmental Management	2.911.270	8.316.290	9.304.212	9.649.248	9.796.486	11.209.902	361.611	**51.549.019**
Other	146.316	8.515.724	7.996.870	8.260.830	8.196.186	8.308.299	183.967	**41.608.194**
TOTAL	**8.458.325**	**297.826.010**	**197.955.743**	**310.555.778**	**363.803.675**	**123.583.751**	**12.509.238**	**1.314.692.520**

Substep 2d: Sensitivity analysis

The additionality study was completed using conservative assumptions for the investment analysis of the Project. For the sensitivity analysis, critical parameters presented below were subjected to

[9] The estimated value of AOM was calculated taking as a basis the hydroelectric power plants average AOM per kW-year of San Carlos (1,240 MW installed capacity) and Miel I (installed capacity of 396MW) for 2007. These two power plants are owned and operated by ISAGEN. The data from these power plants is obtained from ISAGEN integrated information system (SAP ERP. CRM, BW, BI - BO, other) ISAGEN uses an Activity-Based Costing (ABC) method, which allows knowing in detail the cost of its activities, resources and cost objects. The cost objects costing by ISAGEN are customers, projects and power plants by separated.

variations taking into account that each of them represents more than 20% of total costs and/or income of the Project:

- Power price
- Power generation (GWh/year)
- Civil Works (Total Investments)
- CERE Cost

The following table summarizes the results of the sensitivity analysis, indicating variations within a range from -10% to +10% compared to the benchmark of the electric sector expressed as the cost of equity.

Table 6 Results for IRR in sensitivity analysis without CDM

Variable	IRR without CDM				
	-10,00%	-5,00%	0,00%	5,00%	10,00%
Power Price	11,75%	12,36%	12,95%	13,51%	14,06%
Power generation (GWh/year)	12,17%	12,56%	12,95%	13,32%	13,69%
Civil Works (Total Investment)	13,87%	13,39%	12,95%	12,53%	12,14%
CERE Cost	12,17%	12,56%	12,95%	13,32%	13,69%
Benchmark	14,50%				

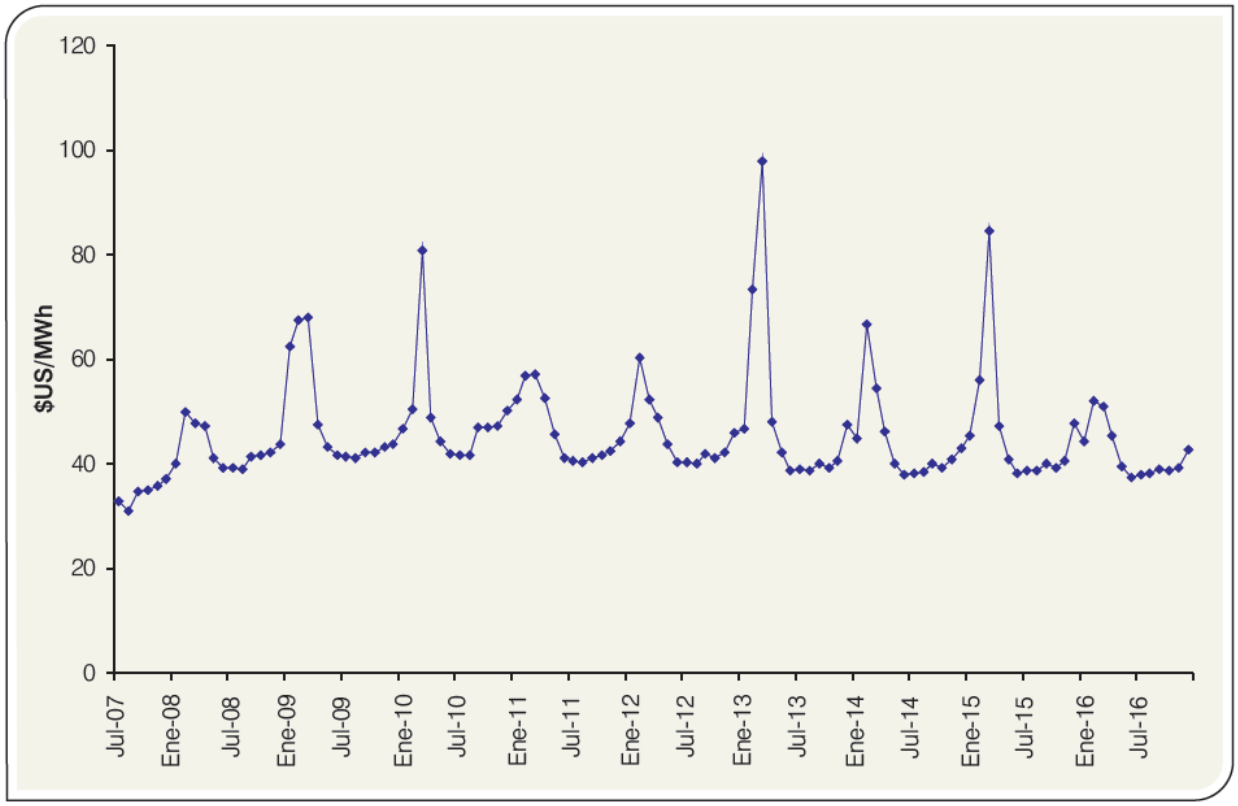
Power price:

Power prices in Colombia are analysed and projected by UPME. Considering the Expansion Plan 2008-2022[10], which is an official study of the government used by power sector companies to evaluate the behavior of different variables that make up the projected energy demand, required generation expansion and resources with which it could make such expansion (water, coal, gas, fuel oils, wind), it is possible to define the behavior of power prices in the market.

The following Figure illustrates the behavior of prices considered by UPME in its Expansion Plan.

[10] UPME, Colombia: Plan de Expansión de Referencia. Generación - Transmisión. 2008 – 2022: Page 94: Graph 4-8 Comportamiento del Costo marginal en caso autónomo, Escenario de demanda alto y medio. Available at http://www.upme.gov.co/Docs/Plan_Exp_Refer_2008_2022.pdf

Figure 4 Behavior of marginal cost of the Colombian system 2008-2016[11],



Source Reference Generation-Transmission Expansion Plan 2008-2022 of UPME page 94 7.

Projections of UPME for the period 2008-2022, consider in the long term a strong thermal expansion. Thermal expansion is based on some expansion with natural gas and a strong use of mineral coal[12].
It is important to note that the Expansion Plan of UPME does not expect prices greater than shown above.

Given that the price used (46.91 USD/MWh as a result of the annual arithmetic average of monthly values within the period 2008-2022, indexed to year 2008) corresponds to the highest prices indicated in the Expansion Plan of UPME and that power prices in the medium and long term have a stable tendency, it is expected that prices increase up to 6.41% maximum as explained below. Assuming a 10% increase in power prices, the Project's IRR increases to 14.06% (Figure below), and as such the IRR would remain below the 14.50% benchmark. This demonstrates that the IRR is not likely to reach the benchmark via an increase in power prices.

An increase of 6.41% is calculated based on average values of prices considered by UPME7. Maximum average value corresponds to 49.92 USD/MWh (constant 2008) in 2014, which corresponds to the increase of 6.41% mentioned above.

The IRR is reached when the variable is increased by 14.21%. It is not feasible to reach this level, as explained and argued above. Additionally, the power price of the financial model corresponds to the highest scenario of prices according to the Expansion Plan 2008-2022 by UPME, which is an official study of the government used by electric sector companies for their projections. Therefore, the possibility of increase of power prices is virtually zero.

[11] Ibid.

[12] Reference Generation-Transmission Expansion Plan 2008-2022 of UPME.

Figure 5 Change in power prices compared to benchmark of the electric sector

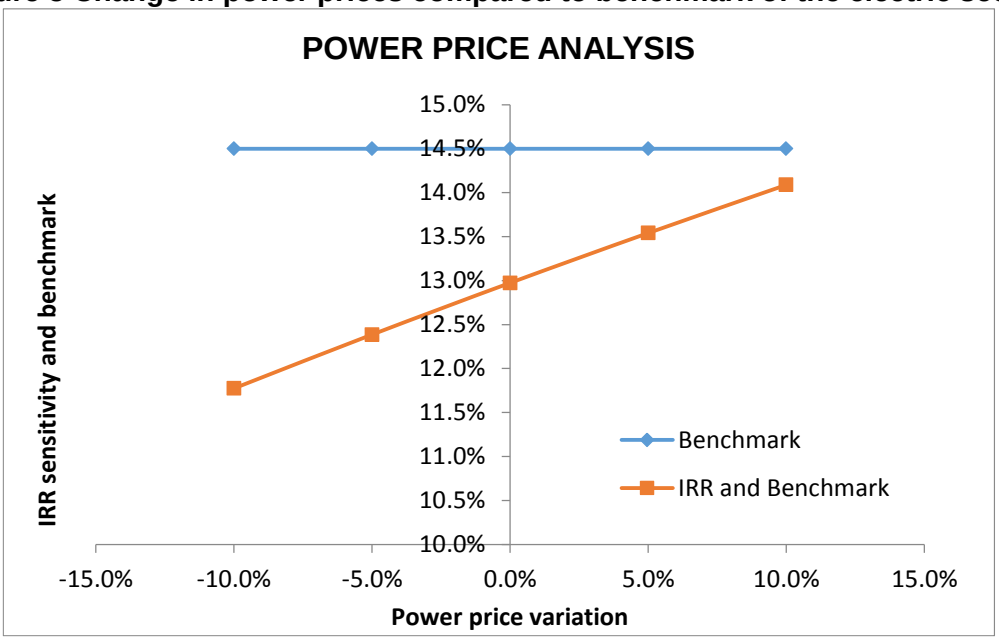


Figure above shows the changes in the IRR of the Project (y-axis) due to different percentage variations of the power price (x-axis). The figure also shows the comparison between this IRR variation and the constant value (in percentage) of the Benchmark.

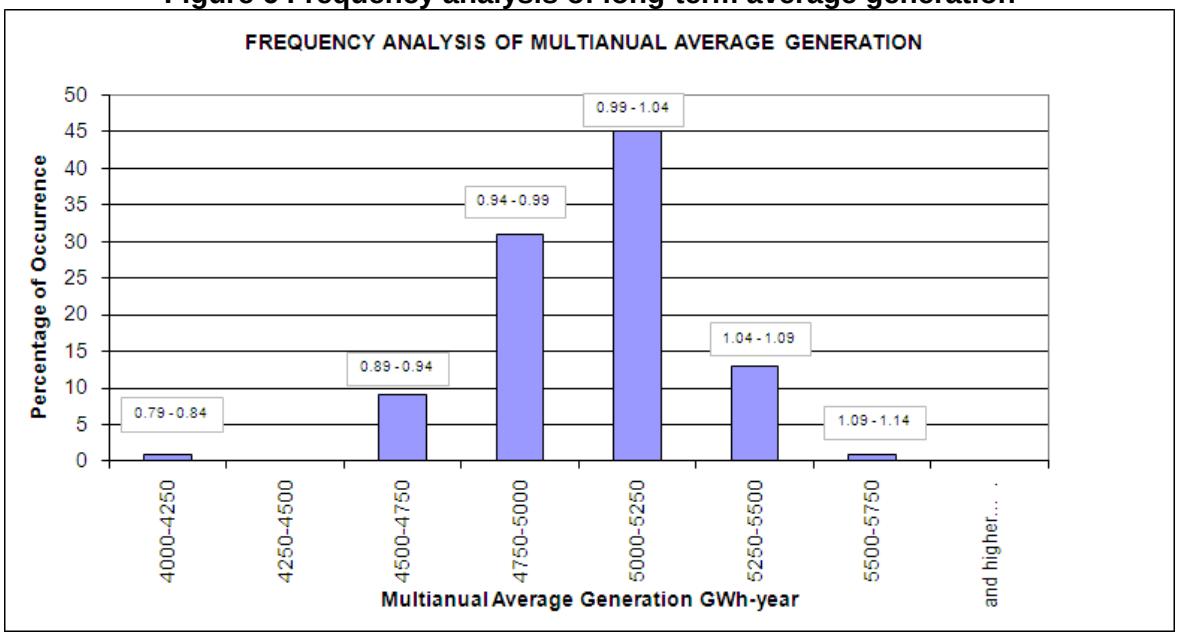
Generation:

The methodology for calculating the long-term average generation uses statistical procedures. Based on available hydrological records for the period from January 1960 to December 2003[13], 100 statistics series were generated associated with the Project dam site. Based on the above information, the simulation is performed on the Project Wholesale Electricity Market, using the hydrothermal dispatch model.

Based on the above records, the figure below shows the percentage of occurrence of the generation of the Project every year and can be seen that there is 98% of probability that the annual average generation in the long-term is between 4,500 and 5,500 GWh/year. Values on the top of each range show the number of times that average annual generation of the Project (5,056 GWh) is repeated in each range.

[13] According to MSExcel records annexed to the report of 2006 by XM: Simulation of Hydroelectric Project of Sogamoso River in the Wholesale Electricity Market.

Figure 6 Frequency analysis of long-term average generation



It is highly unrealistic that the Project average generation in the long-term presents variations over the calculated average. Increasing the average power generation by 10%, the Project's IRR increases to 13.69% (see Figure below), remaining below the 14.50% benchmark of the electric sector. Therefore it is not realistic that the IRR reaches the benchmark via an increase in the energy generation.

The IRR is reached when the variable is increased by 21.5%. It is not feasible to increase power generation by 21.5%, since there are technical limitations that prevent reaching that level of generation, such as the water flows available, the hydraulic head of the plant, and the design of the electromechanical equipment. Additionally, taking into account the historical water inputs in the place of the project´s dam, it is not realistic that the water flow increases. Therefore, the possibility of increase of power generation is virtually zero.

Figure 7 Range of variation of power generation compared to the benchmark of the electric sector

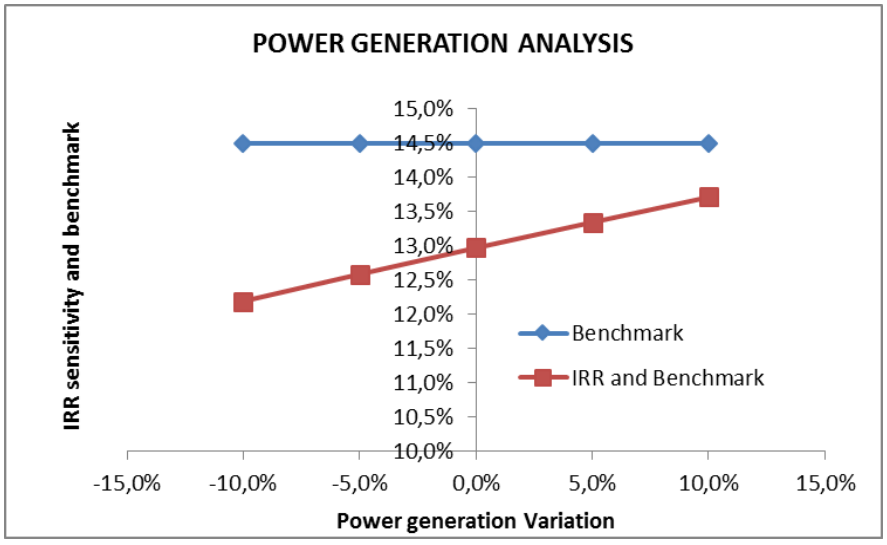


Figure above shows the changes in the IRR of the Project (y-axis) due to different percentage variations of the energy generation (x-axis). The figure also shows the comparison between this IRR variation and the constant value (in percentage) of the Benchmark.

CERE Cost:

This is a cost depending directly on the average energy generated by the Project. The CERE cost is calculated as the average energy generated less the Project's ENFICC by the CERE unit cost defined in the "Assumptions" sheet in the financial model (Average Energy – ENFICC) x CERE Unit Cost. Given that the CERE's unit cost and the Project's ENFICC are fixed values during the Project's whole life, the only factor making the CERE's total cost to vary is the Project's average energy; accordingly, to see the sensitivity of the Project's IRR due to fluctuations in the Project's CERE total cost.

Civil Works:

The investment costs are dependent on prices of material such as cement, iron and steel, which are the main components of this item. In order to obtain lower investment costs it would be necessary that the prices of these materials decrease as a consequence of a decrease in the demand, with a high supply and a negative growth of the economy. In 2007 this was not the case of the construction, equipment and materials costs in Colombia because the internal demand presented a dynamic behavior resulting from the solid growth of consumption and investment and the outstanding performance of the construction sector, which reached growths over 10%, according to the Bank of the Republic of Colombia[14].

In 2007 the Colombian economy grew 7.5%. This continued the cycle of expansion of the economic activity that began in 2002 and since 2004 was showing an increase of the gross domestic product (GDP) above its historical average. The investment, driven mainly by higher gross capital formation in public infrastructure and machinery and equipment, favored the sustainability of growth, expanding the economy's potential and increasing productivity. According to the report of the Executive Board of the Bank of the Republic of Colombia, in addition, the inflation increased from 4.5% in 2006 to 6.3% in 2007, exceeding the target range set for 2007 (between 3.5% and 4.5%), behavior that continued to widen during the first two months of 2008[15], causing the increase of the prices of the equipment, materials and construction.

Colombia was one of the countries with higher growth in cement consumption during 2007 in Latin America, with a consumption increase of 13.4% compared to 2006, reaching historic levels in the licensing of homes and destinations different than housing, as well as investment in public works. The domestic demand had a strong growth due to the sharp increase in public and private investment with solid growth in consumption.

Given that the cost of materials, equipment and buildings are the main costs of the total investment during the construction and given the conditions of the economy in terms of the significant growth in demand and high price levels of the productive sectors, it is unrealistic a decrease in the total investment costs of the Project.

Assuming a decrease of 10% in the investment costs the IRR increases to 13.87%, lower than the 14.50% benchmark. However, a decrease of 10% in the investment costs is unrealistic as has been explained above and the IRR of the Project would remain below the benchmark in this scenario.

The IRR reach the benchmark when the variable is decreased by 16.2%. It is not feasible to reach this level, as explained above, because given that the cost of materials, equipment and buildings are the main costs of the total investment during the construction and given the conditions of the economy in terms of the significant growth in demand and high price levels of the productive sectors, it is unrealistic a decrease in the total investment costs of the Project.

Figure 9. Range of variation of investment compared to the sector benchmark

[14] Bank of the Republic of Colombia. Report of the Executive Board [on line] [cited on 26th May 2010].

[15] Executive board report to the congress of the republic of Colombia: http://www.banrep.gov.co/documentos/juntadirectiva/informecongreso/2007/informe_al_congreso_jul_07_abstract.pdf

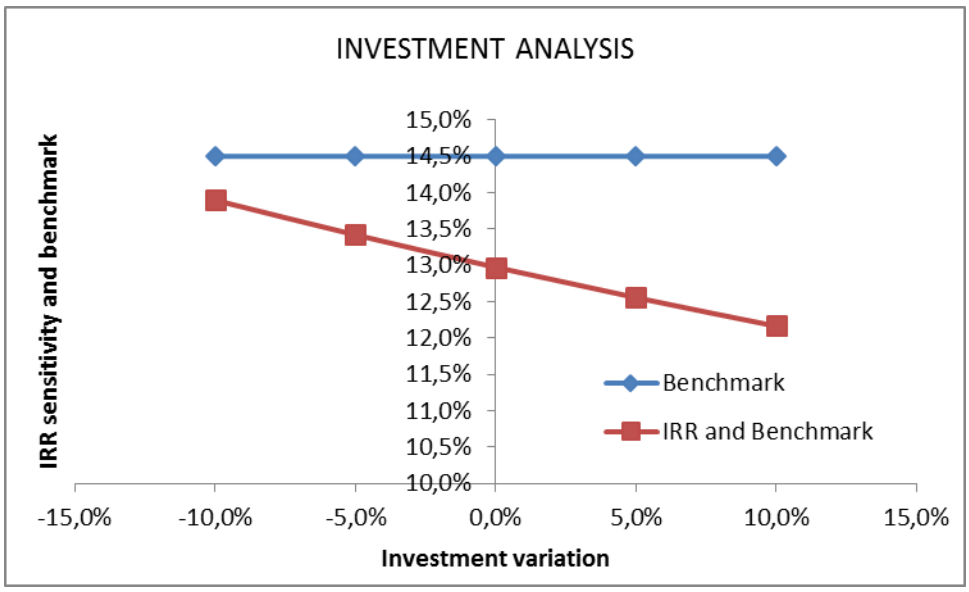


Figure above shows the changes in the IRR of the Project (y-axis) due to different percentage variations of the investment (x-axis). The figure also shows the comparison between this IRR variation and the constant value (in percentage) of the Benchmark.

Results of the analysis in Step 2
The analysis of step 2 demonstrates compliance with the requirements of investment analysis, allowing progress to the next step.

Step 3: Barriers Analysis
This analysis was not carried out by the Project Participants, because only the Investment Analysis was chosen.

Step 4: Common Practice Analysis
In accordance with the Tool for the demonstration and assessment of additionality version 7.0.0 if the proposed CDM project activity applies measures listed as follows, proceed to the Sub-step 4a; otherwise, proceed to Sub-step 4b.

The measures (for emissions reduction activities) area broad class of greenhouse gas emission reduction activities possessing common features. Four types of measures are currently covered in the framework:

i. Fuel and feedstock switch
ii. Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies
iii. Methane destruction
iv. Methane formation avoidance.

The Sogamoso Hydroelectric Project applies measures listed: (ii) use of renewable energies; reason why was proceeded to Sub-step 4a.

Sub-step 4a: The proposed CDM project activity(ies) applies measure(s) that are listed in the definitions section above
According with the methodological tool the latest version of the “Guidelines on common practice” (version 3.1) available on the UNFCCC website shall be applied. According with the Guidelines on common practice version 3.1 the following stepwise shall be followed:

Step 1:

Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The range covering 50% up and down respect to the maximum installed capacity of Sogamoso Project (i.e. 874.8 MW) corresponds to the range from 437.4 MW to 1,312.2 MW.

Step 2:

Identify similar projects (both CDM and non CDM) which fulfil all of the following conditions;

- The projects are located in the applicable geographical area;
- The projects apply the same measure as the proposed project activity;
- The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
- The plants in which the projects are implemented produce goods or services with comparable quality, properties and application areas (e.g. clinker) as the proposed project plant;
- The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
- The projects started commercial operation before the project design document (CDM - PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

Due the starting date of the proposed project activity (July 27 2009) is earlier than the date of PDD was published for global stakeholder consultation (June 25 2010), the similar projects analysis was done taking into account the projects which started commercial operation before July 27 of 2009.

From the information found at the “Unidad de Planeación Minero Energética” –UPME about the electricity generation plants in commercial operation in Colombia by July 27 of 2009, it was created the following table:

Table 5. Similar Projects

Plant Name	Installed Capacity (MW)	Fuel/Energy Source	Year of commissioning
Betania	540	Hydraulic	1987
Chivor	1,000	Hydraulic	1977
Guatapé	560	Hydraulic	1980
Guavio	1,200	Hydraulic	1992
San Carlos	1,240	Hydraulic	1984
Tebsa	791	Fossil Fuel	1998
Termosierra	460	Fossil Fuel	2001

Step 3:
Within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number Nall.

Table 6. Nall List

Plant Name	Installed Capacity (MW)	Fuel/Energy Source	Year of commissioning
Betania	540	Hydraulic	1987
Chivor	1,000	Hydraulic	1977
Guatapé	560	Hydraulic	1980
Guavio	1,200	Hydraulic	1992
San Carlos	1,240	Hydraulic	1984

Tebsa	791	Fossil Fuel	1998
Termosierra	460	Fossil Fuel	2001

Therefore Nall corresponds to the value of 7.

Nall=7

Step 4:
Within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number Ndiff.

According with the tool, Different Technologies, in the context of common practice, are technologies that deliver the same output and differ by at least on the following:

(a) Energy source/fuel;
(b) Feed stock;
(c) Size of installation (power capacity):
    i. Micro (as defined in paragraph 24 of Decision 2/CMP.5 and paragraph 39 of Decision 3/CMP.6)
    ii. Small (as defined in paragraph 28 of Decision 1/CMP.2)
    iii. Large;
(d) Investment climate in the date of the investment decision, inter alia:
    i. Access to technology;
    ii. Subsidies or other financial flows;
    iii. Promotional policies;
    iv. Legal regulation;
(e) Other features, inter alia:
    i. Unit cost of output (unit cost are considered different if they differ by at least 20%)

The proposed project activity consists in the electricity generation using hydropower technology. For this reason, and making use of the mentioned definition of different technologies in the context of common practice, it was identified as plants that utilize different technologies those that do not use the hydraulic resource as energy source or feed stock.

Additionally, making use of the investment climate, specifically to the “Legal Regulation”, the project with year of commissioning earlier than 20 of July of 1995 are considered different to the proposed project activity due to the entry in force of the electric law in Colombia (‘Ley Eléctrica’ 143 of 1994), which gave rise to the electricity market in Colombia, changing the investment climate.

In this way, and considering the definition of different technologies in the context of common practice, it is possible to identify the number of plants that deliver the same output or capacity to the proposed project activity, among the applicable output range, that have started commercial operation before the starting date of the project activity, but uses a different technology to that that will be implemented in the proposed project activity.

Table 7. Ndiff List

Plant Name	Different technology	Description
Betania	Investment climate	Year of commissioning 1987*
Chivor	Investment climate	Year of commissioning 1977*
Guatapé	Investment climate	Year of commissioning 1980*
Guavio	Investment climate	Year of commissioning 1992*
San Carlos	Investment climate	Year of commissioning 1984*
Tebsa	Fuel/Energy Source	Fossil Fuel
Termosierra	Fuel/Energy Source	Fossil Fuel

*Electricity generation plants with year of commissioning earlier than July 20 1995 (entrance in force of Law 143 of 1994 – "Electric Law")

Whit the above information it is demonstrated, that in the applicable geographical area, the number of plants that deliver the same output or capacity to the proposed project activity, among the applicable output range that are in commercial operation but uses a different technology are:

Ndiff=7

Step 5:
Calculate factor F=1-Ndiff/Nall representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

F = 1 – (7/7) = 0

Therefore, the factor F corresponds to the value of 0 and;

Nall – Ndiff = 7 – 7 = 0

Therefore Nall – Ndiff corresponds to the value of 0.

Result of analysis of sub-step 4a
The proposed project activity is NOT a common practice within a sector in the applicable geographical area because at least one (neither in this case) of the following conditions are fulfilled as explained below:

(a) The factor F is greater than 0.2:

Actually, in this case the factor F is NOT greater than 0.2, for the proposed project activity the factor F is 0, therefore, the proposed project activity is NOT a common practice.

(b) Nall-Ndiff is greater than 3:

Actually, in this case Nall – Ndiff is NOT greater than 3, for the proposed project activity Nall – Ndiff is 0, therefore, this is the second reason to NOT consider the proposed project activity as a common practice.

Therefore, the **Sogamoso Hydroelectric Project is not a common practice**, thus the proposed project activity meets all the additionality requirements.

Investment climate explanation
The construction of power generation projects in Colombia can be split in two periods, before and after 1995. Before 1995, in the 1980s and before, sponsored by the Colombian government and subsidized by it, without the requirement of financial and economic feasibility, most of the large hydropower plants in Colombia were constructed. This represented the stagnation of investment and policies that aimed to promote this type of projects. This also means in broad terms that hydropower plants in Colombia are old. Additionally, most of the hydropower plants in Colombia have an installed capacity much lower than Sogamoso Hydropower Project´s (874.8 MW). These two aspects can be seen in table 6.

For this reason the history of power generation projects in Colombia can be split in two periods, before and after 1995.

Before 1995:

The origins of Colombian Electrical System dates back to the end of the nineteenth century, when the first electric power companies were formed, mostly private. The decade of the thirties of the twentieth century were marked by increasing state intervention and, consequently, in 1938 power supply was declared as an essential public service, whereby the country and local entities cooperated in the development and funding of public entities.

The forties continued with the creation of regional entities with the participation of the Nation. evertheless, in the fifties the decentralization process started, which was enhanced with the creation of regional entities such as the Autonomous Regional Corporation of Cauca (1954) and the establishment of municipal entities like Empresas Públicas de Medellin (EEPPMM) (1955) and the Power Company of Bogotá (EEEB – 1959).

In the early sixties the major companies started negotiations in order to interconnect their systems, with the result of the creation of ISA in 1967. ISA set up a system that modified regional autonomy, with a higher level of technical integrated planning, both in investment programming and in the operation of existing systems.

In the nineties the public electric sector in Colombia had significant changes compared with its previous structure. Given the most intense and prolonged rationing in the country's history (rationing lasted from March 2, 1992 to April 1, 1993, with an unmet demand of 5183 GWh), the Government decided to increase thermal generation capacity, and linking the private sector in financing, construction and operation of new plants, by signing long term electric supply contracts.

Table 1 Operative large generation hydropower plants of National Interconnected System in Colombia

#	Company	Hydropower plant	Effective net capacity MW	Units (MW&#)	Year of commissioning	Municipality	Department
1	**CENTRAL HIDROELECTRICA DE CALDAS S.A. - CHEC -**	ESMERALDA	30.0	15*2	1963	Chinchiná	Caldas
2	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	TRONERAS	42.0	21*2	1965	Carolina	Antioquia
3	**EMPRESA DE ENERGÍA DEL PACÍFICO S.A - EPSA -**	PRADO	46.0	15*2+16*1	1973	Prado	Tolima
4	**CENTRAL HIDROELECTRICA DEL RIO ANCHICAYA S.A. E.S.P. - CHIDRAL -**	BAJO ANCHICAYÁ	74.0	13*2+24*2	1957	B/ventura	Valle
5	**EMPRESA DE ENERGÍA DEL PACÍFICO S.A - EPSA -**	CALIMA	132.0	33*4	1967	Calima (Darien)	Valle
6	**CENTRAL HIDROELECTRICA DE CALDAS S.A. - CHEC -**	SAN FRANCISCO	135.0	45*3	1969	Chinchiná	Caldas
7	**ISAGEN S.A.**	JAGUAS	170.0	85*2	1987	San Rafael	Antioquia
8	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	PLAYAS	201.0	67*3	1988	San Carlos	Antioquia
9	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	GUADALUPE IV	225.0	75*3	1985	Alejandría	Antioquia
10	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	GUADALUPE III	270.0	45*6	1966	Gómez Plata	Antioquia
11	**EMGESA S.A. E.S.P.**	PARAISO	276.0	92*3	1987	La Mesa	C/marca
12	**EMPRESA DE ENERGÍA DEL PACÍFICO S.A - EPSA -**	SALVAJINA	285.0	95*3	1985	Silvia	Cauca
13	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	LA TASAJERA	306.0	102*3	1994	Bello	Antioquia
14	**EMGESA S.A. E.S.P.**	LA GUACA	324.0	108*3	1987	La Mesa	C/marca
15	**URRÁ S.A. E.S.P.**	URRÁ	338.0	83*1+85*3	2000	Tierralta	Córdoba
16	**EMPRESA DE ENERGÍA DEL PACÍFICO S.A - EPSA -**	ALTO ANCHICAYÁ	355.0	115*1+120*2	1973	Buenaventura	Valle
17	**ISAGEN S.A.**	MIEL I	396.0	132*3	2002	Norcasia	Caldas
18	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	PORCE II	405.0	135*3	2001	Amalfi	Antioquia
19	**EMGESA S.A. E.S.P.**	BETANIA	540.0	180*3	1987	Yaguará	Huila
20	**EMPRESAS PÚBLICAS DE MEDELLÍN - EEPPM -**	GUATAPÉ	560.0	70*8	1980	Guatapé	Antioquia
21	**CHIVOR S.A.**	CHIVOR	1,000.0	125*8	1977-2001	Santa María	Boyacá
22	**EMGESA S.A. E.S.P.**	GUAVIO	1,200.0	240*5	1992	Ubalá	C/marca
23	**ISAGEN S.A.**	SAN CARLOS	1,240.0	155*8	1984	San Carlos	Antioquia

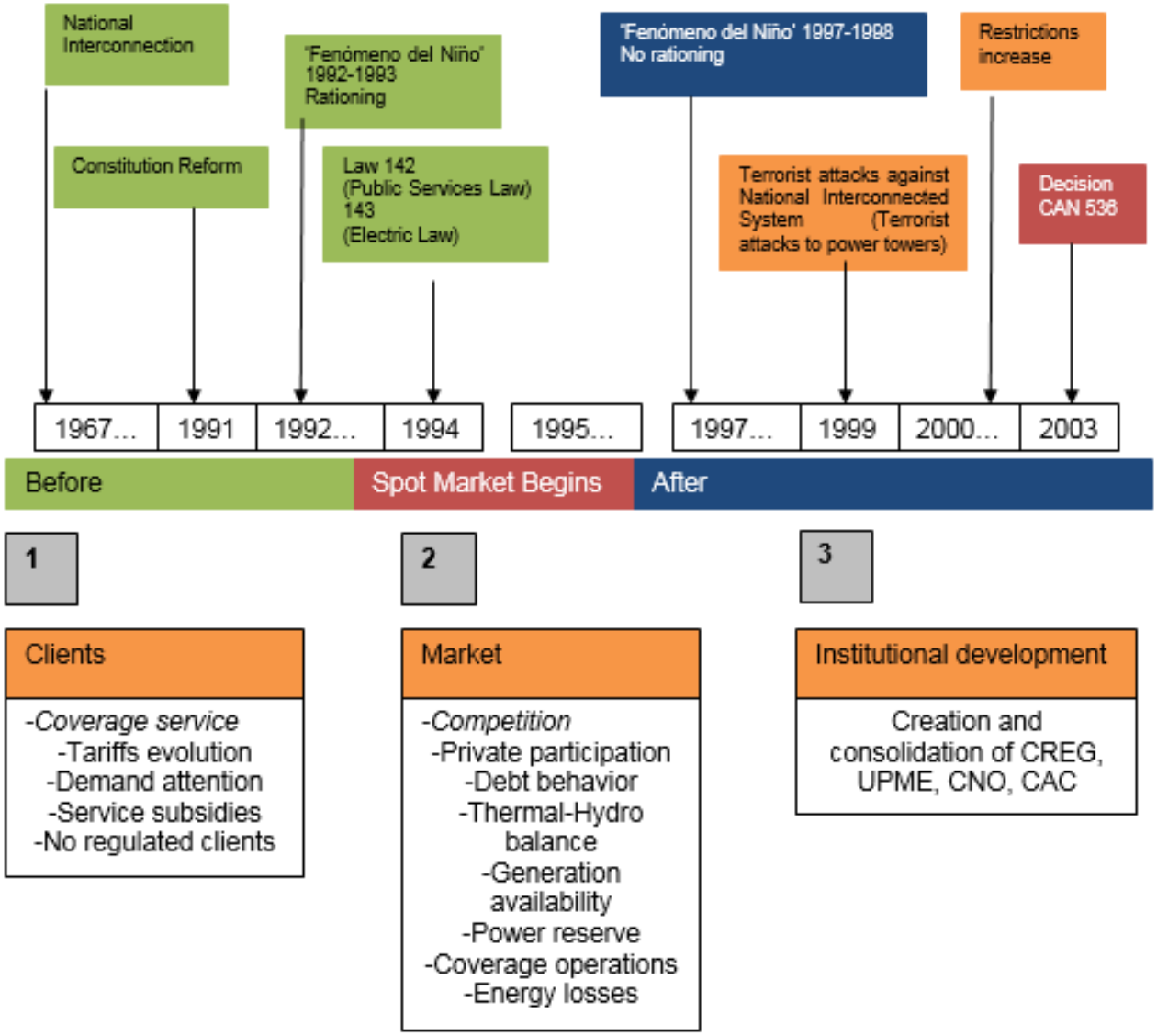
Source: CND - XM - UPME, table by PwC

Additionally, the 1991 new National Constitution and Laws of Public Services (142 1994) and Electric Law (143 of 1994) were the legal bases that changed the system and created the institutional and market order for the national electricity sector. Within the institutional changes, the most significant were the abandonment of the model of monopoly in electricity and allowing the participation of different economic agents, whether public, private or mixed, in the different activities of the sector, under the criteria of efficiency and strengthening the functions of the State in the regulation, surveillance, control and planning.

After 1995:

In July 1995 was created the Energy Exchange of Colombia, managed by ISA, giving way to competition and private participation. From late 1995 to early 2001 the private sector contribution in the activities of generation and distribution of electricity grew from 2% in 1994 to 62% in 1999. Taking the above into account, the year 1995 is observed as a critical change and the start of a new era for the Colombian energy system, which was restructured according to that indicated in the figure 10.

Figure 10 Colombian electricity system restructuring (Source: XM, made by PwC)



Under the new law (Electric Law of 1994) the state no longer funds projects of generation in the country, which since that time must be efficient and be able to compete in a market without the guarantee scheme and subsidies that the State gave them earlier. For this reason, the decision to build hydroelectric plants now presents difficulties not previously presented, which constitutes an

initial obstacle for these projects. Therefore, due to new market conditions which were created from 1995, the construction of new large hydropower plants does not represent common practice in Colombia.

The main differences of the Colombian electric sector between before 1995 and after 1995 can be seen in the following table.

Table 9 Characteristics of the Colombian electricity sector before and after 1995

BEFORE 1995	AFTER 1995
Low reliability	Reliable operation
State monopoly	Market (competition)
Minimum private investment	Large private investment
Direct subsidies by the state	No direct subsidies by the state; electric companies under their own financial risk
State as a business Company	State as a regulator
Users pay costs of inefficiency	Companies assume inefficiency
All activities: monopoly	Natural regulated monopolies

Source: Interconexión Eléctrica S.A. ISA: 10 years of Energy Exchange of Colombia, table by PwC

Evolution of installed capacity of the Colombian electrical system before and after 1995 and the common practice now During the period 1995-2008 it stands out the large increase of installed capacity of generation in the country (4.094 MW), of which the majority, 72 percent, were thermal additions. This demonstrates that construction of thermal power plants was the common practice from 1995. However, there were hydropower plants approved before that date, but commissioned afterwards. (see table 8 below) This situation demonstrates that despite the previous prevalent participation of the hydroelectric sector in power generation in Colombia, the new market conditions created from 1995 did not favor new hydroelectric projects. Therefore, the construction of new power plants based on water resources does not represent the common practice in Colombia.

Table 10 Addition of big power generation capacity in Colombia, 1995-2007

POWER PLANT (UNITS)	CAPACITY (MW)	TYPE OF POWER PLANT	YEAR OF COMMISSIONING
FLORES (2)	112	THERMAL	1996
TERMODORADA	51	THERMAL	1997
FLORES (3)	169	THERMAL	1998
MERILÉCTRICA	169	THERMAL	1998
TEBSA	791	THERMAL	1998
TERMOVALLE	205	THERMAL	1998

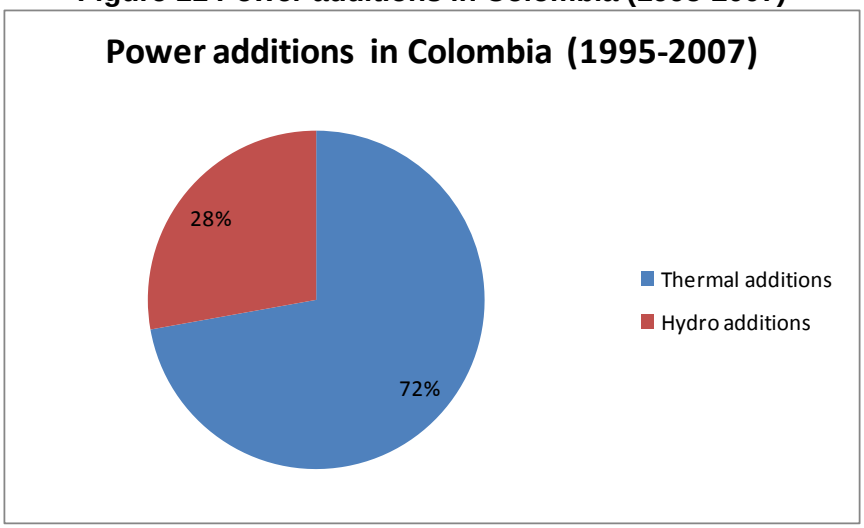
PAIPA (4)	150	THERMAL	1999
TERMOEMCALI	229	THERMAL	1999
TERMOCENTRO	280	THERMAL	2000
TERMOCANDELARIA (1,2)	314	THERMAL	2000
URRÁ	338	HYDRO	2000
PORCE II	405	HYDRO	2001
TERMOSIERRA	455	THERMAL	2001
MIEL I	396	HYDRO	2002
TERMOYOPAL (2)	30	THERMAL	2004
TOTAL	4,094		
HYDRO	28%		
THERMAL	72%		

Source CND- XM - UPME, table by PwC

The new conditions of the electricity market in Colombia originated in 1995 created uncertainty and insecurity for the development of new hydroelectric projects, which is demonstrated by table 8, which shows that since 1995 the expansion of projects has been reflected in 12 thermal power plants while the hydro expansion has been only three projects of installed capacity much lower than the Sogamoso Hydropower Project (see projects Urra, Porce II and Miel I in table 3).

During the period 1995-2007 commissioning of hydropower plants was a minority of the capacity expansion in Colombia compared to thermal power plants. (see Figure 11)

Figure 11 Power additions in Colombia (1995-2007)



Sub-step 4b: Discuss any similar Options that are occurring:
As it was developed the stepwise of the Sub-steb 4a, taking into account that the proposed project activity applies one measure that are listed in the definitions section of the Tool for the demonstration and assessment of additionality Version 07.0.0, this sub-step do not apply.

Result of analysis of step 4
The analysis of sub-step 4a demonstrates that the project is not a common practice in Colombia. Therefore, the Sogamoso Hydroelectric Project is not a common practice, thus the proposed project activity meets all the additionality requirements.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

According to the applied methodology ACM0002, version 16.0 project emissions shall be accounted for using the following equation:

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

Where:

PE_y	Project emissions in year y (tCO_2/yr)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y (tCO_2/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 above mentioned methodology, project emissions from fossil fuel consumption shall be accounted for in geothermal and solar thermal projects. Taking into consideration that the proposed project activity is a construction of a new hydroelectric plant that will not consume fossil fuels, $PE_{FF,y}$, is not taken into account.

As the proposed project activity does not consist in the operation of geothermal power plants it does not emit emissions due to the release of non-condensable gases, therefore $PE_{HP,y}$, is not taken into account.

According to the above mentioned methodology, the hydro power project activities that result in new reservoirs shall not account for CH_4 and CO_2 emissions from the reservoir when the plant's power density is greater than 10 W/m^2. As the power density of the Hydroelectric plant is greater than 10 W/m^2 (the power density of the project power plant is 12.70 W/m^2), $PE_{HP,y}$, is not taken into account.

The power density was calculated as follows:

$$PD = \frac{CAP_{PJ} - CAP_{BL}}{A_{PJ} - A_{BL}} = \frac{(874{,}800{,}000 - 0)\ W}{(68{,}864{,}864 - 0)\ m^2} = 12.70\ {}^{W}/_{m^2}$$

Where:

PD	Power density of the project activity (W/m^2)
CAP_{PJ}	Maximum total installed capacity of the hydro power plant after the implementation of the project activity (W), equaled to 874,800,000 W
CAP_{BL}	Installed capacity of the hydro power plant before the implementation of the project activity (W), equaled to zero as the constructed plant is new.

A_{PJ} Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2), equaled to 68,864,864 m^2

A_{BL} Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2), equaled to zero as the reservoir is new.

Baseline emissions

According to the applied methodology ACM0002, version 16.0, 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. Therefore the baseline emissions 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 (04.0.0) of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

As the project activity is the installation of a new Grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, therefore the 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* is equal to the quantity of net electricity generation supplied by the Project plant to the Grid in year *y:* $EG_{PJ,y} = EG_{facility,y}$

According to the above mentioned methodology the combined margin CO_2 emission factor for Grid connected power generation will be calculated using the version 04.0.0 of the "Tool to calculate the emission factor for an electricity system".

Calculation of the Grid emission factor

For the calculation of the National Grid combined margin emission factor the six steps approach was applied in conformity to the "Tool to calculate the emission factor for an electricity system", version 04.0, using the following official source of data:

☑ **National Dispatch Center (CND)**

Access to CND database "Neón" is available only upon registration on XM Company Webpage: http://www.xm.com.co.

Data used for the calculation:

- Hourly national electricity generation by plants/units[16] connected to the National Grid in kWh
- Hourly electricity bid price of plants/units connected to the National Grid in COP / kWh

☑ **Energy Mining Planning Unit (UPME)**

UPME publishes most of its data on its website http://www.upme.gov.co, which includes: Reference Energy and Mining Expansion Plans, Energy and Mine Statistics Bulletins, International Analysis of Electricity Prices, Colombian Electricity Market Magazine, among others. UPME is in charge of presenting the Indicative Expansion Plan for the energy sector, as well as support the requirement for information from the ministry and stakeholders.

Data used for the calculation:

- Power Plants emission factors in tCO_2e/MWh (or $kgCO_2/kWh$)
- Information of the year of commissioning of plants/units

Step 1: Identify the relevant electricity systems

Colombia´s Wholesale Electricity Market refers to the group of information exchange systems between generators and traders related to large power blocks in the National Interconnected System, in order to sign long term and spot contracts upon defined amounts and prices.

The geographical area of Colombia´s Wholesale Electricity Market is limited to the National Interconnected System, which is the system made up of the following elements connected with each other: power plants and generation equipment, the interconnection network, transmission lines, distribution networks and electric loads of users.

Sogamoso is planned to operate in Colombia´s Wholesale Electricity Market; therefore, the relevant electric power system of this step corresponds to the National Interconnected System.

Colombia´s Wholesale Electricity Market is regulated by the Resolution 024, 1995 of CREG.

Colombia's electricity market scheme is based on a uninodal conception in which the generators' bid price does not depend on the generators' physical location. The reason for the above is that the Colombia's electricity market is based on free competition, where generators are not concerned about power transmission, but rather the electricity market's competitiveness only.

All power plants connected to the National Interconnected System (the Grid) were taken into account. Please refer to the description of a national system given in Appendix 4 of the present document.

Step 2: Choose whether to include off-Grid power plants in the project electricity system (optional) Project participants choose Option 1 given in the "Tool to calculate the emission factor for an electricity system", version 04.0 for the calculation of the operating margin and built margin emission factor that indicates that only Grid power plants should be included in the calculation.

[16] Power plant/unit refers to a power plant/unit which is a facility for the generation of electric power. Several power units at one site comprise one power plant, whereby a power unit characterizes that it can be operated independently of the other power units at the same site. Where several identical power units (i.e. with the same capacity, age and efficiency) are installed at one site, they may be considered as one single power unit. ("Tool to calculate the emission factor for the electricity system", version 2)

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

For the calculation of the National Electricity Grid emission factor, a method of Dispatch Data Analysis conform to the "Tool to calculate the emission factor for an electricity system" version 04.0 was chosen given the access to the detailed hourly generation and hourly energy bidding prices of plants/units connected to the National Grid.

Dispatch Data Analysis is used, because Dispatch Merit is the way generation resources are hourly administrated in Colombia, under the administration of the company XM which has the functions corresponding to the Dispatch National Center.

The dispatch data analysis operating margin (OM) CO_2 emission factor in year y ($EF_{grid,OM-DD,y}$) was calculated using the Dispatch Data Analysis method (option c of step 3) described in the aforementioned tool. For the ex-ante calculation of the baseline CO_2 emissions, the most recent historical data (see the description below) of year 2008 (January 1, 2008 to December 31, 2008) was used for the purpose of calculating the OM CO_2 emission factor for the national electricity system of Colombia to be used for calculation of emission reductions in combination with the projection of the annual energy generation by the proposed project activity for its crediting period (December 1, 2013 to November 30,2020). As required by the methodology, for the Dispatch Data Analysis OM emission factor, it will be used the year in which the project activity actually displaces Grid electricity to update the emission factor annually during monitoring.

Step 4: Calculation of the operating margin emission factor according to the selected method
The dispatch data analysis operating margin (OM) CO_2 emission factor in year year y ($EF_{grid,OM-DD,y}$) is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} * EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	Dispatch Data Analysis operating margin (OM) 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)
$EF_{EL,DD,y}$	CO_2 emission factor for 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

During the crediting period the Dispatch Data Analysis OM CO_2 emission factor $EF_{grid,OM-DD,y}$ will be determined based on the power units that are actually dispatched at the margin during each hour h where the Project is displacing electricity.

The emission factor for grid power units in the top of the dispatch order is calculated as follows:

According to the "Tool to calculate the emission factor for an electricity system", version 04.0, if hourly fuel consumption data is not available, then the hourly emissions factor is determined using the following equation:

$$EF_{EL,DD,h} = \frac{\sum_n EG_{n,h} * EF_{EL,n,y}}{\sum_n EG_{n,h}}$$

Where:

$EF_{EL,DD,h}$	CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh)
$EG_{n,h}$	Net quantity of electricity generated and delivered to the Grid by power unit *n* in hour *h* (MWh)
$EF_{EL,n,y}$	CO_2 emission factor of grid power unit *n* in year *y* (tCO_2/MWh)
n	Grid power units in the top of the dispatch (as defined below)
h	Hours in year *y* in which the project activity is displacing Grid electricity (for the ex-ante calculation year 2008 was taken into account)

According to the "Tool to calculate the emission factor for an electricity system", version 04.0, the CO_2 emission factor of the grid power units *n* ($FE_{EL,n,y}$) should be determined as per the guidance for the simple OM, using the Options A1, A2 or A3. However, the Energy Mining Planning Unit of Colombia (UPME) has published the emission factors of each thermal power plant of the National Interconnected System, therefore, in our case is not necessary to apply to any of the aforementioned options.

For the calculation of the CO_2 emission factor of each grid power unit n in year y ($FE_{EL,n,y}$), emission factors of each power plant in Colombia using fossil fuels will be taken from information or documents from the Energy Mining Planning Unit (UPME.

Emission factor for net electricity imports of 0 tCO_2/MWh was used, as the imports come from connected electricity systems located in other countries.

The set of emission factors of each grid power unit n calculated ex-ante will be reviewed each year of the crediting period based on the official and publicly available data. For the year 2008, plant's emission factors (where available) were updated according to the information given by UPME.

For the calculation of the CO_2 emission factor for power units in the top of the dispatch merit order all power plants connected to the Grid were taken into account. Please refer to the description of the national electricity system given in Appendix 4.

The group of power units n in the dispatch margin corresponds to the units in the top 10% of the total electricity dispatched in each hour of the last year (from January 1 to December 31, 2008), or the quantity of electricity displaced by the project activity during hour h divided by the total electricity generation by grid power plants during that hour h (greater value will be chosen).

To determine the merit order of the plants for the ex-ante calculations of baseline emissions, the following information was obtained from the CND[17]:

- Electricity bid price of each Grid-connected plant in the last year (from January 1 to December 31, 2008).
- Amount of generated electricity[18] that was dispatched by every plant in the system during each hour of the last year (from January 1 to December 31, 2008).

[17] Division of XM (Web-page: www.xm.com.co)

[18] For ex-post determination of the merit order of the actual electricity generation will be used

For hour h, each plant's generation $EG_{n,h}$ was organized using the merit order. The set of plants n consists of those plants at the top of the stack (i.e. having the least merit), whose combined generation $\sum EG_{n,h}$ comprises 10% of the total generation from all plants during that hour or the quantity of electricity displaced by the project activity during hour h divided by the total electricity generation by grid power plants during that hour h (greater value will be chosen).

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. Project Participants has chosen Option 2, that is, "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 of the tool. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The sample group of power units *m* used to calculate the build margin was determined as per the following procedure, consistent with the tool:

(a) Identification of the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-units, in MWh);

(b) Determination of the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identification of the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET 20%) and determination of their annual electricity generation (AEGSET- 20%, in MWh);

(c) From SET5-units and SET 20% the set of power units that comprises the larger annual electricity generation was selected (SETsample).

Identification of the date when the power units in SETsample started to supply electricity to the grid.

None of the power units in SETsample started to supply electricity to the grid more than 10 years ago, then the SETsample was used to calculate the build margin.

For the calculation of the proposed Project baseline emissions, the sample group m that comprised 20% of the system generation for the year 2008 was used, because this represented the larger annual generation from these two options.

The build margin emissions factor is calculated as follows:

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

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)
$EF_{EL,m,y}$	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 electricity generation data is available

According to the "Tool to calculate the emission factor for an electricity system", version 04.0, the CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for y the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin. However, as explained in step 4, the Energy Mining Planning Unit of Colombia (UPME) has published the emission factors of each thermal power plant of the National Interconnected System, therefore, in our case is not necessary to apply to any of the aforementioned options.

To determine the quantity of electricity generated and delivered to the Grid by power unit *m* in year y for the ex-ante calculations of baseline emissions, the following information was obtained:

- Year of commissioning of each Grid-connected plant (from UPME)
- Amount of generated electricity that was dispatched by every power unit *m* during year 2008 (from CND)

For the calculation of the CO_2 emission factor of each grid power unit *m* in year y ($FE_{EL,m,y}$), emission factors of each power plant in Colombia using fossil fuels will be taken from information or documents from the Energy Mining Planning Unit (UPME).

Emission factor for net electricity imports of 0 tCO_2/MWh was used, as the imports come from connected electricity systems located in other countries.

The set of emission factors of each grid power unit *m* calculated ex-ante will be reviewed each year of the crediting period based on the official and publicly available data. For the year 2008, plant's emission factors (where available) were updated according to the information given by UPME.

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

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on the Weighted average CM method because the weighted average CM method (option A) should be used as the preferred option.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = W_{OM} * EF_{grid,OM,y} * W_{BM} * EF_{grid,BM,y}$$

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for the national electricity system in year y (tCO_2e/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)
W_{OM}	Weighting of operating margin emissions factor (%)
W_{BM}	Weighting of build margin emissions factor (%)

The weights W_{OM} and W_{BM} in equation quoted above have been given a default value of 0.5, according to the aforementioned tool. For more information on the calculation of the Grid emission factor, refer to Appendix 4.

Leakage

According to the applied methodology ACM0002, version 16.0, no leakage emissions ought to be considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). According to the above mentioned methodology, these emissions sources can be neglected

Emission reductions

According to the applied methodology ACM0002, version 16.0, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y	Emission reductions in year *y* (tCO_2e/yr)
BE_y	Baseline emissions in year *y* (tCO_2/yr)
PE_y	Project emissions in year y (tCO_2e/yr)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	Cap_{BL}
Data unit	MW
Description	Installed capacity of the hydro power plant before the implementation of the project activity
Source of data	Not applicable
Value(s) applied	Zero because the hydropower plant is new
Choice of data or Measurement methods and procedures	Not applicable
Purpose of data	Not applicable
Additional comment	Not applicable

Data / Parameter	A_{BL}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water before the implementation of the project activity, when the reservoir is full
Source of data	Not applicable
Value(s) applied	Zero because the hydropower plant is new
Choice of data or Measurement methods and procedures	Not applicable
Purpose of data	Not applicable

Additional comment	Not applicable

B.6.3. Ex ante calculation of emission reductions

Baseline emissions

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} = 5.056{,}000\ \frac{MWh}{yr} \times 0.2742\ \frac{tCO_2}{MWh} = 1{,}386{,}355\ \frac{tCO_2}{yr}$$

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* that equals to 5,056,000 MWh/yr

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for Grid-connected power generation in year *y* calculated using the version 4.0 of the "Tool to calculate the emission factor for an electricity system" that equals to 0.2742 tCO_2/MWh. For details on the calculation see Appendix 4.

Equations used for the calculation of Combined Margin CO_2 emission factor are presented in section B.6.1 of the present document.

For the period of January 1 to December 31 of 2008 the OM Emission Factor equaled to **0.3337 tCO_2/MWh**

For the year 2008 the BM CO_2 emission factor equaled to **0.2146 tCO_2/MWh**

For the period of January 1 to December 31 of 2008 the CM CO_2 Baseline Emission Factor (EF) equaled to **0.2742 tCO_2/MWh**

For more details on the calculation of the Grid emission factor refer to section B.6.1. of the presented document.

Project emissions

Project emissions PE_y in every year y of the crediting period are equaled to zero tCO_2/yr. For more information see section B.6.1.

Leakage

There is no leakage due to the project activity. For more information see section B.6.1.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2016	1,386,355	0	0	1,386,355
2017	1,386,355	0	0	1,386,355
2018	1,386,355	0	0	1,386,355
2019	1,386,355	0	0	1,386,355
2020	1,386,355	0	0	1,386,355
2021	1,386,355	0	0	1,386,355
2022	1,386,355	0	0	1,386,355
Total	**9,704,486**	0	0	**9,704,486**

Total number of crediting years	The first crediting period of 7 years is planned to start in January1st, 2016 and to finish in December 31, 2022 or at the time of the Project's registration, whichever is later.			
Annual average over the crediting period	1,386,355	0	0	1,386,355

B.7. Monitoring plan

According to Consolidated baseline methodology for Grid-connected electricity generation from renewable sources, ACM0002, version 16.0, the only data to be monitored during the crediting period will be the generated electric energy delivered by the Sogamoso Hydroelectric plant to the Grid. The generated electric energy will be measured continuously during the operation of the plant and throughout the crediting period. The measurement will be conducted by means of measurement systems installed in the substation interconnecting the plant with the Grid. The measurement system will have the function of getting, recording, transmission and storing of the data related to the variables involved in the electric energy measurement.

B.7.1. Data and parameters to be monitored

Data / Parameter	CAP_{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity (Maximum Installed Capacity of the hydro power plant)
Source of data	Project site
Value(s) applied	874,800,000 W
Measurement methods and procedures	This parameter is based on the generators' nameplate and the generator's guaranteed technical characteristics agreed with the manufacturer. This parameter will be followed up by checking the series model of the installed equipment and by checking that, when necessary replacing equipment, nameplate characteristics of the new equipment is equivalent to the nameplate characteristics of the equipment installed previously. Then, the new equipment will be followed up by checking its series model.
Monitoring frequency	At the beginning of each crediting period.
QA/QC procedures	The best way to assure the value of data of this parameter is by assuring that the equipment installed at the beginning of the Project will keep installed during the entire crediting period or, when necessary replacing equipment, the new equipment will have the same characteristics of the equipment replaced. The first aspect will be followed up by checking the series model of the installed equipment. The second aspect will be determined by checking the equipment characteristics in the nameplates of each new generator, and will be followed up by checking the series model of the new installed equipment.
Purpose of data	Calculation of project emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER's for this project activity, whichever occurs later.

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.
Value(s) applied	68,864,864
Measurement methods and procedures	Measured using bathymetry surveys
Monitoring frequency	At the beginning of each crediting period.
QA/QC procedures	The best way to assure the value of data of this parameter is by contracting the bathymetry survey service with a recognized company or entity.

Purpose of data	Calculation of project emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER's for this project activity, whichever occurs later.

Data / Parameter	$EG_{facility,y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the Project plant to the Grid in every hour of year *y*
Source of data	Continuous measurement by on site metering equipment at the power plant
Value(s) applied	5,056,000 MWh/year
Measurement methods and procedures	Directly measured by the metering systems installed at the approved commercial frontiers installed in the interconnection substation. The measurement will be conducted and recorded hourly and daily sent to the CND. The parameters quantity of electricity supplied to the grid by the Project and quantity of electricity supplied to the Project by the grid will be measured. For further details about measurement methods and procedures see section B.7.2. - Description of the monitoring plan.
Monitoring frequency	Continuous measurement and at least monthly recording (hourly recording indeed)
QA/QC procedures	ISAGEN's experience and know-how in the generation and commercialization fields will be applied to the Project measurement procedures. Wholesale Electricity Market has a system in which the records of all commercial transactions made within the market are archived. This database will serve to compare the records with the data provided by the Project. Meters will be calibrated according to the relevant standards or regulatory norms. In the same way, accuracy of meters will meet the requirements of standards and regulatory principles. Other way to guarantee QA/QC procedures will be taking into account maintenance processes. For more information see the explanation below.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/MWh
Description	Emission factor of the National Interconnected System (The Grid)
Source of data	Mathematical calculation that incorporates the parameters $EG_{n,h}$, $EG_{m,y}$, $EF_{EL,n/m,y}$ and Merit order, which are explained in the following tables
Value(s) applied	It varies by hour
Measurement methods and procedures	According to every parameter explained below
Monitoring frequency	Hourly
QA/QC procedures	According to every parameter explained below
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter	$EG_{n,h}$
Data unit	MWh

Description	Electricity generated and delivered to the Grid by power unit *n* in hour *h*
Source of data	Data supplied by the CND**¡Error! Marcador no definido.**
Value(s) applied	It varies by plant and hour
Measurement methods and procedures	The electricity generation from each power plant connected to the Grid will be monitored and sent to the CND by on site metering equipment at the substation of each power plant. This process is in charge of each power plant belonging to the group of power plants corresponding to this monitored parameter. In Colombia, The Measurement Code "Código de Medida" establishes mandatory high technical standards, conditions and procedures for reading, registering and recording activities for electricity transactions performed in the Colombian Energy Market. This code is part of the Resolution 025 of 1995 of the CREG, which is followed for electricity output measurements.
Monitoring frequency	Hourly
QA/QC procedures	All metering devices used to monitor and measure data follow certain rules that have been summarized in Resolution 025 of 1995 (Resolution 025 de 1995) from the CREG. This Resolution specifies the technical characteristics of measurement and telecommunications and back-up equipment to meet installation, testing, certification, operation and maintenance procedures specified.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter	$EG_{m,y}$
Unit	MWh
Description	Net quantity of electricity generated and delivered to the Grid by power unit *m* in year *y*
Source of data	Data supplied by the CND
Value(s) applied	It varies by plant and year
Measurement methods and procedures	The electricity generation from each power plant connected to the Grid will be monitored and sent to the CND by on site metering equipment at the substation of each power plant. This process is in charge of each power plant belonging to the group of power plants corresponding to this monitored parameter. In Colombia, The Measurement Code "Código de Medida" establishes mandatory high technical standards, conditions and procedures for reading, registering and recording activities for electricity transactions performed in the Colombian Energy Market. This code is part of the Resolution 025 of 1995 of the CREG, which is followed for electricity output measurements.
Monitoring frequency	Yearly
QA/QC procedures	All metering devices used to monitor and measure data follow certain rules that have been summarized in Resolution 025 of 1995 (Resolution 025 de 1995) from the CREG. This Resolution specifies the technical characteristics of measurement and telecommunications and back-up equipment to meet installation, testing, certification, operation and maintenance procedures specified.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter	$EF_{EL,n/m,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of power unit *n* or *m* in year *y*
Source of data	UPME
Value(s) applied	It varies by plant

Measurement methods and procedures	The set of factors calculated ex-ante will be reviewed each year of the crediting period based on the official and publicly available data. If necessary, in order to define the CO_2 emission factors of each power plant of the Grid during verifications, parameters like efficiency of each power plant, type of fuel consumed by each power plant, fuel consumed per power plant and net calorific value of each type of fuel will be acquired from official and publicly available sources. With the necessary parameters, CO_2 emission factor of power unit n or m will be calculated using the appropriate equations of the "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Yearly
QA/QC procedures	UPME, as an official entity follows high quality QA/QC methods on the data supplied to the public. Therefore the data are reliable.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter	Merit order
Unit	Not applicable
Description	Merit order of plants that generate energy to satisfy national hourly demand
Source of data	Data provided by the CND
Value(s) applied	The merit order varies hourly
Measurement methods and procedures	The merit order in the Colombian electricity market is being established using two variables: 1) the programmed electricity generation and 2) the bidding price of every unit connected to the National Grid. Under the SIN, the CND is responsible for managing and operating the SIN dispatch. The CND schedules the dispatch of generators by strict economic order, considering the need to satisfy the demand within the technical parameters of reliability and continuity defined by the CREG. The outcome is the hourly generation program for each power unit and the hourly marginal cost for the SIN (the cost of producing an additional kWh of energy in the system equals the highest operational cost of units in operations in a particular time). All monitored and collected data is subject to auditing and verification.
Monitoring frequency	Hourly
QA/QC procedures	The CND, as an official entity follows high quality QA/QC methods on the data supplied to the public. Therefore the data are reliable.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived during the whole crediting period and until two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

B.7.2. Sampling plan

Data and parameters monitored in section B.7.1 above are not to be determined by a sampling approach.

B.7.3. Other elements of monitoring plan

The monitoring plan defines procedures to measure emission reductions of greenhouse gases of Sogamoso hydropower plant that can be monitored and verified in conformity with the modalities and procedures of the Clean Development Mechanism criteria. The monitoring plan can be updated and/or modified whether changes in Clean Development Mechanism procedures so require.
The monitoring plan will be carried out entirely by ISAGEN.

The monitoring plan implements the necessary procedures to measure and to manage Project operations, in order to determine emission reductions in a transparent way and report them to the audit of independent third party verification.

The calculation of the emission reductions follows the guidance outlined in the ACM0002, version 16.0, "Consolidated baseline methodology for Grid-connected electricity generation from renewable sources".

The calculation of the emission reductions requires multiply annual Project electricity generation by displacement emission factor of the Grid of the respective year.

The calculation of annual Project electricity generation is explained below. The calculation of displacement emission factor of the Grid was explained in section B.6.1. This way, monitoring plan for Sogamoso CDM project will be focused on the following two topics:

i) Project electricity generation
ii) Displacement emission factor of the Grid

The explanation about these two topics is shown below:

i) Project electricity generation: Continuous measurement of net electricity generation supplied by the Project plant to the Grid by means of on-site metering equipment at the power plant.

Technical characteristics of measurement systems to be implemented in Sogamoso power plant will be in line with the provisions of the Resolution CREG 025 of 19957 or its modifications.

The measurement system will be able to measure the three-phase active energy and three-phase reactive energy by means of:

- Bidirectional electronic meters with double storing, no volatile memory or guaranteed feed, with accuracy class IEC 0.2 as stated by regulation entities according to the voltage and power flow in the power plant.
- Current and voltage transformers located in the approved commercial frontiers.

It is important to mention, that the meters are properly calibrated in Metrology Laboratories properly accredited by the Superintendence of Industry and Commerce of Colombia. Meters are sealed to ensure its calibration; additionally ISAGEN has a verification and re-calibration program of measuring equipment every two (2) years.

The measurement system will be able to receive, record and store data from the measurement devices. Likewise, the measurement system will be able to transmit through the communication system (using corresponding passwords) communication protocols, mistakes detection, and others.

Backup devices will have identical characteristics of main devices which will allow replacing them in case of failure and ensuring this way the measurement and recording continuity.

Obtained and registered data related to the energy measurement process will be transmitted to the Commercial Exchanges System Administrator (Administrador del Sistema de Intercambios Comerciales - ASIC per its initials in Spanish), a division of XM7 Company, which is in charge of the CND and Colombian Wholesale Electricity Market operations and its commercial administration.

Power transactions are registered every hour, in the first minute of each hour. Information recorded by the metering equipment is sent every 24 hours, before 8 am the recorded values of the day before, to the Commercial Exchange Administrator. According to that information provided in the same way by all generators agents, the CND processes the bills and payments for all transactions

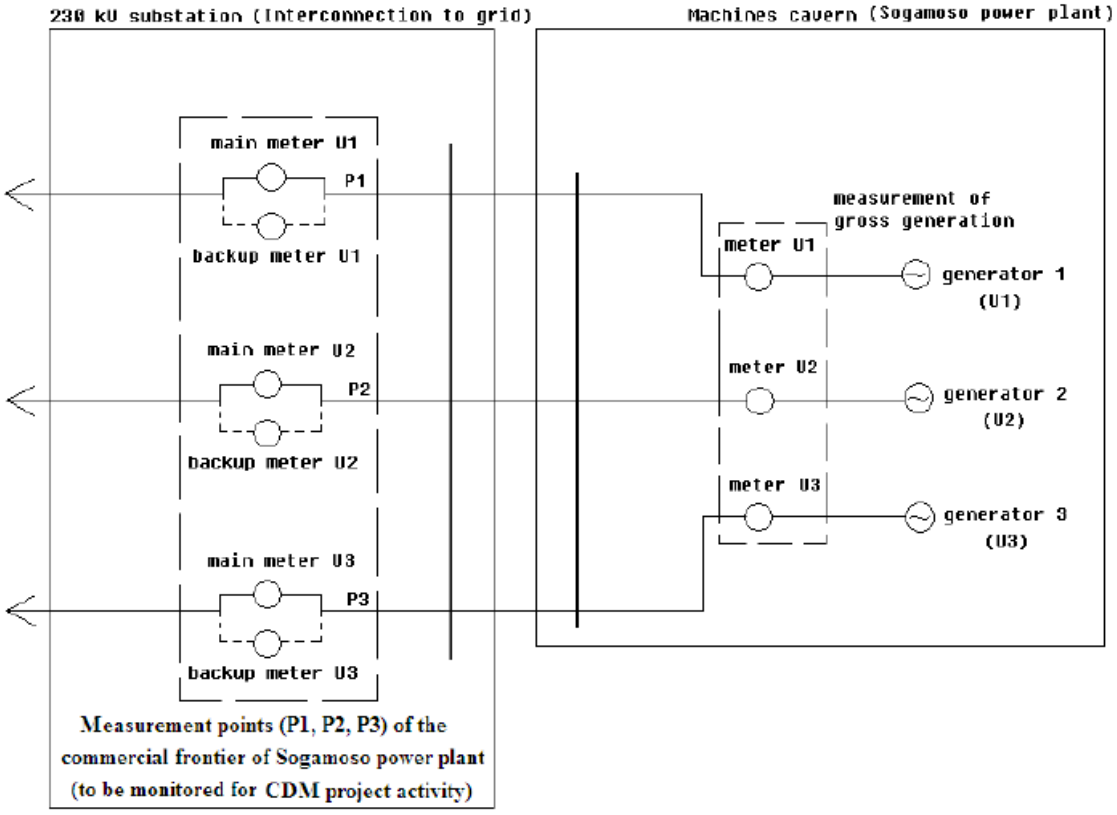
done in the Wholesale Electricity Market. All this information is available to the market agents and to control authorities.

Mentioned above is the current procedure based on the rules and on operating procedures of Wholesale Electricity Market, and may be changed if it is determined by the authorities or entities in charge of administration and control of Wholesale Electricity Market.

Finally, the information related to the electric energy generation of Sogamoso Power Plant will be uploaded and published by XM Company, in the same way for the other power plants of the Grid, by means of "Neón" database in the XM Company webpage. For confidentiality purposes, the release of information about hourly electricity bid price of plants/units connected to the National Grid is made available with a delay of 3 months.

The following figure presents the measurement points of the project activity: (note: the following diagram is indicative only; it does not represent voltage levels or protection systems in an exact way).

Figure 12 Measurement points of the project activity



Parameters involved in this part of monitoring plan (Project electricity generation):

$EG_{facility,h}$ (explained in section B.7.1.)

ii) Displacement emission factor of the Grid:

This topic consists in the calculation of the combined margin CO_2 emission factor for Gridconnected power generation using the latest version of the "Tool to calculate the emission factor for an electricity system", based on the CND database "Neón" and UPME as official sources of data.
The calculation of the Grid emission factor will be done according to the above section B.6.1. (Explanation of methodological choices).

Calculation of combined margin requires:

- Follow up of Electricity generated and delivered to the Grid by power units involved in operation margin
- Follow up of Electricity generated and delivered to the Grid by power units involved in build margin

Calculations of combined margin will require access to the CND database "Neón" which is available only upon registration on XM Company Web-page: http://www.xm.com.co.

The main data used for the calculation is:

- Hourly national electricity generation by plants/units connected to the National Grid in kWh
- Hourly electricity bid price of plants/units connected to the National Grid in COP/kWh

Plants emission factors in tCO_2e/MWh is also required for the calculation, which can be extracted from official information of UPME.

Parameters involved in this part of monitoring plan (Displacement emission factor of the Grid):

$EG_{n,h}$, $EG_{m,y}$, $EF_{EL,n/m,y}$ and **Merit order** (explained in section B.7.1.)

Operational and Management Structure for Monitoring Plan

ISAGEN has a multidisciplinary team, coordinated by the Production Management, who will be responsible for monitoring, recording and analyzing data related to the net electricity generation delivered to the Grid. As it was mentioned below, monitoring and recording data related to the net electricity generation delivered to the Grid is an established process, as the SIN relies on a highly regulated metering setup, which is required to make payments to the generators for electricity delivered by them. This means that for the CDM purposes, ISAGEN will continue with its normal activities for monitoring and recording electricity generation, but Production Management will keep additional copies of the hourly generation records that power plant dispatches to the Grid.

ISAGEN will incorporate or adapt to its internal procedures, activities related with the adequate management of the CDM monitoring system, specifying roles and responsibilities of those activities.

The metering system at ISAGEN for the Project is composed by software and hardware called PRIMEREAD that permits automatic recording of data collected at the meters. All data related to two directions power are measured so that net electricity delivered to the Grid are kept in file. For verification purposes, the data will be available at ISAGEN. Additionally, ISAGEN will have an electronic workbook, which will consist in a database to compile, specifically for the CDM project, all effectively dispatched electric power. The workbook will aggregate the data n different ways: daily, monthly and annual. The workbook will multiply the aggregate annual electric power by the ex-ante Grid emission factor in order to obtain the annual emission reductions required at verification.

ISAGEN's personnel involved in measurement of Project electricity generation:

Operation assistants in Sogamoso power plant, coordinated by the Production Management, will read, check and store electricity generation daily, and check the procedure of automatic data daily sending to Commercial Management of ISAGEN in Medellin and daily sending to CND.

Annual generation electricity data will be available at Commercial Management of ISAGEN in Medellin for monitoring purposes.

ISAGEN's personnel involved in calculations of displacement emission factor of the Grid:

Assistants of the Commercial Management of ISAGEN in Medellin will be willing to do this task either at the end of a year or when necessary data is publicly available or prior to monitoring visits for CDM purposes, according to procedures shown in section B.6.1. and part 2 of Appendix 4.

Calculations of displacement emission factor of the Grid will be available at Commercial Management of ISAGEN in Medellin for monitoring purposes. Commercial Management of ISAGEN in Medellin will use the electronic workbook in order to verify how the aggregate annual electric power is multiplied by the ex-ante Grid emission factor in order to obtain the annual emission reductions required at verification.

QA/QC aspects:

All ISAGEN's operating power plants are part of the following management systems: Quality Management System under ISO 9001, version 2008, the Environmental Management system under ISO 14001, version 2004, and Occupational Health and Safety Management System under OHSAS 18001, version 2007. Sogamoso power plant will be part of the same quality system.

Related to specific topics of monitoring plan, QA/QC aspects for taking into account are:

In case of interruptions in the transmission of the generated electric energy data, the operating staff in charge of the substation will make the opportune reading and transmission of generated electric energy data to the CND, according to conditions established by the CREG.

Before starting commercial exchanges in the Wholesale Electricity Market, measurement equipment will be certified by an entity accredited by the Superintendence of Industry and Trade according to the relevant Colombian regulation. ISAGEN will opportunely send the copy of equipment certifications tests to the CND.

Inspection, calibration and certification reports will be filed according to the company policies.
The main equipment contractors will have the responsibility of the theory and practice training of the ISAGEN's staff in order to operate the machinery in an adequate manner. The training will have a minimum of hours established with the contractor. ISAGEN staff will ensure the professional and technological personnel in the mechanic, electricity, electronics and instrumentation fields.

Other good practice carried out by ISAGEN to ensure the adequate performance of the measurement systems and the generation system is the proper maintenance system executed in the power plants, which will be explained in Appendix 5.

In this way, further details about monitoring plan and QA/QC aspects like maintenance system will be described in Appendix 5.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

27/07/2009

The Starting date of the proposed activity project is July 27, 2009 which corresponds to the date on which the contract for the main construction services for the Sogamoso Hydroelectric project was signed between ISAGEN S.A. E.S.P. and Grupo ICT S.A.S. (Contract No.46-3147).

According to the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM (Version 04), the Board decided that for project activities with a starting date on or after 2 August 2008, the project participant must inform a Host Party Designated National Authority (DNA) and the UNFCCC Secretariat in writing of the commencement of the project activity and of their

intention to seek CDM status; such notification must be made within six months of the project activity start date This is the only requirement for activity projects with a starting date on or after 2 August 2008, which is the case of Sogamoso Hydroelectric Project.

According to the above, on October 05, 2009 was sent the notification to the UNFCCC Secretariat and to the Host Party Designated National Authority (DNA; Ministry of Environment, Housing and Territorial Development of Colombia) about the CDM Prior Consideration of the Sogamoso Hydroelectric Project. In this way, the notification was sent within the six months of the project activity start date, as required by the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM (Version 04).

C.2. Expected operational lifetime of project activity

50 years 00 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period

C.3.2. Start date of crediting period

01/01/2016 or Registration date

The first crediting period is of 7 years and is planned to start on January 1st, 2016 or in case the date of registration is subsequent to the date January 1st, 2016- at the moment of the Project's registration.

C.3.3. Duration of crediting period

7 years 00 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

According to the Colombian Law (Decree 1220 of 2005 of the Ministry of Environment Housing and Territorial Development), a project activity that consists of the construction and operation of power generation plant with installed capacity equal to or greater than 100 MW, as it is the case of the Sogamoso Hydroelectric Project with 874.80MW of maximum total installed capacity, needs an environmental license (paragraph 4 of the Article 8 of the above mentioned Decree). In line with the requirement of the Article 20 of the above mentioned Decree, for the Project to be granted an environmental license, it is essential to elaborate and submit to the competent environmental authority an Environmental Impact Analysis (EIA). According to the Paragraph 4 of the Article 8 of the aforementioned Decree, the Ministry of Environment Housing and Territorial Development is the authority competent to award the environmental license to the proposed project activity. As for the above stated, the project participant elaborated the EIA for the Sogamoso Hydroelectric Project and submitted it to the thorough evaluation of the Ministry of Environment Housing and Territorial Development and subsequently, by means of the Resolution 0206 of 2009, was granted the pertinent environmental license. As per the indications of the Article 3 of the Decree no. 1220 of 2005, environmental license is an authorization for the implementation of a project, work or activity, and carries all the permits, authorizations and/or concessions for the use, development and/or impact on the renewable natural resources, that are necessary for the development and operation of the project, work or activity. In light of the above stated, the proposed project activity complies with the requirements of the Colombian law regarding both the elaboration of the EIA and obtaining an environmental license for the execution of the Project.

It is important to mention that to date the Project has the Environmental Compliance Report #1 for Access Roads Works, corresponding to the period March-August, 2009 according to the Resolution 206 of 2009 of Ministry of Environment, Housing and Territorial Development (MAVDT),

and the Environmental Compliance Report #1 for Main Works, corresponding to the period September 2009 – June 2010 according to the Resolution 1497 and 2329 of 2009 of Ministry of Environment, Housing and Territorial Development (MAVDT). Access Roads Works were required to submit the Environmental Compliance Report #2 as a Final Report to the environmental authority, which was submitted as a part of the Environmental Compliance Report #1 of Main Works, according to that provided in the environmental license of the Project.

The following table presents the summary of the key aspects based on the Environmental Impact Analysis of the Sogamoso Hydroelectric Project. For detailed information, the complete EIA is available for consultation. In order to supervise the activities stipulated in the Environmental Management Plan (EMP forms integral part of the EIA) and to verify the compliance with the obligations agreed in that Plan and approved by the Ministry of Environment Housing and Territorial Development (through the environmental license), the project participant will monitor the agreed parameters during the Project runtime by means of an independent environmental auditor.

According to the commitment made, this independent auditor will submit to the Ministry of Environment Housing and Territorial Development the following documents:

- Semi-annual reports during the construction phase of the Project which evaluate and consolidate information in a comprehensive manner in accordance with the commitments made by the project participant in the Environmental Management Plan and

A consolidated final report on the finalization of the construction phase of the Project.

ENVIRONMENTAL IMPACT	MONITORING, COMPENSATION OR RESTORATION ACTIVITY / PROGRAM INCLUDED IN THE ENVIRONMENTAL MANAGEMENT PLAN
Physical and biotic component	
Loss of vegetation due to the Project works Habitat loss, death and migration of animals Increased pressure on natural resources	- Environmental protection around the reservoir - Protection and preservation of protecting reserve areas in watersheds - Management of excess material from construction - Preliminary demarcation of intervention areas - Clearance (seeds and seedlings rescue - nurseries, banishing, wildlife rescue and relocation) - Storage and protection of soils - Environmental education: management of vegetation and wildlife
Sogamoso River flow regime alteration *The river flow regime will be affected on a monthly basis. During the summer periods natural flow will be slightly higher and during the rainy seasons slightly lower than the natural. Additionally, the varying water levels of river Sogamoso, San Silvestre and Deseo will affect water regimes of the El Llanito Marsh. The volume of sediments that enter with the Sogamoso River to the Llanito Marsh will reduce during the winters.*	- Rules for operation of central flow management ▪ Compatibility between power generation, fish and ecological dynamics requirements - Management of river communication system Sogamoso - El Llanito Marsh ▪ Implementation of the structures to avoid loss of water in the El Llanito marsh and to maintain the input of Sogamoso river waters (intake, conducting channel, discharge structure)

ENVIRONMENTAL IMPACT	MONITORING, COMPENSATION OR RESTORATION ACTIVITY / PROGRAM INCLUDED IN THE ENVIRONMENTAL MANAGEMENT PLAN
Loss or disturbance of soils. Enhancing processes of instability around the reservoir. *Nine active instable zones and 29 potential inactive zones were identified in the areas partially flooded or at the edge of the reservoir.*	- Adaptation of the reservoir basin ▪ Utilization of wood ▪ Rescue of seeds, seedlings (buffer zone) and wildlife - Protection and conservation of the terrestrial habitat - Establishment of areas of environmental protection around the reservoir: buffer zone. - Protection and preservation of protecting reserve areas in watersheds: Creeks El Ramo, Santa Maria, Chafarota, Putana, Golondrina y Aguamieluda, Cerro La Paz and Chucurí River tributaries. - Purchase of land with unstable regions for buffer zone
Pollution of the surface currents Alteration of the hydrobiological communities habitats	- Management of excess material from construction - Management of household and industrial liquid discharges and surface runoff - Management of garbage and common and special solid wastes - Protection and preservation of protecting reserve areas in watersheds

ENVIRONMENTAL IMPACT	MONITORING, COMPENSATION OR RESTORATION ACTIVITY / PROGRAM INCLUDED IN THE ENVIRONMENTAL MANAGEMENT PLAN
Morphological changes and degradation of Sogamoso riverbed downstream of the dam. Alteration of the fish productivity of lower Sogamoso River *The retention of sediment in the reservoir gives the erosive capacity to the turbinate water causing morphological changes in the river downstream of the dam area.*	- Protection of the Sogamoso River shores in the most vulnerable sites (populations of the Sogamoso Bridge and El Pedral) - Protection of the supports and central pier in the Sogamoso bridge, if required. - Implementation of a connection system Sogamoso River - El Llanito Marsh - San Silvestre River - Management of fisheries: ▪ Resettlement of the Sogamoso lower river species with the native species seeding and construction of the fishery station ▪ Development of the criteria for fisheries management in the lower river part during construction, filling and operation of the reservoir ▪ Coordination with the local authorities to adopt best practices for fisheries ▪ Improvement of the reproductive measures to control the affectation of the fish migration routes and to mitigate loss of spawning and growth ▪ Follow-up to identify and correct effects on the fishing, farming and other activities in the lower zones of the Sogamoso River
Potential air pollution and noise *The impact on the quality of air is expected in the Project work zone due to the operation of the crushing plant, use of dynamite, concrete plants, transit and heavy equipment operation. The cones of the polluted air dispersion will depend on the speed and direction of winds.*	- Management of the atmospheric component (air quality, noise levels) - Management of the excess material from construction works
Social component	

ENVIRONMENTAL IMPACT	MONITORING, COMPENSATION OR RESTORATION ACTIVITY / PROGRAM INCLUDED IN THE ENVIRONMENTAL MANAGEMENT PLAN
Involuntary transfer of population due to the Project construction *The involuntary transfer might affect 283 families made up of 1199 people*	- Program for the restoration of living conditions for the population to move ▪ Resettlement to housing, land restitution and production projects ▪ Relocation of homes and families on the same site ▪ Purchase of land and improvements - Program for the restoration of economic activities
Alteration of regional and local economy by affecting agricultural production *The population will be affected in the areas required by the Project (major works, access roads, alternate pathways, reservoir, instable and protected areas) and downstream areas affected by the operation of the Project .*	- Program for the restoration of living conditions for the population to move - Program for the labor incorporation - The Project is expected to increase the value of agricultural production by up to 40 percent - The region will receive annually an estimated value of 16,600 million Colombian pesos for Transfers by Law
Alteration of the downstream Sogamoso River ecosystem services *At present about 1010 households are directly related to the river Sogamoso, 90% of them depend to some degree of fishing and 10% are permanently or together with other activities engaged in agriculture in edges, shores and island.*	With fishermen - Support to the consolidation of the artisanal fishermen organizational process in each sector and across the lowlands - Training and knowledge of the anticipated technical and biotic managements - Definition of the actions to take in order to attain the goals of technical and biotic managements - Employment in the development of the downstream management activities With farmers - Monitoring of the activities of farmers in meadows, riverbanks, borders and islands during construction and early years of the operation of the Project - Assessment of the soil quality along the edges, shores, borders and islands with different samples in areas where agricultural activities are carried out during the construction and operation of the Project - Design and establishment of a signaling and monitoring system to prevent possible risks for the users of the Sogamoso River and the El Llanito Marsh

ENVIRONMENTAL IMPACT	MONITORING, COMPENSATION OR RESTORATION ACTIVITY / PROGRAM INCLUDED IN THE ENVIRONMENTAL MANAGEMENT PLAN
Changes in land use planning *The territories of the municipalities Betulia, Giron, Lebrija, Los Santos, San Vicente de Chucuri and Zapatoca will be affected. They contribute to the Project with a total area of 10,442.5 ha.*	- Institutional strengthening - Review and reformulation of the municipal Territorial Planning Schemes and/or Territorial Planning Basic Plans that present significant changes - Prevention of the migration of the villages adjacent to the Project work centers - Information and community participation
Generation of conflicts and expectations in the population located in the neighborhoods of the Project influence area	- Information and community participation program. - Environmental education program
Migration pressure on the population close to the Project work centers	- Actions to inform about the Project and employment management that gives priority to personnel in the region - Strengthening the community participation to promote the adequate incorporation of the changes that occur in the area - Promotion and preventive health measures, particularly in relation to risks associated with the Project activities - Follow up and monitoring of the immigration processes to the inhabited areas and municipalities adjacent to the Project works - Strengthening of the health services and prevention of the risks in the Project influence area. ▪ Inventory of insects that transmit diseases such as chagas, lehismaniasis, malaria and dengue. ▪ Information and education campaigns in coordination with local authorities ▪ Adaptation of some health posts in coordination with local administrations - Risks prevention and control: signaling, disaster response system
Infrastructure alterations due to the Project construction	- Replacement of the road infrastructure in the affected stretches - Replacement of schools (Zapatoca, Giron and Betulia) - Replacement of the transmission lines in the affected stretches

D.2. Environmental impact assessment

With the activities and programs for the monitoring, compensation and/or restoration of the identified Project environmental impacts, established by the project participant and approved by the pertinent national and local environmental authorities through the environmental license - Resolution 0206 de 2009 and considering the contribution of the Project to sustainable development of the local and national area, the Project is expected to have an overall positive impact on the local and global environment. Mitigation measures will ensure that there are no significant residual impacts associated to the Project.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Sogamoso Hydroelectric Project is located in the Department of Santander, the dam and its reservoir is located in jurisdiction of the municipalities of Girón, Betulia, Zapatoca, Los Santos and San Vicente de Chucurí, in the Department of Santander. The Project's area of influence extends into the lower Sogamoso River area, until it flows into the Magdalena River.

ISAGEN through meetings presented the scope of Sogamoso Hydroelectric Project to the municipalities in the area of influence, these municipalities were: Betulia, Giron, Zapatoca Lebrija, San Vicente de Chucuri, Sabana de Torres, Barrancabermeja, Puerto Wilches and Saints. About 1500 people attended the meetings, which addressed issues related to employment management, relocation of families, the negotiation of land, alternative routes, weather conditions around the reservoir and programs about fishery resource, among others. Additionally, conducted a workshop led by Governor of Santander, the Sogamoso Project Monitoring Committee and ISAGEN.

The Ombudsman's Office (Regional Santander) followed up the meetings conducted by ISAGEN, local authorities also participated, municipality of Betulia, the Development and Peace in Magdalena Medio Program, municipal representatives, various social organizations, leaders of Communal Action Boards and the wider community.

Sogamoso Hydroelectric Project, owned by ISAGEN which is an environmentally and socially responsible Company, follows and incorporates strategic principles, criteria and guidelines established by the World Commission on Dams about policies and corporate expressions of social responsibility. Considering the strategic principles, Sogamoso Hydroelectric Project has achieved public citizen acceptance, has conducted a comprehensive assessment of options and assessed the impacts of Project construction; the Company works towards the conservation of rivers and media subsistence of the population affected by the Project, acknowledges the rights and benefits of population in the area of direct and indirect influence, ensures compliance with both environmental and social obligations and ensures the proper management of water resources among the municipalities affected by the Project. Therefore Sogamoso Hydroelectric Project follows and incorporates each of the strategic principles, criteria and guidelines established by the World Commission on Dams.

To demonstrate the mentioned above, ISAGEN, by means of PwC, contracted with the Spanish Association of Standardization and Certification the official validation of the Compliance Report of the strategic principles, criteria and guidelines established by the World Commission on Dams related with the Sogamoso Hydroelectric Project.

The Sogamoso Project follows and incorporates the totality of each of the strategic principles, criteria and guidelines established by the World Commission on Dams, except those items that are not applicable to the Sogamoso's Dam because the basin is not shared with riverside Countries or States. The strategic principles, criteria and guidelines established by the World Commission on Dams that are followed and incorporated by the Sogamoso Project are indicated below:

- Acceptance by the community

Acknowledgment of rights and risk assessment (basis for the identification and inclusion of the participants in the decision making process on the development of energy and water resources)

All participants have access to the information and to the legal support or otherwise, particularly indigenous and tribal communities, as well as women and other vulnerable groups, in order to enable their reported participation in the decision making processes

Public proven acceptance of all key decisions is achieved by means of negotiated agreements in an open and transparent process, performed in good faith and with the reported involvement of all participants

Decisions on the projects affecting indigenous and tribal communities are guided by their willing, prior and reported consent, obtained by means of both informal and formal representative entities

- Complete assessment options

Development needs and objectives are clearly stated by means of an open and participative process prior to identification and assessment of the options for the development of water and energy resources

Approaches to planning that consider all ranges of development objectives used for the evaluation of all political, institutional, managerial and technical options prior to making the decision to proceed with any program or project

Social and environmental issues receive the same importance as the technical, economic and financial factors for the assessment of options.

The option assessment process gives priority to the ways to increase efficiency and sustainability of the existing water, irrigation and energy systems.

When a dam is chosen by means of such complete process of options assessment, the social and environmental principles are applied in the review and selection

- Addressing the existing DAMS

A complete monitoring and evaluation process following the project, and a system for regular long-term reviews of performance, benefits and impacts for all the major existing dams is introduced.

Programs to restore, improve and optimize benefits for the existing major dams are identified and executed. The options to be considered include overhauling, streamlining and upgrading equipment and facilities, optimize operations of the dam and introduce non-structural measures to improve efficiency in the rendering and usage of services.

Outstanding social situations associated with major existing dams are identified and assessed; remediation processes and mechanisms are carried out with the affected communities

Efficiency of the existing environmental mitigation measures are assessed and the foreseen impacts are identified; opportunities for mitigation, restoration and improvement are identified and acted upon.

All major dams have formalized their operation agreements with licenses for limited time periods; when re-planning or re-licensing processes indicate that significant physical changes in the facilities or even rendering it inactive could be convenient, a complete feasibility study is performed, assessing environmental and social impacts

- Sustaining rivers and living

A global understanding of the whole basin with respect to the functions, values and requirements of the ecosystem and how the community depends upon it and influences it to make a living is a requirement prior to make decisions on the options in terms of development.

Decisions value ecosystems and social and health situations as an integral part of the project's development and of the water basin, as they prioritize ways to avoid impacts following a precautionary approach

A national policy is established to maintain the selected rivers with high functionality and value of ecosystems in their natural state. When reviewing alternative locations for dams in rivers not yet developed, priority is given to locations in the affluent areas.

Projects that avoid significant impacts for threatened or endangered species are selected. When impacts cannot be avoided, viable compensation measures shall be implemented to produce a clear advancement for the species within the region.

Major dams shall foresee release of environmental flows to help maintain the integrity of ecosystems and sustainability of downstream communities as they shall be designed, modified and operated with those objectives.

- Recognition of rights

The recognition of rights and diagnosis of risks are the basis to identify and include the actors adversely affected in the joint negotiations on mitigation, resettlement and development-related decisions

The assessment of impacts include all people in the areas of the dam, upstream and downstream, whose assets, vital resources and non-material valuables are affected. It also includes the people affected by the infrastructure related with the dam such as channels, transmission lines and development of the sites for resettlement.

All people acknowledged as adversely affected make negotiations of the rights by joint, formal and legally enforceable agreements regarding mitigation, resettlement and development.

It is worth recognizing that people adversely affected are the first beneficiaries of the project. Joint agreement mechanisms with legal protection are negotiated in order to share the benefits and ensuring their actual application.

- Ensure compliance

A clear, consistent and common set of criteria and guidelines to ensure compliance is adopted among promoting, contracting and financial institutions; compliance is subject to an independent and transparent review.

A Compliance Plan is prepared for each project prior to its commencement, outlining how to achieve compliance with appropriate criteria and guidelines and specifying binding schemes for the technical, economic, social and environmental commitments related to each individual project.

Costs to establish the compliance mechanisms and the related institutional capacity, along with its effective application, are incorporated in the budget for the project.

Corruption is avoided by applying the legislation, voluntary integrity agreements, disbarment (lawyers, judges, etc.) and other instruments.

Public and private financial institutions develop incentives that compensate proponents of projects for their compliance with criteria and guidelines.

- Sharing rivers for peace

In order to carry out projects in shared rivers among political units within one single country, the necessary legal provisions at national and sectional levels shall be set forth in order to incorporate the Commission's strategic priorities: “achieve acceptance by the community”, “recognize rights”, and “sustain rivers and living-support activities”

Considering the area of Project influence, on November 13, 2009 there was held a forum about: Hydropower, Sustainable Development, organized by the International Hydropower Association, ISAGEN S.A E.S.P., Fundación Natura – Colombia and PricewaterhouseCoopers –PwC-. In forum, ISAGEN S.A E.S.P presented to the participants the Hydroelectric Sogamoso Project structure within the framework of Clean Development Mechanism (CDM).

ISAGEN organized the logistics of the forum and sent 280 letter invitations through the companies Colombia Express and Servicios Postales de Colombia 472. A press release was published in a high circulation Departmental newspaper call “El Barranqueño, edition No.77” and on November 9, 2009 the invitation was published on the website www.isagen.com.co.

In that way, Invitation letters were sent to representative leaders of the Ministry of Environment, Housing and Territorial Development, environmental authorities of Santander, technical research institutes, mayors, ombudsmen, municipal councilors and leaders of the Department of Santander, presidents, vice presidents and directors of associations, corporations, foundations, cooperatives and NGOs in the municipalities in the area of influence; rectors and directors of universities, religious communities, public corporations, private companies and local media; and their assistance was confirmed by phone.

The Forum was held in the auditorium Gustavo Liévano Fonseca of the Cámara de Comercio de Bucaramanga with the following agenda and three Power Point presentations, followed by a questions and comments session:

- Presentation of the Sogamoso CDM Project by general manager of ISAGEN S.A E.S.P.
- Presentation: Hydropower, Sustainable Development by the International Hydropower Association
- Presentation: Climate change and the Sogamoso Hydroelectric Project under the Clean Development Mechanism (CDM) by PricewaterhouseCoopers (PwC) – Colombia
- Presentation: Carbon Zero in municipalities, a new strategy for the integrated management of climate change in Colombia by the Fundación Natura – Colombia
- Answer to questions and receptions comments to the Sogamoso Hydroelectric Project

The guests and attendance list was as follows:

Table 2 List of entities and attendees to the forum

Assistant	Entity
Governmental entities	
Horacio Serpa Uribe	Governor of Santander
José Nelson Mejía	Government of Santander (Gobernación de Santander)
Liliana Díaz	
Lucy Pabón	Ombudsman's (Defensoría del pueblo)
Eddy Ortíz	San Alonso Environment (Medio Ambiente San Alonso)
Ricardo Vergel	Veedurías Association of Metropolitan Area of Bucaramanga -ASOVEMEB – (Asociación de Veedurías del Área Metropolitana de Bucaramanga)
Fanny Melgarejo	Community Action Board (Junta de Acción Comunal)
Luis Ernesto Ortiz	National Learning Service –SENA- (Servicio Nacional de Aprendizaje)
Jasmilly Benavides	National Parks of Colombia (Parques Nacionales de Colombia)

Assistant	Entity
Gustavo Herrera	Hidrosogamoso´s Departmental Committee (Comité Departamental Hidrosogamoso)
Sonia León Nuñez	Betulia´s Council
Environmental authorities	
Helkin Chaparro	Environmental Authority of Bucaramanga (Corporación Autónoma Regional para la Defensa de la Meseta de Bucaramanga)
Horacio Mantilla	
Rafael Villabona Castillo	
Hernando Solano	
Nelson González	
Alexis Lizarazo	
Mercedes Camargo	
Diego Camacho	
Technical research institutes	
Refaat Malek	International Hydropower Association
Academy	
Oswaldo Martínez	Industrial University of Santander (Universidad Industrial de Santander –UIS-)
Janneth Ordúz	
Ligia Patricia Arenas	
Carlos Ríos	
Alberto García	National Open University and Distance -UNAD (Universidad Nacional Abierta y a Distancia UNAD, Bucaramanga)
Luz Emilia Jiménez	Autonomous University of Bucaramanga (Universidad Autónoma de Bucaramanga)
Germán Oliveros	
Rafael Ortíz	Pontificia Bolivariana University of Bucaramanga (Universidad Pontificia Bolivariana de Bucaramanga)
José David Ávila	
Public corporations	
Eliseo Osorio	Bucaramanga´s Metropolitan Aqueduct (Acueducto Metropolitano de Bucaramanga)
Erica Solano Ramos	
Wilson Pérez	Services Enterprises Agricultural Technicians - EPSAGRO - (Empresas Prestadoras de Servicios Técnicos Agropecuarios)
Private companies	
Augusto Martínez	Chamber of Commerce of Bucaramanga - Competitive Santander (Cámara de Comercio de Bucaramanga – Santander Competitiva-)
Camilo Gómez	PricewaterhouseCoopers (PwC)– Colombia
Sergio Salas	
Luis Carlos López	Oasis Dump (Escombrera Oasis)
Diana Smith López	Rincón López Ltda
José Gutiérrez	Piasa
Xiomara Cárdenas	Promisión S.A
Alberto Marulanda	Ingetec S.A
Claudia Torres	Ingetec S.A
Mario Gómez Díaz	PRODIMPORT
Juan Manuel Ramírez	Colidesar
Oscar Zambrano	Colidesar
José Luis González	Electromechanical Ensembles (Ensambles Electromecánicos)
Álvaro Domínguez	
Mixed company (public and private)	
Luis Fernando Rico	ISAGEN
Hernando Salazar	
Alfonso Salazar	
Claudia Álvarez	
José Lino Jurado	
Luis Alberto Posada	
Jorge Correa	
Oscar Cifuentes	
Diana Salazar Ortíz	Public Companies of Medellín –EPM- (Empresas Públicas de Medellín)
Jaime Aramburo	
Local media	
Gabriel Galvis	Barranqueño Newspaper (periódico el barranqueño)
Nancy Celis	Telesantander
María Isabel Sánchez	La República Newspaper (Diario La República)
Diana Delgio	Argus Medio
Nongovernmental organization, associations, corporations, foundations and cooperatives	
Joerg Hartmann	WWF - Dams Initiative
Elsa Matilde Escobar	Natura´s foundation (Fundación natura)
Abelardo Granados	Environmentalists Santander (Ambientalistas Santander)
César Castellanos	Biomas

Assistant	Entity
Ernesto Olave	Agricultural Society (Sociedad de Agricultores)
Marly Peña Mora	COMFORTA -Workers Association for Strengthening Competitiveness Colombiana (Comforta - Asociación de Trabajadores para el Fortalecimiento de la Competitividad Colombiana)
Carlos Julio Durán	Associate and professionals (Profesionales y asociados)
Emilio Valencia Gopor	
Luis Dalmiro Torres	Bonita Water Corporation (Corporación Agua Bonita)
Fadeth Cecilia Hernández	I am, foundation (Fundación Yo Soy)
Luis Feo Chaparro	Re- useful Team (Equipo Re-Útil)
Laura Cabrera	GEA Foundation (Fundación GEA)
Jairo Contreras	
Vicente Otero	Foundation Eco-efficiency (Corporación Eco-eficiencia)
Jairo Gómez	Asocicampo
Fernando Sarmiento	New Seed foundation (Fundación Semilla Nueva)
Roy Antolinez	
Ciro Alfonso Báez	FUNDACOL Foundation (Fundación Fundacol)
Salomón Hasbón	Sicuara Foundation (Fundación Sicuara)
Romualdo Vásquez	Equilibrium, Environmental Corporation (Corporación ambiental Equilibrio)
Libia María Caro	Santander´s Farmers Society (Sociedad de Agricultores de Santander)
Isnardo López	Live Action Corporation (Corporación Acción Viva)
Fernado Fajardo	FUDESCOL
Others	
Carlos Castro	Agronomist
Paola Borrero	
Jacqueline Carrillo	Consultant

Some Pictures from the Forum: Hydroelectricity, Sustainable Development on November 13, 2009 are present below.

Presentation of the Sogamoso CDM Project by Luis Fernando Rico, general manager of ISAGEN S.A E.S.P.

Presentation: Carbon Zero in municipalities, a new strategy for the integrated management of climate change in Colombia by Elsa Matilde Escobar, Executive director of Fundación Natura – Colombia

From left to right: Reefat Abdel-Malek (President of the International Hydropower Association), Luis Fernando Rico (General manager of ISAGEN S.A E.S.P.), Horacio Serpa Uribe (Governor of the Department of Santander), Elsa Matilde Escobar (Executive director of Fundación Natura), Sergio Salas (manager climate change of PWC), IHA Assessor.

Stakeholder doing questions about the project

E.2. Summary of comments received

The last section of the forum was reserved for questions from the audience, and the answers and clarifications from the speakers.

The following are, in a synthetic way, the answers given by Mr. Sergio Salas to each of the queries directed to him relating to his presentation:

Question 1: Since hydropower is an industry without smokestacks, it is clear that offers low impact on climate change. It is possible to say that the other threats such as physical alteration of thousands of hectares of river basin justify hydropower as "sustainable development"? or perhaps the phrase "hydropower, sustainable development" refers only to an industry that is economically viable?

Directed to: Sergio Salas

Question 2: It is the CDM project a smokescreen?

Directed to: Sergio Salas

Answer (1 and 2): The generation of electricity from water, is well regarded as a source of sustainable development, because it is viable in terms of environmental, social and economic.

While it is true that the areas flooded by reservoirs represent an environmental impact on flora and fauna, this impact can be fully compensated.

In the specific case of Sogamoso Hydroelectric Project, it has all required environmental licences, which are issued by the Ministry of Environment, Housing and Territorial Development, after conducting an exhaustive review of environmental impacts generated by the Project and its plans mitigation and compensation, presented by ISAGEN within its Environmental Management Plan.

Question 3: Is Colombia receiving compensation payments for non-emission today?

Directed: Sergio Salas

Answer: Yes, in Colombia there are currently several projects that have already been registered at the UNFCCC Executive Board that are generating Certified Emission Reduction (CER) and some of them are receiving economic benefits from that concept. As an example, As an example, it is possible to quote Jepirachi Windfarm, located in the Department of La Guajira and which was the first CDM project in the country, as well as two projects of EMCALI, the mass transportation system 'Transmilenio'. In terms of hydroelectric projects, Colombia has registered the projects called: Fresh Water, Santa Ana, La Cascada among others.

Moreover, in the international arena, are highlighted hydroelectric projects such as: Youshuishiti and Jorethang Loop, India, Jiajiang Qianfoyan Nansha and Sichuan, China, among others.

Question 4: Which would be the date for Hidrosogamoso to be ratified as MDL?

Directed to: Sergio Salas

Answer: It is expected to start the validation process and national approval in December 2009, to finally get registration in approximately May 2010.

Question 5: What is the weight (volume) of methane generated by Sogamoso following the removal of vegetation and the reservoir level changes?

Directed to: Sergio Salas

Answer: In accordance with the methodology established and adopted by the United Nations Framework Convention on Climate Change (UNFCCC), which in the case of Sogamoso Hydroelectric Project is the ACM0002 version 13.0.0, the Greenhouse Gas Emissions (GHG) generated in reservoirs must be measured and deducted only in those cases in which the power density of the hydroelectric power plant is less than 10 W/m^2. In the specific case of Sogamoso Hydroelectric Project, the power density amounts to 12.70 W/m^2, which is why GHG emissions of the Project can be considered negligible.

Question 6: According to Ministry of Environment, Housing and Territorial Development, Fonce river is one of the 4 most contaminated of Colombia and this goes to Sogamoso rivers, so what happens with methane?

Directed to: Sergio Salas

Answer: Methane is formed by anaerobic decomposition of organic matter. If amounts of air could be 'injected' into the reservoir, it could switch from anaerobic to aerobic conditions, so the formation of methane is avoided. Given that hydroelectric projects the water is discharged through turbines and tunnels, these processes encourage 'the air injection', which improves characteristics of oxidation of organic matter, without generation of methane.

Question 7: It is possible for Hydroelectric Sogamoso to access to CER's benefits taking into account that this construction requires large amounts of concrete, and is well known that the production of cement emits large amounts of CO2, coupled with the large use of machinery that need fossil fuels?

Directed to: Sergio Salas

Answer: Although the UNFCCC methodology for these projects does not cover the emission estimate for this concept, ISAGEN currently develops a project for measuring and offsetting its carbon footprint, which have been considered various aspects, including this.

Upon conclusion of the answers given by Mr. Salas to the questions that were made by various participants, Dr. Luis Fernando Rico (General Manager of ISAGEN) spoke briefly commenting that Sogamoso Hydroelectric Project is a coordinating body for whole area of influence, which may allow to develop strategies for sustainability, climate change mitigation, articulated properly to the actions of municipal authorities and the Department of Santander, in order to create projects such as reforestation, which contribute to the offsetting of carbon footprint emitted by them, and also the implementation of projects aimed to generate employment (direct and indirect), social contributions to the community that benefit the general population, according to sustainability policies that are part of the daily actions of ISAGEN.

E.3. Consideration of comments received

Clarifying explanations were provided to the meeting attendants with regard to the matters expressed in the comments and inquiries received. There were no negative comments or worries about the Project that may require a decision taking action plan from ISAGEN for the Project planning or operation stages.

SECTION F. Approval and authorization

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The letter of approval was issued by the Host Party designated national authority (DNA; Ministry of Environment, and Sustainable Development of Colombia) on 2013/10/02.

The Colombian DNA confirms that the project meets the established requirements, however the PP was requested to explain how petitions and complains raised by the communities were processed and monitored. The main concerns were related to the environmental impact of the project, its contribution to mitigate GHG and the adequate channels to secure wide information and participation from communities.

ISAGEN, provided written answer to the DNA on 2014/04/29 regarding clarifying all the issues raised on the Approval Letter. In particular, the letter clarifies that:

(a) Regarding the environmental concerns, ISAGEN reiterates that hydro power projects reduce GHG and are eligible under the CDM.
(b) Regarding participation, ISAGEN has set up a Community participation and information program (In Spanish Programa de Información y Participación Comunitaria – PIPC). This is a standardized procedure to answer petitions and complains from all the interested stakeholders. This procedure covers all the steps from reception of the complaint, user guidance, internal management, technical visit and written response. That ensures all the concerns raised by of stakeholders are being monitored. ISAGEN performs periodic assessments of the PIPC to monitor its compliance with the environmental plan.

ISAGEN also organizes public hearings on a periodic basis. In the period 2012 - 2014, ISAGEN, carried out public hearings in the project area of influence (in three specific locations up stream, nearby the dam and downstream). The topics discussed, included, the presentation of new community projects, the progress in projects already implemented, progress in the implementation of the environmental plan and clarifications regarding the progress on the construction work. Community leaders, local and regional authorities, contractors, are among the relevant stakeholders attending such meetings.

Finally, and as highlighted in section A.1, the WCD validation report shows that the project complies with all its relevant requirements. This means that Sogamoso project has been developed following a rights-based approach, by implementing a mechanism to ensure that vulnerable stakeholders are engaged in decision making thought a well stablish transparent and participatory consulting processes. In addition, there has been a clear identification and prioritization of environmental impacts (including social dimension) and a consistent management plan for each impact that is periodically monitored. Another relevant issue is that ISAGEN has demonstrated a compliance regarding the fulfilment of agreements with stakeholders.

Appendix 1. Contact information of project participants

Organization name	ISAGEN S.A. E.S.P.
Country	Colombia
Address	Carrera 30 310C – 280
Telephone	+57 4 3256921
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E-mail	afehrmann@Isagen.com.co
Website	www.isagen.com.co
Contact person	Mr. Adolfo Fehrmann

Appendix 2. Affirmation regarding public funding

No public funding was involved in financing of the proposed project activity

Appendix 3. Applicability of methodologies and standardized baselines

Does not exist any further background information on the applicability of the selected methodology (ies).

Appendix 4. Further background information on ex ante calculation of emission reductions

1. BASELINE INFORMATION DESCRIPTION OF THE COLOMBIAN NATIONAL INTERCONNECTED SYSTEM (SIN)

Colombia and its electricity sector in figures[19]

Generation Capacity, 2008	13,457 MW		
Composition of the Generation Capacity, 2008	63.4% hydraulic		
	32.3% thermal		
	4.2% minor		
	0.2% cogeneration		
Total Generation, 2008	54,395 GWh		
Exportations, 2008	611.9 GWh		
Importations, 2008	37.5 GWh		
Demand not attended, 2008	49.1 GWh		
SIN demand, 2008	53,869.7 GWh		
International Interconnections	Venezuela	import capacity	215 MW
		export capacity	285 MW
	Ecuador	import capacity	205 MW

[19] Source: XM Company, http://www.xm.com.co/Pages/DescripciondelSistemaElectricoColombiano.aspx

		export capacity	336 MW
	Next in line Panamá		
Coal Reserves, 2005	2,328 million metric tons		
Proven Reserves of Natural Gas, 2006	4,342.2 Giga cubic fee (by Ecopetrol)		

Map 1: Localization of the main Centrals and National Transmission Connections

Legal framework[20]

The current Colombian Energy Market has its origins in 1994 when the National Congress of Colombia promoted laws No. 142 and No. 143, regulating the four activities in the sector: generation, transmission, distribution and marketing. Through these laws the State compromised itself to promote free competition in these sector activities and to regulate those in which competition does not guarantee efficiency in economic terms (as is the distribution and to a lesser extent, transmission). It also created the Wholesale Electricity Market and defined a new structure and regulation for the market, adopted on 3rd of October 2006[21] and in force since 1st of December of that year.

The participation of the Government in this competitive market model is done through an institutional structure that has not been modified since 1994 and takes place in three instances, as follows: definition of the energy policy, regulation, and surveillance and control.

- The definition of the energy policy is under the jurisdiction of the Ministry of Mines and Energy. A major part of the energy policy is developed through the UPME, which is a special administrative unit attached to the Ministry of Mines and Energy. This unit has many functions, among others; it is mandated to determine the energy requirements of the country and to elaborate, in concordance with the country's National Development Plan, the National Energetic Plan and the Expansion Plan of the Electricity Sector, which are both of indicative nature.

- The task of surveillance and control over the provision of public utility services is carried out by the Superintendence of Public Utility Services. The Superintendent is likewise appointed by the President of the Republic.

- In addition to these governmental institutions, the MEM also relies for its effective operation on a central agency called Commercial Exchanges System Administrator (Administrador del Sistema de Intercambios Comerciales - ASIC per its initials in Spanish), which is in-charge of the registration of contracts, the settlement and billing of all the transactions that take place in this market.

- The planning, supervision and control of the integrated operation of resources for generation, interconnection and transmission of the SIN are exercised by the CND, which together with ASIC, are dependencies of XM Company, a public utility corporation regulated by the CREG.

Table 3: Institutional structure of Colombian Wholesale Electricity Market

Policy	Ministry of Mines and Energy Ministerio de Minas y Energía - MINMINAS	Ministerio de Minas y Energía República de Colombia
Planning	Energy Mining Planning Unit Unidad de Planeación Minero Energética - UPME	UPME
Regulation	Regulation Commission of Energy and Gas Comisión de Regulación de Energía y Gas - CREG	CREG

[20] Source: CREG

[21] CREG Resolution 071 of 2006 was approved on October 3, 2006

Control and Surveillance	Superintendence of Public Utility Services Superintendencia de Servicios Públicos	
System Operation	National Dispatch Center Centro Nacional de Despacho (CND)	
Market Administration	Commercial Exchanges System Administrator Administrador del Sistema de Intercambios Comerciales – ASIC	

General characteristics of the Wholesale Electricity Market (MEM)

The MEM is composed of systems of information interchange between generation and commercialization companies operating in the SIN.

These systems are designed to enable the market participants to make energy transactions of short-term and long-term nature. In this market, all the electric energy required by end-users connected to the SIN, whose demand is represented by commercialization companies, and all the supply offered by generators, whose plants or generation units are connected to the SIN, are traded. The designated participants of the MEM are generation and commercialization companies. The generation companies are required to participate in the MEM with all their generation plants or units with capacities equivalent to or exceeding 20MW connected to the SIN. All these electricity produced should be dispatched centrally by the CND.

The following is the number of agents of the electricity sector in Colombia (December 2008)

Generating Companies	**61**
Transmission Companies	**11**
Distribution Companies	**57**
Commercialization Companies	**117**

All commercialization companies, which deal with final users connected to the SIN, are obliged to make their energy transactions through the MEM. The transactions in the MEM are carried out under the following modalities:

i) Transactions in the Energy Spot Market,
ii) Bilateral financial Contracts; and
iii) Auctions to allocate the Firm Energy Obligations (Obligaciones de Energía Firme - OEF per its initials in Spanish) under the Reliability Charge Scheme.

All generation companies in the MEM can freely participate in any or all of the above mentioned transactions under conditions of equality. The framework and the rules for operation and participation have remained stable since the introduction of the MEM, undergoing only the necessary modifications to further promote market competition and efficiency.
For the summary of the market information for the years 2007 and 2008, refer to the information provided in the following table.

Table 4: Summary of market figures[22]

Transactions	Units	2007	2008	%	Variation
Energy traded in Spot Market	GWh	16,692	16,468	-1.6%	-224
Energy traded in financial Contracts	GWh	55,969	58,056	3.4%	2,087
Total energy traded in the Market	GWh	72,661	74,524	2.3%	1,863
Commercial demand	GWh	53,664	54,433	1.2%	769
Percentage of the demand traded in Spot Market	%	31.1	30.3	-3.0	(0.85)
Percentage of the demand traded in Contracts	%	104.3	136.9	30.9	33
Average price in National Spot Market	$/kWh	83.42	89.03	6.7%	5.61
Average price in Contracts	$/kWh	77.31	88.81	14.9%	11.50
Spot Market purchases	Millions of COP$	1,392,471	1,466,194	5.0%	73,723
Total Market transactions without Contracts	Millions of COP$	1,681,180	2,054,159	21.9%	372,979
Value traded in Contracts	Millions of COP$	4,327,043	5,155,785	18.8%	828,742
Total transactions in the Market	Millions of COP$	6,008,224	7,209,944	19.7%	1,201,720

i. Transactions in the Energy Spot Market of the MEM

The MEM in Colombia relies on a single node system. In this market, the transmission network is neutral, which implies that the generator makes its daily price offer and its hourly availability declaration, without taking into account the physical and technical restrictions in the transmission network. In this market, the energy resources to be dispatched at a particular time are selected based on the lowest price offers. This mechanism is known as the ideal dispatch and it differs from the real dispatch because the latter takes into account the restrictions that may occur in the transmission network. In other words, the ideal dispatch, determined by the CND, is obtained ex post by considering the real demand and the real supply offered by generation plants or units, without taking into account the existing physical and technical restrictions in the transmission network.

The price offers of generation companies that participate in the MEM should reflect the variable costs of generation as well as the opportunity costs. The price of the last resource used to meet the total demand in each hour is the one that sets the price to be used to pay all the inframarginal resources[23] in this same hour and is known as the spot price. Energy demand from commercialization companies that is not covered by bilateral contracts will be

[22] A System designed to guarantee long term economic signals to encourage the expansion of the installed capacity of generation plants to meet the country's development needs. One of the essential features of this new scheme is the existence of the OEF which is a commitment on the part of generation companies backed by a physical resource capable of producing Firm Energy during scarcity periods. This new scheme aims to ensure the reliability in the supply of energy in the long-run at efficient prices.

[23] Inframarginal resources have marginal costs less than the market clearing price.

settled at this same price. The settlement of financial obligations and debts of participants in the Energy Spot Market is done by the ASIC.

ii. Bilateral Contract Transactions in the MEM

Bilateral financial contracts are agreements reached by generation and commercialization companies to sell and purchase energy at prices, quantities and contractual conditions negotiated freely between the contracting parties. The market for bilateral contracts is fundamentally a financial market. The purpose of these contracts is to reduce the exposure of both the supplier and the end-user of energy to price volatilities in the short-term market. The physical delivery of the energy committed in these contracts is done through the Energy Spot Market by the generation company, which initially subscribe to these contracts, or by other generators determined by the ideal dispatch. There is no restriction whatsoever on the energy that a generation or commercialization company can commit to these bilateral contracts and neither on the time period to be covered by these agreements. The only requirement is for the contract to specify the quantity of energy that will be used on an hourly basis to enable ASIC to do the settlement.

The energy purchased by commercialization companies through bilateral contracts to cover Regulated Users' demand [24] is covered by rules that guarantee competition between generators, while energy acquisitions by commercialization companies which will go to Non-Regulated Users[25] are negotiated at prices and under conditions agreed upon by the involved parties.

iii. OEF Auctions in the MEM

The purpose of these auctions in the MEM is to allocate the OEF among generators and investors to guarantee the reliability in the supply of Firm Energy in the long-run at efficient prices.

The OEF is a commitment on the part of generation companies backed by a physical resource capable of producing Firm Energy during scarcity periods. This new scheme aims to ensure the reliability in the supply of energy in the long-run at efficient prices. The electric energy in Colombia comes mainly from hydrogenation plants (80%) and a minor proportion from thermal-generation plants (14.3%). The dependency of the Colombian electricity market on hydraulic resources makes it necessary for the electric energy sector to have enough generation plants with Firm Energy to replace hydro-generated energy in dry periods that occur during phenomena like the El Niño [26] x. Without these alternative resources, demand would have to be rationed, implying high costs on the national economy and restrictions on the well being of the population.

The generator who wins the OEF allocations receives a transparent and stable compensation during a specific period, and in exchange commits to deliver a determined quantity of energy during scarcity periods.

2. COMPLEMENTARY INFORMATION ON THE CALCULATION OF THE EMISSION FACTOR FOR THE NATIONAL ELECTRIC GRID

The calculation of the Emission Factor for the National Grid was made conform to the "Tool to calculate the emission factor for an electricity system", version 4.0.

[24] This refers to end-users whose electricity consumption is subject to the rates established by the CREG.

[25] Users with a monthly energy consumption higher than 55 MWh or 0.1 MW of peak demand, and whose energy transactions are done at prices freely negotiated with the commercialization company.

[26] This is also known as ENSO, which stands for "El Niño Southern Oscillation"

List of conditions set for the calculation

1. All power plants connected to the national (Colombian) Interconnected system were taken into account. Please refer to the description of a national system given above. The calculations were based on the official data obtained from the following sources:

☑ **National Dispatch Center (CND)**
Access to CND database "Neón" is available only upon registration on XM Company Web-page: http://www.xm.com.co.
Data used for the calculation:
- Hourly national electricity generation by plants/units connected to the National Grid
- Hourly energy bidding prices of plants/units connected to the National Grid

☑ **Energy Mining Planning Unit (UPME)**
UPME publishes most of its data on its website http://www.upme.gov.co, which includes: Reference Energy and Mining Expansion Plans, Energy and Mine Statistics Bulletins, International Analysis of Electricity Prices, Colombian Electricity Market Magazine, among others. The UPME is in charge of presenting the Indicative Expansion Plan for the energy sector, as well as support the requirement for information from the ministry and stakeholders.
Data available by UPME:
- Efficiency of power plants/units (conversion factors) expressed in units of thermal energy to electric energy - data obtained from UPME for every plant connected to the Grid
- Information of the year of commissioning of plants/units
- Fuel Emission Factor expressed in units of $kgCO_2/TJ$ – information obtained from the official database "FECOC", published by the UPME.

2. Dispatch Data Analysis was used for the calculation of the Operating Margin based on the available hourly generation of the Grid-connected plants.

3. The emission factor for net electricity imports of 0 tCO_2/MWh was used as the imports come from connected electricity system located in other countries.

4. The CO_2 emission factor for power units in the top of the dispatch merit order in hour h in year y was calculated.

   According to the definition given in the aforementioned tool: "Low-operating cost and must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the Grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants."
   For the proposed Project Baseline calculations of the BM CO_2 emission factor, was calculated ex-ante based on the most recent information available on plants already built for sample group y (year 2008).

5. According to the tool, the sample group m consists of either the set of five power units m that have been built most recently or the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. If 20% falls on part capacity of a unit, that unit is fully included in the calculation. Project participants should use from these two options that sample group that comprises the larger annual generation. For the calculation of the proposed Project Baseline emissions the sample group m that comprised 20% of the system generation for the year 2008 was used, because this represented the larger annual generation from these two options. Furthermore, for the first crediting period, the Build Margin emission factor must be updated annually ex-post for the year in which actual Project generation and associated emissions reductions occur.

In case of not counting with the corresponding type of fuel used by a given plant/unit, a conservative emission factor of 0 tCO_2/MWh was applied.

Table 5: List of power plants/units included in the merit with corresponding type of fuel used and the plants emission factors.

Power plant	Power unit	Date of commissioning	Capacity (MW)	Fuel Type	CO_2 Emmision Factor (tCO_2/MWh)
COGEN. BIOAISE	COGEN. BIOAISE	1999	0,0	Coal and biomass	0,8163
COGEN. CENTRAL CASTILLA	COGEN. CENTRAL CASTILLA	2004	1,0	Coal and biomass	0,2860
COGEN. COLTEJER	MENOR COGENERADOR COLTEJER 1	2006	1,6	Coal and biomass	1,0276
COGEN. INCAUCA	MENOR COGENERADOR INCAUCA 1	1999	9,9	Coal and biomass	0,2860
COGEN. INGENIO PROVIDENCIA	MENOR COGENERADOR INGENIO PROVIDENCIA 1	1999	1,0	Coal and biomass	0,2860
COGEN. INGENIO RIOPAILA	MENOR COGENERADOR INGENIO RIOPAILA 1	2004	1,5	Coal and biomass	0,2860
COGEN. INGENIO RISARALDA	MENOR COGENERADOR INGENIO RISARALDA 1	2003	5,5	Coal and biomass	0,2860
COGEN. PROENCA	MENOR COGENERADOR PROENCA 1	1999	4,0	Coal and biomass	0,2860
COGEN. TUMACO	MENOR COGENERADOR CENTRAL TUMACO 1	2007	2,0	Coal and biomass	0,2860
GUAJIRA 1	GUAJIRA 1	1983	151,0	Coal	1,1590
GUAJIRA 2	GUAJIRA 2	1987	127,0	Coal	1,3222
MENOR CIMARRON	MENOR CIMARRON 1	2007	17,0	Natural Gas	0,8077
MENOR MORRO 1	MENOR EL MORRO I 1	2007	19,9	Natural Gas	0,8884
MENOR MORRO 2	MENOR EL MORRO II 1	2007	17,0	Natural Gas	0,8884
MENOR TERMOPIEDRAS	MENOR TPIEDRAS 1	2000	3,8	Natural Gas	0,8634
MERILECTRICA 1	MERILECTRICA 1	2004	169,0	Natural Gas	0,5629
PAIPA 2	PAIPA 2	1975	70,0	Coal	1,1890
PAIPA 3	PAIPA 3	1982	70,0	Coal	1,1938
PAIPA 4	PAIPA 4	1999	150,0	Coal	0,9000
PALENQUE 3	PALENQUE 3	1972	13,0	Natural Gas	0,8361
PROELECTRICA 1	PROELECTRICA 1	1993	45,0	Natural Gas	0,4769
PROELECTRICA 2	PROELECTRICA 2	1993	45,0	Natural Gas	0,4769
TASAJERO 1	TASAJERO 1	1985	155,0	Coal	0,9147
TEBSA TOTAL	TEBSAB	1998	791,0	Natural Gas	0,4554
TERMO SIERRA 1	TERMOSIERRAB	2001	455,0	Natural Gas	0,3719
TERMOBARRANQUILLA 3	BARRANQUILLA 3	1980	64,0	Natural Gas	0,5664
TERMOBARRANQUILLA 4	BARRANQUILLA 4	1980	63,0	Natural Gas	0,5821
TERMOCANDELARIA 1	TERMOCANDELARIA 1	2000	157,0	Natural Gas	0,5576
TERMOCANDELARIA 2	TERMOCANDELARIA 2	2000	157,0	Natural Gas	0,5652
TERMOCARTAGENA 1	CENTRAL CARTAGENA 1	1980	61,0	Natural Gas	0,6896
TERMOCARTAGENA 2	CENTRAL CARTAGENA 2 (INACTIVO)	1980	53,0	Natural Gas	0,6896

Power plant	Power unit	Date of commissioning	Capacity (MW)	Fuel Type	CO_2 Emmision Factor (tCO_2/MWh)
TERMOCARTAGENA 3	CENTRAL CARTAGENA 3	1980	66,0	Natural Gas	0,6726
TERMOCENTRO 1	TERMOCENTRO 1 CICLO COMBINADO	2000	280,0	Natural Gas	0,4505
TERMOCENTRO 1	TERMOCENTRO CS 1 (INACTIVO)	1997	0,0	Natural Gas	0,4505
TERMODORADA 1	TERMODORADA 1	1997	51,0	Natural Gas	0,5669
TERMOEMCALI 1	TERMOEMCALI 1	1999	229,0	Natural Gas	0,4111
TERMOFLORES 1	FLORES 1	1993	160,0	Natural Gas	0,4554
TERMOFLORES 2	FLORES 2	1996	112,0	Natural Gas	0,5839
TERMOFLORES 3	FLORES 3	1998	169,0	Natural Gas	0,5605
TERMOVALLE 1	TERMOVALLE 1	1998	205,0	Natural Gas	0,4181
TERMOYOPAL 1	MENOR TERMOYOPAL 1	2005	19,0	Natural Gas	0,8884
TERMOYOPAL 2	TERMOYOPAL 2	2004	30,0	Natural Gas	0,8077
ZIPAEMG 2	ZIPAEMG 2	1964	34,0	Coal	1,2282
ZIPAEMG 3	ZIPAEMG 3	1976	63,0	Coal	0,9240
ZIPAEMG 4	ZIPAEMG 4	1981	64,0	Coal	0,8672
ZIPAEMG 5	ZIPAEMG 5	1985	63,0	Coal	0,8355

Appendix 5. Further background information on monitoring plan

ENERGY MEASUREMENT SYSTEM

Objectives and General Aspects:

In this Appendix, technical characteristics of the main measurement equipment are described.
The aim of the measurement system is counting the electric energy generated by Sogamoso Power Plant in the different electricity delivering points.

Measurement points are:

- Terminals of Generator Unit 1 switch-breaker
- Terminals of Generator Unit 2 switch-breaker
- Terminals of Generator Unit 3 switch-breaker
- Connection unit 1 to 230 kV busbar substation (Commercial Frontier)
- Connection unit 2 to 230 kV busbar substation (Commercial Frontier)
- Connection unit 3 to 230 kV busbar substation (Commercial Frontier)

The information about the accounted energy and power quality indicators will be stored locally in the recorder designated for the measurement point.

Through the management system will be possible to access the stored registry and access readings of power quality parameters in real-time in each measurement point, without affect the energy registering.

The management system will have one local management console that permits individual reading, calculations of generation aggregation and power plant reports. The management system will permit remote access to measurement points taking into account necessary security requirements in order to guarantee the integrity of data. Remote access shall be made from ISAGEN offices or

from the entity in charge of verification of the energy generation, using specialized and well-known tools in energy meters management.

Besides energy meters, energy measurement system will have one management console with management meters software, time synchronization network and management meters network.

Magnitudes to be measured:

- Active energy (MWh)
- Reactive energy (MVArh)
- Current (A)
- Voltage (V)
- Active power (MW)
- Reactive power (MVAr)
- Power factor (---)
- Frequency (Hz)

TYPE	DESCRIPTION	PHASE			THREE-PHASE
		A	B	C	
Power	Reactive power	Yes	Yes	Yes	Yes
	Apparent power	Yes	Yes	Yes	Yes
	Power factor	Yes	Yes	Yes	Yes
Demand (maximum/average)	Active demand				Yes
	Reactive demand				Yes
	Apparent				Yes
	Current				Yes
Voltage	Phase-neutral Voltage	Yes	Yes	Yes	
	Phase- Phase Voltage	Yes	Yes	Yes	
Current	Phase current	Yes	Yes	Yes	
Frecuency	System frecuency				Yes

Meters characteristics:

- Three-phase, four wires
- Secondary voltage of voltage transformers: 120/3 V
- Secondary rated current of current transformers: 1 A or 5 A
- Rated frequency: 60 Hz
- Electronic type with no volatile memory, multifunctional, bidirectional, double storing and two independent pulses generators, one for each direction of energy flow.
- Programmable, static type, accuracy class 0,2s
- Meters will calculate, in an accurate and direct way, the energy for each phase, with pulse emitters at three wires free-potential.
- Meters will have anti-backward devices and numeric indicator of measured energy.
- Meters will have communications ports for local and remote access by means of management meters network, and for linking with control system of power plant.

Requirements to be met by the meters:

- Standards to be met by meters: ICONTEC – 2147, IEC 61000-4-7/4-15, 62053-22 or ANSI equivalent.

- Regulation to be met by meters: Networks Code of SIN, Measurement Code, CM-1 annex of the CREG.

Advantages of the Measurement System:

- Meters design will be based on plugged-cards in order to permit easy access for its replacement and maintenance and with the possibility of installing additional modules in the future.
- Communication module will be completely independent of energy module, in order to avoid failures in communication ports that cause blockades in the process of energy measurement.
- Meters will be removable type and will be installed in independent closed boxes; these boxes will have removable front, in order to facilitate disassemble of the meter.
- The montage of meters and boxes will permit to put security seals.
- This montage will have blocks with special terminals in order to permit on-site meter testing and the safe connection and disconnection of the meter.
- Multifunctional energy meters will be appropriate to operate under environmental conditions of the power plant and shall comply electromagnetic compatibility requirements, they will have long-term stability and highly insensitivity to harmonics and voltage and frequency changes, according to their ability to withstand impulses, speed transients and radio interference, as per recommendations of ANSI / IEEE C62.41 or IEC 61000 standards.

Additional characteristics:

- Current transformers and voltage transformers will be of the same accuracy class as meters
- Secondary circuits of current transformers and voltage transformers will be exclusive to be used in the energy meters.
- Total maximum percentage error (in magnitude and phase), at power factor of 0,9, introduced in the energy measurement by the voltage drop, will not surpass 0,1%.
- The measurement will be performed by analog-digital conversion technology, with the guaranteed accuracy for voltage and current wave, independent of load fluctuations.
- Meters will be based on microprocessors with enough memory capacity for storing programming and measurements of current, voltage, power and energy.
- Meters will have self-diagnosis and memory backup systems in case of feed voltage lost.
- Meters will be bidirectional and will have two local reading recorders for exported and imported energy, with corresponding pulses emitters and transducer for tele-transmission of readings of exported and imported energy.
- Meters will have a local display panel LCD type with bright backlight easy to read, so as to permit to show the information of the different measurements required, identifying clearly the measured parameter, taking into account if is exported or imported.

Contingency, emergency and backup systems:

Meters will have no volatile memory EEPROM type for programming the storing and the recording of measurements and parameters obtained, that permits to store 35 days continuous of information related to the data recorded in the communications channels, with recording intervals of 15 minutes. In the memory will be stored as minimum energy variables and related events.

The meters will have real-time clock whose time base is independent of the network frequency of 60 Hz and is taken directly from the GPS signal of the power plant. The meters will ensure monitoring of the time synchronization signal so that no deviations occur with respect to the time given by the GPS.

If the power supply system fails for a time less or equal to 30 calendar days, meters will not lose any of the information recorded and stored in the log data. So the memory will have means of

backup data with an on-site life exceeding ten years and a capability for autonomous at least 30 continuous days.

Communication System Characteristics:

Meters will have the following communication ports:

- Ethernet port with handling of at least one standardized protocol with dating of time to link to control centres (DNP 3 TCP, IEC 60870- 104, IEC 61850).
- RS 485 port that permits GPS synchronization with 1 ms resolution and permits management functions with compatibility with software UTS MV-90.
- Front optical port for total access
- Communication ports will be functionally independent and will do their functions at the same time.
- Management console is made up by personal computer of most recent technology with licensed programs of word processor and spreadsheets, with licensed last available version of operative system Windows and meters management software.
- This console will be connected to control network in order to access the energy meters information.

Management software:

This software will be the only one for every meter and will permit:

- Work easily in graphic environment Windows with minimum training.
- Programming of: limit values and scales, real time presentation of data and measured variables, and reading of mobile reader units.
- Handling of graphics, trends, alerts, etc.
- Recording of energy measurements of every meter
- Local and remote access to every meter
- Backup copies of meters programming parameters
- Protection against non-authorized access. The software will have several security levels for accessing to every meter
- Storing of up to 50 different configurations
- Upgrading of the software

MAINTENANCE ASPECTS

General aspects:

Specific objective: to preserve equipment and facilities in optimum operational and safety conditions, in order to meet, during their operational life-time, the objectives for which they were acquired, taking into account the optimization of total production costs.

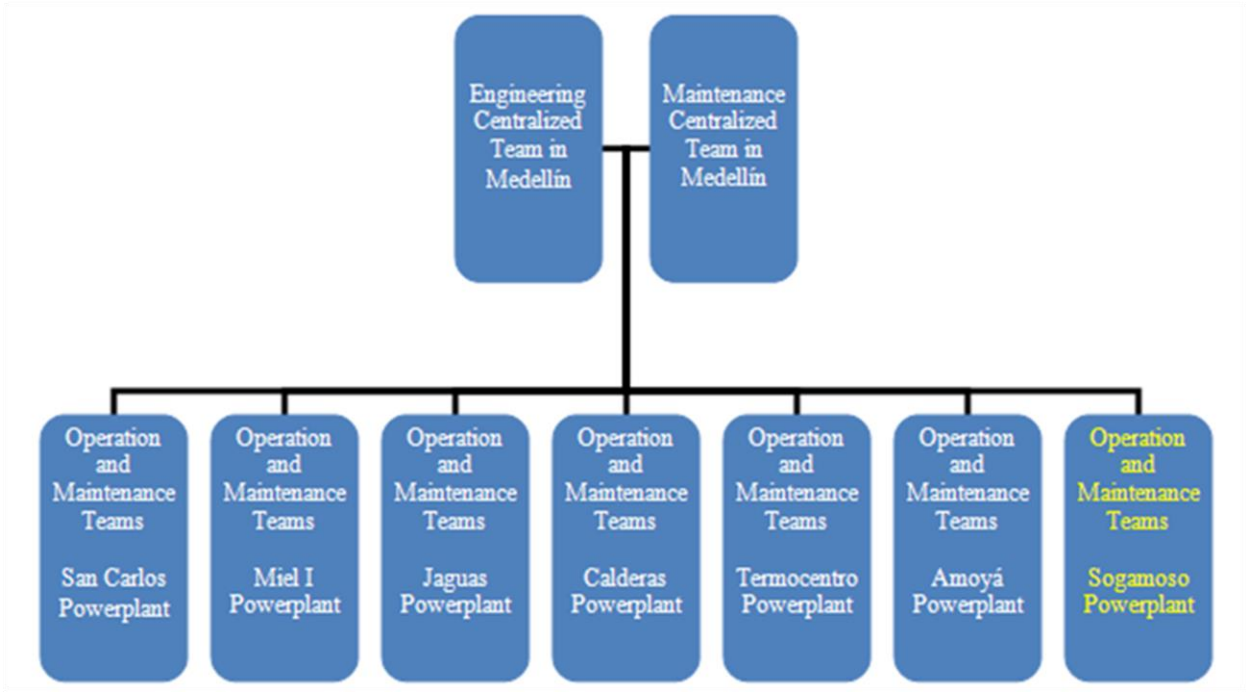
Maintenance philosophy: is based on the continuous improvement cycle PDCA (plan, do, check and act), through planning, programming, execution and evaluation of maintenance.

Criteria of planning and programming: technical condition and performance of equipment, availability and its impact on incomes from energy sales and Reliability Charge, and energy costs variability during hydrologic cycles and commercial commitments

Execution criteria: optimization of availability, reliability, maintainability and people safety, equipment, facilities and environment as per applicable quality standards

Maintenance components: preventive and predictive maintenance. The immediate future is to enter in the third generation of maintenance, which will be focused on greater availability, reliability, safety, better service quality, environmental care, longer life of equipment, all within an optimization cost of maintenance.

Maintenance Structure:



Maintenance management in ISAGEN is carried out by each power plant ISAGEN-owned and by Engineering and Maintenance centralized teams located in Medellin.

Most of the maintenance personnel has more than 15 years of experience in maintenance and projects execution through operation, maintenance and technological up-dating of ISAGEN power plants.

Engineering Centralized Team:

Engineering centralized team, in coordination with the power plants, carries out the following activities:

i. Results analysis of specialized tests of predictive maintenance
ii. Planning and management of modernization, retrofit, and complementation projects
iii. Monitoring of equipment and facilities condition

Maintenance Centralized Team:

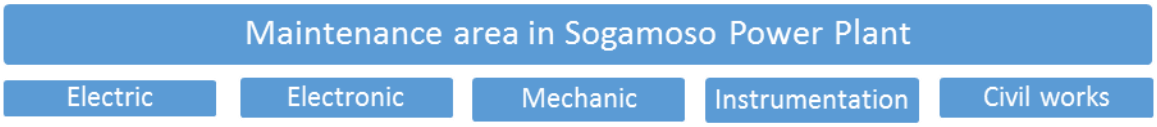
Maintenance centralized team, in coordination with the power plants, carries out the following activities:

i. Management for special spares acquiring with quality and just-in-time criteria
ii. Provision and hiring of specialized technical services
iii. Maintenance evaluation
iv. Management of historical record of failures

In the same way that other power plants of ISAGEN, programming and execution of maintenance in Sogamoso power plant will be done directly by engineers and assistants of operation and maintenance area of the power plant.

Maintenance Teams in each Power Plant:

Maintenance area will have the sub-areas according to the next figure:



Support System of Maintenance:

Management maintenance is supported by a computarized system through the module of Power Plant Maintenance of Information Integrated System SAP R/3 and it is implemented using procedures of:

- Quality system (ISO 9001 standard)
- Environmental system (ISO 14001 standard)
- Occupational safety and health system (OHSAS 18001 standard)

SAP system also has module of Material Requirement Planning which permits an adequate and opportune planning of required materials.

Maintenance Planning:

Equipment and facilities are classified in two classes:

- Equipment and facilities whose maintenance requires to stop generators units

- Equipment and facilities whose maintenance does not require to stop generators units (this kind of equipment is called peripheral equipment)

For the first kind of equipment, maintenance plan is called Machine Stop Program, which is based on manufacturers recommendations and technical aspects but looking for the most appropriate moment to stop the machine due to earns lost for non-availability of the machine. Initial stop program is analyzed through simulation using the tool MPODE (Operational-Energy planning model for minimum cost dispatch, with dual stochastic programming)

For the second kind of equipment, preventive and predictive maintenance plan is carried out.

Materials and spares are classified depending on the complexity level for purchasing process: one of the types of materials and spares is classified as normal consumption material, and other type of materials is classified as generation components that due to technical characteristics and their manufacturing time could cause an important stop if they are not available at that moment in the ISAGEN's store. This type of materials and spares are stored currently in ISAGEN.

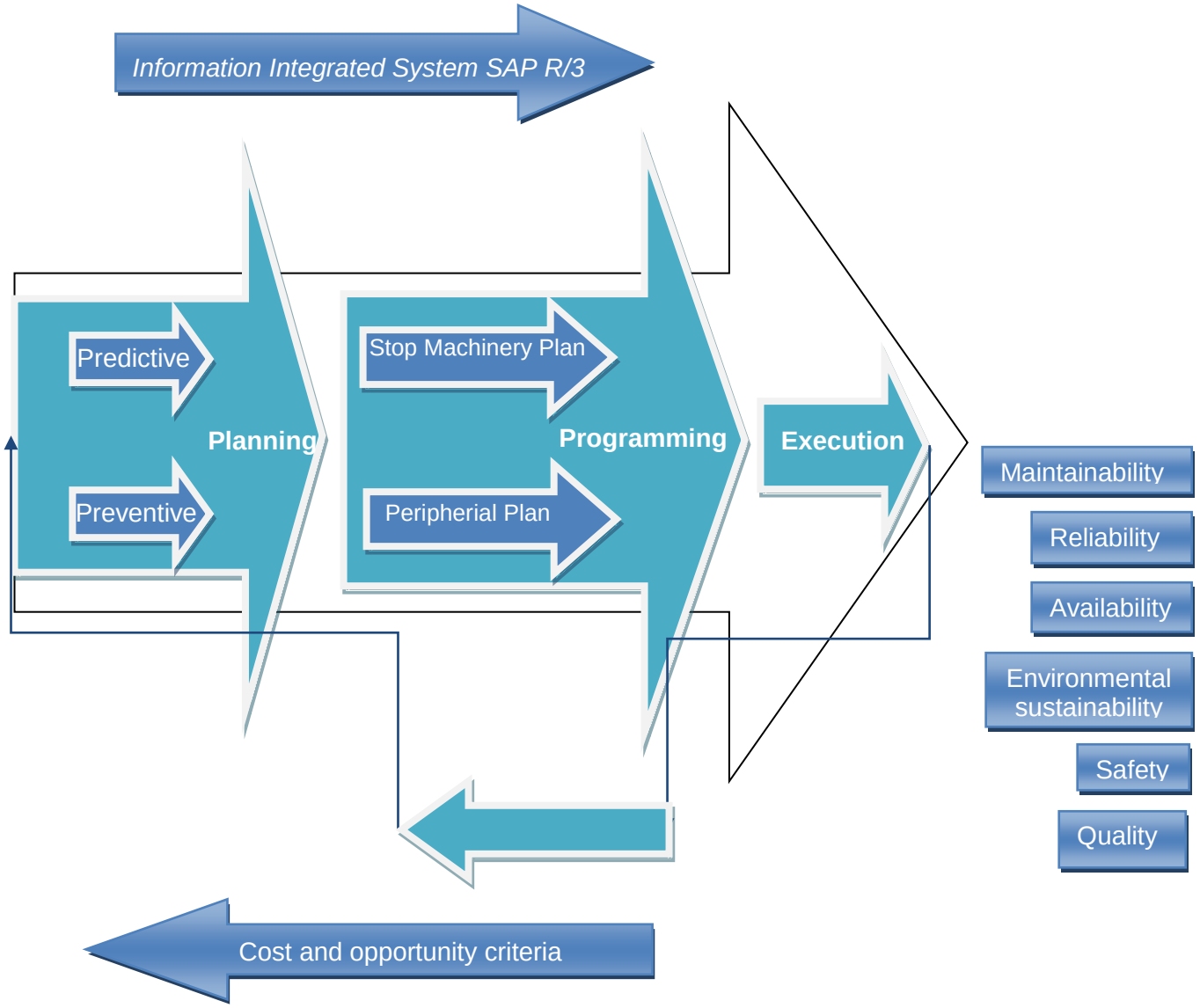
Preventive maintenance schedule is carried out according to maintenance orders generated by SAP, which are revised by technical personnel and by the maintenance manager.

Each of the equipment has maintenance guides in which following topics are explained: execution time, frequency, tools, machines, materials, spares, specific activities, personal safety elements, safety measures, technical information and formats for entering data.

ISAGEN has stand-by equipment, for which preventive maintenance routines are implemented in order to be prepared for emergencies.

Maintenance Cycle:

According to what mentioned above, principles and general aspects of maintenance cycle in ISAGEN are summarized in the following figure:


Information Integrated System SAP R/3
Predictive
Preventive
Planning
Stop Machinery Plan
Peripherial Plan
Programming
Execution
Maintainability
Reliability
Availability
Environmental sustainability
Safety
Quality
Cost and opportunity criteria

Maintenance Personnel:
An approximate reference for management, operation and maintenance structure is shown in the following table:

Position	Number of people	Professional Specialty
Manager	1	Engineer
Information assistant	1	Administrative Technologist
Administrative analyst	1	Administrative Engineer
Maintenance analyst – Electric Maintenance	1	Electrical Engineer
Operation and Maintenance assistants – Electric Maintenance	3	Electrical Technologist
Maintenance analyst – Mechanic Maintenance	1	Mechanic Engineer
Operation and Maintenance assistants – Mechanic Maintenance	3	Mechanic Technologist
Maintenance analyst – Electronic Maintenance	1	Electronic Engineer
Operation and Maintenance assistants – Electronic Maintenance	3	Electronic Technologist
Operation and Maintenance assistants – Instrumentation	3	Instrumentalist Technologist
Maintenance analyst – Civil Works Maintenance	1	Civil Engineer
Civil works assistants – Civil Works Maintenance	2	Civil Technologist
Civil works assistants – Hydrometric	1	Civil Technologist
Environmental analyst	1	Environmental Engineer
Environmental assistant	1	Environmental Technologist
Operation analyst	1	Electrical Engineer
Operation and Maintenance assistants – operation	2	Electrical Technologist
	2	Mechanic Technologist
	2	Electronic Technologist
	2	Instrumentalist Technologist
Storekeeper	1	Electro-mechanic Technologist
	1	Mechanic Technologist

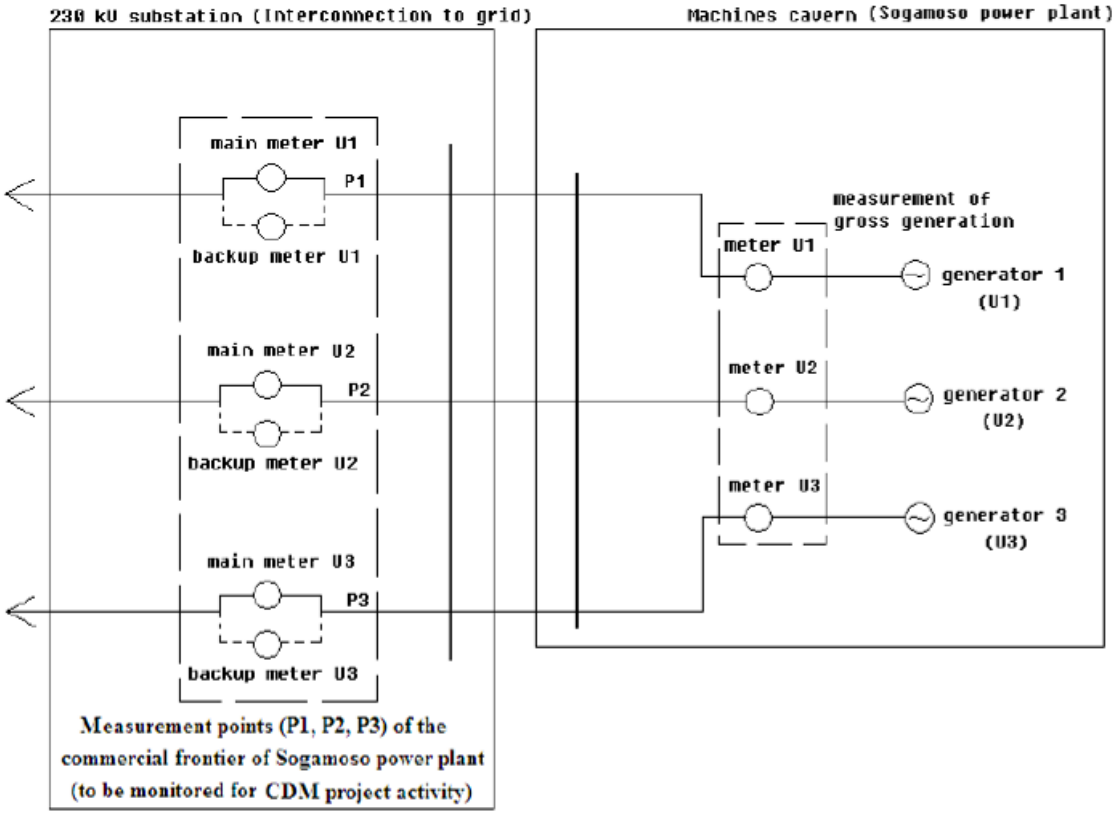
Appendix 6. Summary report of comments received from local stakeholders

Presented in Section E.2.

Appendix 7. Summary of post-registration changes

The following Post Registration Changes were proposed on the verification of the first monitoring period (June 15, 2016 to June 14, 2017):

- According to numeral A.4 of the PDD version 08 (Parties and project participants), ISAGEN S.A E.S.P is a mixed entity with public and private capital. However, as of January 13, 2016, ISAGEN S.A E.S.P was acquired by the Canadian investment fund Brookfield Asset Management Inc. (BAM) and its new nature places it as a private company.
- In June 20th 2018, PricewaterHouseCoopers Asesores Gerenciales Ltda was withdrawn as project participant by UNFCCC, the requested was made on June 18th 2018 through a MoC Annex 2 (Withdraw Project Participant -Voluntary).
- Some of the technical data of the hydraulic turbines described in the section A.3. Technologies and/or measures of the version 08 of the PDD were update, according to the nameplate of the turbine given by the manufacturer. The updated data are Speed: 163.64 rpm instead of 163.63 rpm and Rated Power: 281.35 MW instead of 278.8 MW.
- The measurement points of the project activity (Figure 12 of the version 08 of PDD) was updated, an auxiliary services meter was not installed in the Power Plant, the scheme presented was part of a design document. The actual measurement points of the project activity are presented below:



- The way to measure the Area of the full reservoir in the surface of the water after the implementation of the Project Activity (A_{PJ}), it will be monitored using bathymetry surveys, which are more accurate than measurements using satellite pictures. And also is mandatory for hydroelectric power plants in Colombia with reservoirs to use bathymetry surveys to deliver the operational parameters of the power plant to the National Operation Council (CNO, in Spanish).
- The contact information was updated, accordingly to the last MoC.

The other changes are corrections of editing and misspellings and the deletion of repeated information.

Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.

Version	*Date*	*Description*
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document