

**REQUEST FOR PROPOSALS**

**FEASIBILITY STUDY FOR THE**

**GEOHERMAL POWER GENERATION PROJECT IN COLOMBIA**

**Submission Deadline: 4:00 PM**

**LOCAL TIME (MEDELLIN, COLOMBIA)**

**FEBRUARY 14, 2008**

**Submission Place: ISAGEN S.A. E.S.P.**  
**Av. El Poblado, Carrera 43 A No. 11A 80**  
**Medellín**  
**Colombia**  
**Phone: (57-4) 316-5120**

**SEALED PROPOSALS SHALL BE CLEARLY MARKED AND RECEIVED PRIOR TO THE TIME AND DATE SPECIFIED ABOVE. PROPOSALS RECEIVED AFTER SAID TIME AND DATE WILL NOT BE ACCEPTED OR CONSIDERED.**

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## **Section 1: INTRODUCTION**

The U.S. Trade and Development Agency (USTDA) has provided a grant to ISAGEN S.A. E.S.P. (ISAGEN) ("Grantee") to conduct a Feasibility Study on the proposed Geothermal Power Generation Project ("Project") in Colombia. The Grant Agreement is attached at Annex 4 for reference. The Grantee is soliciting technical proposals from qualified U.S. firms to provide expert consulting services to carry out the Feasibility Study.

### **1.1 BACKGROUND SUMMARY**

ISAGEN is a leading Colombian power company based in Medellín whose majority shareholder is the Government of Colombia. ISAGEN currently operates five hydroelectric and thermoelectric plants with a combined installed capacity of 2,132 MW, which supply approximately 17% of Colombia's energy demand. In addition to generating and selling electricity, ISAGEN sells natural gas, coal, steam, and other forms of energy sources for industrial use.

In order to diversify Colombia's power supply and limit the emissions from carbon-intensive gas and coal electricity generation plants, ISAGEN is committed to developing geothermal power sources. ISAGEN recently conducted an initial study in conjunction with the National University of Colombia (Universidad Nacional de Colombia) that identified promising sites for geothermal power development. The initial study examined geological characteristics around Colombia that are favorable for geothermal power development and identified promising sites that warranted further assessment.

The Feasibility Study will analyze five prospective geothermal power production sites in detail (Chiles/Cerro Negro/Tufino, Volcán Azufral, Complejo del Ruiz, Santa Rosa de Cabal, and Paipa/Iza). In addition to a review of the existing data of the sites' geothermal potential, the Feasibility Study will include field assessments to fill the information gaps that exist. The comprehensive assessment of the five prospective geothermal power production sites will lead to the selection of the most viable site to develop a 50 MW (or greater) geothermal power plant. The Feasibility Study will address issues related to Project sizing, optimal siting, technology selection for geothermal resource recovery and power generation, design standards, technical specifications, economic viability, environmental impacts, economic and social impacts, regulatory and institutional issues, and financing options.

A background Definitional Mission report is provided for reference in Annex 2.

## **1.2 OBJECTIVE**

The objective of the Geothermal Power Generation Feasibility Study is to assess five (5) prospective geothermal power production sites in order to determine the most viable site. The Study will enable ISAGEN to develop a 50 MW (or greater) geothermal power generation project.

The Terms of Reference (TOR) for this Feasibility Study is attached as Annex 5.

## **1.3 PROPOSALS TO BE SUBMITTED**

Technical proposals are solicited from interested and qualified U.S. firms. The administrative and technical requirements as detailed throughout the Request for Proposals (RFP) will apply. Specific proposal format and content requirements are detailed in Section 3.

Cost will not be a factor in the evaluation and therefore, cost proposals should not be submitted; upon detailed evaluation of technical proposals, one firm will be selected for contract negotiations. The amount for the negotiated contract has been established by a USTDA grant of U.S. \$599,310 dollars.

## **1.4 CONTRACT FUNDED BY USTDA**

The negotiated contract will be funded by USTDA in accordance with the terms and conditions of its grant to the Grantee. The contract must include certain USTDA mandatory clauses relating to nationality, taxes, payment, reporting, and other matters. The USTDA nationality requirements and the USTDA mandatory clauses are attached at Annexes 3 and 4 for reference.

## **Section 2: INSTRUCTIONS TO PROPOSERS**

### **2.1 PROJECT TITLE**

The project is called the "Geothermal Power Generation Project."

### **2.2 DEFINITIONS**

Please note the following definitions of terms as used in this RFP.

The term "Request for Proposals" means this solicitation of a formal technical proposal including qualifications statement.

The term "Offeror" means the U.S. individual, or U.S. firm, including any and all subcontractors, which responds to the RFP and submits a formal proposal and which may or may not be successful in being awarded this procurement.

### **2.3 DEFINITIONAL MISSION REPORT**

USTDA sponsored a Definitional Mission to address technical, financial, sociopolitical, environmental, and other aspects of the proposed Project. A copy of the Report is attached at Annex 2 for background information only.

### **2.4 EXAMINATION OF DOCUMENTS**

Offerors should carefully examine this RFP. It will be assumed that Offerors have done such inspection and that through examinations, inquiries and investigation they have become familiarized with local conditions and the nature of problems to be solved during the execution of the Feasibility Study.

Offerors shall address all items as specified in this RFP. Failure to adhere to this format may disqualify an Offeror from further consideration.

Submission of a proposal shall constitute evidence that the Offeror has made all the above mentioned examinations and investigations, and is free of any uncertainty with respect to conditions which would affect the execution, and completion of the Feasibility Study.

## **2.5 PROJECT FUNDING SOURCE**

The Feasibility Study will be funded under a grant from USTDA. The total amount of the grant is not to exceed U.S. \$599,310 dollars.

## **2.6 RESPONSIBILITY FOR COSTS**

Offeror shall be fully responsible for all costs incurred in the development and submission of the proposal or any other cost incurred by Offeror prior to issuance of an agreement or contract. Neither USTDA nor the Grantee assumes any contractual obligation as a result of the issuance of this proposal request, the preparation or submission of a proposal by an Offeror, the evaluation of proposals, or final selection.

## **2.7 TAXES**

Offerors should submit proposals which note that in Annex 4, USTDA Mandatory Contract Provisions, USTDA funds are not to be used to pay taxes or duties under the laws of host country.

## **2.8 CONFIDENTIALITY**

The Grantee will use its best efforts to preserve the confidentiality of any business proprietary or confidential information submitted by the Offeror, which is clearly designated as such by the Offeror.

## **2.9 ECONOMY OF PROPOSALS**

Proposal documents should be prepared simply and economically, providing a comprehensive and concise description of the Offeror's capabilities to satisfy the requirements of the RFP. There is no necessity for expensive bindings, colored displays, or other promotional material unless such material is absolutely pertinent to the proposal. Emphasis should be placed on completeness and clarity of content.

## **2.10 SUBSTANTIVE PROPOSALS**

The Offeror shall certify (a) that its proposal is genuine and is not made in the interest of, or on the behalf of, any undisclosed person, firm, or corporation, and is not submitted in conformity with, and agreement of, any undisclosed group, association, organization, or corporation; (b) that it has not directly or indirectly induced or solicited any other Offeror to put in a false proposal; (c) that it has not solicited or induced any other person, firm, or corporation to refrain from submitting a proposal; and (d) that it has not sought by collusion to obtain for himself any advantage over any other Offeror or over the Grantee or USTDA or any employee thereof.

## **2.11 CONDITIONS REQUIRED FOR PARTICIPATION**

Only U.S. firms are eligible to participate in this tender. However, U.S. firms may utilize subcontractors from host country for up to **thirty percent (30%)** of the amount of the USTDA grant. **USTDA has agreed that the use of subcontractors from host country may not exceed thirty percent (30%) of the USTDA grant amount for this Feasibility Study.** USTDA nationality requirements are detailed in Annex 3.

## **2.12 LANGUAGE OF PROPOSAL**

All proposal documents shall be prepared and submitted in English and Spanish.

## **2.13 PROPOSAL SUBMISSION REQUIREMENTS**

The cover letter in the proposal must be addressed to:

**María Luz Pérez López**  
**Gerente Proyectos de Generación**  
**ISAGEN S.A. E.S.P.**  
**Av. El Poblado, Carrera 43 A No. 11A 80**  
**Medellín**  
**Colombia**  
**Phone: (57-4) 316-5120**

**An original in English, an original in Spanish, one (1) copy in English, and two (2) copies in Spanish of your proposal must be received at the above address no later than 4:00 PM (local time in Medellín, Colombia), on February 14, 2008.**

Proposals may be either sent by mail, overnight courier, or hand-delivered. Whether the proposal is sent by mail, courier or hand-delivered, the Offeror shall be responsible for actual delivery of the proposal to the above address before the deadline. Any proposal received after the deadline will be returned unopened.

Upon timely receipt, all proposals become the property of the Grantee.

## **2.14 PACKAGING**

Each proposal must be sealed to ensure confidentiality of the information. The proposals should be individually wrapped and sealed, and labeled for content including "original" or "copy number x"; the original in English, the original in Spanish, one (1) copy in English, and two (2) copies in Spanish should be collectively wrapped and sealed, and clearly marked for content.

Neither USTDA nor the Grantee will be responsible for premature opening of proposals not properly labeled.

## **2.15 AUTHORIZED SIGNATURE**

The proposal must contain the signature of a duly authorized officer or agent of the Offeror empowered with the right to bind the Offeror.

## **2.16 EFFECTIVE PERIOD OF PROPOSAL**

The proposal shall be binding upon the Offeror for sixty (60) days after the proposal due date, and Offeror may withdraw or modify this proposal at any time prior to the due date upon written request, signed in the same manner and by the same person who signed the original proposal.

## **2.17 EXCEPTIONS**

Firms agree by their response to the RFP announcement to abide by the procedures set forth therein. Material modifications in the TOR or responsibilities of the parties will not be accepted.

Any exceptions in the proposal shall be clearly identified, and shall include the scope of such exception, and its impact, on the procurement. The Grantee shall make final determination as to the responsiveness of such exceptions and their acceptability.

## **2.18 OFFEROR QUALIFICATIONS**

As provided in Section 3, Offerors shall submit evidence that they have relevant past experience and have previously delivered advisory and Feasibility Study services similar to those required in the TOR.

## **2.19 RIGHT TO REJECT PROPOSALS**

The Grantee reserves the right to reject any and all proposals and to accept or reject any or all of the items in the proposal, and to award the contract in whole or in part if it is deemed in the best interest of the Grantee.

## **2.20 PRIME CONTRACTOR RESPONSIBILITY**

Offerors have the option of subcontracting parts of the services they propose. The Offeror's proposal must include a description of any anticipated subcontracting arrangements, including the name, address, and qualifications of consultants and subcontractors. USTDA nationality provisions are set forth in detail in Annex 3. The successful Offeror shall cause appropriate provisions of its contract, including all mandatory USTDA clauses, to be inserted in all subcontracts ensuing to ensure fulfillment of all contractual provisions by subcontractors.

## **2.21 AWARD**

An award resulting from this RFP shall be made to the best qualified Offeror, taking into consideration the evaluation factors set forth herein; however, the right is reserved to reject any and all proposals received and, in all cases, the Grantee will be the judge as to whether a proposal has or has not satisfactorily met the requirements of this RFP.

## **2.22 COMPLETE SERVICES**

The successful Offeror shall be required to (a) furnish all supplies, supervision, transportation, and other execution accessories, services, and facilities; (b) provide and perform all necessary labor; and (c) in accordance with good technical practice, with due diligence, and in accordance with the requirements, stipulations, provisions and conditions of this RFP and the resultant contract, execute and complete all specified work to the satisfaction of the Grantee.

## **2.23 INVOICING AND PAYMENT**

Deliverables under the contract shall be delivered on a schedule to be agreed upon in a contract with the Grantee. The Contractor may submit invoices to the designated Grantee Project Director in accordance with a schedule to be negotiated and included in the contract. Upon approval of each invoice, the Grantee will forward the invoice to USTDA which will process payment to the Contractor. All payments by USTDA under the Grant Agreement will be made in U.S. currency.

### **Section 3: PROPOSAL FORMAT AND CONTENT**

To expedite proposal review and evaluation, and to assure that each proposal receives the same orderly review, all proposals must follow the format described in this section.

Proposal sections and pages shall be appropriately numbered and the proposal shall include a Table of Contents. Offerors are encouraged to submit concise and clear responses to the RFP. Proposals shall contain all elements of information requested without exception. Instructions regarding the required scope and content are given in this section. The Grantee reserves the right to include any part of the selected proposal in the final contract.

The proposal shall consist of a technical proposal only. No cost proposal is required as the value of the USTDA grant is established at U.S. \$599,310 dollars.

Offerors shall submit one (1) original in English, one (1) original in Spanish, one (1) copy in English, and two (2) copies in Spanish of the proposal. Proposals received by fax cannot be accepted.

The following sections and content are required for each proposal:

- Transmittal Letter,
- Cover/Title Page,
- Table of Contents,
- Introduction and Executive Summary,
- Company Information,
- Organizational Structure, Management Plan, and Key Personnel,
- Technical Approach and Work Plan,
- Experience and Qualifications, and
- Miscellaneous.

Detailed requirements and directions for the preparation of each section are presented below.

#### **3.1 SECTION 1: INTRODUCTION AND EXECUTIVE SUMMARY**

An Executive Summary should be prepared describing the major facts or features of the proposal, including any conclusions, assumptions, and generalized recommendations the Offeror desires to make. Offerors are requested to make every effort to limit the length of the Executive Summary to no more than five (5) pages.

## **3.2 SECTION 2: COMPANY INFORMATION**

### **3.2.1 Company Profile**

Provide the information listed below relative to the Offeror's firm. If the Offeror is proposing to subcontract some of the proposed work to another firm(s), similar information must be provided for each subcontractor. Offerors are requested to limit the length of the Company Profile Information to one (1) page per firm.

1. Name of firm and business address, including telephone and fax numbers.
2. Year established (include former firm names and year established, if applicable).
3. Type of ownership and parent company, if any.
4. Project Manager's name, address, telephone and fax number, if different from (1).

### **3.2.2 Offeror's Authorized Negotiator**

Provide name, title, address, telephone and fax number of the Offeror's authorized negotiator. The person cited shall be empowered to make binding commitments for the Offeror and its subcontractors, if any.

### **3.2.3 Negotiation Prerequisites**

1. Discuss any impact of any current or anticipated commitments which may impact the ability of the Offeror or its subcontractors to complete the Feasibility Study as proposed and within the Project schedule.
2. Identify any specific information which is needed from the Grantee before commencing contract negotiations.

## **3.3 SECTION 3: ORGANIZATIONAL STRUCTURE, MANAGEMENT, AND KEY PERSONNEL**

Describe the Offeror's proposed Project organizational structure. Discuss how the Project will be managed including the principal and key staff assignments for this Feasibility Study. Identify the Project Manager who will be the individual responsible for this Project. The Project Manager must have the responsibility and authority to act on behalf of the Offeror in matters related to the proposed Feasibility Study.

Provide a listing of personnel (including subcontractors and consultants) to be engaged in the Project, either U.S. or local with the following information for key staff: position in the Project; pertinent experience, curriculum vitae; other relevant information. If subcontractors are to be used, the organizational relationship between the firms must be described.

A manpower schedule and the level of effort for the Project period, by activities and tasks, as detailed under the Work Plan shall be submitted. A statement confirming the availability of the proposed Project Manager and key staff over the duration of the Project must be included in the proposal.

### **3.4 SECTION 4: TECHNICAL APPROACH AND WORK PLAN**

Describe in detail the proposed technical approach and work plan. Discuss the Project requirements as perceived by the Offeror. Include a brief narrative of tasks within each activity series. Begin with the information gathering phase and continue through delivery and approval of all required reports.

Prepare a detailed schedule of performance that describes all activities and tasks within the Technical Work Plan, including periodic reporting or review points, incremental delivery dates, and other Project milestones.

Based on the Technical Work Plan, and previous project experience, explain when and where Offeror will require support from the Grantee. Detail the amount of staff time required by the Grantee or participating agencies and any work space or facilities needed to complete the Feasibility Study.

### **3.5 SECTION 5: EXPERIENCE AND QUALIFICATIONS**

Provide a discussion of the Offeror's experience and qualifications which are relevant to the objectives and TOR for the Feasibility Study. If a subcontractor(s) is being used, similar information must be provided for the prime and each subcontractor firm proposed for the Project. Relevant experience and qualifications of key staff proposed shall be provided including letters of commitment from the individuals proposed concerning their availability for contract performance.

As many as possible but not more than six (6) relevant and verifiable project references must be provided, including the following information:

- Project name,
- Name and address of client (indicate if joint venture),
- Client contact person (name/ position/ current phone and fax numbers),
- Period of Contract,
- Description of services provided,
- Dollar amount of Contract, and
- Status and comments.

Offerors are strongly encouraged to include in their experience summary primarily those projects that are similar to or larger in scope than the Feasibility Study as described in this RFP.

#### Section 4: AWARD CRITERIA

Individual proposals will be initially evaluated by a Procurement Selection Committee of representatives from the Grantee. The Committee will then conduct a final evaluation and completion of ranking of qualified Offerors, and the Grantee shall promptly negotiate a contract with the best qualified Offeror. If a satisfactory contract cannot be negotiated with the best qualified Offeror, negotiations will be formally terminated. Negotiations shall then be undertaken with the second most qualified Offeror and so forth.

The selection of the Contractor will be based on the following criteria and their corresponding assigned weights:

1. Professional Experience (45%) – Bidders shall propose a project team that is fully qualified to execute the entire study scope of work. The proposed staff should have qualifications and experience in geothermal investigations, engineering, technical analysis, operations planning and modeling, environmental assessments, as well as excellent technical knowledge of geothermal technology, power generation/supply, and appropriate software and hardware. Each member of the proposed project team should provide evidence of satisfactorily executing at least one (1) similar project in the last ten (10) years. Reference projects can be smaller in size, but equal or greater in complexity.
2. Proposed Work Plan (40%) – Bidders shall demonstrate an understanding of all project tasks. Proposed efforts should be responsive to the requirements outlined in the Terms of Reference. The proposed Work Plan should be detailed, realistic, and manageable. Clear objectives should be achieved at the end of each task.
3. International Experience (15%) – Bidders shall exhibit international experience and capability to perform similar feasibility studies in the region, preferably in South or Latin America. Bidders will need to provide evidence of satisfactorily executing at least one (1) similar international project in the last ten (10) years. Reference international projects can be smaller in size, but equal or greater in complexity.

Summary Table:

CRITERIA	WEIGHT / PERCENTAGE	MAXIMUM VALUE
Professional Experience	45%	45 points
Proposed Work Plan	40%	40 points
International Experience	15%	15 points
TOTALS	100%	100 points

Proposals which do not include all requested information may be considered non-responsive.

Price will not be a factor in contractor selection.

**ANNEX 1**

**FEDBIZOPPS ANNOUNCEMENT**

María Luz Pérez López, Gerente Proyectos de Generación, ISAGEN S.A. E.S.P., Av. El Poblado, Carrera 43 A No. 11A 80, Medellín, Colombia, Phone: (57-4) 316-5120, Fax: (57-4) 268-4646

## B – Colombia: Geothermal Power Generation Project Feasibility Study

POC Evangela Kunene, USTDA, 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901, Tel.: (703) 875-4357, Fax: (703) 875-4009. Geothermal Power Generation Project, Colombia. The Grantee (ISAGEN S.A. E.S.P.) invites submission of qualifications and proposal data (collectively referred to as the "Proposal") from interested U.S. firms that are qualified on the basis of experience and capability to conduct a Feasibility Study for developing a geothermal power generation project in Colombia.

ISAGEN S.A. E.S.P. is committed to developing geothermal power generation sources in Colombia. The objective of the Feasibility Study is to assess five (5) prospective geothermal power production sites in order to determine the most viable site. The Feasibility Study will enable ISAGEN S.A. E.S.P. to develop a 50 MW (or greater) geothermal power generation project.

The Terms of Reference (TOR) for the Feasibility Study include the following tasks:

1) Review available data, conduct field assessments, and compare and prioritize prospective geothermal sites; 2) Legal, institutional, and regulatory review; 3) Regional electricity market and technical evaluation; 4) Preparation of preliminary designs and cost estimates; 5) Economic and financial review of options and Project selection; 6) Environmental and development impact assessment; 7) Preparation of detailed cost estimates; 8) Preparation of tender documents; and 9) Preparation and presentation of the Final Report.

The U.S. firm selected will be paid in U.S. dollars from a \$599,310 grant to the Grantee from the U.S. Trade and Development Agency (USTDA).

A detailed Request for Proposals (RFP), which includes requirements for the Proposal, the TOR, and a background Definitional Mission report is available from USTDA, at 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901. To request the RFP in PDF format, please go to: <https://www.ustda.gov/USTDA/FedBizOpps/RFP/rfpform.asp>. Requests for a mailed hardcopy version of the RFP may also be faxed to the IRC, USTDA at 703-875-4009. In the fax, please include your firm's name, contact person, address, and telephone number. Some firms have found that RFP materials sent by U.S. mail do not reach them in time for preparation of an adequate response. Firms that want USTDA to use an overnight delivery service should include the name of the delivery service and your firm's account number in the request for the RFP. Firms that want to send a courier to USTDA to retrieve the RFP should allow one hour after faxing the request to USTDA before scheduling a pick-up. Please note that no telephone requests for the RFP will be honored. Please check your internal fax verification receipt. Because of the large number of RFP requests, USTDA cannot respond to requests for fax verification. Requests for RFP's received before 4:00 PM will be mailed the same day.

Requests received after 4:00 PM will be mailed the following day. Please check with your courier and/or mailroom before calling USTDA.

Only U.S. firms and individuals may bid on this USTDA-financed activity. Interested firms, their subcontractors and employees of all participants must qualify under USTDA's nationality requirements as of the due date for submission of qualifications and proposals and, if selected to carry out the USTDA-financed activity, must continue to meet such requirements throughout the duration of the USTDA-financed activity. All goods and services to be provided by the selected firm shall have their nationality, source, and origin in the U.S. or host country. The U.S. firm may use subcontractors from the host country for up to 30 percent of the USTDA grant amount. Details of USTDA's nationality requirements and mandatory contract clauses are also included in the RFP.

Interested U.S. firms should submit their Proposal in English and Spanish directly to the Grantee by 4:00 PM (local time in Medellín, Colombia), February 14, 2008, at the above address. Evaluation criteria for the Proposal are included in the RFP. Price will not be a factor in contractor selection, and therefore, cost proposals should NOT be submitted. The Grantee reserves the right to reject any and/or all Proposals. The Grantee also reserves the right to contract with the selected firm for subsequent work related to the project. The Grantee is not bound to pay for any costs associated with the preparation and submission of Proposals.

**A N N E X 2**

**BACKGROUND DEFINITIONAL MISSION REPORT**

# USPC

## U.S. POWER CONSULT

130 West Pleasant Avenue, Suite 115

Maywood, NJ 07607

Tel (201) 767-6641

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## COLOMBIA: DEFINITIONAL MISSION: GEOTHERMAL ENERGY DEVELOPMENT PROJECT

(RFQ-CO2007510003)

## FINAL REPORT

November 2007



This report was funded by the U.S. Trade and Development Agency (USTDA), a foreign assistance agency of the U.S. Government. The opinions, findings, conclusions, or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position and policies of USTDA.

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## The U.S. Trade and Development Agency

The U.S. Trade and Development Agency (USTDA) advances economic development and U.S. commercial interests in developing and middle income countries. The agency funds various forms of technical assistance, feasibility studies, training, orientation visits and business workshops that support the development of a modern infrastructure and a fair and open trading environment.

USTDA's strategic use of foreign assistance funds to support sound investment policy and decision-making in host countries creates an enabling environment for trade, investment and sustainable economic development.

Operating at the nexus of foreign policy and commerce, USTDA is uniquely positioned to work with U.S. firms and host countries in achieving the agency's trade and development goals. In carrying out its mission, USTDA gives emphasis to economic sectors that may benefit from U.S. exports of goods and services.

**Mailing and Delivery Address:** 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901  
**Phone:** 703-875-4357 • **Fax:** 703-875-4009 • **Web site:** [www.tda.gov](http://www.tda.gov) • **email:** [info@tda.gov](mailto:info@tda.gov)

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All inquiries regarding this and other USPC projects should be sent via e-mail to [INFO@USPowerConsult.com](mailto:INFO@USPowerConsult.com).

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This report was funded by the U.S. Trade and Development Agency (USTDA), a foreign assistance agency of the U.S. Government. The opinions, findings, conclusions, or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position and policies of USTDA.

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## **1. Executive Summary**

The U.S. Trade and Development Agency (USTDA) awarded U.S. Power Consult (USPC) a contract for a Definitional Mission (DM) to evaluate several geothermal projects in Colombia. The principal objective of this mission was to review a number of selected projects considered viable for further development.

A USPC senior staff member traveled to Bogota and Medellin, Colombia to meet with key, government officials, resident representatives of development agencies, representatives of local power sector institutions, national regulatory and planning agencies and private-sector project developers, as well as to conduct reviews of all the proposed projects.

Only one (1) project out of the proposed five (5) is currently being recommended by USPC for further USTDA development and consideration including grant funding for detailed feasibility assessments. The remaining four are either lower in the development priority or will be handled by other international development organizations that are specializing in project implementation funding including pre-investment assessments.

The recommended project is entitled Colombia Geothermal Power Portfolio Assessment. It was selected based on factors such as national priority for Colombia, significant U.S. export potential, evidence of potential availability of financing for implementation, and there being some foreign competitive element to be addressed by USTDA funding of the feasibility assessment.

## **2. Definitional Mission Background, Overview and Objectives**

USTDA decided to provide Colombia an on-site assessment of viability of project opportunities in the geothermal energy sector, by funding a Definitional Mission (DM). For this purpose, USTDA retained the services of U.S. Power Consult (USPC), an international power and energy sectors consulting firm based in New Jersey with experience in geothermal project development, to conduct a DM to analyze the proposed projects identified by Colombia.

USPC staff traveled to the host country to review the proposed projects and evaluate their technical, economic, and financial viability. Specifically, during the mission, USPC conducted expert analyses in the following areas: overall project technical viability, economic prospects, potential exports of U.S. equipment and services that could be utilized in project implementation, priority of the proposed projects relative to the needs of the host country; potential risks of the proposed projects; foreseeable financeability of the projects; and likely sources of financing.

This USPC report to USTDA resulting from the DM includes an analysis of the foregoing issues and provides recommendations on whether USTDA should fund additional efforts to bring the selected project(s) closer to implementation. Recommendations to fund (or defer funding of)



further feasibility studies of projects examined during the DM are contained in this report, which also includes a Budget and Terms of Reference (TOR) for the recommended activities.

USPC recommendations are based on the following specific considerations:

- Projects that qualify for USTDA funding must: (1) meet national development priorities for the host country; (2) have significant U.S. export potential; (3) be likely to be financed; and (4) have some foreign competitive element that is to be addressed by the USTDA funding of the study; and
- The project sponsor must be willing to allow U.S. companies to compete for contracts during project implementation.

It should be noted that most of the review by USPC of geothermal projects was based on information received at meetings with local government officials/utility representatives, detailed discussions with local expert organizations, view of the sites and surrounding environment from over-flights, and meetings with multilateral funding organizations. This took place during the DM in the host country. In addition, some of the published literature on prior geothermal studies was also examined.

### **3. Overview of Energy Issues and Priorities**

#### **3.1 General**

Colombia was one of the three countries that emerged from the collapse of Gran Colombia in 1830 (the others are Ecuador and Venezuela). A 40-year conflict between government forces and anti-government insurgent groups and illegal paramilitary groups - both heavily funded by the drug trade - escalated during the 1990s. The insurgents lack the military or popular support necessary to overthrow the government, and violence has been decreasing since about 2002, but insurgents continue attacks against civilians and large swaths of the countryside are under guerrilla influence. More than 32,000 former paramilitaries had demobilized by the end of 2006 and the United Self Defense Forces of Colombia (AUC) as a formal organization had largely ceased to function. Still, some renegade remnant paramilitary organizations continue to engage in criminal activities. The Colombian Government, however, has stepped up its efforts to reassert government control throughout the country, and now has a presence in every one of its municipalities. This, together with the steady economic growth of the nation, has helped significantly over the last few years<sup>1</sup>.

Colombia is located in South America, bordering the Caribbean Sea, between Panama and Venezuela, and bordering the North Pacific Ocean, between Ecuador and Panama. The overall land area is 1,038,700 square kilometers with a population of over 44.4 million people (per 2007

<sup>1</sup> CIA Factbook 2007, <https://www.cia.gov/library/publications/the-world-factbook/geos/co.html>



estimate). The national currency is Colombian peso (COP). The exchange rate at the time of host country travel was \$1US = 1,770 COP

The DM host country regional map is presented in Figure 1 below.

**Figure 1– Host Country and its Neighbors**



Source: CIA Factbook 2007

### **3.2 Power Sector Structure and Development Priorities**

#### **Energy Sector General Information**

Colombia is in the comfortable position of still being able to generate most of its electricity without need of imported raw materials. Colombia is South America's biggest producer and exporter of coal and is also a net exporter of oil, especially to the USA. In the medium term, though, Colombia will have to become a net energy importer due to its limited reserves of natural gas and petroleum. At the end of 2002, the country's total installed generating capacity on the interconnected grid amounted to approximately 13,500 MW.

Despite a major increase in gas-fired power plants, Colombia's overall power generating capacity is still clearly dominated by hydropower, the climatic dependence of which has substantial impacts on the supply side and pricing situation. While the power-plant mix shifted in favor of gas-fired power plants between 1991 and 1998, no major changes have since taken place, because new hydroelectric power plants have been added in the interim. In all, 32 large



hydropower plants and 30 thermal power plants, some comprising multiple units, feed electricity into the interconnected power grid.

The power plants scheduled for commissioning by 2007 include several small to medium-size hydroelectric facilities that are already under construction and will provide some 30 MW additional generating capacity,.. In addition, several gas-fired power plants of medium size (150–250 MW) are still at the planning stage. According to present planning, new hydroelectric generating capacities (600 MW and 78 MW) as well as new gas-fired CHP plants (totaling 650–750 MW) are anticipated for the period between 2007 and 2011. The long-term plans extending up to 2011 include scenarios providing for the construction of a 150MW coal-fired power plant.<sup>2</sup> A noteworthy non-conventional generation facility is a wind farm with just under 20 MW of installed capacity (Jepirachi in Guahira Province) that started in late 2003

### Legal Framework and Restructuring

In 1992 the Colombian electricity industry experienced one of its most difficult years, when the hydroelectric plants were not able to supply electricity as scheduled, because of a persistent drought and electricity rationing was the order of the day.

Subsequently, a sectoral reform was introduced with enactment of the Law on the Organisation of Public Services (Law no. 142, dated 11 July 1994, Régimen de Servicios Públicos Domiciliarios) and the Electricity Law (Law 143, dated 11 July 1994, Ley Eléctrica). The generation, transmission, distribution and marketing of electricity were separated, and the previous regional monopoly of utility companies was broken up. Free competition was introduced in areas where there was no natural monopoly, i.e. in the generation and marketing of electricity, while the other areas (i.e. transmission grid) are still regulated and monitored by the state.

The operators of the interconnected grid system, the regional transmission companies (Sistema de Transmisión Regional – STR) and local power distribution companies (Sistema de Distribución Local – SDL) therefore have to open their networks to every user and generator (non-discriminatory access). Moreover, wide-ranging privatization was introduced. This has affected all areas of the electric power industry and has not yet been completed.

Any investor is free to build additional power generating capacities, as long as the framework of other legal provisions is adhered to. A national commission (Comisión de Regulación de Energía y Gas – CREG) was set up to regulate the electricity market. This body regulates the general conditions for the efficient supply of electricity, the step-by-step liberalization of the electricity market, the standards to be applied to the wholesale market, free network access, the transmission and distribution charges, the tariffs for end-use consumers, protection of the consumers' interests, and matters pertaining to the vertical unbundling of the electricity industry.

<sup>2</sup> Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Energy-policy Framework Conditions for Electricity Markets and Renewable Energies



Otherwise, the state's tasks are essentially restricted to planning functions. The Unidad de Planeación Minero- Energética (UPME), organized within the Ministry of Mining and Industry, is responsible for analyzing future energy requirements and the corresponding supply situations and for drawing up the National Energy Plan (Plan Energético Nacional) as well as the Plan to Expand the Electricity Sector (Plan de Expansión del Sector Eléctrico). However, this planning is now only of an analytical nature and is no longer a binding stipulation for the expansion projects.<sup>3</sup>

#### Wholesale Market: Mandatory Pooling

Generating companies whose plants supply power to the national interconnected grid system and have a capacity of at least 20 MW are obliged to participate in the wholesale market (Mercado de Energía Mayorista – MEM) that was established in 1995 (per Resolution CREG-054 of 1994). The power generators must address hourly offers for the next day to the national dispatching centre in Medellín, where they are entered in the load distribution list in accordance with their quotations. There is no preferential treatment for certain types of power stations in that context. In order to prevent them from gaining a dominant position on the market, electricity suppliers are not allowed to provide more than 20% of the total generated quantity for national supply, including their capital involvement in other generating companies. Customers are not allowed to address purchase offers directly to the pool. The pool operator compares the offers with the estimated demand as a basis for setting the hourly pool prices.

Further distributors and large-scale consumers are allowed to enter into bilateral agreements with power generators, as long as the agreements are registered with the pool operator for invoicing purposes. Power trading is based primarily on long-term contracts; the spot market accounts for only about 34% of trading. The Colombian electricity exchange is characterized by uncertainty and widely fluctuating price situations resulting from the country's heavy dependence on hydropower and, in turn, the latter's dependence on sufficient precipitation. Hence, the average price of long-term contracts in dry years regularly drops below the exchange (pool) prices.

Since January 2000, there has been no regulatory binding for any end-use consumers with a power demand of at least 100 kW or electricity consumption of at least 55 MWh/month. By the end of September 2003, the number of unregulated consumers who had entered into free contractual commitments with their own suppliers or who had been able to meet their electricity requirements from the exchange with the help of an electricity trader had reached 3,640, and account for more than 30% of total electricity demand.<sup>4</sup>

#### Policy for Promoting Electricity Generation from Renewable Energy Sources

A development plan for alternative energies (Plan de Desarrollo Nacional de las Energías Alternativas) was announced in 1995 proposed measures intended to help promote the use of

<sup>3</sup> Inter-American Development Bank, The Power Sector in Colombia

<sup>4</sup> *ibid*



renewable energy sources. In practice, however, these announcements did little more than pay lip service to the problem and had no discernible impact.

The National Energy Plan (Plan Energético Nacional) underscores the importance of renewable energy while emphasizing the fact that, thus far, only very inadequate use has been made of it, at least in connection with power generation. The National Energy Plan assigns significant weight to renewable energy sources especially for urban and non-electrified off-grid areas or rural and isolated settlements.

The latest generation plans by private companies incorporate the use of natural gas and coal and, with regard to renewable energy sources, are confined to recommending the development of mini hydropower and pilot projects dealing with other renewable energy sources, such as wind and geothermal.

Some initial steps toward the systematic development of renewable energy sources resulted from Law 697, and the Government of Colombia created a framework for promoting the use of renewable energy sources. According to this law, it is planned to set up a program for the rational use of energy and the use of renewable forms of energy (Programa de Uso Racional y Eficiente de la Energía y Otras Formas de Energía No Convencionales – PROURE) under the auspices of the Ministry of Mines and Energy. It is also intended to develop political guidelines and strategies along with instruments to promote non-conventional energy sources, with the main emphasis being placed on regions that do not have access to electricity. Companies that manufacture or import components for use in exploiting renewable energy sources are to receive special assistance.

One concrete assistance measure in connection with PROURE is a provision of Law 788, dated 27 December 2002, according to which the sale of electricity from wind energy, biomass or agricultural waste is to be exempted from income tax for 15 years, as long as the following criteria are satisfied: participation in CO<sub>2</sub>-permit trading in accordance with the Kyoto Protocol, and reinvestment of at least 50% of revenues from sales in social projects situated within the area served by the utility.

Other incentive programs focusing specifically on the use of renewable energy sources are not yet in force, because the government is giving first preference to a competition-oriented policy in the development of the electricity industry.

Draft bill 170, which specifies the promotion of renewable energy sources within the entire territory of Colombia, was submitted. To begin with, the bill stipulates the exact definition of the term 'renewable energy sources', which covers solar energy, wind energy, geothermal energy, biomass and hydropower (continental as well as oceanic, i.e. ocean currents). However, no precise power rating limits are stated for hydropower, so the roughly approximated boundary lies somewhere between 10 MW and 20 MW.

Also, the Ministry of Mines and Energy is obligated to:



- Take an inventory of all available domestic conventional and renewable sources of energy at two-year intervals;
- Analyze the production costs of the various power generating processes;
- Ascertain and forecast the current and future national power consumption levels; and
- Draw up a new national energy plan based on and duly taking into account the above information.

#### Status of Renewable Energy Sources - Geothermal Energy

Despite multiple preliminary studies on the use of geothermal energy over the past 35 years, in addition to exploratory drilling performed by Geoenergía Andina S.A. (GESA) in 1997, Colombia's geothermal potential is still largely untapped, mainly because other domestic sources of energy, hydropower and coal in particular, are so plentiful. In fact, the only instance of any geothermal resource being put to use at all in Colombia was hot spring water used for heating 38 medicinal baths in 27 communities. All of these facilities together had a total installed capacity of some 13.3 MW, corresponding to an annual energy output of 266 TJ.

#### **4. Export Opportunities for U.S. Firms and Need for USTDA Participation**

The geothermal energy market is determined by the availability of the resources for electricity generation and direct heat use, and the competitiveness and profitability of them. The market for geothermally generated electricity is strictly governed by economic considerations, which are largely determined by the competitiveness of other energy sources.

An analysis of the geothermal turbines and generators market shows that it is dominated by five main companies (three Japanese, one Italian and one Israeli) which during period 1971-1995 installed about 6,771 MW in the world, about the 88% of the total (7,668 MW). The European presence represents only the 16% of the market, while the Japanese manufactures dominate with 73% of the market...<sup>5</sup>

It is advisable to look at the possible development of the geothermal market from different standpoints. There are three kinds of actors present in the market:

- The consulting engineering firms for exploration, field development, plant design, project analysis and management.
- The power plant suppliers (mainly turbo-generators manufacturers) which usually act as general contractors concerned with civil works, field equipment, installation of plant, substation, and fluid collection and disposal systems.
- The investors and operators of the field and/or the power plant

<sup>5</sup> [http://www.geothermie.de/egec\\_geothernet/menu/frameset.htm](http://www.geothermie.de/egec_geothernet/menu/frameset.htm)



As already mentioned, the geothermal market has particular characteristics in distinct parts of the world, and conversely, some countries in different parts of the world can have similar market conditions. This is especially true for Latin America and South East Asia where two main geothermal producers (Indonesia and the Philippines) have the same type of free market situation and Latin America where a transition from state property to a concession system is currently in progress.

In the last ten years there has been a tendency to lease a concession to operate field and power plant together, so that the investor sells electricity rather than steam. In the past, governments and state owned public utilities were clients for the actors listed above. In the new privatized markets the only sector dealing with the primary client (the Government's Agencies) are the investors (project owners) who now deal directly with engineering contractors and equipment suppliers.

The operators now involved in this market are a few companies, generally connected with oil or mining firms, with sound experience in geothermal exploitation and accustomed to dealing with mining risk or geological risk during the early phases of the development.

There are a number of ways for USTDA to help U.S. companies to improve their sales in Colombia. Perhaps the most effective is by including U.S. companies early in the project cycle (feasibility stage), USTDA thus permits them to assess the scope of the project early and allows them to include/take into account factors providing competitive advantages, such as state-of-the-art technology, low production costs, and co-financing. An active effort by USTDA to identify appropriate projects and provide feasibility study assistance will help in encouraging U.S. firms to pursue opportunities where they have strong technology advantages. Other methods that could be utilized in the U.S. and Colombia include active participation and exchanges in trade shows, expositions, orientation visits, and conferences. Most of these methods provide cost-efficient marketing opportunities for U.S. companies.

Colombia is America's 4th largest export market in Latin America after Mexico, Brazil, and Venezuela (which is almost equal with Colombia). Globally, Colombia ranks 25th as a market for U.S. products. Proximity and the established presence of U.S. products and investments in the market contribute to the continued success of U.S. companies in Colombia. Leading imports are industrial equipment, transportation equipment, consumer goods, chemicals, and paper products. The primary exports (on a cost basis) from the United States to Colombia are machinery and transportation equipment, and chemicals and related products.

Excellent opportunities for exports to Colombia exist in oil and gas exploration equipment and services, which is expected to be similar to geothermal exploration and production.. Another promising prospect is electrical power systems, provided that the regaining economic strength of Colombia continues, as does its rising demand for energy. Colombia's Ministry of the Environment estimates that the country's environmental investment needs will total around \$34 billion during the next decade. The best opportunities include water and wastewater treatment plants, water and air monitoring and control equipment, solid waste hauling and disposal equipment, and environmental services. Expected future expansion within the coal mining



industry in Colombia will provide opportunities for additional mining equipment exports, including shovels, excavators, front loaders and related equipment. During the first half of the 1990s, Colombia began lowering and simplifying its import tariffs in order to reform its foreign trade regime and open up the economy to foreign investment.

Since 1991, the Colombian government has implemented policies that do not discriminate against foreign investors and has aimed to treat domestic and foreign investors equally. Investment restrictions in various sectors have been eliminated, with the exception of those activities that relate to national security and toxic waste. As a result, the country has seen a significant increase in foreign investment since 1991. Some of the advantages that Colombia has to offer to foreign investors include duty-free zones, which were established to promote export of industrial products; special foreign trade rules; special tax rules, such as the Tax Refund Certificate (CERT), which was created so that exporters could use it to pay income taxes, tariffs and other taxes; the Paez Law and Quimbee Decrees which promote investment in regions affected by natural disasters; and finally, special trade zones comprised of free trade zones and special economic export zones (SEEZ).

Numerous foreign companies maintain activity in Colombia. Companies such as Exxon-Mobil, Chevron, Texaco, BP Amoco, Arco, Conoco, Triton, Harken, Shell, Elf Aquitaine, Total, Repsol, Lasmo, PetroCanada, Canadian Petroleum, Petrobras, Teikoku, Nexen, Inc. (formerly Occidental), and others continue to play a role in Colombia's oil and gas industries. U.S.-based Drummond Ltd. plays a major role in Colombia's coal mining operations. General Electric, AES, and the Chilean-based firms of ENDESA and Gener S.A. are involved in Colombia's electric industry.

## **5. Financing Energy Projects**

Several financing options should be considered and investigated. International banks and local financial institutions will need to be contacted to identify possible alternatives. Based on the current DM, options to be considered include, but are not limited to, the following:

- Utility Funding (or co-funding) via own Balance Sheet and Off-Balance Sheet Funding;
- Multilateral Lending Institutions (World Bank IBRD, IFC, IADB);
- Private Debt and Equity financing;
- U.S. Export-Import Bank guarantees and loans; and
- OPIC guarantees;

The positive environmental benefits of a renewable energy project may open up additional sources of financing. These may include various types of pollution abatement funds (GEF) associated with entities involved in trading CO<sub>2</sub> credits resulting from reductions in greenhouse gases.

Likely financing terms for each alternative will need to be identified. Financial commitments required from the project Owners may need to be evaluated and the ability to meet these



obligations identified. Concerning ISAGEN, IFC has commented on the strong financial position of ISAGEN at present, and indicated IFC willingness to participate in project implementation in partnership with ISAGEN.

#### Utility Financing and Project Financing

The simplest way to finance a new capital project like a geothermal power plant would be to do so directly from ISAGEN's cash flow. However, given the need to maintain electricity tariffs at affordable levels, and the sheer scale of capital expenditure required to add new capacity in a rapidly growing power system like Colombia, this option may not be fully feasible.

Another option is corporate or full recourse financing. Under such an approach ISAGEN would issue bonds or take corporate loans that would be secured by strength of ISAGEN's balance sheet. By using such a mechanism to finance new plants, ISAGEN takes on all risks associated with the new projects regardless of whether ISAGEN is best equipped to manage those risks. In the event ISAGEN were to default on repayments to corporate lenders or bondholders, those investors would have a claim to ISAGEN's assets.

Full recourse financing would be a more appealing option if ISAGEN not only earned an operating profit, but also earned an economic return on capital. Such a level of earnings would both make ISAGEN attractive to commercial lenders and the capital markets. In this regard, CREG has commented that geothermal power plants would be allowed 20-year contracts for power sales similarly as allowed for coal plants. Earning an economic return would provide ISAGEN with the equity capital base upon which to comfortably leverage debt. This will need to be reviewed and confirmed given current tariff levels vs cost of service. Moreover, ISAGEN has only a finite amount of assets and under investor's perception claiming the associated assets is not a realistic solution, in addition the balance sheet can consequently only support so much full recourse financing before ratings slip to a level that make the cost of such debt unaffordable.

Full recourse financing is in this sense a "last resort" which should be used only when capital expenditures cannot be financed by other means. Sovereign guarantees of ISAGEN debt could expand ISAGEN's ability to take on such debt, but at the expense of the Government's ability to take on debt for other pressing needs such as health, education, and other social services. In the absence of sovereign guarantees, ISAGEN would likely need to pledge or otherwise encumber a significant portion of its operating assets – an unsavory proposition that could work in the short term but would severely limit ISAGEN's options to fund more projects, both big and small, in the long term.

In contrast, project or limited recourse financing is secured on the basis of the cash flow generated by the individual project developed with the financing provided. Such projects can be structured to ensure that risks are allocated to the parties that have the best ability to manage those risks. Most importantly, limited recourse financing segregates project liabilities from the corporate balance sheet by creating a special purpose vehicle to undertake the project (hence



reducing the restrictive covenants on the corporate balance sheet arising from the project's debt financing).

Another feature that could make a geothermal power project attractive to investors is based on CREG comments during the DM that the cost of connecting the power plant to the grid would be assumed by the grid operator if the project were beneficial to the system (i.e. base load generation, which is the case for geothermal plants).

### Multilateral Funding

Most of the multilateral lenders are currently active in Colombia. The World Bank lending operations in Colombia cover power, water supply, wastewater and sanitation management (to help Colombia meet its MDG target to increase access to safe water), national urban transportation and urban upgrading strategy (with a focus on improving shelter and basic services to the lowest income deciles).

The International Financial Corporation, (as the private development arm of the WB) complements the Bank's activity in Colombia, The IFC focus is on supporting new forms of public-private partnership—where complementary public and private investment could improve access to services and fostering local currency-denominated long-term financing through credit enhancement. Together, these operations help improve access of essential public services (e.g., power, water, sanitation and community roads) to the poorest segments of the population, put in place cost recovery and tariff structures that are socially and environmentally responsive, increase private participation and bring in the critically needed investments in these sectors, and help enhance efficiency of infrastructure provision and bring down logistics costs in the economy. Future activities also envision taking advantage of opportunities offered by the Kyoto Protocol through sources such as the Prototype Carbon Fund (PCF) or the IFC-Netherlands Carbon Facility to finance grid and off-grid solutions making use of renewable energy sources (e.g., wind power, geothermal, and small, run-of-river hydro power) and thereby contribute to pursuing a better energy-environment balance.

The Inter-American Development Bank has been active in Colombia for some time. The strategic focus of the IADB in the electrical sector of Colombia in the past was aimed at sustainable growth. In the electricity sector, regulatory and institutional machinery were strengthened, the involvement of private enterprise was facilitated, and a rural electrification policy was developed. Going forward, IADB will focus on (i) helping make the electric power sector financially sustainable; (ii) consolidating the electric sector regulatory function; (iii) devising a rural electrification policy for off-grid areas; and (iv) facilitating private-sector involvement in national power companies. In discussions with IADB in the current DM, IADB mentioned that they would consider using an infrastructure development fund (Infrafund) for conducting pre-investment studies prior to project implementation.

Japan Bank for International Cooperation (JBIC) signed in 2005 a cooperation agreement for promoting the use of the Clean Development Mechanism (CDM) in the Republic of Colombia



with the Ministry of the Environment, Housing and Territorial Development. The cooperation agreement aims at promoting CDM-related projects in the Republic of Colombia through JBIC finance as well as supporting Japanese firms to acquire emission credits (Certified Emission Reductions (CERs)) generated from such projects. Specifically, the cooperation agreement sets forth: (1) exchange of information on candidate CDM projects in the Republic of Colombia and cooperation in obtaining approval within the Republic of Colombia for the candidate CDM projects in which JBIC is involved; and (2) that JBIC will consider financial support for those candidate CDM projects and provide advice on their financing. The proposed geothermal project may qualify under special treatment under CDM.

### U.S. Based Funding and Insurance

The Overseas Private Investment Corporation (OPIC) is the primary U.S. government agency focused on supporting and encouraging private sector investment in the developing world. OPIC helps U.S. businesses invest overseas by providing financing and insuring eligible projects against political risk, fosters economic development in new and emerging markets, helps expand the availability of equity capital, and supports U.S. foreign policy goals. Encouraging significant private investment in Latin America, OPIC political risk insurance is already covering \$212 million in financing for ISAGEN, in order to upgrade and repair its power facilities in Colombia. This enables ISAGEN to increase Colombia's electricity generation. Additionally, the financing will support projects that will generate additional tax revenues for the Government of Colombia, and provide equal employment opportunities including diversity policies, health care, housing and transportation for a largely rural workforce.

The Export-Import Bank of the U.S. (Ex-Im Bank) provides a full range of services in Colombia. Ex-Im Bank offers a range of loan, insurance and loan guarantee programs to facilitate exports of U.S. goods and services to Colombian governmental and private companies.

## 6. Long List of Projects

A total of five (5) projects were identified as having potential for further development by USTDA before the investigation trip to the country. The table below provides the long list of projects that were initially provided to USPC for investigation. Discussions during meetings in the host country, as part of the DM, provided clarifications that resulted in the recommendations below. The project recommended for USTDA follow-up represents a blend of Projects 1 and 4 in the long list and aims at accelerating the overall program. (See Recommended Project 1 section, page 16) Its scope and deliverables were discussed with ISAGEN in detail.



Project No.	Project Name, Owner	Project Type	Technical Details	USPC Comments/ Recommendation
1	Assessment of Geothermal Sites	Power production	Assessment of geothermal energy potential in three promising sites in Colombia.	<i>USTDA feasibility support is recommended.. This will lead to the selection of the Best Site from among the 5 promising sites identified in the DM</i>
2	Geothermal Institutional & Legal Framework Assessment	Power production	Assessment of the institutional and legal framework for the development of Colombia's geothermal energy Potential.	Part of the assessment has already been done (by ISAGEN). Areas remaining are to be done in (1) above
3	Pre-investment Assessment of Geothermal Resources	Power production	Pre-investment studies of specific geothermal sites, including design of the environmental and social Assessments and test drilling to determine geothermal potential.	Assessment to be done after completion of project (1) above under co-financing by the investment partners & third party grant/loan (e.g. IDB's Infracund)
4	Pre-investment Studies for Engineering Design of Geothermal Power Plants	Power production	Pre-investment studies for the preliminary engineering design of geothermal power plants.	<i>Assessment for most promising site to be done as part of project (1) above under USTDA support. Pre-investment assessments for other promising sites can be co-financed by the investment partners &amp; third party grant (e.g. IDB's Infracund)</i>
5	Structuring of Project Finance	Power production	Structuring of (geothermal) project finance and business model development, with an emphasis on private sector participation.	Assessment to be done after completion of project (1) above under financing by the investment partners

## 7. Contacts

The following list provides the names and affiliations of the major contacts made during this Definitional Mission:



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**RECOMMENDED PROJECT**

**Project 1 - Colombia Geothermal Power Portfolio Assessment**



## **Colombia Geothermal Power Portfolio Assessment**

### **Summary**

This project has been identified by Colombia's Ministry of Mines and Energy as having a very high development priority. The project includes the construction of a 50 - 250 MW geothermal-energy based power plant that will be capable of producing electricity, as primary output, with possible production of by-product steam/hot water for heating, industrial or other local uses.

The assessment study proposed to TDA will identify the site and determine the technical and financial feasibility of a plan to construct a greenfield geothermal power generation facility that will provide reliable and efficient base-load electric generation and distribution. In addition, and to the extent any of the options studied may permit, propose the best technical and financial solution for the implementation of a geothermal project with the lowest environmental and local impact and lowest cost.

This project is expected to offset greenhouse gas emissions from older power facilities and individual industrial or residential heating facilities utilizing fossil fuels. The new facility will utilize modern, efficient, and environmentally friendly geothermal energy recovery and power production technology. The project will be able to provide power, to the Colombian grid or locally, roughly equivalent to satisfy the needs of 5,000-25,000 households. The project was proposed initially by ISAGEN with the endorsement of the Ministry of Mines and Energy and reconfirmed during the DM as the most important among those being considered for non-conventional energy development.

Based on the discussions during the DM, both IFC and IADB have indicated that they would consider funding participation and support of project implementation after successful completion of the assessment project being proposed to USTDA. IADB also indicated that they would consider participation in pre-investment studies (e.g. drilling tests at the best site) identified as a result of the TDA project. In addition, ISAGEN has brought the geothermal project to the attention of Colombia's Ministry of the Environment, which has been in contact with the World Bank (GEF) and received confirmation that the geothermal project would be eligible for GEF funding, assuming the normal WB funding criteria is met.

No adverse impact is expected from the execution of the proposed project at a suitable location and based on the application of modern technology. Its significant procurement potential for its implementation would assure a significant share of major goods and services from the U.S. in the host country. No offshore permanent new job creation detrimental to U.S. labor is expected.

The overall project cost is in the range of \$90 to \$127 million (50 MW) to \$450 to \$638 million (250 MW). U.S. exports could be in the range million of 50% (\$45 to \$63 million level for a 50 MW plant). A number of U.S. firms have suitable credentials to be interested in the proposed project. The budget for the assessment study proposed to USTDA is estimated to be \$600,000.



## Project Description

### Background

As mentioned above, the installed generating capacity in Colombia is primarily based on hydro resources, with a capacity representing around 65% of total installed capacity and the hydro-derived energy supplying approximately 80% of the energy demand. The Colombian power system can therefore, be characterized as an environmentally clean electrical system.

On the other hand, during the periods of 1992-1993 and 1997-1998, as a result of the presence of the ENSO phenomenon (El Niño), there were periods with significant limitations in energy supply and power blackouts. Accordingly, the Government of Colombia has been implementing policies with the purpose of diversifying the resources that are used for the country for power generation. As a result, power-sector expansion plans have been proposed with greater use of thermal resources, including gas and coal as fuels, with the objective of reducing the dependency on hydropower. Fossil fuel derived generation, however, increases the emission of gases with green house gas (GHG) effects with the subsequent undesirable climatic changes.

As part of the strategy mentioned above and taking into consideration not to increase the GHG emission risks, the Colombian government is supporting the development of generation projects based on the use of non-conventional energy resources, with emphasis in small-scale hydro generation, wind power generation and other alternatives such as geothermal power.

ISAGEN as part of its generation expansion plan has been carrying out activities that include a component of projects based on non-conventional renewable resources in accordance with the national policies related to cleaner energy production and sustainable development. The proposed project "Colombia Geothermal Power Portfolio Assessment" with the objective of developing power generation based on geothermal resources, is part of this plan.

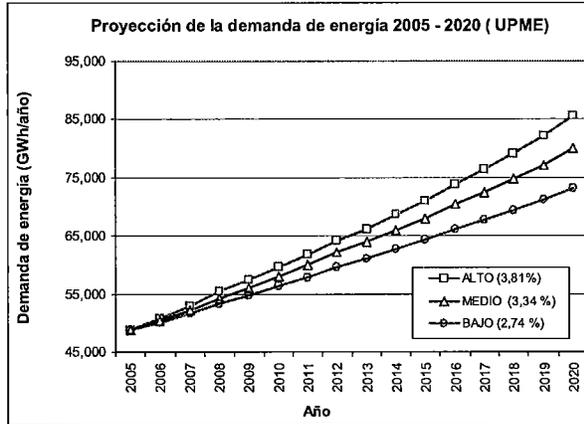
The projections for power demand in Colombia for the years 2007 to 2020, as well the requirements for generation expansion in Colombia's electric system is presented in the following two exhibits prepared by UPME (Planning Unit of the Ministry of Electricity and Mines). ISAGEN's plans for introducing 50 to 250 MW of geothermal derived power by the year 2011 would not be adverse to such plans. In addition, the Ministry of Electricity and Mines has strongly endorsed the development of geothermal resources for power generation in Colombia.



Exhibit on Colombia's Energy Market – Demand projection scenarios (high, medium & low) for the years 2006 – 2020

## MERCADO DE ENERGÍA

### Escenarios de Proyección de Demanda



Fuente: UPME Plan de Expansión de Referencia Generación-Transmisión 2006-2020, Noviembre 2006



Exhibit on Colombia's Electricity Market – Requirements for expansion in generation for the years 2007 – 2020 (h= hydro, g= gas, c= coal)

## MERCADO ELÉCTRICO

### Requerimientos de Expansión en Generación 2007-2020

PROYECTO	GENERACIÓN AL 2020		
	H	G	C
2007		54	
2008			
2009	80	163	
2010	192		
2011	495		
2012			150
2013			160
2014			
2015	400		
2016		166	300
2017	800	150	
2018		400	
2019			
2020			
SUBTOTAL-MW	1967	933	610
TOTAL -MW		3510	

Fuente: UPME



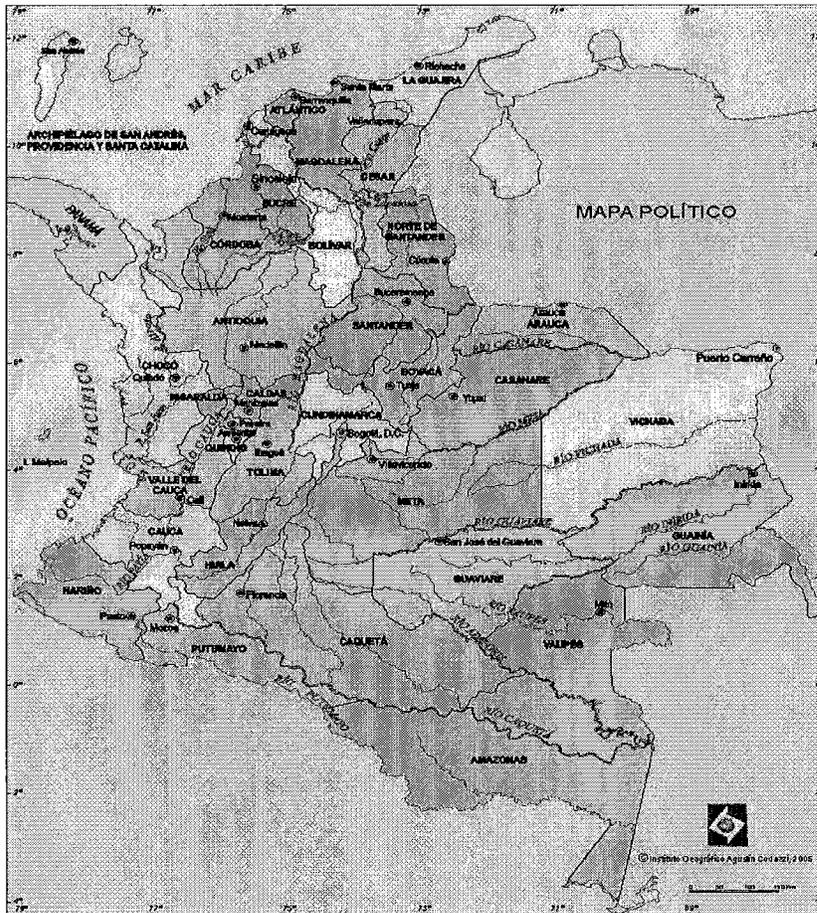


Colombia Geothermal Project Goal

The goal is to establish a geothermal power portfolio (i.e. a set of geothermal projects at different sites that meet typical economic/financial figures of merit and that can be implemented successively in accordance with power demand) with the first project (designated by ISAGEN as Geocolombia I) to be on line by 2011. Subsequent geothermal projects would follow according to the Colombian economic and energy market conditions driving future generation projects development. In accordance with the geological and other characteristics at each site, the most appropriate technology would be selected and applied.

According to prior exploratory-level technical studies of geothermal resources in Colombia, there are four (4) zones (geographic regions) that have been identified where geothermal generation projects may have significant potential for development. They are in the provinces (Departamentos) of Boyacá, Caldas, Nariño and Risaralda, which are shown in the following map).

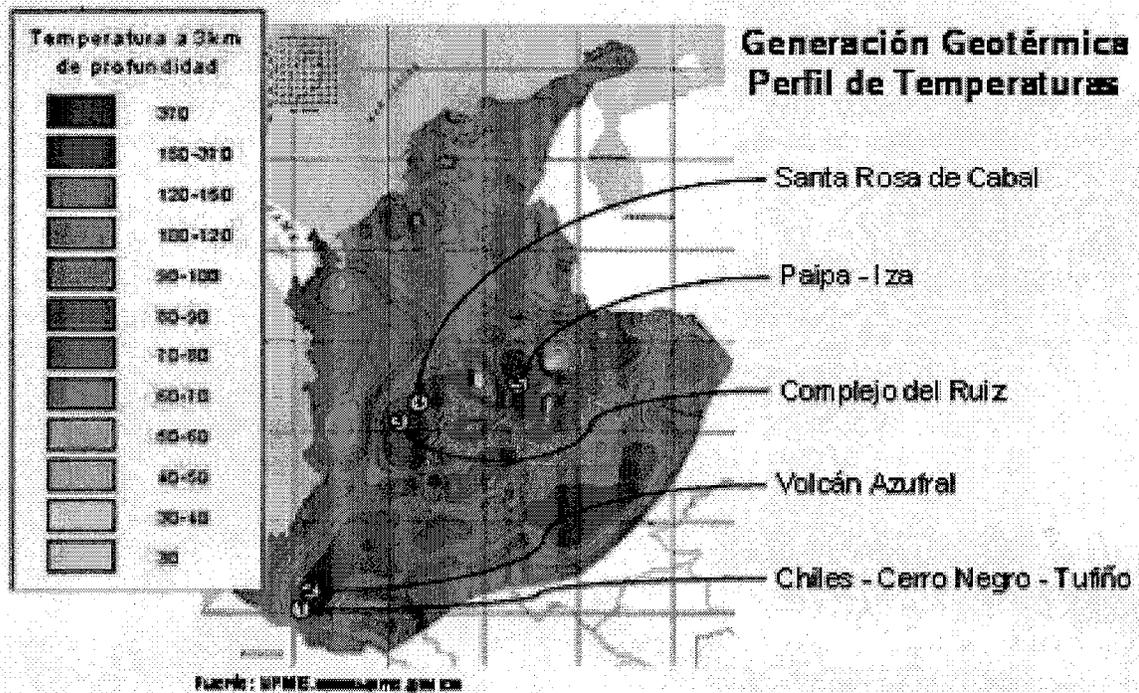
Map of Colombia showing the demarcation of Provinces (Departamentos) in the country





Based on additional studies, the geothermal zones have been further defined according to projected geothermal fluid temperature at a depth of 3 Km. These temperature profiles are shown in the following map. Based on projected fluid temperatures and characteristics of the areas being considered, five (5) sites have been selected to be examined in detail in the proposed project: Santa Rosa de Cabal in Risarada and Caldas Provinces, Paipa-Iza in Boyaca Province, Nevado Ruiz Complex in Caldas Province, Azufral Volcano and Chiles-Cerro Negro areas in Nariño Province:

**Map of Colombia showing projected subsurface fluid temperatures (3 km depth) for areas in the nation**



Summary of the 5 Sites Planned for Assessment in Portfolio of Geothermal Projects

**Geothermal Site 1: Chiles-Cumbal-Cerro Negro-Tufino Area**

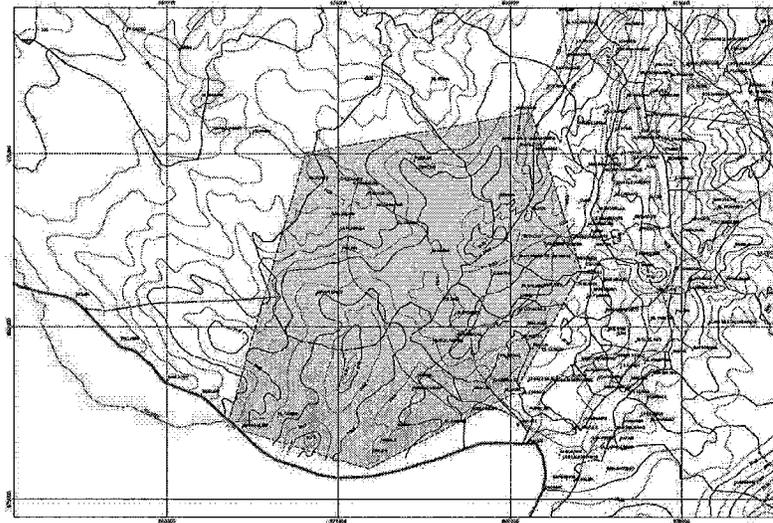
This area (i.e. geographic region) is located in the south of Nariño Province, close to Ecuador and near to the Cumbal, Miraflores, Chiles and Tufino municipalities. The main economic activities are cattle ranching and farming activities.

This area is characterized by having had volcano activity in the Pliocene (last eruption about 30000 years ago) and current thermal fluid manifestations at the ground surface (crater with water table). The underlying geological formations are primarily of magmatic origin (andesites



to rhodasites). The substratum derived from the recent volcanic products is constituted mainly of tertiary volcanic rocks (primarily plagioclase and feldspar).

The area is shown in the following map:



Different studies to obtain geothermal information related with this area have been developed:

- In 1981, OLADE and the ICEL implemented a study of geothermal resources at the national level, which established the high-priority to be assigned to the Chiles – Cerro Negro area, in the border with Ecuador.
- In 1982, Colombia and Ecuador agreed to develop a joint exploration project and signed a Binational Agreement for the Geothermal project Tufiño-Chiles-Cerro Negro.

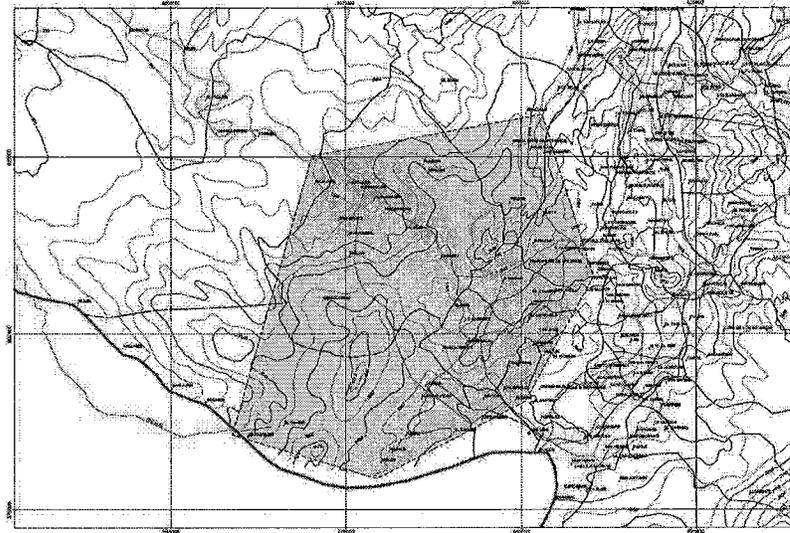
### **Geothermal Site 2: Azufra Volcano Area**

This area is located in the south of Nariño Province (North of Site 1), close to the border with Ecuador and between the municipalities of Sapuyés, Tuquerrez, Santa Cruz and Mallama. The main economic activities are cattle ranching (bovine and pig type), agriculture (wheat) and commerce in the region.

The geological area is classified as a stratovolcano (extensive layered formation), formed on an older volcano base. The geothermal characteristics of interest are: recent age, it has had a large persistence of volcanic activity (at least 400,000 years), presents a complete magmatic evolution at the site from andesites to rhyolites, there is fumarolic activity inside the crater (85-90 °), shows numerous thermal manifestations and there is evidence of the presence of a water-bearing high temperature fluids in the volcano subsoil.



The area is shown in the following map:



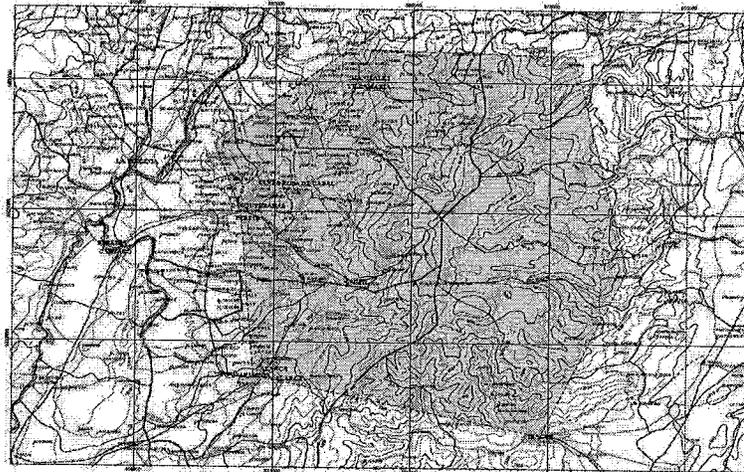
- In 1997, INGEOMINAS started the Azufral Volcano geothermal exploration and development studies including geology, volcanology and geochemistry, with the objective of identifying and characterizing the existence of usable hydrothermal deposits.
- In 2000, INGEOMINAS with support of the Inter American Development Bank, considered a geothermal project in the area of Azufral volcano. However, the studies were not executed because of security conditions in the region.

### **Geothermal Site 3: Nevado Ruiz Complex Area**

This area is located in the northern sector of the Andes (the Colombian Central Mountains), between the Caldas and Tolima Provinces, and the Magdalena and Cauca valleys. The Nevado Ruiz summit reaches an altitude of 5321 m. above sea level. The main local activities are agriculture, cattle ranching, mining and commerce. A glacier of over of 4000 m (.the volcano is covered by a glacier cap with an ice volume calculated to contain 1,200 to 1,500 million m<sup>3</sup> of ice) with easy access from the town of Manizales have made the Ruiz snow-covered mountain a tourist attraction.

Geologically, this area is a stratovolcano. It has had an eruptive history of over 1.8 million years. It is the most active volcano in the north of South America, with fumaroles and ash emissions.

The area is shown in the following map:



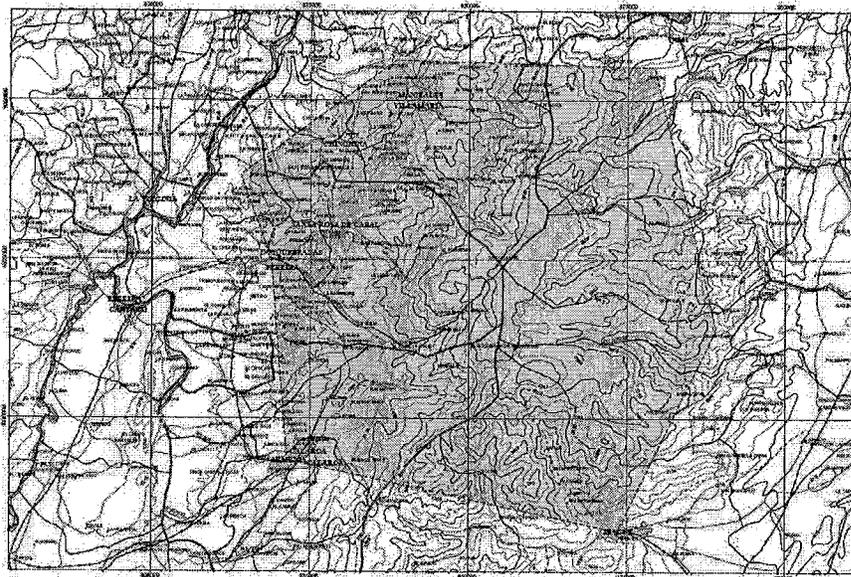
- In 1981, CHEC conducted geothermal pre-feasibility studies in the Ruiz Volcano Area with the participation of ICEL .
- In 1994, Geoenergía Andina S.A. (GESA) summoned an international panel of geothermal experts, who proposed to drill 5 exploration wells from which 8 sites were identified.
- In 1998, GESA made exploratory drillings in the Nereidas area to ascertain geothermal resources.

#### **Geothermal Site 4: Santa Rosa de Cabal Area**

This area is located in the south east of Risaralda Province between the municipalities Chinchina, Villamaría, Pereira, Santa Isabel, Dosquebradas and Marcella. The most significant economics activities are agriculture, cattle ranching and mining.

Santa Rosa de Cabal is recognized by the thermal sources in the region of Santa Rosa, such as San Vicente, el Cráter, la Roca y los Helechos. The source of the thermal water is assumed to be the Ruiz snow-covered volcano and surfaces around the municipality of Santa Rosa de Cabal. The waters are classified as pH neutral waters with high bicarbonate content. These waters are expected to originally having gained heat from deep sources, through existing fractures or faults in the neighborhood of the water-bearing structures.

The area is shown in the following map:



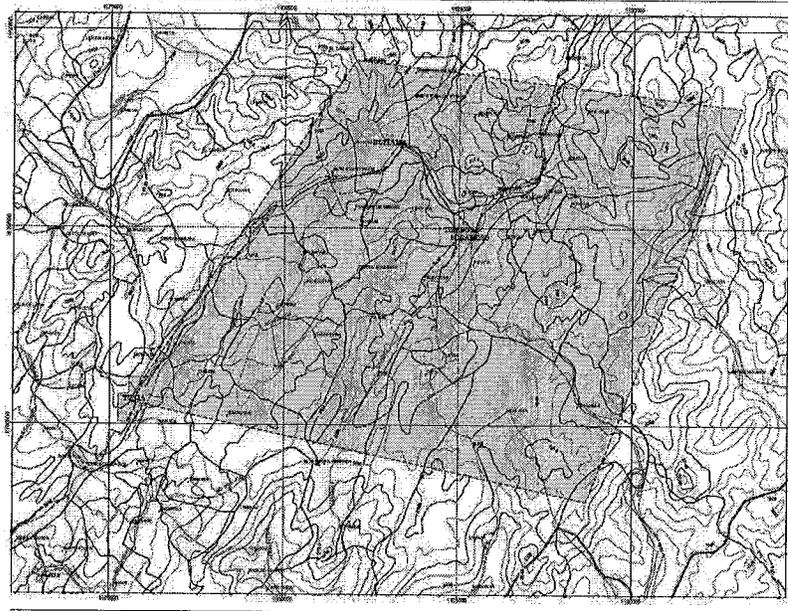
- In 1981, CHEC developed geothermal pre-feasibility studies in the Ruiz Volcano Area with ICEL participation.
- In 1994, Geoenergía Andina S.A. - GESA, summoned an international panel of geothermal experts which proposed to perforate 5 exploration drillings, 8 sites were identified.

#### **Geothermal Site 5: Paipa-Iza Area**

This area is located in Boyacá Province near to Sogamoso, Paipa and Duitama cities. The main economic activities are cattle ranching, agriculture (corn, wheat, radishes, barley; etc), artisans industries (wool knit articles), beneficiation of asphalt deposits, mining of coal and minerals (limestone) and tourism.

The interest in this zone is based on the thermal manifestations at ground surface, such as the acid volcanic rock projection, that has produced domes and tuff-rings with associated pyroclastic products (of type surge and flow), and continuing phenomena of thermal alterations of deposits. Hydrothermal manifestations and hot water can be observed at: Termal de Paipa (52°C), Pozo Hotel Lanceros (72°C), Piscina el Batan (55°) and Piscina Brica Iza (47°). Geologically, the main formation in this zone is arenaceous deposits and argillites.

The area is shown in the following map:



### Development Impact

This project will yield significant economic and technical benefits locally around the geothermal sites developed, to Colombia as a nation, as well as (in the long term) regionally due to the reduction of greenhouse gas emissions from older fossil fuel facilities and residential cooking heating by electricity, wood or coal.

The geothermal plants are proven mechanisms for efficient delivery of power and heat and a plant of this nature is well within the priority accorded to such projects in the Energy Sector Strategy for Colombia. The project was originally proposed by ISAGEN, on behalf of the Ministry of Mines and Energy, and reconfirmed by the Ministry during the DM as one of the most important in the Ministry's list.

In addition to meeting the power needs, geothermal power generation is one of the most efficient and environmentally sound vehicles of energy production and thus is clearly a priority under the Government of Colombia's developmental goals. Project construction will employ a significant amount of local labor (estimated at over 100 construction workers and at least 20-25 operating crew). The project is expected to supply about 50 MW in its first stage. The project will thus be able to provide power to roughly 50,000-75,000 households.

Also, project development would have a positive local impact in the cattle ranching, farming, mining, commercial and other activities, by enhancing electric services. It can improve the regional population quality of life as result of better availability, reliability and quality of electric services and related infrastructure.



## Project Sponsor's Commitment

ISAGEN S.A. E.S.P. has received the endorsement by the Ministry of Mines and Energy as the lead organization behind this project. ISAGEN is a mixed public utility company, of commercial character (partially owned by the Colombian Government but operating as an independent company in the power sector. Its main corporate business objectives are electric energy generation and its commercialization, the commercialization of natural gas by pipeline networks, and coal, steam, and other energy resources development for industrial use.

As part of the above objectives, ISAGEN develops and promotes generation projects through a portfolio of diverse generation options and the development of projects (based on quality, sustainability and profitability criteria), in response to energy market needs and expectations.

For the development of new projects (including geothermal power) ISAGEN has the following capabilities and options:

- i) Participating with third parties in the studies and development of projects, through its implementation
- ii) Selling studies and projects to third parties and
- iii) Establishing companies with the specific purpose of developing projects .

ISAGEN is one of the largest Colombian companies in the field of energy generation. The major shareholders are the Colombian Government (77%) and EEPPM (13%) and the minority shareholders are the energy generation companies EPSA and EEB and the Financiera Energética Nacional S.A. FEN.

The company was created in May of 1995 through the splitting of ISA (currently the electric grid operator), as a result of the electric sector restructuring and the aperture to a competitive open market in accordance with the Laws 142 and 143 of 1994. The operational areas and installed capacity of ISAGEN are summarized in the map and table below.



Map – Location of ISAGEN main power generation plants

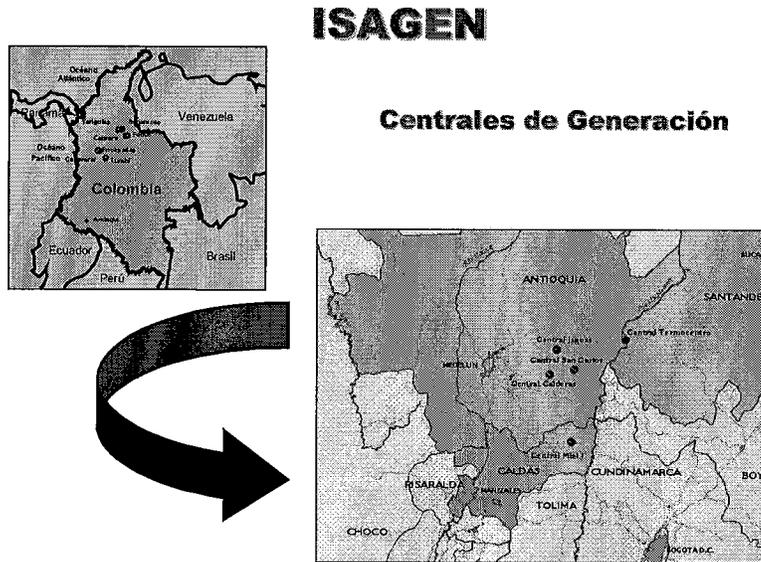


Table – ISAGEN capacity of generation installed at different plants (MW) and energy generated in 2006 (GWH/year)

**ISAGEN**

**Capacidad Instalada y Energía Generada - 2006**

CENTRALES	CAPACIDAD INSTALADA (MW)	ENERGÍA GENERADA GWh / Año
SAN CARLOS	1.240	5.930
JAGUAS	170	717
TERMOCENTRO	300	229
MIEL I	396	1.492
CALDERAS	26	48
<b>TOTAL</b>	<b>2.132</b>	<b>8.443</b>

- La participación en generación en el SIN fue del 16,12% en el 2006.
- La interconexión con Venezuela es equivalente a 150 MW.





ISAGEN current plans for development of hydro and power generation projects are shown below:

**Power and Energy in ISAGEN Expansion Plan**

Project	Power MW	Energy GWh - year	Status
Guarinó River Transfer	-	238	In execution
Manso Phase 1	-	179	In design
Manso Phase 2	27	128	In design
Amoyá River	80	511	In execution
<b>Total</b>	107	1.056	

In addition to the above expansion plans by ISAGEN, there are nationwide opportunities for ISAGEN participation in hydroelectric and thermal power projects as shown below:

**Table – Portfolio of current studies for hydropower projects in Colombia (F= Feasibility & D= Design Status)**

**Portafolio de Proyectos Hidroeléctricos**

Proyecto	Estado Estudios	Capacidad (MW)	Energía (GWh/año)
Andaquí	F	665	4336
Cabrera	F	600	2700
Cañaveral	F	68	415
Encimadas	F	94	548
Fonce	F	434	2138
Sogamoso	D	800	4661

Estado Estudios: D: Diseño; F: Factibilidad





Table – Portfolio of current studies for thermal projects in Colombia (DB=Basic Design Status)

**Portafolio de Proyectos Térmicos**

Proyecto	Estado Estudios	Capacidad (MW)	Energía (GWh/año)
Termo Lumbí	DB	300	2231
Termo Yariguíes	DB	225	1872
Termo Cesar	DB	300	2234

Estado Estudios: DB: Diseño Básico



More detail information about ISAGEN is available at: [www.isagen.com](http://www.isagen.com)

**Implementation of Financing**

As in any developing economy such as Colombia, financing of infrastructure projects remains as a critical component. However, the financial resources and financial/operational track record of ISAGEN is believed to be beneficial to the implementation of the project

The funding agencies have also taken cognizance of the fact that Colombia is endowed with significant energy resources, has a strongly developing economy and is well located to play a significant role in the energy market of the Americas. In addition, Colombia has a good record in trading with the USA, Europe and beyond

During the DM, discussions were held with multilateral funding agencies, notably IFC, Inter American Development Bank and World Bank. It was clear from the discussions that IFC and IDB would support a geothermal project that would offer efficiency and environmental advantages, in particular if this were in partnership with ISAGEN, as a credible organization. The WB has had prior discussions with Colombia’s Ministry of Environment about incorporating a geothermal project in the portfolio of GEF projects. Discussions with Colombian regulatory (CREG) and oversight (DNP) agencies, as well as at the Ministry of Electricity and Mines and



local expert organizations (INGEOMINAS, UPME, etc.) demonstrated a strong support for the project implementation, which support is expected would facilitate project financing. In brief, the results from the discussions with these entities during the DM can be summarized as follows:

*Summary of DM Findings:*

- ISAGEN is considered to be one of the premier organizations in Colombia based on the views of organizations visited during the Mission
- Geothermal energy development has strong support at the Ministry of Energy and Mines. and DNP
- There is significant subsurface information on geothermal resources in Colombia but this needs to be reviewed, organized and complemented by additional info needed for the sites being considered as basis for an investment plan. Ingeominas has done field investigations in the past and its experience would be useful in geothermal development
- Above-surface geothermal energy-to-power plant design and cost estimates should be based on current worldwide experience on geothermal plants..
- Both IFC and IDB would consider cost sharing with ISAGEN on project implementation (i.e. equipment procurement and construction costs). IADB would also consider sharing in the funding of the Pre-investment studies phase (~ \$3.5 Million) following the Resource Assessment phase (which is being proposed by ISAGEN to be funded by USTDA).
- ISAGEN has had prior ('06-'07) interaction with the WB on the use of GEF funds for project implementation and apparently received a positive WB reaction as of that date.
- CREG is supportive of geothermal energy development for power supply and noted that geothermal power would be given similar treatment as base-load coal-fired plants including potential 20-year commitments on energy purchases. Cost for connection to the grid need not be assumed by the geothermal developer but could be absorbed by the grid. These features are likely to help in project financing by outside entities.

## U.S. Export Potential

Taking as reference a geothermal power generation development plan including assessment of five (5) sites, where power projects can be developed with a capacity of about 50MW at each site and possibly more (250 MW), with an approximate cost of USD\$ 1800 to \$2,550/kW, the total project cost would be in the range of \$90 to \$127 million for 50 MW and \$450 to \$638 million for 250 MW. For the purposes of this evaluation a 50 MW geothermal plant size costing \$127 million, is assumed. This would be the first phase of geothermal project development in Colombia. ISAGEN expects the plant size to expand to possibly 250 MW range, at some of the sites, subject to field testing and verification.

In addition, based on the observed manifestations of geothermal resources at more than one of the five sites, it is possible that more than one site will be found suitable for geothermal power production. The geothermal portfolio assessment, accordingly, aims to "select a single site as



best option” that can be implemented in the short term (e.g. two (2) years for start of equipment procurement plus two (2) years for construction up to commissioning). As noted, total cost for this project (best option) is estimated to be about USD \$127 million for a capacity of about 50 MW. The remaining promising geothermal sites could be developed in the medium to long term adding to the scope of geothermal power capacity in Colombia.

Most of the export potential for the implementation of this project is in the exploration/drilling and procurement of generators, turbines, heat exchangers, cooling system, substation equipment, instrumentation and control systems, and engineering services. The overall project cost (w/o construction contingency) is estimated at \$127 million. U.S. exports could be at the \$63 million (50%) level. Exhibit 1 shows the approximate breakdown of major equipment cost and share of U.S. exports.

**Exhibit 1 – Project Budget Estimate and Share of U.S. Exports**

Major Equipment/Services	Approximate Total Cost, \$M	U.S. Exports (U.S. Competitiveness)
Exploratory Drilling at Selected Site	12.5	(Good) 6.3
Confirmation of Deposit Production Design Parameters	17.5	(Good) 8.8
Drilling of Final Production System	32.5	(Good) 16.3
Steam Gathering	5.5	(Good) 2.8
<b>Power Plant (50 MW)</b>	<b>59.0</b>	<b>29.0</b>
- Turbine/Separators/Exchangers	21.0	(Weak) -
- Generator/Electrical	15.0	(Excellent) 15.0
- Piping/Water Treatment/Misc	9.0	(Weak) -
- Auxiliaries (incl. Instrumentation and Controls)	9.0	(Excellent) 9.0
- Engineering and Design	5.0	(Excellent) 5.0
<b>Total Value (w/o Contingency)</b>	<b>127.0</b>	<b>63.0</b>

Source: USPC Estimate

No detailed cost estimate exists for the project.

A number of U.S. firms have suitable credentials to be interested in the proposed project. U.S. equipment suppliers can potentially include:

Geothermal Drilling and Exploration:



- Chevron Geothermal;
- Phillips Petroleum;
- Republic Geothermal;
- Occidental Geothermal; and
- Unocal Geothermal.

Electrical, Controls and Auxiliary Equipment:

- Eaton Electrical (Cutler-Hammer);
- Siemens-Westinghouse;
- Square D Co. (Schneider Electric);
- Encorp Inc.;
- Cooper Power Systems;
- Automated Control Systems;
- GE Energy, GE Industrial, and GE Power Systems;
- Honeywell;
- Motorola;
- Hammond Power Solutions; and
- Kohler Power Systems.

In addition to equipment suppliers, U.S. engineering companies may be interested in EPC or task design contracts. Services suppliers potentially include:

- GeothermEx;
- Geo Hills Associates;
- Stone and Webster (Shaw Group);
- Washington Group; and
- PB Power.

ISAGEN has been quite active in the past in international procurement for major power sector projects. It has bought from European, Japanese and American companies' equipment for electricity production using hydro and thermal resources. Examples of US purchased equipment included:

- Gas turbine: 2x103 MW, 3600 rpm, Westinghouse for Power Plant Termocentro (300MW);
- Steam turbine: 103 MW, 3600 rpm, General Electric for Power Plant Termocentro; and
- Generators 2x103 MVA, 13,8 kV Westinghouse; 1x130 MVA, 13,8 kV General Electric for Power Plant Termocentro.

**Foreign Competition**

In general, U.S. manufacturers are considered to be competitive in the design, manufacturing, and implementation of the proposed project scope. However, geographical location and historical



ties may result in serious competition to U.S. companies in Colombia. ISAGEN has indicated some familiarity with U.S. equipment, especially in areas of thermal power plants.

Major foreign competitors in the Colombian energy market include amongst others:

- ABB (Switzerland/Brazil);
- Siemens, AEG (Germany);
- Fuji Electric, Hitachi, Mitsubishi, Toshiba, Osaka Transformers (Japan);
- Alsthom (France/Switzerland);
- Ansaldo Energia (Spain); and
- Rolls- Royce (UK).

### Environmental Impact

ISAGEN has been carrying out, as part of its generation expansion plan, projects based on renewable energies according to the existing national policies related to cleaner production and sustainable development. Accordingly, it is well aware of environmental issues and the need for impact minimization, as well as issues related to economic and social impacts from generation and infrastructure projects in various parts of Colombia. Specific needs tied to each of the five sites under geothermal assessment would be examined in the proposed project.

The cleaner (than fossil) characteristics of geothermal energy source has a significant potential in the reduction of emissions of GHG. In addition, geothermal generation projects will operate as base load with a utilization factor and availability of around 90%, independently from climatic and hydrological variations, which affect hydropower, or the unit availability and fuel cost constraints of fossil power

Expansion in the construction and operation of geothermal power in the future will also have a direct effect in the composition of the energy alternatives of the country (i.e. energy mix), through the incorporation of a project based on a new renewable.

### Impact on U.S. Labor

There is no reason for concern regarding the possibility of negative impacts on U.S. employment due to this project. The project would generate electricity and not products that could be imported into the U.S. On the other hand, positive impacts will result in the event U.S. exporters succeed in obtaining contracts for equipment and services when the project goes forward and even serve as catalyst for further projects in the region.

No adverse impact is expected from the execution of the proposed project. Its significant export potential would assure the bulk of the production of major goods in the U.S. and their export to host country. No significant permanent new job creation is expected outside of U.S.



## Qualifications

### Owner

The Ministry of Energy and Mines has full political responsibility for the energy sector of the nation. On behalf of the Government of Colombia, it is fully responsible for formulating and implementing energy policy, as well as environmental sustainability of energy sector developments, and lending crucial support to strategic projects.

In order to implement its energy policy the Ministry wishes to promote foreign investments and private sector involvement. Most energy operators are national or private corporations and municipal utilities. The Ministry has given endorsement to ISAGEN to act as lead (Project Owner) in geothermal power development. ISAGEN has significant experience in developing and implementing complex technical power projects with its own and private funding. The Ministry together with organizations such as ISAGEN is working hard to resolve the most pressing problems in the energy sector of Colombia, including assuring electricity supply in the future that is reliable, cost effective, environmentally benign.

Based on the DM, ISAGEN projects itself as an ethical and transparent Company, with stated principles, values, and good governance practices in the management of its affairs, and respect for shareholders' rights. ISAGEN has shown transparency of its management practices and disclosure of business-related information that should be known by interested parties.

For additional information concerning relationships, conditions, rules and requirements between ISAGEN and its Suppliers, US equipment and service providers may wish to refer to the following web address: [www.isagen.com.co](http://www.isagen.com.co) under the topic "Provedores".

### U.S. Contractor Selection Criteria

In the event that USTDA provides grant funds for technical assistance, the selection of a contractor to perform the study should be based on competitive bidding. The selection criteria to be used in ranking the bids received from the qualified bidders is as follows:

**Professional Experience (40%)** – Each bidder shall propose a project team that will be fully qualified to execute the entire study scope of work. The proposed staff should have qualifications and experience in geothermal investigations, engineering, technical analysis, operations planning and modeling, environmental assessments, as well as excellent technical knowledge of geothermal technology, power generation/supply, and appropriate software and hardware. Experience with utility or independent power producer clients would be beneficial. Qualified bidder will need to provide evidence of satisfactorily executing at least two (2) similar projects in the last 10 years. Reference projects can have smaller size, but be equal or more in complexity as the proposed one.



International Experience (30%) – Each bidder shall exhibit international experience and capability to perform similar feasibility studies in the region, preferably in South or Latin America. Qualified bidder will need to provide evidence of satisfactorily executing at least one similar international project in the last 10 years. Reference international project can have smaller size, but be equal or more in complexity as the proposed one.

Proposed Work Plan (30%) – Each bidder shall demonstrate understanding of all project tasks. Proposal efforts should be responsive to the requirements outlined in the Scope of Work. The proposed Work Plan should be detailed, realistic, and manageable. Clear objectives should be achieved at the end of all tasks.

### Justification

The proposed project falls well within the stated developmental objectives of the Republic of Colombia and in particular adheres to the Energy Law 697 (3<sup>rd</sup> October 2001) and ensuing regulations (Decreto 3683) concerning the development of non-conventional energy sources.

Geothermal generation type of projects would seem to fit in several parts of Colombia based on projections of geothermal resources. A successful project in an important commercial, industrial, agricultural or educational area in Colombia would provide impetus to further application of the technology in other parts of the nation.

The execution of the initial project would provide a powerful promotional vehicle for further penetration by US firms in the geothermal equipment and services area of Colombia. Colombia's power sector (in particular hydro and thermal power) is currently an area where Europeans and Japanese have been playing a dominant role and have a historical lead. Geothermal resource development and power technology applications provide an avenue for greater penetration of the overall Colombian power sector by US firms.

The need for US firms to penetrate the market is a justifiable goal as the Colombian economy becomes increasingly market oriented and the competitive forces start to play a dominant role. US firms are certainly able to demonstrate the quality of their equipment and engineering or other implementation skills. However, the assistance by the USTDA in facilitating the first geothermal power project would be crucial based on the foreseeable competition. Without such support, it will be difficult for the U.S. firms to have an edge when facing the competition. In our view USTDA funding becomes critical in projects where even though US firms may have a technological lead, they are faced by European/Japanese firms who have a historical lead.

While it is true that Colombia is rapidly moving towards the creation of an independent power market (and while this market would have reached a reasonable measure of maturity by the time this project is ready for execution), it becomes very important for US firms to get a "jump start" at this juncture with the initiation of a project of this type. This would further familiarize the key players in the Colombian energy market with U.S equipment/services quality and practices as well as promoting closer ties between the two countries.



## Terms of Reference

This document outlines the tasks required in the technical assistance package to aid ISAGEN (the Grantee), a corporation partially owned by the Colombian Government that operates as an independent company in the Colombian electricity sector, in soliciting offers for the project entitled "Colombia Geothermal Power Portfolio Assessment". The assistance is to be provided by a Contractor to be selected by the Grantee, and paid for through a grant provided by U.S. Trade and Development Agency. The Contractor will conduct the work with the active cooperation and support of ISAGEN and relevant agencies of the Government of Colombia. It is also expected that the Contractor may subcontract certain selected subtasks of the project (within the guidelines allowed by USTDA) to a local agency/subcontractor, closely familiar with past geological and technical evaluations conducted at the geothermal sites, in order to expedite the performance of the project.

The Terms of Reference for the proposed project are described in this section. In carrying out the feasibility study, the selected Contractor should address all issues related to project sizing, optimal siting, technology selection for thermal resource recovery and power generation, economic viability, environmental impacts, economic/social impacts at production sites, institutional issues, and financing options. At the same time, the selected contractor should ensure that design standards and technical specifications are prepared in such way so as to not preclude American equipment manufacturers and service providers from bidding during the project implementation phase. The Tenders should allow all international companies and reputable manufacturers to submit bids.

### **Task 1- Review available data and compare and prioritize available sites**

As part of this task the selected Contractor will perform the following activities:

- Review all information available for the four (4) geothermal regions in Colombia, which comprise five (5) prospective geothermal production sites (Chiles/Cerro Negro/Tufino, Volcan Azufral, Complejo del Ruiz, Santa Rosa de Cabal, and Paipa/Iza), access the existing main information sources in the country and meet with the Colombian entities that have conducted or are participating in geothermal activities, such as Ministry of Mines and Energy (Directorate of Electric Energy), INGEOMINAS (Subsurface Resources Directorate), UPME (Energy Supply Planning and Electric System Expansion Planning Units), DNP (Department of National Planning) and others.
- Also, the Contractor will initiate project related discussions with relevant funding and technical international agencies such as IDB (Interamerican Development Bank), World Bank, IFC (International Finance Corporation), OLADE (Latin American Energy Organization), UPADI (Pan American Federation of Engineering Societies) and others. The extensive geothermal information from past geothermal studies in Colombia is available at



local offices of organizations such as INGEOMINAS, OLADE, CHEC, GESA, ICEL, IPSE, etc.

- Based on the information collected and analyzed under the above activities, the Contractor will organize and update the data on individual sites to develop a matrix of information covering all sites. This is to identify areas which require additional studies at individual geothermal production prospective sites, as well as to set up a preliminary framework for inter comparison of all five sites to rank them and select the “best options” for further analysis and development.
- The Contractor will then conduct brief assessments and tests at the geothermal field sites, as may be required to complement available data, to ensure that the requisite information for decision making on the “best option” is available for all five sites. Taking into account that the principal information required for geothermal-resource engineering assessments includes fluid pressure (as indicator of its ability to be brought to the surface for beneficial uses), fluid temperature (as indicator of its capability in power generation), fluid rate of flow and volume (as indicator of the quantity of thermal energy that could be extracted in a given period of time), and reservoir volume or rate of recharging (as indicator of reservoir useful life); the Contractor will need to avail itself of a variety of information, already existing in the above mentioned sources or to be obtained, by brief assessments in the field utilizing geological, geophysical or geochemical methods. This information includes:
  - Geological studies data such as type of subsurface strata, rock-formation specific porosity, rock formation permeability (through interconnected pores, fractures or inter-grain spaces), fluid transport along subsurface faults, etc;
  - Geophysical testing data such as gravity surveys (gravimetry to identify differences in density in subsurface formations), magnetic and magnetotelluric surveys (to identify anomalies in induced/natural magnetic fields and subsurface telluric currents), resistivity surveys (to identify rock formations by electric conductivity variations), electric signal transmission patterns (to measure fluid pressure, temperature and flow velocity), seismic surveys (to identify type of substrata and faults based on sound conductivity), etc
  - Geochemical, isotopic and radiotracing testing data of hydrothermal deposits, springs and local rock samples such as determination of presence of certain ions in hydrothermal fluids (as geothermometers or indicators of temperature in subsurface reservoir causing rock dissolution in hydrothermal fluid), determination of mixing of subsurface fluids, determination of subsurface flows and rates of recharging, etc

The objective of this activity is produce a comprehensive information package for all five sites, including relevant maps of sites (1:10000 scale) that can be used in making a decision on further project development.

The Contractor will then rank the five sites in relation to the overall potential of each site’s geothermal resources for commercial power generation and make recommendations. Based on the results of this Task, a series of meetings (with minimum duration of one week) will be



conducted with ISAGEN and other project stakeholders to review the findings and discuss the results.

### **Task 2- Legal, institutional and regulatory review**

The Contractor will review the existing studies and norms that can have an impact in the geothermal project development, such as Public Services, Electricity and Environmental Laws, Natural Resources Code, local permitting requirements, local environmental topics, local building requirements, and other constraints (right-of-way, zoning ordinances, infrastructure regulations, studies requirements, land or owner rights, etc.), that may need to be taken into account before the project moves into implementation stage.

During this Task, a series of meetings will be conducted with the Ministry of Mines and Energy, Ministry of Environment, Housing and Territorial Development Ministry, CREG, INGEOMINAS, DNP, UPME and other necessary agencies to compile a clear picture of current and prospective legal, institutional, and regulatory issues as related to geothermal project development.

The Contractor has to consider that the proposed project serves a dual purpose of improving the reliability and availability of in-country electricity supply and providing a mechanism for enhancing regional trade (equipment and services) and expansion of the electricity market. The Contractor shall make comments and recommendations on clarifications and/or modifications as related to geothermal regulatory norms considering the Colombian energy market and its integration with other regional markets.

Based on the results of this Task a series of meetings (with minimum duration of two days) will be conducted with the Grantee to review the findings and discuss the results.

### **Task 3- Regional electricity market and technical evaluation**

As part of this Task, the Contractor shall review the prospects of a new geothermal project from the Colombia electricity market point of view. The analysis here will include tariffs, revenue expectations, special incentive mechanisms (Green House Gas allowances), and similar market entry and promotion considerations. The technical evaluation of the feasibility of geothermal plants at the proposed sites will be performed under this Task, including as a minimum, siting constraints, well system for recovery of geothermal resources, thermal energy-to-power conversion plant, infrastructure considerations related to environmental, health and similar requirements, electrical interconnection to the grid, water availability, security considerations. Based on these findings, the Contractor shall prepare a detailed assessment report on the technical feasibility of the plant and prospects within the local electricity market, as part of this Task. This document will be provided by the Contractor for the five (5) proposed geothermal production sites.

### **Task 4- Preparation of preliminary design and estimates**



Following the regional market assessment and technical evaluation of the sites, the Contractor will prepare preliminary designs of a geothermal power plant for each site, considering the geothermal resources local conditions and the development of the geothermal-to-power conversion technology being applied or under development in the world. It is expected that the geothermal and other conditions at the prospective production sites can be very different and therefore involve different technologies for the optimal plant design. A preliminary high-level cost estimate for developing a geothermal power plant in each site will be prepared. Details of such estimates should be sufficient to perform preliminary economic and financial analysis.

#### **Task 5- Economic / Financial review of options and base project selection**

The Contractor shall conduct an economic and financial assessment of power production at the sites based on the proposed preliminary plant design for each site. The Contractor shall calculate net present value, payback time, and Financial and Economic Internal Rates of Return for all alternatives. GHG emission offsets shall be taken into account. Sensitivity analyses related to possible changes in all major external factors, such as electricity cost, interest rates, investment costs, and any other factors, as appropriate, will be performed for all five sites.

Based on the results of Tasks 2, 3, and 4 a series of meetings will be conducted with Grantee to review the findings and discuss the results. Based on the Contractor recommendations and Grantee concurrence (including any relevant commentary by regulatory or local government entities), a single site will be selected as the Best Option for geothermal project development in Colombia. All further evaluations will be performed on this option.

The Contractor shall also assist the Grantee in developing sound financing plans for the Best Option, and shall assist in finding financial source(s) suitable to the Grantee for funding all components or stages of the Project leading to plant construction and commissioning. In this regard, the Contractor shall obtain written expressions of interest (proof of e-mail correspondence is acceptable) on behalf of the Grantee from a number of potential donors/lenders/financial participants and selected credit agencies. In addition, the Contractor shall verify current terms and conditions for each of the potential sources of funding that have been identified.

#### **Task 6- Environmental and social impact assessment**

The Contractor shall perform a preliminary environmental impact assessment of the site selected as the Best Option. In particular, the Contractor shall identify, and propose remedies for, any potential air, water, or noise pollution or discharges, as well as any safety or health concerns, that might result from the Project. The primary objective of this task is to ensure that the proposed Project will comply with all relevant Colombian and Multilateral environmental, health and safety regulations.

The Contractor shall also provide a report on the potential economic and social development impact of the project on the locality of the production plant and host country. In the discussion,



the Contractor shall focus on what the economic development outcomes will be if the project is implemented according to the study recommendations. While specific focus should be paid to the immediate impact of the project, the Contractor shall also include, where appropriate, any additional social impact and developmental benefits of the project, including spin-off and demonstration effects. The analysis of potential benefits of the study should be as concrete and detailed as possible. The development impact factors are intended to provide the decision-makers behind the project, as well as other stake holders and interested parties, with a broader view of the project's potential effects on the geothermal-to-power production area and host country. The Contractor shall provide estimates of the project's potential benefits in the following areas:

- **Infrastructure:** a statement on the infrastructure impact giving a brief synopsis.
- **Market-Oriented Reform:** a description of any regulations, laws, or institutional changes that are recommended and the effect they would have if implemented.
- **Human Capacity Building:** a description of the number and type of positions that would be needed to construct and operate the Project, number of people that will be needed to process construction materials, operating personnel, as well as the number of people who will receive training and a brief description of the training programs.
- **Technology Transfer and Productivity Enhancement:** a description of any advanced technologies that will be brought in or implemented as a result of the project. A description of any efficiency in the electricity sector that will be gained.
- **Other:** any other developmental benefits to the project, including spin-off or demonstration effects.

#### **Task 7- Preparation of detailed cost estimates (for Best Option)**

Upon the selection of the Best Option alternative, the Contractor shall prepare a detailed EPC-type cost estimate. The estimate shall include the detailed breakdown of time and materials for all major components, including well system, geothermal fluid treatment, turbine/generator island, balance of plant, instrumentation and controls, water treatment, electrical interconnection, etc., as well as procurement, logistic, construction and commissioning expenses.

#### **Task 8- Tender document preparation**

The Contractor shall prepare a set of tender documents for bidding purposes. This should be delivered to the Grantee as a stand-alone document (an appendix to main report). The tender documents shall include: (a) Project Background and Information, (b) Requirements for the Environmental Impact Assessment; (c) Technical Specifications; and (d) Draft Contract clauses that would include all appropriate commercial terms for execution of the project

The Technical Specification Documents should be divided into appropriate sections: such as: Major Equipment; Major Geothermal Production Works and Local Civil Works and Construction. The sections shall include the following:



- International Tender for major pumps, separators, heat exchangers, turbines, cooling towers, coolers, accumulators, high-pressure piping and other mechanical equipment.
- International Tender for electrical generator, substation equipment and instrumentation & controls.
- International Tender for drilling and installing a system of production wells for geothermal resource recovery and ground re-injection of spent fluids
- Local Tender for civil works and construction (prices should be based on local rates). Tender documents shall be prepared with the Grantee's staff.

All international tenders related to the major equipment and works should include provisions for allowing local components of the works (in particular as related to erection, installation, commissioning and testing).

### **Task 9 – Draft Final and Final Reports Preparation and Presentation**

The Contractor shall prepare a Draft Final Report that includes all analyses and findings performed under Tasks 1-7 above. The Bidding Tender Documents delivered under Task 8 shall be submitted as stand-alone appendix to the Main Report. The Contractor shall provide the Draft Final Report to the Grantee for review and discussion.

Once the Grantee has provided comments and revisions on the Draft Final Report, the Contractor shall prepare and deliver to the Grantee and USTDA a substantive and comprehensive Final Report of all work performed under these Terms of Reference ("Final Report"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to the Grantee. The Final Report shall incorporate all of the findings, recommendations, and conclusions of the feasibility study and shall incorporate all other documents and/or reports provided pursuant to Tasks 1 through 8 above. It is the Contractor's responsibility to identify prospective U.S. Sources of Supply (i.e. equipment and services) in the Final Report to be submitted to USTDA and the Grantee in accordance with Clause I of Annex II of the Grant Agreement. The U.S. equipment suppliers and service providers' list shall identify the capabilities, addresses, and principal points of contact for each of those listed.

### **Conditions of the Work Effort**

During the course of the Study, the Contractor shall work closely with the staff and management of the Grantee, who shall cooperate fully in the timely completion of all Study tasks. The Grantee shall also provide the services of its technical staff, at no charge, as needed to complete the Study. The Grantee shall arrange for the prompt and complete submittal of all technical data necessary and appropriate for carrying out the Study. The Grantee shall also arrange for translation into English of all relevant Project data. The Contractor shall be responsible for preparing all reports and other documents resulting from the Study in English.



Notes:

- (1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.
- (2) The Contractor and the Grantee shall be careful to ensure that the public version of the Final Report contains no security or confidential information.
- (3) The Grantee and USTDA shall have a worldwide, royalty-free, non-exclusive right to use and distribute the Final Report and all work product that is developed under these Terms of Reference.

Proposed Feasibility Study Schedule and Budget

The proposed project implementation schedule is presented in the Exhibit 2 below. The duration of the total effort is estimated at 8 months with most tasks being accomplished sequentially. With respect to deliverables, Bidding Tender Documents will need to be completed by the end of Month 7. Final Report issuance is expected 4 weeks later.

Exhibit 2 – Project Schedule

No.	Task Name	Timeline, Months									
			1	2	3	4	5	6	7	8	
1.	Review available data and compare and prioritize available sites		■	■	■	■	■				
2.	Legal, institutional and regulatory review			■							
3.	Regional electricity market and technical evaluation				■						
4.	Preparation of preliminary design and estimates					■	■				
5.	Economic / Financial review of options review and base project selection				■	■					
6.	Environmental and social impact assessment				■						
7.	Preparation of detailed cost estimates (for Best Option)						■	■	■		
8.	Tender document preparation								■	■	
9.	Draft Final and Final Reports Preparation and Presentation										■

The recommended feasibility study budget is provided below in Exhibit 3. A detailed break down by task and discipline is provided for labor. Average U.S. rates for the industry were used, as well as estimates for Colombian national staff labor and expenses. The budget also breaks down other necessary expenses, such as travel, miscellaneous, insurance, fee, etc. The total budget for this project is estimated to be \$599,310.



**Exhibit 3 – Feasibility Study Budget**

**DIRECT LABOR COSTS:**

TOR Task	TOR Task Name		Contractor Labor		
			Total Person Days	x Daily Rate*	= TOTAL COST
1.	Review available data and compare and prioritize available sites	Project Manager/Group Leader	45	\$ 1,040.00	\$ 46,800.00
		Geological/Geotechnical Testing Staff	30	\$ 1,040.00	\$ 31,200.00
		Engineer(s)	10	\$ 880.00	\$ 8,800.00
		Environmental/Other Specialist(s)	20	\$ 1,040.00	\$ 20,800.00
		<b>TOTALS</b>	<b>105</b>		<b>\$ 107,600.00</b>
2.	Legal, institutional and regulatory review	Project Manager	5	\$ 1,040.00	\$ 5,200.00
		Legal Advisor(s)	5	\$ 1,280.00	\$ 6,400.00
		Institutional Specialist(s)	5	\$ 1,120.00	\$ 5,600.00
		<b>TOTALS</b>	<b>15</b>		<b>\$ 17,200.00</b>
3.	Regional electricity market and technical evaluation	Project Manager	5	\$ 1,040.00	\$ 5,200.00
		Finance/Econ. Specialist(s)	10	\$ 1,040.00	\$ 10,400.00
		Modeling Specialist(s)	10	\$ 880.00	\$ 8,800.00
		Geothermal Engineer(s)	5	\$ 1,040.00	\$ 5,200.00
		Electrical/Mechanical Engineer(s)	10	\$ 880.00	\$ 8,800.00
<b>TOTALS</b>	<b>40</b>		<b>\$ 38,400.00</b>		
4.	Preparation of preliminary design and estimates	Project Manager	10	\$ 1,040.00	\$ 10,400.00
		Mechanical Engineer(s)	10	\$ 880.00	\$ 8,800.00
		Electrical Engineer(s)	3	\$ 880.00	\$ 2,640.00
		Geothermal Engineer(s)	10	\$ 1,040.00	\$ 10,400.00
		I&C Engineer(s)	3	\$ 880.00	\$ 2,640.00
		Cost Estimator	10	\$ 800.00	\$ 8,000.00
		<b>TOTALS</b>	<b>46</b>		<b>\$ 42,880.00</b>
5.	Economic / Financial review of options review and base project selection	Project Manager	10	\$ 1,040.00	\$ 10,400.00
		Finance/Econ. Specialist(s)	15	\$ 1,040.00	\$ 15,600.00
		Engineer(s)	15	\$ 880.00	\$ 13,200.00
		Modeling Specialist(s)	5	\$ 880.00	\$ 4,400.00
		Cost Estimator	5	\$ 800.00	\$ 4,000.00
		<b>TOTALS</b>	<b>50</b>		<b>\$ 47,600.00</b>
6.	Environmental and social impact assessment	Project Manager	3	\$ 1,040.00	\$ 3,120.00
		Environmental Specialist(s)	15	\$ 1,040.00	\$ 15,600.00
		Institutional Specialist(s)	5	\$ 1,120.00	\$ 5,600.00
<b>TOTALS</b>	<b>23</b>		<b>\$ 24,320.00</b>		
7.	Preparation of detailed cost estimates (for Best Option)	Project Manager	5	\$ 1,040.00	\$ 5,200.00
		Finance/Econ. Specialist(s)	5	\$ 1,040.00	\$ 5,200.00
		Engineer(s)	10	\$ 880.00	\$ 8,800.00
		Cost Estimator	15	\$ 800.00	\$ 12,000.00
		<b>TOTALS</b>	<b>35</b>		<b>\$ 31,200.00</b>
8.	Tender document preparation	Project Manager	5	\$ 1,040.00	\$ 5,200.00
		Mechanical Engineer(s)	10	\$ 880.00	\$ 8,800.00
		Electrical Engineer(s)	5	\$ 880.00	\$ 4,400.00
		Geothermal Engineer(s)	10	\$ 1,040.00	\$ 10,400.00
		Procurement Specialist (s)	10	\$ 880.00	\$ 8,800.00
		I&C Engineer(s)	5	\$ 880.00	\$ 4,400.00
		<b>TOTALS</b>	<b>45</b>		<b>\$ 42,000.00</b>
9.	Draft Final and Final Reports Preparation and Presentation	Project Manager	5	\$ 1,040.00	\$ 5,200.00
		Finance/Econ. Specialist(s)	3	\$ 1,040.00	\$ 3,120.00
		Modeling Specialist(s)	2	\$ 880.00	\$ 1,760.00
		Engineer(s)	10	\$ 880.00	\$ 8,800.00
		Environmental Specialist(s)	3	\$ 1,040.00	\$ 3,120.00
		Cost Estimator	3	\$ 800.00	\$ 2,400.00
<b>TOTALS</b>	<b>26</b>		<b>\$ 24,400.00</b>		
<b>TOTAL CONTRACTOR LABOR</b>			<b>385</b>		<b>\$ 375,600</b>



**Exhibit 3 – Feasibility Study Budget (Continued)**

TOR Task	TOR Task Name	Non-Employee Labor		
		Total Person Days x	Daily Rate**	= TOTAL COST
1.	Review available data and compare and prioritize available sites	Local Engineers, Testing Staff, Security	310 \$	208.00 \$ 64,480.00
2.	Legal, institutional and regulatory review	Local Specialists	0 \$	250.00 \$ -
3.	Regional electricity market and technical evaluation	Local Specialists	45 \$	208.00 \$ 9,360.00
4.	Preparation of preliminary design and estimates	Local Engineers and Specialists	40 \$	208.00 \$ 8,320.00
5.	Economic / Financial review of options review and base project selection	Local Engineers and Specialists	0 \$	250.00 \$ -
6.	Environmental and social impact assessment	Local Engineers and Specialists	55 \$	208.00 \$ 11,440.00
7.	Preparation of detailed cost estimates (for Best Option)	Local Engineers and Specialists	35 \$	208.00 \$ 7,280.00
8.	Tender document preparation	Local Engineers and Specialists	40 \$	208.00 \$ 8,320.00
9.	Draft Final and Final Reports Preparation and Presentation	Local Engineers and Specialists	25 \$	208.00 \$ 5,200.00
<b>TOTAL DIRECT LABOR COSTS</b>		<b>TOTAL HOST COUNTRY LABOR</b>	<b>550.00</b>	<b>\$ 114,400.00</b>
				<b>\$ 490,000.00</b>
<b>OTHER DIRECT COSTS:</b>				
<u>Purchased Services/Contracts***</u>		<u>Tasks</u>	<u>TOTAL COST</u>	
		N/A		
<u>Travel</u>		<u>Trips</u>	<u>Trip Cost</u>	<u>Total Cost</u>
International Air Travel (foreign)		20	\$ 1,200.00	\$ 24,000.00
In Country Air Travel (foreign)		23	\$ 300.00	\$ 6,900.00
In Country Air Travel (local)		10	\$ 300.00	\$ 3,000.00
Per Diem (foreign)		<u>Trip Days</u>	<u>Per Diem Rate (Ave Bogota and Med.)</u>	
Per Diem (local)		106	\$ 260.00	\$ 27,560.00
		145	\$ 130.00	\$ 18,850.00
<u>Other</u>				
Equipment (Field Survey)				\$ 6,000.00
Local Transport				\$ 13,000.00
Communication (foreign)				\$ 3,000.00
Communication (local)				\$ 3,000.00
Reproduction and Binding				\$ 2,500.00
Courier				\$ 1,500.00
<b>TOTAL OTHER DIRECT COSTS</b>				<b>\$ 109,310.00</b>
<b>TOTAL COSTS (DIRECT LABOR COSTS + OTHER DIRECT COSTS)</b>				<b>\$ 599,310.00</b>
<b>Total U.S. Company Cost Share</b>				
<b>PROPOSED USTDA GRANT</b>				<b>\$ 599,310.00</b>

\* Primary Contractor (Employee) Labor Costs = Salary + Overhead + Benefits (No Fee or Profit)

\*\* Non-Employee Labor Cost = Salary + Overhead + Benefits + Reasonable Fee or Profit

\*\*\* Purchased Services/Contracts may include engineering drawings, lab work, surveys, translation, etc. which would not be included in Non-Employee Labor Cost above

**Contacts**

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**A N N E X 3**

**USTDA NATIONALITY REQUIREMENTS**



**U.S. TRADE AND DEVELOPMENT AGENCY  
Arlington, VA 22209-2131**

**NATIONALITY, SOURCE, AND ORIGIN REQUIREMENTS**

The purpose of USTDA's nationality, source, and origin requirements is to assure the maximum practicable participation of American contractors, technology, equipment and materials in the prefeasibility, feasibility, and implementation stages of a project.

**USTDA STANDARD RULE (GRANT AGREEMENT STANDARD LANGUAGE):**

Except as USTDA may otherwise agree, each of the following provisions shall apply to the delivery of goods and services funded by USTDA under this Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from host country may not exceed twenty percent (20%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for implementation of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in host country are not subject to the above restrictions. USTDA will make available further details concerning these standards of eligibility upon request.

**NATIONALITY:**

1) Rule

Except as USTDA may otherwise agree, the Contractor for USTDA funded activities must be either a U.S. firm or a U.S. individual. Prime contractors may utilize U.S. subcontractors without limitation, but the use of host country subcontractors is limited to 20% of the USTDA grant amount.

## 2) Application

Accordingly, only a U.S. firm or U.S. individual may submit proposals on USTDA funded activities. Although those proposals may include subcontracting arrangements with host country firms or individuals for up to 20% of the USTDA grant amount, they may not include subcontracts with third country entities. U.S. firms submitting proposals must ensure that the professional services funded by the USTDA grant, to the extent not subcontracted to host country entities, are supplied by employees of the firm or employees of U.S. subcontractor firms who are U.S. individuals.

Interested U.S. firms and consultants who submit proposals must meet USTDA nationality requirements as of the due date for the submission of proposals and, if selected, must continue to meet such requirements throughout the duration of the USTDA-financed activity. These nationality provisions apply to whatever portion of the Terms of Reference is funded with the USTDA grant.

## 3) Definitions

A "U.S. individual" is (a) a U.S. citizen, or (b) a non-U.S. citizen lawfully admitted for permanent residence in the U.S. (a green card holder).

A "U.S. firm" is a privately owned firm which is incorporated in the U.S., with its principal place of business in the U.S., and which is either (a) more than 50% owned by U.S. individuals, or (b) has been incorporated in the U.S. for more than three (3) years prior to the issuance date of the request for proposals; has performed similar services in the U.S. for that three (3) year period; employs U.S. citizens in more than half of its permanent full-time positions in the U.S.; and has the existing capability in the U.S. to perform the work in question.

A partnership, organized in the U.S. with its principal place of business in the U.S., may also qualify as a "U.S. firm" as would a joint venture organized or incorporated in the United States consisting entirely of U.S. firms and/or U.S. individuals.

A nonprofit organization, such as an educational institution, foundation, or association may also qualify as a "U.S. firm" if it is incorporated in the United States and managed by a governing body, a majority of whose members are U.S. individuals.

## **SOURCE AND ORIGIN:**

### 1) Rule

In addition to the nationality requirement stated above, any goods (e.g., equipment and materials) and services related to their shipment (e.g., international transportation and insurance) funded under the USTDA Grant Agreement must have their source and origin in the United States, unless USTDA otherwise agrees. However, necessary purchases of goods and project support services which are unavailable from a U.S. source (e.g., local food, housing and transportation) are eligible without specific USTDA approval.

### 2) Application

Accordingly, the prime contractor must be able to demonstrate that all goods and services purchased in the host country to carry out the Terms of Reference for a USTDA Grant Agreement that were not of U.S. source and origin were unavailable in the United States.

### 3) Definitions

“Source” means the country from which shipment is made.

“Origin” means the place of production, through manufacturing, assembly or otherwise.

*Questions regarding these nationality, source and origin requirements may be addressed to the USTDA Office of General Counsel.*

**ANNEX 4**

**USTDA GRANT AGREEMENT,  
INCLUDING MANDATORY CONTRACT CLAUSES**

USTDA # 07. 5105B

**GRANT AGREEMENT**

Handwritten initials and a date stamp: SEP 25 2007

This Grant Agreement is entered into between the Government of the United States of America, acting through the U.S. Trade and Development Agency ("USTDA"), and ISAGEN S.A. E.S.P. ("Grantee"). USTDA agrees to provide the Grantee under the terms of this Agreement US\$599,310 ("USTDA Grant") to fund the cost of goods and services required for a feasibility study ("Study") on the proposed Geothermal Power Generation project ("Project") in Colombia ("Host Country").

Handwritten initials: DW, AC, CE, AM, SE

**1. USTDA Funding**

The funding to be provided under this Grant Agreement shall be used to fund the costs of a contract between the Grantee and the U.S. firm selected by the Grantee ("Contractor") under which the Contractor will perform the Study ("Contract"). Payment to the Contractor will be made directly by USTDA on behalf of the Grantee with the USTDA Grant funds provided under this Grant Agreement.

**2. Terms of Reference**

The Terms of Reference for the Study ("Terms of Reference") are attached as Annex I and are hereby made a part of this Grant Agreement. The Study will examine the technical, financial, environmental, and other critical aspects of the proposed Project. The Terms of Reference for the Study shall also be included in the Contract.

**3. Standards of Conduct**

USTDA and the Grantee recognize the existence of standards of conduct for public officials, and commercial entities, in their respective countries. The parties to this Grant Agreement and the Contractor shall observe these standards, which include not accepting payment of money or anything of value, directly or indirectly, from any person for the purpose of illegally or improperly inducing anyone to take any action favorable to any party in connection with the Study.

**4. Grantee Responsibilities**

The Grantee shall undertake its best efforts, subject to applicable law, to provide reasonable support for the Contractor, such as local transportation, office space, and secretarial support.

## **5. USTDA as Financier**

### **(A) USTDA Approval of Competitive Selection Procedures**

Selection of the U.S. Contractor shall be carried out by the Grantee according to its established procedures for the competitive selection of contractors with advance notice of the procurement published online through *Federal Business Opportunities* ([www.fedbizopps.gov](http://www.fedbizopps.gov)). Upon request, the Grantee will submit these contracting procedures and related documents to USTDA for information and/or approval.

### **(B) USTDA Approval of Contractor Selection**

The Grantee shall notify USTDA at the address of record set forth in Article 17 below upon selection of the Contractor to perform the Study. Upon approval of this selection by USTDA, the Grantee and the Contractor shall then enter into a contract for performance of the Study. The Grantee shall notify in writing the U.S. firms that submitted unsuccessful proposals to perform the Study that they were not selected.

### **(C) USTDA Approval of Contract Between Grantee and Contractor**

The Grantee and the Contractor shall enter into a contract for performance of the Study. This contract, and any amendments thereto, including assignments and changes in the Terms of Reference, must be approved by USTDA in writing. To expedite this approval, the Grantee (or the Contractor on the Grantee's behalf) shall transmit to USTDA, at the address set forth in Article 17 below, a photocopy of an English language version of the signed contract or a final negotiated draft version of the contract.

### **(D) USTDA Not a Party to the Contract**

It is understood by the parties that USTDA has reserved certain rights such as, but not limited to, the right to approve the terms of the contract and any amendments thereto, including assignments, the selection of all contractors, the Terms of Reference, the Final Report, and any and all documents related to any contract funded under the Grant Agreement. The parties hereto further understand and agree that USTDA, in reserving any or all of the foregoing approval rights, has acted solely as a financing entity to assure the proper use of United States Government funds, and that any decision by USTDA to exercise or refrain from exercising these approval rights shall be made as a financier in the course of funding the Study and shall not be construed as making USTDA a party to the contract. The parties hereto understand and agree that USTDA may, from time to time, exercise the foregoing approval rights, or discuss matters related to these rights and the Project with the parties to the contract or any subcontract, jointly or separately, without thereby incurring any responsibility or liability to such parties. Any approval or failure to approve by USTDA shall not bar the Grantee or USTDA from asserting any right they might have against the

Contractor, or relieve the Contractor of any liability which the Contractor might otherwise have to the Grantee or USTDA.

**(E) Grant Agreement Controlling**

Regardless of USTDA approval, the rights and obligations of any party to the contract or subcontract thereunder must be consistent with this Grant Agreement. In the event of any inconsistency between the Grant Agreement and any contract or subcontract funded by the Grant Agreement, the Grant Agreement shall be controlling.

**6. Disbursement Procedures**

**(A) USTDA Approval of Contract Required**

USTDA will make disbursements of Grant funds directly to the Contractor only after USTDA approves the Grantee's contract with the Contractor.

**(B) Contractor Invoice Requirements**

The Grantee should request disbursement of funds by USTDA to the Contractor for performance of the Study by submitting invoices in accordance with the procedures set forth in the USTDA Mandatory Clauses in Annex II.

**7. Effective Date**

The effective date of this Grant Agreement ("Effective Date") shall be the date of signature by both parties or, if the parties sign on different dates, the date of the last signature.

**8. Study Schedule**

**(A) Study Completion Date**

The completion date for the Study, which is December 31, 2008, is the date by which the parties estimate that the Study will have been completed.

**(B) Time Limitation on Disbursement of USTDA Grant Funds**

Except as USTDA may otherwise agree, (a) no USTDA funds may be disbursed under this Grant Agreement for goods and services which are provided prior to the Effective Date of the Grant Agreement; and (b) all funds made available under the Grant Agreement must be disbursed within four (4) years from the Effective Date of the Grant Agreement.

## **9. USTDA Mandatory Clauses**

All contracts funded under this Grant Agreement shall include the USTDA mandatory clauses set forth in Annex II to this Grant Agreement. All subcontracts funded or partially funded with USTDA Grant funds shall include the USTDA mandatory clauses, except for clauses B(1), G, H, I, and J.

## **10. Use of U.S. Carriers**

### **(A) Air**

Transportation by air of persons or property funded under the Grant Agreement shall be on U.S. flag carriers in accordance with the Fly America Act, 49 U.S.C. 40118, to the extent service by such carriers is available, as provided under applicable U.S. Government regulations.

### **(B) Marine**

Transportation by sea of property funded under the Grant Agreement shall be on U.S. carriers in accordance with U.S. cargo preference law.

## **11. Nationality, Source, and Origin**

Except as USTDA may otherwise agree, the following provisions shall govern the delivery of goods and services funded by USTDA under the Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from Host Country may not exceed thirty percent (30%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for performance of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source, and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in Host Country are not subject to the above restrictions. USTDA will make available further details concerning these provisions upon request.

## **12. Taxes**

USTDA funds provided under the Grant Agreement shall not be used to pay any taxes, tariffs, duties, fees, or other levies imposed under laws in effect in Host Country. Neither the Grantee nor the Contractor will seek reimbursement from USTDA for such taxes, tariffs, duties, fees, or other levies.

### **13. Cooperation Between Parties and Follow-Up**

The parties will cooperate to assure that the purposes of the Grant Agreement are accomplished. For five (5) years following receipt by USTDA of the Final Report (as defined in Clause I of Annex II), the Grantee agrees to respond to any reasonable inquiries from USTDA about the status of the Project.

### **14. Implementation Letters**

To assist the Grantee in the implementation of the Study, USTDA may, from time to time, issue implementation letters that will provide additional information about matters covered by the Grant Agreement. The parties may also use jointly agreed upon implementation letters to confirm and record their mutual understanding of matters covered by the Grant Agreement.

### **15. Recordkeeping and Audit**

The Grantee agrees to maintain books, records, and other documents relating to the Study and the Grant Agreement adequate to demonstrate implementation of its responsibilities under the Grant Agreement, including the selection of contractors, receipt and approval of contract deliverables, and approval or disapproval of contractor invoices for payment by USTDA. Such books, records, and other documents shall be separately maintained for three (3) years after the date of the final disbursement by USTDA. The Grantee shall afford USTDA or its authorized representatives the opportunity at reasonable times to review books, records, and other documents relating to the Study and the Grant Agreement.

### **16. Representation of Parties**

For all purposes relevant to the Grant Agreement, the Government of the United States of America will be represented by the U.S. Ambassador to Host Country or USTDA and Grantee will be represented by the General Manager. The parties hereto may, by written notice, designate additional representatives for all purposes under the Grant Agreement.

### **17. Addresses of Record for Parties**

Any notice, request, document, or other communication submitted by either party to the other under the Grant Agreement shall be in writing or through a wire or electronic medium which produces a tangible record of the transmission, such as a telegram, cable, or facsimile, and will be deemed duly given or sent when delivered to such party at the following:

To: ISAGEN S.A. E.S.P.  
Av. El Poblado, Carrera 43 A No. 11A 80  
Medellín  
COLOMBIA

Phone: (57-4) 316-5000  
Fax: (57-4) 268-4646

To: U.S. Trade and Development Agency  
1000 Wilson Boulevard, Suite 1600  
Arlington, Virginia 22209-3901  
USA

Phone: (703) 875-4357  
Fax: (703) 875-4009

All such communications shall be in English, unless the parties otherwise agree in writing. In addition, the Grantee shall provide the Commercial Section of the U.S. Embassy in Host Country with a copy of each communication sent to USTDA.

Any communication relating to this Grant Agreement shall include the following fiscal data:

Appropriation No.: 117/81001  
Activity No.: 2007-51015B  
Reservation No.: 2007510032  
Grant No.: GH2007510008

## **18. Termination Clause**

Either party may terminate the Grant Agreement by giving the other party thirty (30) days advance written notice. The termination of the Grant Agreement will end any obligations of the parties to provide financial or other resources for the Study, except for payments which they are committed to make pursuant to noncancellable commitments entered into with third parties prior to the written notice of termination.

## **19. Non-Waiver of Rights and Remedies**

No delay in exercising any right or remedy accruing to either party in connection with the Grant Agreement shall be construed as a waiver of such right or remedy.

## **20. U.S. Technology and Equipment**

By funding this Study, USTDA seeks to promote the project objectives of the Host Country through the use of U.S. technology, goods, and services. In recognition of this purpose, the Grantee agrees that it will allow U.S. suppliers to compete in the procurement of technology, goods, and services needed for Project implementation.

**[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]**

IN WITNESS WHEREOF, the Government of the United States of America and ISAGEN S.A. E.S.P., each acting through its duly authorized representative, have caused this Agreement to be signed in the English language in their names and delivered as of the day and year written below. In the event that this Grant Agreement is signed in more than one language, the English language version shall govern.

**For the Government of the  
United States of America**

**For ISAGEN S.A. E.S.P.**

By: 

By: 

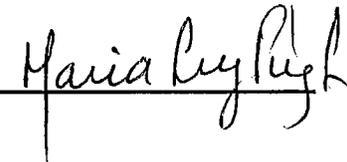
Date: September 17, 2007

Date: SEPTIEMBRE, 19, 2007

Witnessed:

Witnessed:

By: 

By: 

**Annex I -- Terms of Reference**

**Annex II -- USTDA Mandatory Clauses**

## Annex I

### **Terms of Reference**

#### Objective

The objective of the Geothermal Power Generation Feasibility Study ("Study") is to assess five (5) prospective geothermal power production sites in order to determine the most viable site. The Study will enable ISAGEN S.A. E.S.P. ("ISAGEN") ("Grantee") to develop a 50 MW geothermal power generation project ("Project").

#### General Considerations

In carrying out the Study, the Contractor shall address issues related to Project sizing, optimal siting, technology selection for thermal resource recovery and power generation, economic viability, environmental impacts, economic and developmental impacts, institutional issues, and financing options.

The Contractor shall conduct the work with the active cooperation and support of ISAGEN and relevant agencies of the Government of Colombia. It is anticipated that the Contractor may subcontract certain selected subtasks of the Project (within the guidelines allowed by USTDA) to a local subcontractor that is closely familiar with past geological and technical evaluations conducted at the prospective geothermal sites in order to expedite the performance of the Project.

During the course of the Study, the Contractor shall work closely with the management and staff of the Grantee, who shall cooperate fully in the timely completion of the Study tasks. The Grantee shall also provide the services of its technical staff (at no cost to the Contractor or USTDA), as needed, to complete the Study. The Grantee shall arrange for the prompt and complete submittal of all technical data necessary and appropriate for carrying out the Study. The Grantee shall also arrange for translation into English of all relevant Project data. The Contractor shall be responsible for preparing all reports and other documents resulting from the Study in English.

#### Activities

Task 1: Review available data, conduct field assessments, and compare and prioritize prospective geothermal sites

Under this task, the Contractor shall perform the following activities:

- The Contractor shall review the information available for the four (4) geothermal regions in Colombia, which comprise five (5) prospective geothermal production sites (Chiles/Cerro Negro/Tufino, Volcan Azufra, Complejo del Ruiz, Santa Rosa de Cabal, and Paipa/Iza). The Contractor shall access the existing main

information sources in the country and shall meet with the Colombian entities that have conducted or are participating in geothermal activities, such as the Ministry of Mines and Energy (Directorate of Electric Energy), Colombian Institute of Geology and Mining ("INGEOMINAS" - Subsurface Resources Directorate), Mining and Energy Planning Unit ("UPME" - Energy Supply Planning and Electric System Expansion Planning Units), and the Department of National Planning ("DNP").

- Also, the Contractor shall initiate Project-related discussions with relevant international funding and technical agencies such as the Inter-American Development Bank ("IDB"), World Bank, International Finance Corporation ("IFC"), Latin American Energy Organization ("OLADE"), and the Pan American Federation of Engineering Societies ("UPADI"). Extensive geothermal information from past geothermal studies in Colombia is available at the local offices of organizations such as INGEOMINAS, OLADE, Central Hidroeléctrica de Caldas S.A. E.S.P. ("CHEC"), Geoenergía Andina S.A. ("GESA"), Colombian Institute of Electric Energy ("ICEL"), and the Institute for the Planning and Promotion of Energy Solutions for Non-Connected Zones ("IPSE").
- Based on the information collected and analyzed under the above activities, the Contractor shall organize and update the data on the geothermal production sites to develop a matrix of information covering all five (5) prospective geothermal sites. This matrix will help identify the areas that require additional studies at the geothermal production sites, as well as set up a preliminary framework for a comparative analysis of all five (5) prospective geothermal sites to rank and select the best sites for further analysis and development.
- The Contractor shall then conduct brief field assessments and tests at the geothermal production sites, as may be required to complement available data, to ensure that the requisite information for decision-making on the "best option" is available for all five (5) sites. Taking into account that the principal information required for geothermal-resource engineering assessments includes fluid pressure (as an indicator of its ability to be brought to the surface for beneficial uses), fluid temperature (as an indicator of its capability in power generation), fluid rate of flow and volume (as an indicator of the quantity of thermal energy that could be extracted in a given period of time), and reservoir volume or rate of recharging (as an indicator of reservoir useful life); the Contractor shall gather and review a variety of information, already existing in the abovementioned sources or to be obtained through brief field assessments utilizing geological, geophysical, or geochemical methods. This information includes:
  - Geological studies data, such as the type of subsurface strata, rock-formation specific porosity, rock formation permeability (through interconnected pores, fractures, or inter-grain spaces), and fluid transport along subsurface faults.
  - Geophysical testing data, such as gravity surveys (gravimetry to identify differences in density in subsurface formations), magnetic and magnetotelluric surveys (to identify anomalies in induced/natural magnetic fields and subsurface telluric currents), resistivity surveys (to identify rock formations by electric conductivity variations), electric

signal transmission patterns (to measure fluid pressure, temperature, and flow velocity), and seismic surveys (to identify type of substrata and faults based on sound conductivity).

- o Geochemical, isotopic, and radiotracing testing data of hydrothermal deposits, springs, and local rock samples, such as the determination of the presence of certain ions in hydrothermal fluids (as geothermometers or indicators of temperature in subsurface reservoir causing rock dissolution in hydrothermal fluid), determination of mixing of subsurface fluids, and determination of subsurface flows and rates of recharging.

Based on the information gathered and reviewed during this task, the Contractor shall produce a comprehensive information package for all five (5) prospective geothermal sites, including relevant maps of sites (1:10000 scale) that can be used in making decisions on Project development.

The Contractor shall then rank the five (5) prospective geothermal sites in relation to the overall potential of each site's geothermal resources for commercial power generation. Based on the results of this task, the Contractor shall conduct a series of meetings [for a minimum duration of one (1) week] with ISAGEN and other Project stakeholders to review the findings and discuss the results.

Task 2:           Legal, institutional, and regulatory review

The Contractor shall review the existing requirements and norms that can have an impact on the development and implementation of geothermal projects, such as public services, electricity, and environmental laws; natural resources code; local permitting requirements; local environmental topics; local building requirements; and other constraints (such as rights-of-way, zoning ordinances, infrastructure regulations, study/reporting requirements, and land/owner rights).

During this task, the Contractor shall conduct a series of meetings with the Ministry of Mines and Energy; Ministry of the Environment, Housing, and Territorial Development; Energy and Gas Regulatory Commission ("CREG"); INGEOMINAS; DNP; and UPME to compile a clear picture of the current and prospective legal, institutional, and regulatory issues related to the development of geothermal projects.

Since the Project would serve the purposes of improving the reliability and availability of the in-country electricity supply, providing a mechanism for enhancing regional trade, and expanding the electricity market; the Contractor shall make recommendations on clarifications or modifications regarding geothermal regulatory norms taking into account the Colombian energy market and its integration with other regional markets.

Based on the results of this task, the Contractor shall conduct a series of meetings [for a minimum duration of two (2) days] with the Grantee to review the findings and discuss the results.

Task 3: Regional electricity market and technical evaluation

Under this task, the Contractor shall review the prospects of a new geothermal project from the Colombia electricity market perspective. The Contractor's analysis shall include tariffs, revenue expectations, special incentive mechanisms (such as greenhouse gas allowances), and similar market entry and promotion considerations. The Contractor shall perform the technical evaluation of the feasibility of geothermal plants at the prospective geothermal sites, including, at a minimum, siting constraints; well system for recovery of geothermal resources; thermal energy-to-power conversion plant; infrastructure considerations related to environmental, health, and similar requirements; electrical interconnection to the grid; water availability; and security considerations. Based on these findings, the Contractor shall prepare a detailed assessment report on the technical feasibility of a geothermal plant and its prospects within the local electricity market. The detailed assessment report shall cover the five (5) prospective geothermal production sites.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 4: Preparation of preliminary designs and cost estimates

Following the completion of Task 3, the Contractor shall prepare preliminary designs of a geothermal power plant for each of the five (5) prospective geothermal sites, considering the local geothermal resources and conditions and the development of geothermal-to-power conversion technologies being applied or under development around the world (it is anticipated that the geothermal and other conditions at the prospective geothermal sites could be very different and would therefore involve different technologies for the optimal plant design). A preliminary high-level cost estimate for developing a geothermal power plant in each site shall be prepared. Details of such cost estimates shall be sufficient to perform preliminary economic and financial analyses.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 5: Economic and financial review of options and Project selection

The Contractor shall conduct an economic and financial assessment of power production at the five (5) prospective geothermal sites based on the proposed preliminary plant designs for each site prepared during Task 4. The Contractor shall calculate net present value, payback time, and financial and economic internal rates of return for all alternatives. The Contractor shall take greenhouse gas emission offsets into account. Sensitivity analyses related to possible changes in all major external factors, such as electricity cost, interest rates, and investment costs shall be performed for all five (5) prospective geothermal sites.

The Contractor shall conduct a series of meetings with the Grantee to review the findings and discuss the results of all work performed to date under these Terms of Reference. Based on the Contractor's recommendations and Grantee concurrence (including any relevant input from regulatory or local government entities), a single prospective geothermal production site shall be selected as the best option for Project development and all subsequent assessments shall be performed on the best option.

The Contractor shall assist the Grantee in developing sound financing plans for the best option, and shall assist in finding financial source(s) suitable to the Grantee for funding all components or stages of the Project leading to plant construction and commissioning. In this regard, the Contractor shall obtain written expressions of interest (proof of e-mail correspondence is acceptable) from a number of potential donors/lenders/financial participants and credit agencies. In addition, the Contractor shall verify the current terms and conditions for each of the potential sources of funding that have been identified.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

**Task 6: Environmental and development impact assessment**

The Contractor shall perform a preliminary environmental impact assessment of the best option with reference to local requirements and those of multilateral lending agencies (such as the World Bank). The Contractor shall identify potential negative impacts, discuss the extent to which they can be mitigated, and develop plans for full environmental impact assessment in anticipation of the Project moving forward to the implementation stage. In particular, the Contractor shall identify and propose remedies for any potential air, water, or noise pollution or discharges, as well as any safety or health concerns that might result from the Project. The primary objective of this task is to ensure that the Project will comply with all relevant Colombian and multilateral environmental, health, and safety regulations.

The Contractor shall also provide a report on the potential economic and social development impact of the Project on the local area where the Project will be located and on the Host Country. In this discussion, the Contractor shall focus on what the economic development outcomes will be if the Project is implemented according to the Study's recommendations. While specific focus shall be paid to the immediate impact of the Project, the Contractor shall also include any additional social impact and developmental benefits of the Project, where appropriate, including spin-off and demonstration effects. The analysis of potential benefits of the Project shall be as concrete and detailed as possible. The development impact factors are intended to provide the decision-makers behind the Project, as well as other stakeholders and interested parties, with a broader view of the Project's potential effects on the local area where the Project will be located and on the Host Country. The Contractor shall provide estimates of the Project's potential benefits in the following areas:

- *Infrastructure*: Describe any infrastructure improvements.
- *Market-Oriented Reform*: Describe any regulations, laws, or institutional changes that are recommended and the effect they would have if implemented.
- *Human Capacity Building*: Describe the number and type of positions that would be needed to construct and operate the Project, number of people that will be needed to process construction materials, operating personnel, as well as the number of people who will receive training and a brief description of the training programs.
- *Technology Transfer and Productivity Enhancement*: Describe any advanced technologies that will be brought in or implemented as a result of the Project. Describe any efficiency gains in the electricity sector.
- *Other*: Describe any other developmental benefits of the Project, including spin-off or demonstration effects.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 7: Preparation of detailed cost estimates

The Contractor shall prepare a detailed engineering, procurement, and construction ("EPC")-type cost estimate of the best option. The cost estimate shall include a detailed breakdown of time and materials for all major components, including the well system, geothermal fluid treatment, turbine/generator island, balance of plant, instrumentation and controls, water treatment, and electrical interconnection, as well as procurement, logistics, construction, and commissioning expenses.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 8: Preparation of tender documents

The Contractor shall prepare a set of tender documents of the best option for bidding purposes. The Contractor shall prepare the tender documents with the support of the Grantee's staff. The tender documents shall include: (a) Project background and information; (b) requirements for the environmental impact assessment; (c) technical specifications; and (d) draft contract clauses that would include all appropriate commercial terms for execution of the Project.

The technical specification documents shall be divided into appropriate sections, such as major equipment, major geothermal production works, and local civil works and construction. The sections shall include the following:

- International tender for major pumps, separators, heat exchangers, turbines, cooling towers, coolers, accumulators, high-pressure piping, and other mechanical equipment.

- International tender for the electrical generator, substation equipment, and instrumentation and controls.
- International tender for drilling and installing a system of production wells for geothermal resource recovery and ground re-injection of spent fluids.
- Local tender for civil works and construction (the cost of which shall be based on local rates).

All international tenders related to the major equipment and works shall include provisions for allowing local components of the works (in particular as related to erection, installation, commissioning, and testing).

The Contractor shall deliver the tender documents to the Grantee as a stand-alone appendix to the Final Report. The Grantee is responsible for all procurement-related final decisions.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

#### Task 9: Preparation and Presentation of the Final Report

The Contractor shall prepare a draft Final Report that includes all analyses and findings performed under Tasks 1-8 (the tender documents delivered under Task 8 shall be submitted as a stand-alone appendix). The Contractor shall provide the draft Final Report to the Grantee for review and discussion.

Once the Grantee has provided comments and revisions on the draft Final Report, the Contractor shall prepare and deliver to the Grantee and USTDA a substantive and comprehensive Final Report of all work performed under these Terms of Reference ("Final Report"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to the Grantee. The Final Report shall be prepared in accordance with Clause I of Annex II of the Grant Agreement.

#### Notes:

- (1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.
- (2) The Contractor and the Grantee shall be careful to ensure that the public version of the Final Report contains no security or confidential information.
- (3) The Grantee and USTDA shall have an irrevocable, worldwide, royalty-free, non-exclusive right to use and distribute the public version of the Final Report and all work product that is developed under these Terms of Reference.

## Annex II

### USTDA Mandatory Contract Clauses

#### A. USTDA Mandatory Clauses Controlling

The parties to this contract acknowledge that this contract is funded in whole or in part by the U.S. Trade and Development Agency ("USTDA") under the Grant Agreement between the Government of the United States of America acting through USTDA and ISAGEN S.A. E.S.P. ("Client"), dated \_\_\_\_\_ ("Grant Agreement"). The Client has selected \_\_\_\_\_ ("Contractor") to perform the feasibility study ("Study") for the Geothermal Power Generation project ("Project") in Colombia ("Host Country"). Notwithstanding any other provisions of this contract, the following USTDA mandatory contract clauses shall govern. All subcontracts entered into by Contractor funded or partially funded with USTDA Grant funds shall include these USTDA mandatory contract clauses, except for clauses B(1), G, H, I, and J. In addition, in the event of any inconsistency between the Grant Agreement and any contract or subcontract thereunder, the Grant Agreement shall be controlling.

#### B. USTDA as Financier

##### (1) USTDA Approval of Contract

All contracts funded under the Grant Agreement, and any amendments thereto, including assignments and changes in the Terms of Reference, must be approved by USTDA in writing in order to be effective with respect to the expenditure of USTDA Grant funds. USTDA will not authorize the disbursement of USTDA Grant funds until the contract has been formally approved by USTDA or until the contract conforms to modifications required by USTDA during the contract review process.

##### (2) USTDA Not a Party to the Contract

It is understood by the parties that USTDA has reserved certain rights such as, but not limited to, the right to approve the terms of this contract and amendments thereto, including assignments, the selection of all contractors, the Terms of Reference, the Final Report, and any and all documents related to any contract funded under the Grant Agreement. The parties hereto further understand and agree that USTDA, in reserving any or all of the foregoing approval rights, has acted solely as a financing entity to assure the proper use of United States Government funds, and that any decision by USTDA to exercise or refrain from exercising these approval rights shall be made as a financier in the course of financing the Study and shall not be construed as making USTDA a party to the contract. The parties hereto understand and agree that USTDA may, from time to time, exercise the foregoing approval rights, or discuss matters related to these rights and the Project with the parties to the contract or any subcontract, jointly or separately, without thereby incurring any responsibility or liability to such parties. Any approval or failure to approve by USTDA shall not

bar the Client or USTDA from asserting any right they might have against the Contractor, or relieve the Contractor of any liability which the Contractor might otherwise have to the Client or USTDA.

### **C. Nationality, Source, and Origin**

Except as USTDA may otherwise agree, the following provisions shall govern the delivery of goods and services funded by USTDA under the Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from Host Country may not exceed thirty percent (30%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for performance of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source, and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in Host Country are not subject to the above restrictions. USTDA will make available further details concerning these provisions upon request.

### **D. Recordkeeping and Audit**

The Contractor and subcontractors funded under the Grant Agreement shall maintain, in accordance with generally accepted accounting procedures, books, records, and other documents, sufficient to reflect properly all transactions under or in connection with the contract. These books, records, and other documents shall clearly identify and track the use and expenditure of USTDA funds, separately from other funding sources. Such books, records, and documents shall be maintained during the contract term and for a period of three (3) years after final disbursement by USTDA. The Contractor and subcontractors shall afford USTDA, or its authorized representatives, the opportunity at reasonable times for inspection and audit of such books, records, and other documentation.

### **E. U.S. Carriers**

#### **(1) Air**

Transportation by air of persons or property funded under the Grant Agreement shall be on U.S. flag carriers in accordance with the Fly America Act, 49 U.S.C. 40118, to the extent service by such carriers is available, as provided under applicable U.S. Government regulations.

## **(2) Marine**

Transportation by sea of property funded under the Grant Agreement shall be on U.S. carriers in accordance with U.S. cargo preference law.

## **F. Workman's Compensation Insurance**

The Contractor shall provide adequate Workman's Compensation Insurance coverage for work performed under this Contract.

## **G. Reporting Requirements**

The Contractor shall advise USTDA by letter as to the status of the Project on March 1st annually for a period of two (2) years after completion of the Study. In addition, if at any time the Contractor receives follow-on work from the Client, the Contractor shall so notify USTDA and designate the Contractor's contact point including name, telephone, and fax number. Since this information may be made publicly available by USTDA, any information which is confidential shall be designated as such by the Contractor and provided separately to USTDA. USTDA will maintain the confidentiality of such information in accordance with applicable law.

## **H. Disbursement Procedures**

### **(1) USTDA Approval of Contract**

Disbursement of Grant funds will be made only after USTDA approval of this contract. To make this review in a timely fashion, USTDA must receive from either the Client or the Contractor a photocopy of an English language version of a signed contract or a final negotiated draft version to the attention of the General Counsel's office at USTDA's address listed in Clause M below.

### **(2) Payment Schedule Requirements**

A payment schedule for disbursement of Grant funds to the Contractor shall be included in this Contract. Such payment schedule must conform to the following USTDA requirements: (1) up to twenty percent (20%) of the total USTDA Grant amount may be used as an advance payment; (2) all other payments, with the exception of the final payment, shall be based upon contract performance milestones; and (3) the final payment may be no less than fifteen percent (15%) of the total USTDA Grant amount, payable upon receipt by USTDA of an approved Final Report in accordance with the specifications and quantities set forth in Clause I below. Invoicing procedures for all payments are described below.

### **(3) Contractor Invoice Requirements**

USTDA will make all disbursements of USTDA Grant funds directly to the Contractor. The Contractor must provide USTDA with an ACH Vendor Enrollment Form (available from USTDA) with the first invoice. The Client shall request disbursement of funds by USTDA to the Contractor for performance of the contract by submitting the following to USTDA:

#### **(a) Contractor's Invoice**

The Contractor's invoice shall include reference to an item listed in the Contract payment schedule, the requested payment amount, and an appropriate certification by the Contractor, as follows:

(i) For an advance payment (if any):

"As a condition for this advance payment, which is an advance against future Study costs, the Contractor certifies that it will perform all work in accordance with the terms of its Contract with the Client. To the extent that the Contractor does not comply with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA."

(ii) For contract performance milestone payments:

"The Contractor has performed the work described in this invoice in accordance with the terms of its contract with the Client and is entitled to payment thereunder. To the extent the Contractor has not complied with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA."

(iii) For final payment:

"The Contractor has performed the work described in this invoice in accordance with the terms of its contract with the Client and is entitled to payment thereunder. Specifically, the Contractor has submitted the Final Report to the Client, as required by the Contract, and received the Client's approval of the Final Report. To the extent the Contractor has not complied with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA."

#### **(b) Client's Approval of the Contractor's Invoice**

(i) The invoice for an advance payment must be approved in writing by the Client.

(ii) For contract performance milestone payments, the following certification by the Client must be provided on the invoice or separately:

"The services for which disbursement is requested by the Contractor have been performed satisfactorily, in accordance with applicable Contract provisions and the terms and conditions of the USTDA Grant Agreement."

(iii) For final payment, the following certification by the Client must be provided on the invoice or separately:

"The services for which disbursement is requested by the Contractor have been performed satisfactorily, in accordance with applicable Contract provisions and terms and conditions of the USTDA Grant Agreement. The Final Report submitted by the Contractor has been reviewed and approved by the Client."

**(c) USTDA Address for Disbursement Requests**

Requests for disbursement shall be submitted by courier or mail to the attention of the Finance Department at USTDA's address listed in Clause M below.

**(4) Termination**

In the event that the Contract is terminated prior to completion, the Contractor will be eligible, subject to USTDA approval, for reasonable and documented costs which have been incurred in performing the Terms of Reference prior to termination, as well as reasonable wind down expenses. Reimbursement for such costs shall not exceed the total amount of undisbursed Grant funds. Likewise, in the event of such termination, USTDA is entitled to receive from the Contractor all USTDA Grant funds previously disbursed to the Contractor (including but not limited to advance payments) which exceed the reasonable and documented costs incurred in performing the Terms of Reference prior to termination.

**I. USTDA Final Report**

**(1) Definition**

"Final Report" shall mean the Final Report described in the attached Annex I Terms of Reference or, if no such "Final Report" is described therein, "Final Report" shall mean a substantive and comprehensive report of work performed in accordance with the attached Annex I Terms of Reference, including any documents delivered to the Client.

**(2) Final Report Submission Requirements**

The Contractor shall provide the following to USTDA:

(a) One (1) complete version of the Final Report for USTDA's records. This version shall have been approved by the Client in writing and must be in the English language. It is the responsibility of the Contractor to ensure that confidential information, if any, contained in this version be clearly marked. USTDA will maintain the confidentiality of such information in accordance with applicable law.

and

(b) Three (3) copies of the Final Report suitable for public distribution ("Public Version"). The Public Version shall have been approved by the Client in writing and must be in the English language. As this version will be available for public distribution, it must not contain any confidential information. If the report in (a) above contains no confidential information, it may be used as the Public Version [provided USTDA receives a total of four (4) copies]. In any event, the Public Version must be informative and contain sufficient Project detail to be useful to prospective equipment and service providers.

The Contractor shall also provide one (1) copy of the Public Version of the Final Report to the Foreign Commercial Service Officer or the Economic Section of the U.S. Embassy in Host Country for informational purposes.

### **(3) Final Report Presentation**

All Final Reports submitted to USTDA must be paginated and include the following:

(a) The front cover of every Final Report shall contain the name of the Client, the name of the Contractor who prepared the report, a report title, USTDA's logo, USTDA's mailing and delivery addresses, and the following disclaimer:

"This report was funded by the U.S. Trade and Development Agency (USTDA), an agency of the U.S. Government. The opinions, findings, conclusions or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position or policies of USTDA. USTDA makes no representation about, nor does it accept responsibility for, the accuracy or completeness of the information contained in this report."

(b) The inside front cover of every Final Report shall contain USTDA's logo, USTDA's mailing and delivery addresses, and USTDA's mission statement. Camera-ready copy of USTDA Final Report specifications will be available from USTDA upon request.

(c) The Contractor and any subcontractor that performs work pursuant to the Grant Agreement must be clearly identified in the Final Report. Business name,

point of contact, address, e-mail, and telephone and fax numbers shall be included for Contractor and each subcontractor.

(d) The Final Report, while aiming at optimum specifications and characteristics for the Project, shall identify the availability of prospective U.S. sources of supply. Business name, point of contact, address, e-mail, and telephone and fax numbers shall be included for each commercial source.

(e) The Final Report shall be accompanied by a letter or other notation by the Client which states that the Client approves the Final Report. A certification by the Client to this effect provided on or with the invoice for final payment will meet this requirement.

## **J. Modifications**

All changes, modifications, assignments or amendments to this contract, including the appendices, shall be made only by written agreement by the parties hereto, subject to written USTDA approval.

## **K. Study Schedule**

### **(1) Study Completion Date**

The completion date for the Study, which is December 31, 2008, is the date by which the parties estimate that the Study will have been completed.

### **(2) Time Limitation on Disbursement of USTDA Grant Funds**

Except as USTDA may otherwise agree, (a) no USTDA funds may be disbursed under this contract for goods and services which are provided prior to the Effective Date of the Grant Agreement; and (b) all funds made available under the Grant Agreement must be disbursed within four (4) years from the Effective Date of the Grant Agreement.

## **L. Business Practices**

The Contractor agrees not to pay, promise to pay, or authorize the payment of any money or anything of value, directly or indirectly, to any person (whether a governmental official or private individual) for the purpose of illegally or improperly inducing anyone to take any action favorable to any party in connection with the Study. The Client agrees not to receive any such payment. The Contractor and the Client agree that each will require that any agent or representative hired to represent them in connection with the Study will comply with this paragraph and all laws which apply to activities and obligations of each party under this Contract, including but not limited to those laws and obligations dealing with improper payments as described above.

### **M. USTDA Address and Fiscal Data**

Any communication with USTDA regarding this Contract shall be sent to the following address and include the fiscal data listed below:

U.S. Trade and Development Agency  
1000 Wilson Boulevard, Suite 1600  
Arlington, Virginia 22209-3901  
USA

Phone: (703) 875-4357

Fax: (703) 875-4009

#### Fiscal Data:

Appropriation No.:	117/81001
Activity No.:	2007-51015B
Reservation No.:	2007510032
Grant No.:	GH2007510008

### **N. Definitions**

All capitalized terms not otherwise defined herein shall have the meaning set forth in the Grant Agreement.

### **O. Taxes**

USTDA funds provided under the Grant Agreement shall not be used to pay any taxes, tariffs, duties, fees, or other levies imposed under laws in effect in Host Country. Neither the Client nor the Contractor will seek reimbursement from USTDA for such taxes, tariffs, duties, fees, or other levies.

**ANNEX 5**

**TERMS OF REFERENCE  
(FROM USTDA GRANT AGREEMENT)**

## Annex I

### **Terms of Reference**

#### Objective

The objective of the Geothermal Power Generation Feasibility Study ("Study") is to assess five (5) prospective geothermal power production sites in order to determine the most viable site. The Study will enable ISAGEN S.A. E.S.P. ("ISAGEN") ("Grantee") to develop a 50 MW geothermal power generation project ("Project").

#### General Considerations

In carrying out the Study, the Contractor shall address issues related to Project sizing, optimal siting, technology selection for thermal resource recovery and power generation, economic viability, environmental impacts, economic and developmental impacts, institutional issues, and financing options.

The Contractor shall conduct the work with the active cooperation and support of ISAGEN and relevant agencies of the Government of Colombia. It is anticipated that the Contractor may subcontract certain selected subtasks of the Project (within the guidelines allowed by USTDA) to a local subcontractor that is closely familiar with past geological and technical evaluations conducted at the prospective geothermal sites in order to expedite the performance of the Project.

During the course of the Study, the Contractor shall work closely with the management and staff of the Grantee, who shall cooperate fully in the timely completion of the Study tasks. The Grantee shall also provide the services of its technical staff (at no cost to the Contractor or USTDA), as needed, to complete the Study. The Grantee shall arrange for the prompt and complete submittal of all technical data necessary and appropriate for carrying out the Study. The Grantee shall also arrange for translation into English of all relevant Project data. The Contractor shall be responsible for preparing all reports and other documents resulting from the Study in English.

#### Activities

Task 1: Review available data, conduct field assessments, and compare and prioritize prospective geothermal sites

Under this task, the Contractor shall perform the following activities:

- The Contractor shall review the information available for the four (4) geothermal regions in Colombia, which comprise five (5) prospective geothermal production sites (Chiles/Cerro Negro/Tufino, Volcan Azufral, Complejo del Ruiz, Santa Rosa de Cabal, and Paipa/Iza). The Contractor shall access the existing main

information sources in the country and shall meet with the Colombian entities that have conducted or are participating in geothermal activities, such as the Ministry of Mines and Energy (Directorate of Electric Energy), Colombian Institute of Geology and Mining ("INGEOMINAS" - Subsurface Resources Directorate), Mining and Energy Planning Unit ("UPME" - Energy Supply Planning and Electric System Expansion Planning Units), and the Department of National Planning ("DNP").

- Also, the Contractor shall initiate Project-related discussions with relevant international funding and technical agencies such as the Inter-American Development Bank ("IDB"), World Bank, International Finance Corporation ("IFC"), Latin American Energy Organization ("OLADE"), and the Pan American Federation of Engineering Societies ("UPADI"). Extensive geothermal information from past geothermal studies in Colombia is available at the local offices of organizations such as INGEOMINAS, OLADE, Central Hidroeléctrica de Caldas S.A. E.S.P. ("CHEC"), Geoenergía Andina S.A. ("GESA"), Colombian Institute of Electric Energy ("ICEL"), and the Institute for the Planning and Promotion of Energy Solutions for Non-Connected Zones ("IPSE").
- Based on the information collected and analyzed under the above activities, the Contractor shall organize and update the data on the geothermal production sites to develop a matrix of information covering all five (5) prospective geothermal sites. This matrix will help identify the areas that require additional studies at the geothermal production sites, as well as set up a preliminary framework for a comparative analysis of all five (5) prospective geothermal sites to rank and select the best sites for further analysis and development.
- The Contractor shall then conduct brief field assessments and tests at the geothermal production sites, as may be required to complement available data, to ensure that the requisite information for decision-making on the "best option" is available for all five (5) sites. Taking into account that the principal information required for geothermal-resource engineering assessments includes fluid pressure (as an indicator of its ability to be brought to the surface for beneficial uses), fluid temperature (as an indicator of its capability in power generation), fluid rate of flow and volume (as an indicator of the quantity of thermal energy that could be extracted in a given period of time), and reservoir volume or rate of recharging (as an indicator of reservoir useful life); the Contractor shall gather and review a variety of information, already existing in the abovementioned sources or to be obtained through brief field assessments utilizing geological, geophysical, or geochemical methods. This information includes:
  - Geological studies data, such as the type of subsurface strata, rock-formation specific porosity, rock formation permeability (through interconnected pores, fractures, or inter-grain spaces), and fluid transport along subsurface faults.
  - Geophysical testing data, such as gravity surveys (gravimetry to identify differences in density in subsurface formations), magnetic and magnetotelluric surveys (to identify anomalies in induced/natural magnetic fields and subsurface telluric currents), resistivity surveys (to identify rock formations by electric conductivity variations), electric

- signal transmission patterns (to measure fluid pressure, temperature, and flow velocity), and seismic surveys (to identify type of substrata and faults based on sound conductivity).
- o Geochemical, isotopic, and radiotracing testing data of hydrothermal deposits, springs, and local rock samples, such as the determination of the presence of certain ions in hydrothermal fluids (as geothermometers or indicators of temperature in subsurface reservoir causing rock dissolution in hydrothermal fluid), determination of mixing of subsurface fluids, and determination of subsurface flows and rates of recharging.

Based on the information gathered and reviewed during this task, the Contractor shall produce a comprehensive information package for all five (5) prospective geothermal sites, including relevant maps of sites (1:10000 scale) that can be used in making decisions on Project development.

The Contractor shall then rank the five (5) prospective geothermal sites in relation to the overall potential of each site's geothermal resources for commercial power generation. Based on the results of this task, the Contractor shall conduct a series of meetings [for a minimum duration of one (1) week] with ISAGEN and other Project stakeholders to review the findings and discuss the results.

Task 2: Legal, institutional, and regulatory review

The Contractor shall review the existing requirements and norms that can have an impact on the development and implementation of geothermal projects, such as public services, electricity, and environmental laws; natural resources code; local permitting requirements; local environmental topics; local building requirements; and other constraints (such as rights-of-way, zoning ordinances, infrastructure regulations, study/reporting requirements, and land/owner rights).

During this task, the Contractor shall conduct a series of meetings with the Ministry of Mines and Energy; Ministry of the Environment, Housing, and Territorial Development; Energy and Gas Regulatory Commission ("CREG"); INGEOMINAS; DNP; and UPME to compile a clear picture of the current and prospective legal, institutional, and regulatory issues related to the development of geothermal projects.

Since the Project would serve the purposes of improving the reliability and availability of the in-country electricity supply, providing a mechanism for enhancing regional trade, and expanding the electricity market; the Contractor shall make recommendations on clarifications or modifications regarding geothermal regulatory norms taking into account the Colombian energy market and its integration with other regional markets.

Based on the results of this task, the Contractor shall conduct a series of meetings [for a minimum duration of two (2) days] with the Grantee to review the findings and discuss the results.

**Task 3: Regional electricity market and technical evaluation**

Under this task, the Contractor shall review the prospects of a new geothermal project from the Colombia electricity market perspective. The Contractor's analysis shall include tariffs, revenue expectations, special incentive mechanisms (such as greenhouse gas allowances), and similar market entry and promotion considerations. The Contractor shall perform the technical evaluation of the feasibility of geothermal plants at the prospective geothermal sites, including, at a minimum, siting constraints; well system for recovery of geothermal resources; thermal energy-to-power conversion plant; infrastructure considerations related to environmental, health, and similar requirements; electrical interconnection to the grid; water availability; and security considerations. Based on these findings, the Contractor shall prepare a detailed assessment report on the technical feasibility of a geothermal plant and its prospects within the local electricity market. The detailed assessment report shall cover the five (5) prospective geothermal production sites.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

**Task 4: Preparation of preliminary designs and cost estimates**

Following the completion of Task 3, the Contractor shall prepare preliminary designs of a geothermal power plant for each of the five (5) prospective geothermal sites, considering the local geothermal resources and conditions and the development of geothermal-to-power conversion technologies being applied or under development around the world (it is anticipated that the geothermal and other conditions at the prospective geothermal sites could be very different and would therefore involve different technologies for the optimal plant design). A preliminary high-level cost estimate for developing a geothermal power plant in each site shall be prepared. Details of such cost estimates shall be sufficient to perform preliminary economic and financial analyses.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

**Task 5: Economic and financial review of options and Project selection**

The Contractor shall conduct an economic and financial assessment of power production at the five (5) prospective geothermal sites based on the proposed preliminary plant designs for each site prepared during Task 4. The Contractor shall calculate net present value, payback time, and financial and economic internal rates of return for all alternatives. The Contractor shall take greenhouse gas emission offsets into account. Sensitivity analyses related to possible changes in all major external factors, such as electricity cost, interest rates, and investment costs shall be performed for all five (5) prospective geothermal sites.

The Contractor shall conduct a series of meetings with the Grantee to review the findings and discuss the results of all work performed to date under these Terms of Reference. Based on the Contractor's recommendations and Grantee concurrence (including any relevant input from regulatory or local government entities), a single prospective geothermal production site shall be selected as the best option for Project development and all subsequent assessments shall be performed on the best option.

The Contractor shall assist the Grantee in developing sound financing plans for the best option, and shall assist in finding financial source(s) suitable to the Grantee for funding all components or stages of the Project leading to plant construction and commissioning. In this regard, the Contractor shall obtain written expressions of interest (proof of e-mail correspondence is acceptable) from a number of potential donors/lenders/financial participants and credit agencies. In addition, the Contractor shall verify the current terms and conditions for each of the potential sources of funding that have been identified.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

**Task 6: Environmental and development impact assessment**

The Contractor shall perform a preliminary environmental impact assessment of the best option with reference to local requirements and those of multilateral lending agencies (such as the World Bank). The Contractor shall identify potential negative impacts, discuss the extent to which they can be mitigated, and develop plans for full environmental impact assessment in anticipation of the Project moving forward to the implementation stage. In particular, the Contractor shall identify and propose remedies for any potential air, water, or noise pollution or discharges, as well as any safety or health concerns that might result from the Project. The primary objective of this task is to ensure that the Project will comply with all relevant Colombian and multilateral environmental, health, and safety regulations.

The Contractor shall also provide a report on the potential economic and social development impact of the Project on the local area where the Project will be located and on the Host Country. In this discussion, the Contractor shall focus on what the economic development outcomes will be if the Project is implemented according to the Study's recommendations. While specific focus shall be paid to the immediate impact of the Project, the Contractor shall also include any additional social impact and developmental benefits of the Project, where appropriate, including spin-off and demonstration effects. The analysis of potential benefits of the Project shall be as concrete and detailed as possible. The development impact factors are intended to provide the decision-makers behind the Project, as well as other stakeholders and interested parties, with a broader view of the Project's potential effects on the local area where the Project will be located and on the Host Country. The Contractor shall provide estimates of the Project's potential benefits in the following areas:

- *Infrastructure*: Describe any infrastructure improvements.
- *Market-Oriented Reform*: Describe any regulations, laws, or institutional changes that are recommended and the effect they would have if implemented.
- *Human Capacity Building*: Describe the number and type of positions that would be needed to construct and operate the Project, number of people that will be needed to process construction materials, operating personnel, as well as the number of people who will receive training and a brief description of the training programs.
- *Technology Transfer and Productivity Enhancement*: Describe any advanced technologies that will be brought in or implemented as a result of the Project. Describe any efficiency gains in the electricity sector.
- *Other*: Describe any other developmental benefits of the Project, including spin-off or demonstration effects.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 7: Preparation of detailed cost estimates

The Contractor shall prepare a detailed engineering, procurement, and construction ("EPC")-type cost estimate of the best option. The cost estimate shall include a detailed breakdown of time and materials for all major components, including the well system, geothermal fluid treatment, turbine/generator island, balance of plant, instrumentation and controls, water treatment, and electrical interconnection, as well as procurement, logistics, construction, and commissioning expenses.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

Task 8: Preparation of tender documents

The Contractor shall prepare a set of tender documents of the best option for bidding purposes. The Contractor shall prepare the tender documents with the support of the Grantee's staff. The tender documents shall include: (a) Project background and information; (b) requirements for the environmental impact assessment; (c) technical specifications; and (d) draft contract clauses that would include all appropriate commercial terms for execution of the Project.

The technical specification documents shall be divided into appropriate sections, such as major equipment, major geothermal production works, and local civil works and construction. The sections shall include the following:

- International tender for major pumps, separators, heat exchangers, turbines, cooling towers, coolers, accumulators, high-pressure piping, and other mechanical equipment.

- International tender for the electrical generator, substation equipment, and instrumentation and controls.
- International tender for drilling and installing a system of production wells for geothermal resource recovery and ground re-injection of spent fluids.
- Local tender for civil works and construction (the cost of which shall be based on local rates).

All international tenders related to the major equipment and works shall include provisions for allowing local components of the works (in particular as related to erection, installation, commissioning, and testing).

The Contractor shall deliver the tender documents to the Grantee as a stand-alone appendix to the Final Report. The Grantee is responsible for all procurement-related final decisions.

Based on the results of this task, the Contractor shall review the findings and discuss the results with the Grantee.

**Task 9: Preparation and Presentation of the Final Report**

The Contractor shall prepare a draft Final Report that includes all analyses and findings performed under Tasks 1-8 (the tender documents delivered under Task 8 shall be submitted as a stand-alone appendix). The Contractor shall provide the draft Final Report to the Grantee for review and discussion.

Once the Grantee has provided comments and revisions on the draft Final Report, the Contractor shall prepare and deliver to the Grantee and USTDA a substantive and comprehensive Final Report of all work performed under these Terms of Reference ("Final Report"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to the Grantee. The Final Report shall be prepared in accordance with Clause I of Annex II of the Grant Agreement.

**Notes:**

- (1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.
- (2) The Contractor and the Grantee shall be careful to ensure that the public version of the Final Report contains no security or confidential information.
- (3) The Grantee and USTDA shall have an irrevocable, worldwide, royalty-free, non-exclusive right to use and distribute the public version of the Final Report and all work product that is developed under these Terms of Reference.