

**REQUEST FOR PROPOSALS**

**FEASIBILITY STUDY FOR THE**

**VENTANAS SMELTER HEAT RECOVERY SYSTEM**

Submission Deadline: **1:00 pm LOCAL TIME**  
**FRIDAY, DECEMBER 29, 2008**

Submission Place: **Richard Aylwin**  
**Director of Energy Efficiency**  
**Codelco**  
**Huerfanos 1270**  
**Santiago, Chile**  
**Phone: +(56) 2 690 3378**

**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.**

## REQUEST FOR PROPOSALS

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## **Section 1: INTRODUCTION**

The U.S. Trade and Development Agency (USTDA) has provided a grant to conduct a Feasibility Study for the Ventanas Smelter Heat Recovery System project on behalf of the Corporación Nacional del Cobre de Chile (Codelco). 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**

The Government of Chile has placed a high priority on promoting energy efficiency. In 2005, the Government launched the National Energy Efficiency Program ("Programa País de Eficiencia Energética, PPEE"). The PPEE has identified 13 lines of action to accomplish the broad goal of reducing annual energy consumption by 1.5%. In this regard, Chile's state-owned copper company, Codelco, currently faces several challenges in relation to energy efficiency and demands of modernization. Stringent environmental laws require Codelco to reduce its air and water emissions, as the copper industry consumes 34.1% of the total amount of the electrical energy and 5.9% of the total fuel in Chile.

Codelco has therefore requested feasibility study assistance from USTDA for a Heat Recovery Master Plan Project. The objective of the feasibility study is to ascertain the technical and financial viability of recovering the heat, currently wasted, at the Codelco Ventanas plant. Ventanas is located 50km from the city of Viña del Mar and 164km from Santiago.

Chile is facing a shortfall in electricity production and the implementation of this project will add much needed generating capacity to the Chilean electric grid and will help the Chilean government to reduce energy demand. The project will use waste heat, which will supplant the use of high priced fossil fuels and decrease greenhouse gases.

Codelco proposes to insert a Heat Recovery Steam Generator (boiler) into the copper refining process. Gases produced during the refining process must be cooled in order to pass through pollution control equipment. The energy currently being used for the gas cooling process is estimated at 45 million btu/hr or the equivalent of some 2.6 million gallons of fuel oil. The new boiler will capture the heat, currently wasted, and cool the gases. The recovered heat will also produce approximately 40,000lb/hr of steam. With increased steam capacity, approximately 15 MW of electricity could be produced, if three additional boilers are installed.

The FS will address several technical issues regarding the development of the project:

1. Designing a Heat Recovery Steam Generator (HRSG) that will handle the potentially corrosive exhaust gases.
2. Determining the maximum exhaust gas temperature allowed by the HRSG.
3. Determining the effects of adding the HRSG on the existing sulfuric acid plant used to reduce SO<sub>2</sub> emissions.

4. Physically integrating the new HRSG into the existing steam distribution system or directly into the electro refining process.
5. Integrating the electrical generator into the local electric grid and plant electrical systems.

The selected contractor will evaluate the feasibility of two systems: one with steam production (one boiler), one with steam and electricity production (four boilers).

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

## **1.2 OBJECTIVE**

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. \$422,000 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 " Ventanas Smelter Heat Recovery System."

### **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. \$422,000 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. Additionally the Offeror will use its best efforts to preserve the confidentiality of any business proprietary or confidential information submitted by the Grantee, which is clearly designated as such by the Grantee.

## **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 20 percent of the amount of the USTDA grant. USTDA nationality requirements are detailed in Annex 3.

## **2.12 LANGUAGE OF PROPOSAL**

All proposal documents shall be prepared and submitted in English.

## **2.13 PROPOSAL SUBMISSION REQUIREMENTS**

The **Cover Letter** in the proposal must be addressed to:

Richard Aylwin, Director of Energy Efficiency, Codelco, Huerfanos 1270, Santiago  
Chile  
Phone: + (56) 2 690 3378

**An Original and 3 copies of your proposal must be received at the above address no later than 1:00 pm (local time), on December 29, 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 and 3 copies 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. \$422,000 dollars.

Offerors shall submit one (1) original and 3 copies 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, e-mail address, address, telephone and fax number, if different from (1).

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

Provide name, title, address, e-mail 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:

Experience in developing large scale energy infrastructure projects -25 points

Experience with copper smelting processes and the handling/treatment of exhaust gases from smelters – 40 points

Experience with packaging financing for similar large-scale infrastructure projects – 20 points

Spanish language skills – 15 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**

Contact: Richard Aylwin, Director of Energy Efficiency, Codelco, Huerfanos 1270, Santiago Chile  
Phone: +(56) 2 690 3378

## **B - CHILE: VENTANAS SMELTER HEAT RECOVERY SYSTEM PROJECT**

POC John Kusinerek, USTDA, 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901, Tel: (703) 875-4357, Fax: (703) 875-4009. VENTANAS SMELTER HEAT RECOVERY SYSTEM PROJECT. The Grantee invites submission of qualifications and proposal data (collectively referred to as the "Proposal") from interested U.S. firms which are qualified on the basis of experience and capability to develop a feasibility study for a Ventanas Smelter Heat Recovery System for the Corporación Nacional del Cobre de Chile (Codelco).

The feasibility study would evaluate the viability of converting unused heat from the Ventanas smelter into steam energy.

The project proposes to insert a Heat Recovery Steam Generator (boiler) into the copper refining process. Gases produced during the refining process must be cooled in order to pass through pollution control equipment. The energy currently being used for the gas cooling process is estimated at 45 million btu/hr or the equivalent of some 2.6 million gallons of fuel oil. The new boiler will capture the heat, currently wasted, and cool the gases. The recovered heat will also produce approximately 40,000lb/hr of steam. With increased steam capacity, approximately 15 MW of electricity could be produced, if three additional boilers are installed.

The U.S. firm selected will be paid in U.S. dollars from a \$422,000 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 Terms of Reference, and a background definitional mission report are 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 RFPs 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 mail room 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 20 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 directly to the Grantee by 1:00pm (local time), December 29, 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.

**ANNEX 2**



**DEFINITIONAL MISSION FOR POWER SECTOR  
PROJECTS  
IN CHILE**

Project Number: C02007510003

**December 2007**

**GreenMax Capital Advisors**

New York Headquarters:

423A First Street

Brooklyn, NY 11215

Phone: +1718-788-3850

Fax: +1718-989-7329

[www.greenmaxcap.com](http://www.greenmaxcap.com)



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.

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



## **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.**



**GreenMax Capital Advisors (GreenMax)**, is an international energy and environmental investment and management-consulting firm established in 1994. GreenMax supports project developers, investors, financial institutions and donors in the analysis, preparation and implementation of a broad range of energy and environmental investments. Our core business is bringing more rational energy use to the market through renewable energy, project rehabilitation, and more efficient sources of energy. Our firm is unique in that preparation and financing of these projects is our sole activity. We provide design and arrangement of project financing, project identification and assessment and assistance with commercial aspects of project implementation within the energy and environment sectors.

Over the past decade we have focused entirely on emerging markets, specializing on the Eastern, Central and Southeast Europe Regions, the Commonwealth of Independent States (CIS), Sub-Saharan Africa and Latin America. Our deep understanding of these markets plus our network of relationships with investors throughout North America and Western Europe places GreenMax in a unique position to bring financing and technology partners to the most worthy projects. Our locations in New York, Minnesota, Barcelona, Warsaw, Belgrade, Kiev, Prague and Kampala reflects our commitment to build effective bridges between financial markets and projects in emerging economy environments.

The GreenMax team of experts has extensive backgrounds evaluating project development potential in the specific economic and political realities of these countries. Our experts all have diverse work histories serving as commercial managers, project developers, investors, advisors, board members and entrepreneurs. Acting as advisors primarily to financiers and developers and with direct development experience ourselves, we bring the perspective of hands-on practitioners to each assignment.

#### **Contact GreenMax:**

<b>Clifford Aron</b> Principal, Warsaw Office: ul. Gen Zajaczka 28 01-510 Warsaw, Poland Phone: +48 22 869 0580 Fax: +48 22 869 0586 Email: cja@greenmaxcap.com	<b>Jose Luis Bobes</b> Principal Barcelona Office: Victoria Suites Avda. Pedralbes, 16 08034 Barcelona, Spain Phone: +34 93 371 6230 Fax: +34 93 371 6208 Email: jlbobes@greenmaxcap.com	<b>Bruce Browers</b> Principal Minnesota Office phone 218-525-4165 fax 218-525-4165 Email: brue.browers@greenmaxap.com
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**Website: [www.greenmaxcap.com](http://www.greenmaxcap.com)**



## DEFINITIONAL MISSION for Power Sector Projects in Chile

### 1. Executive Summary

GreenMax Capital Advisors (GreenMax) has been selected by the U.S. Trade and Development Agency (USTDA) to carry out a Definitional Mission to consider energy efficiency projects in Chile on behalf of the agency. The principal objective of this mission was to review projects in the energy sector and provide an independent recommendation to USTDA as to whether such projects meet USTDA's funding criteria.

GreenMax's Principal, José Luis Bobes, traveled to Santiago de Chile, in August 2007. Mr. Bobes stayed in Santiago for 13 days and met with key private-sector developers, senior government officials, relevant organizations, and others to conduct due diligence on a select set of projects.

After careful review, GreenMax is proposing two projects to be considered for funding by USTDA.

- **Market Evaluation Study to Assess Potential Business Opportunities for ESCO Companies in Chile**
- **Feasibility Study for Industrial Energy Efficiency Project at Codelco Copper Refinery Plant**

A review of both of these projects is included in this report, as well as an overview of other projects reviewed but not recommended at this time.

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

GreenMax has been tasked with investigating ways the USTDA can support projects in the Chilean power sector. Specifically the agency received grant requests for geothermal, biomass combined heat and power projects and energy efficiency projects.

One of the long term goals of these alternative energy developments is to assist Chile in achieving energy independence as it currently imports over 70% of its fuel as oil, gas and coal.

Hydropower has historically been Chile's single largest power source. Droughts, however, have periodically curtailed hydropower production, causing supply shortfalls and blackouts. In response, the Chilean government began in the 1990s to diversify its energy mix to become less reliant on hydropower, mainly by building natural gas-fired power plants.

After being delayed for several years by opposition from local residents and environmental activists, Endesa's Ralco hydropower plant on the Biobio River began operations in September 2004. Ralco is the largest power plant in Chile, with generating capacity of 570 megawatts (MW). In December 2004, Chile's environmental agency approved plans by Endesa to expand Ralco's capacity to 690-MW.

In 2004, Chile had total installed electricity generating capacity of 10.7 gigawatts. The country produced 50.9



## DEFINITIONAL MISSION for Power Sector Projects in Chile

billion kilowatthours (Bkwh) of electricity in 2004, while consuming 49.1 Bkwh. Hydroelectricity supplies the largest share of Chile's electricity supply, contributing 43 percent in 2004 and 60% in 2006. However, the contribution of conventional thermal sources has grown rapidly since the start of natural gas imports from Argentina in the late 1990s.

The Argentine gas crisis has revitalized other Chilean hydropower projects. Chilean power generator Colbun announced in November 2004 that it would proceed with construction of the 70-MW Quilleco hydroelectric plant on the Rio Laja; Colbun originally received regulatory approval for the \$80 million project in 1999, and construction is now slated to be completed by 2007. Colbun is also developing the Chiburgo (19 MW) and Hornitos (55 MW) hydroelectric projects. Endesa plans to complete the 32-MW Palmucho plant, which will work in conjunction with the company's Ralco facility, in the second half of 2007. Australia's Pacific Hydro and Norway's SN Power Invest are developing the 155-MW La Higuera hydroelectric plant on the Tinguiririca River, scheduled for completion in 2008.

Chile privatized its electricity sector in the 1980s, and all generation, transmission, and distribution activities are now in private hands. CNE (Comisión Nacional de Energia or the National Commission of Energy) is mostly responsible for government regulation of Chile's electricity sector, along with the Ministry of Economy and Energy (MEE). The government of Chile has recently

created an independent Ministry of Energy.

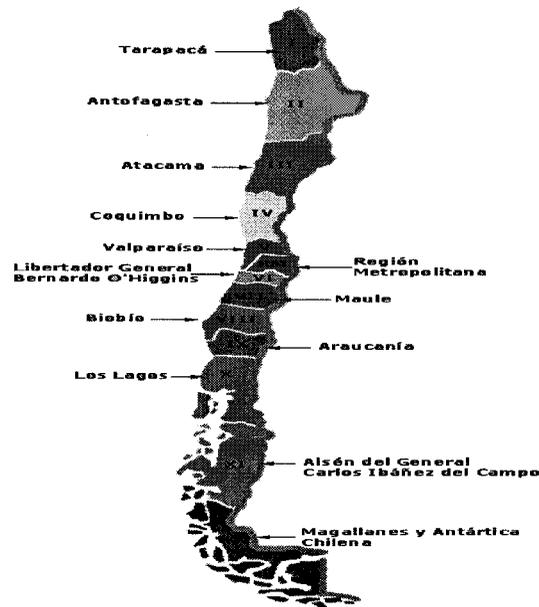
Chile has four separate electric systems: the Sistema Interconectado Central (SIC), which serves the central part of the country; the Sistema Interconectado del Norte Grande (SING), which serves the desert mining regions in the north; and the Aysen and Magallanes systems, which serve small areas of the extreme southern part of the country. The systems are mostly autonomous, as long distances between the four make integration difficult. Transelec controls almost the entire national transmission grid that serves the four systems. In August 2006, Hydro-Quebec sold its majority stake in Transelec to a consortium of private investors.



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### 3. Overview of Chile's Energy Sector

#### 3.1 General



Most of Chile's energy sector is privatized. Energy policy decisions are the shared responsibility of the National Energy Commission (Comisión Nacional de Energía - CNE), the Ministry of Economy and Energy (Ministerio de Economía y Energía - MME), and the Superintendency of Electricity and Fuels (Superintendencia de Electricidad y Combustibles - SEC). Chile has limited indigenous energy resources other than hydropower. Nonetheless, the country met nearly 70% of its total primary energy consumption with domestic energy resources between 1970 and the mid-1980s. In the early 1990s, Chile's economy experienced rapid economic expansion, increasing not only its demand for energy but also its dependence on energy imports. While total primary

energy demand grew at an annual rate of 4.8% between 1992 and 2002, total domestic energy production fell at an annual rate of 0.5%. By 2002, Chile met only 29% of the country's total primary energy demand, with hydropower accounting for over 75% of domestic energy production.

Chile's growing reliance on energy imports, particularly on natural gas, has not been without consequences. In April 2004, Argentina began restricting natural gas exports to Chile, with cuts reaching nearly 50% of contracted volumes on some days. Chile, in turn, has been forced to reconsider its energy policy, which, prior to the import restrictions, assumed an increased use of natural gas and power imports from Argentina. Some policy changes include incentives for using less Argentine gas, as well as construction of a liquefied natural gas (LNG) import facility and new hydropower plants

#### 3.2 Chilean Electricity Sector

Hydropower has historically been Chile's single largest power source, at times comprising over half of the country's installed electric generation capacity and production. In 1995, for example, hydropower supplied 72% of Chile's power and accounted for 59% of installed electric capacity. Droughts, however, have periodically curtailed hydropower production, causing supply shortfalls and blackouts (see graph). In response, the Chilean government began in the 1990s to diversify its energy mix to become less reliant on hydropower, mainly by building natural gas-fired power plants.



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As mentioned above, the recent natural gas export restrictions by Argentina not only have cast doubt on the reliability of Chile's gas imports, but also have prompted the Chilean government to rethink its entire energy strategy. One proposal suggested by the government would provide incentives to encourage power producers to diversify their energy sources and reduce dependence on natural gas supplies from Argentina. One incentive would be to award gas-fired plants that have fuel-switching capabilities (e.g., coal or fuel oil) with higher prices for their power while allocating plants which only use natural gas a lower price. The government hopes that this program would encourage power producers to invest in backup capacity and to use fuels other than natural gas.

### 3.3 Chilean Natural Gas Sector

As with oil, Chile's natural gas reserves are limited - an estimated 3.5 trillion cubic feet (Tcf) as of January 2004. Natural gas production in Chile is low and declining. In 2002, Chile produced 41.7 billion cubic feet (Bcf) of natural gas, marking the fourth consecutive year of stagnant production. Conversely, consumption has skyrocketed over the past decade, from 61.8 Bcf in 1993 to 230.3 Bcf in 2002, representing an annual growth rate of 12.3%

Historically, natural gas has played a small role in Chile's energy mix, accounting for approximately 13% of the country's total energy demand between 1970 and 1996. In the early 1990s, however, increased energy demand,

environmental concerns, and security of supply considerations (i.e., Chile's hydropower was susceptible to droughts) prompted the Chilean government to revise its energy policy, encouraging the use of natural gas. In 1997, Chile began imports of natural gas from Argentina through new pipelines. Since then, natural gas' share in Chile's energy mix has increased substantially, from 8% of all energy consumed in 1996 to 23% in 2002.

On March 25, 2004, the Argentine government published Resolution 265, which called for restrictions on natural gas exports to Chile in order to conserve gas reserves for domestic use. Between April and June 2004, daily restrictions on exports to Chile fluctuated between 20% and 47% of contracted volumes, depending on domestic demand. In June 2004, after weeks of negotiations, Argentina agreed to reduce the peak restriction level to 61.4 million cubic feet per day (Mmcf/d), down from 423 Mmcf/d in May 2004.

The impact on Chile of Argentina's gas export cutbacks has varied. For example, Chile's northern grid, known as SING, has been most impacted by the natural gas restrictions, as 58% of power generation capacity in that region is gas-fired, while central and southern regions have been relatively immune to the cuts. Gas-fired power plants in northern Chile, particularly those that are unable to switch fuels, have been forced to purchase electricity from third parties in order to meet contractual obligations. Even those power plants which have fuel-



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switching capabilities have been affected by the restrictions, due to the cost of purchasing other fuels (e.g., fuel oil and coal) at higher prices.

### 3.4 Chilean Energy Sector Regulation

As part of its Energetic Security Policies, which seeks to harmonize obtaining integrity of supply and improved economic efficiency of the above mentioned supply while promoting environmental sustainability in the development of the sector, the Government decided to establish a law that seeks to promote the development of the Renewable Energy Sources, (RES), such as wind, geothermal, biomass, solar and mini-hydro.

The aim of the law is to stimulate the development of the RES to increase the safety of supply and to propitiate the development of the energy sector. This initiative will allow diversification of participants and sources of generation. It will also reduce the external dependence on energy. Chile has an installed capacity of 12.326 MW, of which only 294 MW (2.4%) can be categorized as "Renewable". Nevertheless, the legal changes introduced with the short laws I and II in the year 2004 and 2005 have increased the number of investors who want to participate in the development of these types of projects.

Currently, 22 projects with an estimated capacity of 454 MW exist in different stages of progress in the System of Evaluation of Environmental Impact (SEIA). Another 86 projects have been

funded using a competitive RFP process by CORFO-CNE which co-finances the pre investment costs. The third round of this ongoing process is still in development with a targeted budget of USD 1,000 million.

According to the Secretary of State the current market prices are high enough to support competitive RES projects. Nevertheless, this does not assure that the projects will be implemented. The risk of not obtaining a power sales agreement may stymie some project developers.

Due to this scenario, the government decided to issue a new law in September 2007 that seeks to promote the development of RES.

This law establishes that:

- It is required all electrical companies that sell energy in the SING and SIC systems, to provide that 5% of the total sold energy annually be produced by renewable energy.
- The period for the obligation is 20 years (2010-2029). This is consistent with the objective of the law, that only an initial mandate is required and then the RES will enter naturally in the electric market in the future.
- The energy supplies that are accounted for in this obligation are those deliveries to distributor companies and individual customers that have subscribed from 2007, but the obligation is



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for electricity to be supplied from 2010.

- Those companies that do not comply with the requirements in any year after 2010 will have to pay a fine of 0,4 UTM (26USD) for each MWh not credited during one calendar year. That is to say that the penalty is proportional to the level of non compliance.

Some flexibility has been built into the law to aid firms in complying with the mandates.

- Over injections of RES from a previous year can be used to balance the current year's requirements.
- Injections of RES can come from other electric systems. For example, injections in SIC can be used to credit fulfillment generated in the SING.

The expected impact of the new law is an increase of the installed capacity of RES in the electric system.

### 3.5 Chile's Renewable Energy Potential

There is some long range potential for Renewable Energy in the following areas:

- Wind
- Hydro Power
- Geothermal
- Solar

### Wind

Recently, the CNE completed studies that quantify information about the regions of Atacama and of Los Lagos. It also developed a preliminary evaluation of the wind potential between the Regions I and IX, based on the processing of available results of meteorological models.

The studies identify some coastal zones in the analyzed regions where an attractive wind potential can be found. The studies are available at CNE.

### Hydro Power

The conventional Hydro Power is one of the principal primary sources of energy supply in Chile.

The mini and micro hydroelectric grids are considered as non conventional renewable energies, because of their minor level of current implementation. In rural sectors these mini grids are an alternative to electricity supplied by the main grid. There are about 110 facilities of this type in the country, principally supplying electricity to houses and telecommunications facilities.

There exists in the country regions with favorable geographical and climatic conditions, which, make them a favored place to the exploit hydropower. Many places in the south and central extension are uniquely suitable for the installation of many small hydropower grids. For this reason, this type of energy has an essential role for promotion in the rural electrification program.



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### Solar

In Chile, solar energy is used in the north of the country, where there exists one of the highest levels of solar radiation of the world. The information available in the Technical University Federico Santa María, reveals that the solar radiations of the country' regions are the following:

Region	Solar Radiation (Kcal/(m <sup>2</sup> /day))
I	4.554
II	4.828
III	4.346
IV	4.258
V	3.520
VI	3.676
VII	3.672
VIII	3.475
IX	3.076
X	2.626
XI	2.603
XII	2.107
RM	3.570
Antártica	1.563

The evaluation of this information shows that the north of Chile presents extremely favorable conditions for the use of solar energy. Specifically between regions I and IV, the solar energy potential can be classified as the highest in the world.

The development of photovoltaic technology in Chile includes the following types of uses: applications

effected by telecommunications companies, applications effected in retransmission of television in isolated sectors, illumination systems with photovoltaic panels and rural electrification.

### Geothermal

Chile is located entirely, in what is known as the "Pacific Fire Belt", a region of the world characterized by its seismic and volcanic activity. This is the most common geologic feature of the last 130 million years. Volcanoes have created many potential areas for geothermal activity.

The National Service of Geology and Mining provides a listing of potential geo-thermal sites. The following table summarizes these places:



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Region	Comuna	Sites
Primera	Putre	5
Total: 23	Huara	1
	Camuña	1
	Colchane	6
	Pica	9
	Pozo Almonte	1
Segunda	Ollague	1
Total: 13	Calama	3
	San Pedro de Atacama	8
	Antofagasta	1
Tercera	Diego de Almagro	2
Total: 5	Copiapó	3
	Tierra Amarilla	2
Cuarta	Vicuña	1
Total: 2	Combarbalá	1
Quinta	Santa María	2
Total: 3	San Esteban	1
Metropolitana	Colina	1
Total: 7	Las Condes	1
	San José de Maipo	5
Sexta	Cauquenes	1
Total: 2	San Fernando	1



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Séptima	Curicó	3
Total: 6	Molina	1
	San Clemente	1
	Linares	2
	Longaví	1
	Parral	1
Octava	San Fabián	1
Total: 10	Coihueco	1
	Santa Bárbara	7
	Quilaco	1
Novena	Curacautín	2
Total: 13	Melipeuco	1
	Curarrehue	3
	Pucón	7
Décima	Lanco	2
Total: 25	Futrono	3
	Panguipulli	2
	Puyehue	2
	Puerto Varas	3
	Cochamó	3
	Chaitén	6
	Hualaihué	4
Undécima	Cisnes	4
Total: 6	Río Ibañez	2



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Although Chile has abundant geothermal potential through all the national territory, it has not been used as a source to generate electric energy. It has instead been used mainly for medical and tourist purposes. It is expected that technological advances will decrease the cost of producing electricity from geo-thermal resources in the future.

### **Biomass**

Biomass from waste products is currently used to generate electricity in Chile.

The extraction of Biogas from wastes is an important contribution to the non conventional renewable energy use. The gas is used as a supplement to the gas from Santiago and Valparaiso.

Another potential application of Biomass is the generation of electricity in isolated rural places. In 1999, the CNE developed a project to generate electricity from the gasification of Biomass and to supply electric energy to 31 families in Metahue, Butachauques Island. The main objective of this project was to introduce a new technology as an alternative for the supply of electricity in isolated rural places.

### **3.6 New Comittment to Energy Efficiency**

Chile's government commemorated World Energy Efficiency Day on May 7, 2007 by launching a new energy plan aimed at saving USD 10,000 million in energy-related costs in the next 10 years. The Country's Energy Efficiency

Program (PPEE) hopes to bring about a 1.5 percent reduction in annual energy consumption. Chile's increasing demand for energy currently grows by 6.8 percent every year.

The government introduced three key areas where they hope the country could seriously tackle its energy consumption. First, all new electronic domestic goods, such as refrigerators and microwaves, will be labeled to indicate their energy efficiency, as is currently practiced in Europe and the U.S.. Second, industrial companies will receive energy audits audited to assess their energy management potential. Third, social housing is to be redesigned to minimize energy use and Greenhouse Gas emissions.

The government has stressed that such energy savings would be the first step towards reducing energy demand and ensuring better energy security for the nation.

The PPEE is an interdisciplinary group of experts from the private and public sector. They will launch a larger campaign aimed at reducing energy wastage later this year.



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### 4.0 Donors

We have researched donor involvement from USAID, IDB, IFC, EU, EBRD, UNIDO, UNDP, GEF, GBEP and WBCSD. The findings are summarized below:-

#### *Inter American Development Bank*

In July the IADB announced a loan of \$17 million to strengthen the Chilean pension system.

But most importantly on Thursday 9th August 2007 (Business News America) the IADB announced that they have launched the Sustainable Energy and Climate Change Fund with an initial US\$20mn contribution to support economically and environmentally sound energy options and responses to climate change in Latin America and the Caribbean.

The fund will foster increased investment in renewable energy, energy efficiency, biofuels and carbon financing, the bank said in a statement. Resources will finance the development and implementation of country-level assessments, policy framework analysis and assistance for policy reforms.

Institutions that could access the fund include government ministries, national climate change authorities, planning agencies, public and private corporations, regional governments, private project developers, NGOs and academic and research institutions.

In September 2006 the Inter-American Development Bank (IDB), as administrator of the Multilateral Investment Fund (MIF), approved the non-refundable technical cooperation ATN/ME-9862-CH "Promotion of Market Activities for Clean Energies", which is being carried out by Fundación Chile until September 2009. To meet the planned objectives, the project has been divided into four components: (i) development of local capacity in clean energy and demonstration cases; (ii) development of a market for energy services companies (ESCO); (iii) strengthening instruments and economic incentives; (iv) promotion of clean energies and dissemination of the results.

The main results expected from the project are: to develop evaluation methodologies for RE and for ESCOs; to train in the methodologies developed; to perform 14 energy audits in companies that are part of the project's objective; to train ESCOs in energy and financial topics to support the EE and RE; to assist with five projects for the preparation of the carbon credits projects; to implement three RE demonstration cases and 7 EE cases; and to widely disseminate the project results.

**This program is especially important for the recommended USTDA grant to promote ESCO development in Chile. The TOR for the recommended grant has been prepared with a careful eye to complement and work together with this Fundación Chile program.**



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### *International Finance Corporation*

IFC's involvement with Chile remains focused on projects where their investment has high demonstration effects, in sectors such as infrastructure including water and power. Its development contribution is to provide relatively scarce long term capital for small and medium hydropower projects. Current projects are:-

1. Hidromaule SA – a hydropower project founded 2005 with an Italian shareholder Sargent-e S.R.L
2. Hidroelectrica La Confluencia SA – A current hydropower project (158MW) disclosed July 2007 with an Australian sponsor Pacific Hydro Pty Ltd and Statkraft Nofund Power Invest AS (Norwegian)
3. La Higuera hydropower plant(155MW) – planned completion 2008 with the same consortium as La Confluencia SA

### *Global Environment Facility/ United Nations Development Programme*

There are several ongoing projects:-

1. Preparation of Second National Communication for UNDP – This is funded through the National Communication Support Programme (NCSU) to be completed in 2008. It is an ongoing project to support the formulation of an effective climate change policy in Chile.

2. Elimination of CFC's in Chile - They are working with CONAMA on two projects to stop the use of CFC's in Chile. One is working with SINDELEN, a Chilean company, to eliminate their use in refrigerators by using different circuits using isobutano.
3. Rural Electrification Program - 3000 photovoltaic electricity systems have already been put in place in collaboration with the CNE since 2003 in isolated areas of region IV.
4. Evaluation of Wind Power – UNDP worked with the CNE in 2003 in initial sites:- Robinson Crusoe Island (V); Juan Fernandez (V); Isla Huapi (X); Islas del archipelago de Chiloé (X) and resulting projects of collaboration are underway with universities such as UTFSM, UDA, UMAG and ULS.
5. Hybridizing Diesel Systems

### *Energy Efficiency & Renewable Energy Department, US Department of Energy*

On July 13<sup>th</sup> 2007 a US delegation headed by Henry Paulson, US Treasury Secretary, signed a Biofuels Research and Development Cooperation Agreement with Chile. This will be managed by EERE and by CORFO in Chile. Full details are yet to be announced but the focus will be on development in semi arid areas avoiding competition with farmland.



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### 5.0 Financing and U.S. company interest

Chile has been rated by the Economist Intelligence Unit (EIU) as the most attractive Latin American country to invest in and has been placed 22<sup>nd</sup> in the world (between Spain and Israel). It has strong economic growth and low inflation which together with the advantages created by its open economy and continuing political stability, prove it to be a good investment opportunity.

There is already a strong investment presence of US companies in the Chilean electricity distribution networks with Semptra, PPL and PSEG. Through Chilquinta Energía SA, Semptra and PSEG are the third largest electricity distributors in Chile. Currently US companies as a whole account for 25% of total foreign investment in Chile.

However despite the strong government drive for foreign investment in renewable energy there is a general lack of incentives and regulatory frameworks in general in this field. The exception is the geothermal energy market which already has a regulatory framework in place. Since 2006 the German overseas development aid advisor GTZ has had a positive influence on Chile's policy in the renewable energy field encouraging smaller producers into the market (See Appendix), although a varying tariff system to encourage renewable energy does not exist in Chile.

### 6.0 Other Projects Reviewed

GreenMax also reviewed these other projects which we are not currently recommending for grant funding:

- **PrunESCO Biomass Project.** PrunESCO processes some \$40 US million of dried prunes each year. A by product of this process is the left over pits. PrunESCO supplied the following estimates of prune pit quantities.

Year	Volume of Pits – tons
2005	3300
2006	4950
2010	7700

These left over pits are trucked away for disposal adding to the cost of prune processing. PrunESCO desires assistance to conduct a feasibility study for utilizing the excess pits as fuel for a biomass project producing steam and electricity.

While 7000 metric tons is a large disposal problem for PrunESCO the volume of pits results in a very small biomass energy facility.

Rough estimates of the project size are provided in the following table:

Fuel Input (pits)	.88 tons/hour
Fuel Heating Value	6500 BTU/lb
Boiler Heat Input	• 11.5 Million BTU/hr
Electrical Output	.3 - .5 MW
Steam Output	8000 lbs/hr
Capital Cost	\$3-5 US Million



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

### 7.0 List of Meetings from Definitional Mission

<b>Chile</b>		
Meeting 1	Carlos Capurro Senior Commercial Analyst	US Embassy
Meeting 2	Alberto Martin (3 meetings) Country advisor	Ediconsult and Grupo Errázuriz
Meeting 3	Professor Misael Gutierrez Professor Manuel Toral	Faculty of Foresty Sciences University of Chile
Meeting 4	Mario Manriquez VP Ejecutivo	ACERA (Association of Renewable Energy)
Meeting 5	Nicola Borregaard (2 meetings) Executive Director, PPEE	PPEE (Energy Efficiency National Program)
Meeting 6	Mario Valcarce President Endesa Chile	Endesa Chile
Meeting 7	Richard Aylwin (2 meetings) Director of Energy Efficiency	CODELCO (Copper Corporation)
Meeting 8	Anastas P. Mbawala Director of Electricity	Energy and Water Utilities Regulatory Agency
Meeting 9	Antonio Aguirre (2 meetings) Export Marketing Director	PrunESCO
Meeting 10	Winfredo Jara General Manager Endesa Eco.	Endesa Eco.
Meeting 11	Luis Fredes General Manager	Geotermia Del Pacifico
Meeting 12	Christian Santana Daniel Salazar	Gobierno de Chile Comisión Nacional de Energía
Meeting 13	Javier García (2 meetings) Mario Castillo Francisco Alborno Investment Department	CORFO (Chile National Economic Development Agency)
Meeting 14	Marcelo Tokman Minister of Energy	• Ministry of Energy



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

### 8.0 List of Contacts

#### CHILE CONTACTS: Contacts Made By GreenMax On Behalf of the Definitional Mission

Embassy of the United States of America  
Carlos Capurro  
Senior Commercial Advisor  
US Commercial Service, Avenida Andres Bello 2800, Las Condes, Santiago, Chile  
Tel: +562 330 3311/ 3307  
Fax: +562 330 3172  
E-mail: [carlos.capurro@mail.doc.gov](mailto:carlos.capurro@mail.doc.gov)  
Website: [www.buyusa.gov/chile](http://www.buyusa.gov/chile)

Embassy of the United States of America  
Marcelo Orellana  
Investment & Trade Advisor  
US Department of Commerce, Avenida Andres Bello 2800, Las Condes, Santiago, Chile  
Tel: +562 330 3455  
Fax: +562 330 3172  
E-mail: [marcelo.orellana@mail.doc.gov](mailto:marcelo.orellana@mail.doc.gov)  
Website: [www.buyusa.gov/chile](http://www.buyusa.gov/chile)

Embassy of the United States of America  
Mitch Larsen  
Commercial Counselor  
Avenida Andres Bello 2800, Las Condes, Santiago, Chile  
Tel: +562 330 3316  
Fax: +562 330 3172  
E-mail: [mitch.larsen@mail.doc.gov](mailto:mitch.larsen@mail.doc.gov)  
Website: [www.buyusa.gov/chile](http://www.buyusa.gov/chile)

Endesa Chile  
Andres Salvestrini  
Deputy C.F.O  
Santa Rosa 76, Santiago, Chile  
Tel: +562 630 9701  
Fax: +562 635 4980  
E-mail: [asb@endesa.cl](mailto:asb@endesa.cl)  
Website: [www.endesa.cl](http://www.endesa.cl)



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

Fax: +28 1 820 8979

E-mail: [dbrewington@powertubeinc.com](mailto:dbrewington@powertubeinc.com)

Website: [www.powertubeinc.com](http://www.powertubeinc.com)

### RWTHAACHEN

Joachim Vogdt

Wüllnerstrabe 2 – D 52062 Aachen

Tel: +49 241 / 80 957 04

Fax: +49 241 / 80 922 32

E-mail: [vogdt@ifa.rwth-aachen.de](mailto:vogdt@ifa.rwth-aachen.de)

Website: [www.iar.rwth-aachen.de](http://www.iar.rwth-aachen.de)

### Codelco

Jose Espinoza Villarroel

Superintendente Suministros y Servicios

División Ventanas

Carretera F-30-E 58270, Ventanas, Puchuncavi Cas. 126 B Quintero, Chile

Tel: +5632 293 3495 / 293 3487

Fax: +5632 293 3445

E-mail: [jespi025@codelco.cl](mailto:jespi025@codelco.cl)

Website: [www.codelco.cl](http://www.codelco.cl)

### Codelco

Richard Aylwin

Director Eficiencia Energética y Nuevos Servicios

Casa Matriz

Huéfanos 1270, Casilla 150 - D, 834 0424, Santiago, Chile

Tel: +562 690 3378

Fax: +562 690 3366

E-mail: [raylwin@codelco.cl](mailto:raylwin@codelco.cl)

Website: [www.codelco.cl](http://www.codelco.cl)

### Gobierno de Chile – Comisión Nacional de Energía

Area de Medio Ambiente y Energías Renovables

Christian Santana Oyarzún

Almirante Gotuzzo 124 – Piso 9, Santiago, Chile

Tel: +562 365 6876

Fax: +562 365 6863

E-mail: [csantana@cne.cl](mailto:csantana@cne.cl)

Website: [www.cne.cl](http://www.cne.cl)

### Asset Chile

Rodrigo Gutiérrez

Coyancura 2283, Of. 1103, Providencia, Santiago, Chile

Tel: +562 335 1876

Fax: +562 335 1885



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

E-mail: [rgutierrez@assetchile.com](mailto:rgutierrez@assetchile.com)

Website: [www.assetchile.com](http://www.assetchile.com)

### Asset Chile

Benjamín Viel

Coyancura 2283, Of. 1103, Providencia, Santiago, Chile

Tel: +562 335 1876

Fax: +562 335 1885

E-mail: [bviel@assetchile.com](mailto:bviel@assetchile.com)

Website: [www.assetchile.com](http://www.assetchile.com)

### Uría Menéndez

Javier Ruiz - Cámara Bayo

El Golf, 40° P 20, Santiago, Chile

Tel: +562 364 3784

Fax: +562 364 3797

E-mail: [jruiz-camara@philippi.cl](mailto:jruiz-camara@philippi.cl)

### Geotermia del Pacífico

Luis Fredes

Gerente Comercial

Hernando de Aguirre 3962 , Ñuñoa, Santiago, Chile

Tel: +562 225 1562

Cel: +569 916 30787

E-mail: [lfredes@geotermia.cl](mailto:lfredes@geotermia.cl)

### Electroconsultores

Francisco Aguirre

Director Ejecutivo

Barros Errazuriz 1953, Of 1002, Providencia, Santiago

Tel: +562 204 5288

Fax: +562 205 9503

E-mail: [faguirre@electroconsultores.cl](mailto:faguirre@electroconsultores.cl)

### Superintendencia de Electricidad y combustibles de Chile (SEC)

Patricia Chotzen G

Superintendente

Av Libertador Bernardo O'Higgins 1465, Santiago

Tel: 600 6000 732

### Comision Nacional de Energía

Marcelo Tokman

Ministro de Economía

Teatinos 120, Piso 7, Santiago, Chile

Tel: +562 365 6800

Fax: +562 695 6404



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

E-mail: [mtokman@cne.cl](mailto:mtokman@cne.cl)

Comision Nacional de Energía  
Daniel Salazar  
Area eléctrica  
Teatinos 120, Piso 7, Santiago, Chile  
Tel: +562 365 6800  
Fax: +562 695 6404  
E-mail: [dsalazar@cne.cl](mailto:dsalazar@cne.cl)

Asociación de Distribidores de Gas Natural  
Carlos Cortés  
Secretario Ejecutivo  
Isidoro Goyenechea 3250, Of 802, Santiago, Chile  
Tel: +562 249 7626  
E-mail: [ccortes@agnchile.cl](mailto:ccortes@agnchile.cl)

Programa de Chile Sustentable  
Sara Larrain  
Directora Ejecutivo  
Seminario 774, Ñuñoa, Santiago, Chile  
Tel: +562 209 7028  
Fax: +562 364 0472

CONAMA  
Alvaro Sapag Rajevic  
Director Ejecutivo  
Teatinos 254/258 , Santiago, Chile  
Tel: +562 240 5600/241 1800  
Fax: +562 240 5758

CONAF  
Santiago de Pozo Donoso  
Director Regional  
Valenzuela Castillo 1868, Santiago  
Tel: +562 328 0300/0334  
E-mail: [santiago@conaf.cl](mailto:santiago@conaf.cl)

ARAUCO  
Jose Tomás Guzmán  
Presidente Directorio  
Av El Golf 150, Piso 14, Las Condes, Santiago, Chile  
Tel: +562 461 7200  
Fax: +562 698 5967  
E-mail: [Info@arauco.cl](mailto:Info@arauco.cl)



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Natural Resources & Infrastructure Division  
UN Economic Commission for Lat Am & Car (ECLAC)  
Manlio Coviello  
Expert in Energy  
Vitacura 3030, Santiago, Chile  
Tel: +562 210 2470  
Fax: +562 208 0252  
E-mail: [mcoviello@eclac.cl](mailto:mcoviello@eclac.cl)

AES Gener  
Juan Ricardo Inostroza López  
Gerente de Regulación y Desarrollo  
Mariano Sánchez Fontecilla 310, Piso 3, Santiago, Chile  
Tel: +562 686 8900  
Fax: +562 686 8991

Energia Verde (subsidiary of AES – biomass plants)  
Jaime Zuazagoitia Viancos  
Gerente General  
O'Higgins 940, Of 901, Concepción  
Tel: +5641 240 1900/1930  
Fax: +5641 225 3227/240 1935

Empresa Nacional de Petróleo (ENAP)  
Nelson Muñoz Guerrero  
Exploration & Production Division Manager (also Chairman of ENG Board which is the company with ENEL –italy)  
Av Vitacura 2736, Piso 10, Las Condes, Santiago, Chile  
Tel: +562 280 3000  
Fax: +562 280 3199

Colbun SA  
Bernardo Larrain Matte  
Gerente General  
Av Apoquindo 4775, Piso 11, Santiago  
Tel: +562 460 4000  
Fax: +562 460 4005

FondElec Capital Advisors LLC  
Fernando Acosta-Rua  
Vice President  
333 Ludlow St, Stamford, Ct 06902  
Tel: +203 326 4570  
Fax: +203 326 4578  
E-mail: [Facostarua@FondElec.com](mailto:Facostarua@FondElec.com)



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Cleantech Fund Americas  
Econergy International – General Manager  
Frederick (Rick) Renner  
President  
1881 9th Street, Suite 300, Boulder, CO 80302  
Tel: +303 473 9007  
Fax: +303 473 9060  
E-mail: [renner@econergy.net](mailto:renner@econergy.net)

E and Co  
Gonzalo Rico Calderón  
South America Representative  
Av. Santa Cruz No. 12742, Piso 7, Oficina No. 3, Cochabamba, Bolivia  
Tel: +5914 429 4006  
Fax: +5914 429 4007  
E-mail: [gonzalo.rico-calderon@EandCo.net](mailto:gonzalo.rico-calderon@EandCo.net)

RNK Capital LLC  
Martin Berg  
527 Madison Ave, 6<sup>th</sup> Floor, NY 10022  
Tel: +212 419 3967  
Fax: +212 419 3950  
E-mail: [martin.berg@rnkcapital.com](mailto:martin.berg@rnkcapital.com)

InterAmerican Development Bank (IADB)  
Avenida Pedro de Valdivia 0193, 11<sup>o</sup> Piso, Correo 9, Santiago  
Tel: +562 431 3700  
Fax: +562 431 3713  
E-mail: [COF/CCH@iadb.org](mailto:COF/CCH@iadb.org)

International Finance Corporation (IFC)  
Yolande Duhem  
*Chile contact is based in Argentina*  
Tel: +5411 4114 7200  
E-mail: [yduhem@ifc.org](mailto:yduhem@ifc.org)

Ministerio de Economía, Fomento y Reconstrucción  
Nicola Borregaard  
Director Ejecutivo del PPEE  
Teatinos 120, Piso 9, Santiago  
Tel: +562 473 3603  
E-mail: [mcastillo@economia.cl](mailto:mcastillo@economia.cl)



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

### Project #2: Feasibility Study – Copper Smelter Heat Recovery

#### A. Project Description

Project Summary Information	
Host Country	Chile
Project Name	Feasibility Study – Copper Smelter Heat Recover
Sector	Energy
Region	South America
Project Location	Codelco Ventanas Division
Total Capital Requirement	Ventanas: \$6,550,000 – 33,800,000 Country Total: 85,150,000 – 439,400,000
Potential US Exports	\$ Ventanas: 5,050,000 – 21,300,000 \$ Country Total: 65,650 – 276,900
Grant Amount	\$421,824
Grantee	Codelco

#### 1. Introduction

Codelco, Chile's leading copper concern has requested USTDA assistance to fund a Feasibility Study for a Copper Smelter Heat Recovery Project. The Corporación del Cobre (Codelco) is Chile's largest copper company and the country's industrial giant.

Chile is the biggest producer of copper in the world. Chilean copper production was 5.4 million metric tons of fine copper in 2004. The mining industry requires an

intensive consumption of energy which is divided into electricity and fuel.

The copper industry consumes 34.1% of the total amount of the electrical energy consumed in Chile and 5.9% of the total fuel.

Just one Codelco mine spends US\$50 million on energy each year.

Codelco faces a number of challenges that are relevant to energy efficiency:

- The increasing depth of its mines requires more energy consumption. Codelco is responding by increasing the use of controls and mechanization to reduce energy costs.
- More stringent regulations under Chile's environmental laws require Codelco to seek the lowest cost way to reduce its air and water emissions.
- Increasing competition in the national and international copper market is forcing the company to maintain and increase the quality of its copper while staying competitive. Codelco views modernization of its operations as a way to simultaneously increase product quality and capital productivity.

Codelco has begun to respond to these pressures by improving the energy efficiency of the mining and production processes. As a first step, Codelco evaluated the energy efficiency potential in motors and transformers in its Chuquicamata mine, the world's largest open pit copper mine and installed high efficiency motors. Codelco has made a



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major commitment to develop and implement further energy efficiency, cogeneration and energy efficiency projects utilizing the CDM mechanism under the Kyoto protocol. The proposed heat recovery project is another in a series of such projects being proposed for investment at Codelco. The project is especially interesting for USTDA support due to its innovativeness, its replication potential throughout Codelco's smelters and smelters in the rest of the Chilean copper industry, and the high potential for US exports in an area of strong US technology and current cost competitiveness.

### 2. Copper Refining Process

To understand the technology and purpose of the proposed project it is necessary to first understand the industrial copper refining processes in use at Codelco's facilities.

#### 2.1 Business Description

The purpose of Copper Casting is to process concentrates, with copper content of about 30%, for the production of anodes with a pureness of 99.7% of copper. These anodes are sent later to an electrolytic refinery where a commercial cathodic copper (99.995 Cu) with high pureness is obtained. Sulfuric acid, gold and silver are sub products of this process.

The business is managed through key management indicators such as unit cost, copper recovery, etc. and the market price for treatment and refining. (TC/RC)

#### 2.2 Concept of the process

The concentrate is a solid material with approximately 8-10% of humidity, composed typically with 28-30% of copper, 24-28% of iron, 25-34% of sulfur and the remainder can be silica (SiO<sub>2</sub>), alumina (Al<sub>2</sub>O<sub>3</sub>), and an unaccountable number of heavy metals and other elements like lead, mercury, cadmium, etc. Copper is chemically associated with sulfur and iron in composition denominated sulfides of copper. The process generally consists of separating the Fe and S and making them react with oxygen. These generate, in different stages of the process, a stream increasingly rich in copper. The process also produces gasses, that absorb the S in the form of SO<sub>2</sub> (non metallic sulfuric or sulfur dioxide), and scum, picked up by the iron and the other inert metals. This process, called pyrometallurgy is realized at high temperatures, which involves the use of cast materials.

#### 2.3 Description of the Generic Process

##### i. Drying

The concentrates that come from the process of grinding-flotation is sent to the casting with 8-10% of humidity. Therefore, the first stage of the process consists of drying the concentrates, reducing the content of humidity to 0.02%. This is done by conveying the concentrates in a continuous way in contact with hot gasses, produced by the mixture of air with gasses that come from the combustion of oil or gas.



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### ii. Melting

Once dried, the concentrates are transported and injected pneumatically to a Melting process, where air is also injected and enriched with oxygen that reacts with the sulfur and the iron of the concentrate, obtaining the separation of two cast phases: the “white metal” or “axis”, that absorbs copper in its chemical form of copper sulfur (CU<sub>2</sub>S) and the “scum phase” that absorbs mainly iron (as iron oxide), ganga ( the material that comes from the main rock) and also a fraction of copper. The process also generates a gas with high concentration of sulfur dioxide (SO<sub>2</sub>).

The energy generated because of the reaction of oxidation of the components of the concentrate is used to cast a new solid charge, allowing to reduce considerably and in some cases avoid completely, the use of external energy (fossil combustion, electric energy),.

### iii. Conversion of the white metal

The white metal or “axle” (60-75%) is loaded in a reactor where again air or air with O<sub>2</sub> is injected to continue the oxidation of the rest of the sulfur and iron. This is a “batch type” process realized in ovens called Pierce Smith Converters. The process generates a stream of gas with average SO<sub>2</sub> content, a scum that can be returned to the Melting or pervious stage and a copper blister of 99.3% of Cu.

### iv. Refining and molding

The copper blister, still with a significant level of impurities, must continue the

refining process. It is next loaded in Anodic Furnaces where two further stages are developed:

1. Oxidation of the remaining sulfur from the conversion process, which increases the content of O<sub>2</sub>
2. Reduction of the oxygen from the bath through the injection of some hydrocarbon (oil or gas)

These furnaces have fuel burners to keep an adequate temperature of the cast bath. Once the copper is ready it is channeled in liquid form to the molding wheel where it is “dosified” in molds to anode form. Once the mold is full, the copper is cooled in a first stage with water sprinklers arranged in a wheel, then the anode is separated from the mold and immersed in water to finish the cooling process. .

### v. Scum treatment.

The scum that comes from the Melting process has normally an appreciable content of dragged and/or trapped copper (4-10%) that must be recovered. For this to happen, the scum is further processed in two stages:

1. First the degree of oxidation of the iron is reduced by injection of some hydrocarbon (oil or carbon) which reduces the viscosity of the scum and facilitates the separation of the copper.
2. Next the copper particles go through sedimentation by gravity.



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This two stage process causes separation of the initial scum in two parts: a) the "white metal", which sediments to the bottom of the reactor, and the discarded scum, that is sent for waste disposal, with a copper content between 0.7-1%. In Codelco Ventanas, electric furnaces are used for the treatment of scum that comes from the Melting stage, where the temperature is maintained due to the electric resistance produced by electrodes in contact with the scum.

### **vi. Gas managing and treatment**

The Teniente Converters (TC), generate large volumes of hot gasses that have to be reduced in temperature. It is necessary to reduce the temperature of the gasses to bring them to the downstream pollution control equipment. To cool hot gasses that come out from the mouth of the TC in temperatures near the 1100°C, first they are mixed with air from dilution in the mouth of the furnace. Decreasing to 600-650°C, and then, water is injected directly to the gas. The water injected evaporates and absorbs part of the gas heat, thereby decreasing its temperature, down to 350-370°C. The gasses must remain here at greater than 300°C, which is the minimum recommended temperature for the process of gas treatment, to avoid the condensation of SO<sub>2</sub>, that with the water incorporated in the cooling can become a totally corrosive acid. This is known as "System of Evaporative Cooling". The resulting gas passes to the gas cleaning system, composed of electrostatic precipitators and the sulfuric acid plant.

The heat used to evaporate the water and cool the hot gases is estimated at 45

million BTU/hr. The energy is thrown away and not used. This is equivalent to some 2.6 million gallons of fuel oil.

Eliminating this waste and placing this energy to good use is the main goal of the proposed heat recovery process

### **vii. Electrolytic Refinery**

The anodes produced in the Copper Casting are fed to a conventional electrolytic refinery where the copper electrolysis is produced in barrels, through the circulation of a high continuous stream, transferring the copper from the anode to the cathode.

## **4. Project Description**

Codelco proposes to insert a Heat Recovery Steam Generator (boiler) into the process just after the TC. The boiler will capture the heat now wasted by the water injection approach described in the previous section 3.vi. The boiler will cool the gases from approximately 1200 °F to 575 °F. The recovered heat will produce approximately 40,000 lb/hr of steam.

Codelco mentions that a boiler could also be installed on the other 3 Converters. With the increased steam capacity approximately 15 MW of electricity could be produced.

Both these configurations have merit and should be studied further.



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### 5. Financial Analysis – Steam Production Only

Codelco provided information indicating the capital cost estimate for a single boiler was \$6.27 US millions. GreenMax performed our own cost estimate and came up with a very similar figure. The cost breakdown is in the following Table 1.

**TABLE 1: Capital Cost Steam Production Only**

Category	Total - \$1000
Boiler	4000
Turbine	0
Controls	300
Switchgear	250
Mechanical Equipment	250
Local Materials	500
Labor	1000
Eng/PM	250
<b>Total Cost</b>	<b>6550</b>

A simplified pro forma analysis, shown in table 2 below, was performed to test the financial viability of the project given the following economic parameters also supplied by Codelco.

- Economic life – 15 years
- Value of Steam - \$10/ million BTU
- Tax Rate – 55%



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TABLE 2: Pro forma	Steam	Only	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Calendar Year																			
Capital Cost		6550																	
Inflation			1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	
MACRS Depreciation - 15 Year			0.05	0.10	0.09	0.08	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.03
Electricity Selling Price - \$/MWh			95	97	100	102	105	107	110	113	116	119	122	125	128	131	134	138	
Process Heat Selling Price - \$/MBTU			10	10	11	11	11	11	12	12	12	12	13	13	13	14	14	14	14
Process Heat Sales - MBTU			32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672	32672
Electricity Sales - MWh			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revenue																			
Heat			3267	3349	3433	3518	3606	3697	3789	3884	3981	4080	4182	4287	4394	4504	4616	4732	
Power			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total Revenue</b>			<b>3267</b>	<b>3349</b>	<b>3433</b>	<b>3518</b>	<b>3606</b>	<b>3697</b>	<b>3789</b>	<b>3884</b>	<b>3981</b>	<b>4080</b>	<b>4182</b>	<b>4287</b>	<b>4394</b>	<b>4504</b>	<b>4616</b>	<b>4732</b>	
Expenses																			
Fuel			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor			200	205	210	215	221	226	232	238	244	250	256	262	269	276	283	290	
Non Labor			300	308	315	323	331	339	348	357	366	375	384	394	403	414	424	434	
Fixed																			
<b>Total Expenses</b>			<b>500</b>	<b>513</b>	<b>525</b>	<b>538</b>	<b>552</b>	<b>566</b>	<b>580</b>	<b>594</b>	<b>609</b>	<b>624</b>	<b>640</b>	<b>656</b>	<b>672</b>	<b>689</b>	<b>706</b>	<b>724</b>	
EBITA			2767	2836	2907	2980	3054	3131	3209	3289	3372	3456	3542	3631	3722	3815	3910	4008	
Income Taxes			-1522	-1560	-1599	-1639	-1680	-1722	-1765	-1809	-1854	-1901	-1948	-1997	-2047	-2098	-2151	-2204	
Depreciation Tax Shield			129	246	221	199	179	161	153	153	153	153	153	153	153	153	153	153	76
<b>After Tax Cash Flow</b>			<b>1375</b>	<b>1522</b>	<b>1529</b>	<b>1540</b>	<b>1554</b>	<b>1570</b>	<b>1597</b>	<b>1633</b>	<b>1670</b>	<b>1708</b>	<b>1747</b>	<b>1787</b>	<b>1828</b>	<b>1869</b>	<b>1912</b>	<b>1880</b>	
IRR			6550.0	0	0.228														

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The results of the financial analysis confirm the findings of Codelco's own preliminary study. Utilization of the waste heat allows Codelco to displace high cost natural gas and fuel currently used in the copper refining process. The Internal Rate of Return for the project is estimated at 22.8%.

### 6. Financial Analysis – Steam and Electric Production

GreenMax performed an analysis of the economics related to installing four boilers and a 15 MW steam turbine. This configuration was referenced by Codelco and confirmed by GreenMax as an appropriate size for this installation. The preliminary capital cost estimate is contained in the following Table 3.

**TABLE 3: Capital Cost Steam+ Electricity Production**

Category	Total - \$1000
Boiler	16000
Turbine	3000
Controls	300
Switchgear	500
Mechanical Equipment	5000
Local Materials	3000
Labor	5000
Eng/PM	1000
<b>Total Cost</b>	<b>33800</b>

A project that combines both steam and electric production is a much larger project. As such, U.S. exporters will find it more attractive to pursue. The ramifications of this will become clear in Section G below

which estimates the U.S. Export potential for each scenario.

The Terms of Reference for this project will evaluate the financial and technical viability for a project only providing steam and then providing both steam and electricity.

A simplified pro forma analysis was performed to test the financial viability of the project given the following economic parameters provided by Codelco.

- Economic life – 15 years
- Value of Steam - \$10/ million BTU
- Tax Rate – 55%
- Electricity - \$65/MWh (used the low end of the range)

The Internal Rate of Return is estimated at 17.3%.

The pro forma is shown below in Table 4.



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### B. About the Grantee

The Grantee for the Feasibility Study will be The Corporación del Cobre (Codelco).

Codelco is a world-class Chilean Corporation. It has the world's largest and best copper reserves. It is a leader in mining and process technology and know-how. It has a business model and organizations that stimulates value creation. Its employees are motivated and trained to participate in building the company's future, led by highly skilled executives.

The Corporación Nacional del Cobre de Chile, Codelco, is the world's top copper producer and one of the industry's most profitable companies. Codelco's owned assets are worth in excess of US\$10.739 billion and in 2005 its equity reached US\$2.941 billion. Its main commercial product is grade A copper cathodes. The company operates through four mining divisions:

- Codelco Norte (Chuquicamata and Radomiro Tomic orebodies);
- Salvador,
- Andina, and
- El Teniente

Since May, 2005, the Ventanas Smelter and Refinery is Codelco's fifth Division. Codelco also holds shares in major mining ventures such as El Abra (49%), and other mining joint ventures focused on geological exploration in Chile and abroad. Codelco has built its world leadership in the copper industry on five major pillars:

**Leading presence:** In 2005, Codelco produced 1,831,183 metric fine tons of copper, including its share of El Abra. This equals 15.1% of total western world production. Codelco also was the world's top molybdenum producer, with 36,567 tons in 2005.

**Cost efficiency:** The company is one of the industry's lowest cost producers, with this figure reaching USD 11.6cents per pound in 2005.

**Copper reserves:** Codelco owns the world's highest known copper reserves. It is estimated that current reserves will ensure more than 70 years of operations at the current production levels.

### C. C. Development Impact

The proposed project when fully implemented would have a positive benefit to the Chilean copper industry, electric power sector, and imports of expensive fuels such as diesel and natural gas.

The project configuration with either steam production only or both steam and electric production will improve the energy efficiency of the Teniente Converter. Heat energy that is currently wasted through the evaporation of water used to cool the exhaust gas will be recovered and used for the production of steam and potentially electricity. The result of this project will be to lower the cost of copper refining.

Chile is facing a shortfall in electric production. Implementation of this project



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will add much needed generating capacity to the Chilean electric grid. A side effect of this project will be to locate electrical generation at the point of load use reducing the transmission losses associated with delivering the power to Codelco.

This project will also reduce the emission of greenhouse gases by substituting waste heat recovery for the burning of either fuel oil or natural gas.

### D. Project Sponsor Commitment

Codelco has provided detailed technical and economic data on the proposed project. Mid level Codelco managers have spent substantial time to ensure that the GreenMax team well understands the copper refining process and the benefits of the proposed project. Company officials have assured GreenMax of the seriousness of this proposal and of the intent to implement it. Codelco has demonstrated its commitment to energy efficiency and greenhouse gas emissions reduction through the development of several projects through the CDM mechanism of the Kyoto Protocol. The company has a dedicated department established specifically for identifying and implementing energy efficiency investments, which is the best indication of a strong commitment to this activity.

### F. Implementation Financing

Codelco, as Chile's largest enterprise, has adequate resources and credit lines to undertake the project.

### G. U.S. Export Potential

U.S. firms are very competitive in the power generation market in general. Most U.S. manufacturers' produce equipment world wide and are able to competitively deliver equipment into many of the world's markets. Specific areas where the U.S. would be in a good competitive position are:

- Heat Recovery Steam Generators
- Steam Turbines
- Transformers
- Switchgear
- Process Controls
- Cable
- Pumps
- Cooling Tower

Tables 5 and 6 below estimate the US Export Potential for the two possible project implementation approaches..

**TABLE 5**  
**Export Potential**  
**Steam Only**  
**1000's US Dollars**

Category	Total	Export Potential
Boiler	4000	4000
Turbine	0	0
Controls	300	300
Switchgear	250	250
Mechanical Equipment	250	250
Local Materials	500	0
Labor	1000	0
Eng/PM	250	250
<b>Total Cost</b>	<b>6550</b>	<b>5050</b>



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**TABLE 6**  
**Export Potential**  
**Steam and Electric**  
**1000's US Dollars**

Category	Total	Export Potential
Boiler	16000	16000
Turbine	3000	3000
Controls	300	300
Switchgear	500	500
Mechanical Equipment	5000	500
Local Materials	3000	0
Labor	5000	0
Eng/PM	1000	1000
<b>Total Cost</b>	<b>33800</b>	<b>21300</b>

The export potential could be much larger once the above results are extrapolated to consider replication to the much larger copper smelting market in Chile. Codelco provided the following information related to existing smelters in Chile shown in the following Table 7.

**TABLE 7**  
**Chilean Smelters and Capacity**  
**Tons/year**

Name	Capacity
Altonorte	1,000,000
Chagres	503,000
Chuqcamata	1,621,000
Potreillos	680,000
Ventanas	472,000
Caletones	1,521,000
Heman Videla Lira	250,000
<b>Total</b>	<b>6,097,000</b>

The proposed project is at the Ventanas location which is 7.7% of the copper smelting capacity in Chile. Therefore the export potential is approximately 13 times the values shown in above tables. The recalculated figures for total export potential for implementation of heat recovery under

the two possible project approaches in the entire Chilean copper smelting market are shown in the following Tables 8 and 9..

**TABLE 8**  
**Export Potential**  
**All Chilean Copper Smelters**  
**Steam Only**  
**1000's US Dollars**

Category	Total	Export Potential
Boiler	52000	52000
Turbine	0	0
Controls	3900	3900
Switchgear	3250	3250
Mechanical Equipment	3250	3250
Local Materials	6500	0
Labor	13000	0
Eng/PM	3250	3250
<b>Total Cost</b>	<b>85150</b>	<b>65650</b>

**TABLE 9**  
**Export Potential**  
**All Chilean Copper Smelters**  
**Steam and Electric**  
**1000's US Dollars**

Category	Total	Export Potential
Boiler	208000	208000
Turbine	39000	39000
Controls	3900	3900
Switchgear	6500	6500
Mechanical Equipment	65000	6500
Local Materials	39000	0
Labor	65000	0
Eng/PM	13000	13000



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While the Ventanas Project may provide modest potential for US exports of \$5.05 – 21.3 million the total Chilean market may

provide an opportunity for \$65.6 – 276.9 million in US export potential.



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### H. Primary U.S. Suppliers

Heat Recovery Steam Generators	<p>Deltak 2905 Northwest Blvd. Plymouth, MN 55441 763-557-7440 <a href="http://www.deltak.com">www.deltak.com</a></p> <p>Vogt Power 4000 DuPont Circle Louisville, KY 40207 502-899-4699 <a href="http://www.vogtpower.com">www.vogtpower.com</a></p> <p>Nooter Erickson 1509 Ocello Drive Fenton, MO 63026 636-651-1000 <a href="http://www.ne.com">www.ne.com</a></p>	Steam Turbines	<p>Siemens Westinghouse 4400 Alafaya Trail Orlando, FL 32826 407-736-2000 <a href="http://www.swpc.siemens.com">www.swpc.siemens.com</a></p> <p>General Electric One River Rd. Schenectady, NY 12345 518-385-4593 <a href="http://www.gepower.com">www.gepower.com</a></p> <p>Dresser Rand 1200 W. Sam Houston Pkwy N. Houston, TX 77043 713-935-3490 <a href="http://www.dresser-rand.com">www.dresser-rand.com</a></p>
Evaporators	<p>Progressive Recovery, Inc. 618-286-5000 <a href="http://www.progressive-recovery.com/">http://www.progressive-recovery.com/</a></p> <p>Pfaunder 585-235-1000 <a href="http://www.pfaunder.com/">http://www.pfaunder.com/</a></p>	Controls	<p>Emerson Process Mgmt <a href="http://www.emersonprocess.com">http://www.emersonprocess.com</a> 847-956-8020</p> <p>Honeywell <a href="http://www.honeywell.com/">http://www.honeywell.com/</a> 973-455-2000</p> <p>Foxboro <a href="http://www.foxboro.com">http://www.foxboro.com</a> 866-746-6477</p>



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

Process Tanks & Vessels	<p>MPC Containment Systems LLC 773-927-4120 <a href="http://www.mpccontainment.com/">http://www.mpccontainment.com/</a></p> <p>Canamer Services Inc 608-687-9800 <a href="http://www.canamerservices.com/">http://www.canamerservices.com/</a></p> <p>BMT 281-252-9809 <a href="http://www.bmt-tank.com/">http://www.bmt-tank.com/</a></p>	Switchgear	<p>EMSCO <a href="http://www.emscomn.com">http://www.emscomn.com</a> 800-328-1842</p> <p>General Electric <a href="http://www.ge.com">http://www.ge.com</a> 713-803-0446</p> <p>Enercon <a href="http://www.enercon.com/">http://www.enercon.com/</a> 918-665-7693</p>
Centrifuges	<p>optek-Danulat, Inc 800-371-4288 <a href="http://www.optek.com/">http://www.optek.com/</a></p> <p>Chromalox 412-967-3828 <a href="http://www.chromalox.com/">http://www.chromalox.com/</a></p>	Engineering & Services	<p>Black &amp; Veatch <a href="http://www.bv.com/">http://www.bv.com/</a> 913-458-2000</p> <p>MWH Global <a href="http://www.mwhglobal.com/">http://www.mwhglobal.com/</a> 303-533-1900</p> <p>Fluor <a href="http://www.fluor.com/">http://www.fluor.com/</a> 469-398-7000</p> <p>Bechtel <a href="http://www.bechtel.com/">http://www.bechtel.com/</a> 415-768-1234</p> <p>Foster Wheeler <a href="http://www.fwc.com">http://www.fwc.com</a> 908-730-4000</p>
Pipes & Valves	<p>Berg Pipe <a href="http://www.bergpipe.com/">http://www.bergpipe.com/</a> 713-465-1600</p> <p>Ameron International <a href="http://www.ameron.com">http://www.ameron.com</a> 626-683-4000</p> <p>B.F. Shaw <a href="http://www.shawgrp.com">http://www.shawgrp.com</a> 864-682-4000</p>	Dryers	<p>Progressive Recovery, Inc. 618-286-5000 <a href="http://www.progressive-recovery.com/">http://www.progressive-recovery.com/</a></p> <p>Heyl &amp; Patterson Inc. 412-788-9810 <a href="http://www.heylpatterson.com/">http://www.heylpatterson.com/</a></p> <p>Epcon Industrial Systems, LP 936-273-3300 <a href="http://www.epconlp.com/">http://www.epconlp.com/</a></p> <p>FEECO International, Inc. 920-468-1000 <a href="http://www.feeco.com/">http://www.feeco.com/</a></p>
Pumps	<p>Gould Crane ITT Industries</p>	Wire & Cable	<p>Rockwell Automation <a href="http://www.rockwellautomation.com/">http://www.rockwellautomation.com/</a></p>



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

<http://www.goulds.com/>  
315-568-7123

Electric Machinery  
<http://www.electricmachinery.com/>  
612-378-8000

Caterpillar  
<http://www.cat.com>  
309-675-1000

Rockwell Automation  
<http://www.rockwellautomation.com/>  
414-382-2000

Dresser  
<http://www.dresser.com>  
972-391-9800

414-382-2000

Amer Cable  
<http://www.amercable.com/>  
800-643-1516

Northwire  
<http://www.northwire.com/>  
800-468-1516

### I. Foreign Competition

The U.S faces significant competition from overseas companies for all of the higher value equipment such as:

- Heat Recovery Steam Generators
- Steam Turbines
- Transformers
- Switchgear
- Process Controls
- Cable
- Pumps
- Cooling Tower

The Germans are strong in Heat Recovery Steam Generators, the Japanese in steam turbines. Europe and Asia in general are strong in all areas. The Central and Eastern European countries (former Soviet Union) also manufacture this equipment although their reputation for quality is not as high as Western European or Japanese companies.

U.S. companies enjoy a strong reputation for quality. The selection of a U.S. Consultant to perform the study should aid U.S manufacturing companies in supplying equipment.

For lower value materials such as pipe, valves, structural steel, and re-bar, etc. China, Indonesia, and India are strong competitors.

### J. Social and Environmental Impact

This project would have a very modest positive Social Impact. Copper refining and smelting is a highly technical endeavor which requires a highly skilled and trained work force. That work force already exists. The addition of a boiler or a boiler/turbine into the Codelco facility would require the same skill sets currently employed at the facility. Increases to the Operating and Maintenance Staff would be approximately 10-15 personnel.



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

The major positive impact for this project is in the Environmental Area.

The use of waste heat to generate steam alone or steam electricity will displace the burning of expensive fuels such as fuel oil or natural gas. Initial estimates indicate that 2.6 million gallons of fuel oil would be displaced by this project. The result is less emission of NO<sub>x</sub>, particulate, and greenhouse gases.

Energy security for Chile is improved because expensive imports of fuel oil from the world market and natural gas from Argentina are reduced.

### **K. Impact on U.S. Labor**

This project will have no direct negative impact on U.S. labor. Instead, we expect that the project will have a positive direct impact on US labor due to the potential export of US equipment and services.

The project's positive impact on US labor is directly related to the manufacture, sale and installation of high end equipment. The US industry is mature and competitive in several areas of service and equipment needed to supply and construct the heat recovery system. Many similar systems have been supplied with US equipment worldwide. A successful completion of any project implemented by a US team is bound to leverage their potential capture of the ever expanding market for electricity production in South America, the value of which is expected to be in the range of several billion

dollars. Even if US companies succeed in capturing a small share of this market, the impact on US labor will be significant.

Since Codelco is one of the world's largest copper concerns, potential adverse employment impacts on the US copper industry from efforts to help reduce energy costs at Codelco needed to be considered carefully. USTDA researched this matter and confirmed to GreenMax that no negative impacts were envisioned.

Implementation of the underlying Project will in no way create:

- 1) Financial incentive to any business enterprise currently located in the United States for the purpose of inducing such an enterprise to relocate outside the United States if such incentive or inducement is likely to reduce the number of employees of such business enterprise in the United States because United States production is being replaced by such enterprise outside the United States;
- 2) Assistance for the purpose of establishing or developing in a foreign country any export processing zone or designated area in which the tax, tariff, labor, environment, and safety laws of that country do not apply, in part or in whole, to activities carried out within that zone or area;
- 3) Assistance for any project or activity that contributes to the violation of internationally recognized workers rights;



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

- 4) Direct assistance for establishing or expanding production of any commodity for export by any country other than the United States, if the commodity is likely to be in surplus on world markets at the time the resulting productive capacity is expected to become operative and if the assistance will cause substantial injury to United States producers of the same, similar, or competing commodity.

### **L. Qualifications of the Feasibility Study Contractor**

It is critical that the selected Contractor organizes a team that brings appropriate experience to the structuring of energy project ownership and financing within an existing industrial complex.

The Offeror's team should consist of a small group of energy engineers and finance professionals. GreenMax recommends that the team be comprised of individuals with the skills set described below, understanding that specific skills may be found in different of the individual staff presented by the Offeror, than what is described below. The critical factor in evaluation will be that all skills are properly addressed. Several key members of the team should have both oral and written Spanish language skills.

**Project Manager** – It is recommended that the Project Manager have a minimum of 15 years broad experience in all technical, commercial, and financial aspects of energy sector project transactions in the metals refining industry. The Project Manager

should have experience in evaluating different project financing structures, preparing investment memoranda, advising on the business tools necessary to be included in all underlying project agreements (PPA, EPC Contracts, land lease, insurance, etc), and experience working with regulatory requirements to facilitate project financing. The Project Manager should offer a demonstrated track record in working with International Financial Institutions and other relevant stakeholders to bring energy projects in developing country environments to financial close. Fluency in Spanish is essential.

**Mechanical Engineer (Lead)** - It is recommended that the Lead Engineer have a minimum of 15 years of consulting, construction, or operating expertise in copper smelting. Fluency in Spanish is highly desirable. .

**Mechanical Engineer (Junior)** – It is recommended that the Junior Engineer have at least 10 years of experience in some aspect of copper smelting. Fluency in Spanish would be helpful.

**Electrical Engineer** – It is recommended that the Electrical Engineer have a minimum of 10 years of experience in a heavy industrial or electric utility setting.

**Civil Engineer** – It is recommended that the Civil Engineer have a minimum of 10 years of experience in a heavy industrial or electric utility setting.



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

**Socio/Environmental Specialist** - It is recommended that the S/E Specialist have a minimum of 5 years of experience carrying out environmental impact analyses for large-scale infrastructure/energy development projects in developing countries. This specialist must have strong experience in socio-economic impact analyses in this context as well. Fluency in Spanish is essential.

**Attorney** - It is recommended that the Attorney have a minimum of 15 years of experience working on regulatory issues related to large-scale infrastructure developments and project finance, preferably in emerging markets. Fluency in Spanish is highly desirable.

**Financial Specialist** - It is recommended that the Financial Specialist have a minimum of 10 years of experience in packaging financing for large-scale infrastructure/energy developments in an emerging market context. The Financing Specialist must offer significant past experience in financing energy projects, with a preference for past pipeline experience. Fluency in Spanish is preferred.

To qualify for selection for this project and approval by the USTDA, the bidding team should demonstrate the following qualifications:

- Experience in developing large scale energy infrastructure projects -25%
- Experience with copper smelting processes and the handling/treatment of exhaust gases from smelters – 40%

- Experience with packaging financing for similar large-scale infrastructure projects with a preference for electric generation projects – 20%
- Spanish language skills – 15%

### **M. Justification**

The Chilean government has made energy efficiency a main component of its new energy strategy to reduce dependence on foreign gas imports and to diversify electricity production away from an overdependence on hydropower.

This project when implemented will displace the equivalent of approximately 2.6 million gallons of fuel oil in the case of heat recovery for steam production. Electricity production would add another 15 MW of capacity to the grid. Since the project will use waste heat there will be a decrease in greenhouse gases as electricity production from high priced fossil fuel is displaced. .

### **N. Terms of Reference**

#### **Objectives**

The purpose of the Feasibility Study is to ascertain the technical and financial viability of recovering the heat (now wasted) from the Teniente Converter located at the Codelco Ventanas Division. The Contractor shall evaluate two configurations.

- One with only steam production
- One with steam and electricity production



## DEFINITIONAL MISSION for Energy Sector Projects in Chile

### O. Budget and Schedule

TASK	LEVEL OF EFFORT (IN PERSONS DAYS)	PM	ME Lead	ME Jr.	Elec Eng	Civil Eng	Socio/Env Specialist	Legal	Finance Specialist	Total days
1.0	Project Kickoff Meeting	5	5	5	5	5	0	0	0	25
2.0	Characterize Smelting Process	5	20	20	2	2	0	0	0	49
3.0	Size HRSG/Turbine	5	10	20	0	0	0	0	0	35
4.0	Physical Layout	5	10	10	5	5	0	0	0	35
5.0	Develop Cost Parameters	2	5	20	10	10	0	0	2	49
6.0	Economic Analysis	10	5	2	2	2	0	0	20	41
7.0	Socio/Econ/Env Impact	2	0	0	0	0	20	2	0	24
8.0	Review Regulatory Issues	2	0	0	0	0	5	10	5	22
9.0	Financial Analysis	5	0	0	0	0	0	2	10	17
10.0	Proposed Equipment and Services	1	1	2	2	2	0	0	0	8
11.0	Development Impact	1	0	0	0	0	20	5	0	26
12.0	Project Schedule	5	5	5	2	2	1	1	2	23
13.0	Final Report	10	5	10	5	5	2	2	5	44
		58	66	94	33	33	48	22	44	398





## DEFINITIONAL MISSION for Energy Sector Projects in Chile

**FIGURE 5 -- TRAVEL BUDGET**

International Travel	Point of Origin	Destination	No. of Rd Trips	Rate	Total Airfare	Days	Per diem Rate	Per diem Total	Grand Total
Task									
1			5	2000	10000	25	300	7500	17500
2			0	2000	0	0	300	0	0
3			0	2000	0	5	300	1500	1500
4			3	2000	6000	15	300	4500	10500
5			0	2000	0	0	300	0	0
6			2	2000	4000	10	300	3000	7000
7			0	2000	0	0	300	0	0
8			0	2000	0	0	300	0	0
9			0	2000	0	0	300	0	0
10			0	2000	0	0	300	0	0
11			0	2000	0	0	300	0	0
12			0	2000	0	0	300	0	0
13			0	2000	0	0	300	0	0
			10			55			
<b>Total Air Fare and Per Diem</b>					<b>20000</b>			<b>16500</b>	<b>36500</b>
<b>Other Travel</b>									
Local Transportation		No of trips	rate						
U.S. Airport Transportation		55	50						2750
<b>total other travel</b>		20	50						<b>1000</b>
<b>TOTAL TRAVEL</b>									<b>40250</b>
<b>Other Direct Costs</b>									
Visa Services		10	0						0
Document Translation									7500
Telecommunications									1200
Report Printing and Distribution									1000
Reproduce Drawings									1000
DBA Insurance (in country salaries of \$48125) at \$1.66/100 of salary									799
<b>TOTAL OTHER DIRECT COSTS</b>									<b>11499</b>
<b>GRAND TOTAL EXPENSES</b>									<b>51749</b>

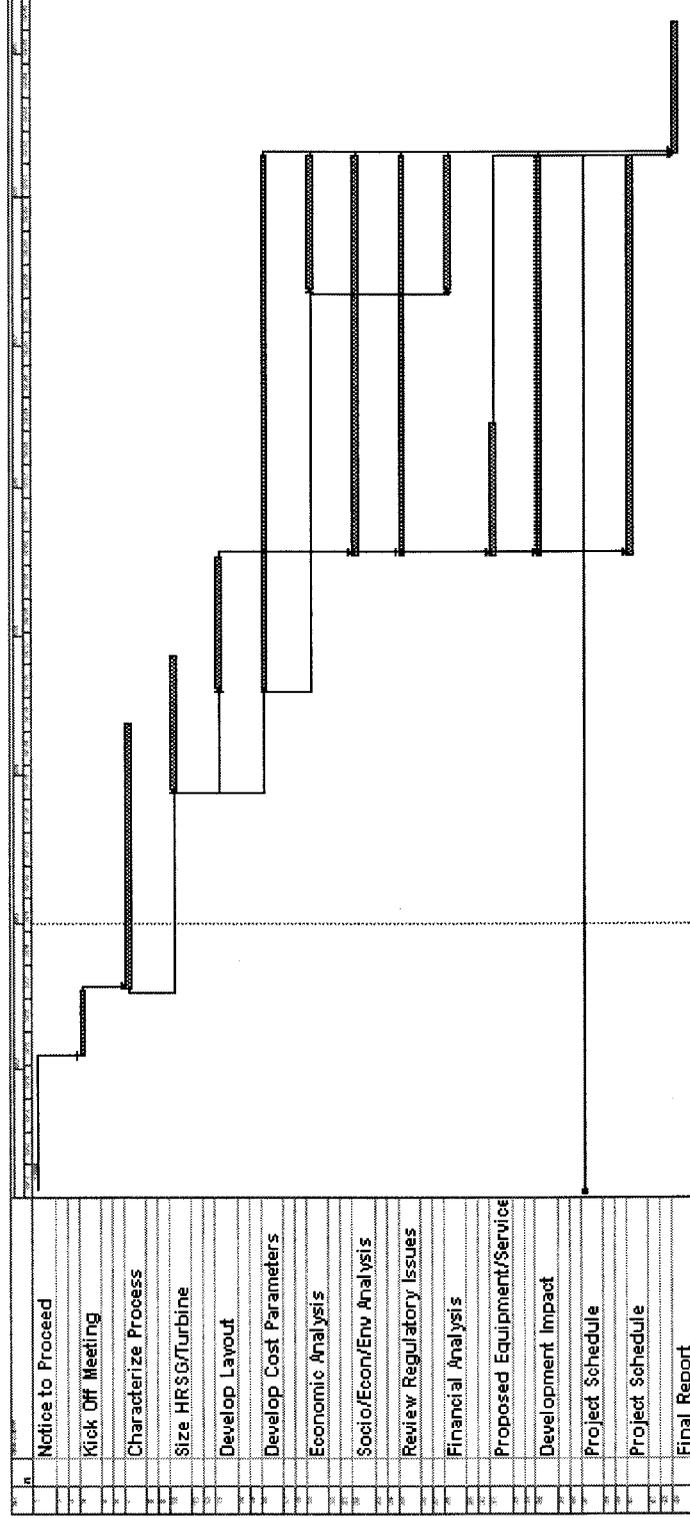
**GREENMAX CAPITAL ADVISORS**



**DEFINITIONAL MISSION for Energy Sector  
Projects in Chile**



## DEFINITIONAL MISSION for Energy Sector Projects in Chile





## DEFINITIONAL MISSION for Energy Sector Projects in Chile

### **P. Recommendation**

GreenMax is recommending that USTDA approve a grant to support a Feasibility Study for the Copper Smelter Heat Recovery at the Codelco Ventanas Division.

The Grantee for this project would be Codelco.

The total study cost is \$421,824.

**ANNEX 3**



**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.

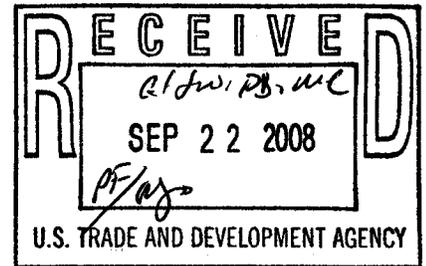
“Origin” means the place of production, through manufacturing, assembly or otherwise.

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

**ANNEX 4**

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Chile

## GRANT AGREEMENT



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 the Corporación Nacional del Cobre de Chile ("Grantee"). USTDA agrees to provide the Grantee under the terms of this Agreement US\$422,000 ("USTDA Grant") to fund the cost of goods and services required for a feasibility study ("Study") on the proposed Ventanas Smelter Heat Recovery System ("Project") in Chile ("Host Country").

Ny  
RM  
EK  
ITC  
NS

### 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 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 March 31, 2010 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 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 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 Director of Energy Efficiency and New Products. 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: Richard Aylwin  
Director of Energy Efficiency and New Products

Corporación Nacional del Cobre de Chile  
Chile

Phone: (56-2) 690-3378

Fax: (56-2) 690-3000

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.: 118/91001  
Activity No.: 2007-5107c  
Reservation No.: 2008510060  
Grant No.: GH2008510019

#### **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]**

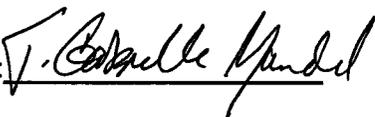
IN WITNESS WHEREOF, the Government of the United States of America and the Corporación Nacional del Cobre de Chile, each acting through its duly authorized representative, have caused this Agreement to be signed in the English language in their names and delivered as of the day and year written below. 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

By:   
Nathan Young  
Regional Director for Latin America  
and the Caribbean  
U.S. Trade and Development Agency

Date: 11/9/08

Witnessed:

By: 

Annex I -- Terms of Reference

Annex II -- USTDA Mandatory Clauses

For the Corporación Nacional del Cobre  
de Chile

By:   
Alex Acosta  
General Manager of Ventanas  
Division  
Corporación Nacional del Cobre de Chile

Date: 11-09-08

Witnessed:

By:   
RICHARD AYWIN

## Annex I

### Terms of Reference

#### Objectives

The purpose of the Feasibility Study is to ascertain the technical and financial viability of recovering the heat from the Teniente Converter located at the Codelco Ventanas Division. The Contractor shall evaluate two configurations:

- One with only steam production; and
- One with steam and electricity production.

There are several challenging technical issues that must be addressed as part of the study:

- Designing a Heat Recovery Steam Generator (HRSG) that will handle the potentially corrosive exhaust gases;
- Determining the maximum exhaust gas temperature allowed by the HRSG;
- Determining the effects of adding the HRSG on the existing sulfuric acid plant used to reduce SO<sub>2</sub> emissions;
- Physically integrating the new HRSG into the existing steam distribution system or directly into the electro refining process; and
- Integrating the electrical generator into the local electric grid and plant electrical system.

Once the technical parameters of the plant are determined, a set of pro forma analysis shall be prepared to demonstrate the economic viability of producing steam or a combination of steam and electricity.

**Note:** The Grantee shall be responsible for forming a Technical Advisory Committee ("Advisory Committee"), composed of senior level managers from the Ventanas Division and Corporate Headquarters. Codelco shall provide a Project Manager for the duration of the work in Chile. In addition, Codelco shall also provide at minimum the following types of project support:

- Office Space;
- Administrative Support Staff ;
- Transportation and drivers; and
- Telephone, internet access, copy facilities, etc.

The purpose of the Advisory Committee shall be to coordinate the Study, provide feedback on the Contractor's work, and take a proactive role in assisting the Contractor's activities. It is expected that the members of the Advisory Committee shall convene at their own cost in Chile for the Project Kick-Off meeting and shall provide feedback to the Contractor in an expedited manner, when requested, within 3 weeks of each request.

## Scope of Work

### **Task 1: Background Research and Kick-Off Meeting**

To begin the assignment, the Contractor shall travel to Chile to meet with the Grantee. Prior to the Kick-Off Meeting, the Grantee shall have provided to the Contractor all necessary studies and background documents describing the Project as well as copies of all relevant laws, regulations and ordinances. The Contractor shall be prepared to review some documentation which will be available only in Spanish and to conduct meetings in Spanish. The Contractor shall review all background information in advance of the Kick-Off Meeting so that the mission may be productively utilized. The Contractor shall discuss with the Grantee its goals for the Project, what has been done to date towards Project implementation, and preferences for both financing and ownership arrangements.

**Task 1 Deliverable** The deliverable from Task 1 shall be an Inception Memorandum providing a discussion of the tasks to be accomplished, necessary amendments to the work-plan and schedule, information requests, and a list of possible obstacles to execution of further tasks for discussion with the Grantee. In addition, the complete findings of Task 1 shall be included in the Final Report. No changes may be made to these Terms of Reference unless USTDA and the Grantee first enter into a Grant Agreement Amendment providing for those changes.

### **Task 2: Characterize Existing Smelting Process**

The purpose of this task shall be to define the major parameters of the existing smelting process. This is a crucial first step in the design process. The Contractor shall prepare heat and material balances for the smelter showing high, low and expected flows of exhaust gases and their temperatures. The Contractor shall prepare an analysis showing the constituents of the flue gas such as particulates, SO<sub>2</sub>, CO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, etc. for the high, low, and expected cases. Once the exhaust gas is characterized, the Contractor shall contact at least two major manufacturers of HRSG equipment and engage them in technical discussions related to designing an HRSG to handle these types of exhaust gases. A maximum exhaust gas temperature entering the HRSG shall be established.

### **Task 3: Size Heat Recovery Steam Generator(s) and Steam Turbine**

Using the results from Task 2 the Contractor shall prepare heat and material balances for the high, low, and expected case for the two configurations referenced earlier:

- Configuration 1 – Steam production only
- Configuration 2 – Steam and electric production.

In this step the Contractor shall also propose how the HRSG(s) shall be integrated into the existing steam distribution system or into the smelting electrorefining process. This includes an analysis of the impact on the sulfuric acid plant and a calculation of the amounts of dilution air (if any) required to reduce the exhaust gas temperature to suitable

levels for the HRSG design. The Contractor shall also propose a methodology to interconnect the steam produced by the HRSG into the steam distribution system or to the refinery processes (Configuration 1) or the electric generator into the local electricity grid and plant electrical system (Configuration 2). The Contractor should be prepared to conduct a load flow analysis in support of the project design.

**Tasks 2 and 3 Deliverable:** The Contractor shall provide an interim report to the Technical Advisory Committee regarding the Contractor's findings for Tasks 2 and 3. The Technical Advisory Committee shall provide any comments or suggestions regarding the findings to the Contractor within two (2) weeks of the Contractor's delivery, which the Contractor shall incorporate into the remainder of the Study and the Final Report.

#### **Task 4: Develop the Physical Layout**

The Contractor shall develop the physical layout of the facility for Configuration 1 and Configuration 2, taking into account constructability, physical space, and interferences with the existing process and equipment.

**Task 4 Deliverable:** The Contractor shall deliver necessary plot plans and schematics in CAD compatible format.

#### **Task 5: Develop Cost Parameters**

The Contractor shall provide an estimate of capital and operating costs for Configuration 1 and 2. Capital costs shall include direct costs such as HRSG, steam turbine, civil works, piping, switchgear, electrical interconnection, etc. and other relevant costs, plus indirect costs such as engineering, permitting, legal, construction management, etc. Operations costs shall include personnel, station service, chemical, long term overhauls, consumables, and other applicable costs.

#### **Task 6: Economic Analysis**

The Contractor shall provide an economic cost analysis for the Project and propose a set of steam and electric tariffs for the Project. The analysis shall include capital cost, operations cost, optimal debt/equity ratio, internal rate of return, economic life, and debt structure for both configurations. In addition, Codelco Ventanas shall give the Contractor the estimated minimum period in which the process of hot gas evacuation of the Teniente Converter will remain unchanged (do nothing case). The Contractor shall make the economic analysis of two scenarios: if the process changes after the estimated period; and if the process remains unchanged. The estimated minimum period at the present time in Codelco Ventanas, with the information available today, is 2008-2015. The Contractor shall provide a sensitivity analysis showing at a minimum how the steam and electric tariffs would change given changes in demand, product mix, capital cost, operating cost, and financing arrangements. The Contractor shall also provide an economic cost benefit analysis of the project compared to the "do nothing" case.

**Task 5 and 6 Deliverable:** The Contractor shall deliver an Interim Report to the Technical Advisory Committee representing the findings of Tasks 5 and 6. The financial pro-forma shall be presented in MS Excel format. The Contractor shall travel to Chile to present the Task 5 and 6 Report.

**Task 7: Preliminary Socio-Economic and Environmental Impact Analysis**

In agreement with its Environmental Policy, Codelco Ventanas is interested in determining the influence on emissions reduction through the implementation of this Project. Accordingly, the Contractor shall determine the actual emissions baseline related to fossil fuels, and the estimated reduction due to the fuel consumption reduction related to the Project. The Contractor also shall prepare a preliminary review of the Project's environmental impact with reference to local requirements and those of the World Bank and other relevant financial institutions. This review shall identify potential negative impacts, discuss the extent to which they can be mitigated, and develop plans for a full environmental impact assessment in anticipation of the Project moving forward to the implementation stage. Among other things, this review shall include the impacts caused by equipment failure (inadvertent air emissions, for instance), wetlands and other areas of sensitive biodiversity, historical sites, availability of land for the Project sites, and soil erosion. The Contractor shall also conduct a socioeconomic impact analysis of the Project, including (but not limited to) employment creation, community impacts, safety, etc. The Contractor shall provide recommendations on the means and cost of mitigation of identified significant adverse impacts.

**Task 7 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 7 activities which shall also be included in the Final Report.

**Task 8: Review of Regulatory Issues**

The Contractor shall review and analyze all regulatory issues in Chile that could impact the viability of constructing and operating a steam production facility or a steam and electric production facility. Key to this portion of the work shall be the review of transmission interconnection standards and regulations. This shall include, but not be limited to, national, regional, and local codes/regulations for building, operating, and financing the Project. This shall also include areas of property rights, setting of rates/tariffs, siting/routing, environmental impacts, etc. The Contractor shall provide recommendations to the Advisory Committee regarding key legal and regulatory requirements that will need to be considered to facilitate the implementation of the Project and provide a proposed roadmap and projected timeline for this process.

**Task 8 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 8 activities which shall also be included in the Final Report.

**Task 9: Financial Analysis**

Considering the large size of the investment requirement for the Project, especially if implemented in all of Codelco's smelters, the Contractor shall carry out an assessment of alternative project financing structures, including private development and ownership, public-private partnership (PPP), and build-operate-transfer (BOT) modalities, considering a range of private and public sector financing options. The Contractor shall provide an opinion on the feasibility of a fully private ownership.

**Task 9 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 9 activities which shall also be included in the Final Report.

#### **Task 10: Proposed Equipment and Services**

The Contractor shall prepare a list of potential equipment and services required for the Project, including potential U.S. sources of supply in accordance with Clause I of Annex II of the Grant Agreement. Business name, point of contact, address, telephone, e-mail, and fax numbers shall be included for each source. The list shall be included in the Final Report.

#### **Task 11: Development Impact**

The Contractor shall report on the potential development impact of the Project in Chile. 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 include, where appropriate, any additional developmental benefits to the Project, including spin-off and demonstration effects. The Contractor's analysis of potential benefits shall be as concrete and detailed as possible. The development impact factors are intended to provide the Project's decision-makers and interested parties with a broader view of the Project's potential effects on Chile. The Contractor shall provide estimates of the Project's potential benefits in the following areas:

- Infrastructure / Industry. The Contractor shall provide a statement on the infrastructure impact giving a brief synopsis.
- Market-Oriented Reforms. The Contractor shall provide a description of any regulation, laws, or institutional changes that are recommended and the effect they would have if implemented.
- Human Capacity Building. The Contractor shall address the number and type of positions that would be needed to construct and operate the proposed Project as well as the number of people who will receive training and a brief description of the training program.
- Technology Transfer and Productivity Enhancement. The Contractor shall provide a description of any advanced technologies that will be implemented as a

result of the Project, and a quantitative description of any efficiency that will be gained.

- Other. The Contractor shall identify any other developmental benefits of the Project, including any spin-off or demonstration effects.

The Development Impact results shall be included in the Final Report.

### **Task 12: Project Schedule**

The Contractor shall prepare an implementation schedule for Configurations 1 and 2, clearly showing the duration of different activities, important milestones, permitting, interconnection agreements, etc. The Project Schedule shall be included in the Final Report.

### **Task 13: 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. The Contractor shall also prepare an Executive Summary discussing the Project, the key findings of the Study, and the recommendations for further development of the Project, to be included in the Final Report. In addition to the copies of the Report that shall be provided to USTDA, as outlined in Clause I of Annex II of the Grant Agreement, the Contractor shall provide to the Grantee six (6) copies of the Final Report in English and six (6) copies in Spanish. Electronic versions of the report shall also be provided to the Grantee.

**Timeline:** It is expected that the Study shall be completed within nine (9) months of contract award.

### **Notes:**

- (1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of these 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 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 the Corporación Nacional del Cobre de Chile ("Client"), dated \_\_\_\_\_ ("Grant Agreement"). The Client has selected \_\_\_\_\_ ("Contractor") to perform the feasibility study ("Study") for the Ventanas Smelter Heat Recovery System project ("Project") in Chile ("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 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 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 a mobilization 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 a mobilization payment (if any):

"As a condition for this mobilization payment, 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 a mobilization 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 mobilization 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) One (1) copy 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. In any event, the Public Version must be informative and contain sufficient Project detail to be useful to prospective equipment and service providers.

and

(c) Two (2) CD-ROMs, each containing a complete copy of the Public Version of the Final Report. The electronic files on the CD-ROMs shall be submitted in a commonly accessible read-only format. As these CD-ROMs will be available for public distribution, they must not contain any confidential information. It is the responsibility of the Contractor to ensure that no confidential information is contained on the CD-ROMs.

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. If the complete version of the Final Report contains confidential information, the Contractor shall be responsible for labeling the front cover of that version of the Final Report with the term "Confidential Version." The Contractor shall be responsible for labeling the front cover of the Public Version of the Final Report with the term "Public Version." The front cover of every Final Report shall also contain 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 shall affix to the front of the CD-ROM a label identifying the Host Country, USTDA Activity Number, the name of the Client, the name of the Contractor who prepared the report, a report title, and the following language:

“The Contractor certifies that this CD-ROM contains the Public Version of the Final Report and that all contents are suitable for public distribution.”

(d) The Contractor and any subcontractors that perform work pursuant to the Grant Agreement must be clearly identified in the Final Report. Business name, point of contact, address, telephone and fax numbers shall be included for Contractor and each subcontractor.

(e) 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, telephone and fax numbers shall be included for each commercial source.

(f) 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 March 31, 2010, 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.:	118/91001
Activity No.:	2007-5107c
Reservation No.:	2008510060
Grant No.:	GH2008510019

### **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**

## Annex I

### Terms of Reference

#### Objectives

The purpose of the Feasibility Study is to ascertain the technical and financial viability of recovering the heat from the Teniente Converter located at the Codelco Ventanas Division. The Contractor shall evaluate two configurations:

- One with only steam production; and
- One with steam and electricity production.

There are several challenging technical issues that must be addressed as part of the study:

- Designing a Heat Recovery Steam Generator (HRSG) that will handle the potentially corrosive exhaust gases;
- Determining the maximum exhaust gas temperature allowed by the HRSG;
- Determining the effects of adding the HRSG on the existing sulfuric acid plant used to reduce SO<sub>2</sub> emissions;
- Physically integrating the new HRSG into the existing steam distribution system or directly into the electro refining process; and
- Integrating the electrical generator into the local electric grid and plant electrical system.

Once the technical parameters of the plant are determined, a set of pro forma analysis shall be prepared to demonstrate the economic viability of producing steam or a combination of steam and electricity.

**Note:** The Grantee shall be responsible for forming a Technical Advisory Committee ("Advisory Committee"), composed of senior level managers from the Ventanas Division and Corporate Headquarters. Codelco shall provide a Project Manager for the duration of the work in Chile. In addition, Codelco shall also provide at minimum the following types of project support:

- Office Space;
- Administrative Support Staff ;
- Transportation and drivers; and
- Telephone, internet access, copy facilities, etc.

The purpose of the Advisory Committee shall be to coordinate the Study, provide feedback on the Contractor's work, and take a proactive role in assisting the Contractor's activities. It is expected that the members of the Advisory Committee shall convene at their own cost in Chile for the Project Kick-Off meeting and shall provide feedback to the Contractor in an expedited manner, when requested, within 3 weeks of each request.

## Scope of Work

### **Task 1: Background Research and Kick-Off Meeting**

To begin the assignment, the Contractor shall travel to Chile to meet with the Grantee. Prior to the Kick-Off Meeting, the Grantee shall have provided to the Contractor all necessary studies and background documents describing the Project as well as copies of all relevant laws, regulations and ordinances. The Contractor shall be prepared to review some documentation which will be available only in Spanish and to conduct meetings in Spanish. The Contractor shall review all background information in advance of the Kick-Off Meeting so that the mission may be productively utilized. The Contractor shall discuss with the Grantee its goals for the Project, what has been done to date towards Project implementation, and preferences for both financing and ownership arrangements.

**Task 1 Deliverable** The deliverable from Task 1 shall be an Inception Memorandum providing a discussion of the tasks to be accomplished, necessary amendments to the work-plan and schedule, information requests, and a list of possible obstacles to execution of further tasks for discussion with the Grantee. In addition, the complete findings of Task 1 shall be included in the Final Report. No changes may be made to these Terms of Reference unless USTDA and the Grantee first enter into a Grant Agreement Amendment providing for those changes.

### **Task 2: Characterize Existing Smelting Process**

The purpose of this task shall be to define the major parameters of the existing smelting process. This is a crucial first step in the design process. The Contractor shall prepare heat and material balances for the smelter showing high, low and expected flows of exhaust gases and their temperatures. The Contractor shall prepare an analysis showing the constituents of the flue gas such as particulates, SO<sub>2</sub>, CO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, etc. for the high, low, and expected cases. Once the exhaust gas is characterized, the Contractor shall contact at least two major manufacturers of HRSG equipment and engage them in technical discussions related to designing an HRSG to handle these types of exhaust gases. A maximum exhaust gas temperature entering the HRSG shall be established.

### **Task 3: Size Heat Recovery Steam Generator(s) and Steam Turbine**

Using the results from Task 2 the Contractor shall prepare heat and material balances for the high, low, and expected case for the two configurations referenced earlier:

- Configuration 1 – Steam production only
- Configuration 2 – Steam and electric production.

In this step the Contractor shall also propose how the HRSG(s) shall be integrated into the existing steam distribution system or into the smelting electrorefining process. This includes an analysis of the impact on the sulfuric acid plant and a calculation of the amounts of dilution air (if any) required to reduce the exhaust gas temperature to suitable

levels for the HRSG design. The Contractor shall also propose a methodology to interconnect the steam produced by the HRSG into the steam distribution system or to the refinery processes (Configuration 1) or the electric generator into the local electricity grid and plant electrical system (Configuration 2). The Contractor should be prepared to conduct a load flow analysis in support of the project design.

**Tasks 2 and 3 Deliverable:** The Contractor shall provide an interim report to the Technical Advisory Committee regarding the Contractor's findings for Tasks 2 and 3. The Technical Advisory Committee shall provide any comments or suggestions regarding the findings to the Contractor within two (2) weeks of the Contractor's delivery, which the Contractor shall incorporate into the remainder of the Study and the Final Report.

#### **Task 4: Develop the Physical Layout**

The Contractor shall develop the physical layout of the facility for Configuration 1 and Configuration 2, taking into account constructability, physical space, and interferences with the existing process and equipment.

**Task 4 Deliverable:** The Contractor shall deliver necessary plot plans and schematics in CAD compatible format.

#### **Task 5: Develop Cost Parameters**

The Contractor shall provide an estimate of capital and operating costs for Configuration 1 and 2. Capital costs shall include direct costs such as HRSG, steam turbine, civil works, piping, switchgear, electrical interconnection, etc. and other relevant costs, plus indirect costs such as engineering, permitting, legal, construction management, etc. Operations costs shall include personnel, station service, chemical, long term overhauls, consumables, and other applicable costs.

#### **Task 6: Economic Analysis**

The Contractor shall provide an economic cost analysis for the Project and propose a set of steam and electric tariffs for the Project. The analysis shall include capital cost, operations cost, optimal debt/equity ratio, internal rate of return, economic life, and debt structure for both configurations. In addition, Codelco Ventanas shall give the Contractor the estimated minimum period in which the process of hot gas evacuation of the Teniente Converter will remain unchanged (do nothing case). The Contractor shall make the economic analysis of two scenarios: if the process changes after the estimated period; and if the process remains unchanged. The estimated minimum period at the present time in Codelco Ventanas, with the information available today, is 2008-2015. The Contractor shall provide a sensitivity analysis showing at a minimum how the steam and electric tariffs would change given changes in demand, product mix, capital cost, operating cost, and financing arrangements. The Contractor shall also provide an economic cost benefit analysis of the project compared to the "do nothing" case.

**Task 5 and 6 Deliverable:** The Contractor shall deliver an Interim Report to the Technical Advisory Committee representing the findings of Tasks 5 and 6. The financial pro-forma shall be presented in MS Excel format. The Contractor shall travel to Chile to present the Task 5 and 6 Report.

**Task 7: Preliminary Socio-Economic and Environmental Impact Analysis**

In agreement with its Environmental Policy, Codelco Ventanas is interested in determining the influence on emissions reduction through the implementation of this Project. Accordingly, the Contractor shall determine the actual emissions baseline related to fossil fuels, and the estimated reduction due to the fuel consumption reduction related to the Project. The Contractor also shall prepare a preliminary review of the Project's environmental impact with reference to local requirements and those of the World Bank and other relevant financial institutions. This review shall identify potential negative impacts, discuss the extent to which they can be mitigated, and develop plans for a full environmental impact assessment in anticipation of the Project moving forward to the implementation stage. Among other things, this review shall include the impacts caused by equipment failure (inadvertent air emissions, for instance), wetlands and other areas of sensitive biodiversity, historical sites, availability of land for the Project sites, and soil erosion. The Contractor shall also conduct a socioeconomic impact analysis of the Project, including (but not limited to) employment creation, community impacts, safety, etc. The Contractor shall provide recommendations on the means and cost of mitigation of identified significant adverse impacts.

**Task 7 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 7 activities which shall also be included in the Final Report.

**Task 8: Review of Regulatory Issues**

The Contractor shall review and analyze all regulatory issues in Chile that could impact the viability of constructing and operating a steam production facility or a steam and electric production facility. Key to this portion of the work shall be the review of transmission interconnection standards and regulations. This shall include, but not be limited to, national, regional, and local codes/regulations for building, operating, and financing the Project. This shall also include areas of property rights, setting of rates/tariffs, siting/routing, environmental impacts, etc. The Contractor shall provide recommendations to the Advisory Committee regarding key legal and regulatory requirements that will need to be considered to facilitate the implementation of the Project and provide a proposed roadmap and projected timeline for this process.

**Task 8 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 8 activities which shall also be included in the Final Report.

**Task 9: Financial Analysis**

Considering the large size of the investment requirement for the Project, especially if implemented in all of Codelco's smelters, the Contractor shall carry out an assessment of alternative project financing structures, including private development and ownership, public-private partnership (PPP), and build-operate-transfer (BOT) modalities, considering a range of private and public sector financing options. The Contractor shall provide an opinion on the feasibility of a fully private ownership.

**Task 9 Deliverable:** The Contractor shall provide a report summarizing the findings of the Task 9 activities which shall also be included in the Final Report.

#### **Task 10: Proposed Equipment and Services**

The Contractor shall prepare a list of potential equipment and services required for the Project, including potential U.S. sources of supply in accordance with Clause I of Annex II of the Grant Agreement. Business name, point of contact, address, telephone, e-mail, and fax numbers shall be included for each source. The list shall be included in the Final Report.

#### **Task 11: Development Impact**

The Contractor shall report on the potential development impact of the Project in Chile. 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 include, where appropriate, any additional developmental benefits to the Project, including spin-off and demonstration effects. The Contractor's analysis of potential benefits shall be as concrete and detailed as possible. The development impact factors are intended to provide the Project's decision-makers and interested parties with a broader view of the Project's potential effects on Chile. The Contractor shall provide estimates of the Project's potential benefits in the following areas:

- Infrastructure / Industry. The Contractor shall provide a statement on the infrastructure impact giving a brief synopsis.
- Market-Oriented Reforms. The Contractor shall provide a description of any regulation, laws, or institutional changes that are recommended and the effect they would have if implemented.
- Human Capacity Building. The Contractor shall address the number and type of positions that would be needed to construct and operate the proposed Project as well as the number of people who will receive training and a brief description of the training program.
- Technology Transfer and Productivity Enhancement. The Contractor shall provide a description of any advanced technologies that will be implemented as a

result of the Project, and a quantitative description of any efficiency that will be gained.

- Other. The Contractor shall identify any other developmental benefits of the Project, including any spin-off or demonstration effects.

The Development Impact results shall be included in the Final Report.

### **Task 12: Project Schedule**

The Contractor shall prepare an implementation schedule for Configurations 1 and 2, clearly showing the duration of different activities, important milestones, permitting, interconnection agreements, etc. The Project Schedule shall be included in the Final Report.

### **Task 13: 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. The Contractor shall also prepare an Executive Summary discussing the Project, the key findings of the Study, and the recommendations for further development of the Project, to be included in the Final Report. In addition to the copies of the Report that shall be provided to USTDA, as outlined in Clause I of Annex II of the Grant Agreement, the Contractor shall provide to the Grantee six (6) copies of the Final Report in English and six (6) copies in Spanish. Electronic versions of the report shall also be provided to the Grantee.

**Timeline:** It is expected that the Study shall be completed within nine (9) months of contract award.

### **Notes:**

- (1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of these 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 Final Report and all work product that is developed under these Terms of Reference.

