

Invitation for Proposals

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**STRATEGIC OPTIONS FOR SUSTAINABLE POWER GENERATION
INTEREST GROUP (SOIG)**

CEATI PROJECT No. SOIG-10-01

**CONVERSION OF WASTE HEAT TO ELECTRICITY: TECHNOLOGY
UPDATE AND ASSESSMENT OF POTENTIAL APPLICATIONS**

CEATI International Inc. (CEATI) invites the submission of proposals to perform research work on the following topic:

TITLE

Conversion of Waste Heat to Electricity: Technology Update and Assessment of Potential Applications

INTRODUCTION

Recent studies undertaken on behalf of CEATI's utility participants suggest that there may be tens of thousands of MW of industrial and commercial enterprise waste heat streams in North America that could be cost-effectively converted to electric power with little or no negative air quality or environmental impacts. The landscape of viable and commercially available waste heat to electricity conversion technologies is growing, and there are increasing numbers of such installations now in place. With escalating targets for renewable and clean energy production, and rising consumer and public expectations that they will make the most of existing resources in meeting demand for new power generation, utilities are under pressure to explore every clean energy and energy efficiency alternative. Accordingly, CEATI's utility participants require a thorough understanding of the opportunities and challenges they may encounter in pursuing the waste heat to electricity alternative.

PROJECT OBJECTIVES

The objectives of this study are:

- 1) to review and if necessary update recent analyses of the North American technical market potential for conversion of industrial and commercial waste heat streams to electricity, and to provide an update regarding the status, commercial readiness and economics of available waste heat to electricity conversion technologies, including case studies of recent commercial installations;
- 2) to undertake detailed engineering assessments for a minimum of two new opportunities for industrial/commercial facility waste heat to electricity conversion within the operating territories of selected project funding utilities (proposals should specify the added cost per detailed engineering assessment).

SCOPE OF THE STUDY

This project will investigate the potential for electricity generation from various industrial/commercial waste heat streams that are not currently being utilized, and the status of technologies and equipment that would allow the conversion of these waste heat streams into electrical energy (MWh). Recognizing that most industrial sectors, as well as conventional electricity generators, already make use of conventional techniques to capture and use obvious "high value" waste heat sources, the study will concentrate on medium and lower value waste heat streams (e.g. 80-300°C) for which novel alternatives (such as the Organic Rankine Cycle) might be used where not previously considered. Particular attention will be given to the

experiences gained and lessons learned from actual installations, and to applying this knowledge in identifying and assessing potential new installations.

POTENTIAL BENEFITS

Commercially viable techniques for converting thermal waste streams to electricity would improve the efficiency of the processes involved, save millions of dollars annually, and could emerge as a new source for much needed electrical power and energy. As a result of this study, project funders will be in a better position to firmly understand the waste heat to electricity market potential in various industrial sectors and power generation facilities, the technologies that are available to allow this conversion, and the associated business, economic and technical opportunities and challenges that are likely to be encountered.

PROJECT STAGING

Task 1 - Technical Potential Review

Review and, if necessary, update recent studies that have been undertaken to determine the broad technical potential (MW) for waste heat recovery and conversion in key industrial and commercial sectors as well as the power generation industry. Provide a summary of possible applications with greatest potential for commercial exploitation, with priority given to characterizing the market potential within the jurisdictions of the various project funders. Key considerations:

- Characterization and properties of waste heat, eg, high grade, low grade, clean waste heat, accessibility, etc.
- Technical potential from key industrial and commercial sectors (eg chemical, refineries, pulp & paper, steelmaking, cement, gas pipelines, etc)
- Technical potential from a typical utility fleet of generating assets (coal, gas, nuclear)
- Technical potential from non-utility owned generating assets, particularly with respect to smaller-scale or distributed generation applications (eg recip engines, small gas turbines)

Task 2 - Technology Status Update

Review and update recent studies that have been undertaken regarding the status and commercial readiness of available waste heat to electricity conversion technologies, including:

A high-level review of waste-heat recovery and energy conversion technologies:

- Available technologies
- Status of each technology and its provider(s); SWOT analysis
- Well suited potential applications for each technology

A detailed overview of commercial and near-commercial waste heat recovery and energy conversion systems:

- Identify specific system manufacturers
- Track records and detailed case studies for systems identified
- Timing horizon for commercialization of certain technologies

- Approximate installed cost on a per kW basis, and estimates of the economics (eg ROI) of potential and recent installations

Task 3 – Opportunities Assessment

Working with one or more project funding utilities, identify a minimum of two specific “untapped” opportunities for industrial/commercial facility waste heat to electricity conversion, and recovery/conversion technologies suitable for these opportunities:

- Undertake detailed “paper study” of each opportunity
- Identify technical and non-technical issues and barriers
- Costs/benefits/project economics
- Business case for utility and/or host site customer
- Potential for reproducibility
- Strategies for further exploitation

DELIVERABLES

The successful proponent is expected to prepare a ready-to-publish report on the results of the investigation and present the results to funding consortium members. The completed report must be submitted for CEATI approval in editable, electronic format (Microsoft Word). In addition, the platform and version should be specified for any software or programs to be developed. An interim report will also be required upon completion of Tasks 1 and 2.

The successful proponent is also expected to provide the following:

- A ten to fifteen (10-15) slide Power Point Presentation. This should be composed of three main sections:
 1. The factors motivating the initiation of the work;
 2. A description of the main findings;
 3. Summary of the conclusions and recommendations for future research.
- Contents for the Project’s Technical Brief. This is a summary of the report (between 1,000 and 1,500 words), which is published separately by CEATI. Proponents are not responsible for the preparation of a ready-to-print Technical Brief, but solely to provide the contents for the following 4 sections: Background, Summary, Conclusions and Recommendations.
 1. The Report Background section should be short (approximately 200 words) and should detail the reasons the work was conducted.
 2. The Summary section should be approximately 700 words. It must provide a general description of the work program.
 3. The Conclusions section should be about 150 words and should provide a general outline of the key results (do not include specifics).
 4. The Recommendations section should be about 200 words and should include a description of the potential applications of the results.

Please note that all reporting must be submitted in English. If written English is not the author’s strong suit, it is recommended that a technical writer be hired to review the document prior to submission.

BUDGET AND SCHEDULE

The proposal must contain a schedule and a quote of required remuneration for the work in US or Canadian dollars. All prices shall be presumed to be in Canadian dollars (CAD) unless explicitly specified otherwise in the proposal. Proponents' responses to this section must include a full breakdown of the budget and schedule, including an indication of rates and hours and the task allocation for the key personnel by task and must correspond to any phases or milestones outlined above. (Please refer to the Proposal Template for more information).

It is expected that this project can be completed (draft final report submitted for review and approval) within four (4) months of initiation.

The proposal must include the names and qualifications of the key individuals who will be involved, as well as the name of the accountable manager.

CEATI is not bound to accept any proposal but any selection will take into account technical merit, qualifications, price and schedule. A proposal may be accepted in whole or in part. A commitment to proceed with the first phase of a multi-phase project does not automatically imply that the work of the subsequent phases will be undertaken.

ALTERNATIVE WORKS

Proponents shall generally follow the above description of work, but are encouraged to offer alternative works if these alternatives will meet the objectives and provide a better end product to the utilities sponsoring this work. Alternatives shall be fully described including logistics explaining why the alternate works are being offered and the benefits to be realized by the funding utilities. Where alternatives are proposed, separate budgets shall be calculated for each alternative.

SUBMISSION OF PROPOSALS

The consideration of proposals received will be limited to those who indicate their intent to employ a suitable experienced project team and who possess proper facilities to perform the work. Receipt of this "IFP" does not necessarily constitute a prior determination by CEATI that your organization has the requisite experience and facilities.

The proposal must be properly completed and executed in accordance with the CEATI guidelines available at <http://www.ceati.com/guidelines.php>, and shall be submitted to CEATI as an attachment in Microsoft Word at the following website: www.ceati.com/private/submissions. Be sure to indicate project number "SOIG-10-01" on the submission form. For assistance, please contact us at 514-866-5377 x 236.

CLOSING DATE FOR RECEIPT OF PROPOSALS

Thursday, April 8, 2010, 4:00 pm EDT