



## **Request for Preproposals in the Area of Carbon Mitigation through Carbon Capture and Separation, Systems Optimization and Alternative Processes**

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Preproposal Due: July 21, 2011

### **Introduction**

As part of its charter to support research to create options for energy transformations that have low greenhouse gas emissions, the Global Climate and Energy Project (GCEP) requests a preproposal in the area of carbon mitigation through carbon capture and separation, systems optimization or alternative processes. It is anticipated that three to five proposals may be funded with a cumulative total of approximately \$5,000,000.

The generation of carbon dioxide is a direct consequence of extracting energy from fossil fuels and biomass. Electricity generation alone accounts for approximately a third of the global CO<sub>2</sub> emissions. A sustainable energy future requires strategies to facilitate the use of fossil fuels with reduced emissions or concentrations of CO<sub>2</sub> in the atmosphere. One option for carbon mitigation is through carbon capture and storage (CCS). While there are many elements to the CCS chain, capture and separation technologies dominate upwards of 80% of the total CCS costs.

Carbon dioxide capture and separation is a costly and inefficient process using present day technology. At thermodynamic efficiencies of 15% - 25%, these unit operations can consume 10% - 30% of a power plant's output, and their use is predicted to raise electricity generation costs by over 30% and sometimes as much as 75-80%. There is significant opportunity to exploit fundamental advances in chemistry, materials science and engineering to drive down the penalties that CO<sub>2</sub> capture and separation technologies imposes on power production. There are also opportunities that reduce the CO<sub>2</sub> generated or emitted through overall system optimization and process alternatives. These ideas can involve biological concepts, increased system efficiency and avoided costs or emissions.

**GCEP is seeking preproposals from academic institutions for research on carbon management via carbon capture and separation technologies, alternative processes and system optimization. To be successful, a preproposal must summarize a research concept that has ALL the following attributes:**

- 1. an excellent scientific basis rooted in the fundamentals;**
- 2. addresses novel technology options, systems or processes that enables a step-out or game-changing improvement in the context of ongoing research;**

3. **involves an approach that may have significant risk but could result in a large global impact in a 10 to 50 year timeframe; and**
4. **the capture and separation technology, system or process enabled by the research is on a pathway to meet or exceed all the performance criteria described within this request.**

This request for preproposals outlines the procedures to be followed for submission of a three-page preproposal whitepaper and summarizes the subsequent process of proposal invitation, submission and review.

### **Criteria for a Successful Preproposal**

A successful preproposal will outline a program of research that, if successful, could enable reduced CO<sub>2</sub> emissions or concentrations in the atmosphere through carbon capture and separation technologies, systems optimization and alternative processes. This request is an opportunity to explore creative but credible ideas that could be applied to electricity generation, transportation, or industrial processes. GCEP welcomes research agendas that contain a high element of risk such that funding through other sources is difficult to obtain. Since GCEP funds research that may have a significant impact on greenhouse gas emissions in the 10 to 50 year timeframe, fundamental research that is more long term than is often undertaken in this field is encouraged. While the level of technology readiness should be at the basic research level, proposal authors should demonstrate that the proposed concepts lie on a pathway to commercialization. The proposed research should investigate carbon mitigation through capture and separation technologies, systems or processes that significantly improve upon the performance of comparable technologies or systems and that have the potential to lead to commercial systems at scale that meet the following criteria:

- Can capture and separate 90% or more of the CO<sub>2</sub> emissions from the energy generation system;
- The energy penalty associated with the entire capture and separation lifecycle should be no greater than 10% of the total energy output of the overall system;
- The incremental cost for the carbon management process leading to captured CO<sub>2</sub> in a form ready for storage should be no greater than 15% of the cost of the overall system;
- Has a reliability comparable to that for other components of the energy generation system;
- Has a lifetime equal to the lifetime of the associated energy generation system;
- Has minimal lifecycle environmental impacts and water demand;
- Uses only earth abundant and non-toxic constituents; and
- Has the potential for a pathway to low-cost integration and to deployment at large scale.

Successful preproposals must outline research that could enable carbon mitigation strategies **on a clear pathway** to improving all of the above criteria. In addition, the research outlined must be scientifically excellent, highly distinct from other research in the field, and sufficiently fundamental that the research is unlikely to be performed by private industry. GCEP encourages research programs aimed at the fundamental understanding or development of material systems, chemistries or novel device concepts through a combination of theoretical analysis and experimental work constrained by engineering aspects relevant to the potential development of a working device. **Preproposals outlining research that could be considered incremental with**

**respect to the previous work of the proposer or other research groups will not be successful.** Joint research among multiple academic institutions and research disciplines is encouraged but not mandatory.

This request is intended only for academic institutions whose primary role is educating students and granting advanced academic degrees. Preproposals received from commercial organizations will not be considered.

### **Preproposal Format, Review, and Proposal Invitation**

GCEP is requesting a three-page pre-proposal whitepaper summarizing a research concept in the area of carbon mitigation through carbon capture and separation, system optimization or alternative processes. The white papers will be internally evaluated, and the most promising pre-proposals will be selected for submission as full length proposals.

#### *Format*

The submitted white paper should be a maximum of three (3) pages. Given such limited space, it is expected that the bulk of the preproposal will focus on the core science and technology ideas. However, each of the following sections is required:

- Description of the proposed research;
- Fundamental science that will be advanced as part of the proposed research program;
- How the proposed work is “step-out” and game-changing in the context of current scientific and technological state-of-the-art;
- Potential for application at a significant scale; and
- Pathway towards substantially reducing global greenhouse gas emissions over the long-term if the research is successful.

In addition to the three-page preproposal, a short (no longer than one page) summary of the relevant expertise and/or facilities of the research team is optional.

#### *Review*

The review of three-page white papers will be performed internally by GCEP staff according to the criteria outlined above. All reviewers will be asked to treat proposal information and materials as confidential. If unusual issues of confidentiality, sensitivity, or intellectual property exist surrounding a proposal, the faculty submitting the proposal is asked to bring these to the attention of GCEP staff before proposal submission.

#### *Proposal Invitation*

If the preproposal appears to include concepts that fulfill the attributes required for GCEP funding, we will invite the proposal teams to submit a 15-page full-length proposal. Invitations for full-length proposals will be made on or around August 1, 2011 with a submission deadline on or before September 10, 2011. Full details about the criteria for a successful full-length proposal and proposal format, review, and project awards will be given with the invitations. However, a brief summary of this process is provided below. Award decisions will be announced around December, 2011.

### **Summary of Invited Proposal Format, Review, and Project Awards**

Invited, full-length proposals will be up to 15 pages in length. Budgets will be constructed for projects extending for not more than 36 months. Budget requests will be expected to reflect the level of effort proposed. Subcontracts from Stanford to other institutions for any intellectually significant portion of your proposed project are permitted under the GCEP agreement. Normal contracts for standard research services which are not intellectually significant are also allowable. The submitted proposals will go through a three-tier review process including 1) independent experts in the project area; 2) independent and Sponsor experts who have a broad knowledge of the greenhouse gas impact of energy technologies; and 3) GCEP staff who will evaluate the reports provided in the previous stages of review to develop a set of funding recommendations. The final funding recommendations require approval by the GCEP Sponsor Management Committee. We plan to announce award decisions in December, 2011 and have research begin on or after March 1, 2012.

### **Terms and Intellectual Property Provision Highlights**

The Office of Sponsored Programs at academic institutions other than Stanford University should review the GCEP subcontract template, available on the GCEP web site at [http://gcep.stanford.edu/pdfs/subcontract\\_agreement.pdf](http://gcep.stanford.edu/pdfs/subcontract_agreement.pdf). This document is the basis for the terms of subcontract agreements with institutions external to Stanford University. Noteworthy intellectual property terms include: (1) Subcontractor institutions will hold formal title to all technology developed on their campus solely by their employees or students, (2) Stanford, Subcontractor and each Sponsor will have a perpetual, nonexclusive, worldwide, irrevocable, royalty-free license to technology developed under the award. The GCEP agreement, which contains the general terms of the Project as well as intellectual property provisions specific to research performed by Stanford University faculty, is available on the GCEP web site at [http://gcep.stanford.edu/pdfs/GCEPAgreement\\_9-1-08.pdf](http://gcep.stanford.edu/pdfs/GCEPAgreement_9-1-08.pdf).

### **Preproposal Submission Procedure and Deadline**

GCEP is accepting only three-page preproposals summarizing a research concept at this time. Please submit an electronic copy of the three-page preproposal along with an optional one page institution description as a single document in PDF format by the submission deadline to Teresa Tang [tmtang@stanford.edu]. Alternatively preproposals may be uploaded onto the GCEP website at <http://gcep.stanford.edu/research/preproposal.html>. Preproposals are due by July 21, 2011.

In your submission cover letter, please include a list of five (5) possible reviewers, independent of Stanford University, your institution, or the GCEP Sponsors, including names, institution affiliations, email addresses, and telephone numbers. Your preproposal will not be reviewed externally. However, GCEP would like these names at this early stage so that qualified reviewers may be invited as early as possible in the case that you are invited to submit a full proposal.

### **Contacts**

Questions about any aspect of this RFPP are welcome. For technical or programmatic issues, please contact:

Prof. Sally Benson, Director: [smbenson@stanford.edu](mailto:smbenson@stanford.edu)  
Dr. Richard Sassoon, Managing Director: [rsassoon@stanford.edu](mailto:rsassoon@stanford.edu)  
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For all other issues associated with the submission procedure, budgets, and collaborations with external institutions, please contact:

Ms. Teresa Tang, Administrative Manager: [tmtang@stanford.edu](mailto:tmtang@stanford.edu)