

# Proposal for UCSB Bren School Group Project

## ***Development of CO<sub>2</sub> Sequestration Methods***

**1. Bren Sponsors:** Faculty sponsor: Trish Holden ; Student sponsor: Kapil Kulkarni

**2. Client:** ENTRIX, Inc. (contact: Thomas A. Umenhofer, [tumenhofer@entrix.com](mailto:tumenhofer@entrix.com))

**3.A. Problem Statement:** Pursuant to Section 1605(b) of the Energy Policy Act of 1992, the U.S. Department of Energy (DOE) promulgated a program for voluntary reporting of Greenhouse Gases (GHG). In December 2003, DOE proposed new rules as General Guidelines that provide for flexibility in reporting GHG sources and sinks. These DOE programs focus on the mechanics of reporting and traditional emission sources and sinks (i.e., facility emission control technology or facility decommissioning). Many electric utilities may have little opportunity to employ CO<sub>2</sub> reduction. In addition, little is generally known regarding alternative CO<sub>2</sub> reduction approaches available outside of traditional emission source control (which historically has not been “GHG specific”). Therefore, the voluntary GHG reduction/sequestering programs may well be limited in their effectiveness due to the lack of traditional emission reduction opportunities and the lack of development of alternative CO<sub>2</sub> reduction/sequestration methods. Utilities lack and need economically-practical and technically-feasible recommendations for following the current guidelines, particularly when it comes to making sound decisions in sequestration.

**3.B. Objective:** The overall objective of this project is to develop CO<sub>2</sub> reduction/sequestration methods that yield quantifiable, verifiable, and sustainable benefits. These methods will be non-traditional (i.e., not associated with facility emission control technology or facility decommissioning). Rather, atmospheric CO<sub>2</sub> sequestering through anthropogenic (i.e., CO<sub>2</sub> removal and storage) or natural (agricultural) methods will be investigated. Furthermore, quantification methods will be developed and verified for use in GHG reporting programs. These methods will incorporate the DOE initiative of defining emissions by “intensity” (i.e., relative to baseline) as opposed to absolute emission reductions.

**3.C. Project Significance:** Currently, utilities are expected to reduce or offset their emissions of GHGs but specific guidance for making prudent, scientifically-sound choices is lacking. The scientific literature contains results of research in GHG sequestration but the translation of this literature into actionable decisions by utilities has not been performed. Further, quantifying and analyzing the real benefits of specific GHG sequestration options is not within the normal purview of public utilities. The Bren School is perfectly poised to take on a project of this nature: it is academic yet the outcome of the academic work is badly needed by utilities for their sequestration planning and alternative selection efforts. The significance of this project is that it would delineate choices to utilities that are not in the business of research or synthesizing others’ research results. More importantly, it would also provide a quantitative framework for accounting that would be broadly transferable to all utilities.

**3.D Background:** The DOE Voluntary Greenhouse Gas Emissions Reporting Program is the first step in what ultimately will likely become U.S. policy for required GHG (and specifically CO<sub>2</sub> emission) reductions. Private and public entities including electric utilities are currently reviewing the implication of the proposed rules regarding reporting. In anticipation of future GHG emission reduction requirements, certain entities including municipal utilities are investigating alternative strategies to CO<sub>2</sub> emission reductions. However, little is known on the viability of alternatives to the traditional “command and control” approach. A major issue is the connectivity between a sequestering activity and true air quality benefit. Method definition and reliable emission or emission intensity estimating techniques are either unavailable or not widely understood. Given the regulatory nature of the GHG reporting programs, this issue appears to be a significant barrier to the use of alternative GHG approaches.

**3.E. Study Location:** The particular context for this study is Burbank Water & Power. However, the results and approaches will be made to be transferable beyond this case.

**3.F. Stakeholders:** Specifically, Burbank Water & Power will benefit from this project and are enthusiastic about being the target for this study. The proposer of this project, Tom Umenhofer, has initiated contact with Burbank Water & Power and has confirmed that they are on board. More broadly, stakeholders include electric utilities (including municipal utilities in California), the U.S. Department of Energy (DOE), and the U.S. Environmental Protection Agency (EPA).

**3.G. Possible Approach and Available Data:** The methodologies for offsetting GHG emissions would include land-based sequestration (forestation and agriculture) and ocean-based sequestration. Agricultural capture processes would depend on soil type and management process. Land management could include changes regarding crop rotation and conservation tillage. There are also nascent methods to sequester CO<sub>2</sub> from transportation and other smaller sources that make up a large part of emissions. The quantification methodology developed for this project would generally be to apply deterministic models to existing land and management data. To date, DOE has published a proposed rule that establishes General Guidelines for voluntary reporting of greenhouse gas emissions and sequestration (December 2003). The agency is also in the process of developing a series of Technical Guidelines. The Center for Energy and Environmental Policy of the University of Delaware, with the guidance of the Delaware Climate Change Consortium (DCCC), researched and wrote The Delaware Climate Change Action Plan (DCCAP) in January 2000. The report includes data on CO<sub>2</sub> sequestration possibilities. Iowa State University produced a Carbon Sequestration Budget for a farm in Iowa using agricultural capture processes.

The project will draw heavily on the scientific literature and on the studies cited above. The project will also use DOE reports on emissions and sequestration, as well as specific data from participating utilities. The potential for carbon sequestration in agricultural lands is large, but the options for realizing that potential are unknown. In this project, students would delineate all carbon sequestration methods currently reported and discussed in the literature, and quantify estimates of carbon sequestration potential for these various methods. Using data from the literature, and mass and energy balance-based models developed by the students, students would develop

protocols for implementing sequestration methods, identify bottlenecks in implementation, and quantify the comparative benefits of sequestration versus other options for emissions reduction that do not involve sequestration. For example, public utilities may invest in foreign forests as a means of offsetting their own carbon dioxide emissions, but what is the real benefit of the decision to GHG emission management? Further, could the same benefit be realized at the local level through alternative means such as the utility investing in local transportation infrastructure in ways that reduce GHG emissions? These are real decisions that currently need to be made by utilities but for which no decision making framework is available.

**3.H. Deliverables:** The project will create estimates regarding process alternative costs, emissions output and sequestering activity, and air quality benefits. The project will result in the production of a final presentation and report. The report will contain an analytical and decisionmaking framework that is transferable to other utilities but specifically tested for Burbank Water & Power. The report will also include recommendations for how to use the framework and specific recommendations for the immediate target (Burbank Water & Power) in their GHG management activities.

**4. Support:** ENTRIX will provide significant interaction with the group (including independent review) as well as technical information regarding public utility GHG inventories. ENTRIX will also continue in 2004 to be a Bren School Corporate Partner. ENTRIX is in the process of approaching Burbank Water & Power with regards to providing project funding for internships and supplies. Burbank Water & Power has expressed great interest in this project and we fully expect that they will financially support this work.