PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 10-4

February 25, 2010

Agenda Item No.: 10-2-1

WHEREAS, the Air Resources Board (ARB or Board) has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2695-266, entitled "Inverse Modeling to Verify California's Greenhouse Gas Emissions Inventory" has been submitted by California State University, Hayward;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee (RSC) has reviewed and recommends for funding:

> Proposal Number 2695-266 entitled "Inverse Modeling to Verify California's Greenhouse Gas Emissions Inventory" submitted by California State University, Hayward, for a total amount not to exceed $150,000.

NOW, THEREFORE, BE IT RESOLVED that ARB, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of RSC and approves the following:

> Proposal Number 2695-266 entitled "Inverse Modeling to Verify California's Greenhouse Gas Emissions Inventory" submitted by California State University, Hayward, for a total amount not to exceed $150,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $150,000.

ATTACHMENT A

Inverse Modeling to Verify California's Greenhouse Gas Emissions Inventory

Background

In California, methane (CH_4) emissions in 2006 were estimated to be approximately 27 million metric tons of carbon dioxide equivalents ($MMTCO_2$), accounting for approximately 5 percent of total greenhouse gas (GHG) emissions in California. Assembly Bill 32 (AB 32) requires that GHG emissions in California be reduced to 1990 levels by 2020. Careful accounting of current CH_4 emissions and future reductions is therefore essential. Air Resources Board's (ARB) CH_4 emission inventory was developed using the Intergovernmental Panel on Climate Change recommended methodologies involving a "bottom-up" approach that calculates emissions based on emission factors multiplied by activity data.

Atmospheric inverse modeling can provide an alternative approach to assess California's CH_4 emissions estimated from the "bottom-up" approach. ARB intends to operate six high-precision carbon monoxide (CO)/CO_2/CH_4 monitors in the Central Valley of California in 2010. During the CalNex field study scheduled in May-June 2010, ARB will further deploy two mobile platforms to measure CH_4 levels in California. In addition, Lawrence Berkeley National Laboratory (LBNL) and University of California, San Diego (UCSD) each have been operating two monitoring stations measuring CH_4 in California. The combined use of these measurements will provide an unparalleled dataset for performing inverse modeling to assess California's "bottom-up" CH_4 emissions inventory.

Objective

The objectives of this project are: 1) to use an inverse modeling tool to quantify CH_4 emissions in California for four months of 2010 using data to be collected at CH_4 monitoring stations operated by ARB, LBNL, and UCSD; 2) to transfer the codes of the inverse modeling tool to ARB and train ARB staff to use this tool for continued inverse modeling analysis.

Methods

To assess the "bottom-up" emission inventory of CH_4/CO in California, this project will apply the Weather Research & Forecasting – Stochastic Time-Inverted Lagrangian Transport (WRF-STILT) model with a Bayesian estimation tool to CH_4/CO measurements collected in 2010 from up to 12 stations in California. The principal investigator will compile quality-controlled CH_4/CO measurement data collected at the Sacramento River's Delta's Walnut Grove tower and the San Francisco's Sutro Tower for the study period. ARB staff will supply quality-controlled CH_4/CO measurement data at all other sites including the UCSD stations for the same period. The *a priori* "bottom-up" CH_4 emission inventory will be provided by ARB. The *posterior* emission estimate for CH_4 from the WRF-STILT/Bayesian estimation tool will be used to evaluate the

"bottom-up" CH_4 emission inventory for different sectors such as livestock and landfills in California.

Expected Results
This project is expected to provide an independent test of the current CH_4 emission estimate in California as well as useful insight for improving CH_4 emission inventory in California. A final report and a journal paper summarizing the proposed work will be prepared. The inverse modeling package including the WRF-STILT and Bayesian estimation codes will be transferred to ARB. In addition, a one-week training tutorial will be conducted for ARB staff to use the inverse modeling tool for future applications.

Significance to the Board
Accurate GHG emission inventory is crucial to the design and implementation of mitigation measures to fulfill the goal of AB 32. This project will help ARB evaluate and improve the "bottom-up" CH_4 emission inventory in California, which is the basis for developing effective CH_4 emission mitigation plans.

Contractor:
California State University, Hayward

Contract Period:
18 months

Principal Investigator (PI):
Dr. Marc L. Fischer

Contract Amount:
$150,000

Basis for Indirect Cost Rate:
The State and the California State University System have agreed to a 25% indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Marc Fischer has been actively involved in the measurement and modeling of GHG emissions in California through funding from the Department of Energy and the California Energy Commission.

Prior Research Division Funding to California State University, Hayward:

Year	2008	2007	2006
Funding	$0	$0	$0

B U D G E T S U M M A R Y

Contractor: California State University, Hayward

Inverse Modeling to Verify California's Greenhouse Gas Emissions Inventory

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	25,084	
2.	Subcontractors	$	110,000[1]	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	0	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	1,916	
7.	Mail and Phone	$	0	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
	Total Direct Costs			$137,000
INDIRECT COSTS				
1.	Overhead	$	13,000	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$13,000
TOTAL PROJECT COSTS				**$150,000**

[1] The subcontract is necessary to support a research associate at LBNL, who is very experienced in atmospheric inverse modeling, to perform a substantial amount of work included in this project. In addition, the subcontract with LBNL can take advantage of excellent computational facilities at LBNL.

S U B C O N T R A C T O R S' B U D G E T S U M M A R Y

Subcontractor: Lawrence Berkeley National Laboratory

Description of subcontractor's responsibility: The subcontractor at LBNL will carry out the WRF-STILT and inverse model calculations and participate in preparing the final report and training ARB staff.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	55,108	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	0	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
	Total Direct Costs			$55,108
INDIRECT COSTS				
1.	Overhead	$	39,851	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	15,041	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$54,892
TOTAL PROJECT COSTS				**$110,000**