

State of California  
AIR RESOURCES BOARD

**Monitoring Carbon Dioxide and Methane in Los Angeles, California through  
Source Attribution and Long-term Trend Analysis**

RESEARCH PROPOSAL

Resolution 16-18

**October 20, 2016**

Agenda Item No.: 16-9-1

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 2802-285, titled, "Monitoring Carbon Dioxide and Methane in Los Angeles, California through Source Attribution and Long-term Trend Analysis" has been submitted by the California Institute of Technology for a total amount not to exceed \$250,000;

WHEREAS, the Research Division staff has reviewed Proposal Number 2802-285 and finds that in accordance with Health and Safety Code section 39701, the results of this study will independently evaluate ARB's greenhouse gas (GHG) emission inventory, provide GHG measurement data which will aid other ARB-supported research efforts, and will help track the effectiveness of GHG emission reduction efforts made under Assembly Bill 32 (AB 32) programs while providing information for future GHG programs; and

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends funding the Research Proposal.

NOW, THEREFORE BE IT RESOLVED, that ARB, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and staff and approves the Research Proposal.

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 Proposal as further described in Attachment A, in an amount not to exceed \$250,000.

I hereby certify that the above is a true and correct copy of Resolution 16-16 as adopted by the Air Resources Board.

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Janice Harlan, Clerk of the Board

## **Resolution 16-18**

October 20, 2016

### **Identification of Attachments to Board Resolution 16-18**

**Attachment A:** "Monitoring Carbon Dioxide and Methane in Los Angeles, California through Source Attribution and Long-term Trend Analysis" Summary and Budget Summary

## ATTACHMENT A

### “Monitoring Carbon Dioxide and Methane in Los Angeles, California through Source Attribution and Long-term Trend Analysis”

#### Background

ARB is mandated by Assembly Bill (AB) 32 to implement policies to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020 and beyond. Carbon dioxide (CO<sub>2</sub>) and methane are important pollutants that contribute 84 percent and 9 percent, respectively, of the total GHG emissions in California. Current efforts, such as the Cap-and-Trade Program and the Low Carbon Fuel Standard, have improved air quality and reduced GHG emissions; however, additional reduction efforts are required to meet the 2020 goals under AB 32. Furthermore, in order to evaluate the effectiveness of the program, ARB also requires independent datasets and research analyses to track program effectiveness and inform the programs. ARB has utilized a Statewide GHG Monitoring Network, in combination with advanced scientific modeling capabilities, to evaluate regional emissions and their trends. Additional monitoring data, along with detailed information regarding their chemical and isotopic signatures, is needed to effectively evaluate source contributions and their changing trends during the AB 32 program implementation period.

#### Objective

The objective of the proposed project is to conduct continuous monitoring of ambient concentrations of important GHGs including methane and CO<sub>2</sub>, and collect and analyze flask samples of ambient air at two sampling sites in the Los Angeles air basin to study CO<sub>2</sub> emissions from human activities and natural sources using the isotopic carbon signatures of ambient carbon measurements. This research will help track GHG emission reduction efforts, and will provide an independent dataset to evaluate the effectiveness of AB 32 programs in a representative region of the State (Los Angeles), help evaluate ARB's emissions inventory, and inform future GHG programs.

#### Methods

The first task of this research involves continued operation of two ground sites in the Los Angeles air basin through 2020, conducting continuous monitoring of ambient concentrations of methane and CO<sub>2</sub>, collecting flask samples on alternate days in Pasadena (source-oriented site) and once a week in Palos Verdes (background site). Each of the flask samples collected through 2020 will be analyzed in a well-equipped laboratory for CO<sub>2</sub> mixing ratios, radiocarbon ( $\Delta^{14}\text{C}$ ), and isotopic carbon compositions ( $\delta^{13}\text{C}$ ). The collected data will be used to develop a long-term comprehensive understanding of carbon emissions and source contributions (human activities and natural sources) in the Los Angeles air basin through time series analysis and source attribution techniques. The data will be compiled to track the progress made under AB 32 programs in reducing GHG emissions, and help provide an independent evaluation of ARB's CO<sub>2</sub> and methane inventories.

**Expected Results**

The proposed project, in collaboration with ARB staff and the federally funded Megacities Carbon Project in Los Angeles, will complement ARB's bottom-up GHG inventory with atmospheric measurements of CO<sub>2</sub>, CO<sub>2</sub> isotopes, and methane. This effort will track the progress toward meeting the 2020 goals of GHG emission reduction under AB 32 using a representative dataset in Los Angeles. This study will provide an independent determination of the trend of CO<sub>2</sub> emissions from fossil fuel combustion in the Los Angeles region for the period between 2006 and 2020, and will aid in the evaluation of AB 32 programs.

**Significance to the Board**

This study will be useful to evaluate the effectiveness of GHG emission reduction efforts made under AB 32 by independently evaluating ARB's inventory and programs using ambient air measurements of CO<sub>2</sub> in Los Angeles, which is a representative sub-area of the State with roughly 40% of the population and emission sources in the State. This project will build on previously collected data in the Los Angeles Air Basin, and allow for a long-term analysis of the effect of AB 32 programs in the region between the program initiation in 2006 through the program target date of 2020. The results from this project will also provide important information for the Megacities Carbon Project, which aims to provide scientifically robust capabilities to measure multi-year emission trends of carbon-based gaseous emissions attributed to individual megacities and selected major sectors. This project will provide an additional monitoring station for CO<sub>2</sub> and methane in southern California, which will expand the spatial coverage of ARB's Statewide GHG Monitoring Network in the region, providing useful data to support other ARB-supported research efforts, including a GHG inverse modeling analysis to evaluate statewide emissions and trends for CO<sub>2</sub>, methane, and other GHGs.

**Contractor:**

California Institute of Technology (Caltech)

**Contract Period:**

60 months

**Principal Investigator (PI):**

Dr. Yuk L. Yung

**Contract Amount:**

\$250,000

**Basis for Indirect Cost Rate:**

The State and Caltech have agreed to a fifteen percent indirect cost rate.

**Past Experience with this Principal Investigator:**

Dr. Yuk L. Yung is an expert in atmospheric chemistry and physics with particular expertise in radiative transfer. Dr. Yuk L. Yung will supervise and provide logistical support to Dr. Sally Newman who has been collecting CO<sub>2</sub> data in Pasadena since

1998, using manometry, mass spectrometry, infrared spectroscopy, and cavity ring-down spectroscopy. Dr. Newman has been involved in the CalNex study and played a critical role in the processing and analysis of flask samples from the 2013-2014 campaign at ARB's San Bernardino tower. Through interdisciplinary collaboration, Dr. Yung and Dr. Newman have been able to apply techniques normally used in remote sensing applications to in-situ monitoring.

**Prior Research Division Funding to Caltech:**

Year	2015	2014	2013
Funding	\$ 0	\$ 0	\$ 0

## B U D G E T   S U M M A R Y

Contractor: California Institute of Technology

Monitoring Carbon Dioxide and Methane in Los Angeles, California through Source  
Attribution and Long-term Trend Analysis

### **DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	165,895
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	\$	51,496 <sup>1</sup>
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>0</u>
Total Direct Costs		\$	217,391

### **INDIRECT COSTS**

1.	Overhead	\$	32,609
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>
Total Indirect Costs		\$	<u>32,609</u>

**TOTAL PROJECT COSTS** **\$ 250,000**

NOTE:

<sup>1</sup>The contractor requires procurement of high-precision calibration gases and other essential supplies for the mass spectrometers and other instruments throughout the contracted period (\$13,600 for vacuum line supplies and maintenance, \$11,896 for calibration gases, \$9,000 for instrument supplies, \$5,500 for mass spectrometer supplies, and \$10,000 for accelerator mass spectrometer supplies).