State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 07-1

January 25, 2007

Agenda Item No. 07-1-4

WHEREAS, the Air Resources 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; and

WHEREAS, a research proposal, number 2622-254 entitled "Inventory of Direct and Indirect Greenhouse Gas Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning," has been submitted by Ecole des Mines de Paris, ARMINES;

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

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

> Proposal Number 2622-254 entitled "Inventory of Direct and Indirect Greenhouse Gas Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning," submitted by Ecole des Mines de Paris, ARMINES, for a total amount not to exceed $225,060.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2622-254 entitled "Inventory of Direct and Indirect Greenhouse Gas Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning," submitted by Ecole des Mines de Paris, ARMINES, for a total amount not to exceed $225,060.

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 $225,060.

I hereby certify that the above is a true and correct copy of Resolution 07-1, as adopted by the Air Resources Board.

Lori Andreoni

Lori Andreoni, Clerk of the Board

ATTACHMENT A

"Inventory of Direct and Indirect Greenhouse Gas Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning"

Background

Millions of stationary refrigeration and air conditioning (RAC) systems exist in California, ranging from small, hermetically sealed residential refrigerators to large, supermarket direct expansion (DX) refrigeration systems containing thousands of pounds of refrigerant. Emissions from RAC systems are categorized as direct refrigerant emissions (typically high global warming potential [GWP] ozone depleting substances [ODS] or hydrofluorocarbons [HFCs]) and indirect emissions (CO_2 emissions resulting from equipment energy use).

High GWP greenhouse gas (GHG) emissions are expected to grow substantially over the next several decades, primarily from the use of ODS substitutes, such as HFCs. The introduction of ODS substitutes to the RAC sector is the major driver of this growth. Additionally, although they are being phased out, ODS (many of which have high GWPs) are currently employed in older RAC equipment, and recycled refrigerants may be used indefinitely in equipment purchased before either 2010 or 2020. ODS and HFC refrigerants are relatively inexpensive, often comparable in price, and readily available.

Although leak and venting rates of various refrigeration and A/C systems need to be defined for inventory purposes, U.S. EPA data indicate that ODS and HFC emissions from retail food systems are considerably higher than those of other stationary RAC systems; also, CEC data indicate that retail food stores are the most energy-intensive systems in the commercial sector. Therefore, special attention should be given to retail food systems in terms of examining leak reduction and venting from existing systems, advanced, low-charge or low-GWP designs for new systems, and energy efficiencies of both existing and new systems.

The U.S. EPA's Vintaging Model predicts that unitary A/C systems currently account for a significant percentage of ODS refrigerant emissions, and are expected to account for approximately 12% of US HFC emissions in 2010, as HCFC 22 use is phased out. Therefore, quantification of direct emissions from these systems should also be given particular consideration in the process of RAC inventory development.

Objective

The contractor will provide a bottom-up inventory of defined stationary RAC systems in California, which will include equipment populations, installed capacity and energy usage as well as refrigerant emissions rates and banks. Past, current, and projected future emissions and banks will be generated for retail food and unitary A/C systems using three scenarios: 1) business as usual (BAU), 2) "progressive changes," or reduction strategies based on demonstrated technologies, and 3) "radical changes and innovation," resulting from major technological advances. Energy usage will be calculated and energy savings strategies recommended for retail food systems. Additionally, recommendations for retail food system leak reduction, energy saving devices, and advanced refrigeration designs will be given.

Methods
The contractor, Professor Denis Clodic at Ecole des Mines de Paris, and members of his research laboratory at ARMINES (a contract research association partner of Ecole des Mines) are world-experts in refrigerant and foam inventories. Professor Clodic has utilized his equipment and bank databases to develop country-specific and global RAC emissions inventories. These inventories have been used by the U.S. EPA and the IPCC to generate reports examining the relative contributions of high GWP gases from various sources to stratospheric ozone depletion and climate change.

Professor Clodic will rely on his previously developed and continuously updated, global and US RAC databases, in addition to gathering data and conducting surveys to generate California-specific inventory data.

Staff proposes to address the RSC's suggestion for QA/QC oversight by a California or US expert (familiar with the California RAC market), by forming a Technical Advisory Committee (TAC) composed of Dave Godwin from U.S. EPA, a representative from Alliance for Responsible Atmospheric Policy (ARAP), and a representative from CEC. This TAC will comment on the quarterly progress reports and the final report, and will also provide general advice and suggestions for improvements where necessary.

Expected Results
The results expected from the proposed research include a detailed, bottom-up, California-specific equipment and refrigerant inventory with corresponding energy use data, and estimations of the following: 1) past, present, and future direct GHG emissions and banks from defined stationary RAC systems, 2) current indirect GHG emissions from retail food systems, and emissions reductions associated with energy saving strategies, and 3) future direct and indirect emissions, as well as lifecycle climate performance (LCCP), from advanced design retail food systems.

Significance to the Board
AB 32, the Global Warming Solutions Act of 2006, codifies in law targets set by the California Climate Action Team (CAT) to reduce CO_2-equivalent greenhouse gas emissions to 1990 levels by 2020. Controlling high global warming potential GHG emissions, such as refrigerants employed in RAC equipment, can lead to significant, cost-effective GHG reductions.

The Climate Change section within ARB's Research Division is charged with generating strategies that will lead to regulations or voluntary measures to reduce refrigerant emissions. The development of a refrigerant equipment and emission inventory is a critical part of creating strategies to reduce GHG emissions; regulations cannot be enacted to reduce refrigerant emissions in a cost-effective manner without a RAC inventory. The research proposed in this project will produce heretofore non-existent stationary RAC emission inventories in California, which will form the basis of ARB's future emissions reduction policies and allow California to make significant progress towards meeting its 2020 GHG emissions target.

Contractor:
ARMINES

Contract Period:
18 months

Principal Investigator (PI):
Denis Clodic

Contract Amount:
$225,060

Basis for Indirect Cost Rate:
The only indirect costs that will be incurred during the course of this project are personnel overhead and indirect travel costs. The personnel overhead rate of 37% includes operational expenses of the research laboratories. The overhead rate agreed upon in France by the administrative organizations with whom ARMINES contracts varies from 80 to 94% of the direct costs of salaries. Because ARB is not willing to accept such a rate, ARMINES agrees to apply an exceptional rate of 37%. The difference in cost will be made up by ARMINES' own funds.

ARMINES indirect travel costs were calculated to be 10% of the baseline travel costs.

Past Experience with this Principal Investigator:
The PI has not worked under contract for ARB in the past. However, ARB staff do have extensive experience and interaction with Dr. Clodic. His leading work on refrigerant emission measurements is internationally recognized and was fundamental in the development of the technical support document for AB 1493, the greenhouse gas emission regulation for motor vehicles, adopted by the Board in 2004. Based on this previous experience with the PI, ARB staff have great expectations for the work to be performed and the benefit for ARB's climate change protection efforts.

Prior Research Division Funding to ARMINES:

Year	2006	2005	2004
Funding	$0	$0	$0

BUDGET SUMMARY

ARMINES

Inventory of Direct and Indirect GHG Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 146,852	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 22,104[1]	
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		$168,956
INDIRECT COSTS			
1.	Overhead	$ 54,335	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 1,769	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$56,104
TOTAL PROJECT COSTS			**$225,060**

[1] Travel charges include airfare and per diem at the government rate for three people for 41 days to perform the necessary survey work in California.