State of California
AIR RESOURCES BOARD

The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute

RESEARCH PROPOSAL

Resolution 13-20

June 27, 2013

Agenda Item No.: 13-6-1

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 2760-276, entitled "The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute," has been submitted by the University of California, Davis; and

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

> Proposal Number 2760-276 entitled "The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute," submitted by the University of California, Davis, for a total amount not to exceed $330,934.

WHEREAS, the Research Division staff has reviewed Proposal Number 2760-276 and finds that in accordance with Health and Safety Code section 39701, this research project will provide essential information on the most cost effective and environmentally friendly pathways for commercially producing renewable natural gas in California.

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 recommendations of the Research Screening Committee and Research Division staff and approves the following:

> Proposal Number 2760-276 entitled "The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute," submitted by the University of California, Davis not to exceed $330,934.

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 $330,934.

I hereby certify that the above is a true and correct copy of Resolution 13-20, as adopted by the Air Resources Board.

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute"

Background

In order to achieve California's climate and air quality goals, emissions from transportation will need to decline significantly in the coming decades. ARB's Low Carbon Fuel Standard (LCFS) calls for a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. The LCFS incentivizes the production and sale of low carbon-intensity transportation fuels by establishing a set of performance standards in the form of declining carbon-intensity levels that fuel producers and importers must meet each year for their fuel pools beginning in 2011.

Certain industry studies have contended that the fuels necessary to comply with the LCFS standards in the 2015 timeframe will not be available when they are needed, but these studies are both pessimistic with respect to availability, and also focus on the assertion that the LCFS will have large cost impacts on consumers. There are already examples of low carbon intensity fuels coming into the market, for example, the landfill gas-to-liquefied natural gas (LNG) facility at the Altamont landfill produces enough LNG to power a portion of Waste Management's fleet. Maximizing the market penetration of renewable natural gas requires research to identify the technical, commercial, financial, marketplace, and regulatory barriers that are specific to renewable natural gas production.

Objective

This project will determine the technological and commercial feasibility of producing large quantities of renewable natural gas fuels for use in California.

Methods

The research team will complete a literature review of information related to renewable natural gas production and distribution for transportation fuel use in California and the United States. This literature review will cover the variety of technologies that are needed to convert the diverse biomass resource base into renewable natural gas. Particular attention will be paid to the United States Environmental Protection Agency's Waste to Energy program in order to evaluate potential sources from out of state. The team will also review existing and recent literature concerning leakage and greenhouse gas life-cycle emissions for the renewable natural gas pathways and its application to CA-GREET and the LCFS, and studies on feasibility and costs. The researchers will conduct a series of greenhouse gas emissions and criteria pollutants life-cycle analyses of some of the most relevant renewable natural gas pathways in California using the CA-GREET model. The researchers will then develop a geo-referenced dataset of current and potential sources for renewable natural gas production and facility locations in both California and the United States. This will be combined with techno-economic models of the conversion technologies in a profit maximizing optimization model. Cost evaluation will include, amongst others: a) the competition between biofuel and bio-power industries for

biomass feedstock, b) the cost of upgrading biogas/digester gas/landfill gas to pipeline quality gas, and, c) the cost of injecting upgraded biomass into the existing natural gas pipeline and truck network. The analysis will consider optimizing facility locations in order to maximize production of renewable natural gas while minimizing potential environmental impacts, and will provide a preliminary estimate of the life-cycle greenhouse gas emissions as well as localized emissions of criteria and toxic air pollutants, and other potential environmental and public health impacts that are of significant concern. Feedstock choices will include manure, food waste, landfill gas, wastewater treatment sludge, forest and agricultural residues, and organic municipal solid waste. Technologies under consideration will include anaerobic digestion and thermal conversion. Researchers will also compile and categorize barriers to the successful expansion of renewable natural gas production into thematic areas that will be useful for making recommendations to policymakers and industry decision-makers. The team will also conduct interviews with stakeholders that are currently engaged, or anticipate being engaged, in the production and distribution of renewable natural gas to better understand the obstacles to successful development. These interviews will allow for comparisons of different types of renewable natural gas resources, obstacles to development and distribution across California, and future research needs.

Expected Results
This research project will provide essential information on the most cost effective and environmentally friendly pathways for commercially producing renewable natural gas in California.

Significance to the Board
Results will provide essential data that will inform future refinements to the State's LCFS program and other climate change initiatives.

Contractor:
University of California, Davis

Contract Period:
24 months

Principal Investigator:
Amy Jaffe

Contract Amount:
$330,934

Basis for Indirect Cost Rate:
The State and the University of California, Davis have agreed to a 10 percent indirect cost rate.

Past Experience with the Principal Investigator:
ARB staff has worked with a number of staff at the University of California, Davis' Institute for Transportation Studies (ITS) in the past, but have no experience working

directly with the principle investigator, Amy Jaffe. However, Mrs. Jaffe is a widely published, leading expert on global energy policy and energy and sustainability. The ITS team also includes experts on life cycle analysis, carbon accounting, alternative fuel modeling and geospatial analysis. A portion of the work for this project will build on previous work that members of the ITS team have completed for the California Biomass Collaborative.

Prior Research Division Funding to the University of California, Davis

Year	2012	2011	2010
Funding	$4,949,363	$1,394,560	$508,267

BUDGET SUMMARY

University of California, Davis

"The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 275,428	
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	$ 27,834[1]	
	Total Direct Costs		$303,262
INDIRECT COSTS			
1.	Overhead	$ 27,672	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 27,672
TOTAL PROJECT COSTS			**$330,934**

[1] This cost includes general liability insurance for salaries and resident student fees for two graduate student researchers, which are required by university policies when hiring graduate student personnel.