

State of California
AIR RESOURCES BOARD

**Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction
and Production Activities in California**

RESEARCH PROPOSAL

Resolution 18-43

October 25, 2018

Agenda Item No.: 18-8-1

WHEREAS, the California Air Resources Board (CARB 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 2822-289, titled "Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California," has been submitted by University of California, Berkeley for a total amount not to exceed \$299,988;

WHEREAS, the Research Division staff has reviewed Proposal Number 2822-289 and finds that, in accordance with Health and Safety Code section 39701, the results of this study will seek to advance scientific understanding of the potential health implications of oil and gas development, especially for vulnerable and disadvantaged populations; 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 CARB, 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 \$299,988.

I hereby certify that the above is a true and correct copy of Resolution 18-43 as adopted by the Air Resources Board.

Cristina Granados, Clerk of the Board

Resolution 18-43

October 25, 2018

Identification of Attachments to Board Resolution 18-43

Attachment A: “Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California” Summary and Budget Summary

ATTACHMENT A

“Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California”

Background

CARB has a legislative mandate to set ambient air quality standards and perform research to guide regulations that protect the health of the public (Health and Safety Code §§ 39003, 39606). Even though California’s crude oil production has declined in the past 30 years, the state ranks among the top five producers of crude oil in the nation, accounting for about six percent of total United States (U.S.) production in 2016. Four of the ten largest conventional U.S. oil fields are in the State: Midway-Sunset, Kern River, and South Belridge in the San Joaquin Basin, and Wilmington-Belmont in the Los Angeles Basin. The proliferation of domestic oil and gas exploration activities, including unconventional extraction methods (such as hydraulic fracturing and horizontal drilling), have raised concerns about the potential health and equity impacts on local communities due to increases in air pollution and water contamination, among other effects. The process of producing natural gas can lead to significant methane (CH₄) emissions—the primary component of natural gas. Recent research has shown a skewed distribution in the volume of fugitive CH₄ emissions by site or facility, and CH₄ emissions could be an indicator of benzene and other toxic emissions. A small portion of the sites appear to account for a large portion of the emissions, and these sites are labeled as super-emitters. Super-emitters occur seemingly at random, often when a piece of equipment breaks down or cement casing fails on a well. This study will focus on analysis of oil and gas infrastructure, including refineries and oil and gas development (OGD) sites and super-emitters. Although there is emerging evidence of adverse birth outcomes associated with oil and gas development in other states, no studies exist regarding the relationship between OGD and birth outcomes in California.

Objective

The objective is to conduct an epidemiological study that will address a health gap in California on OGD activities. It will use a large, ethnically and economically diverse pregnancy cohort to evaluate the relationship between prenatal exposures to OGD and fetal growth outcomes. This study is significant because it will evaluate potential health hazards and risks from OGD including active, inactive, conventional, and unconventional wells. The results will be stratified by socioeconomic status (SES) within urban, rural, and suburban settings to understand how SES in combination with OGD affect birth outcomes. This study will also identify and characterize socioeconomic and demographic disparities associated with drinking water system susceptibility to potential OGD-related routes of water contamination in California focusing on the San Joaquin Valley. This study will assess potentially interactive effects by exploring whether observed effect estimates are stronger for births located in areas with potentially vulnerable drinking water systems compared to births that are not located in these areas. This study will also conduct a sub-analysis to assess the extent to which observed effect estimates are stronger among births located near wells and associated infrastructure that have been identified as methane super-emitters. A

cross-sectional analysis of environmental equity patterns as well as migraine prevalence and severity will be investigated with the super-emitter OGD activities data.

Methods

The investigators propose three analyses. Analysis 1 will be an epidemiological study of the relationship between OGD and production and adverse birth outcomes in California. The investigators will run models for key regions separately and also statewide. They will also examine separate models for urban versus rural areas to assess potential effect modification based on this indicator. The investigators will further assess potentially interactive effects by exploring whether observed effect estimates are stronger for births located in areas with potentially vulnerable drinking water systems compared to births that are not located in these areas from Analysis 2 (below). Finally, they will assess the extent to which observed effect estimates are stronger among births located near wells and associated infrastructure identified as methane super-emitters from Analysis 3 (below). Analysis 2 will be a spatial analysis to characterize drinking water vulnerability associated with OGD activities. The investigators will characterize socioeconomic and demographic disparities associated with drinking water system susceptibility to determine the connection to potential OGD-related routes of water contamination. Analysis 3 will be a preliminary assessment of the environmental justice and health implications associated with proximity to methane super-emitters. The investigators will leverage CARB's monitoring data on methane super-emitters to explore cross-sectional environmental equity patterns and health outcomes (migraine prevalence and severity).

Expected Results

The expected results from Analysis 1 include: an assessment of whether maternal exposure to OGD during pregnancy is associated with reduction in fetal growth, an assessment of whether prenatal OGD exposure is associated with increased risk of preterm birth, and an assessment of whether race/ethnicity and Index of Concentration at the Extremes influence OGD-related adverse birth outcomes. These results will be stratified by SES, exposure to vulnerable drinking water systems identified in Analysis 2, and methane super-emitters identified in Analysis 3 to understand how these factors in combination with OGD affect birth outcomes.

The expected results from Analysis 2 are a characterization of the spatial relationship between three potential OGD-related routes of drinking water contamination and the location of vulnerable drinking water systems. They will also include an assessment of the patterns of environmental inequalities in potential OGD-related threats to vulnerable drinking systems.

The expected results from Analysis 3 are an assessment of whether communities located within 3km of a super-emitter contain a higher proportion of residents of lower SES compared to communities located 5-10km away, as well as an assessment of the prevalence of migraine sufferers in communities located within 3km of a super-emitter compared to those located 5-10km away.

Significance to the Board

CARB is legislatively mandated to set ambient air quality standards and perform research to guide regulations that protect the health of the public (Health and Safety Code §§ 39003, 39606). The results of this study will seek to advance scientific understanding of the potential health implications of OGD. The demographic and socioeconomic diversity of this study population provides a unique advantage for enhancing the scientific understanding of the potential effects of OGD on fetal growth and development in vulnerable and disadvantaged populations. It will also assess the environmental equity implications of potential drinking water threats posed by OGD activities and the health and equity implications of methane super-emitters. Findings from this study could inform the potential adverse health consequences that OGD and production activities have in vulnerable and disadvantaged populations.

Contractor:

University of California, Berkeley

Contract Period: 24 months**Principal Investigators (PIs):**

Rachel Morello-Frosch, Ph.D., M.P.H. and Joan Casey, Ph.D.

Contract Amount:

\$299,988

Basis for Indirect Cost Rate:

The State and UC Berkeley have agreed to a twenty-five percent indirect cost rate.

Past Experience with the Principal Investigators:

The PI for this project is Professor Rachel Morello-Frosch from UC Berkeley, Department of Environmental Science Policy and Management & School of Public Health, and a member of the CARB's Scientific Research Screening Committee. Dr. Morello-Frosch has a Ph.D. of Environmental Health Science, from the School of Public Health, University of California, Berkeley, and an M.P.H. of Epidemiology & Biostatistics, University of California, Berkeley. Her research focuses on environmental health and environmental justice. She is particularly interested in addressing the double jeopardy faced by communities of color and the poor who experience high exposures to environmental hazards and who are more vulnerable to the toxic effects of pollution due to poverty, malnutrition, discrimination, and underlying health conditions. Dr. Morello-Frosch has successfully completed multiple CARB contracts, including development of the Environmental Justice Screening Method with co-PI's Manuel Pastor and James Sadd, and an analysis of the impact climate change and mitigations policies will have on poor and minority communities.

The Co-PI is Dr. Joan Casey, Ph.D., a postdoctoral associate with UC, Berkeley, School of Public Health. Dr. Casey has unique expertise in the analysis of and access to electronic health record data (through Sutter Health) and the use of this data in environmental health research. Dr. Casey’s recent work focused on the emergence of unconventional methods to extract natural gas from shale formations (i.e., “fracking”). In addition, she is experienced in using advanced spatial statistical techniques to predict radon levels statewide. She has also been a part of two projects using Geisinger Health System HER data to evaluate potential health effects of unconventional natural gas development.

Drs. Morello-Frosch and Casey have collaborated extensively on projects examining the joint effects of environmental and social exposures on perinatal health outcomes and are well published in the field. The investigators are well-recognized in the area of cumulative environmental and social impacts and environmental justice research, particularly in California, and have published numerous articles on these topics in leading journals.

Prior Research Division Funding to the University of California, Berkeley:

Year	2017	2016	2015
Funding	\$ 0	\$ 0	\$ 730,514

BUDGET SUMMARY

Contractor: University of California, Berkeley

“Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California”

DIRECT COSTS

1.	Personnel (Salary and Fringe Benefits)	\$	164,592
2.	Travel	\$	7,640
3.	Materials & Supplies	\$	1,500
4.	Equipment	\$	0
5.	Consultant(s)	\$	0
6.	Subrecipient(s)	\$	53,851
7.	Other Direct Costs	\$	<u>23,911</u>

Total Direct Costs \$ 251,494

INDIRECT COSTS

Indirect (F&A) Costs \$ 48,494

Total Indirect Costs \$ 48,494

TOTAL PROJECT COSTS \$ **299,988**

ATTACHMENT 1

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: Sutter Bay Hospital dba California Pacific Medical Center (RD&D)
Description of subcontractor's responsibility: Sutter Health will assist with the analysis of the EHR data on site and gain IRB approval for use of this data for this.

DIRECT COSTS

1.	Personnel (Salary and Fringe Benefits)	\$	43,081
2.	Travel	\$	0
3.	Materials & Supplies	\$	0
4.	Equipment	\$	0
5.	Consultant(s)	\$	0
6.	Subreceptient(s)	\$	0
7.	Other Direct Costs	\$	<u>0</u>

Total Direct Costs \$ 43,081

INDIRECT COSTS

Indirect (F&A) Costs \$ 10,770

Total Indirect Costs \$ 10,770

TOTAL PROJECT COSTS \$ **53,851**