Assessing the Impact of Supply Side Policies on Oil Extraction, GHG emissions, Health, and Employment in California

2023-2024 Master of Environmental Data Science Capstone Project Proposal

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Authors

Flora Hamilton | flora_hamilton@bren.ucsb.edu | +1 503-866-4751 | Master of Environmental Data Science Student, Bren School of Environmental Science and Management
Haejin Kim | haejin_kim@bren.ucsb.edu | +1 805-252-6937 | Master of Environmental Data Science Student, Bren School of Environmental Science and Management
Oksana Protsukha | oprotsukha@bren.ucsb.edu | +1 415-670-0620 |Master of Environmental Data Science Student, Bren School of Environmental Science and Management

Client

Lucas Boyd | Executive Director | The 2035 Initiative | lucasboyd@ucsb.edu
Tracey Mangin | Data Scientist | emLab | tmangin@ucsb.edu

Proposed Project

Objectives

The primary objective of this project is to assess the effects of supply-side policies designed to phase out oil infrastructure in California. Crucially, a holistic approach will be applied to analyze the effects of policies designed to reduce oil extraction and greenhouse gas (GHG) emissions, including impacts on public health, air quality, and employment. Specifically, the project team will aim to complete the following:

- Estimate projections for emissions, oil supply, health impacts, and employment statistics under the proposed 3,200-foot setback policy (defined as drilling bans on new and existing oil wells near homes, schools, health clinics, and other sensitive sites). Notably, Deshmukh et al. (2023) analyzed only the 2,500-foot and 1-mile setbacks. Students will build on this existing model to complete the analysis [1].
- Develop a machine learning model (MLM) to predict the locations of new oil infrastructure in California using historical drilling data. Compare MLM results with the original empirical model and map abandoned wells, well ownership, and the presence of methane and other toxic pollutants.
- Create interactive maps to visualize the results of the analyses.

Stretch Goals

The project team can choose additionally to develop a Shiny map to visualize the model outcomes based on different input parameters. If national-level data becomes available, there is the potential to apply the methods developed in this project to the entire United States.

Significance

While California has set an ambitious goal to achieve zero GHG emissions economy-wide by 2045, it remains the seventh-largest oil-producing state in the United States. GHG emissions from oil drilling are a large share of California's overall carbon footprint. Furthermore, oil drilling operations have a detrimental impact on the health of individuals living near active oil and gas wells [4]. Oil supply-side policies, including setbacks, as well as excise taxes and carbon taxes, can contribute to phasing out oil extraction and achieving carbon emissions mitigation goals. However, these policies have tradeoffs: they lead to health benefits from reduced air pollution but also employment losses that can vary across communities. Senate Bill 1137 [3], signed by the California governor in 2022, seeks to ban new permits for oil and gas wells within 3,200 feet of homes, schools, clinics, and other sensitive sites and to tighten restrictions on existing wells within the buffer zones. But after the bill was signed, the oil and gas industry fought back, spending more than $20 million in an orchestrated campaign to kill the new law. They succeeded in suspending the law’s enactment and are pushing SB 1137 to a referendum in November 2024.

The 2035 Initiative will use project’s deliverables to inform their advocacy around SB 1137 and other clean energy policies in California and across the U.S, giving MEDS students the opportunity to have an immediate impact on the state’s climate future. Further, emLab will

build upon the updated model in their ongoing research into the impacts of phasing out fossil fuels.

Background

The 2035 Initiative supports policies that equitably phase out fossil fuels.They intend to utilize the findings from the 'Equitable Low-Carbon Transition Pathways for California's Oil Extraction' model [1], developed by a research team at the University of California, Santa Barbara (available on a GitHub repository) to inform their advocacy. This model assesses the impact of supply-side policies on GHG emissions from oil drilling operations, employment, and the health of individuals within a certain distance of oil wells. It is constructed upon an empirical field-level oil production model, an air pollution model, and an employment model. The model characterizes spatially explicit decarbonization scenarios from 2020 to 2045 resulting from various policies – setbacks, excise taxes, and carbon taxes – applied to California [1]. While the study analyzed multiple scenarios, it only included setbacks at distances of 1,000 feet, 2,500 feet, and 1 mile. The study does not offer sufficient details to assess the impact of the recent proposal for implementing a 3,200-foot setback policy in California [3], requiring additional analysis at this setback distance.

Equity

This project aims to understand how environmental policies impact vulnerable communities. More than 1 million Californians live near active oil or gas wells, a population that is disproportionately Black, Latinx or low-income [5]. The project will evaluate how the proposed 3,200-foot setback requirement for new fossil fuel infrastructure, as well as other supply-side policies, contribute to a more equitable distribution of health benefits. Additionally, the analysis will assess the impact of job loss in affected communities to ensure that disadvantaged communities are not left behind in the transition to clean energy.

Data

The MEDS team will have access to the original model as developed by Professor Ranjit Deshmukh and his team, along with all the input data necessary for us to build upon his research. These data are described below, and can be accessed through this GitHub repository. The existing input data for the model can be broken down into “Extraction”, “Health”, “Labor”, and “Scenario” categories.

- **Field-level data:** the project will draw on field-level data across existing sources such as RMI SPECT, BingMaps, and the Rystad Upstream Exploration Solution to build upon the current model.
- **National-level data:** we hope to obtain national-level data to expand the analysis beyond the state of California as outlined in the stretch goals section.

For additional details refer to the table in the Data section under the Supporting Materials.

Computational Tools and Needs

The central server is named Taylor, with R serving as the primary modeling language. Students are granted the flexibility to opt for either R or Python when it comes to building an MLM.

Possible Approaches

1. Update the input parameters of the primary model for the new setback limit and rerun the policy scenario simulations to predict the effects of setback policies, oil supply, emissions, and health impacts.
2. Develop MLM to predict the locations of new oil infrastructure in California based on historical data and using existing datasets, including geographical information for California wells and oil fields from the Department of Conservation (DOC), monthly well-level production data, spud date data, and oil prices. The MLM will enhance accuracy and efficiency in predicting where oil infrastructure will be built to better understand the associated impacts. Various machine learning techniques, such as spatial analysis and geostatistical methods, time series analysis, and predictive modeling with algorithms will be explored to create robust and precise location predictions.
3. Utilize mapping technology to visualize the results of the analyses. Interactive maps and graphics will be created to provide an intuitive understanding of the results.

Deliverables

- Primary deliverables
    - A written summary detailing the policy's impact on oil supply, emissions, health, employment, and equity as identified through data analysis.
    - A comparative analysis between the empirical model and the machine learning model.
    - Interactive maps for visualizing the results of the analyses.
- Additional deliverables
    - Shiny application for interacting with the model using a set of predefined input parameters.

Audience

Our project and its deliverables will contribute to the work of the researchers and policy analysts at emLab, the 2035 Initiative, policy advocates involved in Senate Bill 1137, and the Californian voting public. The emLab is a research team at UC Santa Barbara focused on using market-based approaches to solve environmental problems and works with partners such as the California Environmental Protection Agency and Conservation International. The 2035 Initiative is a UC Santa Barbara “think-and-do” tank that uses empirical research, policy development, and media engagement to support actionable roadmaps for enacting climate policy.

Supporting Materials

Data

This following summary is descriptive but not exhaustive. For a complete description, please refer to the README.md of the referenced Github Repository. Proprietary data from IMPLAN and Rystad will be provided to the student team on the condition that those raw input data are not shared outside of the project team.

	Extraction Data	Health Data	Labor Data	Scenario Data
Summary:	Extraction inputs include geographical information for wells, oil and gas production information, spatial files, and economic production data.	Heath inputs include the California Office of Environmental Health Hazard Assessment's CalEnviroScreen 3.0 data, a dataset that analyzes census tracts based on potential exposures to environmental and socioeconomic conditions. Other health inputs include census data, population projections, mortality incidence data, and spatial files.	Labor input data include county specific employment and compensation multipliers for the oil extraction and refining industries, county and industry-specific Multi-Region Input/Output analysis results, and industry-specific ratios of the number of job-years per FTE worker.	Scenario data include innovation scenario inputs developed for the study, carbon price scenario inputs, and carbon capture scenario inputs.
Sources:	California Department of Conservation, the Energy Information Administration (EIA), and International Energy Agency (IEA), as well as Rystad.	National Historical Geographic Information System, California Department of Finance, and the EPA.	Economic Impact Analysis for Planning (IMPLAN)'s 2018 edition data library	Developed by original study team using publicly available data sources (e.g., EIA)

Citations

[1] Deshmukh, R., Weber, P., Deschenes O.,Hernandez-Cortes D., Kordell, T., Lee, R., Malloy, C., Mangin, T., Meng, M., Sum, S., Thivierge, V., Uppal, A., Lea, D., Meng, K. (2023)., Equitable low-carbon transition pathways for California's oil extraction Nature Energy, 8, pages 597-609 (2023)https://www.nature.com/articles/s41560-023-01259-y

[2] Deshmukh, R., Weber, P., Deschenes O.,Hernandez-Cortes D., Kordell, T., Lee, R., Malloy,

C.,Mangin, T., Meng, M., Sum, S., Thivierge, V., Uppal, A., Lea, D., Meng, K. (2023).Well setbacks limit California's oil supply with larger health benefits and employment losses than excise and carbon taxes, Nature Energy, 8, pages 562–564 (2023) https://www.nature.com/articles/s41560-023-01273-0

[3] Senate Bill 1137, Gonzalez. Oil and gas: operations: location restrictions: notice of intention: health protection zone: sensitive receptors. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB1137

[4] CalGEM Questions for the California Oil and Gas Public Health Rulemaking Scientific Advisory Panel https://www.conservation.ca.gov/calgem/Documents/public-health/Public%20Health%20Panel%20Responses_FINAL%20ADA.pdf

[5] Kara Manke, Black, Latinx Californians face highest exposure to oil and gas wells https://news.berkeley.edu/2023/03/23/black-latinx-californians-face-highest-exposure-to-oil-and-gas-wells#:~:text=A%20new%20study%20appearing%20today,intensive%20oil%20and%20gas%20operations

[6] Donaghy, T, Healy, N., Jiang, C., Battle, C. Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities. Energy Research & Social Science Volume 100, (2023) https://www.sciencedirect.com/science/article/pii/S2214629623001640

Budget and Justification

We estimate that no additional budget is required to complete the project. Proprietary data sources will be provided by the client.

Client Letter of Support

UC SANTA BARBARA

Environmental Studies Department
Bren Hall, Santa Barbara, CA 93106

To: Bren MEDS Program Committee
Re. Letter of support for Support for the Capstone Project: "Assessing the Impact of Supply Side Policies on Oil Extraction, GHG Emissions, Health, and Employment in California"

I wholeheartedly support the proposed Capstone Project by the talented team from the Bren School of Environmental Science and Management. Their project, "Assessing the Impact of Supply Policies on Oil Extraction," is both timely and important.

This project's primary goal is to evaluate the impact of supply side policies , alongside excise and carbon taxes, on oil extraction, greenhouse gas (GHG) emissions, public health, air quality, and employment. Given recent political developments, such as Senate Bill 1137, which aims to implement the 3,200-foot setback requirement, this project is instrumental in providing data-driven insights to support policy-makers and inform the public's vote.

The team's commitment to equity and access to necessary data and computational tools positions them well for success. Proprietary data will be provided to the students, on the condition that they agree to not share the raw data outside of the project team.Their approach, including data analysis, machine learning, spatial analysis and visualization, and policy scenario simulations, aligns with the project's objectives.

I believe this project has the potential to drive positive change and produce valuable insights for academia, policy advocacy, and the broader community. I wholeheartedly support this endeavor and look forward to collaborating with the project team.

I am excited to work with the student team on this proposal. While I have the subject matter expertise and some of the data science skills to help guide the team, I am really looking forward to learning from the students and developing opportunities for them to explore their own research interests through this project.

Thank you for the consideration,

Lucas Boyd

Lucas Boyd
Executive Director, The 2035 Initiative
lucasboyd@ucsb.edu

Tracey Mangin

Tracey Mangin
Data Scientist, emLab
tmangin@ucsb.edu