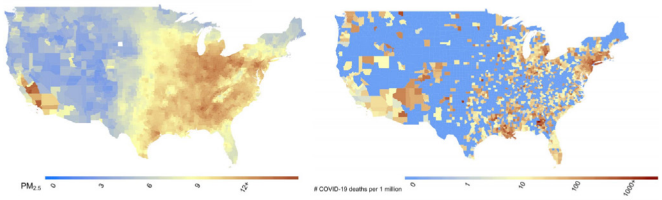
COVID-19 Sequestration Impacts on Air Quality and Health: Phase 2



Side-by-side map comparing county-level 17-year long-term average PM2.5 concentrations and county-level number of COVID-19 deaths per 1 million population in the United States (Image from "Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study", medRxiv 2020)

- **Characterize Health Benefits Associated with Changes in Air Quality:** Were short-term health outcomes affected by changes in air quality during this period?
- **Examine Source-Specific Health Benefits:** Did air quality improvement from reductions in generation vs. industrial vs. transportation emissions result in different health benefits?
- **Potential Future Emissions Scenarios with Efficient Electrification:** Inform the effectiveness of efficient electrification on public health benefits

Background, Objectives, and New Learnings

The COVID-19 pandemic has led to the sequestration of a large portion of the U.S. population, closure of commercial and industrial operations, and a dramatic reduction in car, rail, ship, and air transportation. This is turn has led to unanticipated changes in emissions from multiple source categories and corresponding improvements in ambient air quality. The improvements in air quality are likely to result in improvements to health. Phase 1 of this project is assessing overall air quality improvements due to source-specific emissions reductions. These findings will be important in understanding potential public health benefits from overall behavior changes that effect the emissions typically seen by the energy system infrastructure.

The "natural experiment" provided from the COVID-19 sequestration period provides a unique opportunity to assess the impact of reduced emissions from multiple source sectors on public health. This type of natural intervention study has several advantages compared with a traditional observational epidemiology design. Standard population-based epidemiological studies compare either the impact of current air pollution levels to historical levels (or current levels to future assumed or simulated levels). The study also looks at air pollution exposures for different populations in different geographic areas. These approaches are highly susceptible to different types of bias, including temporal and spatial confounding, that are difficult to control. With a natural experiment such as the current pandemic and associated societal changes, the same population is studied before and after the changes, with other variables remaining constant; this has the advantage of reducing the risk of confounding.

Similar health analyses have been conducted on a number of different interventions, including closure of industrial facilities (e.g., steel mills), regional changes in heating fuel type, traffic congestion reduction plans, and large sporting events. When the analysis is conducted from emissions, to ambient air quality, to health outcome, this is termed an "accountability study". The full "accountability chain" can provide valuable insights into the full societal impact of the particular intervention, and, when properly conducted, allow air pollution to be investigated in isolation as a potentially causative factor in adverse health impacts.

To date, most of the focus of research on air quality and COVID-19 has been on the potentially modifying effect of air pollution on severe COVID-19 outcomes, such as mortality. Several studies have reported a significantly increased risk of COVID-19 mortality associated with several air pollutants ($PM_{2.5}$, NO_2, and O_3), positing that chronic exposure to air pollution may render the respiratory system more susceptible to infection. However, there has not been any evaluation of the health impacts of improved air quality during the stay-at-home or shelter-in-place orders. The changes in emissions over a relatively short timeframe can impact acute health effects associated with air pollution, e.g., hospital emergency department visits for asthma. Using air quality changes from source-specific emissions reductions can also allow calculation of projected air quality benefits in the future, under efficient electrification scenarios.

The objectives of Phase 2 of this project are to (1) conduct three-dimensional air quality modeling to compare results from Phase 1 of this effort and develop additional inputs for health analyses; and (2) conduct epidemiological analyses to link changes in source-specific air quality to changes in adverse health effects from air pollution. The evaluation of health impacts will consider both short-term and long-term effects.

Benefits

The changes in air quality that result from the COVID-19 pandemic allow a real-life opportunity to evaluate how emissions reductions from different source sectors may impact health. As an extension, this opportunity also allows assessment of the health implications of a changing energy system. Findings from Phase 2 of this study will help with understanding the public health implications of a future emissions scenario in which low-emitting generation, including gas and renewables, continues to increase, along with efficient electrification. Source-specific contributions to changes in air quality from this study can shed light on how resources could be prioritized in different source sectors that can maximize the public health benefits.

Project Approach and Summary

Phase 2 of this project uses the changes in source-specific contributions to air quality (Phase 1 results) to build out the remainder of the accountability analysis. Specifically, this work takes source attribution results (tied to emissions) to ambient air quality, and finally to health impacts. The approach includes:

- Apply three-dimensional air quality modeling to generate ambient air quality data for representative regions before and during (or with and without) the stay-at-home or shelter-in-place orders. This modeling would leverage data sources such as in-roadway sensors, CEMS data for point sources, ship transponder data, and rail freight statistics, among other data sources and is informed from the receptor modeling results performed in phase 1.
- Collect available health data of interest.
- Develop appropriate epidemiological models to quantify the impact of air quality changes on short-term health effects.
- Calculate projected changes in long-term health effects based on specified air quality scenarios, using the benefits evaluation methodologies, including EPRI's Integrated Uncertainty Assessment tool.

Deliverables

- 2-page Communication Summaries of results for public distribution
- Two peer-reviewed journal manuscripts

Price

The price of the project is $100,000 per funder payable over 2 years. The project qualifies for Self-Directed Funding (SDF) and Tailored Collaboration Funding.

Project Status and Schedule

The project is scheduled to take approximately 12 months to complete and will begin in the July 2020 timeframe. While some of the work will be dependent on the completion of Phase 1, research can begin as soon as funding is assembled.

Who Should Join?

This project is applicable to all utilities with generation, electrification and sustainability interests.

Contact Information

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