New toolset evaluates economic impacts of ozone reduction policies for nine income groups

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One of the two top air pollutants in the U.S., ground-level ozone is harmful not only to your health but also to your bank balance. Long-term exposure to high concentrations of ozone can lead to respiratory and lung disease such as asthma, conditions that drive up medical expenses and sometimes result in lost income. Ozone exacts a particularly heavy toll on people living in economically disadvantaged areas, where industrial and power plants tend to cluster. While policies have been implemented to reduce ozone emissions across the country, they have not yet addressed built-in inequities in the U.S. economy, leaving low-income Americans at greatest risk for health and economic damages.

Now a study by researchers at the MIT Joint Program on the Science and Policy of Global Change provides the first breakdown of ozone exposure, health, and economic impacts by household income across the U.S. The study, which appears in the journal *Environmental Science and Technology*, uses a modified version of the MIT Joint Program's U.S. Regional Energy Policy (USREP) model to simulate the health and economic impacts of ozone exposure and ozone-reduction policy on nine U.S. income groups. Comparing a set of policies under consideration in 2014 with a business-as-usual scenario, the researchers found the policies to be most effective in reducing mortality risks among lowest-income (less than $10,000 per year) households, which netted twice the relative economic gains as their highest-income (more than $150,000 per year) counterparts.

"I hope our findings remind decision-makers to look at the distributive effects of environmental policy and how that relates to economic disparity," says the study's lead author, Rebecca Saari PhD '15, a former Joint Program research assistant and engineering systems PhD student who is now an assistant professor of civil and environmental engineering at the University of Waterloo in Canada. "If you ignore those effects,

you underestimate the importance of ozone reduction for low-income households and overestimate it for high-income households. Now that we have better tools, we can actually model the differences among income groups and quantify the impacts."

To obtain their results, the researchers combined a regional chemical transport model (Comprehensive Air Quality Model with extensions, or CAMx), health impacts model (Benefits Mapping and Analysis System, or BenMAP), and model of the continental U.S. energy and economic system (USREP) into a single computational platform. They then enhanced that platform to simulate ozone concentrations and their health and economic impacts across nine household income categories. Using 2005 U.S. ozone concentration data as a base year, they compared results from two simulations—one representing a baseline scenario in which no new ozone-reduction policy was applied, the other implementing a U.S. EPA-evaluated suite of policies once planned for the year 2014.

The study determined that ozone exposure—and hence mortality incidence rates—declined with increasing income, with the proposed 2014 policies reducing these rates by 12-13 percent. People earning the lowest incomes were better off economically by 0.2 percent, twice as much as those in the highest income group—and were twice as economically vulnerable to delays in policy implementation.

The model could enable today's decision-makers to evaluate any new ozone reduction policy proposal in terms of its potential impacts on Americans in all income groups, thereby gauging whether or not it will reduce or exacerbate existing economic inequality.

"Integrating air pollution modeling with economic analysis in this way provides a new type of information on proposed policies and their implications for environmental justice," says study co-author Noelle Selin, associate professor in the MIT Institute for Data, Systems and

Society and Department of Earth, Atmospheric and Planetary Sciences. "This type of approach can be used to help policymakers better identify policies that will mitigate environmental inequalities."

More information: Rebecca K. Saari et al. Human Health and Economic Impacts of Ozone Reductions by Income Group, *Environmental Science & Technology* (2017). DOI: 10.1021/acs.est.6b04708

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