Evaluating Reduced-form Tools for Estimating Air Quality Benefits: Charge Questions

Background:

Quantifying and valuing the public health impacts of changes in air quality can be a time- and resource-intensive endeavor that often requires large, detailed datasets and sophisticated computer models. The U.S. Environmental Protection Agency (EPA) routinely undertakes these analyses as part of Regulatory Impact Analyses (RIAs) to estimate the costs and health benefits of major air pollution regulations. EPA strives to estimate the public health benefits of air quality changes in ozone and/or fine particulates ($PM_{2.5}$) using a state-of-the-science "full-form" approach that couples a photochemical air quality model, such as the Community Multiscale Air Quality (CMAQ) model, with a health benefits tool such as the Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE). However, there are times when EPA has instead used "reduced-form" tools, which employ simpler models to approximate the more complex analyses with a lower computational burden. This can occur when time and resources are constrained, such as when rule development timelines are compressed, or air quality policy details required for full-form photochemical modeling are not available until very late in the rulemaking process. Over the last several years, the number of reduced-form tools that estimate air quality changes and associated public health benefits has grown, giving EPA and other analysts of air policies more options to consider in this regard. Because these reduced-form tools may be used to inform regulatory or policy decisions, it is important to evaluate how the results from such tools compare to each other and to more comprehensive full-form approaches. In several recent regulatory actions where it was determined to be fit-for-use, EPA has utilized a benefit-per-ton (BPT) approach to estimate benefits (e.g., Clean Power Plan (CPP) repeal among others).

The objective of EPA's study of reduced-form tools was to develop and demonstrate a protocol for systematically comparing $PM_{2.5}$ monetized health benefits estimated using reduced-form tools with those generated using full-form air quality and health benefits models, in the specific context of using such tools to inform the economic impacts of regulatory analyses. As such, the project documentation subject to this peer review first describes the analytical approach developed to compare the two types of approaches and then presents the evaluation results for a number of reduced-form tools across multiple policy scenarios. The tools evaluated include: 1) EPA's Source Apportionment Benefit-per-Ton (SA-BPT) approach based on the 2005 National Emissions Inventory (NEI); 2) Air Pollution Emission Experiment and Policy Analysis Model (APX); 3) Intervention Model for Air Pollution (InMAP); and Estimating Air Pollution Social Impacts Using Regression (EASIUR). The project report concludes with a description of the limitations of the evaluation approach and findings, with suggestions for future research. EPA also has publicly provided all of the modeling inputs and processing scripts to assist model developers and users in conducting similar evaluations of new or updated reduced form tools.[1] EPA expects that reduced-form tools will continue to evolve in the future. As recommended within the current report, EPA has already begun to update its 2005 National Emissions Inventory (NEI) BPT tool to reflect recent updates to the emissions inventories and also plans to investigate other efficient modeling techniques that can also approximate full-form modeling approaches. As a result, EPA believes there is value in having a peer review panel deliberate as to whether the evaluation framework developed in this study is appropriate, and to provide input with regard to future design improvements to enhance the capabilities of reduced form tools.

Charge Questions on EPA's Reduced Form Evaluation Report:

[1] Available here: https://github.com/epa-kpc/RFMEVAL

Question 1. Please comment on the evaluation approach developed by EPA to compare reduced-form models to full-form equivalents. Please comment on whether the emissions reduction scenarios used in the proposed evaluation approach provide enough diversity to adequately assess reduced-form performance over a range of possible applications (e.g., magnitude, type, and spatial variations of emissions reductions). Please discuss whether the specific assumptions that EPA made to apply each tool as consistently as possible (e.g., emissions, meteorology, use of direct vs. BenMAP estimates, etc.) are appropriate and clearly explained. Please assess whether the report's description of its limitations is complete.

Question 2. Please comment on the results of the reduced form tool evaluation in Section 3, considering both the quantitative and qualitative aspects of the model intercomparison. Was the information clearly presented and informative? Were EPA's conclusions reasonable? Are there other results which would be useful to include in the comparison?

Question 3. Exhibit ES-4 "*Ratio of National Avoided Premature Mortality Benefits Estimates*," shows how different reduced-form tools generated different estimates as compared to full-scale air quality models.

3a. Does the report provide a clear and thorough explanation for why some tools under- or over-estimated $PM_{2.5}$ health benefits as compared to the full-scale air quality modeling? Please add any additional explanations for the pattern of results observed.

3b. How do the results of this study inform our understanding of the suitability of these tools for regulatory economic analyses in their current form?

3c. Can any of the reduced-form tools explored in this report easily be modified to allow quantifying the extent to which the total health benefits accrue to specific geographic areas (e.g., by state, or where ambient concentrations are above or below the NAAQS)?

Question 4. Since 2008 EPA has used SA-BPT to estimate the health impacts of numerous regulations. Under the scenarios examined in this report, EPA's SA-BPT approach over-estimated $PM_{2.5}$-related health benefits by between 10 and 30 percent, depending on the sector. To ensure BPT estimates correspond to full-form results as closely as possible, the report recommends updating the underlying emissions inventories and air quality modeling used to inform the EPA SA-BPT approach over time.

4a. In the interim, how might EPA improve its characterization of results derived from the 2005 SA-BPT approach, specifically the potential degree of over- or underestimation in BPT-based results for a particular regulatory scenario?

4b. What criteria (e.g., geographical scale, regulated sector, pollutants/precursors) should EPA examine to determine the potential for divergence between SA-BPT results vs full-form air quality modeling results (resulting in over- or under-estimation)?

4c. Based on the results of this study, does the panel have any additional recommendations about BPT-based approaches?

Question 5. How do the results of this study inform the future development of reduced-form tools that are capable of providing reliable estimates of impacts associated with different sectors, across a variety of spatial scales, and for different portions of the air quality distribution? Are there other, less

resource intensive approaches than full-scale air quality modeling for informing the public about the size and distribution of PM health benefits associated with alternative regulatory scenarios?