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At our [October 25] meeting, discussion occurred around possible air quality and health impacts that might be associated with RGGI.

There seem to be, broadly, 2 options.

SCENARIO 1: RGGI in DE may not actually result in changes in local coal power plant operations (a table was circulated showing that the RGGI policy scenario -- posted at the RGGI site -- forecasts no significant change in the operating hours or annual generation levels of coal plants in the Delmarva Zone compared to the reference / business as usual scenario). In this case, the local air quality benefit of RGGI may have to derive from greater use of renewables outside the Delmarva Zone because greater renewable generation inside the Zone would not affect the operation of local plants which sell into the PJM market. Here we would need to know how to estimate air quality and health effects deriving from actions beyond the Delmarva Zone.

SCENARIO 2: If the RGGI policy scenario is not correct or incomplete in its analysis and new cleaner generation in the Zone would affect run hours of local
coal plants selling into the PJM market, we would need to know how to estimate
air quality and health effects both for impacts in the Zone and beyond it.

With these SCENARIOS in mind, I wanted to learn how air quality and health effects would need to be analyzed. This seems to be relevant for our RGGI Workgroup as we move forward with justifications for recommendations to the General Assembly.

I asked EPA Region III for help in this vein and was referred to their expert
air quality and health impacts modeler, Dr. Cimorelli.

I have copied below for the benefit of the RGGI Workgroup the recent reply I received from Dr. Cimorelli. It might be helpful for us to consider developing
a research protocol of the kind recommended below so that we can objectively judge the impacts we wish to associate with State participation in RGGI.

Regards, John
Member, SCR 28 Workgroup

Date: Mon, 5 Nov 2007 12:34:11 -0500
From: Cimorelli.Alan@epamail.epa.gov

Dr. Byrne,

If I understand your request, you are asking me to describe the steps that would be involved in estimating specific improvements in public health that one could expect to occur in Delaware as a result of increasing the use of renewable energy for electrical generation. I assume that the basis of this premise is that, for each unit of electric power produced using renewable energy there would be a commensurate reduction in the use of fossil fuels. As you know, my expertise is in the area of air quality modeling and therefore the methodology that I present below relates only to estimating reduced health impacts from the air, or inhalation pathway. The approach, or protocol, that I believe would need to be followed involves a number of complex steps that would result in a considerable amount of work. Based on your request I assume that you are interested in the health impacts related to ozone and fine particles. To make the estimates that you desire is an extremely complex and time consuming endeavor. However, I believe that unless an effort of the magnitude I describe below is undertaken it would not be possible to determine, with any degree of certainty, the health impacts that would result from any renewable energy project. A basic outline of the analyses that would be required follows.

In addition to estimating the reduction in fossil fuel use that would result from a renewable energy project, one would have to identify which specific power plants would realize these reductions. Would these plants be coal or oil fired? Would they be base loaded or peaking? Where would they be located? If not in Delaware, then where? The location of the plant, its type as well as it exit gas characteristics would all have a significant effect on the degree of air quality improvement that might be expected in Delaware. Given the complexities of the power grid I believe that a substantial number of possible scenarios would need to be tested.

Before any reduction scenario could be tested, however, a base case run of a model such as, the Community Multi-scale Air Quality (CMAQ) (http://www.cmaq-model.org/) modeling system would have to be made. The CMAQ model is a state-of-the-science Eulerian model designed in part to estimate ozone and fine particle concentrations that result from emissions throughout the entire continental US and Canada. This model is designed to simulate the complex atmospheric chemistry, pollutant advection and dispersion mechanisms that are central to the production of ozone and fine particle pollution.

Using CMAQ one would first need to estimate the ozone and fine particle fields that presently exist in Delaware. Then a similar analysis would have to be made for each reduction scenario and the difference in pollutant concentration fields constructed. The change in the concentration fields can then be used to estimate potential health benefits from the reduced emissions. To do this I would recommend using a model known a BenMap (http://www.epa.gov/air/benmap/). BenMAP is a tool for estimating the health impacts, and associated economic values, associated with changes in ambient air pollution. It accomplishes this by running health impact functions (based on numerous epidemiological studies), which relate a change in the concentration of

a pollutant with a change in the incidence of a health endpoint. Inputs to health impact functions typically include:

a. the change in ambient air pollution level,
b. health effect estimate,
c. the baseline incidence rate of the health endpoint, and
d. the exposed population.

To produce either the baseline or reduction scenario concentration fields, a model ready emissions inventory has to be constructed that would include air emissions throughout the entire eastern third of the US and represent the baseline and scenario emissions profiles. To do this a preprocessing program known as the Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System (http://www.smoke-model.org/index.cfm) would need to be used. The purpose of SMOKE is to convert the resolution of the emission inventory data to the resolution needed by CMAQ. Emission inventories are typically available with an annual-total emissions value for each emissions source, or perhaps with an average-day emissions value. CMAQ, however, requires emissions data on an hourly basis, for each model grid cell (and perhaps model layer), and for each model species. Consequently, emissions processing involves transforming an emission inventory through temporal allocation, chemical speciation, and spatial allocation, to achieve the input requirements of CMAQ.

Once the emissions have been processed through SMOKE, meteorological data must be preprocessed for input to CMAQ. Meteorological preprocessing is accomplished using a state-of-the-science prognostic meteorological model such as MM5. The PSU/NCAR mesoscale model (known as MM5) is a limited-area, nonhydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation (http://www.mmm.ucar.edu/mm5/). Since pollutant concentrations vary significantly with meteorology, it is necessary to estimate concentrations over a wide variety of meteorological conditions if worst case impacts are to be determined. Because of the large computational resources needed to run MM5 it is not practical to run a multi-year period in order to examine meteorological variability. Therefore, a set of meteorological episodes need to be constructed and preprocessed using MM5 which are known to produce high concentration fields. These MM5 output files along with the SMOKE emissions files are input to CMAQ for estimating the desired concentration fields.

As you can see, the prospect of estimating specific health benefits from a renewable energy project, as you have described for Delaware, would be an extremely complex and resource intensive matter. As a final thought, before I would go down this road I would have to feel confident that there were only a limited number of possible reduction scenarios otherwise the resource burden would be overwhelming or the uncertainty in the estimates, from running a small set of scenarios, would be unacceptably high.

I hope this is helpful. If you should have any further questions please let me know.

Regards,

Alan J. Cimorelli, Lead Meteorologist
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