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United States Environmental Protection Agency
Office of Air Quality Planning and Standards • Air Quality Strategies and Standards Division
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From: **Scott Mathias**
Phone No: **(919) 541-5310**
Facsimile No: **(919) 541-0839**

Message:

Attached is EPA's latest revisions to the ozone mortality section of Volume 2 of the NOx SIP Call RIA (Health and Welfare Benefits). These revisions are based on written comments received from CEA on December 31, 1998. Per CEA's written suggestion, EPA has agreed to strike the last three sentences of the paragraph following Table 4-8, and ended with the sentence "This would generate a benefits estimate considerably higher than the high estimate in Table 4-8." We assume that this latest revision is acceptable and consider Volume 2 to now be final. Thanks for your input.

cc: Ron Evans
Bryan Hubbell
Bill Harnett

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cc: Ron Evans
Bryan Hubbell

Because of differences in the averaging times used in the underlying studies (some use daily average ozone levels, while others use 1-hour daily maximum values), it is not possible to conduct a meaningful meta-analysis directly on the coefficients of the C-R functions. Instead, for each pair of air quality modeling results (for the baseline and a given regulatory alternative) for the NOx SIP call, each C-R function is translated into a set of predicted mortality incidence changes that would be estimated by that C-R function, given the set of air quality changes. The meta-analysis approach is then applied to the predicted mortality incidence changes that would be estimated by each of the studies. Additional details of the approach are described in the technical support document for the NOx SIP call (Abt Associates, 1998a).

Table 4-8 presents the range of estimates of avoided incidences of ozone-related mortality and monetary benefits associated with five regulatory alternatives for the NOx SIP call. Note that the lower estimate for this endpoint is zero to reflect both the number of peer-reviewed studies finding no significant relationship between ozone and premature mortality and the lack of a directly established biological mechanism linking ozone and premature mortality. In its review of the epidemiological ozone-mortality literature, EPA has determined that there is a reasonable probability that increased ozone concentrations are associated with incidences of premature mortality. In Table 4-8 the higher estimate allows for the existence of an ozone-mortality relationship, but assumes there is some probability that for any specific location within the SIP call region that the effect of ozone on premature mortality is zero. This probability is embedded in the previously discussed meta-analysis approach, which includes studies both with and without findings of a statistically significant relationship between ozone concentrations and premature mortality.

Table 4-8
Range of Avoided Ozone-related Mortality Incidences and Monetary Benefits Associated with the NOx SIP Call[a]

Regulatory Alternative	Avoided Incidences (cases/year)		Monetary Benefits (millions 1990$)	
	Low	High	Low	High
0.12 Trading	0	315	$0	$1,496
0.15 Trading	0	279	$0	$1,326
Regionality 1	0	251	$0	$1,191
0.20 Trading	0	234	$0	$1,108
0.25 Trading	0	174	$0	$824

[a] Annual baseline incidence for non-accidental deaths in the general population for all ages is 803/100,000. Total annual baseline incidence for the NOx SIP call region is 1,768,014 non-accidental deaths.

Note that the high estimate presented in Table 4-8 does not represent the limiting upper end of potential ozone-related mortality benefits. The high estimate in Table 4-8 represents the mean estimate of benefits derived from the distribution of concentration-response functions generated from the meta-analysis

described above. The limiting upper end for ozone-related mortality is generated by assuming that the highest concentration-response function applies everywhere. This would generate a benefits estimate considerably higher than the high estimate in Table 4-8.

PM-related Mortality

PM-associated mortality in the benefits analysis is estimated using the $PM_{2.5}$ relationship from Pope et al., 1995. This decision reflects the Science Advisory Board's explicit recommendation for modeling the mortality effects of PM in both the completed §812 Retrospective Report to Congress and the ongoing §812 Prospective Study. The Pope study estimates the association between long-term (chronic) exposure to $PM_{2.5}$ and the survival of members of a large study population. This relationship is selected for use in the benefits analysis instead of short-term (daily pollution) studies for a number of reasons.

The Pope long-term study is selected as providing the best available estimate of the relationship between PM and mortality. It is used alone, rather than considering the total effect to be the sum of estimated short-term and long-term effects, because summing creates the possibility of double-counting a portion of total mortality. The Pope study is selected in preference to other available long-term studies because it uses the best methods (i.e., a prospective cohort method with a Cox proportional hazard model), and has a much larger cohort population, the longest exposure interval, and more locations (51 cities) in the United States, than other studies. It is unlikely that the Pope study contains any significant amount of short-term harvesting. First, the health status of each individual tracked in the study is known at the beginning of the study period. Persons with known pre-existing serious illnesses were excluded from the study population. Second, the Cox proportional hazard statistical model used in the Pope study examines the question of survivability throughout the study period (10 years). Deaths that are premature by only a few days or weeks within the 10-year study period (for example, the deaths of terminally ill patients, triggered by a short duration PM episode) are likely to have little impact on the calculation of the average probability of surviving the entire 10 year interval. In relation to the other prospective cohort study (Dockery, et al., 1992, the "Six-cities" cohort study), the Pope study found a smaller increase in excess mortality for a given PM air quality change.

Table 4-9 presents point estimates of avoided incidences of long-term PM-related mortality and monetary benefits associated with the five regulatory alternatives for the NOx SIP call. As noted earlier, non-linearities inherent in the RADM-RPM air quality model lead to an inconsistent ranking of results between the RADM-RPM and S-R Matrix results. With the exception of the 0.12 trading alternative, estimated premature mortality incidences are higher for S-R Matrix generated PM changes than for RADM-RPM generated PM changes.