UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

May 14, 1993

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

EPA-SAB-CAACAC-LTR-93-007

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

Subject: Science Advisory Board's review of the Office of Policy, Planning, and Evaluation 's (OPPE) and the Office of Air and Radiation's (OAR) progress on the retrospective and prospective studies of the impacts of the Clean Air Act.

Dear Ms. Browner:

On March 25, 1993, the Clean Air Act Compliance Analysis Council (CAACAC) met to address a variety of issues related to the retrospective and prospective Clean Air Act (CAA) impact studies required by Section 812 of the CAA amendments of 1990. The discussions at that meeting reflected both the Charge provided to the Council and issues raised by the background documents that were also provided in advance. The Council's reactions to the three major topics covered at the meeting follow.

a) Estimation of Costs and Macromodeling

At our previous two meetings, the Council had expressed a number of concerns regarding the methods and assumptions of macroeconomic modeling employed in the retrospective study. At its March 25 meeting, the CAACAC was very impressed by the progress that has been made in addressing the five major concerns raised in our earlier reviews.

1) The CAACAC had observed that the change in Gross Domestic Product (GDP) is not a conceptually valid measure of economic cost. In response, a new equivalent variation (EV) measure was presented. This measure, based on the work

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of Jorgenson and Slesnick, relies on an intertemporal utility function for infinitely-lived "dynasties" with different economic characteristics. The Council believes that this is a very sound basic approach (The "dynasty" formulation has a distinct air of unreality about it. However, the CAACAC does not believe this approach is biased in any obvious way and recommends against attempting to develop a superior approach within the Section 812 study). We have not yet seen the details of the models and calculation methods employed in this analysis, however, and, accordingly, the CAACAC cannot put its imprimatur on the numbers provided.

Four additional points were raised regarding the macroeconomic cost analysis. First, the calculation of EV seems to depend on extrapolated future compliance costs, while traditional income measures do not. It would be useful to have some assurance that results are not sensitive to alternative plausible extrapolations. Second, the measures presented mix stocks and flows. The reported EV measure is a wealth-like stock, as opposed to the flow concepts (output, consumption, etc.) used elsewhere in the macroeconomic modeling. It would be highly desirable to present a flow magnitude that would bear some family resemblance to GDP. Within the current EV structure, perhaps the annuitized value of the lifetime wealth change ("annuitized augmented income," or AAI) would be preferable for the purpose of presentation.

Third, the presentation made to the CAACAC employed numerous different measures to deal with the range of issues considered (output, capital, consumption/leisure, consumption, and so on). As far as possible, the final written presentation should rely on a single preferred measure of impact (such as the AAI just mentioned) to tie together the different issues. Fourth, while we believe that the estimated relations between EV and such variables as income and family size are of interest, we urge the Agency to de-emphasize the Jorgenson-Slesnick summary measures of equity in the final presentation. These are both complex and controversial measures and seem unlikely to provide much information to most readers beyond that contained in the results for different family types.

2) The treatment and presentation of direct and indirect costs was responsive to our expressed concerns. The presentation could be unified by presenting the results for the AAI concept discussed above. Some CAACAC members noted that adaptation and substitution might imply that indirect costs should be negative, whereas in the Jorgenson-Slesnick analysis these costs are positive because of impacts on capital accumulation.

3) This analysis now clearly distinguishes endogenous technical change (ETC) from factor substitution (FS). The CAACAC had argued that this distinction is crucial because the ETC effect is not as well-established in the economic literature as is the FS effect. As we now understand the analysis, estimates of the cost of the CAA without the ETC effect are roughly double the estimates with ETC. Because the ETC effect is apparently of critical importance, *the CAACAC strongly recommends that runs with and without ETC be made for each of the major variations, sensitivity analyses, and experiments in the macroeconomic analysis.*

4) In response to our earlier suggestions, the modelers made alternative assumptions about net capital flows from abroad. These had no significant effect on the results of the analysis. Although none of these assumptions are strictly consistent with the model's strong emphasis on maximizing behavior, the CAACAC does not recommend that this topic be pursued further in the context of this study.

5) The CAACAC had asked that the Agency analyze the implications of alternative cost estimates produced by other U.S. government agencies -- in particular, the estimates of mobile source compliance costs produced by the Bureau of the Census. As we had expected, total cost estimates are very sensitive to which mobile source cost series is employed. Because no study of this sort can be stronger than the data on which it rests, *we urge the Agency to assign a high priority to careful examination and analysis of at least all alternative cost estimates published by U.S. government agencies.* The final report should contain a careful analysis of the reasons for important differences between these estimates, to the extent these reasons can be ascertained. *If it is not possible to reduce the range of credible estimates to a single point by strong theoretical and empirical arguments, the final report should show the dependence of all main results on choice of cost estimates.*

b) Health Effects of Lead and Other Air Toxics

A wide range of issues were discussed under this general heading. The CAACAC's reactions and recommendations are as follows.

1) In the analysis presented to the CAACAC, health effects estimates associated with exposures to outdoor air toxics have been restricted to cancer incidence for 27 pollutant categories. The estimated total annual cancer cases number between 1,726 and 2,706, of which one pollutant category, products of incomplete combustion (PIC)

accounts for between 438 and 1,120 cases. *We urge the EPA to develop methods to deal with a range of important toxics that are not carcinogens.* Such methods will be important in the prospective study and could be significant in the retrospective study as well. In addition, in order to evaluate both the retrospective and prospective studies, the CAACAC would like a pollutant-by-pollutant indication as to whether the assumed exposure-response relationships were based on human, other primate, or rodent studies.

2) The numbers presented to the Council were based on sums of 95% upper confidence limits for individual incidence rates. While it may be appropriate to work with such upper bounds in a regulatory setting, measures of central tendency are required for cost/benefit analysis. The only valid way to determine an unbiased estimate for the total impact is to sum a central tendency estimate, such as the mean or median number of cases in each category. (This problem may also arise for population distributions as well as exposure-response relationships.) *The Agency must develop and apply the methods necessary for an analysis based on measures of central tendency, not 95% upper bound limits.* When this is done, we expect the total impact of the 27 carcinogens considered would most likely be well below 1,000 cases per year.

3) It should also be noted that the incidence estimates presented to the CAACAC were based on some assumptions we find to be untenable, such as nearly continuous exposure to the concentrations found out-of-doors. In fact, most people spend about 90% of their time indoors, and the concentrations of pollutants having outdoor sources are much lower in indoor air, especially for chemically reactive vapors and all forms of particulate matter. If exposures are really less than those currently assumed, then the risk will be less in proportion to the reduced exposure. In order to evaluate responsibly the Agency's estimates of CAA costs and benefits, the CAACAC would like a pollutant-by-pollutant indication of the extent to which the modeling uses actual exposures rather than some hypothetical exposure. *Ideally, of course, all risk estimates for cost/benefit analysis should be based on sound estimates of actual exposures, rather than the sort of worst case scenarios often employed in regulatory contexts.*

4) With reasonable adjustments for exposure and means, rather than 95% upper bound risks, the total annual cancer impact of ambient air toxics is probably closer to a few hundred than a few thousand cases. In contrast, EPA has estimated

that there are 5,000 to 20,000 radon-associated lung cancers per year in the U.S., approximately 3,000 long cancers associated with environmental tobacco smoke (ETS), and about 2,000 cancers associated with volatile organics (VOCs). VOCs include many chemicals also included among ambient air toxics, but, for these agents, the indoor concentrations are generally much higher than outdoor concentrations. In addition, the adverse health effects of ETS and VOCs are not limited to cancer. Finally, all of these health impacts are, however, small in comparison to those associated with exposures to three of the criteria pollutants: lead (Pb), particulate matter (PM), and ozone (O_3). This reinforces the importance of developing methods to deal with adverse health effects other than cancer.

5) The data bases on lead exposure, human health effects, and benefits are more comprehensive and more thoroughly validated than those for any of the other pollutants under consideration. *We urge the Agency to take full advantage of the large amount of research that has been done on this important pollutant.* Lead is also interesting as a paradigm for the CAACAC evaluation because it is a persistent pollutant that can reach humans by direct inhalation, by inhalation after re-suspension from soil, and via incorporation into the food supply.

Among the benefits to the analytic program from further refinement of the lead exposure and effects evaluations are the lessons from these analyses that can be applied to evaluations of the exposures and effects of other pollutants. For example, the atmospheric dispersion and lead uptake-biokinetic models can be improved through the determination and validation of transfer coefficients beyond those needed in earlier applications of the models. Thus, the results of the forthcoming modeling of lead dispersion from coal burning power plants could be extended to the modelling of the dispersion of other toxic metals (such as mercury, arsenic, and cadmium) from the same power plants, and similar extrapolations could be made on biological fate and metabolism.

6) The CAACAC believes it was appropriate to review contingent valuation (CV) studies eliciting willingness-to-pay for avoiding exposures to carcinogens; such studies might serve either to corroborate or to correct estimates of the value of a statistical life (VSL) derived from hedonic wage studies. In view of the state of the CV literature, however, the CAACAC recommends that statistical lives saved as a result of air toxics control be valued using hedonic techniques. Any bias that might be introduced as a

result is likely to be very small compared to the uncertainties attached to the corresponding dose-response functions.

The major complication is that the number of life-years saved must be approximately the same. Since the median age of workers in the typical labor market study is about 43 years, preventing an immediate fatality saves approximately 30 life-years. If the cancers that may be prevented by controlling air toxics would claim an equivalent number of life-years, no problem exists. If, as seems possible, these cancers claim fewer life-years, an appropriate adjustment would have to be made in the VSL.

c) Design of the Prospective Assessment

The CAACAC was pleased to have an opportunity to discuss a range of issues affecting the design of the prospective study early in the design process. Our main substantive recommendation is that *the Agency should learn from the retrospective study that as a rule, resources are better spent on developing sound, comprehensive data relevant to key issues than on elaborate modeling or literature review efforts.* On process, *the CAACAC feels strongly that the Agency should actively seek to involve CAACAC, its individual members, and other outside experts throughout the design of the prospective study.* It will be a major challenge to do this highly visible study well, and the Agency will be well-served by frank, early discussions of important problems and issues at a range of informal expert gatherings.

We appreciate the opportunity to review the progress to date on the CAA impact analysis and look forward to receiving your response to the major points raised in this letter.

Sincerely,

Dr. Richard Schmalensee
Chair
Clean Air Act Compliance Analysis Council

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