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Review of the Health Benefit Estimates from Emission Reductions in the Construction Fleet

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The ARB Staff has presented an estimate of the economic health benefits from the emission reductions to be realized from the proposed in-use off-road diesel vehicle regulation of \$18 to \$26 billion. However, the Staff analysis is seriously flawed in several key respects and the Staff has overreached the ability both to estimate changes in morbidity and mortality and to place a value on those changes.

- The Staff relied on a series of studies, culminating in a meta-analysis across 500 studies (Pope & Dockery 2006).¹ The Staff did *not* include a subsequent review by a panel of experts published by the same journal that calls into question the ability to quantify the effects of PM emission reductions (Chow et al 2006).²
- In addition, a recent estimate of the value of a statistical life (VSL) published in the premier environmental economics journal shows conclusively that the VSL decreases with age in contrast with the assumption embedded in the Staff's analysis (Viscusi & Aldy 2007).³
- Finally, the Staff failed
 - to account for the fact that the emission reduction benefits are short-lived which contradicts the premise of the studies on which the Staff's analysis is based; and
 - to net out the increase in mortality and morbidity in other states from the compensating increased use of Tier 0 and 1 equipment in neighboring states assumed in the Staff's compliance cost analysis.

As a result, the no valid estimate of the benefits from the emission reductions can be made based on the current state of knowledge.

Current Research Is Insufficient to Estimate Mortality and Morbidity Benefits

Chow et al 2006 provides a review of Pope & Dockery 2006 by nine experts who have published numerous studies on emission benefit estimates, including several seminal ones that were instrumental in shifting the policy debate to focus on reducing PM emissions.^a The panel did *not* deny that PM emissions are associated with increased mortality and morbidity. However, ***the reviewers were unanimous in finding that the science was not yet ready to quantify the expected improvements in mortality and morbidity rates from reducing PM emissions.*** The reviewers criticized Pope and Dockery for drawing

^a Joe L. Mauderly, Lovelace Respiratory Research Institute; David L. Costa, U.S. EPA; Ronald E. Wyzga, EPRI; Sverre Vedal, University of Washington; George M. Hidy, Envair/Aerochem; Sam L. Alshuler, formerly of PG&E; David Marrack, Fort Bend Medical Clinic; Jon M. Heuss, Air Improvement Resource; and George T. Wolff, GM.

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conclusions that were not warranted by the literature cited. Among the key issues are the following:

- Many of the cited studies in Pope & Dockery 2006 show either ranges that include *increased* mortality with emission reductions,^b or large regional differences, including a 9% *increase* in mortality in the West from reduced PM emissions.^c
- The effects of PM alone, and specifically the toxicity of PM_{2.5} cannot yet be distinguished from other pollutants.^d
- A mathematical functional relationship that is linear with no minimum threshold is not supported by the literature.^e

With such a wide range of uncertainty around the effect estimates, particularly in the West, the inability to distinguish effects of PM from other pollutants, and the apparent lack of foundation for a valid mathematical form, the Staff has no basis for estimating the expected impacts, even a range, based on the current science available.

The Economic Benefit Estimates Are Not Consistent with Current Knowledge

Even if the Staff could make a reasonable estimate of the mortality and morbidity benefits, it has failed to update its analysis for recent work that indicates that the VSL is not constant as individuals age. In a recent article, Viscusi & Aldy 2007 found that the VSL for the age 55-62 years-old cohort is 58% lower at \$3.8 million than the peak of \$9 million in the age 35-44 cohort.^f Given that the effects from PM reductions are unlikely to be distributed evenly across age groups, this could have a significant impact on the benefit estimates.

The Benefits from the Emission Reductions Are Not in Perpetuity and Are Only a Shift in a Few Years of Benefits that Will Be Realized in Any Case

Both the estimates of reductions in mortality and morbidity and the associated economic valuations rely on the premise that the relevant emission reductions are a permanent reduction from current levels in perpetuity. In other words, the estimates assume that emissions have been at one constant level and are being lowered to another constant level. However, the proposed regulation will only lower emissions temporarily, with the inventory converging in 2030 with that under the current regulations.

Comparing the PM emission paths under the current and proposed rules, we find that the emission reductions are shifted forward an average of 5.7 years in the 2010 to 2030 time

^b Wyzga p. 1372; Hidy p. 1374; Heuss and Wolff, p. 1376.

^c Wyzga, p. 1372; Hidy p. 1374; Heuss and Wolff, pp. 1376-1377.

^d Mauderly, pp. 1370-1371; Costa, p. 1371; Hidy p. 1374; Ashulter p. 1375; Marrack p. 1375; Heuss and Wolff, pp. 1377-1378.

^e Costa, p. 1371; Vedal, p. 1373; Hidy p. 1374; Heuss and Wolff, p. 1377.

^f Viscusi is considered the premier researcher in this field and the previous US EPA and ARB reviews rely on many of his studies.

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period. Given that these reductions would have occurred in any case, the maximum gain in expected lifetime can be no greater than 5.7 years.

Yet the studies that the Staff relies on the estimate changes in mortality and morbidity are largely cross sectional. These imply that the change in life expectancy is the average for the population (roughly 77 years) minus the average age of the population experiencing premature deaths and morbidity (probably about 31 years). Thus the reduction in life expectancy implied in these studies is closer to 40 years, or six to eight fold that which might be produced by adopting the proposed rule. For this reason, the Staff has grossly overestimated the improved mortality and morbidity rates.

This issue also is salient in valuing changes in these rates. The VSL studies typically rely on labor market surveys in which the oldest of the cohort is 62 years old. Even the oldest workers have at least 15 more years of life expectancy, and the average is probably in excess of 30 years. Thus, the VSL relies on a very large reduction in life expectancy. The studies do not have the resolution to estimate a change of 6 years or less in life expectancy. Given that Viscusi & Aldy 2007 find that the VSL declines with age, the the analysis must be adjusted for the large discrepancy between the risk reduction created by the proposed rule and the risk reductions upon which the valuation method is based.

This shift in the rates also arises when considering any proposed changes in the regulation. Everyone will die eventually, so any debate about the potential effects is not about *increased deaths*, but rather about *decreased life expectancy*. Thus, we cannot reasonably estimate a comparable change in premature deaths from a shift in the emission path.

Shipping California's Tier 0 and Tier 1 Equipment to Other States Will Offset Gains in Health Benefits Here

The Staff in its cost compliance studies has insisted that 1) California can meet its targets by purchasing used equipment in the higher Tiers from other states and 2) California firms can offset their costs by selling their used equipment to other states. If California is buying newer used equipment from other states, those states will have to retain their older equipment for longer periods, and if California is selling its older used equipment to those states, then the population of Tier 0 and Tier 1 vehicles will increase in those states. In any case, NOx and PM emissions will increase in those states. That implies that while emissions will go down in California, emissions will increase by some commensurate amount elsewhere.

Yet, the Staff also relies on studies such as Pope & Dockery 2006 that show that changes in PM emissions have linear health impacts (i.e., one-for-one) with no minimum threshold. So an increase in emissions in other states will lead to an increase on mortality and morbidity in those states regardless of their current emission levels. In other words, the health benefit estimates must be offset by the increased emission costs in other states if the ARB is to take a truly holistic, rather than legalistic, approach to rulemaking.

The Staff has not prepared an analysis that shows what proportion of California's fleet is likely to be sold out of state, nor what portion of other states' fleets will be retained for a longer period as a result of this rule. Without this analysis, we cannot determine by how much the Staff has overestimated the expected health benefits from the proposed rule.

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References

¹ C. Arden Pope III and Douglas W. Dockery, "Health Effects of Fine Particulate Air Pollution: Lines that Connect" *Journal of the Air & Waste Management Association*, 56:709-742, June 2006.

² Judith C. Chow, et al, "Health Effects of Fine Particulate Air Pollution: Lines that Connect--Critical Review Discussion," *Journal of the Air & Waste Management Association*, 56:1368-1380, October 2006.

³ W. Kip Viscusi and Joseph E. Aldy, "Labor market estimates of the senior discount for the value of statistical life," *Journal of Environmental Economics and Management*, 53: 377-392, May 2007.