

**Summary Minutes of the  
U.S. Environmental Protection Agency Science Advisory Board  
Environmental Economics Advisory Committee  
Public Meeting  
March 7-8, 2016**

**Date and Time:** Monday, March 7, 2016, 9:00 a.m. – 5:00 p.m.  
Tuesday, March 8, 2016, 8:30 a.m. – 4:30 p.m.

**Location:** Crowne Plaza Washington National Airport Hotel, 1480 Crystal Drive, Arlington, VA, 22202

**Purpose:** To conduct a review of the EPA’s proposed methodology for updating its mortality risk valuation estimates for policy analysis.

**Participants:**

*Members of the EPA Science Advisory Board (SAB) Environmental Economics Advisory Committee (Committee roster is provided in attachment A)*

Dr. Madhu Khanna  
Dr. Kevin Boyle  
Dr. Sylvia Brandt  
Dr. Richard Carson  
Dr. Mary Evans  
Dr. Wayne Gray  
Dr. F. Reed Johnson  
Dr. Matthew Kotchen  
Dr. Matthew Neidell  
Dr. James Opaluch  
Dr. Daniel Phaneuf  
Dr. Andrew Plantinga  
Dr. Richard Ready  
Dr. V. Kerry Smith  
Dr. Stephen Swallow  
Dr. George Van Houtven  
Dr. JunJie Wu

*EPA Science Advisory Board (SAB) Staff:*

Dr. Thomas Armitage, Designated Federal Officer  
Mr. Thomas Carpenter, SAB Staff Office  
Dr. Holly Stallworth, SAB Staff Office  
Mr. Christopher Zarba, Director SAB Staff Office

*EPA Representatives:*

Dr. Chris Dockins, EPA National Center for Environmental Economics  
Dr. Al McGartland, EPA National Center for Environmental Economics

Dr. Steve Newbold, EPA National Center for Environmental Economics  
Dr. Nathalie Simon, EPA National Center for Environmental Economics

*Other Attendees (either present at the meeting or listening via audio webcast):*

Joel Corona, EPA  
Neal Fann, EPA  
Sandy Germann, EPA/OP  
Maria Hegstad, IWP News  
Bob Hetes, EPA  
Julie Hewitt, EPA  
Sandra Hoffman, USDA/ERS  
Achyut Kafle  
Atsuo Kisimoto  
Leila Lackey  
Amy Lamson, EPA  
Maricruz MaGowan, EPA  
Kelly Maguire, EPA  
John Norman, ExxonMobil Biomedical Sciences  
Zach Pekar  
Cody Rice, EPA  
Amanda Thomas, OMB  
Max Yoeli, NYU Law

### **Meeting Summary:**

**Monday, March 7, 2016**

#### **Convene the Meeting**

Dr. Thomas Armitage Designated Federal Officer (DFO) for the SAB Committee, convened the meeting at 9:00 a.m. on Monday, March 17, 2016. He stated that the Environmental Economics Advisory Committee operated as part of the EPA Science Advisory Board which is a chartered Federal Advisory Committee under the Federal Advisory Committee Act (FACA) and is empowered by law to provide advice to the EPA Administrator. He stated that summary minutes of the meeting would be prepared and certified by the Chair. He noted the Committee's compliance with ethics requirements. Dr. Armitage indicated that meeting materials were available on the SAB web site. These meeting materials included: the Federal Register Notice announcing the meeting,<sup>1</sup> meeting agenda,<sup>2</sup> Committee roster,<sup>3</sup> EPA review documents,<sup>4</sup> background documents provided by the EPA,<sup>5</sup> Charge to the Committee,<sup>6</sup> EPA briefing material,<sup>7</sup> preliminary written comments from Committee members,<sup>8</sup> and written public comments.<sup>9</sup> He noted that time had been included on the agenda to hear oral public comments but no requests had been received to present comments.

Mr. Christopher Zarba, Director of the SAB Staff office welcomed the members of the Committee, EPA staff, and members of the public to the meeting. He indicated that the Committee had been asked to provide advice to EPA on an important topic. He noted the depth of expertise on the Committee. Mr. Zarba encouraged members to have thoughtful open-minded discussion of responses to EPA's charge questions as they developed a consensus report of findings and recommendations.

## **Review of Agenda and Purpose of the Meeting**

Dr. Madhu Khanna, Chair of the SAB Committee, welcomed members of the Committee and other attendees to the meeting. She noted that the Committee would be meeting for the next two days to review the EPA's proposed methodology for updating its mortality risk valuation estimates for policy analysis. She indicated that the Committee had been charged with reviewing three documents and responding to EPA's specific charge questions. The three review documents were: (1) a White Paper prepared by the EPA Office of Policy to describe the Agency's meta-analysis that was conducted to estimate the value of mortality risk reductions, (2) a report prepared for EPA that described options for updating the estimate of income elasticity of the value of statistical life, and (3) an EPA technical memorandum providing supplementary information to the income elasticity report.

Dr. Khanna asked members of the Committee to introduce themselves and indicate their affiliations. She then reviewed the purpose of the meeting and the agenda. She said that the goal of the meeting was to begin developing a consensus report of findings and recommendations in response to 19 charge questions from the EPA. She noted that the Committee would first hear a presentation from EPA's National Center for Environmental Economics. The Committee would then review the charge questions and deliberate on responses to the charge questions. She noted that time had been provided on the agenda for public comments but no requests to speak had been received. She said that Committee members had been assigned to be lead writers and lead discussants for the charge questions. Dr. Khanna indicated that after the meeting, the lead writers would develop written responses to their assigned charge questions and she would work with the Designated Federal Officer to develop a first draft of the Committee's report, which would be sent to the Committee members for review and discussion on a teleconference. She further noted that after the Committee approved the report, it would be sent to the chartered SAB for review and final approval.

## **Remarks from EPA's National Center for Environmental Economics**

Dr. Khanna introduced Drs. Al McGartland, Nathalie Simon, Steve Newbold, and Chris Dockins of EPA's National Center for Environmental Economics (NCEE) who made a presentation to the Committee. Their presentation slides are included in the meeting materials available on the SAB website (see materials cited). Dr. McGartland, Director of the NCEE, thanked the Committee for reviewing the EPA's updated methodology for mortality risk valuation. He indicated that determination of the value of statistical life (VSL) was a cornerstone in EPA's *Guidelines for Preparing Economic Analyses* and it was important for EPA to develop an updated estimate of VSL.

Dr. Simon indicated that the EPA's presentation provided an overview of the proposed methodology for estimating VSL. She noted that the presentation would cover: how the data were assembled, the approach that was used to estimate VSL, and how income elasticity of the VSL was determined and applied in the analysis. Dr. Simon indicated that current EPA guidance recommended using a VSL estimate of \$9.7 million (\$2013). This estimate was based on 21 hedonic wage studies and 5 stated preference studies published between 1974 and 1991. She noted that in 2011 the SAB had recommended specific screening criteria for selecting studies to update the VSL estimate. Dr. Simon described these study screening criteria and presented a diagram showing how EPA had applied the criteria to select the stated preference studies and hedonic wage studies that had been used to develop an updated VSL estimate. She indicated that some of the Committee's charge questions focused on whether the study selection criteria that were previously recommended by the SAB had been appropriately applied.

Dr. Steve Newbold discussed the meta-analysis and meta-regression approach EPA had used to estimate the average VSL for the U.S. adult general population. He noted that some studies had contributed multiple observations to the meta-database. Dr. Newbold indicated that EPA had computed non-parametric estimates of the average VSL by calculating weighted averages of the VSL estimates from the primary literature that met the selection criteria. Dr. Newbold described the weighting scheme used to develop the non-parametric estimates and how EPA had estimated standard errors for the weighted means using a bootstrap approach. Dr. Newbold indicated that, in addition to the non-parametric estimation approach, EPA had used a parametric approach based on maximum likelihood to estimate the average VSL for the general U.S. adult population. Dr. Newbold further indicated that the non-parametric and parametric estimates of the VSL had been developed four different ways using: 1) hedonic wage studies reporting only mean estimates, 2) stated preference studies reporting mean or median estimates, 3) pooled estimates based on weighted averages of all included hedonic wage and stated preference observations, and 4) balanced estimates based on the simple average of the separate estimates calculated using the hedonic wage and stated preference observations alone. Dr. Newbold reviewed four of the charge questions that focused on the estimation approaches used by EPA.

Dr. Newbold also presented a summary of the results of the non-parametric and parametric modeling that EPA had used to estimate VSL. He indicated that in the EPA's White Paper, the Agency had proposed using an estimated VSL of \$10.3 million. He noted that this was an average of the non-parametric balanced mean of study means (\$10.4 million) estimate and the parametric balanced estimate (\$10.2 million). Dr. Newbold explained why EPA had proposed using the average of these two estimates. He indicated that the non-parametric estimate with the lowest estimated variance was chosen and the parametric estimate from the balanced model was chosen because it gave equal weight to the stated preference and hedonic wage study estimates. Dr. Newbold noted that Charge Question 9 asked the Committee to comment on whether EPA's proposed estimates represented reasonable and scientifically sound conclusions.

Dr. Chris Dockins presented a summary of EPA's analysis of the income elasticity of VSL. He noted that an income elasticity of 0.7 had been used in EPA's analysis. Dr. Dockins indicated that EPA had commissioned a review by Industrial Economics to examine the available published literature and determine income elasticity of VSL. Dr. Dockins indicated that two alternatives were considered: (1) equally weighted mean results from hedonic wage and stated preference literatures yielded a central income elasticity of VSL estimate of 0.7; (2) a meta-analysis of hedonic wage studies yielded a central income elasticity of VSL estimate of 1.1. Dr. Dockins indicated that he looked forward to hearing the Committee's comments about the most appropriate and scientifically sound alternative, and the Committee's responses to the other charge questions concerning income elasticity.

#### *Questions from Committee members*

Dr. Khanna thanked EPA staff for their presentations and called for questions from the Committee. A Committee member asked whether EPA was thinking about how the VSL estimate might vary by type of risk and population. EPA staff responded that they wanted to examine this issue but it was difficult because of the limited number of studies available.

A Committee member commented that in previous advice to EPA, the SAB had not recommended that the agency search for a single VSL. He noted that the SAB had previously suggested alternatives to a meta-analysis. These alternatives included specific studies and a benefits transfer approach. He asked EPA staff why they had not applied such alternative approaches. EPA staff responded that the agency

had considered developing estimates for specific health outcomes but found that there would be few studies to use for developing the estimates. EPA staff further responded that they decided to blend two of the recommendations from the previous SAB advisory, namely to develop a baseline distribution of estimates for fatal injury and a set of adjustment factors for risk and individual characteristics as warranted and develop a meta-regression model to estimate the VSL as a function of risk and individual characteristics. EPA staff indicated that, as the literature evolved, they hoped it would be possible to develop adjustment factors to account for variations in VSL by type of risk and population.

A Committee member noted that mortality risks occurred over a long term but EPA had chosen to look at immediate risk reduction. She questioned why EPA had chosen this option. EPA staff responded that because they opted to develop a baseline or benchmark estimate of VSL, it was appropriate to focus on risk reductions for ‘immediate’ deaths as a first step and then develop adjustment factors to account for relevant risk characteristics as the literature allows. A Committee member commented on EPA’s analysis and the weighting scheme used. He noted that EPA had appeared to use benefit transfer assumptions. He commented that it was not clear that samples were independent because they had been adjusted. An EPA staff member responded that in some ways, the analysis could be viewed as something like benefit transfer. A Committee member commented on limitations of the available data, noting that the hedonic wage studies did not consider part time workers and it was difficult to consider cancer risk separately. Another member commented that it was important to bring together studies that represented specific populations.

### **Review of the Charge Questions**

The Committee next reviewed the charge questions. Dr. Khanna briefly described the topics addressed by the charge questions. She noted that EPA had given the Committee 19 questions listed under five topics. The topics were: (1) the meta-analysis data set (six questions), (2) the analysis conducted in EPA’s white paper (four questions), (3) the results presented in the white paper (two questions), (4) establishing a protocol for future revision of the value of statistical life (VSL) (two questions), and (5) EPA’s technical memorandum on income elasticity of the VSL (five questions). Dr. Khanna asked Committee members whether any of the charge questions needed clarification and whether any aspects of the charge questions needed further discussion. There were no requests for clarification or further discussion.

### **Public Comments**

Dr. Khanna noted that time had been included on the meeting agenda for public comments but no requests to speak had been received. She therefore moved to the next agenda item which was discussion of the Committee’s responses to EPA’s charge questions.

### **Discussion of the Committee’s Responses to EPA’s Charge Questions**

Dr. Khanna called for the discussion of responses to EPA’s charge questions. She noted that Committee members had already developed individual preliminary written responses to the questions. These preliminary responses had been distributed to the Committee and posted on the SAB website. She noted that lead discussants had been assigned to begin the discussion of each charge question.

*Charge Question 1(a) – Evidence of Validity for Stated Preference Studies*

The Committee discussed the response to charge question 1(a). The question asked for advice on whether the methods the EPA had used to assess the validity of VSL studies and estimates were appropriate and scientifically sound. The lead discussants assigned to the question were Drs. Boyle and Carson.

Committee members commented that there was a need to find additional VSL studies for the analysis. Members noted that the evidence of study validity considered by the EPA was appropriate but incomplete. Members suggested that the EPA clarify how evidence of validity was considered for all of the studies. Members discussed concepts of stated preference study validity. These concepts included content, construct, and criterion validity. Members commented that there was no perfect test of validity. They noted that validity assessment should be an evaluation of the weight of evidence. Members commented that tests of scope (applied in the white paper) were tests of construct validity and that a scope failure did not necessarily mean that the measures derived from the study were invalid. Members further discussed the meaning of study validity. Members also commented that additional detail was needed in the White Paper to document the evidence of validity that was considered in evaluating all of the studies used (and considered for use) in the meta-analysis. A member commented that the EPA had evaluated the validity of the studies used in the meta-analysis, but not necessarily the bigger issue of validity of the meta-analysis itself.

The Committee discussed whether the term “value of statistical life” was appropriate to describe what was being measured. A member commented that in the previous review, the SAB had recommended that this term not be used, and that the measure be approached in a different way.

The Chair commented that the Committee needed to discuss how the EPA should decide which studies were to be used in the analysis. A member responded that there was no litmus test to indicate whether a study was valid or not. He noted that this was a weight of evidence decision, and it was important to provide detailed information indicating how the studies were evaluated. A member commented that some of the studies that the EPA had excluded from the analysis seemed to provide valid estimates for some subpopulations. Another member commented that it was important to consider study design. He noted that a study that passed a weak scope test should be excluded from the analysis if the design did not make sense. Members commented that it was not clear whether the EPA’s evaluation process included contacting authors to obtain information on pre-testing procedures. A member noted that this kind of information was not usually included in published papers. EPA staff responded that the agency had looked at study validity in terms of scope. With the exception of questions about scope, they had not asked authors questions about the analyses. EPA staff further indicated that estimates were primarily excluded from the analysis based on scope.

Other members reiterated that it was important to look at evidence of validity in a broad context. A member commented that it was important for studies to be well documented. Another member noted that decisions about study validity were often based on professional judgment. Members further commented that all criteria for inclusion and exclusion of studies and observations should be documented systematically in the White Paper. They noted that evidence in the literature could be used to establish whether stated preference design and implementation procedures lead to valid estimates. The Chair then thanked the members of the Committee for their comments and indicated that she would turn next to the discussion of Charge question 1(b).

*Charge Question 1(b) – Construction of the Risk Variable in Hedonic Wage Studies*

The Committee discussed the response to Charge Question 1(b). The VSL analysis in the White paper was conducted using hedonic wage studies where the risk measure was differentiated by industry and at least one other characteristic (e.g., occupation, gender, age). The Committee was asked to comment on whether the hedonic wage studies included in the White Paper had constructed the risk variable in a manner appropriate for use in the meta-analysis. The lead discussants assigned to the charge question were Drs. Gray and Boyle.

Members commented that they were concerned about classical measurement errors. Members noted that the use of the “industry and one other characteristic” risk measures posed problems when considering characteristics such as gender and age. This was because the risks were likely to be varied within an industry and because wage discrimination might affect the wage-risk differential across some groups. Members discussed possible options for addressing these issues but noted that any assignment of group risk to an individual would be associated with measurement error. A member commented that exclusion of industry only studies (i.e., studies not differentiated by occupation within an industry) might not provide better results. A member commented that the EPA could consider using its own analysis of Census of Fatal Occupational Injuries (CFOI) data rather than using published studies. A member suggested that the SAB might set up procedures for the EPA to conduct its own hedonic wage studies.

Members discussed additional studies that could be included in the meta-analysis. Some members commented that the EPA could include in the White paper a summary of recent meta-analyses of hedonic wage studies. They noted that the summary could provide information about how the results of those studies varied according to study design and data sources. This would enable the White Paper to convey the likely sensitivity of the final VSL summary measure to variations in the set of studies included in the calculations.

Members again noted that the VSL generated by hedonic wage studies may be systematically biased relative to the VSL for the whole population obtained from stated preference studies. Several potential biases were discussed. Members discussed potential problems associated with using different risk measures to estimate VSL. Members noted that in one study that examined both an industry-only risk measure and an industry and occupation risk measure, the results for the industry only VSL were twice as large as the industry and occupation VSL. Members indicated that it was important to understand why these differences occurred. The Chair next called for discussion of the response to Charge Question 1(c).

*Charge Question 1(c) - Estimates of the Average Value of the Marginal Willingness to Pay for Reduced Risk of Immediate Death*

The Committee discussed the response to charge question 1(c). The question focused on whether appropriate estimates from the stated preference literature were used in the White Paper to estimate marginal willingness to pay for reduced risk of immediate death. The lead discussants for the question were Drs. Johnson and Van Houtven.

Members commented that a protocol was needed to analyze the large number of studies that were associated with latency. Members discussed the following points: (1) whether risk of immediate death was a policy-relevant outcome; (2) whether discounting correctly accounted for the effect of time on VSL; (3) whether survey respondents were able to evaluate long-latency risks; and (4) whether a 3%

discount rate was arbitrary. Members commented on the need for an approach that was consistent with how estimates were to be used. Members discussed some additional studies that could be included in the White Paper.

At 12:00 p.m. following the discussion of Charge Question 1(c) the Committee meeting was recessed for a lunch break. The Committee continued its discussion of the responses to the charge questions at 1:15 p.m. after the lunch break.

*Charge Questions 2 and 3 – Adequacy of the Empirical Studies in the White Paper; and Appropriateness of the Population Weighting Approach used to Construct Estimates in the Meta-Analysis Data Set*

The Committee discussed the responses to Charge questions 2 and 3. Charge question 2 focused on whether relevant empirical studies in the stated preference and hedonic wage literatures were adequately captured in the White Paper. The lead discussants for Charge Questions 2 and 3 were Drs. Swallow and Gray.

Committee members noted that there had been a lack of growth in the VSL literature in the period of time since the topic was previously considered by the SAB. Members suggested a number of additional studies for inclusion in the White Paper but no firm recommendations were provided about how the additional studies should be incorporated. Members commented that it was important to recognize limitations concerning the scope of hedonic wage studies, particularly in relation to forms of sampling bias and whether these studies could provide a nationally representative estimate. Members suggested that more information could be included in the White Paper to enable better assessment of how the reliance on published studies, particularly other meta-analyses, might lead to results that were biased (due to publication bias, lags in publication, or other concerns).

Charge Question 3 focused on whether the population weighting approach used in the White Paper to approximate a VSL for the general population was appropriate and scientifically sound. Members commented that some of the sub-population studies used in the White Paper appeared to omit data that were directly applicable to some portion of the U.S. adult population. For example, hedonic wage studies appeared to omit non-workers and therefore also omitted older individuals.

Members commented that there appeared to be some numerical inconsistencies in the weighting results presented in the White Paper, however a more detailed explanation of how the weighting was actually done was needed to further understand how the studies were brought together for the aggregate estimate. The following points were also discussed: the EPA should address potential sources of selection bias associated with particular studies; weighting approaches should give greater consideration to the details of the specific studies being weighted (for example, population weighting and benefit-transfer weighting may involve different principles); and weighting to adjust for income differences should be done after determining the estimates to be drawn from a particular study time period. Members discussed whether the White Paper should provide better justification for excluding studies that were not nationally representative. Committee members also discussed whether the EPA should use studies that were not published in the peer reviewed literature. Some members suggested that the EPA consider establishing a process to review studies that had not been published in the peer reviewed literature. The Committee also discussed problems associated with aggregating Hicksian and Marshallian measures of VSL. The Chair next called for discussion of the response to Charge Question 4.

#### *Charge Question 4 – Estimation of Standard Error*

The Committee discussed the response to Charge question 4 which focused on whether the methods the EPA had used in the White Paper to estimate standard errors of the VSL were scientifically sound. Standard errors had been estimated when such information was not readily available within the original published studies. The lead discussants for Charge Question 4 were Drs. Wu and Van Houtven.

Members commented that additional information was needed in the White Paper to describe how the standard error of the VSL was calculated when it was not reported in the original publication. A member noted that the standard error could be calculated based on the 95% confidence interval. He suggested that the formula used to translate confidence interval to standard error estimate be included in the White Paper.

Committee members noted that in some cases the EPA had calculated standard errors for mean willingness to pay when original studies reported variance for median willingness to pay. A member suggested that the EPA include in the White Paper a detailed explanation of how this had been done. A member commented that the EPA should provide additional information in the White Paper to indicate how the standard error of the VSL had been calculated for hedonic wage studies based on the standard error of the risk coefficient alone.

The Committee discussed alternative approaches for estimating standard error for the overall VSL estimate. It was noted that EPA had suggested five non-parametric approaches for estimating VSL and that a bootstrap approach had been used to estimate standard errors for the non-parametric VSL estimates. Members commented that there may be conceptual problems associated with using the bootstrap approach because it did not reflect the deviation of the VSL estimate from the true VSL. The Committee discussed an alternative approach. A member also commented that the White Paper did not provide detailed discussion about the approach used to estimate the standard error of VSL estimates for the parametric approach. The Chair next called for discussion of the response to Charge Question 5.

#### *Charge Question 5 – Overall Methodology for Analyzing the Data*

The Committee discussed the response to Charge Question 5. This question focused on whether the methodology used in EPA's White Paper to analyze the data represented an appropriate and scientifically sound application of meta-analytic methods to derive generally applicable VSL estimates for policy analysis. The lead discussants for Charge Question 5 were Drs. Van Houtven and Kotchen.

Some Committee members commented that the meta-analytic methods used in the White Paper were, for the most part, scientifically sound and consistent with standard and accepted practices for conducting meta-analysis. Members commented that the White Paper could be more explicit in laying out the best practices for meta-analysis. Members commented that the non-parametric methods used in EPA's analysis included approaches that were fundamentally similar to methods typically referred to in the meta-analysis literature as fixed effect size and random effect size methods. Committee members recommended that the EPA describe how the methods used in the White paper were similar to and departed from these standard practices.

Other members commented that the White Paper should provide more detail about the primary studies used. Members discussed whether the White Paper should provide a better explanation of why a sample size weighted approach was used. Members also commented on concerns about the EPA's adjustments

for income and the pooling of the stated preferences. A member commented that the EPA should conduct both the parametric and non-parametric analysis without a direct adjustment to income. It was also suggested that the meta-regression analysis include specifications with an income measure as an explanatory variable. The Chair next called for discussion of the response to Charge Question 6.

#### *Charge Question 6 – Grouping Samples for Analysis*

The Committee discussed the response to Charge Question 6. This charge question focused on whether the methodology used by the EPA to group samples for analysis represented an appropriate and scientifically sound approach to account for potential correlation of results derived from the same underlying data. The lead discussants for Charge Question 6 were Drs. Phaneuf and Evans. Some Committee members commented that grouping studies in the White Paper based on similar samples was a sensible approach to account for lack of independence in estimates constructed from the samples. Members commented, however, that it would be useful to provide additional detail in the White Paper to clarify how the grouping decisions had been made. In particular members suggested that additional information be provided in Table 6 of the White Paper. A member commented that many standard errors were dependent on the same study. The committee discussed whether there was a need to explore the sensitivity of results to alternative group assignments. It was suggested that influence analysis could be used to examine the robustness of results when individually excluding each group. Members noted that the work of Viscusi was dominant in the hedonic wage studies. Members suggested that an analysis could involve identifying the primary estimate from each study and re-estimating the meta-regression using only the primary estimates. The Chair next called for discussion of the response to Charge Question 7.

#### *Charge Question 7 – Sampling and Non-Sampling Errors*

The Committee discussed the response to Charge Question 7. This charge question focused on whether the expression EPA used to characterize optimal weights that account for sampling and non-sampling errors was appropriate and scientifically sound. The lead discussants for Charge Question 7 were Drs. Evans and Phaneuf. Members discussed the need for more transparency in the description of the approach in the White Paper. Members commented that the steps required to derive the equation in Section 4.1 of the White Paper should be provided. Members discussed the need for citations establishing the validity of the basic approach. Members also discussed the need for clarification and justification of the assumptions regarding the error components. In addition members commented that transparency should be included in the White Paper as a criterion for selecting an estimator.

#### *Charge Question 8 – Non-parametric and Parametric Approaches for Estimating Value of Statistical Life*

The Committee discussed the response to Charge Question 8. This question focused on whether the non-parametric and parametric approaches used by EPA to estimate the VSL were appropriate and scientifically sound. The lead discussants for Charge Question 8 were Drs. Plantinga and Brandt.

Committee members discussed the need for additional information in the White Paper to explain the use of the approaches and to provide additional justification for use of the methods. Members commented that justification was needed to better explain why the methods were relevant to finding the central tendency of VSL estimates from studies that often reported multiple estimates. A member commented that some discussion of the conceptual merits and data requirements of each method should be provided. Members discussed the EPA's conclusion that the mean of group means estimator was the preferred non

parametric method. Members noted that the estimator had the smallest estimated standard error. A member commented that there was much variation across papers in the number of reported estimates. It was suggested that this may be a result of idiosyncratic factors. Members discussed the possibility of using an alternative non-parametric method that incorporated information on the sampling variance from each study.

The Committee also discussed whether there was a time trend in inflation adjusted VSL estimates and how a time trend should be addressed. Some members commented that the time trend could really be a publication author effect correlated with time and therefore using a midpoint could be the best approach. Others commented the time variable could be evaluated in the current year, the end of the data period, or the midpoint of the data period. The Committee also briefly discussed the adjustment for income. A member asked EPA whether particular figures could be provided without the adjustment for income. EPA staff provided this information<sup>10</sup>. The Chair next called for discussion of the response to Charge Questions 9 and 10.

#### *Charge Question 9 and 10 – Proposed Estimates of the Value of Statistical Life; and Influence Analysis*

The Committee discussed the response to Charge Questions 9 and 10. The lead discussants for Charge Questions 9 and 10 were Drs. Smith, Opaluch, and Plantinga. Charge Question 9 focused on whether the proposed VSL estimates provided in EPA's White Paper represented reasonable and scientifically sound conclusions from the analyses in the White Paper and whether there was a different set of results that were preferable based on the data and analysis in the White Paper.

Some Committee members commented that the proposed summary VSL measures presented in the White Paper appeared to be defensible estimates but additional information was needed in to clearly identify how the studies were grouped. Members commented that EPA should consider using the non-parametric sampling error variance weighted group mean in place of the non-parametric mean of group means estimator. Members discussed possible inconsistencies in the weights used across studies. Members also discussed the adjustment of VSL estimates by income elasticity of VSL and index of income growth. Members commented that the documentation of income adjustment in the White Paper was not clear. A member commented that the income adjustment for stated preference measures should account for the fact that these estimates were derived from Hicksian welfare measures. The Committee discussed the difference between Hicksian and Marshallian measures and how this should be taken into account when using hedonic wage and stated preference studies to estimate VSL.

Charge Question 10 focused on whether the results of the influence analysis conducted by EPA suggested any changes or modifications to the VSL estimation approach and whether it was important to conduct an influence analysis. Members discussed the importance of an influence analysis and noted that such an analysis was important, especially given the implicit assumptions underlying the structure of the non-sampling error related to the groups. Members commented that some form of influence analysis was important for meta-analysis in cases where there were few studies to consider, and therefore one or two individual studies might have a substantial influence on estimates. A member commented that there were three stated preference studies that appeared to be influential and two hedonic wage studies that appeared to be influential. Another member noted that several of these studies did not seem to be highly influential. Members suggested that, rather than dropping studies from the analysis, an estimation technique could be used to limit the influence of the observations. Highly influential observations could be down weighted. The Committee also discussed the potential use of regression diagnostic indices for the parametric modeling of the VSL.

Following the discussion of charge questions 9 and 10 the Chair indicated that the meeting would recess for the day. She indicated that the Committee would reconvene at 8:30 a.m. the following day.

## **Tuesday, March 8, 2016**

### **Reconvene Meeting**

The Designated Federal Officer reconvened the Committee meeting at 8:30 a.m. on Tuesday, March 8, 2016. The Chair summarized issues that had been discussed on the previous day and indicated that the Committee would discuss the responses to Charge Questions 11 – 17 before lunch. She indicated that the lead writers would then summarize the key points in the Committee’s discussion of the charge questions and these points would be discussed. She noted that the meeting was scheduled to adjourn at 4:30 p.m. The Chair then called for continued discussion of the responses to the charge questions.

### **Continued Discussion of the Committee’s Responses to EPA’s Charge Questions**

#### *Charge Question 11 – Criteria for Inclusion and Exclusion of VSL Estimated in Future Analyses*

The Committee discussed the response to Charge Question 11. The question focused on: (1) criteria for the inclusion of additional eligible VSL estimates (and the exclusion of older estimates) that could help inform the development of a standardized protocol for future VSL updates, and (2) the timing or frequency of VSL updates. The lead discussants for this charge question were Drs. Opaluch and Ready.

Members discussed the importance of increasing the pool of high quality studies that could support the VSL meta-analysis. Members noted that there were only a small number of data sets available to support hedonic price estimates, and there were relatively few stated preference studies included in the current meta-analysis. Some members commented that high quality gray literature studies may not be of lower quality than studies in the published literature and therefore the EPA might want to consider a process for evaluating such studies for use. Members commented that it was important to make more study data available to researchers. Members noted that some studies reported VSL estimates but did not report standard errors or confidence limits, income elasticities, or estimates by subpopulation. Members discussed steps that could be taken to make more of the study information available. Members suggested that the EPA work in collaboration with other agencies and professional associations to pursue actions to make more data publicly available.

Committee members discussed the appropriate time frame for updating the VSL. Some members commented that a five year interval for updating VSL estimates was appropriate. Members also suggested that the EPA develop a single set of criteria for determining which studies were of sufficient quality to be included in current and future estimates of VSL. Members commented that a standardized data set could be developed, updated, and used year by year to determine the VSL. Members suggested that the EPA consider publishing its own journal or sponsoring special issues of other journals to publish VSL studies. A member pointed out that funding would have to be provided to publish such studies or make data available. The Committee further discussed other issues including: (1) whether EPA should restrict studies used to update the VSL to those published in the peer reviewed literature; (2) whether useful information could be extracted from other kinds of studies to improve the estimate of VSL; (3) whether studies based on non-national samples should be used; and (4) how to make whole data sets available for use by the research community. The Chair next called for discussion of the response to Charge Question 12.

### *Charge Question 12 - Valuing Reductions in Risks of Cancer*

The Committee next discussed the response to Charge Question 12. This charge question focused on whether the literature indicated that people were willing to pay more for mortality risk reductions that involve cancer than for risk reductions from mortality due to other causes (i.e., cancer differential). The lead discussants for the charge question were Drs. Ready and Johnson.

Committee members discussed why cancer mortality was different from mortality associated with other sources. Some members commented that it was not clear that cancer should be treated differently. Committee members commented that cancer deaths could be considered to be worse than sudden accidental death because of the associated morbidity. Members discussed whether and how morbidity could be addressed in valuing the reduction of the risk of cancer mortality. Some members commented that the EPA should continue to look for evidence of a cancer premium.

Members commented that it was difficult to know what to recommend with regard to the cancer differential because there was little information available. Some members commented that there was not enough information available to justify a non-zero cancer differential. Members further discussed information that was available in the literature. Some members suggested that the EPA should value cancer morbidity whether or not it was associated with early death. Members commented that cancer was not a uniform disease and therefore it was important to consider valuation in the context of different kinds of cancer. Members commented that it was important to consider valuation in the context of extension of life as well as quality of life. Members further discussed how to incorporate morbidity information into the VSL calculation. Some members commented that new methods were needed to address this issue. The Chair next called for discussion of the response to Charge Question 13.

### *Charge Question 13 – Income Elasticity of the Value of Statistical Life*

The Committee discussed the response to Charge Question 13. This question focused on whether the EPA's review documents had provided an appropriate and scientifically sound summary of the income elasticity of VSL and income elasticity of non-fatal health effects literature and also whether there were additional empirical studies that should be included in the summary. The lead discussants for the question were Drs. Kotchen and Neidell.

Committee members discussed the summary of the literature in the review documents. Members commented that the review documents provided a reasonable summary of the literature and there were not many studies to add. Two additional studies were suggested. Members commented that, if these additional studies were to be excluded from the summary, the EPA should provide justification for the exclusion. Members commented that little research had been conducted on the income elasticity of VSL. Some members suggested that, in the absence of such studies, the EPA might consider using estimates of the income elasticity for other related goods and services to infer estimates for the income elasticity of the VSL.

The Committee discussed alternative approaches to determining the income elasticity of VSL. Some members commented that they had concerns about using cross-sectional analyses for this purpose. Members suggested that the EPA should support more research to provide methodological guidance and empirical estimates of the income elasticity of VSL. The Chair next called for discussion of the response to Charge Question 14.

### *Charge Question 14 – Analysis of Very Low Income Elasticity Estimates*

The Committee discussed the response to Charge Question 14. This charge question focused on how low or zero estimates of income elasticity of VSL should be addressed in the EPA's analysis. The lead discussants for this charge question were Drs. Neidell and Swallow.

Committee members discussed whether the income elasticity of VSL was likely to be zero or negative. Some members commented that, although low estimates could be derived from the stated preference studies, the income elasticity of VSL was highly unlikely to be zero or negative. Members commented that the stated preference studies used by the EPA were not designed to measure income and it was necessary to decide which studies were valid for such an assessment. The Committee discussed measurement error. Some members attributed small income elasticity numbers to measurement error. Other members commented that it was hard to attribute the small numbers to measurement error.

The Committee discussed how to address low income elasticity estimates. Some members commented that zero or negative income elasticity estimates were theoretically impossible and could be dropped from the analysis. Other members commented that it was hard to find statistical justification for dropping these estimates. It was suggested that EPA might consider using standard errors of individual income elasticity of VSL estimates to calculate a weighted mean. Members suggested that the weighted mean could be calculated both with and without the low or zero estimates to assess the influence of these estimates. The Chair next called for discussion of the response to Charge Questions 15 and 16.

### *Charge Questions 15 and 16 – Study Selection Criteria and Alternative Approaches for Estimating Central Income Elasticity of VSL*

The Committee discussed the responses to Charge Questions 15 and 16. Charge Question 15 focused on whether the criteria applied in the review documents to select studies for estimating income elasticity of VSL were appropriate and scientifically sound, and whether the inclusion of a particular study by Viscusi, Huber, and Bell in the analysis was appropriate. Charge Question 16 focused on whether the alternatives put forward in the review documents for determining the Income elasticity of VSL were appropriate. The lead discussants for Charge Questions 15 and 16 were Drs. Carson and Wu.

Members discussed whether the two alternatives put forward in EPA's review documents represented an adequate basis for providing estimates of the income elasticity of VSL. Members commented that the available studies were well summarized in the review documents, but the alternatives for deriving income elasticity did not appear to be adequate. A member commented that inclusion of the additional study by Viscusi, Huber, and Bell did not change this conclusion. In this regard, members discussed a number of problems associated with determining income elasticity of VSL. Members commented that, in order to estimate the income elasticity of VSL, variation in income was needed. They noted that this was problematic because there had been relatively little change in median income over the past two decades. Members noted that some of the studies used to estimate income elasticity of VSL applied data from a cross-section of individuals, while others estimated the income elasticity of VSL from time series data. Members commented that the EPA's use of income elasticity of VSL estimates to adjust VSL estimates over time called for a time series based measure. Some members commented that the hedonic wage approach did not, by design, provide an estimate of the income elasticity of VSL.

The Chair asked the Committee what could be done immediately to estimate the income elasticity of VSL. The Committee discussed possible alternatives to the use of cross-sectional data. It was suggested that the EPA might consider selecting one of the currently preferred VSL model specifications and use

income variation over time to obtain an income elasticity of VSL. It was suggested that the sensitivity of the income elasticity of VSL estimate to different model specifications could be examined and the results could be averaged if there was not a clear reason for favoring one model specification over another. The Committee also discussed the use of an income elasticity estimate of .4 (the current estimate used by EPA). Some members commented that keeping the current estimate might be a good approach. The Chair next called for the discussion of the response to Charge Question 17.

#### *Charge Question 17 – Income Elasticity of the Value of Non-Fatal Health Effects*

The Committee discussed the response to Charge Question 17. This charge question focused on whether using the income elasticity of VSL to estimate income elasticity for the value of non-fatal health effects represented an appropriate and scientifically sound approach. The lead discussants for this charge question were Drs. Johnson and Smith.

The Committee discussed whether it was conceptually correct to use income elasticity of VSL to estimate the income elasticity of non-fatal health effects. Some members commented that there did not appear to be a theoretical linkage that could justify this. Members commented that the EPA could consider exploring the use of income elasticity of expenditures on private health care products as a possible proxy for the income elasticity of non-fatal health effects. The Committee also discussed the possibility of using income elasticity ranges as an interim approach until better information and guidance was available. EPA staff indicated that Table 2.2 in the Robinson and Hammitt review document contained information on the studies that had provided income elasticity estimates for mortality risk reduction.

At 12:00 p.m. following the discussion of the response to Charge Question 17 the Committee recessed for a lunch break. The meeting was reconvened at 1:00 p.m. after the lunch break.

#### **Clarifying Comments**

Dr. Khanna thanked the Committee members for the discussion of the charge question responses and indicated that time had been included on the agenda to hear brief clarifying comments from the public. She asked whether there were any requests to comment from members of the public or EPA staff. There were no requests to provide comments.

#### **Discussion of Key Points in Responses to the Charge Questions**

The Chair then asked the lead writers and members of the Committee to discuss the key points that had been raised in the discussion of the responses to the charge questions. Members of the Committee discussed the following key points.

#### *Key Points Discussed in Response to Charge Question 1(a)*

- It was unclear how the evidence of validity was applied across all included studies. (Were the same criteria applied by EPA to all studies that were included and excluded?)
- The list of factors considered as evidence of validity was incomplete, especially with regard to study design and administration features.
- It was not clear how, or if, evidence of validity was used to exclude or include studies and observations from EPA's analysis. EPA had identified exclusions, but the White Paper appendix was silent on the investigations for some studies. The threshold for inclusion was not clear.

- The Committee discussed recommending that EPA provide a table listing the evidence of validity that was available or not available for each excluded and included study.
- The Committee discussed recommending that the evidence of study validity be expanded to address the following questions:
  - Was the survey pretested using focus groups, one-on-one interviews, or field pretest?
  - Was the survey applied to a random sample of a clearly specified population?
  - Did the survey clearly define the baseline risk?
  - Did the survey clearly explain the change in risk to be valued?
  - Was the sample of respondents investigated for comparability to the population sampled?
  - Was the stated preference question a binary choice framed as a referendum or product purchase?
  - Were robustness checks conducted of the statistical analyses that led to the value estimate?
  - Were construct validity tests conducted?
  - Was the study peer reviewed?
- The Committee discussed recommending that studies on the margin for inclusion or exclusion from the meta-analysis be carefully scrutinized to assess whether the potential invalidity biases the study value estimates.
- The Committee discussed recommending that, in assessing the weight of evidence of validity for a study, consideration should rely on the broad stated preference literature and pre-existing meta-analyses of VSLs to inform validity and invalidity assessments.
- The Committee discussed recommending that all future updates of the VSL should simultaneously consider whether the conditions for investigating validity should be updated.
- The Committee discussed recommending that all criteria for inclusion and exclusion of studies and observations be documented systematically in a table. The Committee also discussed recommending that manipulations of value estimates to convert them to a homogenous metric be documented.

*Key Points Discussed in Response to Charge Question 1(b)*

- The Committee discussed recommending that the analysis to determine the final VSL measure include only those hedonic wage studies where the risk variable included variation by occupation
- Better documentation of the study selection process was needed.

*Key Points Discussed in Response to Charge Question 1(c)*

- The Committee discussed citations for additional studies that could be included in the White Paper.
- The Committee discussed possible exclusion of some studies but did not reach agreement on recommendations.
- The scope of studies used to derive values for reducing both mortality and morbidity risks could be broadened. There were a significant number of published studies that estimated willingness to pay for improved health and reduced health risks, and literature on benefit-risk and risk-risk tradeoff preferences in health and health care, which could provide a basis for enriching the evidence base on risk preferences and supporting benefits-transfer applications.

### *Key Points Discussed in Response to Charge Questions 2 and 3*

- Citations were provided for additional studies that could be included in the White paper
- Clarification was needed to distinguish weighting for aggregating subpopulation data to obtain a representative estimate for the U.S. population from weighting for transferring a benefit estimate for one population to an omitted or underrepresented population.
- The White paper should discuss the limitations of hedonic wage studies.
- The Committee discussed whether the hedonic wage studies that were used should be restricted to those that applied Census of Fatal Occupational Injury data. Members indicated that studies using other data may offer insight on key populations.
- The Committee discussed whether excluded studies (meta-analyses or studies from other countries) could be used to show whether the VSL in the White Paper was consistent with other studies.
- EPA should consider creating incentives for new studies.
- More detailed information should be provided on how weighting of subpopulation estimates was done
- The Committee discussed whether weights should be tied to the time period of original studies.
- The Committee discussed addressing the issue of discounting VSLs.

### *Key Points Discussed in Response to Charge Question 4*

- The White Paper should provide detailed information about how the standard error of the VSL was calculated in situations where one is not reported in the original study.
- An alternative way to calculate standard errors for each non-parametric VSL estimator was discussed.

### *Key Points Discussed in Response to Charge Question 5*

- The meta-analytic methods used in the White Paper were, for the most part, scientifically sound and consistent with standard and accepted practices.
- The White Paper should provide a more detailed description of standard practices and how they were applied. It should refer to fixed effect size and random effect size methods and describe how the methods used in the white paper deviated from these practices.
- The use of sample size weighted mean should be better justified.
- The analyses could be conducted without directly adjusting the VSL values from different studies to account for differences in income. The parametric meta-regression analysis should include specifications with an income measure as an explanatory variable.

### *Key Points Discussed in Response to Charge Question 6*

- Additional detail should be included in the White Paper to clarify how studies were grouped for the analysis. A column in Table 6 should provide information on the composition of various study groups.
- The EPA should consider identifying the primary estimate from each study and re-estimating the meta-regression using only primary estimates.

### *Key Points Discussed in Response to Charge Question 7*

- The White Paper should include the steps to derive equation (4) (EPA staff provided a derivation of this equation using an example).
- Assumptions regarding error components should be clarified in the White Paper
- Relevant citations should be provided in the White Paper.
- The White Paper focused on efficiency but transparency should also be discussed.

### *Key Points Discussed in Response to Charge Question 8*

- Citations should be provided for the non-parametric estimators. Justification should also be provided, if possible, for why they were appropriate for the problem at hand.
- Estimators that gave equal weight to all estimates were potentially problematic because of idiosyncratic reasons for some groups having a relatively large number of estimates. This argued for the mean of group means estimator.
- The use of the mean of group means estimator had the disadvantage of ignoring sampling error variance.
- The mean of the sampling error variance weighted mean estimator should be considered.
- Time trend should be incorporated into the non-parametric estimator.
- The Committee discussed whether to treat all studies from different years the same or give more weight to recent studies.

### *Key Points Discussed in Response to Charge Questions 9 and 10*

- EPA should consider using the non-parametric sampling error variance weighted group mean in place of the non-parametric mean of group means estimator.
- Documentation of the income adjustment to VSL should be clarified in the White Paper.
- The influence analysis was worthwhile and helpful. EPA should consider using a robust estimation technique that limited the influence of one of the stated preference studies.

### *Key Points Discussed in Response to Charge Question 11*

- A five year interval for updating VSL estimates appeared to be appropriate.
- The pool of high quality studies to support VSL meta-analysis should be increased.
  - EPA could provide grants, sponsor conferences and support special issues of journals.
  - EPA could consider the feasibility of sponsoring its own journal that focused on analyses of relevance to the Agency's needs.
  - EPA should consider whether useful information can be obtained from studies of risk-risk tradeoffs and risk studies in the transportation literature.
- The Committee discussed the possibility of using studies that had not been published in the peer reviewed literature but had undergone a review process.
- Data should be made available to the research community.
- Studies based on non-national samples might be useful as long as there was a set of studies that, as a group, was representative of the nation as a whole.
- There should be a single protocol for determining which studies were of sufficient quality to be included in current and future estimates of VSL

*Key Points Discussed in Response to Charge Question 12*

- The Committee questioned why cancer mortality risk valuation should be treated differently but other environment-related mortality (e.g., cardiovascular disease) would not be treated differently.
- Cancer may be worse than other mortality because of pre-death morbidity
- The Committee discussed valuing morbidity and whether cancer premium means that death from cancer is worse than death from other causes,
- The Committee discussed the conclusion that there was little empirical evidence that a cancer premium existed.
- The Committee discussed the recommendation that EPA continue to look at this issue since it did not appear that a cancer premium was supported by the available evidence.

*Key Points Discussed in Response to Charge Question 13*

- The EPA technical memorandum provided a reasonable summary of the income elasticity literature.
- Some additional studies were suggested.
- The Committee discussed the possibility of using estimates of income elasticity for other related goods and services to infer estimates of the income elasticity of the value of statistical life.

*Key Points Discussed in Response to Charge Question 14*

- Instead of calculating an unweighted mean of income elasticity of VSL estimates, the EPA should consider using standard errors of individual income elasticity of VSL estimates to calculate a weighted mean.
- Given the lack of congruence on low or zero estimates of income elasticity of VSL, a weighted mean of income elasticity of VSL should be calculated with and without the low and zero estimates to assess their influence.

*Key Points Discussed in Response to Charge Questions 15 and 16*

- The currently used income elasticity of .4 is not inconsistent with the available data. Using the Viscusi estimate of 1.1 is hard to justify.
- Neither of the alternatives in the Robinson and Hammitt 2015 paper and the EPA's technical memorandum appeared to represent an adequate basis for providing an estimate of the income elasticity of VSL.

*Key Points Discussed in Response to Charge Question 17*

- There are limited data available on income elasticity of non-fatal health effects but it is not conceptually correct to use the income elasticity of VSL to estimate income elasticity for the value of non-fatal health risks.
- It may be useful to examine other data sets containing information about the income elasticity of expenditures on private health care products.

The Chair then asked members whether there were additional key points to be raised for discussion. Members briefly discussed additional data that might be used to estimate income elasticity of VSL.

Some members commented that information collected 20 years ago might be just as useful as more recent estimates. There were no additional points raised for discussion. The Chair noted that Committee members had raised questions during the discussion and had indicated that additional information should be provided in the White Paper. She indicated that if members wanted to request additional information from the EPA they should send their requests to the DFO who would ask the EPA to provide the information.

### Summary of Next Steps

Dr. Khanna reviewed action items and the next steps to be completed. She asked the lead writers to develop written synthesis responses for their assigned charge questions and to also incorporate comments from the lead discussants for their questions. She indicated that the lead writers should send their written synthesis responses to the DFO by Friday, March 25<sup>th</sup>. Dr. Khanna indicated that she would work with the DFO to incorporate the synthesis responses into a draft Committee report which would be sent to the entire Committee for review. She indicated that a Committee teleconference would be scheduled to discuss the draft report and she noted that the DFO would contact members to schedule the call. She further indicated that if there were areas of disagreement on the draft report, they should be discussed on the teleconference. She stated that, if necessary, the DFO would schedule a second teleconference for the Committee to discuss its draft report.

Dr. Khanna asked members if there were questions or additional issues to be discussed. There were none so she thanked the members of the Committee for their work and thanked the EPA staff for their presentations and responses to the Committee's questions. Dr. Khanna then asked the DFO to adjourn the meeting. The DFO also thanked the members for their participation, reminded them of the specific action items to be completed, and adjourned the meeting.

Respectfully Submitted:

Certified as Accurate:

*/signed/*

*/signed/*

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Dr. Thomas Armitage  
Designated Federal Officer

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Dr. Madhu Khanna, Chair  
SAB Environmental Economics Advisory  
Committee

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Committee members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from Committee members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings.

## ATTACHMENT A: COMMITTEE ROSTER

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**U.S. Environmental Protection Agency  
Science Advisory Board  
Environmental Economics Advisory Committee**

**CHAIR**

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\*Did not participate in the review of the EPA's proposed methodology for updating mortality risk valuation estimates for policy analysis.

## Materials Cited

The following meeting materials are available on the EPA Science Advisory Board website, [www.epa.gov/sab](http://www.epa.gov/sab), on the March 7th meeting page of the Environmental Economics Advisory Committee.

<https://yosemite.epa.gov/sab/sabproduct.nsf/MeetingCal/3BB25C1179A3D92585257F3E006D4B56?OpenDocument>

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<sup>1</sup> Federal Register Notice

<sup>2</sup> Agenda

<sup>3</sup> Committee Roster

<sup>4</sup> Agency Review Documents. (1) a white paper titled Valuing Mortality Risk for Policy: a Meta-analytic Approach (February 2016); (2) a report titled The Effect of Income on the Value of Mortality; and (3) a memorandum titled Morbidity Risk Reductions Recommended Income Elasticity and Income Growth Estimates: Technical Memorandum

<sup>5</sup> Background Documents. (1) SAB report titled Review of Valuing Mortality Risk Reductions for Environmental Policy: A White Paper (December 10, 2010) EPA-SAB-11-011; (2) On-line appendix to Viscusi, Huber, and Bell. (2014), "Assessing whether there is a cancer premium for the value of a statistical life"; (3) Instructions for running the computer programs written for Matlab (VSLMETA\_Matlab.m) and Octave (VSLMETA\_Octave.m); (4) File containing the code (Matlab) and data used produce results presented in the EPA report "Valuing mortality risk reductions for policy: a meta-analytic approach."; (5) File containing the code (Octave) and data used produce results presented in the EPA report "Valuing mortality risk reductions for policy: a meta-analytic approach"; and (6) Additional information provided by EPA concerning the derivation of equation 4 in the Agency's White Paper

<sup>6</sup> Charge for the SAB Environmental Economics Advisory Committee review of valuing mortality risk reductions for policy: proposed updates to valuation and income elasticity estimates

<sup>7</sup> EPA Presentation. Valuing mortality risk reductions for policy: Proposed updates to valuation and income elasticity estimates

<sup>8</sup> Committee Members' Comments

<sup>9</sup> Public Comments.

<sup>10</sup> Follow-up information provided by EPA to the Committee. Graphics showing VSL estimates by data collection year.