EPA-SAB-xx-xxx

The Honorable Andrew Wheeler
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Transmittal of the Science Advisory Board Report titled "SAB Peer Review of the EPA's Revised Guidelines for Preparing Economic Analysis," dated September 17, 2020.

Dear Administrator Wheeler,

Please find the enclosed final report from the Scientific Advisory Board (SAB). The EPA's National Center for Environmental Economics (NCEE) requested that the SAB review their revised "Guidelines for Preparing Economic Analysis." In response to the EPA's request, the SAB assembled a panel with subject matter experts to conduct the review.

The SAB Economic Guidelines Review Panel (later referred to as Panel) convened three public meetings to conduct a peer review of the EPA's revised document. Meetings were held on May 18, 2020, May 21, 2020, and May 26, 2020. Oral and written public comments were considered throughout the advisory process. The Panel also met on June 9, 2020 to discuss its draft report. Oral and written public comments were considered throughout the advisory process. This report conveys the consensus advice of the SAB.

The SAB compliments the Agency on the extensive work undertaken to update the Guidelines. The SAB has made numerous recommendations to further strengthen the quality of the Guidelines. Recommendations are prioritized to indicate relative importance during EPA's revisions. This letter highlights a handful of recommendations that may be of special interest to Agency leadership. The order of the highlighted recommendations relates not to their relative importance but to when the recommendations first appear in the report.

1. The SAB recommends that the Guidelines distinguish between guidance for analysts and advice for policy makers. The Guidelines should emphasize that economists and policy analysts are not expected to adjust their analyses to support particular decisions; nor are analysts expected to make policy decisions (Section 2.1).

2. The SAB recommends that the Guidelines include more discussion; possibly a separate chapter, on how rules should be designed to facilitate retrospective reviews and the unique analytic issues confronted in post evaluation of rules. When setting priorities for retrospective review, the SAB suggests that the Guidelines recommend a focus on final rules where there are high ex-ante cost

estimates, and/or large uncertain benefit estimates, and/or where estimated costs vastly exceed estimated benefits (Sections 2.2 and 2.4).

3. In its definition of market failures, the EPA should make clear that such failures must be systemic and provide evidence to demonstrate the likelihood of their persistence (Section 2.3 and Section 2.4). A new section should also be added on the proper use of evidence from behavioral economics in market failure analysis (Sections 2.3, 2.7 and 2.8).

4. The EPA should include an additional section to discuss how analysts can generate different options for the coverage of regulations, providing insight for policy makers on how a broader or more limited regulatory coverage influences the benefits and costs of rulemaking (Section 2.3).

5. The SAB recommends that the EPA, when selecting discount rates for rules with both intragenerational and intergenerational impacts, employ both the consumption rate of interest and opportunity cost of capital approaches, consistent with Office of Management and Budget (OMB) guidance for regulatory impact analyses (Section 2.6).

6. Economic analysis of regulatory or policy options should present all identifiable benefits and costs that are incremental to the regulation or policy under consideration. This comprehensive accounting should include direct impacts (benefits and costs) as well as ancillary (or co-) benefits and costs, as explained in OMB guidance. (Sections 2.5, 2.7, 2.8, 2.11)

7. Reducing mortality risks represents the single largest category of monetized benefits in EPA's regulatory actions, yet the agency continues to rely on studies that are at least three decades old for monetizing these benefits. The SAB again recommends that EPA incorporate the most recent evidence from the peer reviewed value of statistical life literature. (Sections 2.7 and 2.13).

8. Most of the draft Guidelines focus on improving assessments of the aggregate benefits and costs of regulations and policies. The SAB recommends that the Guidelines provide more in-depth technical guidance on how to perform distributional analysis of benefits and costs for specific subgroups (e.g., low-income populations). (Sections 2.9 and 2.10).

9. Categorization of costs and benefits. The SAB suggests that Chapter 7 ("Benefits") and Chapter 8 ("Costs") begin with a description of what each category includes. The distinction is arbitrary, because some compliance costs of a regulation would become the benefits of an ensuing deregulatory action. And similarly, some health benefits of a regulation would become the costs of deregulation.

10. Sometimes the Guidelines seems to address a readership of economic novices, while at other times, the Guidelines contain language that might be cryptic even for experienced economists. The SAB suggests that the authors comb through the Guidelines with a focus on its target audience, eliminating elementary material and moving technical material to appendices.

11. The Guidelines are a daunting 343 pages – longer than many RIAs. Moving technical discussion to an appendix would help, as would eliminating elementary material. Another suggestion would be to provide an executive summary with key things an analyst should consider, with links to the appropriate places in the document where details could be found. That could consist of one

overall executive summary, or one for each chapter, or both. While in principle that might make the Guidelines longer, it would ease the burden on readers.

As the EPA finalizes its Guidelines, the SAB encourages the Agency to address the points raised in the enclosed report and consider the presented SAB advice and recommendations. The SAB appreciates this opportunity to review the revised "Guidelines for Preparing Economic Analysis" and looks forward to the EPA's response to these recommendations.

Sincerely,

Enclosure:

## NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board, a public advisory committee providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use. Reports of the EPA Science Advisory Board are posted on the EPA website at http://www.epa.gov/sab.

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# U.S. Environmental Protection Agency
# Science Advisory Board

**[ROSTER TO BE ADDED]**

# SAB Peer Review of the EPA's Revised Guidelines for Preparing Economic Analysis (DRAFT REPORT, dated September 17, 2020)

## TABLE OF CONTENTS

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BCAs | Benefit and cost analyses |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CGE | Computable general equilibrium |
| CV | Compensating variation |
| DWL | Deadweight loss |
| EIA | Economic impact analysis |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| EV | Equivalent variation |
| GDP | Gross domestic product |
| GHG | Greenhouse Gas |
| MCL | Maximum Contaminant Levels |
| NCEE | National Center for Environmental Economics |
| NHTSA | National Highway Traffic Safety Administration |
| OIRA | Office of Information and Regulatory Affairs |
| OMB | Office of Management and Budget |
| PRP | Potentially responsible parties |
| RIA | Regulatory impact analysis |
| SAB | Science Advisory Board |
| SL | Supply of labor |
| VOI | Value-of-information |
| WTA | Willingness-to-accept |
| WTP | Willingness-to-pay |

# 1. INTRODUCTION

The Environmental Protection Agency (EPA) National Center for Environmental Economics (NCEE) requested that the Science Advisory Board (SAB) conduct a peer review of its draft revised document titled "Guidelines for Preparing Economic Analyses" (later referred to as Guidelines). The purpose of the document is to define and describe best practices for economic analysis grounded in the economics literature. It also describes Executive Orders and other documents that impose analytic requirements and provides detailed information on selected important topics for economic analyses.

In response to the EPA's request, the SAB convened a panel of subject matter experts to conduct the review. The Science Advisory Board Economic Guidelines Review Panel (later referred to as Panel) convened three public meetings to conduct a peer review of the EPA's revised document Meetings were held on May 18, 2020, May 21, 2020, and May 26, 2020. The Panel also met on June 9, 2020 to discuss its draft report. Oral and written public comments were considered throughout the advisory process.

Charge questions were specified by NCEE for Chapters 1 -10 of the Guideline document. In order to provide a thorough review of the document overall, the Panel also provided comments on Chapter 11 and appendixes A and B. Recommendations are prioritized to indicate relative importance during EPA's revisions. Priorities are defined as follows:

- Tier 1: Key Revisions – Actions that are necessary in order to improve the critical scientific concepts, issues and/or narrative within the guidelines.

- Tier 2: Suggestions – Actions that are encouraged to strengthen the scientific concepts, issues and/or narrative within the guidelines, but other factors (e.g., Agency need) should be considered by the Agency before undertaking these revisions.

- Tier 3: Future Considerations – Useful and informative scientific exploration that may inform future evaluations of key science issues and/or the development of future guidelines. These recommendations are likely outside the immediate scope and/or needs of the current guidelines under review.

When the SAB was unable to reach consensus, members with differing opinions were asked to provide responses and recommendations separately. All dissenting opinions (or additional comments) are presented within appendix B. All materials and comments related to this report are available at: https://yosemite.epa.gov/sab/sabproduct.nsf//MeetingCalBOARD/A7E98FA28E40593A852585520058733A?OpenDocument.

# 2. RESPONSE TO CHARGE QUESTIONS

## 2.1. Chapter 1: Introduction.

Laws and Executive Orders (EO) govern how and when economic analyses are performed. They also provide guidance to policy makers on how to use the results of economic analysis to make regulatory decisions. In particular, instructions like "maximize net benefits", "choose the least cost option", and "costs should be justified by benefits" are written for policy makers. Alternatively, Regulatory Impact Analyses (RIA) and other economic analyses are written *for anyone* who is involved in EPA decisions; including EPA policy makers and the Administrator, the President and Executive Branch staff, Congress, the Courts, stakeholders and the general public. As this chapter provides an overview of how to do economic analysis for EPA regulations; the SAB suggests that the Guidelines clearly distinguish between advice for policy makers and instructions for subject matter experts, i.e., economic analysts.

Many years ago, the Office of Personnel Management set guidelines for policy analysts. An excerpt from 1981 concludes:

> *The policy analyst, as defined in this guide, is set apart from other participants in the decision-making process by his or her professional objectivity, nonpartisanship, balance, and ability to provide comprehensive advice and analysis. The policy analyst serves the political decision-making process by providing comprehensive, balanced information and analysis to all sides of policy issues rather than by advancing the ideas of a single decision maker, philosophy, or point of view.*[1]

This requirement was changed from earlier views that subject matter experts be used to "defend" policy maker's decisions (U.S. OMB 1981). The SAB agrees that subject matter experts defend their analyses, both internally and externally without trying to defend a particular decision, as is currently suggested throughout the Guidelines. Alternatively, policy makers are defined as those individuals who are empowered to make decisions on regulatory options. The SAB recommends that all questions or instructions targeted towards policy makers be identified as such or be moved to the policy section of preambles. The SAB believes that separating the instructions for analysts and policy makers will have several positive effects. First, they will help to remove pressure on economists to make analyses conform to decisions. Second, it will help to allay the suspicion that economists are making decisions based on their own relatively narrow paradigm of evaluating the efficiency of regulatory options, i.e., choosing the regulatory option that maximizes net benefits (benefits minus costs).

The SAB notes that policy makers often use other criteria to drive decisions including: the perceived intention of Congress; law; distributional equity, such as protecting highly sensitive or highly exposed subpopulations; agency resources; or ethical considerations. Options using these alternative criteria may or may not be the most economically efficient option.

### 2.1.1. Charge Question 1:

> *Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB finds that statements and recommendations for the chapter consistent.

[1] https://www.opm.gov/policy-data-oversight/classification-qualifications/classifying-general-schedule-positions/functional-guides/gspolanl.pdf

### 2.1.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

Peer reviewed economics literature or analytic methods are not included in this chapter.

### 2.1.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that several topics within this chapter would benefit from further explanation. An expanded definition of market failures should be provided to discuss why market failures must be systemic, and evidence be provided to demonstrate the likelihood of their persistence. The Guidelines should also distinguish between proposed and final rules; providing separate guidance for each. For example, final rules can be distinguished by the requirement to address public comments. Final rules, could also be referred to as the "selected" rule (among all present options). The purpose of this is to separate a policy maker's judgment from the benefits and costs of various policy options.

Defense of decision options should be included in the preamble of the rule, not in either the proposed RIA or the final RIA. That defense may include a discussion of how the economic analysis informed the decision. The SAB recommends that this receive strong emphasis in the opening to Chapter 1. The SAB finds that economists should never try and bias an analysis for any reason; especially never to defend a decision. The SAB recommends that this also receive strong emphasis in the opening to Chapter 1. The SAB suggests that the Guidelines differentiate between welfare losses that arise from individual choices, and welfare losses involving market failures such as externalities, where one person or firm's activities affect the welfare or profits of others.

Accounting for clarifications noted above, the SAB suggests that the Textbox 1.1 be revised (as shown in Figure 1) and include a reference to unquantified and qualitative costs and benefits. Textbox 1.1 should also provide cross references to places in the Guidelines where guidance to answer the questions listed may be found.

**Figure 1. Proposed revisions for Textbox 1.1.**

**Questions for Analysts**

Does the RIA include a reasonably detailed description of the need for regulatory action?
Does the RIA use an appropriate baseline?
Is the information in the RIA based on the best reasonably obtainable scientific, technical, and economic information and is it presented in an accurate, clear, complete, and unbiased manner?
Are the data, sources and methods used in the RIA provided to the public on the internet so that a qualified person can reproduce the analysis?
To the extent feasible, does the RIA quantify and monetize the anticipated benefits from the regulatory action?
To the extent feasible, does the RIA quantify and monetize the anticipated costs?
Does the RIA assess the potentially effective and reasonably feasible alternatives?
Does the RIA assess different regulatory provisions separately if included in the rule?
Does the RIA assess at least one alternative that is less stringent and at least one alternative that is more stringent?

Does the RIA consider setting different requirements for large and small firms?
Does the RIA use appropriate discount rates for benefits and costs that are expected to occur in the future?
Does the RIA include, if and where relevant, an appropriate uncertainty analysis?
Does the RIA include, if and where relevant, a separate description of distributive impacts and equity?
Does the analysis include a clear, plain language executive summary, including an accounting statement that summarizes the benefit and cost estimates?
Does the analysis include a clear and transparent table presenting anticipated benefits and costs?

**Questions for Policy Makers (To be answered in the preamble to the regulation)**
Does the RIA include an explanation of how the regulatory action will meet that need?
Does the RIA explain and support a reasoned determination that the benefits of the intended regulation justify its costs?
Does the preferred option have the highest net benefits – unless a stature requires a different approach?
Does the RIA include an explanation of why the planned regulatory action is preferable to the identified potential alternatives?

*Adapted from OMB's Agency Checklist: Regulatory Impact Analysis (2009).*

On page 1-5, the Guidelines states that analysts should "adhere to applicable directives in EOs", but that a statute might preclude consideration of costs. The SAB finds that "adherence" is too strong a word and suggests an alternative be chosen. Finally, there is a tremendous amount of redundancy across chapters. The SAB suggests that the document be shortened considerably by including references to appropriate sections where a complete explanation is made. For the electronic version, links to appropriate other chapters could be used rather than being repetitive.

### 2.1.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB finds that there are inconsistencies within the chapter. There are direct benefits and costs, co-benefits and costs, and countervailing benefits and costs. Some are market driven and some are nonmarket driven. The distinction between benefits and negative costs (or costs and negative benefits) is at times arbitrary. As an example, the RIA for Model Year 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards lists fuel savings separately from costs and benefits; but as a positive number and so implicitly as a benefit (Executive summary Table 1). In that same rule, the "increased accidents, noise, and congestion associated with additional vehicle use due to the rebound effect" are noted as a negative benefit rather than as a cost (Table 7.3-4). One could easily make the case for fuel savings as being a subtraction for costs, and/or accidents and congestion being an addition to costs. This is why net benefits (B-C) are used instead of benefit/cost ratios (B/C). The distinction between benefits and negative costs doesn't matter for the difference but matters for the ratio.

The SAB recommends that the EPA create consistent definitions, perhaps including standardized names. The placement of those terms within the Guidance will be covered in subsequent comments. This

chapter would also benefit from a discussion of the different tools economists use to analyze policies that go beyond benefit-cost analysis and include cost-effectiveness analysis (efficiency), distributional and equity analysis, risk-risk analysis, and health (wealth)-health analysis.

### 2.1.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

Relative to Chapter 1, the glossary is missing definitions for co-benefits and costs and countervailing benefits and costs.

***The following recommendations are noted for Chapter 1:***

Tier 1

- Identify and reference the proposed rule as the "proposed rule" rather than "preferred." For final rules, refer to the final option as the "selected" rule.

- Defense of decision options should be emphasized and included in the preamble of the rule, not the proposed RIA or the final RIA. That defense may include how the economic analysis informed the decision.

- Include a sentence to state that economists should never produce biased analysis for any reason, including and in particular, to defend a decision.

- Revise Textbox 1.1 as noted above, to distinguish between instruction for policy makers and analysts.

Tier 2

- Create consistent definitions for following terms: benefits, costs, ancillary benefits and costs, and countervailing benefits and costs.

- Include a reference to unquantified benefits.

Tier 3

- For future revisions of the Guidelines, cross references should be maximized to reduce redundancies and shorten the document.

## 2.2. Chapter 2: Executive Order and Statutory Requirements for Conducting Economic Analyses.

Chapter 2 provides a list of all EOs and Laws that govern the work of EPA economists. There are many different requirements and, if possible, this chapter may be strengthened by demonstrating where complying with the same requirements might be lumped together. Overall, the SAB finds this chapter helpful and well written.

### 2.2.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB finds that the statements and analytic recommendations included in the chapter are consistent.

### 2.2.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds that the chapter contains reasonable presentation and interpretation of literature and methods. They appear to be objective balanced and reasonable although there are improvements noted elsewhere.

### 2.2.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

There are a couple of topics that should discussed further within this chapter. First, the SAB suggests that Section 2.1.1 include notice that anything deemed "significant" by Office of Information and Regulatory Affairs (OIRA) must be viewed by the EPA as the final determination. Analysts should be aware that one of the primary reasons for determining significance is whether it triggers an OIRA review. Secondly, footnote 12 in the Guidelines mentions EO 13563 (OMB guidelines for regulatory review). The SAB finds that that this footnote should be moved into the main text and expanded to include a summary of the EO. Third, the SAB suggests that the EPA include information for analyzing federal investments in water sources. Finally, in Section 2.1.7, the SAB suggests that the EPA prioritize rules for retrospective review where there are high costs or benefits with large uncertainties.

### 2.2.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB suggests that Section 2.1.2 mention costs to minority and low-income subpopulations and refer to Chapter 9 and 10 for further information. In Sections 2.1.3 and 2.2.2, the Guidelines ask that explanations for policy choices be included. The SAB finds that these requirements should be rewritten to say that the analyst supplies information to policy makers or remove it. The SAB further suggests that this chapter would be a good place to determine what information will be needed to do further analysis.

### 2.2.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The SAB finds that the glossary is accurate relative to Chapter 2.

***The following recommendations are noted for Chapter 2:***

Tier 1

- Expand footnote 12 to cover more of what is in the EO and move it to the main text. In particular, it would be helpful to discuss more 'innovation in regulatory approaches" and "consideration of alternative regulatory approaches."

- In Section 2.1.2, mention costs to minority and low-income subpopulations and refer to Chapter 9 and 10 for further information.

- In Section 2.1.7, identify rules for retrospective review where, there are high costs, benefits with large uncertainties, or costs vastly exceeding benefits. Also note these conditions should be identified as such in final rules.

Tier 2

- Conclude Section 2.1.1 by noting that OIRA's final determination triggers an OMB review.

Tier 3

- The SAB has no recommendations for this tier.

## 2.3. Chapter 3: Need for Regulatory Action and Evaluation of Policy Options.

This chapter provides an overview of evaluating the need for regulatory intervention into private markets and analyzing options for solving problems. Market failures are not one-off issues but rather systemic problems that are expected to continue into the future. Every market failure is also a market opportunity and markets may be in the process of self-correcting at the point at which government is considering intervening. Also, assertion of market failure requires that evidence be produced, it is not enough to theoretically speculate on failures. Some theoretical market failures of the past may no longer be so, particularly given the existence of the internet.

Recent EPA analyses use behavioral economics to justify the need for regulatory action or as a "nudge" regulatory option. It is suggested that this chapter include a discussion that separates the more problematical use of behavioral economics as justification for regulatory interventions with the uses of nudges as a regulatory option.. While the Guidelines contain guidance on the severity of potential interventions, they do not provide sufficient detail on the scope of regulatory options and suggestions are made for a new section to cover this.

### 2.3.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

In Section 3.1, the discussion of market failure may lead some to conclude that a market failure can be a "one-off" issue. In fact, market failures must be systemic, and the SAB finds that evidence needs to be provided to prove the existence of a market failure. Where the market does not fail, benefits cannot exceed costs, with the possible exception of internalities.

### 2.3.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds that the description of providing evidence of market failures as a systemic problem could be enhanced

### 2.3.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that this chapter needs a new section on regulatory options titled "Coverage of Regulatory Action" with the following information provided:

*A key issue in regulatory design is the coverage of the regulatory action. "Coverage" refers to the breadth of a regulation's applicability, which will influence how many or types of entities or persons are covered by the requirements and what the magnitudes of benefits and costs are for each type. Stringency refers to how intrusive or demanding a particular requirement is whereas coverage refers to who is included.*

*Here are some key issues that commonly arise in scope/coverage determinations:*

*--Should the regulatory action cover all sectors of the economy or only a subset (e.g., electric utilities, manufacturing, agriculture and so forth)?*

*If the environmental problem is concentrated in one or two economic sectors, it may make sense to have a narrow focus but if the problem is significant in all sectors, broader coverage may be appropriate. Regulations that cover sectors without significant problems may create costly capital investments, monitoring and reporting requirements without commensurate or any environmental benefits. In some situations, sufficient information exists to justify prompt coverage of one sector, but further inquiry is necessary to determine whether other sectors should be covered. The preamble to a proposed rule may seek public comment on which sectors of the economy should be included.*

The SAB notes that coverage of a sector should not be based on potential risks, but rather existing risks based on the available evidence. Any sector may, in the future, change practices, or experience may reveal new information about the risks of existing practices that warrant a federal solution. Regulatory coverage should only be given to those economic sectors with current and well-documented risks that are likely to persist into the future

*--Should the regulatory action cover only new products/processes or should it cover existing products/processes already in use or operation?*

*It is frequently less expensive to incorporate environmental innovations into new products and new production processes than to retrofit them on existing products or processes. Moreover, the environmental benefits of a retrofit approach may be limited if the remaining life of the product or process is limited. The practice of covering only new products/processes in a rulemaking action, while common, has some drawbacks. It may inadvertently discourage investments into new products/processes, since they are subject to regulatory scrutiny, and cause existing*

*products and processes to be used longer. In some cases, the costs and benefits are so different that a separate rulemaking action is appropriate for new versus existing products/processes.*

*--Should the regulatory action cover all regions of the country or only a limited number of regions, states or localities?*

*A federal rulemaking action may be limited in coverage by certain criteria that focus compliance activities on entitles located in certain regions, states or localities. Some clean-air requirements are applicable only in regions of the country that do not meet national air-quality standards. Environmental science may suggest that the same pollutant emitted in some cities generates more smog than the same pollutant generated in another city, due to differences in sunlight, weather and other factors Since the costs and benefits of rulemaking action may vary widely by location, the geographic and jurisdictional scope of a rulemaking is an important economic issue.*

*--Should the regulatory action cover all businesses or only businesses larger than a certain size?*

*These are issues that are typically addressed in a Regulatory Flexibility Analysis and have different requirements, including for example, how a regulation will affect small entity profits. The costs and benefits of including small businesses may be quite different than larger business, particularly when there are fixed costs. Consultation with the Office of Advocacy Office of the Small Business Administration is appropriate at the early stages of a regulation.*

The SAB notes that regulations can address market failures, government failures or overriding social needs (McLaughlin 2014). In the latter case, where a regulation addresses an overriding social need as, for example, is required by law, the SAB recommends that it clearly states that there is no market failure and identify the exact overriding social need.

Regarding Textbox 3.1, the SAB suggests that this section be updated to reflect newer literature, particularly addressing new technologies. As discussed in Clay Shirky's "Here Comes Everybody" (2008), the internet provides consumers with robust search and monitoring tools that lowers search and transactions costs. Using social platforms like LinkedIn, Facebook, Twitter and Flickr, it is now easier for groups to discover one another and to arrive at bargained solutions. The internet also goes a long way to ameliorating information asymmetries. Coase theorem solutions may emerge over time and can be included in the baseline correcting a temporary market failure. Another recommended book is Foldvary and Klein's "The Half-Life of Policy Rationales" (2003).

The SAB recommends that Section 3.2 contain emphasis that RIAs may, but are not required to, contain options that are not currently legal. This may be particularly true when economic theory points to clearly superior options than those allowed by law. It should be emphasized here that RIAs and other economic analyses are written for a broad audience beyond the EPA.

The SAB finds that footnote 63, on page 3-6, should be included in the body of the text. In general, it is useful to identify separate categories of benefits and costs and their sources, especially when some categories might not be quantified or monetized but nonetheless deemed important. However, the Guidelines should be clear that useful economic analysis requires consideration of all expected impacts of different regulatory alternatives. And just as it is important to consider other (realistic and potentially

more efficient) ways of achieving different benefits, it is important to consider when pollutants are best regulated jointly (whether most realistically or most efficiently) to achieve net benefits.

Regarding footnote 48, the SAB suggests that the EPA include Buchanan and Stublebine (1962) and Bator (1958), as references along with Scitovsky and Mishan.

On page 3-2, lines 20-21, the SAB suggests alternative language such as "when actions taken by one individual enter the utility or production function of another without passing through markets or contracts."

On page 3-3, the paragraph beginning "when left unaddressed…" is debatable. If high transactions costs prevent internalizing externalities, then internalizing them doesn't lead to increased welfare. It's just another way of saying it would fail a benefit-cost test. Perhaps what is meant here is that private parties cannot profitably internalize an externality because of transactions costs, but regulation can (at lower costs). If so, that should be clarified.

### 2.3.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB did not find any inconsistencies within the chapter.

### 2.3.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The SAB finds that the glossary is accurate relative to Chapter 3.

***The following recommendations are noted for Chapter 3:***

Tier 1

- Expand the definition of market failures to include discussions of using only on systemic market failures and evidence to demonstrate the likelihood of their persistence. Expand the discussion of market failures to emphasize the importance of addressing persistent systemic market failures resulting in well-documented risks."

- Include a new section to discuss different options for the scope of regulations.

- Highlight that coverage of an industrial sector should not be based on a possible future risk but rather an existing, demonstrable risk.

- Include guidance that analysts should specify when a rule is promulgated for which there is no market failure and, in turn, identify the exact reason for government intervention, e.g., to protect a sensitive subpopulation.

- Include options that are currently not legal.

- Include a balanced discussion of the use of behavioral economics as a reason to intervene in markets.

- Expand footnote 63 and include it the body of the text.

Tier 2

- Revise Textbox 3.1 to reflect the influence of the internet on remedying past market failures such as asymmetric information and Coase theorem solutions for externalities.

- On page 3.2, lines 20-21, revised sentence … to reflect "when actions taken by one individual enter the utility or production function of another without passing through markets or contracts."

- Add Buchanan and Stublebine (1962) and Bator (1958) to footnote 48.

- Clarify language on page 3.3 that differentiates between government intervention and private parties internalizing externalities.

Tier 3

- The SAB has no recommendations for this tier.

## 2.4. Chapter 4: Regulatory and Non-Regulatory Approaches to Pollution Control.

Chapter 4 describes several different regulatory and non-regulatory approaches used in environmental policymaking. It also includes a discussion of criteria used to evaluate these approaches. The chapter helps economic analysts design reasonable policy options and anticipate the welfare implications from the choice of approach.

Overall, the SAB commends the EPA on its revision of the chapter. In particular, we applaud the inclusion of additional approaches and the reorganization of some of the discussion. The SAB recommends, however, that the chapter refocuses on describing the relative costs and benefits of each approach. We also recommend balancing the discussion and including additional approaches. Finally, the SAB recommends removing discussion of issues and considerations that are either irrelevant to economic analysis or redundant or inconsistent with information in other chapters.

### 2.4.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The statements in the chapter are largely consistent with the theoretical and empirical peer-reviewed economics literature. There are two statements, however, that are inconsistent or at least misleading in their current form. The first statement asserts that cost-effective policies always result in equal marginal abatement costs across polluters. The second statement asserts that strict liability rules create disincentives for land redevelopment. In addition, the SAB suggests changing one of the section headings and defining a few terms to promote clarity. Below, we discuss each of these suggestions in turn.

1. The SAB recommends that the EPA remove the first sentence in the discussion in Section 4.1.2 on cost-effectiveness that begins with the following statement: "*A policy is considered cost-effective when marginal abatement costs are equal across all polluters*" (page 4-2, line 22). This statement, however, is not generally true.

   The theoretical and empirical peer-reviewed literature carefully distinguishes different types of pollutants, especially uniformly mixed and non-uniformly mixed pollutants. The given statement is true for uniformly mixed pollutants. For non-uniformly mixed pollutants, where damages vary based on location, a cost-effective policy would have marginal abatement costs that vary across sources according to the degree of damage caused (Montgomery, 1972; Tietenberg, 2006; Muller and Mendelsohn, 2009; Phaneuf and Requate, 2017). The current statement may mislead regulatory designers toward equal marginal abatement costs in cases where such a design would not be cost-effective.

   The SAB recommends that the EPA remove this sentence from the discussion. Alternatively, the EPA should move this sentence back to the end of the paragraph on cost-effectiveness (its location in the 2010 Guidelines) with the caveat that the statement refers to the case of uniformly mixed pollutants. The Guidelines should then explain as follows: "*More complex cases, such as those involving non-uniformly mixed pollutants with damages that vary based on location, may require unequal marginal abatement costs across sources*."

2. The SAB recommends that the EPA correct the discussion of the effects of strict liability in section 4.4.3. Section 4.4.3 discusses the use of liability rules. On page 4-16, lines 6-7, the Guidelines states, "*[S]trict liability rules can create disincentives for the redevelopment of contaminated land because newly involved firms become liable for past contamination*." This statement is incorrect; strict liability does not introduce the distortion referred to in the study. The reason "newly involved firms become liable for past contamination" under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is because CERCLA defines current owners as "potentially responsible parties" (PRP), embraces joint and several liability, and limits the defenses PRPs can invoke to avoid liability. These features, specific to CERCLA, are not necessary features of a strict liability regime.[2] In addition, the Guidelines should not discuss strict liability here (at lines 6-7) before defining the term (lines 11-12) and should not comment on the disincentives of a specific statute (at lines 6-7) before introducing the statute (lines 18-19).

   The SAB recommends that the EPA remove this sentence about strict liability from that paragraph. A version of the sentence can be added to 4-16, line 20, right after CERCLA is first introduced, as follows: "*The scope of liability may be relevant for economic efficiency. Under CERCLA, for example, new owners of contaminated land are defined to be potentially responsible parties that can be held liable for past pollution, creating disincentives for the redevelopment of contaminated land (Jenkins, Kopits, and Simpson 2009).*" This sentence would fit well with the next sentence on statutory changes that were made to encourage the redevelopment of brownfields.

3. The SAB suggests that the EPA rename Section 4.4.1.3 as "Combining Standards and Pricing" and streamline the discussion. Section 4.4.1.3 is newly titled "Safety Valve Systems." The heading in the 2010 Guidelines—"Combining Standards and Pricing"—is clearer because the literature (and the

[2] Under a strict liability regime, a firm taking reasonable precautions is, nonetheless, liable for damages caused by its actions, while under a negligence regime, such a firm taking reasonable precautions would not be liable for any damages.

discussion in the section) refers to these systems as combining standards and taxes/pricing mechanisms. The SAB also suggests streamlining the section and discussing the implications for government revenue (and its use). We refer the EPA to Pezzey and Jotzo (2012) for a clear discussion on the welfare and distributional effects of revenue recycling.

4. The SAB suggests that the EPA clarify its use of terms such as "approaches" and "instruments". The chapter describes several regulatory and non-regulatory "approaches" to pollution control. At times, however, the chapter refers to some of these approaches as options, policies, instruments, methods, mechanisms, incentives, initiatives, and regulations. To promote clarity, we suggest that the EPA use a consistent term throughout the chapter, to the extent possible. If it introduces another term, it should define the intended scope of that term.

### 2.4.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds that the chapter contains a mostly objective, balanced, and reasonable presentation of the literature. But there are key improvements that the EPA could make to the presentation to promote objectivity, balance, and reasonableness. Most importantly, the SAB recommends that the EPA be more consistent in its discussion of the relative costs and benefits of different approaches. We also recommend several specific changes to some sections as discussed below.

1. The SAB recommends that the EPA consistently present the relative advantages and disadvantages of each of the approaches. The relative advantages and disadvantages of the approaches are the key useful insights for economic analysis from this chapter. But the chapter does not consistently discuss relative advantages and disadvantages of each of the approaches, making the treatment seem unbalanced and arbitrary. The SAB recommends that the EPA thoroughly describes relative advantages and disadvantages for each approach. Below we identify a few specific examples that warrant more consistent treatment within the chapter.

   At times, the chapter describes an issue as a disadvantage of a particular approach even though the issue is relevant to other (or all) approaches. For example, it mentions grandfathering only on page 4-3 in the context of discussing prescriptive regulations. But other approaches, including market-based ones, might also provide for preferential treatment for existing sources for a number of reasons. For example, a cap-and-trade system might freely allocate permits to existing sources based on their historical emissions. Such decisions are related to policy coverage and scope and will have welfare implications under all approaches. The Guidelines should provide the analyst with objective information of these kinds of cross-cutting issues for all approaches and discuss their relative importance.[3]

   This inconsistent treatment occurs in the description of market-based approaches, too. The chapter suggests that illegal dumping, rent seeking, political incentives, and revenue-collection concerns are unique to market-based approaches (pages 4-4 to 4-5). But, again, these are important considerations for any regulatory approach. Compliance, monitoring, and enforcement are common concerns, and

[3] Regarding regulatory coverage and scope of policy proposals, in particular, the SAB recommended that the EPA devote a section in an earlier chapter to this issue (see our recommendations for Chapter 3).

all approaches face political pressures; for example, prescriptive regulations that require a specific type of control equipment make compliance monitoring easier but are likely to generate rent seeking by producers of the equipment and current users. The chapter should not single out market-based approaches as having these special considerations; instead, it should discuss these considerations for all approaches and focus on relative effects. Similarly, the chapter fails to discuss persistent challenges faced by policymakers implementing market-based approaches, especially quantity-based ones. For example, many cap-and-trade markets have experienced challenges with setting an initial cap too high or allowing too many banked allowances, leading to persistently low allowance price, little trading, and lower than expected environmental gains. An objective discussion of implementation challenges and the importance of initial allocations and allowance prices would be useful given the significant experience with market-based approaches both within the United States and across the world.

The chapter also fails to discuss relative advantages of approaches in a consistent way. For example, it discusses the role of different kinds of uncertainty in choosing between quantity-based and price-based instruments. It fails to mention, however, that prescriptive policies can provide increased certainty regarding quantity and price, which can be an advantage in some situations.

Overall, there are common issues of scope, flexibility, information availability, implementation, enforcement, compliance, monitoring, and uncertainty that all have welfare implications, but these issues may affect each approach differently. The chapter should consistently identify these issues and explain their relative effect on different approaches. Thus, the SAB recommends that the EPA provide consistent information on relative advantages and disadvantages of the approaches.

The SAB also suggest that the EPA create a summary table that presents this important information clearly. In the future, EPA should consider moving the background information on approaches to an appendix and focusing entirely on relative advantages and disadvantages of the approaches, preferably as a summary table included with Chapter 3.

2. The SAB recommends that EPA remove Section 4.6, especially Section 4.6.8. Section 4.6 discusses various considerations for selecting the most appropriate policy approach. Some of these relate to relative advantages and disadvantages of approaches from an economic perspective. These considerations should be clearly and consistently discussed for each approach. These considerations include the type of market failure, nature of environmental problem, degree of available information, degree of uncertainty, and monitoring and enforcement issues. Alternatively, this entire section could be reformatted into a table that summarizes how each of these criteria relate to different approaches.

Section 4.6.8, in particular, should be clarified or moved to another chapter. It currently discusses the influence of "policy makers" and their goals in selecting an appropriate instrument. It does not define policy makers, so the intention of the discussion is unclear.[4] Statutory constraints might limit the available set of options that the agency is authorized to ultimately implement and, given scare

[4] If "policy makers" refers to Congress, then this section refers to statutory authorization. It should be explicitly titled as such, and the focus should be about whether statutory directives constrain the agency's choice of alternatives to analyze and its ability to adopt an efficient approach. But any such discussion about how statutory directives can constrain economic analysis would fit better in Chapter 1 because it could affect the choice of both approach and stringency. If instead "policy makers" refers to presidential priorities, then the discussion should be clear about this and, again, would fit better in Chapter 1, where the intended audience and role of the Guidelines and economic analysis generally could be clarified.

resources, may limit the set that the agency will choose to analyze. Further, political officials at agencies, to the extent permitted by statute, might pursue other goals beyond aggregate welfare maximization or cost-effective achievement of a particular end when they choose an option. Any discussion of these issues and their effect on the economic analysis should be clear. This discussion, because it pertains to other chapters, too, might fit best in an earlier chapter, such as Chapter 1.

The SAB recognize that statutory constraints may play a particular role in selecting the set of alternatives. But alternatives include other stringency levels in addition to other regulatory or non-regulatory approaches—and statutory constraints are relevant to both categories. Thus, information about the role of statutory constraints in choosing the set of alternatives to analyze is particularly relevant to multiple chapters and not just Chapter 4. In general, the SAB believes that there is value to describing the effects of stringency levels and approaches that are not currently allowed under a statute, especially when those other stringency levels or approaches are efficient. But in some cases, especially when the overall stakes of the regulation are low, deploying scarce resources to evaluating legally unavailable alternatives may be unreasonable. The SAB agrees with the Guidelines that the alternatives analyzed should be reasonable, which sometimes could include currently unavailable options and sometimes would not. A discussion of this nuanced issue—who decides which options to analyze and how this decision is made—would be useful at the outset of the Guidelines, in Chapter 1.

3. The SAB recommends that the EPA provide a more balanced discussion of information disclosure in Section 4.4.2. Section 4.4.2 on information disclosure should outline the necessary conditions for such interventions to be effective and welfare-improving, including that target populations must understand the information and that the information must not be misleading. In addition, while the section describes evidence that TRI reporting can be effective in reducing emissions, it omits the broader literature that is mixed on the effectiveness. This literature investigates whether any associated reductions are persistent as opposed to one-time shocks.

4. The SAB recommends that the EPA rewrite Section 4.5 using an economic framework and ensure balanced discussion of the economic literature evaluating the efficacy of voluntary initiatives. Section 4.5 on voluntary initiatives is currently organized around congressional priorities from the Pollution Prevention Act (4-18 to 4-20).[5] The SAB recommends that EPA rewrite this section focusing on an economic framework. The section should provide analysts with guidance for when voluntary approaches might be effective/efficient and how these initiatives should be designed based on the economic literature. The current discussion presupposes "four general methods to achieve environmental improvements" (one "voluntary" approach is to "require" firms to set goals) and describes them in turn, without discussing any literature on their effectiveness. When the discussion finally turns to the economic literature, it reports only the more favorable results from the literature, despite admitting that the efficacy of voluntary programs is "decidedly mixed" (page 4-20, line 1). The last sentence, in particular, is confusing and unsupported. The section concludes that "*when the threat of regulation is strong, levels achieved are closer to those under optimal conditions*" (page 4-20, line 10-11). But the section does not explain what it means by optimal conditions and, whatever its meaning, why a voluntary approach would be pursued under those circumstances. These issues can be resolved or clarified by rewriting this section in an economic framework that in general would

[5] No other section opens with such policy considerations and priorities. If the purpose is to demonstrate statutory authorization, then it is odd to include this discussion only in this section. Statutory authorization is a separate concern that is relevant to all approaches and might vary by statute.

not contain a hierarchy. The SAB refers the EPA to sources such as Helfand (1994; 1992) to improve the framing of this discussion.

### 2.4.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

This chapter is valuable for the list of approaches it provides for achieving environmental objectives. The SAB recommends several topics that warrant inclusion or more discussion in order to make the list comprehensive.

The SAB recommends that the EPA include a discussion of additional approaches, such as insurance mechanisms, licensing programs, and pilot programs. Mandating insurance coverage or assurance bonds could help achieve compliance with environmental goals under certain conditions, and it would be valuable for the EPA to include such mechanisms as potential regulatory approaches.

The SAB recommends that the EPA include a discussion of strategies such as pilot programs or targeted research-and-development programs that could generate valuable information about optimal regulatory approaches. When the results of an economic analysis of a regulatory approach are highly uncertain—in particular, when there is significant uncertainty about costs or benefits—it may be appropriate to consider strategies meant to gather information about costs and benefits as a regulatory option. Examples of such approaches that help generate information on costs and benefits include pilot programs, which could also provide valuable information about implementation challenges as well as effects, and targeted research-and-development programs. These approaches could bridge the gulf between doing nothing and doing too much when information on costs and benefits is unavailable or highly uncertain.

The decision to employ such a strategy should be based on a value-of-information (VOI) analysis. A VOI analysis formally accounts for the expected costs and benefits of delaying a rulemaking decision until additional information is compiled. We refer the EPA to several useful references on VOI analysis: Raiffa (1968) (for the theory of VOI analysis); Howard et al. (1972) (for a classic applied illustration); Finkel et al. (1987) (for an early application in the environmental field). Experts in this field include Dr. Alison Cullen, Dr. Chris Frey, Dr. Igor Linkov, and Dr. Kimberly Thompson.

The SAB recommends that the EPA include more discussion of prescriptive approaches. The chapter devotes two pages to prescriptive approaches and more than eight pages to market-based approaches. But prescriptive approaches are more common, and the chapter should provide more guidance on how to design and evaluate different forms of prescriptive regulation. Meanwhile, some of the background information on market-based approaches could be moved to an appendix.

The SAB recommends that the EPA revisit its discussion of emissions taxes to reflect the importance of opportunity costs, deadweight loss, and the use of tax revenue, in light of resulting welfare effects. Section 4.3.2 on emissions taxes recognizes that "*[a]nalysts should always consider the opportunity costs associated with collecting and spending public funds*" (page 4-11). This issue, sometimes called the Marginal Cost of Public Funds (*e.g.*, Boardman et al. 2018), is important and deserves more discussion. The chapter should also provide more guidance to analysts on how to evaluate the deadweight loss associated with different taxes. The use of revenue is particularly important. When revenue is used to cut other distorting taxes, there may be an economic gain due to resulting increases in

employment or investment. This gain has been termed the revenue-recycling effect. We refer the EPA to Pezzey and Jotzo (2012) for a clear discussion on the welfare and distributional effects of revenue recycling.

### 2.4.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB recommends the following actions based on inconsistencies that we have identified:

1. The SAB recommends that the EPA remove Section 4.1, evaluating environmental policy, because it is inconsistent/redundant with the discussion in Chapter 1. Alternatively, the SAB recommends that the EPA make this section consistent with Chapter 1.

   This section starts by explaining that policymakers must sometimes consider non-efficiency-based considerations when evaluating approaches, such as statutory constraints and "policy goals." We understand that these considerations are undoubtedly relevant to a policymaker's choice of regulatory or non-regulatory approach. But they are not specifically relevant to Chapter 4 and the choice of approach. If the EPA would like to include a discussion of these kinds of overarching constraints in its Guidelines, then a list of these constraints belongs in Chapter 1, ideally before Section 1.3 (economic framework for analysis).

   The section then singles out two "economic concepts" that are useful for "framing the discussion and comparing the options," "economic efficiency," and "cost-effectiveness." Section 4.1.1 on economic efficiency, however, is redundant with Chapter 1, Section 1.3, which discusses the framework for economic analysis and focuses on efficiency. Also, the discussion of cost-effectiveness, Section 4.1.2, should not be limited to Chapter 4. Cost-effectiveness is a potentially useful way to compare policy alternatives in general, not just when they vary based on approach. Cost-effectiveness, therefore, should be discussed in Chapter 1, along with efficiency (Section 1.3.1) and distributional analysis (Section 1.3.2). Finally, it is odd, then, that "economic and distributional impacts," included in Chapter 1, Section 1.3.2, as considerations that are "important to policy evaluation" (page 1-4), are not also included in this list in Chapter 4, as these considerations are also useful in comparing approaches. If this section is purposefully duplicative of Chapter 1, Section 1.3, then the discussion should be consistent and include this distributional consideration as well.

   Our recommendation is to remove this discussion from Chapter 4. These considerations are not specific to comparing approaches and should be instead discussed in Chapter 1 as overarching considerations. If the discussion remains in Chapter 4, the SAB recommends that the discussion in the two chapters be made consistent and include all important considerations —and preferably, the discussion in Chapter 4 would be shorter and refer readers back to Chapter 1.

2. The SAB recommends that the EPA remove the current Section 4.7 because it is redundant. The SAB recommends that the EPA instead use this section or a new chapter to discuss how regulatory approaches can be designed to promote effective retrospective analysis. In the future, the EPA should consider devoting a chapter to best practices for conducting this retrospective analysis.

This section, titled "Measuring the Effectiveness of Regulatory Approaches or Voluntary Initiatives," simply reiterates different criteria that can be used to compare approaches: effectiveness, efficiency, equity, administrative costs, and effects on innovation (page 4-24). This list of criteria is redundant with Chapter 1, Section 1.3, and with the remainder of Chapter 4 (which should consistently identify relative advantages and disadvantages of different approaches). The SAB recommends that the EPA remove this current section as written.

The SAB finds, however, that there is an opportunity for the EPA to provide real guidance for designing regulatory approaches to allow for meaningful retrospective analysis of their effectiveness. Retrospective analysis and review, or ex post analysis of the performance of a regulatory approach, is valuable for at least two reasons. First, it provides information about the realized costs and benefits of the approach as designed and implemented. Such information can illustrate the efficacy of the regulatory approach—and address the question of whether the implemented regulation delivers on statutory objectives—and it can demonstrate the social welfare of the approach—and address the question of whether the regulation's benefits justify its costs. Second, the information generated could be used to improve the design and implementation of future regulatory approaches and to refine ex ante estimates of the effects of different approaches and improve ex ante design and implementation of approaches.

Every President since Carter has tried to implement retrospective analyses of the costs and benefits of existing regulations, but such analyses have not been prioritized or systematically implemented outside of specific directives (*e.g.*, Aldy 2014). Part of the difficulty is that regulatory approaches are often not designed in ways that facilitate evaluation of their consequences. Previous assessments of the state of retrospective review in federal agencies have concluded that ex ante planning for ex post analysis, when designing regulatory approaches, could increase retrospective analysis (*e.g.*, Aldy 2014). EPA can provide guidance for such planning in this chapter on regulatory approaches.

Therefore, we recommend that the EPA provide guidance in this section or in a new chapter for designing approaches to allow for meaningful retrospective analysis. The guidance could focus on the criteria for selecting regulations for future retrospective analysis and the plans for such analysis. For example, the EPA could identify regulations for which it would develop retrospective analysis plans based on expected economic impacts (*e.g.*, impacts exceeding $100 million annually), potential for learning about novel regulatory approaches, opportunities for informing future reviews and updates of the regulation in question (*e.g.*, periodic reviews of the Clean Air Act's National Ambient Air Quality Standards), and other criteria associated with the value of information of such analysis. In addition, the EPA should ensure that regulatory and non-regulatory approaches include tailored prospective plans for future assessment. For each chosen approach, the EPA should describe the methods it will use to evaluate impacts, with an emphasis on empirical strategies for causal inference; identify measurable objectives and milestones; plan to collect the relevant data and information for evaluating performance; and set a timeline for future retrospective analysis. We recommend the following recent literature and related reviews to inform the development of this guidance: Aldy (2014); Administrative Conference of the United States (2014); Cropper et al. (2017); Cropper et al. (2018); Currie and Walker (2019); Aldy et al. (2020).

In addition, the EPA should consider developing a new chapter with guidance and best practices for actually conducting this retrospective analysis. The U.S. Department of Health and Human Services, for example, devotes a chapter to conducting retrospective analysis in its Guidelines for

Regulatory Impact Analysis (U.S. HHS 2016). This chapter could serve as a model for the EPA as it develops its own guidance.

3. The SAB recommends that the EPA consistently present the relative advantages and disadvantages of each of the approaches (discussed under Charge Question 2). As discussed under Charge Question 2, the chapter does not consistently discuss the relative advantages and disadvantages of different approaches. The SAB refers the EPA to the discussion under Charge Question 2 and our recommendation that the agency remedy this issue.

### 2.4.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The word "externality," which appears in Chapter 4, is not accurately defined in the glossary. In particular, the SAB recommends that the EPA remove the word "unintended" from the definition at i-10, line 2. This word incorrectly suggests that intention matters. We suggest that the EPA use a definition from a standard economic textbook. For example, Hillman (2014) defines externalities as "costs or benefits to society of byproducts of consumption or production that are not factored into the original market price" and Mas-Colell et al. (1995) explain that "[a]n externality is present whenever the well-being of a consumer or the production possibilities of a firm are directly affected by the actions of another agent in an economy . . . exclud[ing] any effects that are mediated by prices."

***The following recommendations are noted for Chapter 4:***

Tier 1

- Refocus this chapter on the relative advantages and disadvantages of different regulatory and non-regulatory approaches, providing a consistent and balanced discussion of these advantages and disadvantages.

- Remove redundant, irrelevant, or inconsistent material. In particular:
  - Remove Section 4.1 (or make the discussion consistent with Chapter 1, Section 1.3).
  - Remove Section 4.6, especially Section 4.6.8.
  - Remove the current Section 4.7 and replace it with guidance for designing approaches for effective retrospective analysis.

- Rewrite Section 4.7 to provide guidance for designing approaches for effective retrospective analysis, which can shed light on the impacts of implemented policies and improve ex ante estimation going forward.

- Discuss additional approaches such as insurance mechanisms.

- Discuss approaches such as pilot programs and targeted research-and-development programs that could generate useful information when uncertainty about costs and benefits is high.

- Correct the inaccuracies related to the implications of a strict liability regime.

- Reframe the discussion of voluntary initiatives.

- Provide a more balanced discussion of information disclosure approaches.
- Revisit its discussion of emissions taxes to reflect the importance of opportunity costs, deadweight loss, and the use of tax revenue, in light of resulting welfare effects.

- Remove the word "unintended" from the definition of "externality" in the glossary and consider more textbook definitions.

Tier 2

- Include a summary table of the relative advantages and disadvantages of different approaches.

- Clearly state what questions this chapter will answer.

- Discuss the role of statutory constraints on selecting the set of alternatives in an earlier chapter or, if it remains in this chapter, that EPA discuss the issue in a clearer way.

- Include more discussion of prescriptive approaches.

- Rename Section 4.4.1.3 as "Combining Standards and Pricing," which was the section name from the 2010 Guidelines.

- Clarify use of terms such as approaches and instruments.

Tier 3

- Move background material on approaches to an appendix so that the chapter can better focus on relative advantages and disadvantages of a comprehensive list of available approaches.

- Distill the relative advantages and disadvantages into a summary table that can be included at the end of Chapter 3, removing the need for a separate Chapter 4.

- Devote a chapter to best practices for conducting retrospective analysis.

## 2.5. Chapter 5: Setting the Foundation: Scope, Baseline, and Other Analytic Design Considerations.

Chapter 5 contains information on some standard foundational aspects of a benefit-cost analysis and some non-standard items that may be of specific usefulness to an EPA analyst. The standard elements of the chapter include issues such as standing, comprehensiveness, time frame and considerations that go into baseline estimation. The non-standard elements relevant to EPA analysts include additional issues for the baseline such as the treatment of regulations in various stages of development and their linkages. The topic of uncertainty is often presented later in a sequence but fits well here as cross-cutting stage setting for more detailed chapters. Finally, there are a number of specific topics which seem to appear as a result of EPA's experience and challenges in developing RIAs. These topics are primarily under a catch-all section on Representing Economic Behavior which includes guidance on topics such as technological change, compliance, and changes in other environmental contaminants.

EPA indicated that this chapter has a substantial amount of new material compared to the previous guidelines and that is worthy of particular review. In general, the SAB finds that the chapter covers topics important to analysts and, with some exceptions, is appropriately grounded in the economics literature.

### 2.5.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB finds that statements in the chapter are largely consistent with the theoretical and empirical peer-reviewed economics literature. There are five topics, however, that are inconsistent or at least misleading in their current form which include: 1) Comprehensiveness, 2) Ancillary benefits and countervailing costs, 3) Compliance, 4) a single year time horizon, and 5) the adding up condition. A recommendation on each topic is followed by a discussion based on the SAB panel deliberations.

1. Create a new section (5.1.1) titled "Comprehensiveness" to clearly emphasize that the over-arching guidance is to include all significant and feasible costs and benefits in an unbiased manner. Supplemental guidance on topics such as ancillary (co) benefits and costs and countervailing risks are recommended to be included to the extent appropriate by deleting section 5.5.6 and including relevant material in this new section which, however, should not detract from the over-arching guidance to the analyst.

Page 5-1 line 19 and later - The subsections of the existing draft section 5.1 Scoping are: Standing, Market effects, and Externalities. Benefit and cost analyses (BCAs) textbooks (e.g. Boardman, et al, page 5) and government guidance (e.g. A-94, A-4, and EO 12866) address the importance of identifying impacts comprehensively or "all" impacts. Here the "all impacts" guidance is currently stated in the 2nd paragraph of the Scoping section (which could be re-used in the new section). Further, guidance to the analyst should be provided as to why this point is central to the use of benefit-cost analysis in a decision-making context should decision-makers wish to follow BCA principles. Biasing the aggregate net benefit calculation by intentionally omitting impacts can lead a benefit-cost decision-maker to the wrong conclusion if the sign of the net benefits is changed (Dudley, et al., 2017; Farrow, 2013).

A later section, 5.5.6 Changes in Other Environmental Contaminants, is related to the issue of comprehensiveness. Changes in other environmental contaminants – and changes in other, ancillary outcomes (e.g., fuel economy benefits) – should be fully accounted for in a BCA. That discussion should be deleted from Section 5.5.6 and incorporated in the new Comprehensiveness section to the extent relevant or otherwise deleted. In addition, the new Comprehensiveness section should explicitly address the potential for other benefits and costs including ancillary benefits and countervailing risks. (See discussion below in item 2.)

In any event, the guidance should make clear that there are no second-class categories of benefits or costs. While Comprehensiveness is the ideal goal; knowledge, data, budget, and scale of the regulation may all alter the level of detail included in an RIA, but priority should be given to the most significant categories to avoid any substantial bias in the estimates.

2. In the discussion of some components of benefits or costs relative to ancillary benefits and countervailing risks, it is best to use the terminology in OMB Circular A-4, "ancillary benefits," instead of co-benefits because it is more inclusive and because a further proliferation in terminology can lead to confusion, especially in intra-agency, interagency and stakeholder discussions. Similarly, "countervailing risks" may usefully be elaborated as a possible element of comprehensive cost.

The term "ancillary benefits" is a broader umbrella than "co-benefits" because the term co-benefit has come to connote the situation where reducing the target pollutant also yields benefits by reducing non-targeted pollutants. Whether a pollutant is a "target" pollutant seems to be related to a legal interpretation of the statutory objective of the rulemaking in question, which is not the analyst's decision. The objective of the rule and the statutory authority are (generally) set out in the preamble of the rule (although it can also be discussed in the "Problem to be Solved" portion of the RIA. While "co-benefits" fall within the scope of ancillary benefits, the term "ancillary benefits" has a link to Circular A-4 and appears to encompass a much broader range of beneficial regulatory impacts. See suggested glossary definitions for Ancillary Benefits, Co-Benefit, and Countervailing Risks.

The term "countervailing risks" as defined in OMB Circular A-4 4 and suggested for the Glossary, is one form of regulatory "cost" (adverse consequence) that is typically not intended by the regulator and is expressed through increased risk to public health, safety and/or the environment. A customary treatment of compliance costs will rarely uncover countervailing risks; they require – like ancillary benefits -- some "out of the box" thinking. Here are two examples: 1) early versions of the catalytic

converter, installed due to EPA tailpipe emissions standards, led to unexpected increases in sulfuric acid pollution that were later solved with catalyst refinement and low-sulfur fuels and 2) lead-free gasoline is a public health success story but the replacement of lead with alternative octane enhancers (e.g., MTBE, ethanol and the BTEX Complex) led to a complex array of countervailing health and environmental risks that are still not fully addressed. Recommended language for new section[6] addressing points 1 and 2 above is presented here.

> 5.1.1 Comprehensiveness
> *Analysts should consider all the potential benefits and costs of the regulatory action to avoid potentially misleading conclusions regarding the net benefits and relative rankings of the analyzed regulatory options. In practice, however, not all changes in economic welfare can be quantified and monetized due to constraints in available tools, data, and resources but such omissions should not knowingly bias the results either too high or too low. Therefore, the results of a BCA should be interpreted with care, evidence for welfare effects that cannot be quantified and monetized should be described, and any analytic limitations and omissions should be explicitly documented and discussed.* The intentional omission of impacts has the potential to change the sign of aggregate net benefits and thus potentially lead a decision-maker acting on benefit-cost principles to an incorrect decision based on those principles (Dudley, et al, 2017; Farrow, 2013).
>
> Analyses are typically broken down into various impacts and categories to assist in estimation and communication. Such organization can also help identify the largest components of the analysis. Various terms have been used in studies of environmental and health regulation to communicate some sub-categories of benefits and costs including ancillary, co- and other terms (see glossary for definition). If these terms are used at all (instead of say, Contaminant Y or Cost Savings X), It is best to use the terminology in OMB Circular A-4, "ancillary benefits," because it is more inclusive than co-benefits and because a further proliferation in terminology can lead to confusion, especially in intra-agency, interagency and stakeholder discussions. Similarly, "countervailing risks" may usefully be elaborated as a possible category for the communication of a subset of comprehensive cost items. However, all monetized impacts are to be included and presented based on their value, there are no second-class categories of value in a benefit-cost analysis.

3. Change the default compliance rate of 100 percent to an evidence-based default with guidance to inform changes to such a default. Make appropriate adjustments in related sections such as Textbox 5-1 and Section 5.5.4.

   The Compliance section currently establishes a default compliance rate of 100% which is, in fact, an upper bound. The compliance rate is almost certainly a random variable with an expected value less than 100% (https://www.epa.gov/aboutepa/about-office-enforcement-and-compliance-assurance-oeca; Farrow and Viscusi, 2011, page 11). Evidence based guidance should be provided on a compliance default rate different than 100 percent as well as characteristics that may guide the analyst to consider integrated regulatory design issues which might affect the compliance rate. A sensitivity analysis might investigate 100% compliance.

4. The guidance should strongly support use of multiple time periods, including the period of initial implementation of the rule, instead of a single out year time period at full implementation. The

[6] Italicized text in following paragraph drawn from EPA draft economic guidance.

relevant section 5.4 Time Horizon could be retitled Time Horizon and Period of Analysis to support this shift in emphasis.

The section is primarily concerned with start and end dates, the time horizon. However, this section is an appropriate place to discuss both the period and what might be called eras of analysis. Regarding the period of analysis, the ideal consideration involves multiple equally spaced annual time periods that capture the dynamics of the regulation and which can be appropriately discounted. Alternatives may exist such as presenting estimates for two or more years depending on the length of the implementation period and then a steady state beyond, during which there may also be new entrants (or exits). This discussion could be referred to in Chapter 6 on discounting and annualization. Discussion on this topic also occurred in Chapter 11 where it was noted that using a single year of implementation in place of an annualized value was not correct.

5. Adding up condition, page 5-11. Clarify the definition of the "adding up" condition.

The economics literature generally uses the adding-up condition to refer to the sum of *incremental* impacts which means that each impact is conditioned on prior events, not the unconditional sum (e.g. Desvouges et al., 2015 but also see Johnson, et al., 2017).

### 2.5.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds that the chapter contains a mostly objective, balanced, and reasonable presentation of the literature. But there are key improvements that the SAB recommends to EPA in order to promote objectivity, balance, and reasonableness. The topic areas are the material related to 1) Standing, 2) Externalities, and 3) Technological change and each is discussed below.

1. Standing (previously Section 5.1.1, now recommended 5.1.2 per Comprehensiveness recommendation). Expand guidance related to the default standing of domestic impacts, the potential role of the legal context in defining standing including impacts beyond national borders, and the nature of a separate analysis when evaluating impacts beyond national borders.

The draft treatment of standing basically refers to Circular A-4 with little elaboration while stating that standing is a policy decision. First, it can be useful to clarify for analysts what is expected when reporting "separately" beyond national borders. While this may mean a sensitivity analysis for both benefits and costs that takes into account impacts beyond national borders, there are a number of analytical issues regarding both international benefits and costs which may add complexity (National Academy of Science, 2017). This complexity might include whether the benefits gained from other countries should be counted if an international agreement exists and whether US citizens express value for impacts beyond US citizens and residents. Further, the "policy" decision regarding standing can be informed by legislation such as the existence of Senate ratified treaties where a regulation may be one aspect of the treaty. It may be that the Preamble or the "Problem to be Solved" portion of the RIA identifies an international component for the analyst in which case supplemental analyses may be called for.

2. Externalities (existing section 5.1.3, recommended 5.1.4 per the Comprehensiveness recommendation). Rebalance this section to supplement core examples and guidance on Externalities (including a consistent and correct definition of externalities as identified in Chapter 4).

   This section is unbalanced by implicitly invoking an incorrect definition of externalities as pointed out in Chapter 4. Working with a consistent definition, provide basic examples as to how "externalities" are a central part of what is to be comprehensively analyzed, whether or not related to environmental contaminants. The imbalance can be seen numerically and substantively in that currently, 3 lines refer to the basic inclusion of externalities while 22 lines have a convoluted discussion of primary or other regulatory purposes which has no clear or well explained link to externalities and is outside the purview of the analysis where monetary values are treated equally. If Appendix A is deleted as was discussed, some of that explanatory material may usefully be moved into this section including some of the appendix discussion of value on undistorted markets to set the stage for externalities. Further, it may usefully be elaborated that at an optimum point, externalities may be "internalized" into the market by the regulation and either no longer exist as externalities or exist as residual real effects that are not economically desirable to reduce. However, partial incorporation of externalities into a market may not be economically sufficient, an example being recent positive net present value estimates for further reduction in particulate emissions, or externalities may be over-incorporated in the market in which case the RIA if done correctly would indicate negative net benefits.

3. Technological change (page 5-16). Suggest other factors that may importantly and specifically influence technological change related to the proposal such as changes in health prevention or mitigation or expanded virtual capability.

   Technological changes occur in areas other than production techniques or pollution control. The analyst may be encouraged to consider whether technological changes in other parts of society may affect the baseline and impacts of the regulation. In addition, the analyst should recognize that the longer the time horizon, the more uncertainty and potential for technological change.

### 2.5.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB recommends the following five topics for inclusion or more discussion covering: 1) Linked rules, 2) Bundled rules, 3) Models and Data, 4) Cost Savings, and 5) Uncertainty.

1. Linked Rules (page 5-9, section 5.3.1). Change title to "Bundled and Linked" Rules. Where rules are linked by law, regulation or guidance; the RIA should include significant effects from the normal operation of linked existing local, state, federal and international regulatory programs.

   When significant federal, state, local and international rules are linked by law, regulation or guidance then the causal link is at least as clear as many economic behaviors that are associated with a regulation. As an example, regulations creating Maximum Contaminant Levels (MCL's) for drinking water appear to be linked to CERCLA clean-up standards as the MCL's appear to be the "in-situ clean-up standards where either surface or groundwater is or *may* be used for drinking" (https://semspub.epa.gov/work/HQ/174076.pdf, page 4-8). Another example may include a GHG standard that results in such large or abrupt down-weighting of vehicles that compliance with

National Highway Traffic Safety Administration (NHTSA) crash-protection standards is affected. Or, a federal/state regulatory program to stimulate deployment of plug-in electric vehicles may lead to increased demand for cobalt (a desired material in lithium-ion battery design) but mining of cobalt occurs predominantly in a developing country that is not in compliance with international child-labor standards. Discussing how to handle these typically non-market linkages in a way consistent with taking all significant benefits and costs into account would help the analyst.

2. Bundled Rules. The guidance should establish that separate BCAs be developed and reported separately for each of the major components bundled within the rule.

   Bundled rulemakings could be done thru separate rules--i.e., linked rules, but are sometimes just reported as an aggregate. Bundling several requirements in a single BCA can disguise significant differences in the net benefits of the individual requirements. For example, a rule may establish emission limits for several different pollutants each with distinct control technologies and separate benefits. In this case, the RIA should present separate BCAs for each requirement. This is stated in Chapter 3 (page 3-5 and 3-6) but can be elaborated upon here.

3. Models and Data. Improve integration of model selection and data issues (Textbox 5-2) and explain standard situations where private or government data may not be available.

   Textbox 5-2 contains some of the most explicit guidance for the analyst and yet is not discussed in the vaguely named Section 5.5.1 Behavioral Response. Textbox 5-2 and its 7 questions for the analyst about models only appears at the end of a paragraph referring the reader to the box. A summary of the issues within the regular guidance text may help focus the reader on the text box if that is the preferred method of presentation. This textbox seems to be the main coverage of material that otherwise is delayed until Chapter 11.2 on presentation and data quality issues which are important in their own right. In selecting models and underlying studies, the analyst should give a preference to models and studies where the documentation and data are publicly available. However, there may be certain legal and other situations where the underlying data may not be publicly available because of confidentiality restrictions (e.g. personal health data, occupational injury data, etc.). In such cases the RIA should explain the reasons for using these sources. Further, the issue of assessing model validity should be incorporated.

4. Cost Savings. Add wording that the modeled behavior may appear inconsistent due to the functional forms chosen, perhaps not the actual behavior. It has been shown in the literature that sometimes apparent "irrationality" can be the result of an inflexible functional form chosen by the analyst. For example, Ketchum, Kuminoff, and Powers (AER, 2016) show how presumed violations of self-interest are often just violations of a utility function that an analyst had picked, whereas other utility functions could have justified the observed choices.

5. Uncertainty (page 5-19, Section 5.6). Make this section and sub-sections an expanded and better structured touchstone for more detailed treatment of issues related to Uncertainty in later chapters. Topics to be expanded include: a) default uncertainty stance for decision-makers for RIAs (expected value), b) uncertainty stance for economic actors such as consumers or firms (reflected in their actual behavior to the extent possible), c) additional topics in estimation and uncertainty including but not limited to guidance on establishing an "alternatives" (scenario?) analysis (page 11-12), expanding guidance to comply with the A-4 requirements for very large regulations (greater than $1 billion per

year), and issues related to improving uncertain information such as pilot or monitoring programs and the value of information (perhaps in Provision of Information section), building on Chapter 4), expert elicitation (perhaps in lay and expert opinions) and real options (perhaps in quasi-option) as it may pertain to compliance and capital decisions.

Uncertainty (and risk) is central to both conceptual structuring and estimation. The analysis of risk preferences of decision-makers, consumers, and firms are important underlying assumptions of analysis about which guidance could be provided. While the discussion of empirical sensitivity analysis in the existing draft appears quite useful, the analyst may benefit from additional guidance of standard practices or examples. Further, an Alternatives analysis appears in Chapter 11 which would seem to be relevant in the Uncertainty section, but it is not discussed in this location. Finally, for major rules (annual effects >$1 billion), Circular A-4 requires that RIAs present a formal quantitative uncertainty analysis. This section should provide guidance on complying with this requirement, including a discussion for developing probability distributions of regulatory benefits and costs which. Value of information can link to its introduction as an "approach" in Chapter 4. Real options, an established approach in private investment but more of a frontier approach for public investment, (Dixit and Pindyck, 1994; Traeger, 2014) may be important to understand industry compliance behavior and adaptation to technological change.

### 2.5.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB finds there are inconsistencies within the chapter regarding externalities. See the discussion under charge question 2.

### 2.5.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The following terms are suggested for inclusion in the glossary:

- Alternatives analysis: (definition should be provided by the EPA).

- Ancillary benefit: (from A-4) ancillary benefit is a favorable impact of the rule that is typically unrelated or secondary to the statutory purpose of the rulemaking (e.g., reduced refinery emissions due to more stringent fuel economy standards for light trucks).

- Co-benefit: an identifying term sometimes used for the benefit from pollution control that is not directly identified as an actual or perceived statutory purpose of a proposed regulation.

- Countervailing risk (from A-4): countervailing risk is an adverse economic, health, safety, or environmental consequence that occurs due to a rule and is not already accounted for in the direct cost of the rule (e.g., adverse safety impacts from more stringent fuel-economy standards for light trucks).

- Expected Value: the probabilistically weighted outcome that defines a statistical mean. In practice, this may be a data based or a subjective measure.

- Externality: see chapter 4 suggestions.

***The following recommendations are noted for Chapter 5:***

Tier 1

- Create a new section (5.1.1) titled Comprehensiveness to clearly emphasize that the over-arching guidance is to include all significant and feasible costs and benefits in an unbiased manner. Supplemental guidance on topics such as ancillary (co) benefits and costs and countervailing risks are recommended to be included to the extent appropriate by deleting Section 5.5.6 and including relevant material in this new section.

- In the discussion of some components of benefits or costs, it is best to use the terminology in OMB Circular A-4, "ancillary benefits," because it is more inclusive and because a further proliferation in terminology can lead to confusion, especially in intra-agency, interagency and stakeholder discussions. Similarly, “countervailing risks” may usefully be elaborated as a possible element of comprehensive cost items.

- In Section 5.5.4, change the default compliance rate of 100 percent to an evidence-based default with guidance to inform changes to such a default. Make appropriate adjustments in related sections such as Textbox 5-1 and Section 5.5.4

- The guidance should support use of multiple time periods, including the period of initial implementation of the rule instead of a single out year time period at full implementation. The section on “Selection of Time Horizon (p 5-13)” could be retitled Time Horizon and Period of Analysis to support this change in emphasis.

- Within the “Standing” section (previously Section 5.1.1, now recommended 5.1.2) expands the guidance related to the default standing of domestic impacts, the potential role of the legal context in defining standing including impacts beyond national borders, and the nature of a separate analysis when evaluating impacts beyond national borders.

- Rebalance the “Externalities” section (existing Section 5.1.3, recommended 5.1.4) to supplement core examples and guidance on Externalities as introduced in Chapter 4 (along with a corrected definition of externalities).

- For Section 5.3.1, change the title to “Bundled and Linked” Rules. Where rules are linked by law, regulation or guidance; the RIA should include significant effects from the normal operation of linked existing local, state, federal and international regulatory programs.

- Include a statement that BCAs be developed and reported separately for each of the major components bundled within the bundled rules.

- Revise Section 5.6 to expand and include a better structured touchstone for more detailed treatment of issues related to Uncertainty in later chapters. Topics to be expanded include: a) default uncertainty stance for decision-makers for RIAs (expected value), b) uncertainty stance for economic actors such as consumers or firms (reflected in their actual behavior to the extent possible), c) additional topics in estimation and uncertainty including but not limited to guidance

on establishing an "alternatives" (scenario?) analysis (page 11-12), expanding guidance to comply with the A-4 requirements for very large regulations (greater than $1 billion per year), and issues related to improving uncertain information such as pilot or monitoring programs (perhaps in provision of information section along with concept of value of information), expert elicitation (perhaps in lay and expert opinions) and real options (perhaps in quasi-option) as it may pertain to compliance and capital decisions.

Tier 2

- Clarify the definition of the "adding up" condition on page 5-11.
- Suggest other factors that may importantly and specifically influence technological change related to the proposal such as changes in health prevention or mitigation or expanded virtual capability.
- Improve integration of model selection and data issues (Textbox 5-2) and explain standard situations where private or government data may not be available.
- Add wording that the modeled behavior may appear inconsistent due to the functional forms chosen, perhaps not the actual behavior.

Tier 3

- The SAB has no recommendations for this tier.

## 2.6. Chapter 6: Discounting Future Benefits and Costs.

Chapter 6 presents guidance on how to employ discounting to address the variation in timing of the benefits and costs of a given regulation or policy in order to convert the streams of monetized impacts over time into today's terms. The chapter addresses the fundamental mechanics of calculating net present value and annualized value measures, the rationale for social discounting, the differences in the consumption rate of interest and the opportunity cost of capital, the estimation of the shadow cost of capital, considerations in intergenerational discounting, and the role of private discount rates in characterizing individual and firm behavior. The chapter closes with a series of recommendations and principles.

### 2.6.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB finds that the chapter is generally consistent with the theoretical and empirical peer-reviewed economics literature.

### 2.6.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds that the chapter contains a reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described.

### 2.6.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that some aspects of the chapter would benefit from clarification, additional discussion, or elaboration.

1. Choice of Discount Rates for Intergenerational Impacts:
   The discount rate used for RIAs is one of the few parameters in regulatory analysis that OMB specifically recommends through Circular A-4. How EPA's guidance on the discount rate squares with the OMB guidance merits some careful elaboration. This guidance should be a bit more general in its deference to Circular A-4. For example, it specifically references 3% and 7% multiple times. A future OMB may update the guidance, and these rates may change. If the OMB circular is updated, with revised discount rates, then this guidance should automatically adjust.

   The SAB recommends the use of an upper end discount rate for intergenerational benefits and costs (page 6-24). In cases where the policy has a long time horizon (and most benefits accrue to one generation and the costs accrue to another), the current draft guidance (p 6-24) recommends restricting discounting for intergenerational analysis to the consumption rate of interest along with two additional approaches – a declining discount rate and a lower constant discount rate. The draft recommendation on page 6-24 would preclude the use of a higher discount rate for intergenerational benefits and costs than the consumption rate of interest.

   There are several reasons for using a discount rate greater than the consumption rate of interest. First, OMB Circular A-4 calls for the use of discount rates of 3 and 7 percent. The 7 percent discount rate is a proxy for the social opportunity cost for capital. One of the key arguments for using the opportunity cost of capital is that everyone is left no better or worse off with this approach – it ensures that there are not other uses of investment capital that would enable everyone to be even better off (thereby satisfying the objective that a Pareto improvement is possible) (Viscusi et al. 2019 and Burgess 2018).

   The revised Guidelines express in other chapters the concern that environmental regulations could operate to reduce capital accumulation, reducing economic output and welfare. For example, refer to pages 8-12 and 5-16. This would highlight the importance of considering the opportunity cost of capital in selecting discount rates.

   In a similar vein, Viscusi et al. (2019) argue that if BCA uses a lower discount rate for effects for future generations and in fact both generations have the same higher discount rate, then, "subsequent policy distortions will lead to policy outcomes that are not consistent with the within-generation intertemporal preferences that future generations would have with respect to impacts on their generation" (page 313). For similar lines of thought, refer to Birdsall and Steer (1993) and Wildavsky (1988), among others in the literature.

   Note that the social opportunity cost of capital has been remarkably stable over the last century. OMB has calculated a long-term pre-tax opportunity cost of capital of 7 percent. The Guidelines note that: "[s]imilar to the approach taken by OMB (2003), the CEA (2017) estimated real rates of return to capital to be around 7 percent based on National Accounts data" (footnote 156,

page 6-16). CEA noted that this approach may be subject to measurement error leading to an overestimate.

Second, extending the Ramsey framework in the intergenerational context to account for potential catastrophic impacts or for the potential that the benefits of the regulation would be correlated with market returns would result in a higher discount rate relative to the risk-free measure of the consumption rate of interest estimated in the Ramsey framework (Stern 2008; Interagency Working Group on the Social Cost of Carbon 2010; Freeman et al. 2018). This is in a sense a "precautionary" argument. It has the effect of adding to the Ramsey framework an adjustment for project (or policy) risk – effectively, a risk premium (Freeman et al. 2018). The rationale for adding a risk premium: (1) to reflect the fact that the returns from climate change projects are positively correlated with the macroeconomy (IWGSCC 2010) or (2) to reflect a non-trivial threat of a major catastrophe, such as depression, war, or a pandemic (Stern 2008).

To provide policy-world context, note that the Interagency Working Group on the Social Cost of Carbon (2010) produced SCC estimates for multiple discount rates, including a rate of 5 percent. In its justification of this rate, the IWGSCC noted that "[t]he upper value of 5 percent is included to represent the possibility that climate damages are positively correlated with market returns. Additionally, this discount rate may be justified by the high interest rates that many consumers use to smooth consumption across periods" (page 23). Stern (2008) accounted for extinction risk by increasing the discount rate by 0.1% per year in his assessment of the economics of climate change. The French Government has adopted a discounting approach that explicitly accounts for these issues with a risk premium of 2% (Freeman et al. 2018).

The intergenerational context may merit consideration of an alternative discount rate, as described in the guidelines. In this context, SAB recommends that EPA employ the OMB recommended rates for the consumption rate of discount and the opportunity cost of capital. Alternative rates for analysis, as described on page 6-24, could be used in addition to these OMB-recommend rates. In these cases, EPA should be clear in explaining its rationale for adopting another rate for such analysis.

2. Employing a Common Discount Rate for Impacts Realized at a Common Point in Time:
The SAB concurs with the first principle identified at the close of the recommendations section: "Regardless of the approach or rate selected, the same discount rate should be applied to all benefits and costs that occur in the same year, independent of whether the policy has intra- or intergenerational consequences, to ensure consistency in the analysis" (page 6-24). This is important given the frequent past practice in RIAs of employing multiple discount rates within a given analysis for impacts occurring in a common year.

It's not clear why this is identified as a "principle" that "should be kept in mind" (page 6-24) and separate from the recommendations presented starting on page 6-23. This principle should be given the same weight and emphasis as the preceding recommendations. It will also help address the potential confusion associated with considering alternative discount rates (as discussed on the bottom of page 6-23 and in our preceding comment) by making clear that regardless of the choice of discount rate, the benefits and costs occurring in any given year will be given the same weight in calculating the present value.

3. Full-Year Implementation "Snapshot" Analysis vs. Net Present Value:

The draft guidance correctly emphasizes the importance of estimating the present values of the streams of benefits and costs in order to evaluate a given regulation or policy. In most of EPA's practice in evaluating regulations, however, the agency presents annual benefits based on a representative year after full implementation and annualized costs constructed from the stream of costs over some timeframe (this is not always transparent in the analysis). In our recent review of nearly 50 Clean Air Act RIAs for major rules issued since 1997, more than 80% presented monetized benefits and costs in this manner (Aldy et al. 2020). This is an apples and oranges comparison. Indeed, for most benefits categories in these RIAs, discounting is moot for the benefits analysis – a future year's benefits are presented for that year without any consideration of how far that year is in the future (in some cases, the full implementation year is more than two decades after the rule promulgation date in the RIA). The notable exceptions are for fine PM premature mortality, which EPA has modeled in some RIAs with a five-year latency and is thus discounted back to that future year (but not to the year of promulgation), and the social cost of carbon.

Snapshot analyses risk communicating misleading information about the costs and benefits of regulatory actions. First, failing to discount values to the present – e.g, the year of rule promulgation – gives the impression of larger monetized benefits and costs as well as larger net social benefits than would be reflected by simply discounting the snapshot year values to produce present values. For example, the Tier 2 motor vehicle emission standards and gasoline sulfur requirements were promulgated in 2000 (65 Federal Register 6698). The RIA focuses on a year 2030 snapshot analysis and presents monetized benefits of $25.2 billion and monetized costs (an "adjusted cost" figure) of $5.3 billion, which yields net social benefits of about $20 billion. If discounted back to 2000, the benefits, costs, and net social benefits would have been $3.3, $0.7, and $2.6 billion, respectively. Second, such an approach could produce a positive net social benefits estimate when a full net present value analysis would produce a negative net social benefits estimate. The primary motivation for discounting in benefit-cost analysis is to account for differences in timing of costs (many of which occur early) and benefits (many of which occur later). For example, the Tier 2 regulation imposes costs in 2003 and 2004 the present value of which exceeds the present value of the year 2030 benefits. Of course, there are benefits between 2000 and 2030, but for the analysis to be informative, the agency should attempt to present these to enable a proper accounting of benefits and costs over time. Indeed, one can easily construct a hypothetical policy in which a snapshot year generates monetized benefits in excess of costs, but present value costs in excess of present value benefits. Finally, snapshot analyses often employ an amortized cost for the snapshot year, which could be sensitive to the choice of time horizon. The assumption of a longer time horizon provides more time over which to amortize initial investment costs, which reduces the annualized cost presented in a snapshot analysis. A long-time horizon, such as in the Tier 2 regulation, also appears inconsistent with regulatory updating. In 2014, the EPA issued its Tier 3 regulations for motor vehicles and gasoline sulfur (79 Federal Register 23414). In the RIA for this 2014 rule, the EPA also used a 2030 snapshot year for its benefit-cost analysis.

Given the varying time horizons across the EPA's regulations and policies, there is value to the various audiences of EPA economic analyses in presenting both the present value of benefits and costs and annualized measures of benefits and costs. The guidelines are very clear in the second bullet of 6.5 that such comparisons of representative year benefits to annualized costs are not adequate proxies for a comparison of the present values of benefits and costs. This explicit description of doing so as inappropriate should be highlighted earlier in the chapter as well, such as when the annualization calculations are introduced.

4. Selecting Time Horizons:
   The time periods chosen for the analysis matter for discounting for several reasons. First, they affect the annualization of costs, which is common in EPA RIAs. Second, they could influence the discount rate if one opts to account for discount rate uncertainty by employing a certainty equivalent discount rate for long-term policies over which discount rates may be plausibly considered uncertain. As Textbox 6-5 clearly illustrates, the certainty equivalent discount rate can decline considerably as one extends the time horizon of analysis. The time period assumption in such analysis should be made based on an understanding of the economic and regulatory context. In addition to the discussion of factors that may inform the choice of time horizon in section 6-1, the likely lifetime of the rule should be accounted for. For example, if a rule will be periodically reviewed and updated (e.g., a NAAQS, or tailpipe standard, or NSPS under the Clean Air Act), then it may not be appropriate to use a long-time horizon. In such cases, a long-time horizon is likely to be overlapped by a future rule-making updating the current rule under consideration. This illustrates again the importance of selecting baselines for analysis, as discussed in other chapters of the guidelines. To enhance the clarity of a given analysis, the reader would benefit from a transparent discussion of the choice of time horizon for the analysis, including justification for the time horizon selected and discussion of the robustness of the findings to this decision.

5. Clarify the Value to the Reader of the Textboxes:
   Textbox 6.1: What is the objective of a text box in the guidelines? Does this hypothetical policy – with benefits 30 years in the future – have a real-world analog? GHG regulations? Title VI regulations under the Clean Air Act? It would be better to illustrate practice with real-world policies to make the calculations more salient for the reader. It is also important to be clear about the take-away for the box. What is actionable from the material presented in the box? Why does it need separate treatment in the chapter? The answers to these questions are not obvious to me here or in the boxes in Chapter 7 on benefits.

   Textbox 6.2: Why use a hypothetical market rate of return? Why not use estimated rates in practice, for example, you could refer to Figure 5 in this 2017 CEA report on discounting: https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf. Again, using real-world examples instead of hypotheticals would be more effective. It may also help make it clearer to the reader what the take-away point is for this box.

   Textbox 6.3: Is EPA recommending an application of the Ramsey framework? It's not clear what the take-away is here.

   Textbox 6.6: The mathematical equation in this text box needs to be corrected. This textbox could also use an additional paragraph that explicitly addresses how new information and the updating of declining discount rates over time could be incorporated in a DDR schedule in a manner that is not time inconsistent (see Arrow et al. 2014 page 159-160).

6. Clarify Base Year Dollars:
   The chapter references inflation briefly in footnote 139 on page 6-2. The SAB recommends that EPA explicitly call attention to the importance of employing a common base year dollar for presenting all information in an economic analysis. The agency should clearly communicate this base year. In addition, the agency should clearly communicate how measures were converted into a common base

year. For example, suppose that an analysis of an air quality regulation presents monetized costs denominated in 2020 dollars. The agency should deflate the value of statistical life, which in this guidance is denominated in 2006 dollars (Table B-1 on page B-2), such that it is also in 2020 dollars and identify the selected deflator. In the context of retrospective analysis, EPA should also convert various measures into a common base year and should clearly identify the selected deflator.

### 2.6.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB recommends that the EPA explicitly state the importance of employing common underlying assumptions related to long-term economic growth. This has implications for the discount rate in those cases in which the EPA employs a discount rate based on long-term per capita consumption growth (e.g., in a Ramsey-style framework). It likewise has implications for estimating the social cost of carbon (Chapter 7), for adjusting the value of statistical life over time with an income elasticity (Chapter 7) and for estimating the economic costs of a regulation, which may depend on how economic growth affects the market(s) in which regulated firms operate (Chapter 8).

### 2.6.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

In the Glossary, consumption rate of interest is defined as: "Consumption rate of interest is the rate at which individuals are willing to exchange consumption over time. Simplifying assumptions, such as the absence of taxes on investment returns, imply that the consumption rate of interest equals the market interest rate, which also equals the rate of return on private sector investments." The second sentence is unnecessary and draws attention to a hypothetical that does not occur in real-world practice (while also abstracting from other factors that contribute to the divergence between the rate of return on investment and the consumption rate of interest). The SAB recommends defining the consumption rate of interest based on the first sentence of the Guidelines definition such that the glossary would read: "Consumption rate of interest is the rate at which individuals are willing to exchange consumption over time."

This identical definition should also be used on page 6-9 where the Guidelines define the consumption rate of interest and other discount-related concepts.

***The following recommendations are noted for Chapter 6:***

Tier 1

- Employ the consumption rate of interest and opportunity cost of capital discount rates consistent with OMB guidance, which is currently 3% and 7%, in all economic analyses.

- In cases in which EPA presents additional analyses based on alternative rates, especially in intergenerational contexts, clearly explain the rationale for the alternative rates.

- Employ a common discount rate for all benefits and costs that accrue for a given year. This will require elevating a "principle" to a "recommendation" in Section 6.5.

- Emphasize that full-implementation year analysis in lieu of a present value analysis or an annualized value analysis fails to comply with economic guidelines and standard practice for benefit-cost analysis.

- Highlight the importance of being transparent about the time horizon for the analysis, especially in the context of communicating the annualization of benefits and/or costs. The agency should be explicit about this assumption in documenting it in its analyses.

- Highlight the importance of employing common assumptions – such as growth in incomes over time – that may influence the discount rate, measures of benefits, and measures of costs within a given analysis.

- Use a common, streamlined definition of the consumption rate of interest in the glossary and the chapter.

Tier 2

- Revise the chapter's text boxes to make it clear to the audience what the take-away messages are from each of the text boxes.

- Clarify the importance of employing a common base year dollar in its analyses.

Tier 3

- The EPA could consider developing a declining discount rate schedule, which could help address the time horizon problem, for intergenerational policy contexts. In doing so, the agency may consider developing the criteria for periodic updating of the schedule and present the necessary information such that independent analysts could understand and replicate the agency's work. This effort could account for the suggestions in Arrow et al. (2014) and EPA may benefit from convening a SAB panel to review this work.

- The EPA could consider identifying a published RIA to designate as a template for good practice in undertaking discounting (and, beyond the scope of this chapter, for other dimensions of economic analysis) as a resource for EPA staff and contractors.

## 2.7. Chapter 7: Analyzing Benefits.

The chapter covers a large amount of ground in a well-organized and thoughtful way. The EPA is to be commended on the quality of the work.

### 2.7.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB finds the statements and analytic recommendations made in the chapter are, with a few exceptions, consistent with the theoretical and empirical peer-reviewed economics literature. These exceptions are discussed below.

General Valuation Theory and Method:

1. Clarification on page 7-1: Willing to Accept (WTA) Compensation is also compatible with potential Pareto Criterion; later in this chapter, WTP is noted to indicate both welfare measures, but that condition is not established on page 7-1.

2. More details needed on page 7-11: As economic value constructs, WTA and WTP make implicit assumptions about property rights; if utilizing initial utility as reference levels, the welfare implicitly assumes property rights exist in the initial state; alternatively, if subsequent utility is reference, property right exists to this state. These details can be important in some applications and should be highlighted in the chapter.

3. Additional method that should be discussed, 7-22: choice models [RUMs] can be used to assess tradeoffs associated with any selection among multi-attribute private or public goods. If the attributes of the good include pollution level, risk, or some other non-market benefit *and some associated private cost*, the model can be used to value that benefit. Examples: choice of neighborhoods with different pollution levels; choice of food products with potential health risks; choice of private goods that certify low ecological impacts or creation of ecological benefits (e.g. organic); choice of driving/walking/biking route with view of amenities; etc.

4. Point deserving additional emphasis, 7-23, line 12: suitability of prices for welfare analysis is *directly dependent on structure of market*; if markets are not sufficiently competitive, it takes additional research/calculations to establish opportunity costs of inputs or products.

Human Health: Value of Statistical Life:

1. Chapter 7 would benefit from a discussion of the age distributions for mortality. Commenters raise the issue of reporting VSL alone vs. reporting VSL together with additional measures such as VSLY/QALY (quality-adjusted life year). The EPA (2007) guidance is to focus on VSL. EPA (2007) goes on to say (page ii) *"However, we also urge the Agency to report the age distribution of statistical lives saved and the average remaining life expectancies of persons in each age group."* Although there are mentions of age distribution in other chapters of the Guidelines, including Appendix B, it would be useful to discuss the reporting of age distribution in the text of Chapter 7.

2. The primary VSL reflects a dated survey of the literature. Table B1 lists the 26 studies that serve as the basis for the agency's primary VSL of $7.4 billion (2006$). The average publication date of these studies is 1985 and the most recent paper in this table was published in 1991. Not a single one of the labor market hedonic papers employs measures of occupational fatality risk based on the BLS Census of Fatal Occupational Injuries, which BLS initiated in 1992. As noted in Viscusi (2004), occupational fatality risk data that pre-date the CFOI suffer from numerous deficiencies that undermine statistical estimation. The contingent valuation studies also predate significant improvements in CV methods. Moreover, 5 of the 26 studies address risk-income trade-offs in non-U.S. contexts, which further raises questions about their applicability for U.S. policy and regulatory analysis.

   In 2007, the SAB was asked to address the potential role of meta-analysis in constructing a VSL estimate for use by the agency. Here is an excerpt from the SAB's response:

   > *"In answer to the meta-analysis charge questions, the SAB does not believe that metaregression—a particular form of meta-analysis—is an appropriate way to combine VSL estimates for use in policy analyses. The SAB does, however, agree that meta-*

> *regression is a useful statistical technique for identifying various aspects of study design or population characteristics that are associated with differences in VSL estimates. Once important sample characteristics, model and estimation factors affecting the VSL have been identified, the Agency must determine a set of criteria for what constitutes a set of acceptable empirical studies of the VSL. The SAB urges the Agency to establish such criteria. The Agency must also determine which studies are appropriate for estimating the VSL in a specific policy context, depending on the nature of the risk addressed by a policy and the population affected. Once these criteria have been determined, and an acceptable sample of VSL estimates from the literature has been formed, appropriate statistical techniques can be used to combine these estimates" (SAB 2007).*

It's difficult to imagine any of these 26 studies satisfying the criteria that the agency would put forward for "what constitutes a set of acceptable empirical studies." Not only would it be unlikely that they would satisfy standards on current, acceptable empirical methods grounds, five of them seem unlikely to be acceptable on the grounds that they estimate VSLs for a non-U.S. population (two UK, one Canada, one Australia, and one Japan study). There have been more recent efforts by the EPA SAB focused on the value of statistical life (e.g., SAB 2017).

The discussion of the VSL should reflect some of the more recent literature and highlight the importance of updating VSLs over time. Indeed, the EPA does this as a regular practice already with adjustments for growth in per capita incomes and it is a topic addressed in SAB (2017). While EPA may not be in a position now to change the primary VSL for economic analysis, it should avoid giving the potentially misleading impression that this literature has been stagnant since 1991. Some of the more recent literature includes publications in the subsequent comment on Heterogeneity in VSLs as well as the following: Viscusi (2015, 2018a, 2018b); Viscusi and Gentry (2015); Gentry and Viscusi (2016); Kniesner and Viscusi (2019). In the context of the VSL income elasticity, several recent publications include: Viscusi and Masterman (2017) and Masterman and Viscusi (2018).

3. Heterogenenity in VSLs. The discussion of the Heterogeneity in Risk and Population Characteristics on page 7-13 (and related text in Appendix B) requires revision. Lines 36 and 37 state: "The empirical and theoretical literature on the effect of many of these characteristics or willingness to pay is incomplete or ambiguous." This statement and the following discussion of the literature as it pertains to how VSLs vary over the life cycle do not do justice to the literature.

   First, this should be framed in terms of how willingness to pay for reductions in mortality risk vary over the life cycle. It is not simply as a function of life expectancy, or an issue for the elderly, or a "senior discount" as once described in the context of the Clear Skies Initiative.

   Second, the theoretical literature – which includes simulations based on calibrated models – is not ambiguous about how the value of reducing mortality risk varies over the life cycle. Shepard and Zeckhauser (1984) does an excellent job of presenting two extreme cases that illustrates that the value of reducing mortality risk may decline over the life cycle or may take an inverted-U shape over the life cycle. Most of the rest of what is an extensive literature falls within these two cases and illustrate how the life-cycle pattern of consumption coupled with life expectancy influences the life-cycle pattern of willingness to pay to reduce mortality risk. The bottom line is that at some point in the life cycle, WTP to reduce mortality risk begins to decline for a given population of individuals as

they move from middle age to later ages in the life cycle. Let us note some of these papers: Arthur 1981, Cordoba and Ripoli 2017, Hall and Jones 2007, Johansson 2002, Murphy and Topel 2006, Rosen 1988, Shepard and Zeckhauser 1984.

Third, the discussion of the revealed preference and stated preference literatures is incomplete and misleading. The SAB recommends citing Aldy and Viscusi (2008) in addition to the Viscusi and Aldy (2007a). The former is the original research published in the *Review of Economics and Statistics*, and the latter is more of a survey paper in the *Review of Environmental Economics and Policy*. The 2008 paper presents VSL estimates over most of the adult life cycle (the age 18-62 segment of the life cycle), while the empirical illustration in the 2007a paper is focused on a single EPA policy proposal in which the epidemiological outputs were for only two age groups. The claim that "older population have higher WTP" does not fully represent the findings in the Kniesner et al. 2006 paper. They find an inverted-U over the life cycle (working years' segment of life cycle) – older populations have higher WTP than young adults, but lower WTP than middle-aged adults. Appendix B cites Viscusi and Aldy (2003) in footnote 513 and note that in this paper's review of the literature, only 5 of 8 papers that included age-risk interactions in labor market hedonic studies found negative, statistically significant coefficient estimates on the interaction. The three insignificant findings are for an Indian sample (used in two papers) and a Canadian sample in the other. The revealed preference literature discussion of life-cycle heterogeneity could also include more recent references, such as Evans and Schaur 2010, O'Brien 2018, and Aldy 2019.

The discussion of the stated preference literature references the Alberini et al (2004) paper. This section should also reference Krupnick (2007), which provides an excellent review of more than two dozen CV studies that evaluate how VSLs vary with age. The evidence is much more mixed than what is implied by citing only the Alberini et al paper. It would also be worth exploring the more recent CV literature, including Robinson and Hammitt (2016). In the context of VSLs for early life-cycle risks (i.e., those applied to children), refer to Robinson et al. (2019). The discussion may also note the challenges in estimating WTP for risk reduction among the very young and the very old populations, neither one of which participates in labor products or in stated preference surveys.

Several of the papers cited above provide support for the claim on lines 28-29 of page 7-13 that a constant VSLY is not consistent with the literature. E.g., Hall and Jones (2007) in the theoretical/simulation literature and Aldy and Viscusi (2008) in the revealed preference literature.

Recreation Demand/ Travel Cost Models:

1. Point of clarification, 7-25, line 18; 7-26, line 25: The literature typically describes 3 or 4 types of rec demand models that utilize travel distance and implicit costs as a source of preference identification: 1) single site demand models, 2) system of demand equations, 3) site choice models, and possibly (4) repeated site choice models; Hellerstein and Mendelsohn (*AJAE* 1993) have a nice paper that explores the theoretical connection between site choice (extensive margin) and quantity of trips (intensive margin).

2. Point of clarification, 7-25, line 32: opportunity cost is often assumed 1/3 of the "household wage rate", which is usually backed out of income assuming a single primary wage earner (e.g. working 2000 hours a year with 2 weeks' vacation). There is potential for improvements here, inquiring about employment status of all adults & contributions to household income; analyst would still need to know which household members travel.

3. Correction, 7-26, line 18: time onsite is not usually included in most estimates of travel cost; it's only travel time. Onsite time and expenditures are separate decisions that have received little attention in the literature (Bell and Leeworthy 1990; McConnell 1992; Larson 1993; Berman and Kim 1999; Landry and McConnell 2007). There is also a recent working paper by English, et al. (2018).

4. Suggestion, 7-26: Chapter should address issue of operating vs. full monetary cost of travel; AAA reports both; most researchers consider operating costs as the more relevant measure, but if a household maintains a car primarily for recreation trips (e.g. someone that lives in a big city, mostly utilized public transportation day-to-day, but maintains a recreational vehicle for camping trips), full monetary costs could be more accurate.

5. Suggestion, clarification, 7-26, line 30: the role of substitute prices in demand modeling is complicated; if recreation demand trips to various sites are separable in the utility function (from other consumption goods), their demands represent a system of demand equations with theoretical cross-equation linkages. That system must be 1) homogeneous of degree zero in travel costs and income (or recreation budget); 2) abide the Cournot and Engel aggregations; and 3) conform to the Slutsky Substitution Matrix. In regard to the latter, restrictions on substitute price parameters are very strict (most straightforward interpretation for commonly used semi-log model is that the substitute coefficient must equal zero) (LaFrance 1990; von Haefen 2002; Landry, et al. 2016). This result applies whether are not you estimate one or all equations in the separable part of the utility function. Alternatively, you can assume other recreation trips as separable in utility from the site your analyzing. In this case, Slutsky imposes no restrictions on the substitute price parameter (but this is less compelling from a theoretical perspective). Unfortunately, this is barely simmering in the peer-reviewed literature but could be a focus of future research.

6. Point of clarification, 7-29, line 7: Parsons and Wilson (1997) suggest including a multi-purpose dummy and use the parameter estimate to negate multiple trips during welfare analysis. Empirical literature has followed this recommendation in many instances.

7. Point of clarification, 7-29, line 9: Many papers consider single and multi-day trips as separate goods and analyze them in separate models. There has been limited treatment of onsite time (Bell and Leeworthy 1990; McConnell 1992; Larson 1993; Berman and Kim 1999; Landry and McConnell 2007 English, et al. 2018). Building on the work of Bockstael and McConnell (various papers), McConnell (1992) and Landry and McConnell (2007) argue that as long as the system of endogenous variables (e.g. trips, onsite time, onsite expenditures) is optimized, welfare analysis can focus on one equation (e.g. trips). If single-day trips are generally seen as a distinct good from multiple-day trips, it makes sense to analyze them separately.

Hedonic Price Analysis:

Suggestion, 7-32: Spatial regressions have mostly fallen out of favor in environmental economics and typically are just used for robustness checks. (see, e.g., Mostly Useless Spatial Econometrics – Gibbons and Overman 2012)

Averting Behavior:

Point of clarification, 7-33: significant complication in many averting behavior analyses is that output level (e.g. health) is unobserved and may change when aversion is engaged. This complicates calculation of WTP (Compensating Variation).

Cost of Illness:
Page 7-34: The COI illness section highlights a general issue with the treatment of morbidity in RIAs. As the text notes on page 7-34, COI is likely to be too low in most circumstances. WTP estimates are expensive to develop, but it may be worthwhile having the EPA, perhaps in conjunction with other federal agencies, invest in estimation of estimates for the most significant sources of morbidity. Otherwise one is left with a situation where the vast majority of benefits in RIAs accrue from mortality and relatively little accrue from morbidity. This can lead to an undervaluation of regulations that primarily reduce morbidity.

Stated Preference Methods:

1. Note, 7-36: NOAA report generally recognized as outdated.

2. Note, 7-36: Good paper on validity & suitability of SP in response to JEP papers: Haab, et al. (2013).

3. Point of clarification, 7-43: an additional *ex ante* bias correction that has received lots of attention and seen some positive results is known as "consequentialism" - highlighting consequences to survey respondents in such a way that the respondents may perceive that their choices could be binding (in some probabilistic sense) (Cummings and Taylor 1998; Carson and Groves 2007; Landry and List 2007; Vossler and Evans 2009; Herriges et al. 2010; Vossler and Watson 2013).

4. Point of clarification, 7-43: experiments have (to varying degrees) successfully simulated public good provision in various ways (Carson et al. 2001; List et al. 2004; Landry and List 2007; Vossler and Evans 2009; Vossler et al. 2012).

### 2.7.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB concurs that the chapter contains a reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described.

### 2.7.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that some aspects of the chapter could benefit from clarification, additional discussion, or elaboration. These aspects are discussed below.

1. The division of material between Chapters 7 and 8 warrants more discussion. There are two main options. First, the EPA could organize the material around externalities vs. markets. This is different than the current organization and could have implications for other chapters. Second, the EPA could maintain the current organization, but begin Chapter 7 with a discussion of why the material is organized as it is. This general issue of organization is in response to some specific issues in the

early part of Chapter 7. Specifically, the chapter opens on page 7-1 with text that could give the impression that only environmental benefits merit consideration. Why limit benefits analysis to the "social benefits resulting from environmental changes"? If "environmental changes" means "environmental regulations" or "environmental policy," then that would be fine. Rules and policies can influence social benefits beyond environmental and/or public health dimensions. In particular, a notable omission in this chapter in general and in Table 7-1 in particular are the non-environmental impacts associated with improving fuel economy, such as changes in consumer fuel expenditures, energy security, congestion, and traffic accidents that have been quantified and monetized in RIAs for joint EPA/NHTSA rules addressing fuel efficiency and tailpipe carbon dioxide emissions. There are important considerations in estimating and monetizing several of these endpoints that could be usefully addressed in this chapter.

2. Although Chapter 7 mentions behavioral economics in various places (eg pages 7-7, 7-8, 7-17, 7-20), it would be useful to have a brief initial discussion that sets the stage and points to whichever chapter contains a more extensive discussion.

3. Chapter 7 does not directly discuss the assumptions of rationality that underlie most valuation methods. It would be beneficial to discuss these assumptions and provide examples of situations where violation of these assumptions might affect estimates. For example, estimates from hedonic models will only capture health effects if consumers are fully informed about health endpoints.

4. Chapter 7 does not have anything on retrospective analysis. It would be useful to mention the issue early on in the chapter and reference the main discussion in Chapter 4 (or wherever the material ends up). The reference in Chapter 8 is on page 8-7.

5. Chapter 8 contains fairly extensive discussion of computable general equilibrium (CGE) models and their use in estimating costs. Chapter 7 would benefit from a short parallel discussion of CGE models and their use in estimating benefit.

6. Chapter 7 would benefit from explicitly encouraging analysts to consider, whenever possible, the normal operation of existing local, state, federal and international regulatory programs. Cost savings can be included in the benefits analysis (Chapter 7) or in the cost analysis (Chapter 8).

7. The discussions of uncertainty and of breakeven and bounding in Chapter 7 overlap with Chapters 5 and 6. It would be useful to consolidate the discussion in those chapters and include a pointer to that discussion in Chapter 7.

8. The main takeaways from a number of the textboxes are not clear. Part of the issue is that the goal of the textboxes is unclear. The goal may be to provide readers who are less familiar with a topic some background and direct guidance. If direct guidance is part of the goal, it seems too often to be missing. In addition to clarifying the main takeaways, it may be helpful to bold/italicize or otherwise highlight the takeaways.

    a. With respect to Textbox 7-1 (page 7-4), for example, the takeaway is unclear. One possibility given the evolving nature of IAM and greenhouse gases, might be for policymakers to consult with NCEE on the current best practice or current best estimates of the value of GHGs. Instead the last paragraph leaves the reader guessing as to what they should do:

*"IAMs used to estimate the SC-CO2 and other GHGs are necessarily highly simplified and limited by the current state of the rapidly expanding climate economics literature. In January 2017, The National Academies of Sciences, Engineering, and Medicine issued a report recommending specific criteria for future updates to the SC-CO2 estimates, a modeling framework, and both near-term updates and longer-term research needs pertaining to various components of the estimation process.**
Notes: Since the framework used to estimate the social cost of methane and nitrous oxide is the same as that used for SC-CO2, the Academies' recommendations on how to update many of the underlying modeling assumptions also apply to the estimates of the social cost of non-CO2 GHGs."

b. Although Textbox 7-2 (page 7-8) has a substantial discussion of economics and risk assessment, the main points are less than clear. The main point *might* be that coordination is necessary between economists and risk assessors. More specifically, the main point *might* be that it is particularly important to "to produce expected or central estimates of risk, rather than bounding estimates as in safety assessments. At a minimum, any expected bias in the risk estimates should be clearly described." It may be that these are not the main points. In any case, the main points should be clarified.

c. Textbox 7-3 (page 7-16), which discusses non-willingness to pay measures, misses an opportunity for clearer guidance in the box or in the text. It says "Measures of economic value that do not measure WTP and cannot be related to changes in utility are not valid. Others should be used only in a limited set of circumstances." It would be helpful to offer more detail on the list of circumstances or at least more clearly point the reader to such a description. For example, the COI discussion in the textbox ends with "Section 7.3.1.5 provides more details on the COI method and its use in benefits analysis." If the limited circumstances are discussed here, then the text should say this.

9. Point of clarification, 7-7, Step 3: *Estimate the monetary value of endpoints*. Representative agent approaches are often used, but models can incorporate heterogeneity in some cases. For example, it is sometimes possible to incorporate underlying subject heterogeneity (using finite mixture or random parameter approaches) in the valuation analysis. In such cases, it may be possible to estimate a range of values for different kinds of households and scale up the estimates using inference on population proportions from the sample that is used to conduct benefit estimation.

10. Additional details possibly needed, 7-10, line 9: A short summary of standard assumptions underlying the existence of preference relations that give rise to utility structures could be useful before turning to money-metric utility measures.

11. Further details needed, 7-11: WTA and WTP also make implicit assumptions about property rights; if utilizing initial utility as reference levels, the welfare implicitly assumes property rights exist in the initial state; alternatively, if subsequent utility is reference, property right exists to this state. These details can be important in some applications.

12. Further details, 7-11: critical appraisal of divergence of WTP and WTA (at least a citation or two); perhaps some guidance on when to use one or the other.

13. More details, 7-25, line 1: complications arising from the role of taxation in benefit assessment; discussion unclear

### 2.7.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The EPA treatment of topics is, with a few exceptions, consistent. These exceptions are discussed below.

1. The treatment of the opportunity cost of nonwork time appears to be inconsistent in places. For example, it differs in Chapter 7 (pages 7-25, 7-26, 7-36) and in Chapter 8 (page 8-16). Further, the discussion on page 7-25 is confusing given the Department of Transportation's approach and the Department of Health and Human Services approach (not mentioned). Further, the discussion on page 7-26 seems to permit the inclusion or exclusion of children's time. In contrast, the Department of Health and Human Services applies its post-tax wage figure to children's time costs as well as seniors and other adults who may not be employed. It would be useful to more clearly explain why the values differ from other agencies and why the valuations appear to vary within the document.

2. The SAB recommends explicit, consistent text throughout the report on the importance of accounting for all benefits associated with a regulation or policy, regardless of whether any given benefit was the intended target of the regulation. The Guidelines are much too vague about the inclusion of ancillary impacts – co-benefits and co-costs – in economic analysis. Chapter 7 on benefits does not address in any way co-benefits or ancillary benefits. Indeed, these terms only appear in a brief footnote (#129) on page 5-18, and even in this case, the characterization is unnecessarily constrained. In the footnote, co-benefits are defined as "changes in environmental contaminants other than those related to the statutory objective of the regulation," but this excludes co-benefits unrelated to environmental contaminants. For example, RIAs for rules targeting CO2 emissions in mobile sources include monetized benefits associated with fuel savings, energy security, traffic accidents, congestion, and noise (note that some of these measures have negative signs, which some analysts may label as disbenefits or co-costs).

   Consider the contrast between the 2014 updated version of the Economic Guidelines and this draft:

   2014 Guidelines: "An economic analysis of regulatory or policy options should present all identifiable costs and benefits that are incremental to the regulation or policy under consideration. These should include directly intended effects and associated costs, as well as ancillary (or co-) benefits and costs" (EPA 2014, page 11-2).

   Proposed Draft: "An economic analysis of regulatory or policy options should present all identifiable costs and benefits that are incremental to the regulation or policy under consideration" (page 11-1).

   There is no credible reason for increasing ambiguity by dropping the second sentence from the 2014 draft in this revision. Indeed, given the confused commentary about this topic among non-economists in the public sphere, it is all the more important to explicitly state the importance of accounting for the economic effects of all changes that result from an EPA rule in comparison with its baseline. In addition, the guidelines could be more explicit about important considerations in the

evaluation of co-benefits. For example, the guidelines could address double-counting, regulatory rebound, and related regulatory baseline issues.

The analyst's challenge is whether to express the bonus pollution-control benefit as a health/environmental benefit or as a savings in compliance cost for future emitters covered by criteria air pollution control programs, or some combination of the two. Criteria air pollution in many communities in the United States is effectively capped due to non-attainment status, fear of entering non-attainment status, or existing PSD programs. A screening-level approach is to prepare one calculation that assumes all of the benefit will occur in the form of public health/environmental protection; the other calculation assumes all of the benefit occurs in the form of future savings in compliance costs for emitters that do not need to control emissions as much as they would have otherwise. In most RIAs, those bounding calculations will be sufficient, since results of the analysis are typically the same regardless of which approach is used. A more precise estimate requires understanding of where (geographically) the criteria air pollutants are reduced and whether those areas are subject to implicit or explicit caps on criteria air pollution control.

The guidelines could also consider alternatives analysis that examine alternative regulations that target so-called co-benefits in tandem with alternatives analysis of regulatory approaches that address the so-called targeted pollutant. Such an alternatives analysis would be in the spirit of including assessments of policy approaches beyond EPA's current statutory authority that could highlight for Congress, key stakeholders, and the public the potential for legislative reforms to improve the efficacy and/or economic efficiency of environmental law.

### 2.7.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

Terms specific to this chapter are, with a few exceptions, identified correctly in the glossary. These exceptions are discussed below.

1. Baseline – described status quo, but definition also mentions evolution of state; I would term the latter a counterfactual; draft alternative?

2. BCA – refers to evaluation of regulation, but also applies to *projects, programs, and policies*; draft alternative?

3. Elasticity of Demand & Supply – append "Price" at the beginning to be clear about what kind of elasticity is being defined.

4. Marginal Benefit – second sentence describes *average benefit*; draft alternative?

5. Marginal Cost – second sentence describes *average cost*; draft alternative?

6. Market Failure – also refer to existence of public goods & common pool resources; draft alternative?

7. Opportunity Cost – value of foregone allocation during some resource economic decision; the value of foregone allocation is often described as "value of the next best alternative use" of the resource.

8. Value of Statistical Life Year – The SAB recommends striking the second and third sentences in the definition in the glossary. These two sentences are unnecessary to convey the key point and restrict the consideration of VSLY in a way that is inconsistent with the revealed preference, stated preference, and theoretical/simulation literatures (e.g., Aldy and Viscusi 2008; Cameron and DeShazo 2013; Hall and Jones 2006).

***The following recommendations are noted for Chapter 7:***

Tier 1

- Page 7-1: When introducing measures of economic value, discuss both WTA, Compensation and WTP as compatible with potential Pareto Criterion.

- Include cost savings in Figure 7-1 (page 7-2) and Table 7-1 (page 7-3) and the discussion of the table and figure.

- Clearly state the need to consider all benefits, both direct and ancillary.

- Discuss the division of material between Chapters 7 and 8.

- Page 7-11: Discuss implicit assumptions about property rights inherent in WTP and WTA as economic value constructs.
- Page 7-11: The chapter should include critical appraisal of divergence of WTP and WTA (at least a citation or two) and perhaps some guidance on when to use one or the other.

- EPA should explore investing with other federal agencies in studies to estimate WTP for the most significant sources of morbidity. For example, EPA could collaborate with the Department of Health and Human Services to support NSF-sponsored scholarship that would estimate WTP for various types of morbidity reductions. The discussion of the value of statistical life in 7.2.1.1 and Appendix B should include an assessment of the recent economic literature on this issue. As a starting point, EPA should refer to the findings of Viscusi (2018a) and consider using these results as the basis for a primary VSL. EPA should also update its assessment of the literature on how VSL varies over the lifecycle and how it may vary with other characteristics of risks and affected populations.

- Page 7-12: The discussion of adjusting VSLs over time with an income elasticity should explicitly state the importance of employing a common assumption for income growth across all potentially relevant elements of the policy evaluation, including VSL, discount rates, other benefits categories (e.g., social cost of carbon), and drivers of economic costs.

- Page 7-22: Add discussion of revealed preference choice models [RUMs] for non-market valuation.

- Page 7-23, line 12: Clarify that the suitability of prices for welfare analysis is *directly dependent on structure of market*.

- Ensure that the discussion of nonwork time is consistent within and across Chapters 7 and 8.

- Page 7-26, line 18: Time onsite is not usually included in the estimate of travel cost; *it's only travel time*. Chapter needs to better reflect theory and empirical literature.

- Page 7-26: Chapter should address issue of using operating vs. full monetary cost of travel in travel cost models.

- Page 7-36: Add citation and discussion on validity and suitability of stated preference methods: Haab, Interis, Petrolia, and Whitehead, *Applied Economic Perspectives and Policy* (2013).

- Page 7-43: The chapter should include brief description and commentary on an additional *ex ante* bias correction method, "consequentialism".

Tier 2

- Include a brief discussion of the assumptions of rationality that underlie most valuation methods and examples of situations where violation of these assumptions might affect estimates.

- Include a discussion of CGE models.

- Encourage analysts to take into account, whenever possible, the normal operation of existing local, state, federal and international regulatory programs.

- Consolidate the discussion of breakeven and bounding in Chapter 5 and include a pointer to that discussion in Chapter 7.

- Textbox 7.1, 7.2, and 7.3 should be revised to clarify the main takeaways.

- Page 7-7, Step3: Focus less on representative agent approaches and include discussion of models that incorporate heterogeneity.

- Include a brief discussion of behavioral economics early on in the chapter with a reference to the main discussion (in Chapter 4 or elsewhere).

- Include a brief discussion of retrospective analysis early on in the chapter with a reference to the main discussion (in Chapter 4 or elsewhere).

- Page 7-10, line 9: The chapter could include a short summary of standard assumptions underlying the existence of preference relations that give rise to utility structures before turning to money-metric utility measures.

- Page 7-12: the EPA should reevaluate how it is accounting for income growth in its primary VSL. The agency adjusts the VSL over time to account for inflation (i.e., updating base year dollars) and for growth in income per capita with an income elasticity (see discussion on pages B-4 – B-5). For example, the 2002 EPA rule "Control of Emissions From Nonroad Large Spark-Ignition Engines, and Recreational Engines (Marine and Land-Based)" (RIN 2060-AI11) adjusted VSLs for income growth for its year 2030 full-implementations snapshot of the rule's

public health benefits. If it's appropriate for accounting for income growth over 2002-2030, then it should also be appropriate to account for income growth over 1985-2020 (the period of time for the average VSL study in the set of 26 used by EPA for its primary VSL). This is not inconsequential. For example, personal income per capita (https://fred.stlouisfed.org/series/A792RC0A052NBEA), deflated with CPI-Urban (https://fred.stlouisfed.org/series/CPIAUCSL#0), shows a 59% real growth in income over 1985-2019. With an income elasticity of 0.4 (the middle of three values EPA uses), that implies a 23% increase in the VSL due to income growth relative to the $7.4 billion (2006$) that is the EPA default. EPA should ensure consistency in accounting for income growth over time across the various components of a given analysis. The same rate of growth should be applied for updating a VSL for a future year as is used in the regulatory cost of compliance dimension of the analysis, the social cost of carbon calculation, any potential adjustments to long-term discount rates, etc.

- Page 7-13 to 7-14: Discuss the reporting of the age distribution in the text of the chapter.

- Page 7-23, line 33: text is confusing. *"Note a fourth equivalent way to estimate environmental effects on production possibilities."*

- Page 7-25, line 1: Consider clarifying the discussion on complications arising from the role of taxation in benefit assessment.

- Page 7-25, line 18; page 7-26, line 25: Clarify typology of recreation demand models.

- Page 7-26, line 30: Recognize complications in treatment of substitute prices in Marshallian recreation demand models. (Parsons and Wilson 1997).

- Page 7-29, line 7: One way to incorporate recreation demand data with single-purpose and multi-purpose trips is to include a dummy variable accounting for differences in multi-purpose trips (Parsons and Wilson 1997). The dummy variable can be interacted with travel cost and income to permit flexibility in the model, without dropping observations on multi-purpose trips (which could make the difference between utilizing data for welfare analysis or having to employ benefit transfer).

- Page 7-32: Perhaps temper endorsement of spatial regression models (see, e.g., Mostly Useless Spatial Econometrics – Gibbons and Overman 2012).

- Page 7-33: A significant complication in many averting behavior analyses is that output level (e.g. health) is unobserved and may change when aversion is engaged. This complicates calculation of WTP for compensating variation.

- Page 7-36: The NOAA report is generally recognized as outdated; there may some literature updating recommendations or caveats on when NOAA recommendations should apply.

- Page 7-43: The chapter could clarify that experiments have (to varying degrees) successfully simulated public good provision in various ways (Carson et al. 2001; List et al. 2004; Landry and List 2007; Vossler and Evans 2009; Vossler et al. 2012).

- Page 7-47: The unit value transfer discussion may want to reference Boardman et al. (2011).

Tier 3

- The EPA may consider updating the literature it employs for estimating a primary VSL for its economic analysis. This could require work in response to SAB (2017) and convening a new SAB panel for guidance and review. As an alternative, the agency could opt to use a recent assessment of the literature published in a peer reviewed journal, such as Viscusi (2018a). In addition, EPA may also review and update its application of an income elasticity for updating VSLs over time as well as consider how the value of statistical life varies over the life cycle.

- Additional research and further synthesis of results on valuing opportunity cost of travel time is warranted. Typical heuristics presume time is valued at a fraction (often assumed 1/3) of the "household wage rate", but time costs likely vary across households and trips in ways that can be informed by additional theory and empirical research. Time costs can be a significant portion of travel costs, so value-of-time can have a large impact on welfare estimates (page 7-25, line 32).

## 2.8. Chapter 8: Analyzing Costs.

With a few exceptions, noted below, this is a comprehensive and detailed overview of the challenges and potential solutions analysts face when trying to estimate the social costs of environmental regulations. The SAB commends the authors—both the current and past NCEE staff—for their work.

In general, our concerns about the Chapter are the same as for the Guidelines in general.

1. Audience. Sometimes the Guidelines seem to address a readership of economic novices, as on page 8-3 when they describe market equilibria: "The intersection of the supply (S0) and demand (D) curves determines the equilibrium price (P0) and quantity (Q0)." At other times, the Guidelines contain language that might be cryptic even for experienced economists. For example, in the first paragraph of Section 8.2.3.4 when the Guidelines mention without defining unbiased and biased technical change.

   The SAB suggests that the authors comb through Chapter 8 and the rest of the Guidelines with a focus on the target audience, eliminating elementary material and moving technical material to appendices.

2. Categorization of costs and benefits. The SAB suggests that Chapter 7 (Benefits) and Chapter 8 (Costs) begin with descriptions of what each category includes. The distinction is arbitrary, because some compliance costs of a regulation would become the benefits of an ensuing deregulatory action. And similarly, some health benefits of a regulation would become the costs of deregulation. Even within a regulation the distinction can be blurry. If regulating one pollutant causes another to increase, are the damages from that second pollutant "ancillary costs" or "negative ancillary benefits"?

   After reading Chapters 7 and 8 it becomes clear that the EPA's categorization is based on the tools of analysis. Chapter 7 discusses the models and analyses used to quantify the monetary value of changes in environmental endpoints, whether they be positive or negative. Chapter 8 contains the

models and analyses used to identify changes in more standard economics valuations consumers and producers place on market activities.

Early, on page 1-3, the Guidelines recognize that "Ultimately, from the perspective of economic theory, the treatment of disbenefits [*sic*] and avoided costs in the analysis is primarily a communications issue and should not affect efficiency analysis and whether net benefits are positive or negative." But perhaps Chapters 7 and 8 might begin by clarifying what each chapter includes.

3. Length. The Guidelines are a daunting 343 pages—longer than many RIAs. Moving technical discussion to an appendix would help, as would eliminating elementary material. Another suggestion would be to provide an executive summary with key things an analyst should consider, with links to the appropriate places in the document where details could be found. That could consist of one overall executive summary, or one for each chapter, or both. While in principle that might make the Guidelines longer, it would ease the burden on readers.

### 2.8.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB recommends including more discussion of imperfect competition—both for the market being regulated as well as input markets. As shown in Fowlie, Reguant, and Ryan (JPE 2016), welfare effects of a regulation may differ in the short and long run depending on the extent of market power. This is an important point that the chapter does not make as clearly as it should. The point is probably relevant to a wide range of EPA regulations, such as many regulations for the industrial sector. Fowlie et al. also discuss the possibility that regulation can affect market structure and competition, and that these effects can have important welfare consequences. This possibility is discussed only briefly in 8.2.3.6. Moreover, the literature on the Acid Rain Program has highlighted the importance of imperfect competition in input markets, such as coal, and more broadly, standard IO textbooks discuss double marginalization. Considering the attention that the chapter devotes to pre-existing distortions due to taxes, it would be appropriate given the recent literature on imperfect competition to elevate that topic to roughly the same level. In other words, accounting for imperfect competition could have profound welfare consequences that would be missed if one assumes price-taking firms and consumers.

As Section 5.2.2 of the Guidelines mentions, behavioral economics can have implications for benefits and costs of a regulation. For example, if consumers mis-optimize or are loss averse, they may not adopt energy-saving technologies for which private benefits of adoption appear to exceed private costs. This raises the possibility that a regulation that causes technology adoption to occur that would not have happened in its absence could yield positive net benefits to consumers or firms. The federal fuel economy/GHG standards for passenger vehicles are a prominent example of this situation. In response to the charge questions for Chapter 4, the SAB notes that the Guidelines should explain that behavioral economics should be referenced when justifying a regulation. In addition, the Guidelines should explain that the economic model that the agency uses to quantify benefits and costs of the regulation should be consistent with the behavioral factors that help justify the regulation. For example, if consumers do not adopt an energy-saving technology because of a misperception of that technology's energy savings, this misperception should be included when analyzing consumer decisions with and without the regulation (Allcott and Greenstone Journal of Economic Perspectives 2012).

The section on model parameterization includes some important suggestions. However, the section muddles the point that the empirical strategy for parameter estimation needs to be consistent with the model being used for the cost analysis. The statement that "inconsistencies between the underlying structure of the model and the empirical analyses from which values are drawn can lead to inaccuracies" may be unclear readers who do not have a PhD. in economics and may not understand what it means for the underlying structure of econometric analysis to be consistent with an economic model. Moreover, this sentence it should not be stuck in the middle of the paragraph. Footnote 304 offers a solution to this problem, but that should be stated more clearly in the text. Moreover, the problem pertains not just to situations in which parameters are taken from the literature. It is also relevant when the analysts estimate the parameters themselves rather than taking the estimates from the literature. In that case, the assumptions used to identify the parameters need to be consistent with the assumptions in the model being used for the welfare analysis. The recently finalized light-duty fuel economy/Greenhouse Gas (GHG) RIA makes this mistake in the estimation of vehicle scrappage decisions because the econometric model used to estimate scrappage decisions implicitly assumes that fuel costs affect vehicle ownership decisions, whereas the computational model used for benefit-cost analysis assumes that fuel costs do not affect choices among new vehicles.

Within Figure 8.2. (page 8-3), the black triangle should not be labeled "deadweight loss." There was an implied deadweight loss in Figure 8.1 that the regulation is designed to correct. The regulation eliminates a deadweight loss. Instead, call the triangle "lost CS+PS above and beyond compliance costs." Also see page 8-4 lines 15 and 20, which describe the triangle in Figure 8.2 as a deadweight loss. This is the first place in the document that uses the term deadweight loss. In fact, the term never appears in Chapter 7, "Analyzing Benefits."

Footnote 244. (page 8-3) Producers surplus is profits *plus fixed costs*. The area under the supply curve is total private variable costs, not total private costs.

The SAB is uncertain of Figure 8.3. It seems as though a change in price of the regulated good should shift the supply of labor (SL) curve. This looks like a standard public finance figure drawn for a new tax on the other market, with a preexisting tax in the labor market. The new tax on the other market exacerbates the deadweight loss (DWL) from the preexisting tax in the labor market. But in this case the regulation on the other market corrects a market failure. The original SL curve in the labor market was inefficient, because goods prices were inefficiently low. Perhaps it would help to add a second panel to 8.3 that shows a labor market without a pre-existing distortion, to clarify how much larger is the change in DWL when there's a pre-existing distortion.

The meaning of page 8-10, line 15 ff. is unclear:

> *"For example, taxes are generally thought of as transfers between households or firms and government. However, when environmental regulation interacts with them in ways that distort behavior relative to what would occur absent government intervention in the marketplace, the welfare loss from these distortions should be included in an estimate of cost."*

Is this about rent seeking? Are there any examples of RIAs that include this or should have included this?

Footnote 269, Page 8-10. The characterization of the equivalent variation (EV)/ Compensating variation (CV) distinction could be improved. The footnote says: "The difference between them is based on whether one assumes that the change will occur (EV) or is not yet in place (CV)." Instead, the text

might read: "The difference between them is based on whether one assumes the beneficiaries are being asked to pay for the regulated improvement (CV), or whether they are entitled to the improvement and must be paid to forego it (EV). It is the difference between WTP for environmental quality and WTA compensation for environmental degradation."

### 2.8.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

In practice, RIAs use the compliance cost and partial equilibrium approaches more commonly than the CGE approach. This chapter would be strengthened by adding specific discussion about when it may be reasonable to use a partial equilibrium or compliance cost approach, rather than CGE. Frequently, the chapter says something like CGE is appropriate when the regulation may affect multiple sectors. But when is that likely to happen? Can the chapter provide some rough criteria to help practitioners understand when CGE would be preferable? Frequently the document mentions data limitations as a reason why partial equilibrium or compliance cost approach is used rather than CGE. Other reasons include assumptions in CGE (e.g., market structure, CES) and existence of a suitable model. Although these limitations are discussed on the subsection specifically about CGE models, the chapter does not treat CGE models consistently, in that much of the chapter appears to favor CGE models over other approaches.

Page 8-23, line 19. According to communication from NCEE staff, the bullet points on the "Limitations" of CGE models was omitted inadvertently. This should be fixed, and the list should also include lack of transparency. In general, the chapter does a good job contrasting pros and cons of the compliance cost and partial equilibrium approaches. The discussion of CGE models is somewhat less balanced, however. For example, and continuing the theme of imperfect competition, most CGE models assume price-taking firms and consumers, which contrasts with many partial equilibrium models in which firms have market power. This limitation of CGE models should be noted in textbox 8.2 as well as table 8.2 and under "Limitation" on page 8-23. Moreover, the end of 8.3.3 does not list the disadvantages of CGE models that were discussed in the preceding text, such as aggregation across firms, sectors, and regions as well as a simplified characterization of abatement opportunities. The authors should check that the lists of limitations of these approaches include all of the limitations that are discussed in the main text.

### 2.8.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that the following areas warrant addition discussion:

1. Textbox 8.1 (page 8-7): The textbox is informative and provides a useful discussion about the challenges facing retrospective analysis. However, the purpose of this textbox in the "Guidelines for Preparing Economic Analyses" is unclear, and it is unclear why it belongs in Chapter 8 Analyzing Costs. The main purpose seems to be to note that retrospective analysis is valuable and hampered by lack of data. Both are true of prospective analyses. The last paragraph recommends that the EPA identify analytic requirements when a regulation is promulgated, which seems to us like a good recommendation, but this chapter in these Guidelines may not be the right setting.

The text also appears to include the assumption that such retrospective analysis will use some sort of econometric analysis. Alternatively, structural or computational models could be used (including whatever model(s) EPA might have used for the prospective analysis), which could circumvent some of the econometric and data challenges that the textbox discusses. Of course, the structural and computational models have their own limitations, and the suggestion here is to provide some balance here, discussing pros and cons of the different approaches.

2. Page 8-11, line 3 ff. It's good to list the reasons Gross Domestic Product (GDP) is not a good measure of welfare. Additional reasons to include are:
   a. GDP doesn't include environmental cost or benefits.
   b. If people get sick from pollution and go to the doctor more, that increases GDP.
   c. GDP is a flow measure of expenditure, and it omits changes to capital stocks. If a pollutant damages buildings and people spend more money repairing and painting them, that increases GDP.

3. Footnote 276 (page 8-13) provides citations cites for realized costs of 1990 CAA Amendments. A more recent citation would be Chan, Cropper and Muller, "The Impact of Trading on the Costs and Benefits of the Acid Rain Program" Journal of Environmental Economics and Management, 88, 180-209, March 2018.

4. Regarding Section 8.4.3 (Model Parameterization), the text should emphasize the need to include the most recent scientific findings and data available, and parameters estimated using recent data. These points may appear to be obvious, but they are particularly relevant in the current context of deregulatory actions. In fact, the chapter might benefit from including a section (or text box) about particular issues that arise when considering deregulation (or, potentially, re-regulation). In this situation, analysts should update assumptions on model inputs to incorporate the best available information, and they should distinguish sunk costs that have already been incurred from other costs—i.e., the issues that appear to have been ignored in the recent Mercury and Air Toxics Standards rule.
5. Uncertainty over future regulation or market conditions can affect compliance decisions. For example, firms may have two compliance options, one of which includes large sunk costs and the other does not—such as choosing to install a scrubber or switch to low-sulfur coal to reduce sulfur dioxide emissions. Because uncertainty creates an incentive to choose the reversible option, failing to account for the effect of uncertainty on decision making could cause the analyst to over-predict investment in the technology with sunk costs. Note that this issue is distinct from using scenario analysis to quantify uncertainty, because scenario analysis misses the fact that uncertainty itself affects compliance decisions. This consideration may be at the research frontier now, but like lots of other frontier topics, soon it could become standard practice in the literature to include decision-making under uncertainty in regulatory analysis. If this occurs before a new revision to the Economic Guidelines, the EPA should adopt it without waiting for new Guidelines. This suggestion to continually update analysis applies equally to the benefits chapter.

6. Page 8-3, line 8. The reference to "market power" in the parentheses should be deleted. The rest of the paragraph is correct, that partial equilibrium may be accurate if markets outside the analysis aren't affected. But the existence of market power is really a separate issue and including it as an example may be confusing.

7. First full paragraph of 8.2. The text states that costs incurred to meet other regulations are not included in the incremental costs of the regulation being analyzed. This is certainly true. But it would also be appropriate to exclude future costs expected to be incurred for other regulations, but which haven't already been incurred. For example, there will be costs of meeting tier 3 tailpipe standards in the future, which shouldn't be included in the incremental costs of a hypothetical tier 4. Footnote 259 hints at this point, but this should be more explicit in the main text.

8. Section 8.2.1.1. footnote 263 defines sunk costs, which is useful. The text should explain that typically a large share of fixed costs is sunk, such as research and develop costs. As noted above, the text should discuss how to treat sunk costs in an RIA for a deregulatory action.

9. Section 8.2.2, first two paragraphs. The paragraphs refer to a utility function, which comes out of nowhere, since previous discussions of consumer welfare in this chapter referred to consumer surplus without referencing an underlying utility function.

10. Section 8.2.3.2. Another reason to conduct a dynamic analysis is that the effects of the regulation itself may vary over time. For example, a regulation may cause some firms to exit, which would increase equilibrium output prices unless/until other firms enter the market or remaining firms increase production. Other parts of the chapter discuss transitional costs, which is related to the point here about entry and exit.

11. Section 8.2.3.4. In the first full paragraph, references to unbiased and biased technical change may be cryptic to some readers. These terms should be defined, or perhaps replaced with less technical language.

12. Section 8.2.3.6. Both in the section heading and the main text, there should be a more careful distinction between two issues related to market power and competition. The first is that market power can create distortions that have large welfare consequences—see in particular Fowlie et al. referenced in a previous comment. This point could be made by adding a graph similar to 8.3 that shows the pre-existing wedge that exists between price and marginal costs in an imperfectly competitive market. The second issue is that the regulation itself may affect market structure. This point is already made in the text, but it would be helpful to distinguish it more clearly from the first.

13. Introduction to section 8.3. The introduction to this section has a useful list of criteria for selecting an appropriate model. Whether a model has been peer-reviewed, either in the academic literature or otherwise, is also a consideration that should be added to this list. That may be obvious, but it wouldn't hurt to state it in these Guidelines.

14. Text box 8.4. This text box contains a nice discussion about separability of benefits and costs, although it could be helpful to provide the example of climate change. In particular, a policy that reduces GHG emissions causes global temperature to drop, which can reduce demand for electricity used for air conditioning. Lower electricity demand would affect factor prices and compliance costs.

15. Section 8.4.4. It would be helpful if this subsection can include some suggestions about how to characterize uncertainty. Typically, RIAs using deterministic models report results under alternative sets of parameter assumptions, which is fine. Some partial equilibrium and CGE models include uncertainty explicitly, which can be an important advantage of these models over deterministic ones.

16. The chapter focuses on compliance costs of firms. The chapter should include discussion of costs to consumers, such as changes in product quality or elimination of products caused by regulation. For example, there has been some research on the effects of energy efficiency standards for home appliances on product quality.

17. The cost of public funds should be discussed, since it is in chapter 4—maybe just to say it's complicated.

18. The benefits chapter should discuss retrospective analysis to provide balance with the costs chapter. And alternative approach would be to place a single section on retrospective analysis in Chapter 4 and then include references to that section in Chapters 7 and 8. Either way, the Guidelines should discuss the Evidence Based Policy Act of 2018, which could be interpreted as giving EPA a mandate to do retrospective analysis.

19. This chapter (along with Chapter 9) discusses employment effects of regulation and transitional costs. Estimating these costs could be included in sensitivity analysis.

20. For consistency with the benefits chapter and the last chapter on presentation, Chapter 8 should start with an accounting perspective on cost. The analyst identifies each item of cost attributable to the regulatory action, including a list of those cost items and an indication as to whether the cost has been quantified and monetized. EPA should include a box with a draft template for cost identification, perhaps using for illustration purposes a hypothetical rule requiring GHG reductions from new motor vehicles. The illustration should include direct costs, including ancillary costs to human health, safety, and the environment. Costs incurred by regulated entities are included but also costs to consumers, workers and the public. Here is a partial list of cost items that might be included in the illustrative box:
    a. initial technology costs (e.g., new electric propulsion system)
    b. maintenance and repair costs (e.g., battery replacement)
    c. technological waste management, including materials separation/recycling costs (e.g., re-use of cobalt and other valuable materials)
    d. psychic costs to consumer (e.g., diminished performance)
    e. safety risks of technology (e.g., lightweight materials and occupant crash protection)
    f. occupational risks (workers during mining of cobalt and lithium for batteries and assembly of battery packs)
    g. environmental risks of toxic pollution (during mining and processing of inputs to lithium ion batteries)
    h. costs associated with rebound effect (e.g., traffic congestion, safety, pollution)
    i. costs associated with slower fleet turnover (e.g., safety, pollution).
    j. paperwork/reporting/administrative costs of the rule.

### 2.8.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The SAB finds that the following areas warrant addition discussion:

- Footnote 242. (page 8-3) "market distortions are … move consumers or firms away from what would occur under perfect competition be economically efficient."

- Section 8.2.3.6 (page 8-14 ff) *Effects on Market Structure and Entry and Exit*. It's not clear why this section is in the Chapter 8. No mention is made as to why a change in market power would be a cost of a regulation. If it doesn't affect social costs, the section might be more appropriate in Chapter 9.

- Why are so many pages and boxes devoted to I-O analysis, which is not recommended for use? (page 8-23, Section 8.3.4 ) "However, these methods should not be used to estimate the social cost of environmental policy (U.S. EPA 2017)."

- The chapter should discuss the use of public data for parameter estimation or about model selection. Chapter 5 discusses the choice of publicly available and documented models, and it may be appropriate to adopt the same criteria to data as to models.

- The current version of Chapter 8, "Analyzing Costs", appears to be silent on ancillary costs. A separate section in Chapter 8 should call for a qualitative identification of possible "ancillary costs" associated with the rule-making action, since these are costs. For each possible ancillary cost that is identified, the RIA should explain whether the risk has been quantified, and why or why not.

- The chapter contains little discussion about where models are chosen from. In some cases, the EPA has used a model for a long time, like IPM. What are possible sources for models? Chapter 5 discusses this, so chapter 8 could simply refer readers to that chapter.

- The chapter should include a comprehensive list of supporting EPA guidance. Or this information could be put in chapter 2, following the list of EOs and laws.

- Public commenters suggested that the SAB look at the Draft Guidance to ensure that the analytic treatment of "ancillary benefits" (as the term is used in OMB Circular A-4) and "ancillary costs" are addressed appropriately. The text of the Guidance should include an unequivocal endorsement of OMB's call for identification and consideration of "ancillary benefits" and ancillary costs. The issue should not be "buried" in footnotes. We recommend it be located in a free-standing section of Chapter 5, and then followed up with some specific discussion in Chapters 7 and 8. An economic analysis should not address how much policy or legal weight to give to such issues.

- When analyzing all benefits and costs (including ancillary benefits and costs), the RIA should take account, whenever possible, the normal operation of existing local, state, federal and international regulatory programs. When interactions occur with other programs, the analyst should consider one presentation that assumes public health/environmental impacts and another that assumes changes in compliance-cost expenditures.

### 2.8.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

Based on discussions in Chapter 8, the SAB finds that the glossary would benefit from the inclusion of the following:

- a distinction between all the rates of discounting (social opportunity cost of capital, social rate of time preference and shadow cost of capital).

- annualized value as a constant stream of benefits or costs. The annualized cost is the [**constant**] amount that a party would have to pay at the end of each period ***t*** to add up to the same cost in present value terms as the [**varying**] stream of costs being annualized.

- elasticity of supply where "… quantity supplied can be increased by … developing competitive products than can substitute."

The SAB is unclear as to why "developing competitive products that can substitute" amounts to a supply increase. Perhaps the agency is referring to a demand reduction?

***The following recommendations are noted for Chapter 8:***

Tier 1

- Revise Chapter 8 and the rest of the Guidelines with a focus on its target audience, eliminating elementary material and moving technical material to appendices.

- The introductions to Chapters 7 and 8 should explain the categorization of benefits and costs. An alternative would be to change the titles of the chapters to something that describes what is in them. For example, Chapter 7 could be something like "External Effects" and Chapter 8 could be something like "Private Market Effects." Note that changing the titles could have implications for other parts of the Guidelines, such as Chapter 11.

- The main text of the Guidelines should be shortened substantially, either by deleting unnecessary material or moving material to an appendix.

- Emphasize the need to use the most recent science and data available, and parameters estimated using recent data in Section 8.4.3.

- Provide guidance about when each of the various models (compliance cost, partial equilibrium, computable general equilibrium) would be preferred.

- Clarify that these Guidelines are based on the state of science and economics at the time of writing, and that future RIAs may have available unanticipated developments in analysis. The EPA should adopt such new modes of analysis without waiting for revisions to these Guidelines.

- The chapter focuses on compliance costs for producers. The chapter should note that some RIAs should include compliance costs for consumers, for example when regulations affect product quality.

- The chapter as written discusses employment effects. It is unclear why those belong here, rather than exclusively in Chapter 9.

- Section 8.2.3.6 discusses effect of regulation on market structure and entry and exit. It is unclear why this is here rather than in Chapter 9.

- Include an accounting perspective on costs, similar to that in Chapter 7.

- Include more discussion of imperfect competition.

- Briefly note why I-O analysis is not recommended and drop the description.

- Be clear that the costs of a regulation include all costs, including those in ancillary markets not directly targeted by the regulation. In the same way that an RIA should consider "co-benefits" or "ancillary benefits," it should also consider "co-costs" or "ancillary costs." The text should include an unequivocal endorsement of OMB's call for identification and consideration of "ancillary benefits" and "ancillary costs". The issue should not be "buried" in footnotes. It should be located in a free-standing section of Chapter 5, and then followed up with some specific discussion in Chapters 7 (Benefits) and 8 (Costs). An economic analysis should not address how much policy or legal weight to give to such issues.

- Analysis of benefits and costs should account for interactions with existing state, federal, and international regulations.

Tier 2

- The chapter should contain a brief reference to whichever part of the Guidelines end up including the main discussion of the implications of behavioral economics for characterization of benefits and costs.

- Clarify the section on consistency between empirical analyses and models, as in footnote 304.

- Relabel Figure 8.2 so that the triangle is not a deadweight loss.

- Correct footnote 244 to reflect that producer surplus is profits plus fixed costs.

- Clarify or drop Figure 8.3.
- Clarify or drop the discussion on page 8-10, line 15.

- In footnote 269, correct the definition of the distinction between EV and CV.

- Add limitations of CGE models, including lack of transparency and assumed perfect competition.

- Relocate Textbox 8.1 ("Retrospective Analysis"). The SAB was not clear why this belongs in the cost chapter or why it would be in Chapter 8 and excluded from Chapter 7. The chapter could reference the Evidence Based Policy Act of 2018. This chapter should include a brief reference to whichever part of the Guidelines end up including the main discussion of retrospective analysis.

- Add reasons GDP is not a good measure of welfare.

- Footnote 276, cite Chan, Cropper, and Muller 2018.

- Include discussion about how uncertainty can affect compliance decisions, such as delaying irreversible investments.

- Page 8-3, line 8. Delete reference to "market power."

- First full paragraph of 8.2. Note that analysts should exclude future costs expected to be incurred for other regulations.

- Section 8.2.1.1. Explain how to treat sunk costs in an RIA for a deregulatory action.

- Section 8.2.2. Drop discussion of "utility function."

- Section 8.2.3.2. Note that an additional reason to conduction a dynamic analysis is that the effects of the regulation itself may vary over time.

- Section 8.2.3.4. Drop use of "unbiased and biased technical change," or define, or replace with less technical language.

- Section 8.2.3.6. Make clear that market power can have large consequences for the welfare effects of a regulation. See Fowlie et al referenced earlier.

- Section 8.3. Add to the list of criteria for selecting a model that the model has been peer reviewed. Perhaps reference Chapter 5.

- Textbox 8.4. Suggest adding an example illustrating the lack of separable costs and benefits. One possibility is that reducing GHG emissions ameliorates the hottest temperatures, reducing demand for air conditioning, affecting energy prices and lowering compliance costs.

- Section 8.4.4. Add suggestions about how to characterize uncertainty.

- Discuss the cost of public funds and reference Chapter 4.

- Correct footnote 242. (page 8-3)

- Add the following to the glossary:
    - a distinction between all the rates of discounting (social opportunity cost of capital, social rate of time preference and shadow cost of capital).
    - annualized value as a constant stream of benefits or costs. The annualized cost is the *constant* amount that a party would have to pay at the end of each period ***t*** to add up to the same cost in present value terms as the *varying* stream of costs being annualized.
    - elasticity of supply where "… quantity supplied can be increased by … developing competitive products than can substitute."

Tier 3

- The SAB has no recommendations for this tier.

## 2.9. Chapter 9: Economic Impacts

This chapter presents methods for identifying the disparate impacts of environmental regulations on various groups. As stated in Section 9.2, analysis of these disparate impacts is rooted in OMB's Circular A-4 (OMB 2003). According to Section 9.3, although "virtually any economic measure of the consequences of a regulation may be included in an EIA," "frameworks … presented in terms of welfare effects are useful for understanding parts of an EIA because they illustrate the different pathways through which regulatory costs are distributed across population groups." Such frameworks structured around the distribution of welfare effects are appropriate because they have been part of federal benefit-cost guidance for 50 years. OMB's Circular A-4 is explicit about this. For example, it recommends that "You should study alternative levels of stringency to understand more fully the relationship between stringency and the size and distribution of benefits and costs among different groups" (emphasis added).

After a brief discussion of analytic components in 9.4, Section 9.5 provides the meat of the chapter with a discussion of impact categories. Overall, the section provides a good framework for think-ing through the various effects that have distributional consequences. The list of effects is good and much of the discussion is excellent. As we detail below, some of these individual areas are not always discussed with an up-to-date evaluation of the peer-reviewed literature, so there is some room for improvement with respect to balance.

More generally, though, Section 9.5 does not live up to the framework set out in Section 9.2 and 9.3. Despite the emphasis in A-4 and elsewhere on the distribution of benefits and costs, this chapter does not lay out a framework for doing so (nor does any other chapter). Section 9.5.6 comes closest, discussing the distribution of benefits and the importance of heterogeneity across groups in the effects of pollution changes on health. However, the chapter stops at identifying some of the channels through which the distribution could be affected, leaving it to a set of "effects" that are neither compared nor reconciled.

There was some disagreement among SAB members as to precisely the purpose of this chapter, especially compared with Chapter 10. Some read this chapter to examine potential differential impacts, and, if the analysts found large differentials – and if such differentials were measurable – to incorporate them into the regulatory analysis. If this is the objective, then the chapter should be more precise in terms of guidance to the analyst that this is indeed the purpose and provide more guidance as to when the differential impacts should be included into the analysis.

Others read this chapter as addressing how best to incorporate distributional effects into regulatory analyses. If so, the distributional objective needs to be better specified: equality, yes, but equality of what? Of exposure to a contaminant? Of environmental health? Or, most generally, overall welfare? Ultimately, the most fundamental distributional objective is equity in welfare, as implied by Circular A-4. Because it is the most fundamental, it is this objective that should guide the EPA's thinking about distributional effects.

### 2.9.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

As previously stated, the basic framework for the impacts discussed in this chapter is the effect of a proposed regulation on the distribution of benefits and costs among different groups. The peer-reviewed economics literature on this subject is over 100 years old, but the chapter generally ignores it in favor of documenting various "effects" taken separately. As a starting point for thinking about distributional effects, one could consider a social welfare function (see e.g. Adler 2012, 2019 for an up-to-date presentation). A social welfare function essentially involves two stages. In the first stage, each group has its own definition of welfare, which is impacted by the various effects set out in this chapter. In the second stage, the groups are weighted to account for distributional concerns. The second stage is generally the most controversial. However, the literature has long suggested the possibility of setting out just the first stage. The net benefits for each group can be calculated and displayed in a table. These net benefits would take into account social costs falling on the group, price changes and other transfers, environmental and other benefits, and any other relevant effects. Benefits would be evaluated by group specific WTP.

Turning to the discussion of specific, individual effects, the statements and recommendations in this chapter are, on the whole, consistent with existing and theoretical frameworks. This does not mean there are not difficult issues to consider.

First, the economics literature has established that there is not a one-for-one relationship between effects on prices and effects on groups. However, the chapter frequently speaks as if a price change maps only into an effect on consumers (page 9-2 line 17, page 9-4, line. 4, § 9.5.1). In fact, a price change impacts both sides of the market symmetrically.

Second, the discussion of effects on capital and on employment is not consistent with the most relevant parts of the economics literature. The issue of how fast an asset may return to production is an integral part of the evaluation of the economic impact of a policy. Regulations may strand assets. For instance, a mine that closes will not reopen as a manufacturing site; consequently, the asset becomes valueless, or even represent a liability. This is a much different occurrence than the closure of a warehouse in a transportation hub that will be soon refitted and used in another industry.

While labor demographics at first glance may appear fundamentally different, workers and firms make investments in human capital that is often not portable across firms or across location. One way to think about the impact of regulations on workers is that the regulation destroys (or renders valueless) some of their human capital, just as the regulation destroys some of the physical capital of the firm. When a worker is young this destruction may be less important than when the worker is older. If the worker is, say, 25, there is plenty of time to reinvest in human capital and obtain the returns from the investment. If the worker is, say, 55, then the loss is much larger for at least two reasons. First, often older workers have accumulated more human capital so presumably their losses are larger. Second, the payback period is much shorter for these individuals. In our mine example, workers from the closed mine have usually made substantial investments in learning the skills of mining, skills that are now rendered valueless with the closing of the mine. The failure to account for these losses will cause us to understate the cost of the regulation.

The impact on workers could be summarized by discussing these human capital considerations of the dislocation. People often think of labor as the malleable input that can be used anywhere. The human capital model provides a nice lens to discuss the heterogeneity with respect to age of the impact of worker dislocation. The literature on worker dislocation is extensive, the classic reference is Jacobson, LaLonde, and Sullivan (1993). The work by Walker (2013), though cited elsewhere in the chapter, is particularly relevant to the discussion at page 9-20. More references are provided at the bottom.

### 2.9.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The EPA should be commended for its careful review and consideration of many technical issues in the literature. Given the complexities involved, it is not surprising that there are some issues overlooked, which are highlighted in our comments.

Perfect competition versus other industrial structure*:*
The analysis is quick to go to perfect competition. While this is certainly a model that is well understood, we question how relevant this model is for large polluters, especially outside of farming. If there is market power, then there may be incomplete transfer of increased marginal costs from producers to buyers (e.g. Preonas 2019). Also, there is a large literature on how various kinds of regulations on the electricity sector do or do not get passed through electricity prices depending on whether there is regulated average-cost pricing. A discussion of these issues in the Guidelines would provide more guidance to the analysts.

Heterogeneity of impacts:
A firm closure is not the same in the booming economy of the Silicon Valley as it is in a declining town of the rust belt. Nor is losing a job with large investments in human capital the same in the two locations. The Guidelines do not provide any help to analysts attempting to deal with the heterogeneity.

Capital market imperfections:
If capital markets are perfect, shocks arising from the regulations would reduce lifetime wealth, but they would not generate any short-term crisis. Sadly, capital markets are not perfect, and people with limited wealth will presumably suffer more.

To see why the assumption matters, consider the loss $100,000 in lifetime income at either age 25 or age 65. With perfect capital markets, workers would be indifferent between the two possible events. If it occurs when the worker is young, the worker will borrow money around the age to smooth consumption. If capital markets are imperfect, a worker may not be able to carry out such a transaction, and we would see welfare decline.

A general result is that the poor and the young suffer more than older, wealthier workers. One might hope that the safety net would mitigate some of these short-term effects. A discussion of the assumption of perfect capital markets would aid the analyst in thinking about the impact of the regulations. A full treatment of the issues of imperfect capital markets is a Tier 3 suggestion.

Labor market impacts:

The SAB has already noted that labor market impacts can be better modeled through recognition of changes in the value of the stock of human capital. Recent advances in the economic evaluation of job losses include Bartik (2015) and Kuminoff, Schoellman, and Timmins (2015).

Additionally, Textbox 9.1 understates the literature on the social cost of job loss. In addition to the work of Sullivan and von Wachter, Rege, Telle, and Votruba (2009) also is highly relevant. M. Banzhaf (2018) documents the effects of job loss on divorce.

Impact on declining places:
When firms and jobs are removed from declining places they are often not replaced, speeding the decline of the declining areas. The impact on declining places is extremely complex because it affects labor markets, real estate markets, and the provision of local public services. It would be useful to analysts to have these issues discussed.

Health-Health (or risk-risk) tradeoff:
Regulations that affect real incomes will have feedback effects on health that may undermine any direct effects on health of environmental improvements. Viscusi and Broughel (2020) discuss this issue.

### 2.9.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that three areas within Chapter 9 warrant additional discussion.

Land markets – renters versus property owners**:**
Section 9.5.2.5 discusses impacts on land, but only as a "productive factor"—that is, only through the channel of firm's demands for land as a factor input in production. However, as the large literature on "hedonic pricing" shows, if there are benefits from pollution reductions in a particular location, then households' demand for residential land in that location increases relative to other areas. Thus, those landowners should benefit from the increase in property prices. If property prices do increase, renters tend to get a double hit: they suffer adverse labor market impacts and they must pay higher rent, too.

Migration section 9.5.3 and 9.5.4:
This is a delicate issue, but one that needs to be discussed. For instance, if the coal producing areas of Appalachia are not coming back (perhaps because we price carbon emissions or pollution emissions more highly) then there are more people in the region relative to an efficient distribution. Thus, the area will shrink. This places a financial burden on these communities and can be harmful for the incumbent residents of these communities, especially property owners. A discussion of the issues associated with migration would greatly help the analysts.

Spillovers with safety net program:
The dislocation of workers has big spillovers to social programs. While it is complicated, shifting the burden between states and the federal government, it also provides some relief to displaced workers and their families. Some direction on how the analysts should deal with these issues would be useful.

### 2.9.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The major inconsistency within this chapter, as highlighted above, is that it is rooted in a framework of the distributional effects of benefits and costs; but provides no guidance on the distribution of net benefits.

A minor inconsistency is that Chapter 10 discusses environmental justice as a distributional effect at least partly related to the distribution of baseline pollution burdens, but pollution burdens are not mentioned as an important baseline socioeconomic characteristic in Section 9.4.1 (page 9-7, line 16-20).

### 2.9.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The SAB finds that the glossary is accurate relative to Chapter 9.

***The following recommendations are noted for Chapter 9:***

Tier 1

- Follow through on the route sketched out in Sections 9.2 and 9.3 and perform, whenever justified by the significance of the regulation, a distributional analysis of net benefits across relevant groups. This analysis should account for all costs, including social costs as they fall on each group as well as transfers across groups through price and other effects. It also should account for environmental benefits as they fall on each group. To the extent practicable, environmental benefits accruing to each group should be evaluated using group specific WTP functions. For example, different age groups could have different VSLYs. Subsection 9.5.6 already opens the door to this issue, but it is not fully developed. For example, suppose the effect of the policy is to change environmental quality by dQ. The effect of a small change in Q on health for a specific group is dH/dQ. The value of that change in health is dW/dH. Then the value for each group would be dQ*(dH/dQ)*(dQ/dH). Section 9.5.6 considers group specific dH/dQ suggesting group-specific values for dQ. Group specific dQ/dH functions would only be an additional piece of the same picture.

  Accounting for such heterogeneity is absolute essential for understanding distributional effects. Indeed, assuming homogeneity in WTP when it does not exist only masks important social transfers, sweeping the problem under the rug. This point is very general to economics and is not specific to environmental analyses. For example, a policy that gave everybody a nice new car and charged them $25,000 for it is, in one sense, very equitable. Everybody is treated the same. But in another, very important sense, it is not at all equitable. Households who are willing to pay at least $25,000 for the car benefit from the policy, while those who do not want to pay that much for the car (or do not have the ability to pay it) are harmed by the policy.

The current literature supports such distributional analyses.

Tier 2

- Price effects should be treated as transfers between groups, not just as effects on consumers. To facilitate this change, it might be helpful to switch Sections 9.5.1 and 9.5.2 but also combine consumers with factors of production. First the direct effect on the regulated firm can be discussed. Then, the question arises as to whether the firm can pass on the effects to consumers and/or to factors of production, respectively down- and upstream from the regulated firm.

- Additionally, when evaluating price effects, more allowance should be made for the possibility of non-competitive conditions.

- More consideration should be given to the social consequences of job loss, following the literature cited above.

- Additionally, capital market imperfections should be introduced into comparative analyses of costs. If agents are borrowing constrained, the timing of an income shock in the lifecycle can matter. Younger, poorer households can be harmed more by the same dollar shock as older, richer households.

- More consideration should be given to the effects on land and real estate. Land prices are affected not only through factor demands (as rightly suggested by 9.5.2.5) but also through amenity effects on household demand. Like all price effects, these effects differentially impact buyers and sellers, in this case landlords and renters.

- More consideration should be given to impacts on communities, especially declining communities. An important consideration here is out-migration which can affect the value of land and capital, as noted above.

- The dislocation of workers has big spillovers to social programs. This should be discussed.

Some very specific suggestions:

- Page 9-2, l. 4. The Guidelines might emphasize, "Transfers, including price changes, must be excluded from a BCA … but may be included or even be key within an EIA"

- FN 322 seems out of place. This is a major idea that belongs in Chapter 4 or maybe Chapter 7, not a side note in Chapter 9. This relates to comments made elsewhere.

- Page 9-4. The Guidelines could unintentionally be giving the impression this is about price-based policies. That could be clarified. Fullerton and Heutel (2010) has a nice framework for analyzing the incidence of other kinds of regulations.

- For consistency with Chapter 10 and with subsection 9.5.6, pollution burdens should be mentioned as an important baseline socioeconomic characteristic in Section 9.4.1 (page 9-7, l. 16-20).

- The last paragraph of text box 9.1 seems out of place. Should it be third from last?

Tier 3

- Our Tier-1 suggestion was for the EPA to document net benefits across groups using heterogenous WTP for environmental improvements. This can be thought of as the "first stage" input that would be needed for an overall study of the impacts on social welfare that account for distribution. Future consideration might be given to consider such broader impacts (Adler 2012, 2019).

## 2.10. Chapter 10: Environmental Justice and Life Stage Considerations.

According to the introduction, this chapter is about the effects stemming from changes in environmental quality, in contrast to Chapter 9 which is about the effects of compliance costs.

Most of the chapter is focused on environmental justice considerations, which is sensible given EOs governing this topic and existing EPA guidance. Less attention is given to children's health, but the coverage is adequate. Intergenerational concerns receive only two paragraphs at the end, giving the impression of being an afterthought. As discussed in more detail below, the relationship between Chapters. 9 and 10 is not always clear, nor is the relationship between costs or benefits, or effects stemming from compliance vs. the quality of the environment.

### 2.10.1. Charge Question 1:

*Are the statements and analytic recommendations made in the chapter consistent with the theoretical and empirical peer-reviewed economics literature?*

The SAB has some doubts on whether Subsection 10.2.6 is consistent with the economic literature. To establish that, we first ask a clarifying question: Is the section meant to address empirical estimation or the analysis of benefits? While *statistical estimation* of effects on specific groups may require a control group, *documentation* of how a group is affected by a policy does not require comparison. The effect is just the effect; it is not a relative comparison.

Some of the discussion in the last par. of Section 10.2.1 is a bit across purposes. The point of Banzhaf et al. (2012), Banzhaf and Walsh (2013), and Depro et al. (2015) is that, when equilibrium relationships change, one cannot use a basic difference-in-difference design to identify sorting or re-sorting effects.

In Textbox 10.1, the last sentence of the third paragraph is not correct, or at least it is misleading. Inequality indices are not cardinal; they are ordinal. The distinction is that ordinal functions have cardinal rates of tradeoff. It is always true, in a utility function, social welfare function, etc., that the function itself is ordinal, but the rate of trading off two arguments in the function, at a constant level, is cardinal. Page 10-20, l. 17. Baden et al. (2007) also is relevant to the issue of sensitivity to the geographic area of analysis.

### 2.10.2. Charge Question 2:

*Does the chapter contain an objective, balanced, and reasonable presentation and interpretation of the peer-reviewed theoretical and empirical economics literature, as well as any analytic methods described?*

The SAB finds the chapter to be objective and balanced.

### 2.10.3. Charge Question 3:

*Are there topics that warrant more discussion or elaboration in the chapter?*

The SAB finds that Section 10.2.3.2 could use more discussion of cash and non-cash government transfers in measures of deprivation. Also, it does not necessarily need more elaboration, but it could be more decisive about its recommendation. Several options are given, but what is the guidance about how to measure income and poverty? In terms of underlying risk factors, Section 10.2.7.5 could be updated to include the microbiome where the distribution of gut microbes may vary by sociological group.

### 2.10.4. Charge Question 4:

*Are there any inconsistencies in the way an issue or topic is discussed either within or across chapters?*

The chapter is inconsistent in its treatment of costs. page 10-1 suggests it covers "impacts that stem from changes in environmental quality." Section 10.2.2.2 opens the door to consideration of costs and the possibility that "economic costs of the regulatory action will be concentrated among particular types of households." If we put these two together, does that mean that we are only considering costs that stem from changes in environmental quality, such as gentrification effects on rental values, but not other costs that stem from regulation, such as employment effects or energy prices? It strikes the SAB as odd and inconsistent to include costs through one channel and not the other.

More broadly, and most importantly, the chapter is inconsistent with Chapter 9. On one hand, its relationship to Chapter 9 is ambiguous. In some ways it is a special case of Chapter 9, which considers the distributional effects on different groups, where here in Chapter 10 those groups are defined by environmental justice considerations or intergenerational considerations. In other ways, it is very different because it is much more focused on changes in environmental quality alone, and not the larger array of effects considered in Chapter 9 (although as noted in the previous point the chapter is not always consistent here).

On the other hand, if we take at face value the comments that Chapter 9 is about distributional effects stemming from compliance whereas Chapter 10 is about effects stemming from changes in environmental quality, then two additional inconsistencies arise. First, the groups considered in Chapter 9 for compliance cost impacts do not align with those considered in Chapter 10 for quality changes. Second, economic parameters simultaneously affecting affected by both sides are not treated harmoniously. For example, land values might be affected by changes in firms' factor input de-mands (as noted in Chapter 9), but also by amenity effects and gentrification (as noted in Chapter 10). The joint effect of these two channels is ultimately what matters, but apparently the two would never be brought together.

### 2.10.5. Charge Question 5:

*Are the definitions provided in the glossary accurate? Please identify any in need of revision.*

The SAB finds that the glossary is accurate relative to Chapter 10.

***The following recommendations are noted for Chapter 10:***

Tier 1

- The relationship between the activities described by Chapters 9 and 10 should be made clearer, especially in light of our comments on Chapter 9.
- Chapter 9 should give broader guidelines on documenting a wide array of benefits and costs across groups, as currently discussed in the chapter. As noted in our comments on that chapter, we also recommend that EPA extend those guidelines to an analysis of net benefits across groups. In that analysis, the groups may or may not include the environmental justice communities highlighted in Chapter 10. Given that recommendation, and given the above comments about the inconsistencies across Chapters 9 and 10, we recommend the following simple solution.

  First, as suggested in our recommendations for it, Chapter 9 should give guidance on how to document benefits and costs for relevant groups, stemming from compliance costs, quality changes, and the joint price effects from the two. This would be Second, the very short discussion of intergenerational effects, which have the quality of an afterthought in subsection 10.4.2, should be cut from Chapter 10 and moved to Chapter 9. Generations or age groups can be considered as one example of group-specific comparison of benefits and costs. Third, with these changes, then Chapter 10 can be constructed much more narrowly around guidance for a separate, more straight-forward, but still important analysis. Namely, an analysis of the quality-of-the-environment effects, including health effects, on two groups of specific concern: environmental justice communities and children. As part of that narrowing, Section 10.2.2.2 and Textbox 10.1 can then be cut or moved to Chapter 9. These changes would have the merit of mapping Chapter 9 into an analysis that addresses the distributional analysis of costs and benefits, called for by Circular A-4 and other documents, in a holistic way, while mapping Chapter 10 into an analysis that specifically addresses the health and other environmental effects on environmental justice communities and children, as called for by EO 12898, EO 13045, and other documents.

Tier 2

- Because EPA's definition of environmental justice includes "Meaningful Involvement" of disadvantaged groups, SAB recommends that, when comparing alternative policy approaches for addressing an environmental harm, EPA include a comparative analysis of the potential for ongoing input and feedback. That is, "meaningful involvement" does not just come at the stage of public comments about a regulation. Different policy approaches might have different opportunities for ongoing feedback.

- The point should be made somewhere that, with tragic exceptions, children grow to adults. Thus, if a policy were enacted that improves infant health at a cost falling on adults, this would benefit all generations moving forward but also impose costs on each of those generations (with delay, of course). After a transitional stage, effects by age are not the same as effects by generation.

- Section 10.2.6 should be revised as indicated above.

- The expression "environmental justice perspective" (e.g. page 10-1) should not be used. It is not a perspective but a topic, on which there are many perspectives.

Tier 3

- The SAB has no recommendations for this tier.

## 2.11. Chapter 11: Presentation of Analysis and Results.

The EPA's charge to the SAB provided questions specific to chapters 1 – 10. As such, the SAB did not perform an in-depth analysis of this chapter. The SAB did review the chapter for completeness and has prepared several recommendations for improvements.

Chapter 11 calls for useful summary tables that organize information about regulatory costs and benefits. Three of the tables address regulatory benefits and one combines information on benefits and costs. No templates are provided for cost information. Although regulatory benefits are sometimes more complicated than regulatory costs, a "Template for Regulatory Costs Checklist" should be presented. The Cost Checklist should contain the conventional categories of regulatory costs (compliance costs for regulated entities, adverse impacts on consumers, adverse impacts on workers, and administrative costs/paperwork/reporting burdens) plus several categories of countervailing/ancillary risks (public health, safety, and environmental risks induced by rulemaking action). The structure of the new table could be similar to the structure of Table 11.1 Template for Regulatory Benefits Checklist, with columns on whether the impact could be quantified (in natural units) and whether the impact can be monetized (put in dollar terms); the final column could contain notes and references to appropriate text.

A "Template for Quantified Regulatory Costs and Ancillary Risks" should also be presented. The structure of the new table could be similar to the structure of Table 11.2 – Template for Quantified Regulatory Benefits, or it could combine the types of information in Tables 11.2 and 11.3 into one table. If the number of summary tables needs to be reduced, it might be feasible to combine Tables 11.2 and 11.3 on regulatory benefits into a single table.

Compared to the previous version of the EPA Economics Guidelines, Chapter 11 of the Guidelines was edited to reduce the emphasis on ancillary benefits (co-benefits; see comments in section 2.7.4 above)); ancillary costs (e.g., countervailing risks) are not emphasized in this draft or the previous version. The SAB believes that the text of Chapter 11 should have a strong paragraph on comprehensiveness, possibly a separate section, calling for analysts to investigate, analyze and report information on the ancillary benefits and costs (including countervailing risks) of rulemaking action. The natural tendency of regulatory analysts will be to focus only on those benefits and costs that relate directly to the statutory purpose of the rulemaking and are of concern to the regulated entities. If "tunnel vision" occurs, important ancillary impacts may be ignored in the analysis. Good economic analysis includes a comprehensive assessment of ancillary benefits (e.g., co-benefits) and ancillary costs (e.g., countervailing risks to human health, safety and the environment) of rulemaking action. This recommendation is consistent with the analytic directions provided in OMB Circular A-4.

One of the most important conclusions that an RIA or final RIA has is identification of specific margins that can be added or subtracted from a regulation. For example, analyses can suggest to the policy maker that removing certain industries or smaller firms where their inclusion shows that marginal benefits are vastly exceeded by the marginal costs can make a rule much more efficient. The time for compliance can also have an enormous effect on marginal costs with sometimes minimal effect on marginal benefits when firms do not have access to capital to comply.

The SAB suggests including a chart that highlights key margins where adding or subtracting regulatory options can make the regulation come closer to maximizing net benefits (benefits minus costs). This may prove more useful that discussions of the total costs and benefits of a regulation.

***The following recommendations are noted for Chapter 11:***

Tier 1

- Include a "Template for Regulatory Costs and Ancillary Risks Checklist".

- Include a "Template for Quantified Regulatory Costs and Ancillary Risks", modeled after Table 11.2 for Quantified Regulatory Benefits.

- Revise the narrative for Chapter 11 to include strong language calling for the analyst to investigate and present information on ancillary benefits (co-benefits) and ancillary costs (including countervailing risks).

Tier 2

- Page 11-2 and 11-3. In the discussion of non-quantified and non-monetized impacts, several parenthetical examples refer to avoided adverse health impacts even though it is often feasible to quantify and monetize such impacts. It might be better to use ecological examples that are difficult to quantify and/or monetize.

- Page 11-3, lines 1-2. "Technological innovation" is described as an important category of benefit or cost. While technological innovation is important in regulatory analysis, it is not a conceptually appropriate category of benefits or costs. It is an intermediate process leading to benefits and costs. In this discussion of benefit and cost categories that can be described only qualitatively, a more appropriate example should be provided.

- Page 11-3, line 16. Mention non-quantified costs and ancillary risks as well. Here is also a good place to re-emphasize ancillary benefits (co-benefits) of rulemaking action.

- Page 11-4. Before discussing the suggested templates in Tables 11.1 to 11.4, the reader should be reminded that the templates presume that the rulemaking action is designed to achieve health and environmental-protection benefits, albeit at some cost. In the case of a deregulatory action, the structure of the templates may need to be reversed if the costs are foregone environmental benefits and the benefits are avoided regulatory costs and ancillary risks.

- Page 11-10. In addition to their accepted use in CEA, there is another use of health-indices in BCA that is worthy of mention. If WTP information on certain types of health impacts is not available, insights about potential WTP may be gleaned by consulting health-status indices for those health effects and comparing them to indices for health impacts where WTP information is available. The HHS Guidelines on economic analysis provide a good discussion on this use of health indices. The IOM, 2006 reference included in the Guidelines is also relevant.

- There are two sections related to uncertainty, 11.1.4 and 11.2. It may be worth consolidating the two sections.

- Page 11-11, lines 2-4. For $1 billion rules, the OMB requirement is for "probabilistic" analysis of uncertainties, not simply quantitative analysis of uncertainties (which is readily accomplished with simple sensitivity analysis).

- Page 11.1.4. In addition to the IEc 2004 reference, it might be useful to cite a textbook treatment of uncertainty analysis such as text authored by M Granger Morgan (YEAR).

- Page 11-13, top. For rulemaking actions plagued with a high degree of uncertainty about costs and benefits, this chapter should emphasize the importance of considering a policy alternative that entails gathering more data/evidence on the key uncertainties prior to making a regulatory decision. The tools of value-of-information analysis are well suited to analyzing such situations, since they combine the costs/risks of delayed rulemaking (including R&D costs) and compare them to expected benefits of making the rulemaking decision based on a stronger information base. Our recommendations on uncertainty in Chapter 5 should provide a foundation for the brief paragraph on value-of-information analysis appropriate for Chapter 11.

Tier 3

- The SAB has no recommendations for this tier.

## 2.12. Appendix A: Economic Theory.

The EPA's charge to the SAB provided questions specific to chapters 1 – 10. As such, the SAB did not perform an in-depth analysis of this appendix. Rather than updating this appendix periodically, the SAB recommends that the Agency consider referring the reader to appropriate sections of well-established textbooks.

***The following recommendations are noted for Appendix A:***

Tier 1

- The SAB has no recommendations for this tier.

Tier 2

- The SAB has no recommendations for this tier.

Tier 3

- The SAB recommends that the EPA create a reference list to appropriate sections of well-established textbooks.

## 2.13. Appendix B: Mortality Risk Valuation Estimates.

The EPA's charge to the SAB provided questions specific to chapters 1 – 10. As such, the SAB did not perform an in-depth analysis of this appendix. Once the Agency has performed an up-to-date review of

the available literature, it may be appropriate to request a specialized SAB panel to review the Agency's new position. Refer to comments in section 2.7.1 above relevant to this appendix.

***The following recommendations are noted for Appendix B:***

Tier 1

- The SAB has no recommendations for this tier.

Tier 2

- The SAB has no recommendations for this tier.

Tier 3-

- Should the EPA perform an up-to-date review of available literature, the SAB recommends that a peer review of that information be conducted.

# REFERENCES

Adler, Matthew D. (2019). Measuring Social Welfare: An Introduction, *Oxford*.

Administrative Conference of the United States (2014), Administrative Conference Recommendation 2014-5, available at https://www.acus.gov/sites/default/files/documents/Recommendation%25202014-5%2520%2528Retrospective%2520Review%2529_1.pdf.

Aldy, J. E. (2019). Birds of a feather: Estimating the value of statistical life from dual-earner families. *Journal of Risk and Uncertainty* 58(2-3): 187-205.

Aldy, J.E. (2014). "Learning from Experience: An Assessment of the Retrospective Reviews of Agency Rules and the Evidence for Improving the Design and Implementation of Regulatory Policy." Report Prepared for the Administrative Conference of the United States, available at https://www.acus.gov/sites/default/files/documents/Aldy%2520Retro%2520Review%2520Draft%252011-17-2014.pdf.

Aldy, J.E., Auffhammer, M., Cropper, M.L., Fraas, A.G., and Morgenstern, R.. (2020). "Looking Back at Fifty Years of the Clean Air Act." NBER Working Paper No. 26687, available at https://www.nber.org/papers/w26687.

Aldy, J.E., Kotchen, M., Evans, M., Fowlie, M., Levinson, A., and Palmer, K.. (2020). Co-Benefits and Regulatory Impact Analysis: Theory and Evidence from Federal Air Quality Regulations. NBER Working Paper No. 27603, available at https://www.nber.org/papers/w27603.

Aldy, J.E. and Viscusi, W.K. (2008). Adjusting the value of a statistical life for age and cohort effects. *The Review of Economics and Statistics* 90(3): 573-581.

Arthur, W. B. (1981). The economics of risks to life. *The American Economic Review* 71(1): 54-64.

Banzhaf, Melissa Ruby. (2018) When It Rains, It Pours: Under What Circumstances Does Job Loss Lead to Divorce. *Southern Economic Journal* 85.2: 349-377.

Baden, Brett M., Noonan, D.S., and Turaga, R.M.R. (2007). Scales of justice: Is there a geographic bias in environmental equity analysis? *Journal of Environmental Planning and Management* 50.2: 163-85.

Bartik, Timothy J. (2015). The social value of job loss and its effect on the costs of US environmental regulations." *Review of Environmental Economics and Policy* 9.2: 179-197.

Bator, Francis M. (1958). The anatomy of market failure. *Quarterly Journal of Economics* 72.3: 351-379.

Bell, FW and Leeworthy, VR.. (1990). Recreational Demand by Tourists for Saltwater Beach Days. *Journal of Environmental Economics and Management* 18: 189-205.

Berg J, Campbell P, Kiermer V, Raikhel N, Sweet D. (2018). Joint statement on EPA proposed rule and public availability of data. *Science*. May 4; 360(6388):eaau0116.

Berman, MD and Kim, HJ. (1999). Endogenous Onsite Time in the Recreation Demand Model. *Land Economics* 75: 603-19.

Birdsall, N., and Steer, A. (1993). Act now on global warming-but don't cook the books. *Finance and Development* 30.1: 6.

Boardman, A.E. et al. (2018.) Cost-Benefit Analysis. Cambridge University Press, 5th Ed.

Boardman, A.E.; Greenberg, D.H.; Vining, A.R.; Weimer, D.L. (2018). Cost-Benefit Analysis: Concepts and Practice. Pearson Prentice Hall.

Browning, Martin, Dano, Anne Moller and Heinesen, Eskil. (2006). Job Displacement and Stress-Related Health Outcomes. *Health Economics* 15: 1061–1075.

Buchanan and Stublebine. 1962. Externality. *Economica* 29.116 (1962): 371-384.

Burgard, Sarah, Brand, Jennie and House, James. (2007). Toward a Better Estimation of the Effect of Job Loss on Health. *Journal of Health and Social Behavior* 48: 369–384.

Burgess, D. (2018). The Appropriate Measure of the Social Discount Rate and Its Role in the Analysis of Policies with Long-Run Consequences. Mercatus Research Paper, December. https://www.mercatus.org/publications/regulation/appropriate-measure-social-discount-rate-and-its-role-analysis-policies-long

Cameron, T.A. and DeShazo, J.R., (2013). Demand for health risk reductions. *Journal of Environmental Economics and Management* 65.1: 87-109.

Carson, RT and T Groves. (2007). Incentive and informational properties of preference questions. *Environmental and Resource Economics* 37:181-210.

Carson, RT, NE Flores, and NF Mead. (2001). Contingent valuation: Controversies and evidence. *Environmental and Resource Economics* 19: 173-210.

Chan, Cropper and Muller, (2018). The Impact of Trading on the Costs and Benefits of the Acid Rain Program. *Journal of Environmental Economics and Management* 88: 180-209,

Chan, Sewin, and Stevens, Ann Huff, 2001. Job Loss and Employment Patterns of Older Workers, Journal of Labor Economics, 19: 484–521.

Córdoba, J. C., and Ripoll, M. 2017. Risk aversion and the value of life. The Review of Economic Studies 84(4): 1472-1509.

Cropper, M.L. et al. (2017). "Looking Backward to Move Regulations Forward." *Science* 355(6332): 1375-1376.

Cropper, M. L. et al. (2018). "Policy Brief—Facilitating Retrospective Analysis of Environmental Regulations." Review of Environmental Economics and Policy 12(2): 359-370.

Cummings, R.G. and Taylor, L.O.1998. Does realism matter in contingent valuation surveys? Land Economics. 74. 203-215.

Currie, J., & Walker, R. (2019). "What Do Economists Have to Say about the Clean Air Act 50 Years after the Establishment of the Environmental Protection Agency?" *Journal of Economic Perspectives* 33(4): 3-26.

Desvouges, W., Mathews K. and Train, K. 2015. An adding-up test on contingent valuations of river and lake quality. Land Economics 91: 556–71.

Dixit, A. and R. S. Pindyck, Investment Under Uncertainty (Princeton: Princeton University Press, 1994).

Dudley, S., Belzer, R., Blomquist, G., Brennan, T., Carrigan, C., Cordes, J., . . . Zerbe, R. (2017). Consumer's Guide to Regulatory Impact Analysis: Ten Tips for Being an Informed Policymaker. Journal of Benefit-Cost Analysis, 8(2):187-204.

English, E, McConnell, KE., von Haefen, RH. and Lupi, F. 2018. Should single day and multiple day trips be pooled when estimating travel cost models? working paper, May 30

Evans, M. F., & Schaur, G. 2010. A quantile estimation approach to identify income and age variation in the value of a statistical life. Journal of Environmental Economics and Management 59(3): 260-270.

Executive Order 12866. 1993. Regulatory Planning and Review.

Farrow Scott, 2013. How (Not) to Lie with Benefit-Cost Analysis, The Economists' Voice, 10(1): 45-50, December.

Farrow, S. and W. K. Viscusi, 2011. Principles and Standards for the Benefit-Cost Analysis of Safety. Journal of Benefit-Cost Analysis, 2(3):#5.

Finkel, A.M. & Evans. J.S. (1987). "Evaluating the Benefits of Uncertainty Reduction in Environmental Health Risk Management." *Journal of Air Pollution Control Association* 37(10): 1164- 1171.

Freeman, M., Groom, B., & Spackman, M. 2018. Social discount rates for cost–benefit analysis: a report for HM treasury. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685904/Social_Discount_Rates_for_Cost-Benefit_Analysis_A_Report_for_HM_Treasury.pdf

Foldvary and Klein's "The Half-Life of Policy Rationales (2003). New York University Press, New York, NY.

Fowlie, M, Reguant, M, and Ryan, S.P. 2016, Market-Based Emissions Regulation and Industry Dynamics, Journal of Political Economy Volume 124(1).

Fullerton, Don and Garth Heutel. 2010. The general equilibrium incidence of environmental mandates." American Economic Journal: Economic Policy 2(3): 64-89.

Gentry, Elissa Philip and W. Kip Viscusi. 2016. The Fatality and Morbidity Components of the Value of Statistical Life. Journal of Health Economics 46: 90-99.

Gibbons, S and HG Overman. 2012. Mostly Pointless Spatial Econometrics. Journal of Regional Science 52(2): 172 - 191.

Haab, TC, Interis, MG, Petrolia, DR, and Whitehead, JC. 2013. From Hopeless to Curious? Thoughts on Hausman's "Dubious to Hopeless" Critique of Contingent Valuation. Applied Economic Perspectives and Policy 35(4): 593-612

Hall, R. E., & Jones, C. I. 2007. The value of life and the rise in health spending. The Quarterly Journal of Economics 122(1): 39-72.

Helfand, G.E. 1992. The Simple Economics of Pollution Prevention. Toxic Substances Journal.

Helfand, G.E. 1994. Pollution Prevention as Public Policy: An Assessment. Contemporary Economic Policy: 104-13.

Hellerstein D, and R Mendelsohn. 1993. A Theoretical Foundation for Count Data Models. American Journal of Agricultural Economics 75(3): 604-611

Herriges, J, C Kling, CC Liu, and JTobia. 2010. What are the consequences of consequentiality? Journal of Environmental Economics and Management 59: 67-81.

Hillman, T. 2014. Economics.

Howard, R. (1972). "The Decision to Seed Hurricanes." *Science* 176: 1191-120

Jacobson, Louis, LaLonde, Robert, and Sullivan, Daniel. 1993. Earnings Losses of Displaced Workers, American Economic Review, 83:685–709.

Johansson, P. O. 2002. On the definition and age-dependency of the value of a statistical life. *Journal of Risk and Uncertainty* 25(3): 251-263.

Johnson, et al. 2017, Contemporary Guidance for Stated Preference Studies. *Journal of the Association of Environmental and Resource*, 4:2, 319-405.

Kuminoff, Nicolai V., Schoellman, Todd and Timmins, Christopher. 2015. Environmental regulations and the welfare effects of job layoffs in the United States: A spatial approach. Review of Environmental Economics and Policy 9.2: 198-218.

Kniesner, Thomas J. and Viscusi. W. Kip. 2019. The Value of a Statistical Life. Oxford Research Encyclopedia of Economics and Finance.

Krupnick, A. 2007. Mortality-risk valuation and age: stated preference evidence. Review of Environmental Economics and Policy 1(2): 261-282.

LaFrance, J 1990. Incomplete Demand Systems and Semilogarithmic Demand Models Australian *Journal of Agricultural Economics* 34(2): 118-31

Landry, CE and KE McConnell. 2007. Hedonic Onsite Cost Model of Recreation Demand. *Land Economics* 83(2): 253-67.

Landry, CE and JA List. 2007. Using Ex Ante Approaches to Obtain Credible Signals of Value in Contingent Markets: Evidence from the Field. *American Journal of Agricultural Economics* 89(2): 420-32.

Landry, CE, AR Lewis, H Liu, and H Vogelsong. 2016. Economic Value and Economic Impact of Visitation to Cape Hatteras National Seashore: Addressing Onsite Sampling. Marine Resource Economics 31(3): 301-22.

Larson, DM 1993. Joint Recreation Choices and Implied Values of Time. *Land Economics* 69: 270-86.

List, JA, R Berrens, A Bohara, and H Kerkvilet. 2004. Examining the role of social isolation on stated preferences. American Economic Review 94: 741-752.

Mas-Colell, A. et al. 1995. Microeconomic Theory.

Masterman, Clayton and Viscusi, W. Kip. 2018. The Income Elasticity of Global Values of a Statistical Life: Stated Preference Evidence. *Journal of Benefit-Cost Analysis* 9(3): 407–434.

McConnell, KE 1992. Onsite Time in the Demand for Recreation. American Journal of Agricultural Economics 74: 918-25.

McLaughlin, Patrick A. et. al., 2014. Regulatory Reform in Florida: An Opportunity for Greater Competitiveness and Economic Efficacy. FSU Business Review, p. 109

Montgomery, W. 1972. Markets in Licenses and Efficient Pollution Control Programs. Journal of Economic Theory 5(3): 395-418.

Muller, N.Z. & Mendelsohn, R. 2009. Efficient Pollution Regulation: Getting the Prices Right. American Economic Review 99(5): 1714-39.

Murphy, K. M., & Topel, R. H. 2006. The value of health and longevity. *Journal of Political Economy* 114(5): 871-904.

National Academy of Sciences. 2017. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. Washington, DC: The National Academies Press. https://doi.org/10.17226/24651.

O'Brien, J. 2018. Age, autos, and the value of a statistical life. *Journal of Risk and Uncertainty* 57(1): 51-79.

Parsons, GR and AJ Wilson. 1997. Incidental and Joint Consumption in Recreation Demand. Agricultural and Resource Economics Review

Pezzey, J.C.V. & Jotzo, F. 2012. Tax-versus-Trading and Efficient Revenue Recycling as Issues for Greenhouse Gas Abatement. *Journal of Environmental Economics and Management* 64(2): 230-36.

Phaneuf, D.J. & Requate, T. 2017. A Course in Environmental Economics. Cambridge University Press.

Preonas, Louis, 2019, "Market Power in Coal Shipping and Implications for U.S. Climate Policy," working paper, https://www.louispreonas.com/s/preonas_jmp.pdf

Raiffa, H. (1968). "Decision Analysis, Introductory Lectures on Choices Under Uncertainty." Random House, New York.

Rege, Mari, Kjetil Telle, and Mark Votruba, 2009. The Effect of Plant Downsizing on Disability Pension Uti-lization," *Journal of European Economic Association*. 7(4): 754-785.

Robinson, L.A. and Hammitt, J.K. 2016. Valuing reductions in fatal illness risks: Implications of recent research. Health Economics *25*(8): 1039-1052.

Robinson, L.A., Raich, W.J., Hammitt, J.K. and O'Keeffe, L. 2019. Valuing Children's Fatality Risk Reductions. *Journal of Benefit-Cost Analysis* 10(2): 156-177.

Rosen, S. 1988. The value of changes in life expectancy. *Journal of Risk and uncertainty* 1(3): 285-304.

Shapiro, Stuart. 2018. Case Studies in the classroom: Lessons Learned, in S. Farrow (ed), Teaching Benefit-Cost Analysis, Edward Elgar, Cheltenham, UK.

Shepard, D. S., & Zeckhauser, R. J. 1984. Survival versus consumption. Management Science 30(4): 423-439.

Shirky, Clay. 2008. Here Comes Everybody, Penguin Press, New York, NY.

Stern, N. 2008. The economics of climate change. American Economic Review 98(2): 1-37. Available at https://pubs.aeaweb.org/doi/pdf/10.1257/aer.98.2.1

Tietenberg, T.H. 2006. Emissions Trading—Principles and Practice. 2d Ed., Washington, DC.

Traeger, Christian P. 2014. On option values in environmental and resource economics. Resource an Energy Economics, 37: 242-252.

U.S. Department of Health and Human Services (2016). "Guidelines for Regulatory Impact Analysis," available at https://aspe.hhs.gov/system/files/pdf/242926/HHS_RIAGuidance.pdf.

U.S. OMB (U.S. Office of Management and Budget). 2003. Circular A-4, Regulatory Analysis, September 17, 2003. Available at: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf.

U.S. OMB (U.S. Office of Management and Budget). 1981. Policy Analysis Grade-Evaluation Guide TS-52 March 1981. Available at: https://www.opm.gov/policy-data-oversight/classification-qualifications/classifying-general-schedule-positions/functional-guides/gspolanl.pdf.

U.S. EPA SAB (U.S. Environmental Protection Agency Science Advisory Board). 2007. Issues in Valuing Mortality Risk Reduction. EPA-SAB-08-001. Available at https://yosemite.epa.gov/sab/sabproduct.nsf/4128007E7876B8F0852573760058A978/$File/sab-08-001.pdf

Viscusi, W. K. 2004. The value of life: estimates with risks by occupation and industry. *Economic Inquiry* 42(1): 29-48.

Viscusi, W. Kip. 2015. The Role of Publication Selection Bias in Estimates of the Value of a Statistical Life. *American Journal of Health Economics* 1(1): 27-52.

Viscusi, W.K. 2018a. Best Estimate Selection Bias in the Value of a Statistical Life. *Journal of Benefit-Cost Analysis* 9(2): 205-246.

Viscusi, W. Kip. 2018b. Pricing Lives: Guideposts for a Safer Society. Princeton: Princeton University Press.

Viscusi, W. Kip and Gentry, Elissa Philip. 2015. The Value of a Statistical Life for Transportation Regulations: A Test of the Benefits Transfer Methodology. *Journal of Risk and Uncertainty* 51(1): 53-77.

Viscusi, W. K., Huber, J., & Bell, J. 2019. Responsible Precautions for Uncertain Environmental Risks. *Journal of Benefit-Cost Analysis* 10(2): 296-315.

Viscusi, W. Kip and Masterman, Clayton J.. 2017. Income Elasticities and Global Values of a Statistical Life. *Journal of Benefit-Cost Analysis* 8(2): 226–250.

Viscusi, W. Kip, and Broughel, James. 2020. The Mortality Cost of Expenditures. Contemporary Economic Policy, Forthcoming.

von Haefen, RH. 2002. A complete characterization of the linear, log-linear, and semi-log incomplete demand system models. *Journal of Agricultural and Resource Economics* 27(2): 281-319.

Vossler, C, Doyon, M., and Rondeau, D.. 2012. Truth in consequentiality: Theory and field evidence on discrete choice experiments. American Economic *Journal: Microeconomics* 4, 145-171.

Vossler, C and M Evans. 2009. Bridging the gap between the field and the lab: Environmental goods, policymaker input, and consequentiality. *Journal of Environmental Economics and Management* 58: 338-345.

Vossler, C and SB Watson. 2013. Understanding the consequences of consequentiality: Testing the validity of stated preferences in the field. *Journal of Economic Behavior & Organization* 86: 137– 147.

Walker, W. Reed. "The Transitional Cost of Sectorial Reallocation: Evidence from the Clean Air Act and the Workforce" Quarterly *Journal of Economics* 2013 1787-35

Wildavsky, A. B. 1988. Searching for Safety (Vol. 10). Transaction Publishers.

# APPENDIX A: EDITIORIAL CORRECTIONS

The SAB recommends that the following editorial corrections be addressed for the final draft.

1 Page 1-4: In the Text Box please correct the typo within the 5th question: ". . . used in the RIA provided to the public . . ."

2 Page 10-9 l. 12 contains a typo: a stray "is".

3 Roberts and Spence (1976), J. Pub. Ec. Cited in existing guidance but missing in reference list.

# APPENDIX B: ADDITIONAL COMMENTS

TBD