



ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS: FEDERAL PRIORITIES AND DIRECTIONS FOR FUTURE RESEARCH

Annual Report by the

SUBCOMMITTEE ON FRONTIERS OF BENEFIT-COST ANALYSIS

of the

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

DECEMBER, 2023

About the National Science and Technology Council

The National Science and Technology Council (NSTC) is the principal means by which the Executive Branch coordinates science and technology policy across the diverse entities that make up the federal research and development enterprise. A primary objective of the NSTC is to ensure science and technology policy decisions and programs are consistent with the President's stated goals. The NSTC prepares research and development strategies that are coordinated across federal agencies aimed at accomplishing multiple national goals. The work of the NSTC is organized under committees that oversee subcommittees and working groups focused on different aspects of science and technology. More information is available at <http://www.whitehouse.gov/ostp/nstc>.

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976 to provide the President and others within the Executive Office of the President with advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget with an annual review and analysis of federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the federal government. More information is available at <http://www.whitehouse.gov/ostp>.

About the NSTC Subcommittee on Frontiers of Benefit-Cost Analysis

The Subcommittee on Frontiers of Benefit-Cost Analysis (SFBCA or “Frontiers” group) was established by OSTP as a Subcommittee under the Committee on Environment of the NSTC in March of 2023. The SFBCA is co-chaired by Council of Economic Advisors (CEA), Office of Information and Regulatory Affairs (OIRA), and OSTP. The purpose of the SFBCA is to coordinate and advance efforts that harness the best-available science and economics to address challenges in quantifying and monetizing a broad range of relevant impacts in benefit-cost analyses across federal agencies.

About this Document

The charter of the SFBCA calls on the Subcommittee to create an annual public report that identifies opportunities to advance the frontiers of benefit-cost analysis in federal practice. The report is intended to identify a subset of common effects that are currently difficult to monetize or quantify in analyses of agency regulations, projects, programs, or other actions. The report summarizes current relevant guidance or examples related to the challenges identified. To encourage progress, the report also summarizes how planned agency activities can help address the identified gaps, and identifies recommendations for how these challenges could usefully be addressed by external researchers. The scope of issues that can be covered in this and future annual reports includes costs or benefits that are difficult to fully monetize, distributional analysis of any effects, and identification of estimates, inputs, and parameters used in analyses that could usefully be updated. This document is a state-of-practice report that identifies gaps and opportunities for the federal government.

Following this report, the SFBCA will identify topics and forums for further knowledge-sharing or collaboration, and will engage the public on opportunities to advance the frontiers of federal benefit-cost analysis.

Copyright Information

This document is a work of the United States Government and is in the public domain. Subject to the stipulations below, it may be distributed and copied with acknowledgment to OSTP. Copyrights to graphics included in this document are reserved by the original copyright holders or their assignees and are used here under the Government’s license and by permission. Requests to use any images must be made to the provider identified in the image credits or to OSTP if no provider is identified. Published in the United States of America, 2023.

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

Chair

Arati Prabhakar, Assistant to the President for
Science and Technology and Director, White
House Office of Science and Technology Policy

Executive Director (Acting)

Kei Koizumi, Principal Deputy Director for
Policy, OSTP

COMMITTEE ON ENVIRONMENT

Co-Chairs

Jane Lubchenco, Deputy Director for Climate and Environment, OSTP

Rick Spinrad, Administrator, NOAA

Chris Frey, Assistant Administrator, Office of Research and Development, EPA

SUBCOMMITTEE ON FRONTIERS OF BENEFIT COST ANALYSIS

Co-Chairs

Elena Patel, Senior Economist, CEA

Emily Pindilli, Assistant Director for Ecosystem Services and Natural Capital, OSTP

Jason A. Schwartz, Senior Advisor, OIRA (through November 2023)

Judy Scott-Clayton, Senior Economist, CEA
(through September 2023)

Jeffrey Shrader, Senior Advisor, OIRA

Heather Tallis, Assistant Director for Biodiversity and Conservation Sciences, OSTP
(through September 2023)

Subcommittee Members

Arnab Acharya, DOC-NOAA	Travis Grout, DOC-NOAA	Lydia Olander, CEQ
Hope Allen, ED	Shelley Harrow, HHS	Matthew Oreska, OIRA
Sarah Baker, DOT	Troy Hillier, USDA	Alexis Pelosi, HUD
Sam Berger, OIRA	David Houser, DHS	Hillary Perkins, ED
Brandee Blumenthal, DOI- Reclamation	Solomon Hsiang, OSTP	Daniel Pollard, ED
Ben Bolitzer, DOC	Mary Hyde, AmeriCorps	Regina Powers, DOC
Benjamin Bryant, MCC	John Iselin, CEA	Kate Quigley, DOC-NOAA
Alex Bush, USDA	Al Kaylani, HHS	Taylor Rhodes, NSF
Susan Chesley, ED	Aaron Kearsley, HHS	Julien Rosenbloom, CEA
Sarah Coffman, DOI-BOEM	Hong Kim, DOL	Aliya Sassi, HHS
Dan Cohen, DOT	Georgia Kosmopoulou, NSF	Tara Scott, DOC-NOAA
Julie-Ann Cronin, Treasury	Michael LeGower, FTC	Kevin Stange, ED
Christian Crowley, DOI	Ephraim Leibtag, HHS	Andrew Stawasz, OIRA
John Cymbalsky, DOE	Arik Levinson, Treasury	Todd Steiner, DHS
Raj Darolia, ED	Nellie Lew, FTC	Karl Stock, DOI-Reclamation
Sydney Day, CEA	Benjamin Lidofsky, OMB	Jamie Taber, OMB
Anastasia de Santos, USAID	John Linder, OIRA	Eric Thunberg, DOC-NOAA
Louis Desroches, DOE	Zach Liscow, OMB	Patricia Toppings, DOD
Polina Dineva, DOC-NOAA	Alex Marten, EPA	Maria Wegner, DOD-Corps
Erik Durbin, CFPB	Jordan Matsudaira, ED	Andrew Wilson, CEA
Dave Evans, EPA	Emily McDonald, AmeriCorps	Josh Zajdel, Treasury
Peter Feather, USDA	Alastair McFarlane, HUD	Lily Zandniapour, AmeriCorps
Christina Foreman, OMB	Al McGartland, EPA	Nancy Zhang, HHS
Madison Fox, CEA	Alex Mechanick, OIRA	
Steven Furnagiev, OMB	Michelle Michaels, DOD	
Suzanne Gleason, Treasury	Greg Miller, DOD-Corps	
Barry Goodstadt, AmeriCorps	Fran Moore, CEA	
Doug Gorecki, DOD-Corps	Julie Morgan, CFPB	
	Gabriel Movsesyan, DOT	

Acknowledgments

This document was prepared by subject matter experts from across the Executive Branch. It was a whole-of-Government endeavor and represents a dedicated effort to provide an overview of a number of complex scientific challenges facing the federal government. The Subcommittee on Frontiers of Benefit-Cost Analysis thanks all the contributors to this document: authors, reviewers, editors, and advisors.

Table of Contents

Glossary of Acronyms and Definitions of Key Terms.....	vi
Executive Summary	1
Chapter 1: Non-Fatal Health Effects.....	4
Chapter 2: Ecosystem Services Effects.....	8
Chapter 3: Wildfire and Extreme Weather Effects	12
Chapter 4: Information and Transparency Effects	17
Chapter 5: Effects of Public Benefit Programs	21
Chapter 6: Cross-Cutting Issues: Analyzing Distributional Effects.....	25
Chapter 7: Cross-Cutting Issues: Analyzing Risk.....	30
Chapter 8: General Opportunities to Advance the Frontiers of BCA	33
Appendix.....	40

Glossary of Acronyms and Definitions of Key Terms

BCA: Benefit-Cost Analysis—a systematic method of assessing the impacts of government projects or policies, in which benefits and costs are reported and compared to the extent feasible using a common measure (usually money)

CEA: Council of Economic Advisors, Executive Office of the President

CGE: model: Computable General Equilibrium model—a model to simulate the workings of the price system jointly across multiple markets to represent the behavior of the economy

Circular A-4: the Office of Management and Budget’s guidance on regulatory analysis

COI: Cost of Illness study—a study estimating the financial burden of an illness based on the combined value of direct and indirect costs associated with the illness, which may include direct costs like expenditures associated with diagnosis, treatment, rehabilitation, and accommodation, and indirect costs like lost income, productivity, and leisure time

Detailee: an employee of a government agency temporarily assigned to a position within another agency

DHS: Department of Homeland Security

Distributional analysis: a quantitative or qualitative estimate of likely effects on those in a particular group across the population and economy

DOC: Department of Commerce

DOI: Department of the Interior

DOL: Department of Labor

EJ: Environmental Justice—the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies

Elasticity: a price elasticity of supply or demand measures the relationship between a change in a good’s price and the quantity supplied or demanded. It is calculated as the percentage change in quantity supplied (or demanded) that occurs in response to a percentage change in price.

EPA: Environmental Protection Agency

EOP: the Executive Office of the President

Ex ante: an estimate made prospectively, before the policy, program, or action of interest is in effect

Ex post: an estimate made retrospectively, after the policy, program, or action of interest is in effect

Expert elicitation: a formal, highly structured, and well-documented process for obtaining the judgments of multiple experts

Externality: externalities arise any time one person’s actions have costs or benefits (that do not operate through market prices) for anyone not directly part of the decision-making process

FEMA: Federal Emergency Management Agency, Department of Homeland Security

Focal Category: one of the categories of effects that this Report highlights for research into enhanced quantification and monetization

Hedonic model: hedonic price equations use regression analysis of market behavior to identify the implicit price associated with an attribute of interest; for example, using housing market data, an analysis can reveal the implicit price associated with changing a particular attribute or amenity of a house, such as number of bathrooms, access to quality education, or access to environmental amenities like public parks.

HHS: Department of Health and Human Services

Incidence: a measure of costs or benefits that describes who ultimately bears these effects, which may be different than who is initially affected. In some other literatures, “incidence” may refer to “frequency” (e.g., the incidence of flu in a particular region).

IPA: the Intergovernmental Personnel Act, which allows the temporary assignment of personnel to federal government from state, local, or Tribal Nations and Indigenous Peoples governments, academic institutions, federally funded research centers, and other eligible organizations

Meta-analysis: a statistical method of pooling data and/or results from a set of comparable studies

Monetization: the process for partially or fully valuing effects in monetary terms, typically by measuring willingness to pay or willingness to accept. Translating effects into a common metric (such as dollars) facilitates comparison across effects and provides context for decision-makers and the public.

NOAA: National Oceanic and Atmospheric Administration, Department of Commerce

NSF: National Science Foundation

OECD: Organization for Economic Co-operation and Development

OIRA: Office of Information and Regulatory Affairs, Office of Management and Budget

OMB: Office of Management and Budget, Executive Office of the President

OSTP: Office of Science and Technology Policy, Executive Office of the President

PRA: Paperwork Reduction Act of 1995

Public Benefit Programs: programs that provide either cash assistance or in-kind benefits to individuals and families from any governmental entity

Reference dose: an estimate of oral daily exposure to a substance that is likely to be without an appreciable risk of deleterious effects during a lifetime

Retrospective review: the process by which agencies assess existing regulations, programs, or other decisions to evaluate whether the costs and benefits of those actions, as they take effect, are different than originally estimated or have changed over time

Revealed preference method: a method for estimating the value of goods or services—or attributes of those goods or services—based on observable tradeoffs people make

SFBCA or Subcommittee: the Subcommittee on Frontiers of Benefit-Cost Analysis

Stated preference method: a method for estimating the value of goods or services—or attributes of those goods or services—that relies on choice data that are reported as a response to hypothetical situations, rather than on choice behavior observed in actual markets. Stated preference methods include contingent valuation, attribute-based methods (sometimes called choice experiments), and risk-tradeoff analysis.

Stated preference survey: a survey used to reveal willingness-to-pay through stated preference methods

USACE: U.S. Army Corps of Engineers, Department of Defense

USDA: U.S. Department of Agriculture

USGS: U.S. Geological Survey, Department of the Interior

VSL: Value of Statistical Life, sometimes called the value of mortality risk reduction—a summary measure of the dollar value of small changes in mortality risk experienced by a large number of people

WTP and WTA: willingness-to-pay (WTP) is the maximum amount of money an individual would be willing to give up in order to acquire a good or service or to avoid an effect; willingness-to-accept (WTA) is the minimum amount of money an individual would be willing to accept in order to relinquish a good or service.

Executive Summary

A basic premise of federal evidence-based decision-making is that the public benefits of a decision should justify the costs. Agencies conduct analyses in a range of contexts to test this premise for important federal policies, programs, and other decisions—from regulatory impact analyses to programmatic cost-effectiveness assessments to environmental impact reviews. Robust analysis of costs and benefits can make the consequences of federal actions more transparent to the public, and can provide richer guidance to decision-makers as they weigh, explain, and support policy choices to promote public well-being.

On his first week in office, President Biden issued a memorandum to federal agencies, directing them to modernize their analytical approaches.¹ Among the directives were two complementary goals: agencies should fully account for the effects of their actions, even those that may currently be difficult or impossible to quantify or monetize; and agency analyses should reflect the newest developments in scientific and economic understanding. This Report responds directly to those goals by identifying a set of common effects that agencies find difficult to quantify or monetize, and by exploring strategies to advance the scientific and economic understanding of those effects.

Current federal guidance² supports a range of options for appropriate analysis, recognizing the varying authorities, types of effects, and evidence bases relevant to the wide scope of analyses supporting agency decisions. Federal guidance recommends that agencies monetize (i.e., in dollar terms), quantify (i.e., in other terms such as number of visitors to national parks) or describe expected changes, in that order of preference. This approach provides as much information as possible to both decision-makers and the public about the size of expected changes that result from a policy and who will experience them. This Report recognizes this spectrum of approaches, and explores opportunities to advance the frontiers of analysis to strengthen agency decision-making. Improved quantification or monetization of effects could reveal benefits or costs that are lower or higher than previously anticipated. Improved quantification efforts could also improve understanding of who will be affected (the incidence of effects across population groups). For example, even if an estimate of total regulatory costs is already accurate, agencies may want to understand who will bear those costs across the population and economy, such as among regulated entities, their employees, their customers or suppliers, or other stakeholders.

Identifying Research Priorities

This Report highlights five focal categories, emphasizing benefits and costs that have significant effects on public well-being, are relevant to analyses of many upcoming agency actions, and have potential for expanded quantification or monetization. For each focal category, the Report identifies data gaps and other obstacles to further quantification and monetization. The focal effects, and examples of current challenges include:

- **Non-Fatal Health Effects**, such as liver disease, low birthweight, and mental health. Key data gaps include a lack of dose-response functions for non-cancer diseases, and distribution of baseline health risks and exposure data across different population groups, among others. Major methodological challenges include, for example, accounting for latency, and identifying social determinants of health—like health care access—that may lead to different dose-response relationships across population groups.
- **Ecosystem Services Effects**, such as recreational and subsistence uses, and climate mitigation. Major data challenges relate to a lack of environmental data on current conditions (e.g., the extent of certain habitats, the effect of ecosystem functions) and data linking ecosystem conditions to

¹ Executive Office of the President, *Modernizing Regulatory Review*, 86 Fed. Reg. 7223 (Jan. 26, 2021).

² Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>; Office of Management & Budget, *Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94.pdf>.

social outcomes (e.g., mental health outcomes, cultural uses). Key methodological challenges relate to inconsistent use of definitions for some effects, and the need to employ challenging survey methods to fill some data gaps.

- **Wildfires and Extreme Weather Effects**, including the benefits and costs of disaster relief, risk reduction, and resilience-building efforts. Challenges for these effects are dominated by data gaps, including data needed to help differentiate effects of specific wildfire management actions, separate costs borne by different wildfire actors, and evaluate health impacts from extreme events, among others.
- **Information and Transparency Effects**, such as consumer information, contract transparency, and information on public risks. Examples of data gaps include baseline information on consumer choices and preferences, such as how consumers respond to information about whether produce is organic or non-organic. Methodological needs include more experiments and models of how informational improvements may affect consumer or producer behavior.
- **Effects of Public Benefit Programs**, such as the long-term benefits to program recipients, paperwork costs and barriers to access, and cost-savings to related government programs. Data gaps include links between recipients of public benefit programs and their families' outcomes, and more complete information on the burdens of accessing programs. Methodological challenges include understanding whether, in the absence of federal programs, recipients would otherwise obtain similar direct or long-term benefits from other sources (such as local governments or private institutions).

Two additional cross-cutting themes—**Distributional Analysis** and **Risk Analysis**—are also called out for advancement. Distributional analysis challenges surfaced across all focal themes. For example, data for differentiating effects on various income or social groups (e.g., race and ethnicity, sex, gender, geography, wealth, disability, sexual orientation, religion, national origin, age or birth cohort, family composition, occupation, or veteran status) are lacking for many effects, such as baseline estimates of disease incidence. Risk analysis challenges were also common across all focal themes, such as how to estimate low-probability catastrophic risks like pandemics or major wildfires.

Opportunities for Advancement

The Report closes with recommendations for how federal agencies and the broader research community—both independently and in collaboration—can advance key needs for federal analysis. Recommendations to federal agencies include:

- **Share resources across agencies**, including through data access, research collaborations, and personnel (such as through detailees from one agency to another).
- **Participate in the NSTC Subcommittee on the Frontiers of Benefit-Cost Analysis**, which plans to host seminars for agencies and other engagements to highlight advances from the research community. The Subcommittee may also develop additional resources, including case studies or topic-specific guidance.
- **Use Strategic Plans and Learning Agendas** to map out and budget for efforts to refine costs and benefits, including through retrospective review studies.
- **Engage with the public**, including early engagement on agencies' Learning Agendas, Strategic Plans, and Regulatory Agendas. Within available authorities, agencies can also develop partnerships with researchers to encourage collaboration.
- **Seek Executive Office of the President (EOP) support**, such as conferring with OIRA on flexibilities, including generic clearances, that may be available under the Paperwork Reduction Act to facilitate stated preference surveys and other information collections, and working with OMB to develop budget priorities related to research goals.

Recommendations to the broader research community, including academia, non-profit organizations, stakeholders, communities, companies, and foundations, include:

- **Incentivize more replication and benefit-transfer studies**, and studies that explore external validity more broadly.
- **Encourage additional research on elasticities, stated preferences, computable general equilibrium models**, and other policy-relevant parameters and tools. Agencies report an ongoing demand for a broader hiring pool trained in these topics and for more published work addressing specific policy-relevant parameters.
- **Prioritize funding and research** that responds to this Report’s focal categories.
- **Engage early with agencies**, including on their Learning Agendas, Strategic Plans, and Regulatory Agendas. Researchers are also encouraged to submit written public comments, especially updated data and additional literature, recognizing the value to agencies of knowledgeable and supportive comments, as well as constructive critiques.
- **Consider serving** through temporary assignments to government, potentially by making use of agency authorities under the Intergovernmental Personnel Act, to share subject-matter expertise more directly.
- **Compile or synthesize available resources**, including catalogues of the state of the literature or new meta-analyses on relevant topics like non-fatal health effects and nature-based solutions.
- **Develop new data, tools, and methodologies**, such as by conducting behavioral change experiments, developing large language modeling techniques to extract data from databases, and ensuring that distributional data is published in ways that supports re-use in various federal applications.

The effects and opportunities discussed in this Report are not a comprehensive review of what is needed for full monetization of these focal categories. Rather, the Report reflects specific, focused challenges raised by agency analysts, and identifies opportunities to overcome those challenges. The Report’s Appendix includes an extensive list of topics suggested for prioritization, because this inclusive list may be of interest to researchers and funders in considering areas for further study and may help generate ideas for future areas of focus for this Subcommittee (such as highlighting additional priorities in future annual reports).

The “frontiers” of quantification and monetization explored in this Report, by definition, either push the cutting edges of scientific and economic understanding or probe the limits of available evidence, knowledge, and data. There is increasing evidence to support richer analysis on several of these topics, and many agencies are actively expanding the frontiers to increase the accuracy, robustness, and transparency of their analyses. Importantly, this Report recognizes that each agency faces its own particular context in conducting analysis and must consider its own authorities, resources, and other factors when deciding how best to incorporate a new frontier into its analyses. Agencies will continue to exercise judgment and rely on qualitative descriptions of effects when further quantification or monetization is not feasible or appropriate. When possible, this Report, aligned with federal guidance, encourages agencies to coordinate their research efforts, draw from the latest scholarship, and work together to advance the government’s analysis of costs and benefits across these high-impact categories of effects.

Chapter 1: Non-Fatal Health Effects

Description and Significance of Effects

Agency analyses of federal actions with significant health effects have historically focused attention more on changes in mortality risks than on changes in non-fatal health effects. A myriad of agency actions can affect public health: beyond actions by agencies with a specific mission to improve health, health effects can arise from agency actions ranging from housing and education to land management. Across agency analyses, changes in mortality risk have often been more readily and more fully quantified and monetized with existing methods (e.g., through application of estimates of the Value of Statistical Life, or VSL) than changes in non-fatal health risks.³ For many federal actions, premature mortality effects are also likely to be the health effect of greatest magnitude and public salience. However, key non-fatal health effects may affect more people. The public salience of non-fatal health effects may also increase over time,⁴ especially because they may affect the overall distribution of the benefits and costs of federal action.⁵ Agency analysts identified many non-fatal health effects as challenging to fully monetize or quantify (see Appendix for a list of identified effects). This chapter explores a subset of these challenges.

Advances in knowledge are allowing agencies to increasingly quantify and monetize non-fatal effects for certain major cardiopulmonary diseases and cancers. Additional agency priorities for expanded valuation include non-fatal effects involving the endocrine system (e.g., diabetes, hormonal disorders), reproductive health (e.g., infertility, low birthweight), the hepatic system (liver), and neurodevelopment (e.g., ADHD, dementia). Mental health effects—including the incidence of such effects across population categories, and across a range of causal factors from physical health to extreme weather disruptions—is also a high priority for more quantitative analysis. Subclinical health effects, such as how health effects spill into labor productivity, school disruptions, and even criminal activity, are also currently difficult to quantify, and could be crucial for understanding the overall magnitude and distribution of the benefits and costs of federal action.

Assessing the incidence of such health effects is critical, both to capture the distribution of costs and benefits, and because different populations across income levels, race, age cohorts, or other groupings may have different underlying risks and sensitivities to certain health effects. For worker health and safety, for example, certain symptoms (like fatigue) or subclinical spillovers (like productivity) could be especially relevant, and risks can also vary by industry.

Current Challenges

This section, though not comprehensive, overviews some recurring obstacles that agencies may face when analyzing non-fatal health effects. Data gaps are a common challenge to quantifying health effects (Box 1; Appendix Table 1).

³ See Richard L. Revesz, “Quantifying Regulatory Benefits,” *California Law Review* 102, no. 6 (2014): 1423-56 (contrasting, for example, the prominence of the VSL in analyses with harder-to-monetize health effects like anxiety and stress).

⁴ As one example, the public discourse over Covid-19 initially focused more on mortality risks but now increasingly focuses also on the morbidities associated with “long Covid.” See, e.g., Dzifa Adjaye-Gbewonyo et al., “Long COVID in Adults: United States, 2022,” *NCHS Data Brief* no. 480 (Sept. 2023).

⁵ See, e.g., U.S. Environmental Protection Agency, *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* 63 (June 2016), https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf (identifying the lack of monetized benefits for some health endpoints as a challenge for preparing EJ and distributional analyses).

Box 1. Non-Fatal Health Effects: Key Data Gap Examples. *This list is not exhaustive.*

- Dose-response functions for non-cancer health effects at low doses
- Biomonitoring data for quantifying exposures
- Baseline information on health risk and susceptibility by population groups
- Exposure data for emerging contaminants across different population groups
- Evaluations connecting specific policy interventions (e.g., training or education programs) to outcomes like reduced safety or health risks
- Valuation data for welfare losses (beyond cost of illness) such as low birth weight, neurodevelopment outcomes, liver disease, mental health effects
- Cost-of-illness measures that include caregiver time costs, costs of co-morbidities, complications and causally related morbidities
- Worker safety and health for specific populations

For example, agencies may lack dose-response functions⁶ to describe the relationship between exposures and health outcomes, especially for non-cancer effects or when low-dose human data is not available. As many risk assessments, toxicology studies, and other literature focus on identifying a single exposure level below which no adverse health effects are likely to occur (e.g., the reference dose), analysts may lack the data on risks of non-fatal health effects across a wider range of exposure levels affected by federal actions.⁷ Agencies would also benefit from more highly resolved biomonitoring data, which may, for example, be a more complete surrogate for risk across exposed populations than ambient concentrations of pollutants alone. Data are also needed to help support distributional analyses, including baseline information on different populations' exposure to environmental, food-borne, occupational, or other hazards and their underlying health risks and susceptibilities. While evidence of effectiveness for some types of interventions are robust, agencies lack sufficient data to establish causal links on how some programs, like those that support training and education programs, may affect the risk of specific health and safety outcomes.

Data challenges also affect monetization of health effects. While data on direct medical expenditures are often available for some morbidities, such cost of illness studies omit other significant costs of poor health. Such cost of illness estimates could be supplemented with measurements of caregiver time costs and the costs of co-morbidities and complications, such as when myocardial infarction leads to depression and so triggers new medical expenses. Moreover, new willingness-to-pay (WTP) or willingness-to-accept (WTA) studies could provide insight regarding the value of avoiding the risk of personal welfare losses—beyond the cost of illness—for morbidities like low birthweight, neurodevelopment outcomes, liver disease, and mental health effects.

Efforts to expand quantification and monetization of non-fatal health effects will also need to address important methodological challenges, including:

- Accounting for latency periods between exposures and outcomes, and measuring and valuing the experience of dread that could occur during latency or remission periods (while attending to the possibility of double-counting if such effects were captured in the health outcome's valuation);
- Identifying social determinants of health, like health care access, that may lead to different dose-response relationships across population groups;

⁶ In addition to single dose-response functions, exposure to mixtures of contaminants, especially when the co-occurrence of certain contaminants may lead to a non-linear response health effect, are not well understood.

⁷ See Al McGartland et al., "Estimating the Health Benefits of Environmental Regulations," *Science* 357, no. 6350 (2017): 457-58.

- Forecasting future safety benefits based on retrospective incidents (see Chapter 7 on Risk Analysis for more on challenges of predicting emerging risks that may have limited precedent);
- Approximating control groups for worker safety studies (because, for example, it would be unethical to selectively deprive some workers of safety protections for the purposes of a study);
- Incorporating in appropriate contexts relevant evidence of expenditures to avoid exposure or prevent health effects, which may provide some lower-bound valuations; and
- Exploring whether, when, and how cost-of-illness measures can be combined with private willingness-to-pay measures, given that the individual experiencing the health effect may not be the party paying for the health care.

Relevant Federal Guidance and Examples

Guidance: Current OMB guidance to federal agencies⁸ provides some relevant recommendations for addressing the challenges agencies face in fully monetizing non-fatal health effects. For example, federal guidance reminds agencies that the private WTP to avoid non-fatal health effects may be a distinct valuation from the externalities associated with poor health, which may include medical costs and lost economic production. Agencies are encouraged, when monetization of a specific effect is not available, to consider using available clinical literature that may reveal how patients and providers value health states in terms of measures like health utility or quality-adjusted life-years (which then may be monetizable).⁹ OMB’s Circular No. A-4 also provides guidance on benefit-transfer methodologies, including criteria for when benefit-transfer may be more or less appropriate. When considering a benefit-transfer from, for example, a water quality study on one body of water to value water-mediated health effects at another waterbody, or from one population’s willingness-to-pay to prevent health risks to another population, agencies should compare how similar the study context and policy context are. By transferring a study’s *function*, instead of just transferring a single point estimate, agencies may be able to represent and address some differences between the study and policy contexts through adjustments in the function.

Examples: Some agencies have made recent advances that provide useful examples to address identified challenges. For example, HHS matched symptoms of mild, severe, and critical cases of COVID-19 with available valuations of diseases with relevant symptoms to develop a value of avoiding a statistical case of COVID-19.¹⁰ The methodology HHS followed could provide a playbook for agencies in measuring the costs or benefits of addressing future novel diseases.

Some agencies have developed specific databases or valuations of particular relevance to their analyses, which may be useful to other agencies facing data challenges. For example, USDA hosts a database on the cost of particular foodborne illnesses,¹¹ and FDA regularly updates its model to estimate the economic costs of particular foodborne illnesses.

⁸ Office of Management & Budget, *Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94.pdf>.

⁹ See, e.g., Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* n. 6 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf> (citing “Cost-Effectiveness Analysis (CEA) Registry,” Center for the Evaluation of Value and Risk in Health, <https://cevr.tuftsmedicalcenter.org/databases/cea-registry>). However, as noted in Circular No. A-4, a main drawback of monetizing such values is that they must meet some restrictive assumptions to represent a valid measure of individual preferences, and analysts should acknowledge assumptions and the limitations of these estimates. *Id.* at 49.

¹⁰ Lisa A. Robinson, Michael R. Eber, and James K. Hammitt, *Valuing COVID-19 Mortality and Morbidity Risk Reductions in U.S. Department of Health and Human Services Regulatory Impact Analyses* 9-10 (July 2021), <https://aspe.hhs.gov/reports/valuing-covid-19-risk-reductions-hhs-rias>.

¹¹ “Cost Estimates of Foodborne Illnesses,” U.S. Department of Agriculture, Economic Research Service, <https://www.ers.usda.gov/data-products/cost-estimates-of-foodborne-illnesses/cost-estimates-of-foodborne-illnesses/>.

Advancing This Frontier

Agencies are advancing new activities over the next few years that will help address some of the data gaps and methodological needs to more fully monetize non-fatal health effects. The examples below reflect a non-exhaustive subset of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to addressing additional challenges. In particular, EPA has multiple active workstreams related to non-fatal health effects. EPA is also collaborating with many other partners on an OECD-led effort to generate new valuations for up to ten non-fatal health effects over the next few years.¹² Finally, in several recent proposed rulemakings, EPA has quantified and valued certain health effects for the first time, and is seeking public comment on these methods. For example, EPA has proposed for the first time a valuation of birthweight effects.¹³

¹² For additional information and valuation estimates generated by OECD’s Surveys on Willingness to Pay to Avoid Negative Chemicals-related Health Effects (SWACHE) project, see “The Costs and Benefits of Regulating Chemicals,” Organisation for Economic Co-operation and Development, <https://www.oecd.org/chemicalsafety/costs-benefits-chemicals-regulation.htm>.

¹³ Environmental Protection Agency, *PFAS National Primary Drinking Water Regulation Rulemaking*, 88 Fed. Reg. 18,638 (Mar. 29, 2023).

Chapter 2: Ecosystem Services Effects

Description and Significance of Effects

Ecosystem services are contributions to human welfare from the environment or ecosystems such as water purification or flood mitigation. Regulations, programs, and other federal actions can affect ecosystem services by enhancing or degrading natural, built, or social systems, and analyses should reflect these effects when feasible and appropriate. Ecosystem services effects can arise from policies or programs related to natural resource management and conservation, and these are the areas where these effects have been analyzed most commonly to date. Ecosystem services effects can also arise from agency decisions regarding housing and urban development, transportation and other infrastructure, risk reduction and emergency management, health concerns (especially through social determinants of disease, pollution, and climate-related health risks), and national security.

Data and methods for estimating ecosystem services effects of some actions have been better developed than for others. Agencies are interested in improving or expanding analyses of effects from some types of actions, including habitat designations or other efforts focused on species protection or recovery, and allocations of fishery catches among sectors (e.g., recreational, commercial, subsistence, Tribal Nations and Indigenous Peoples). In addition, some ecosystem services have been more extensively studied in some systems than in others. Agencies seek increased understanding of how changes in coastal and marine habitats and soils affect climate mitigation (carbon storage and sequestration), recreational use, existence values, and Tribal Nations and Indigenous Peoples use values, which have been more extensively studied in terrestrial systems. There is also interest in better understanding how riverine, coastal, or wetland management affects flood risk, non-fatal health effects of storms, indirect loss of life from floods or storms, and return to normalcy following storm events. Multiple agencies aim to more fully reflect effects on subsistence uses, including the use of fish and other wildlife and plant products. Increased climate change impacts are heightening agency attention to the effects on mental health including climate anxiety due to extreme weather disasters.

Agencies' ability to fully reflect ecosystem services effects influences their ability to fully account for the benefits gained from investments in preservation, conservation, and restoration —like those made towards achieving the goals of the America the Beautiful initiative.¹⁴ Challenges to fully considering ecosystem services effects related to climate mitigation (e.g., forest regrowth and coastal habitat or seafloor carbon storage effects) and adaptation (e.g., flood risk reduction, mental health effects, recovery costs) may limit agencies' ability to effectively and efficiently advance climate goals and install resilient infrastructure. In this chapter, we highlight some of the ecosystem services effects identified by multiple agencies as challenging to fully monetize or quantify (see also Appendix Table 2). This is not a comprehensive list of ecosystem service costs and benefits, but rather a subset of those that currently present challenges in analysis.

Current Challenges

Some agencies reported that some ecosystem services effects, despite their relevance, are difficult to fully monetize or quantify. Data gaps were the most common challenges identified for fully valuing ecosystem services effects (Box 2; Appendix Table 2). Some of the identified data challenges relate to gaps in environmental data needed to estimate how a federal action may affect an ecosystem that underpins an ecosystem service (Box 2: Ecological data). Other data are needed to better estimate how environmental changes affect human welfare, or to estimate people's preferences or behavior changes relevant to ecosystem services (Box 2: Ecological-economic data). In several cases, data may exist at a coarse

¹⁴ See U.S. Department of the Interior et al., *Conserving and Restoring America the Beautiful* (2021), <https://www.doi.gov/sites/doi.gov/files/report-conserving-and-restoring-america-the-beautiful-2021.pdf>.

Box 2. Ecosystem Services Effects: Key Data Gap Examples. *This list is not exhaustive.*

Ecological Data

- Habitat extents for understudied habitats (e.g., deep sea coral)
- Baseline surface water quality data (to estimate effects and calibrate models used for estimating effects)
- Carbon storage and sequestration data for specific coastal habitats and peatland forests (data, or estimation model to relate habitat changes to carbon changes)
- Effects of various levels of antibiotic use on ecosystem elements or processes related to disease prevention, agricultural productivity, species existence
- Relationship between wetlands and other natural features and flood risk reduction

Ecological-economic Data

- Existence values for specific endangered species and habitats
- Relationship between population size changes for some species (e.g., whales) and any benefits
- Incidence of mental health effects from storm events of different magnitudes and other extreme weather
- Preferences for Tribal Nations and Indigenous Peoples cultural uses of coral reefs
- Subsistence fish use rates (total, and by user group)
- Fisher behavior changes in response to fishery quota changes
- Dose-response functions for health effects from water quality changes

resolution, for a few specific locations, or for the entire affected population, but not for specific regions or groups of people. These gaps limit agencies’ ability to assess national-scale effects, and to explore distributional impacts of a federal action.

Agency analysts identified additional challenges with methods or resource issues, such as insufficient data on monetizing existence values (how people value the existence of places or species, unlinked to their seeing or experiencing it themselves). The current dominant method for monetizing changes in existence values relies on stated preference studies, and new studies can be costly and time consuming. In another methodological challenge, some agencies noted the use of different definitions of, for example, “subsistence fishing” (also called cultural or customary use) across agencies. Standardization of definitions, methods, and metrics for subsistence, cultural, or customary uses across agencies would facilitate better analysis of these effects. When agencies consider flood risk reduction effects from coastal habitat changes, the current method of using property values can under-represent effects on low-income communities. For some agencies, these challenges lead to effects being partially monetized, partially quantified, or described largely qualitatively in current analyses (see Appendix Table 2).

Relevant Federal Guidance and Examples

Guidance: Forthcoming OMB guidance to federal agencies on ecosystem services¹⁵ provides recommendations for addressing some of the challenges identified by agencies. For example, many of the challenges relate to a lack of data. The draft guidance notes that when baseline information is not available for certain ecosystem services effects, the models used for evaluating alternatives can often be applied to estimate baseline conditions and provide a relevant comparison, as model input data (e.g., biophysical or social conditions) may be more readily available than directly observed ecosystem-service data. Another common approach for valuing ecosystem service changes in data-limited settings is to apply benefit-transfer

¹⁵ Office of Management & Budget, *Request for Comments on Proposed Guidance for Assessing Changes in Environmental and Ecosystem Services in Benefit-Cost Analysis*, 88 Fed. Reg. 50,912 (Aug. 2, 2023).

methods. The draft guidance emphasizes using benefit-function transfer that reflect important features (e.g., biophysical or social characteristics that affect the ecosystem service of interest), rather than using benefit-point transfer, or simple, area-based transfers that can misrepresent the magnitude of effects. The draft guidance also notes that some ecosystem services effects are already captured through common methods used for valuation of other effects. This is especially true when an ecosystem service is an input to a commonly-valued effect, such as agricultural production (where ecosystem services such as pollination can be an input). As a further example, ecosystem services (such as reduced flooding or climate stabilization) can be inputs to mental health, but such mental health outcomes may be embedded in intervention-relevant WTP or WTA estimates and thus not appropriate for *separately* being added into benefit or cost tallies. In these cases, analysts should avoid double counting that can occur if these ecosystem services are valued both directly and as part of estimates of other costs or benefits.

The forthcoming OMB guidance may also be helpful in addressing one of the main methodological challenges reported by agencies: the time and resource constraints of developing stated preference methods. The guidance suggests that alternate methods relying on existing market data (e.g., revealed preference methods) may be applicable and should be explored before determining that a new survey is necessary. For example, a policy that is expected to improve water quality may create property value benefits because some homeowners prefer to live on or look at cleaner water. Stated preference methods could be used to elicit homeowner preference for cleaner water, but similar estimates of homeowner preference for this specific ecosystem service could also be produced using hedonic pricing methods, if relevant market data are available.

Engagement with agencies also revealed that analysts may not be fully familiar with the ways in which federal actions can affect ecosystem services. The forthcoming OMB guidance provides useful examples and extensive appendices that describe how common types of policies and programs (e.g., housing, risk reduction and emergency management, infrastructure, waste management, energy production, public health and health care, and others) can affect specific ecosystem services. This may serve as a valuable resource for analysts less familiar with causal pathways related to these costs and benefits.

Examples: Regarding subsistence, customary, or cultural harvest, agencies noted a challenge with varying definitions, data, and methods across the federal family. USACE¹⁶ and EPA¹⁷ report having a definition of subsistence harvest that could serve as a starting reference point. Agencies provided examples¹⁸ of recent

¹⁶ U.S. Army Corps of Engineers, *Planning Guidance Notebook 3-3* (Apr. 22, 2000), https://www.publications.usace.army.mil/portals/76/publications/engineerregulations/er_1105-2-100.pdf (defining Subsistence Fishing as “the activity of individuals who fish primarily for personal or family consumption and whose incomes are normally at or below the minimum subsistence level established by the Department of Commerce”).

¹⁷ U.S. Environmental Protection Agency, *National Ecosystem Services Classification System (NESCS) Plus 127* (Dec. 2020), https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=350613&Lab=CEMM (differentiating between two beneficiary subclasses: “051. Water Subsisters - This Beneficiary relies on a wild source for drinking water and may use wells or cisterns for storage (i.e., they do not receive municipal drinking water).” and “052. Food and Medical Subsisters - This Beneficiary use the abundance of [edible] Flora, Fungi, and Fauna whether collecting, hunting, or fishing as a major supplement to their existence.”).

¹⁸ U.S. Army Corps of Engineers, *Final Interim Feasibility Report Environmental Assessment and Finding of No Significant Impact: Navigation Improvements Diomedes, Alaska* (June 2014), <https://www.poa.usace.army.mil/Portals/34/docs/civilworks/currentproj/DiomedesFeasibilityReport06022014.pdf> (evaluating effects on subsistence fishing); U.S. Environmental Protection Agency, *Benefit and Cost Analysis for Proposed Supplemental Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category 5-2* (Feb. 28, 2023), <https://www.epa.gov/system/files/documents/2023-03/steam-electric-benefit-cost-analysis-proposed-feb-2023.pdf> (evaluating effects on subsistence fishing, using assumptions to allow estimation of effects in a data-limited setting).

analyses that included effects on subsistence uses, and these and other agencies (e.g., DOC, DOI, USDA) could benefit from an interagency process to align definitions and methods.

Advancing This Frontier

Agencies are advancing new activities over the next few years that will help address some of the data gaps (Box 2) and methodological needs to more fully quantify and monetize ecosystem services effects. The examples below reflect a subset of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to remaining challenges.

- **System of Environmental Economic Statistics:** DOC, OSTP, and OMB have initiated a fifteen-year-long effort to establish a national system of environmental economic statistics.¹⁹ This effort will aggregate and align hundreds of data sources relevant to ecosystem service assessment. While a major purpose of this system is to support the production of national natural capital accounts, the data curated in this system will be a valuable resource for analysts conducting BCA. The aggregation of data through this system will also make it easier to identify data gaps.
- **Expanding data for valuing surface water quality changes:** EPA is fielding a national stated preference study that will estimate (1) the impact of a household’s distance from an improved resource on their WTP and (2) the relative importance of recreation value versus existence value when answering the valuation questions.²⁰ Survey administration and data analysis will be conducted through 2024.
- **Improving recreation visitation data:** EPA is testing new large-scale methods of revealed preference valuation using cellular device location datasets and remotely sensed visitation methods (car counts) combined with traditional intercept survey methods to estimate recreational use values. The methods would increase the temporal resolution of visitation data, and allow stronger modeling of how policy or program effects on the environment (e.g., water clarity changes) change visitation rates and associated costs and benefits. Starting in 2017, DOI and USDA’s Forest Service have developed a community of practice to share information about emerging issues and methods for developing data on recreational visitation.
- **Advancing models for valuing surface water quality changes:** EPA is developing an integrated assessment model²¹ for surface water quality improvements that will allow rapid assessment of resource management changes and resulting welfare impacts. EPA continues to work on important modifications before peer reviewing the model and making it publicly available for analysts.
- **Evaluating effects of climate change programs:** AmeriCorps’ research and evaluation program has initiated a study of climate-related programs that focus on education and training, disaster response, conservation, wildfire mitigation, and energy efficiency. The study will improve understanding of effects of these programs on ecosystem services, community resilience, and benefits to at-risk populations.

¹⁹ Office of Science and Technology Policy, Office of Management & Budget, and U.S. Department of Commerce, *National Strategy to Develop Statistics for Environmental-Economic Decisions* (Jan. 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/01/Natural-Capital-Accounting-Strategy-final.pdf>.

²⁰ U.S. Environmental Protection Agency, *Agency Information Collection Activities; Submission to the Office of Management and Budget for Review and Approval; Comment Request; Survey To Improve Economic Analysis of Surface Water Quality Changes (New)*, 88 Fed. Reg. 3405 (Jan. 19, 2023).

²¹ See Joel Corona et al., “An Integrated Assessment Model for Valuing Water Quality Changes in the United States,” *Land Economics* 96, no. 4 (2020): 478-92 (describing the model).

Chapter 3: Wildfire and Extreme Weather Effects

Description and Significance of Effects

A critical role of the federal government is to help communities avoid, prepare for, and respond to natural hazards and extreme events, like wildfires, floods, hurricanes, sea-level rise, drought, earthquakes, and extreme heat and cold. Effective government actions can limit the extent to which these hazards translate into harms when they do occur. Many resources exist to help communities reduce risks before hazards happen, such as adopting the latest consensus-based building codes and standards to reduce damage caused by hazard events, and restoring wetlands to manage extreme rainfall. Other efforts focus on supporting communities to recover and build resilience in the wake of events.

As the climate is changing, extreme events are increasing in frequency and intensity. Agencies are developing and implementing regulations, programs, and projects to help communities respond and adapt.²² Measuring the costs and benefits of efforts to address extreme events can help agencies identify the most efficient regulatory and programmatic alternatives. Multiple agency analysts identified challenges associated with quantifying the benefits and costs of disaster relief, risk reduction, or resilience-building programs. Without reliable and consistent estimates of costs and benefits, it remains difficult to determine which programs generate the greatest positive social returns. The pressure to design regulations and programs to maximize net gains for society will likely rise as climate change increases the scale of and demand for government actions. Agency analysts identified current challenges with analyzing the effects of managing a subset of natural hazards and extreme events, emphasizing challenges related to wildfire and extreme weather. This does not cover the full range of effects relevant to natural hazards, but focuses in on a subset of those identified as priorities for expanded quantification or monetization.

Current Challenges

In recent years, the frequency and severity of wildfires and other extreme weather effects have attracted more public attention and spurred more government action.²³ To some extent, the research community may already be starting to respond by ramping up research efforts on events like wildfires.²⁴ Nevertheless, the Subcommittee determined that these effects merited specific designation as a Focal Category due to their heightened public salience, wide-ranging relevance to future agency actions, and continued data gaps and other methodological challenges.

The most common challenge identified for analyzing effects of extreme events is quantifying and monetizing the benefits of federal actions to manage these hazards (see Appendix Table 3). Some agencies identified data gaps (Box 3) and technical modeling challenges as obstacles to fully monetizing these

²² See, e.g., “FACT SHEET: Biden-Harris Administration Hosts First-Ever White House Climate Resilience Summit and Releases National Climate Resilience Framework,” The White House, <https://www.whitehouse.gov/briefing-room/statements-releases/2023/09/28/fact-sheet-biden-harris-administration-hosts-first-ever-white-house-climate-resilience-summit-and-releases-national-climate-resilience-framework/>.

²³ See, e.g., Wildland Fire Mitigation and Management Commission, *ON FIRE: The Report of the Wildland Fire Mitigation and Management Commission 1*, 254 (Sept. 2023), <https://www.usda.gov/sites/default/files/documents/wfinmc-final-report-09-2023.pdf> (declaring that “[t]he wildfire crisis in the United States is urgent, severe, and far reaching” and recommending that, among many other steps, “[a] periodic review of the wildfire mitigation and management system should include a quantitative analysis of changes in both the built and natural environments, the intersection between wildfire and public health, and the impact of those changes to pre-fire mitigation, incident response, and proactive recovery.”).

²⁴ See, e.g., “Wildland Fire Research: Health Effects Research,” U.S. Environmental Protection Agency, <https://www.epa.gov/air-research/wildland-fire-research-health-effects-research>; “Fire Research,” U.S. Forest Service, U.S. Department of Agriculture, <https://www.fs.usda.gov/science-technology/fire/fire-research>; “Wildfires: Science With and For Society,” National Center for Atmospheric Research, <https://ncar.ucar.edu/wildfires>.

benefits. In general, monetization of these benefits requires complex modeling that integrates baseline hazard risks, the attributable impact of government action on these risks, and a full accounting of harms that result with and without the government action.

Box 3. Wildfire & Extreme Weather Effects: Key Data Gap Examples.

This list is not exhaustive.

- Temporally current, geographically complete, and consistent information on monetized benefits of wildfire management
- Approaches for assessing currently non-monetized benefits of wildfire management
- An approach to determine effects attributable to specific wildfire management actions (e.g., preparedness, fuels management, suppression, post-fire stabilization and recovery), given the complementary and substitutability among some actions
- Wildfire modeling to develop counterfactual scenarios to compare effects with and without wildfire management
- Data on wildland fire management costs at all phases (fuels treatment, readiness, fire suppression, post-wildfire recovery), disaggregated by source (e.g., federal, state, private)
- Data on relationship between wildfire characteristics (e.g., intensity, acreage, proximity to population centers and other values at risk) and wildfire management costs (federal, state, Tribal Nations and Indigenous Peoples, private)
- Incidence of health impacts from flood and coastal storm events of different magnitudes
- Valuation data on health impacts of flood and coastal storm events
- Incidence and temporal patterns in educational disruption post-extreme events
- Valuation data on community cohesiveness
- Data on levels of building protections sufficient to reduce climate-affected flood risks
- Data on impact of extreme events on income and livelihood options

Characterizing the risk of a hazard occurring under baseline and with-action scenarios is a key difficulty. For example, in some cases, agencies face data gaps on the distribution of current hazard risks for historically rare disasters, a result of such events occurring so infrequently in the past that it is difficult to estimate their future likelihood. In other cases, agencies identified that historical data on risks are becoming less useful for representing current risks, due to shifts in the climate that in turn shift the distribution of hazard probabilities. For more on these issues, see Chapter 7 on Analyzing Risk.

Connecting specific federal actions with changes in risk and specific outcomes is a challenge for quantification of costs and benefits. In the case of wildfires, for example, analysis of benefits (and avoided costs) can be limited by difficulty attributing changes in actual or potential wildfire impacts to specific management actions. Complete and consistent accounting is also difficult for fire costs and impacts (actual or potential, particularly ecosystem services impacts or those not easily monetized).²⁵ Data gaps similarly affect the ability to estimate how different levels of building protections may reduce flood risks. Accounting for human behavior can also create methodological challenges in this area, as individuals may take additional risks or not purchase sufficient private insurance either in the baseline or in the action scenarios in anticipation of federal actions to protect them from the consequences of such risks.

²⁵ For a discussion of wildfire suppression costs and impacts on ecosystem services see Michele R. Crist et al., “Trends, Impacts, and Cost of Catastrophic and Frequent Wildfires in the Sagebrush Biome,” *Rangeland Ecology & Management* 89 (2023): 3-19.

Another widespread challenge is the enumeration of harms or costs under any condition, requiring that estimates either capture a limited subset of effects, or rely heavily on strong assumptions to impute missing categories of harm or cost. As an example, it can be difficult to quantify the health impacts of wildfire, as well as the health and safety risks to fire personnel, making it difficult to quantify the corresponding net health and safety benefits attributable to various fire management actions. Other wildfire effects such as changes in aesthetics and impacts on recreation are highly site-specific, making incorporation of those effects potentially challenging. Agencies could benefit from richer data on how extreme events like fires, floods, and coastal storms of different magnitudes cause disruptions to education, family stability, health, and other effects, and how to value such consequences.

Challenges also arise with characterizing the distribution of both benefits and costs. For example, when extreme weather effects can be monetized, such estimates may exist only for the general population, and not for different segments of the population. On the cost side, it may be difficult to fully differentiate wildfire management costs, for example, among Tribal Nations and Indigenous Peoples, territorial, federal, state, and local agency sources, private insurers, and households—which can limit agencies’ ability to isolate the federal costs of certain actions.

In multiple cases, agencies reported facing several of these challenges, such that a full monetization would require surmounting multiple challenges simultaneously.

Relevant Federal Guidance and Examples

Guidance: Much of the guidance discussed in other chapters—such as Analyzing Risks, Ecosystem Services Effects, and even the Effects of Public Benefit Programs (as it may relate to government-backed insurance)—may be relevant for valuing costs and benefits on this topic as well.

Examples: Recent agency advances provide some useful starting points for addressing certain challenges to fully monetizing the effects of extreme weather events. For example, with respect to challenges with fully accounting for the costs and benefits of coastal storm and flood events, FEMA’s Hazard Mitigation Assistance program has developed a toolkit for estimating the benefits from various mitigation activities for certain non-residential and residential buildings.²⁶ These benefits include avoided property damages from flood inundation (including from coastal storms), avoided displacement (costs incurred while staying in a temporary location), and avoided loss to a community from a lack of critical services. The toolkit may provide a useful starting point for the expansion of estimates related to other effects from coastal storms and floods.

To effectively fill some data gaps, other agencies have combined diverse data sources from government, non-governmental organizations, and the private sector, while ensuring data quality and privacy, to expand their understanding of flood and fire risks.²⁷ In addition, the United States collects and reports disaster loss data as part of the Sendai Framework for Disaster Risk Reduction.²⁸ The Sendai Framework outlines seven global targets and 38 data indicators to measure progress towards these targets. These metrics provide a useful reference for assessing the effects of wildfire and extreme events, but are also difficult to collect.²⁹

²⁶ See “Benefit-Cost Analysis,” Federal Emergency Management Agency, <https://www.fema.gov/grants/tools/benefit-cost-analysis>.

²⁷ For an example of private data that can inform flood and fire risks, see “Risk Statistics Available for Purchase,” First Street Foundation, <https://firststreet.org/data-access/paid-access/> (providing “property-level data for flooding, wildfire, wind, and extreme heat risk.”).

²⁸ For information on the Sendai Framework for Disaster Risk Reduction, see “What is the Sendai Framework for Disaster Risk Reduction?,” United Nations Office for Disaster Risk Reduction, <https://www.undrr.org/implementing-sendai-framework/what-sendai-framework>.

²⁹ See Aleeza Wilkins et al., “Challenges and Opportunities for Sendai Framework Disaster Loss Reporting in the United States,” *Progress in Disaster Science* 10 (2021): 1-9.

As agencies aim to monetize the effects of wildfire and extreme events under future climate conditions that often diverge from historic conditions, a recent analysis led by OMB may be helpful. Responding to Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,”³⁰ OMB evaluated the fiscal risks to the federal government of climate change and subsequently has worked with agencies to conduct a variety of assessments that monetize different impacts of climate change on federal programs and financial commitments. The data and analytical methods used by OMB may inform some of the analytic challenges facing the agencies.

Advancing This Frontier

Agencies are advancing new activities over the next few years that will help address some of the data gaps (Box 3) and methodological needs to more fully monetize effects of wildfire and extreme events. The examples below reflect a subset of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to additional challenges.

- **Wildfire effects on Tribal Nations and Indigenous Peoples communities:** USGS (with support from Interior’s Bureau of Indian Affairs, BIA) is producing a study on wildfire effects on cultural resources in a Tribal Nations and Indigenous Peoples context. This project was motivated by the need for improved risk assessments, with better methods of evaluating values at risk. The value of cultural uses of fire extends beyond the benefits of fuel treatments, also embracing language, sense of community, and cultural continuity. One focus common to the USGS projects described in this section is improving the temporal aspect of risk assessment, by, for example, incorporating recovery curves to examine the difference between resource impacts during a fire and in post-fire years.
- **Looking beyond built infrastructure to natural resource values at risk:** DoD has funded USGS to examine the fire-risk effects to land-use benefits. While the BIA example above has a more qualitative focus, this project has a more quantitative focus on the ability to meet DoD’s mission while managing natural resources in specific areas. The project relies on data from usage logs to develop supply and demand schedules for eventual valuation. Interactions between fire and weather is another aspect of this project. The project uses a modular approach to update risk assessments as data become available.
- **Effects of specific fire management actions:** USGS is undertaking a study to examine the effectiveness of fuel treatments, fire hazard modeling, and classification of values at risk. Initial work planned for 2024 includes identifying and addressing data gaps. The current approach to valuation relies on expert elicitation, which could be strengthened with more data. To help meet monitoring, maintenance, and treatment plan requirements of the Infrastructure Investment and Jobs Act of 2021 (commonly known as the Bipartisan Infrastructure Law), the USGS inventoried existing wildfire hazard and risk assessments and created an interactive web application, the Wildfire Hazard and Risk Assessment Clearinghouse.³¹ Variation among the assessments in the clearinghouse demonstrates that while they provide baseline information to evaluate and identify existing hazard and risk assessment gaps, no assessment perfectly represents all lands or values at risk.
- **Improving data on extreme weather risks:** NOAA is working with the Census Bureau to determine how information about weather events (or lack of information) affects an area’s preparedness for the event. Increased precision of information can be beneficial to avoid impacts

³⁰ Executive Office of the President, *Tackling the Climate Crisis at Home and Abroad*, 86 Fed. Reg. 7619 (Feb. 1, 2021).

³¹ “USGS Wildfire Hazard and Risk Assessment Clearinghouse,” U.S. Department of the Interior, https://apps.usgs.gov/wildfire_hazard_and_risk_assessment_clearinghouse.

from extreme weather, such as droughts and tornadoes. This study will provide crucial information that will help better define which communities need to prepare for an environmental disaster.

- **Hazards and natural capital accounting:** The Administration is developing multiple accounts as part of implementing the *National Strategy to Develop Statistics for Environmental-Economic Decisions*, which includes a call for the development of a satellite account on natural capital related hazards, extreme weather and climate events, and resilience to improve our understanding of hazard recovery costs.

Chapter 4: Information and Transparency Effects

Description and Significance of Effects

An important function of the government is to provide information to its citizens, enhancing their understanding and empowering them to make better-informed decisions. In some cases, people may lack sufficient information (i.e., imperfect information), or certain parties may have key information that others do not have access to (i.e., asymmetric information). As a result, people may make under-informed decisions in a variety of circumstances, from real estate or insurance transactions, to health care decisions—and overall public welfare suffers. Agencies across the federal government regularly explore regulations, projects, and programs that increase transparency and facilitate the generation and sharing of knowledge.³² As agencies evaluate such options, they need to understand and predict how changes in information will create social costs and benefits. In this section, we highlight some of the effects related to changes in information and transparency that are challenging to fully monetize or quantify (see Appendix Table 4 for the full list). This is not a comprehensive list, but rather a subset of current key issues.

Current Challenges

Some agencies reported that quantifying the value of changes in information is challenging. As a result, the benefits of improved information are often discussed qualitatively or partially quantified in analyses. Agency analysts identified three major areas for advancement: accurate and transparent consumer information, contract transparency, and valuing the benefits of information to the broader public.

One set of challenges concerns valuing accurate and transparent consumer information in various markets for goods or services. In one example, agency analyses would benefit from improved understanding of whether and how consumers make sub-optimal decisions based on the asymmetric or imperfect information available to them. This understanding would improve estimates of how much or when additional information will improve consumer decisions and so create benefits. Relatedly, imperfect information or asymmetries could distort producers' or consumers' market behavior and may so may bias willingness-to-pay estimates drawn from market data. Better understanding the relationship between fuller information and consumer actions could therefore improve a variety of willingness-to-pay estimates.

A second set of challenges relates to valuing the benefits of improved contract transparency, both for consumers and for producers. While consumer-facing agencies are aware that asymmetric information related to trusted professionals and fiduciaries can create conflicts of interests, there are seldom sufficient data to quantify the effect of improving access to information (Box 4). The same is true of the lack of transparency within contract markets. Asymmetric or incomplete information within contracts can lead to parties to the contract making less than optimal decisions; however, quantifying the extent of the efficiency improvement related to increasing transparency is difficult given existing data and tools. In addition, agencies also highlighted transparency regarding data privacy and cybersecurity as an increasingly important feature that is challenging to quantitatively value. In all cases, the benefits of additional transparency are difficult to quantify due to a lack of data relevant to these situations.

³² Though both market producers and consumers have some incentives to generate or demand information, information may be a public good that markets will often, on their own, under-invest in producing. This is because information can be costly to produce but, once public, those who bore the upfront costs of generating the information cannot necessarily exclude others from enjoying the benefits. Government action can help overcome this disincentive to invest in informational public goods.

Box 4. Information and Transparency Effects: Key Data Gap Examples.

This list is not exhaustive.

- Baseline evaluations on development of AI and effects on society
- Magnitude and frequency of conflicts of interest in fiduciary contracts
- Value of enhanced reporting by employee benefit plans
- Consumer preferences for goods like organic produce and sustainable fish, and the rate of fraudulent labels
- Quantity of illegal fish entering the fish market in the United States
- Investment advisors' contracts and advice given
- Baseline information on consumer choice and potential “mistakes” in consumption decisions
- Compliance to price transparency regulations of firms in all industries
- Correlation between public decision-making and increased information

Finally, it can be challenging to quantify the value of information that benefits the broader public. Specific examples include information describing location-specific environmental risks, the effects of technological advances including but not limited to artificial intelligence (AI), and transparency in pay and benefits.³³

Information can also have costs that may be difficult to quantify or monetize, including the costs associated with the time and effort spent generating and processing new information. Simplification of disclosures, forms, and other kinds of paperwork can therefore have cost-savings that may be important, but currently may be difficult to quantify.³⁴

Relevant Federal Guidance and Examples

Current OMB guidance to federal agencies³⁵ suggests that some of the above challenges can be addressed by using market data to examine, when feasible, the extent to which improved information may help lower costs or increase benefits for consumers. For example, the Department of Education took this approach in a recent rulemaking,³⁶ taking advantage of market data on earnings outcomes for different postsecondary programs and using other research to estimate how improved information would shift enrollment choices. Similarly, the Department of Housing and Urban Development (HUD) examined the extent to which better information helps improve bower outcomes.³⁷

³³ The public also benefits when resource-management agencies have access to more and better information to inform management decisions. This includes reduced management costs as well as public health, safety, and avoided societal costs related to the hazards discussed in Chapter 3. For an overview of the topic, see U.S. Geological Survey, *The Value of Scientific Information—An Overview* (2023), <https://pubs.usgs.gov/of/2023/1011/ofr20231011.pdf>.

³⁴ See, e.g., Harold Bunce et al., “The Impact of Mortgage Disclosure Reform Under RESPA,” *Cityscape: A Journal of Policy Development and Research* 11, no. 2 (2009): 117-36 (discussing the value of simplifying complex information to reduce asymmetry between consumer and seller, such as with mortgage products). See also Susan E. Woodward and Robert E. Hall, “Consumer Confusion in the Mortgage Market: Evidence of Less than a Perfectly Transparent and Competitive Market,” *American Economic Review* 100, no. 2 (2010): 511-15.

³⁵ Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>; Office of Management & Budget, *Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94.pdf>.

³⁶ U.S. Department of Education, *Financial Value Transparency and Gainful Employment (GE), Financial Responsibility, Administrative Capability, Certification Procedures, Ability to Benefit (ATB)*, 88 Fed. Reg. 32,300 (May 19, 2023).

³⁷ “HUD First-time Homebuyer Study,” U.S. Department of Housing and Urban Development, https://www.huduser.gov/portal/hud_firsttime_hmbyr_study.html.

More generally, OIRA released a memorandum on *Disclosure and Simplification as Regulatory Tools* in 2010 that provided guidance on how agencies could use experimentation, pilot programs, and other *ex ante* studies—as well as *ex post* retrospective studies—to assess the costs and benefits of information provision, including both how the disclosure may affect consumer welfare and the harder-to-quantify value of informed choice itself. This excerpt reflects some of the memorandum’s relevant guidance:

To the extent feasible, and when existing knowledge is inadequate, agencies should consider several alternative methods of disclosure and test them before imposing a disclosure requirement. Scientifically valid experiments are generally preferable to focus group testing, and randomized experiments can be especially valuable. When focus groups are used, they should attempt to elicit information about actual choices and behavior (rather than simply reactions to or preferences for labels and formats). Consultation with experts can also be a valuable supplement to focus group testing.

Consistent with available resources, an agency requiring or making a disclosure should also consider performing market surveys or research to determine whether the desired effect is being achieved. These studies should determine whether users are aware of the disclosure, whether they understand the disclosure, whether they remember the relevant information when they need it, whether they have changed their behavior because of the disclosure, and, if so, how; agencies should consider the fact that improvements in welfare are a central goal of disclosure requirements, but should also note that informed choice is a value in itself (even if it is difficult to quantify that value).³⁸

Advancing This Frontier

Agencies are advancing new activities over the next few years that will help address some of the data gaps (Box 4) and methodological needs to more fully monetize effects of policies and programs that improve transparency and information. The examples below reflect a subset of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to additional challenge.

- **New Data Collection Methods:** NOAA, NASA, USGS, and the World Wildlife Fund launched a new consortium to create innovative methods to value Earth observations, such as satellite data.³⁹ This effort will provide new information to individuals, companies, nonprofits, and government agencies to better inform decisions on topics ranging from optimizing crop management to improving the efficiency of natural disaster responses.
- **New methods to estimate the baseline costs of cyberattacks:** DHS has been working to develop cost estimates of cyberattacks.⁴⁰ A key area of focus is valuing important direct and indirect social

³⁸ Office of Management & Budget, Office of Information & Regulatory Affairs, *Disclosure and Simplification as Regulatory Tools* 5-6 (June 18, 2010), https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/assets/inforeg/disclosure_principles.pdf. See also Office of Management & Budget, Office of Information & Regulatory Affairs, *Informing Consumers through Smart Disclosure* (September 8, 2011), https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/inforeg/inforeg/for-agencies/informing-consumers-through-smart-disclosure.pdf. As this language suggests, people may have a positive WTP for information independent of any behavioral changes the information prompts. Evidence may indicate, for example, that informed people may feel more confident in their decisions (even if those decisions do not change), may find other applications for the information, or may value the information for other reasons.

³⁹ See “New Consortium to Create Innovative Methods to Value Earth Observations,” National Aeronautics and Space Administration (June 13, 2023), <https://appliedsciences.nasa.gov/our-impact/news/new-consortium-create-innovative-methods-value-earth-observations>.

⁴⁰ U.S. Cybersecurity & Infrastructure Security Agency, *Cost of a Cyber Incident: Systematic Review and Cross-Validation* (Oct. 26, 2023), https://www.cisa.gov/sites/default/files/publications/CISA-OCE_Cost_of_Cyber_Incidents_Study-FINAL_508.pdf.

impacts related to cybersecurity, especially scenarios that consider downstream economic impacts of cyberattacks on suppliers, producers, and consumers. Part of the ongoing effort is to develop more tailored scenarios and methodology to account for potential loss of availability of specific critical infrastructure, transportation services, or information systems. Valuing social impacts from cyberattacks, which could shed light on the value of the information economy and cybersecurity, is still a further frontier to develop.⁴¹

⁴¹ During the development of this report, other important areas were identified for advancement including methodologies or frameworks to account for the value of privacy and the potential loss of confidentiality or integrity of information systems.

Chapter 5: Effects of Public Benefit Programs

Description and Significance of Effects

The federal government provides many public programs that deliver an array of direct benefits and services to individuals and families, such as nutritional support, housing subsidies, health insurance, and student aid programs, among many others. Analyses of such public benefit programs and the laws shaping them sometimes focus on the monetary transfer involved from the government to individuals, or the government's costs in administering the program. Though those kinds of effects are important, the real-world consequences of such programs extend far beyond those effects. Notably, families, neighbors, or broader communities of recipients could experience positive or negative externalities from such programs. For example, housing subsidies could contribute to familial and neighborhood stability, which could in turn yield positive community spillover effects. Also, if the recipients of the programs experience credit constraints or other such financial frictions, they may enjoy long-term benefits to health or income in ways that exceed the initial monetary value of the direct financial transfer. For example, nutritional support can lead to long-term benefits from educational gains and related wage growth that can exceed program costs.⁴² In addition, applicants may face paperwork costs and other barriers to accessing the program in ways not always captured in traditional estimates of costs. Finally, the government incurs costs associated with administering the specific benefit program, but may also gain cost-savings or spillover effects to other programs. For example, if housing subsidies contribute to job stability and wages that allow recipients to better manage their nutrition and health, the government may subsequently save money on other nutrition and health programs.

Some agencies reported a range of common challenges in valuing the impacts of such programs. In this section, we highlight some of the effects related to public benefit programs that may be particularly challenging to fully monetize or quantify (see Appendix Table 5). This is not a comprehensive list, but rather a subset of those that currently present challenges.

Current Challenges

One commonly mentioned challenge was limited or incomplete data (Box 5) to estimate certain program impacts, like longer-term welfare impacts to recipients, or benefits or costs that may extend beyond recipients themselves. For example, multiple analysts noted that administrative data are not always collected with long-term program evaluation in mind, and sometimes are limited to the identification of specific negative events rather than a broader range of outcomes. Enhanced recognition of the value of administrative records for program evaluation may lead agencies to consider strategies for improving these data systems and for increasing administrative data accessibility between agencies, and ultimately to improve program outcomes. Some agencies also expressed an increasing need to understand how to apply available data to future predictions of the costs and benefits of programs in light of emerging developments, such as how climate change could impact the costs and benefits of federal insurance programs.

⁴² See, e.g., Council of Economic Advisers, *Long-Term Benefits of the Supplemental Nutrition Assistance Program* (Dec. 2015), https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/SNAP_report_final_nonembargo.pdf.

Box 5. Effects of Public Benefit Programs: Key Data Gap Examples.

This list is not exhaustive.

- Measurements of changes in nutritional outcomes
- Earnings gains from increased education
- Links between beneficiaries of welfare programs and their families' outcomes
- Correlation between education and economic growth, productivity, health, etc.
- Additional health outcomes related to mental health resources
- Valuation of stress, cognitive load, and other costs to program participants of accessing programs
- Relationship between marginal cost of access increases and reduced program participation
- Health benefits of accessing or continuing to receive public assistance as a result of reducing burdens or barriers to participation
- Additional research on how to best incorporate health and welfare benefits into benefit cost analysis while accounting for potential double counting of transfers

Even with sufficient data on outcomes for program beneficiaries, estimating program impacts is not always straightforward. Federal public benefit programs may provide benefits and services that some beneficiaries would otherwise obtain from other sources (such as local government or private institutions), but estimating the extent and likelihood of this type of counter-factual substitution requires data and models that may not be readily available to agencies. Similarly, analysts need to be careful not to double count costs or benefits that may already be valued. Accounting for spillover effects to beneficiaries' families and to society also poses challenges. Some effects, like the dignity value of reducing homelessness through a housing voucher for the recipient and their family may be difficult to fully monetize, though richer quantification or distributional presentations may be possible.⁴³ Finally, even when rigorous research exists on the impacts of a transfer program in general, this research may not be sufficient to support agency analysis of the incremental effects that a specific change in a policy or program might cause.

Administrative burdens to applicants are also sometimes difficult to quantify. The costs of accessing benefits include paperwork costs related to applications, and may include a variety of other barriers to using the benefits (for example, if landlords are unwilling to accept housing vouchers⁴⁴), or overcoming fears related to accessing benefits (such as a fear of disclosing highly personal information about themselves or household members to determine program eligibility⁴⁵). The time costs, stresses, and barriers to access can even contribute to reduced participation, but quantifying the relationship between a marginal cost increase and reduced access can be challenging.

Distributional analysis (e.g., do the costs and barriers to accessing programs vary by demographic groups?) and reductions in risk (e.g., how much do educational programs reduce the risk of defaulting on student loans?) are particularly significant considerations in the analysis of public benefit programs. These two

⁴³ On developing more robust qualitative or quantitative descriptions for hard-to-value effects like equity, human dignity, and fairness, see Office of Management & Budget, Office of Information & Regulatory Affairs, *Draft Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act, Fiscal Years 2020, 2021, 2022* 21 (Oct. 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/10/FY-20-21-22-BCA-Report.pdf>.

⁴⁴ For research on landlord participation in voucher programs, see "Landlord Participation Research and Studies," U.S. Department of Housing and Urban Development, https://www.hud.gov/program_offices/public_indian_housing/programs/hcv/landlord/research.

⁴⁵ See Office of Management & Budget, *Improving Access to Public Benefits Programs Through the Paperwork Reduction Act* 9 (April 13, 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-10.pdf> (citing Julian Christensen et al., "Human Capital and Administrative Burden: The Role of Cognitive Resources in Citizen-State Interactions," *Public Administration Review* 80, no. 1 (2020): 127-36).

cross-cutting challenges are discussed in more detail below in Chapters 6-7. For example, estimates of impact—including estimates of take-up or substitution between federal programs and other public or private sources of funding—may vary in important ways across different groups.

Relevant Federal Guidance and Examples

Guidance: OMB guidance to federal agencies notes how transfers, including through public benefit programs, can induce important behavioral changes, and the importance of capturing such costs and benefits to the extent feasible. For example, “consider a regulation that increases payments to recipients of a public benefits program available only to retired individuals by five percent. The most straightforward impact of this regulation is a transfer to these recipients. In addition, this regulation might have important implications for retirement decisions for individuals eligible for the public benefits program. This, in turn, could have broad impacts across the labor market, with potentially large implications for the benefits and costs of the regulation.”

Recently released OMB guidance to federal agencies on *Improving Access to Public Benefits Programs Through the Paperwork Reduction Act*⁴⁶ speaks to the challenge of more fully accounting for and managing the costs of public benefit programs. The memorandum encourages agencies to “more completely and transparently articulate burdens and associated costs experienced by the public when accessing essential public benefits programs,” and then try to minimize those burdens.⁴⁷ Specifically, the memorandum advises agencies to describe and account for “the public’s beginning-to-end experience” of accessing benefits, including the cost of time spent researching and learning the program’s requirements, gathering documents, consulting with third parties, traveling, scheduling meetings, or waiting to speak with agency personnel. To improve the accuracy of burden estimates, the memorandum advises agencies to proactively consult with individuals with relevant lived-experience, front-line personnel, subject matter experts, and advocacy groups, and to discuss “sources of psychological costs...such as the cognitive load, discomfort, stress, or anxiety a respondent may experience as a result of attempting to” access benefits. Among the recommended strategies to reduce burdens, the memorandum encourages pre-testing and pilots to help identify the costs of application procedures.

The OMB memorandum also helpfully reassures agencies that may be “conscientious about how increases in a burden estimate may appear in OMB’s annual report to Congress on the Information Collection Budget” that such “increases in estimated burden that stem from improved analysis will be highlighted as successful examples of agencies improving the transparency, analytical rigor, and practical utility” of their program analyses.

Examples: As agencies strive to account for the full value of public benefit programs, an example from AmeriCorps demonstrates what is possible. In 2021, AmeriCorps commissioned a study to quantify the return on investment of a parenting education and support intervention program designed to reduce child abuse and neglect. Assessing effects like increased lifetime earnings due to gains in secondary education, and government benefits from reduced spending on corrections and public assistance, the study found a positive return on investment.⁴⁸

⁴⁶ Office of Management & Budget, *Improving Access to Public Benefits Programs Through the Paperwork Reduction Act* (April 13, 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-10.pdf>.

⁴⁷ The minimization of information collection burdens must be weighed against other goals, such as ensuring the utility of information collected and maintaining privacy protections.

⁴⁸ AmeriCorps, *Return on Investment Study: Birth & Beyond Home Visitation Program* (Sept. 6, 2021), https://americorps.gov/sites/default/files/document/ROI_B%20and%20B%20a_RELEASE.pdf. For additional studies, see “Evidence Exchange,” AmeriCorps, <https://www.americorps.gov/about/our-impact/evidence-exchange>.

Advancing This Frontier

Agencies are continually working to improve their processes for quantifying and monetizing the effects of public benefit programs. The examples below are a non-exhaustive list of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to addressing additional challenges.

- **Benefits of Nutrition Programs:** There is a rich body of research on the benefits of nutrition and food security programs, including effects on health, lifetime income, educational attainment, and other long-term benefits. However, additional research is required to distinguish between program-specific benefits and behavioral changes induced by financial transfers. USDA’s Food and Nutrition Service (FNS) and Economic Research Service (ERS), often in partnership with contractors and academic institutions, evaluate the Department’s network of nutrition assistance programs.⁴⁹ The Department’s research includes routinely assessing the dietary benefits of participating in programs like the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). For example, a recent longitudinal cohort study tracking feeding practices among WIC participants starting at birth finds that longer participation in WIC is associated with better diet quality among young children compared to those who leave WIC early.⁵⁰
- **Documenting Costs and Benefits of Aging in Place Programs:** HUD is conducting a joint study with HHS on “aging in place.”⁵¹ A priority of this partnership is to pilot evidence-informed approaches to affordable senior housing programs and collect data on beneficial outcomes to overall health and wellness as well as possible savings for other more costly health care services.

⁴⁹ See “Research & Analysis,” U.S. Department of Agriculture, Food and Nutrition Service, <https://www.fns.usda.gov/research-analysis>; “U.S. Food and Nutrition Assistance Programs Continued To Respond to Economic and Public Health Conditions in Fiscal Year 2022,” U.S. Department of Agriculture, Economic Research Service (Aug. 21, 2023), <https://www.ers.usda.gov/amber-waves/2023/august/u-s-food-and-nutrition-assistance-programs-continued-to-respond-to-economic-and-public-health-conditions-in-fiscal-year-2022/>.

⁵⁰ U.S. Department of Agriculture, Food and Nutrition Service, *WIC Infant and Toddler Feeding Practices Study-2: Fifth Year Report 7-2* (June 2022), <https://fns-prod.azureedge.us/sites/default/files/resource-files/WIC-ITFPS2-Year5Report.pdf>.

⁵¹ “Aging in Place Joint Study with HHS (PD64),” U.S. Department of Housing and Urban Development, <https://www.huduser.gov/portal/ongoing/Aging-in-Place-Joint-Study-with-HHS.html?q=ongoing%2FAging-in-Place-Joint-Study-with-HHS.html>.

Chapter 6: Cross-Cutting Issues: Analyzing Distributional Effects

Description and Significance of Effects

Across all of the Focal Categories explored above, agencies recognized the potential to expand not just the quantification of costs and benefits, but also the evaluation of the incidence of those costs and benefits across relevant groups of people. Identifying the economic incidence of the benefits and costs of a federal program is determining who ultimately experiences or bears its benefits and costs. The incidence of benefits and costs of a given federal program, regulation, or action is unlikely to be distributed uniformly across all groups of people. In some cases, programs or regulations are designed with an explicit intention of addressing underlying disparities across groups. In other cases, agencies need to consider how a proposed program or policy may unintentionally create or worsen disparities across groups. For example, the underlying susceptibility to certain non-fatal health effects could vary by gender, race, or ethnicity; certain ecosystem services effects could be geographically concentrated affecting some towns and not others; wildfire management and response costs may be spread across different levels of government, private insurers, or ultimately borne by homeowners; the value of particular informational disclosures could be more relevant to consumers at different income levels;⁵² and longer-term effects of public benefit programs could differ across age or family composition.

In this section, we highlight some of the challenges to distributional analyses that agencies identified (see Appendix Table 6). This is not a comprehensive list, but rather a subset of those that currently present challenges.

Current Challenges

One of the most common challenges is a lack of data to estimate impacts to population groups or entities (Box 6). Existing data often treat entire populations uniformly, not capturing information about potential impacts by relevant demographic indicators. In some cases, historical datasets may use categories that do not perfectly align with current agency practices on categorizing distributional groups, and analysts would benefit from guidance on how to integrate such data into their analyses.

Box 6. Distributional Analysis: Key Data Gap Examples. *This list is not exhaustive.*

- Information on Tribal Nations and Indigenous Peoples and how specific regulations affect them
- Data on immigrants' well-being and employment
- Wages for workers who are classified as H-2b
- Current baseline environmental conditions across communities, as they relate to climate change
- Disease incidence by race and ethnicity
- Health information of miners
- Detail on characteristics of FEMA benefits recipients
- Information on individuals with disabilities
- Coastal habitat recreational use values by region and income level
- Tribal Nations and Indigenous Peoples values associated with coral reefs
- Final incidence of costs and benefits associated with regulatory expenditures

⁵² For example, the value of disclosures on payday loans may affect consumers at certain income levels more, due to the types of consumers more likely to use such products.

Estimating the distribution of benefits and costs can also be challenging because benefits and costs may vary across groups for a number of (non-mutually-exclusive) reasons. For example, there could be variation in baseline conditions between groups that influences how the policy or regulation affects them, and there could also be differential take-up or compliance between groups. In light of these and other challenges, full quantification of distributional effects can be a resource-intensive endeavor, and some agencies indicated that staff capacity can be a constraint.

To characterize the distribution of costs of an action, agencies aim to consider not just how costs may vary across different types of affected entities, but also how entities may pass-through costs to owners, employees, beneficiaries, or consumers. Characterizing the distribution of costs therefore may entail better characterizing the responses of entities (for example, in terms of their compliance with a regulation), and of consumers (particularly in terms of their supply/demand elasticities for affected and substitute goods and services), in order to identify what portion of costs are passed on to consumers as compared to business owners or employees. (Similar considerations arise when an action delivers cost-savings or benefits to businesses.)

Agency analysts also expressed a need for more detailed demand elasticities for specific consumer populations, to understand how different consumers respond to higher prices for specific goods and given substitutes. Quantifying the incidence of costs may also require fuller understanding of business behavior and price passthrough under conditions of imperfect competition, and for regulated monopolies.⁵³ Estimating elasticities can require complex economic and econometric modeling that may strain agency resources.

Finally, agencies conveyed that their approach to distributional analysis is often context-specific, making highly standardized templates less useful and increasing the necessary resources devoted to this task. Moreover, agency analysts cited that the lack of a standard menu of adaptable methodologies can pose an additional challenge in conducting distributional analysis.

Given these challenges in assessing distributional consequences, in most cases agencies currently report that these effects are typically considered qualitatively.

Relevant Federal Guidance and Examples

Guidance: OMB's guidance to agencies⁵⁴ offers recommendations on when it may be most informative to produce a distributional analysis; considerations for identifying appropriate groups for distributional analysis; and considerations for incorporating quantitative and monetized estimates into a distributional analysis. When relevant disaggregated data are not available for a quantitative analysis, Circular No. A-4 encourages agencies to provide a qualitative distributional analysis. Distributional analyses are more informative about the welfare effects of regulation when agencies can more precisely identify and monetize the distributional incidence of benefits and costs.

⁵³ For guidance on modeling competition effects, *see* Office of Management & Budget, Office of Information & Regulatory Affairs, *Guidance on Accounting for Competition Effects When Developing and Analyzing Regulatory Actions* (Oct. 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/10/RegulatoryCompetitionGuidance.pdf>.

⁵⁴ Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* 61-67 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>; Office of Management & Budget, *Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* 15-17 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94.pdf>.

Individual agencies have developed additional guidance on certain specialized types of analysis. For example, EPA’s *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis*⁵⁵ may be useful to other agencies estimating effects of proposed policies or programs on environmental outcomes for particular communities.

The Office of the Chief Statistician of the United States has released best practices when collecting sexual orientation or gender identity data through statistical surveys, which emphasize that the context of the data collection may influence the optimal categories for collection and analysis.⁵⁶ Agencies should consider those best practices as they collect, analyze, and report data in support of expanded distributional analyses (including adequate privacy protections when collecting sensitive data from individuals and whether sample sizes are large enough to provide not only confidentiality but also meaningful estimates). The Office of the Chief Statistician is also leading an interagency process to update standards for collecting and presenting data on race and ethnicity.⁵⁷

Finally, the Equitable Data Working Group (now the Subcommittee on Equitable Data), co-chaired by OSTP and OMB, released recommendations on gathering the data necessary to understand the effect of federal policies on equity outcomes.⁵⁸ The report explains, for example, that while sample sizes of national surveys may need to be increased to generate estimates for smaller populations (such as smaller racial and ethnic groups) without jeopardizing the survey’s confidentiality, larger sample sizes are not always a cost-effective way to study the smallest population subgroups. Agencies can explore other options, like multi-year datasets, that may allow more cost-effective study of small populations. The report also encourages agencies to explore opportunities to estimate program participation by demographic characteristics while preserving privacy, such as by matching existing federal data held by the Census.

Examples: Agencies are taking action to close data gaps that currently stymie distributional analysis. In one such example, the Department of Education took recent action to change the Free Application for Federal Student Aid in order to collect information on race and ethnicity.⁵⁹ In other cases where data gaps persist, several agencies have developed methods to conduct distributional analyses with the limited data available. For example, the Office of Tax Analysis in the Treasury Department is developing a methodology to impute race and Hispanic ethnicity to the administrative tax data.⁶⁰ These imputations can provide additional clarity in regulatory analysis regarding the distributional impact of tax policy. Alternatively, DHS often lacks sufficient data to quantify the distribution of social benefits by income, demographic, or

⁵⁵ See U.S. Environmental Protection Agency, *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* (June 2016), https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf; EPA is in the process of revising this Guidance. See U.S. Environmental Protection Agency, *Science Advisory Board Environmental Justice Science and Analysis Review Panel; Nominations Request*, 88 Fed. Reg. 72,754 (Oct. 23, 2023).

⁵⁶ Office of the Chief Statistician of the United States, *Recommendations on the Best Practices for the Collection of Sexual Orientation and Gender Identity Data on Federal Statistical Surveys* 4 (Jan. 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/01/SOGI-Best-Practices.pdf>.

⁵⁷ See “Recent News and Updates,” U.S. Office of Management & Budget Interagency Technical Working Group on Race and Ethnicity Standards, <https://spd15revision.gov/>.

⁵⁸ Equitable Data Working Group, *A Vision for Equitable Data: Recommendations from the Equitable Data Working Group* (Apr. 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/04/eo13985-vision-for-equitable-data.pdf>.

⁵⁹ U.S. Department of Education, *Agency Information Collection Activities; Comment Request; FAFSA Form Demographic Survey*, 87 Fed. Reg. 35,745 (June 13, 2022).

⁶⁰ U.S. Department of the Treasury, *Tax Expenditures by Race and Hispanic Ethnicity: An Application of the U.S. Treasury Department’s Race and Hispanic Ethnicity Imputation* (Jan. 2023), <https://home.treasury.gov/system/files/131/WP-122.pdf>.

geographic groupings of certain immigration regulations. In these cases, DHS provides a qualitative discussion of the potential distributional effects.⁶¹

Regardless of the approach, conducting distributional analyses takes agency technical expertise and other resources. Agencies have used various means to increase their analytical capacity. For example, the use of experts bought in through the Intergovernmental Personnel Act (IPA) allowed one agency to build its own microsimulation model to analyze individual-level responses and so facilitate distributional assessments.

Advancing This Frontier

Agencies are continually working on improving their processes related to analyzing distributional effects. The examples below are a non-exhaustive list of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to addressing additional challenges.

- **Opportunities at NSF:** The NSF’s Directorate of Social, Behavioral, and Economic Sciences offers various programs that facilitate the basic scientific study of distributional effects. Those include the programs in Economics, Decision, Risk and Management Sciences (DRMS), Methodology, Measurement, and Statistics (MMS), among others.⁶²
- **Distribution of transportation costs and benefits:** DOT is developing new data collections that can help close some data gaps on the distribution of costs and benefits from some transportation programs. The effort is focused on capturing individual and household cost, travel time, trips not taken, accessibility, and access to key resources across different demographic groups. Data products are expected in 2026.⁶³
- **Distribution of the costs and benefits of environmental regulation:** EPA is incorporating demographic information into its water quality benefits model, called BenSPLASH.⁶⁴ For the distribution of social costs of regulations, EPA is refining its CGE model, SAGE,⁶⁵ to facilitate its use in more regulatory and other applications to track the pass-through of costs through markets. EPA is also working on consumer demand models for aggregate goods and services differentiated by income to allow for greater refinement in the representation of elasticities in the SAGE model.⁶⁶
- **Distribution of job benefits:** At the Department of Labor, the Wage and Hour Division is working to advance analysis of how back wages are distributed among groups of workers.

⁶¹ See U.S. Department of Homeland Security, *Asylum Application, Interview, and Employment Authorization for Applicants*, 85 Fed. Reg. 38,532, 38,620-21 (June 26, 2020). Though DHS lacked data to monetize the distributional effects of the rule, DHS qualitatively discussed how the rule might affect asylum applicants and businesses depending on labor market conditions, and also discussed further effects of the rule on asylum applicant support networks.

⁶² For more information on supported research, see “Social, Behavioral and Economic Sciences (SBE) Home,” National Science Foundation, <https://www.nsf.gov/dir/index.jsp?org=SBE>; “Awards Simple Search,” National Science Foundation, <https://www.nsf.gov/awardsearch/>.

⁶³ U.S. Department of Transportation, *Equity Action Plan 10* (Jan. 2022), https://assets.performance.gov/cx/equity-action-plans/2022/EO%2013985_DOT_Equity%20Action%20Plan_2022.pdf.

⁶⁴ For model description, see Joel Corona et al., “An Integrated Assessment Model for Valuing Water Quality Changes in the United States,” *Land Economics* 96, no. 4 (2020): 478-92.

⁶⁵ For model description, see “CGE Modeling for Regulatory Analysis,” U.S. Environmental Protection Agency, <https://www.epa.gov/environmental-economics/cge-modeling-regulatory-analysis>.

⁶⁶ U.S. Environmental Protection Agency, *Consumer Demand and the Economy-wide Costs of Regulation: Modeling Households with Empirically Estimated Flexible Functional Forms* (Sept. 2022), <https://www.epa.gov/system/files/documents/2022-09/2022-05.pdf>.

- **Distribution of housing benefits:** A project by FEMA underway since 2019 will assess whether certain housing programs benefit higher-income households over lower-income households. The incidence and amount of benefit were evaluated, as well as drivers of variance in benefit amounts, to better understand both the program’s effectiveness and its distributional impacts.
- **Distribution of fishing benefits:** The National Marine Fisheries Service within NOAA is commissioning a study by the National Academy of Sciences to improve the analysis of equity in the distribution of the benefits of fishery management.⁶⁷

⁶⁷ “Assessing Equity in the Distribution of Fisheries Management Benefits: Data and Information Availability,” National Academy of Sciences, <https://www.nationalacademies.org/our-work/assessing-equity-in-the-distribution-of-fisheries-management-benefits-data-and-information-availability>.

Chapter 7: Cross-Cutting Issues: Analyzing Risk

Description and Significance of Effects

How can agencies value the reduction of a low-probability but catastrophic risk of a debilitating health effect or a major wildfire? How should agencies account for the potential collapse of a critical ecosystem service like pollination?⁶⁸ How might people with different risk preferences react to new informational disclosures about possible hazards from consumer goods? How can agencies quantify the likelihood and benefits of a public benefit program reducing the risk of a major event such as a loan default or bankruptcy? Across all the challenging effects discussed in this Report, the themes of estimating risk changes and their associated costs and benefits came up repeatedly. In this section, we highlight some of the effects related to analyzing risk⁶⁹ that agencies identified as challenging to evaluate (see Appendix Table 7). This is not a comprehensive list, but rather a subset of those that currently present challenges.

Current Challenges

Agencies cited a lack of data as a major challenge in evaluating risks (Box 7). In particular, data gaps complicate efforts to describe baseline risk levels within the context of a given policy, program, or action. Consistent with the nature of cross-cutting issues, agencies mentioned this challenge across a multitude of contexts. For example, accounting for the risk of catastrophic events is challenging because they historically have occurred relatively infrequently, and so data on their occurrence is limited. These challenges are often exacerbated in the case of historically uncommon events that are becoming or may become more common or more damaging in the future. In particular, climate change is forcing increased attention on high-impact, low-frequency environmental disasters. Future risks can be similarly difficult to predict for new markets and new technologies that lack strong historical or analogous baselines (e.g., self-driving cars). Another data challenge occurs when available data are not updated as more accurate estimates of the effects or frequency of rare events become available.

Box 7. Risk Analysis: Key Data Gap Examples. *This list is not exhaustive.*

- Well-being of persons seeking to become permanent residents, level of fear, etc.
- Student loan default rates and amounts
- Probability of environmental disasters and effects of these events
- Baseline risks related to cybersecurity
- Impacts of large cybersecurity breaches on society

⁶⁸ See James R. Meldrum et al., “Considering Pollinators’ Ecosystem Services in the Remediation and Restoration of Contaminated Lands: Overview of Research and Its Gaps,” *Integrated Environmental Assessment and Management* (2023): 1-15 (conducting a structured review of available knowledge about pollinator ecosystem services, concluding that “[m]ost studies pertain to provisioning services provided [by] . . . primarily honeybees,” and highlighting the need for “examples of the quantification and valuation of nonmaterial and regulating services associated with pollinators, including through indirect pathways.”).

⁶⁹ In this report, we focus specifically on the challenge of measuring and quantifying the economic value of reductions in statistical risks (that is, the probability that a given negative event or outcome will occur).

Beyond projecting risk, agency analysts also raised challenges with monetizing some of the benefits of reducing risk, like accounting for the reduction of fear that people may experience as the result of risks. Individuals may also have difficulty evaluating the benefits of reducing the chance a harmful risk will occur from, for example, a 10% chance down to a 5% chance. The fear that individuals experience due to the salience, magnitude, and other factors associated with a risk can have important effects on behavior, and reducing that fear could be valuable.

Finally, agency analysts cited challenges in accounting for personal risk preferences, which can vary across individuals or groups. While some people and firms exhibit risk neutrality in some circumstances, risk aversion is widespread in many contexts and is consistent with common economic models for rational preferences.⁷⁰ People are risk averse if they prefer more certain outcomes to less certain outcomes with the same expected value.⁷¹ When valuing non-fatal health risks, ecosystem service risks like pollination collapse, risky wildfire and weather events, or risks related to information-laden consumer products like mortgages, for example, the presence of risk aversion may imply that beneficiaries place a relatively higher value on reducing some of the riskiest possible outcomes. Some agencies noted the need for additional data and models to value such risk preferences.

Relevant Federal Guidance and Examples

Guidance: OMB offers agencies guidance⁷² on when it may be appropriate to account for risk aversion versus assuming risk neutrality and how to use certainty-equivalent valuations to adjust estimates of benefits or costs to reflect risk aversion. Additional formal tools exist to address risk and uncertainty, including using statistical techniques to characterize the probability distribution of effects, and using a real options framework to assess uncertain, irreversible outcomes in light of the value of additional information about such outcomes that could be learned over time. OMB’s Circular No. A-4 also notes that simulation models or expert elicitations can help address uncertainty.

Examples: In 2010, when the Interagency Working Group on the Social Cost of Carbon⁷³ first developed an estimate of the climate damages from each additional ton of carbon dioxide, the Working Group recognized that its models and data at the time did not capture the risk of low-probability but high-impact catastrophes, like the collapse of the polar ice sheets or extreme temperatures. To reflect aversion to such high-impact catastrophes, with people likely willing to pay extra to reduce the likelihood of such low-chance but devastating potential damages, the Working Group calculated and encouraged prominent consideration of an estimate drawn from the 95th percentile of the distribution of estimated cost per ton emitted. The Working Group used Monte Carlo techniques to combine its model inputs across 10,000 runs and generate probability distributions of the cost per ton, and then not only reported a central estimate from the probability distribution, but also reported the 95th-percentile value. The Working Group encouraged agencies using its estimates to give appropriate attention to the 95th-percentile value, to capture risk aversion

⁷⁰ Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* 72-74 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>.

⁷¹ A risk-neutral individual is indifferent between (1) a 100% chance of receiving \$500, or (2) a 50% chance of receiving \$1000 but a 50% chance of receiving \$0, which both have the same expected value. Risk-averse individuals prefer and are willing to pay more to ensure the first scenario than the second; risk-seeking individuals may prefer the second scenario. In some markets, rational risk preferences may need to be disentangled from other effects that can distort consumers’ valuations, including information asymmetry and behavioral biases like salience or loss aversion. Agencies could benefit from additional guidance on how to disentangle such effects.

⁷² Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* 72-74 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>.

⁷³ Interagency Working Group on Social Cost of Carbon (IWG). 2010. “Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866.” February, 2010. United States Government. Available at: <https://www.whitehouse.gov/omb/information-regulatoryaffairs/regulatory-matters/#scghgs>.

around catastrophic outcomes; without the estimation and encouragement to incorporate the 95th-percentile value those risks which are becoming increasingly likely wouldn't have been considered in projections.

Advancing This Frontier

Agencies are continually working on improving their processes related to analyzing distributional effects. The examples below are a non-exhaustive list of activities that the federal government may pursue in coming years, and Chapter 8 identifies opportunities for the research community to contribute to additional challenges.

- **Updating security risk scenarios:** Economists at DHS are frequently updating scenarios used to evaluate security rules.⁷⁴ This includes updating the scope of the impacts and refining the number of scenarios affected by regulation.
- **Data on risk of housing loan default:** HUD is conducting research using data on loss mitigation to determine which methods are the most effective to reducing the risk of default.

⁷⁴ For an example of scenarios used in security rules, see Transportation Security Administration, *Passenger Screening Using Advanced Imaging Technology*, 81 Fed. Reg. 11,363 (Mar. 3, 2016); Transportation Security Administration, *Passenger Screening Using Advanced Imaging Technology: Regulatory Impact Analysis and Final Regulatory Flexibility Analysis* (Feb. 18, 2016), <https://www.regulations.gov/document/TSA-2013-0004-5583>.

Chapter 8: General Opportunities to Advance the Frontiers of BCA

In support of evidence-based decision-making, federal agencies and the broader research community are constantly improving methods, collecting and aggregating new data, and strengthening the evidence base relevant to federal action. Each of the challenges discussed in this Report reveals opportunities for federal experts and the broader research community to make advances that can serve this pursuit. This first Annual Report on Frontiers of Federal Benefit-Cost Analysis aims to strengthen exchanges between federal researchers and the community, to enable the best use of existing knowledge, the identification of high-value topics for future research, and the continued removal of barriers to progress. To facilitate that exchange, this chapter reviews general ways that federal agencies can pursue advances and flags specific opportunities for the research community to advance key needs for federal analysis.

Opportunities within Government

Unsurprisingly, limited resources can constrain agencies' capacity to pursue new research to expand quantification and monetization. While some agencies are able to allocate some staff time to long-term research, at least some agency analysts report that they only "seldom or sometimes" have internal capacity to undertake new research to quantify or monetize new effects. Facing these constraints, agencies can and do collaborate with other agencies and, if authorities and funds are available, award grants and hire contractors to expand their capacities. Agencies could further consider enhancing their individual capacities by sharing resources:

- **Data access:** Agencies could share access or explore discounted pricing for expensive databases, such as on nationwide property sales data to help support hedonic property price analyses. Some agencies could update existing data collection tools to help other agencies address key data gaps. For example, as part of NSF's larger portfolio, the Methodology, Measurement, and Statistics (MMS) Program in the Directorate of Social, Behavioral, and Economic Sciences partners with a consortium of federal statistical agencies to support research proposals that further the production and use of official statistics. The Research Infrastructure in the Social and Behavioral Sciences Program (RISBS) supports projects aiming to create computational tools and data to enable research by social scientists.⁷⁵
- **Computing resources:** Agencies could identify their computing resources and explore opportunities to share such resources for data analysis.
- **Research collaborations:** Many of the challenges identified are multi-disciplinary and could efficiently be addressed through interagency collaboration. Agencies can also reach out to EOP components, including OMB, CEA, OSTP, CEQ, and others, when research is being planned for assistance in new quantification and monetization efforts.
- **Detailees:** Experts can be detailed from one agency to another to provide temporary capacity and transfers of knowledge. Some agencies identify having more interdepartmental detailees as being of particular importance, both to exchange knowledge as well as for professional development.

Agencies can also find efficiencies, share lessons, and strengthen analyses by engaging in the NSTC Subcommittee on the Frontiers of Benefit-Cost Analysis that is authoring this Report. The Subcommittee serves as a federal technical community of practice, and will continue to develop opportunities for discussion and innovation. Staff involved in the Subcommittee noted that the process of contributing to this

⁷⁵ Agencies interested in partnering with NSF on these and other activities should reach out to officials and/or program directors at the Directorate of Social Behavioral and Economic Sciences. For pertinent opportunities identified by the Division of National Center for Science and Engineering Statistics, *see also* "What's New From NCSES," National Center for Science and Engineering Statistics, <https://ncses.nsf.gov/about/whats-new>.

Report has itself been useful for stimulating internal conversations within an agency about its own research priorities.

Beyond annual publication of this Report, the Subcommittee may host seminars, roundtables, and other engagements to highlight the latest advances from the research community. The Subcommittee may also develop additional specific resources, including case studies, illustrative examples, or topic-specific guidance. Within this remit, some Subcommittee members suggested future activities such as organizing useful examples of cutting-edge analyses into an internal government database, developing future guidance on how benefit-transfer methods or retrospective reviews can support improved quantitative and monetized estimates, or developing future guidance on when available evidence of an effect’s causality is sufficient to support quantification.

The Foundations for Evidence-Based Policymaking Act of 2018⁷⁶ calls on agencies to strategically plan their evidence-building, data management, and data access functions to ensure an integrated connection to their policymaking needs. The Act requires agencies to develop Learning Agendas, to focus agency attention on the evidence needed to solve big problems. Some agencies have incorporated data collection goals into their Strategic Plans.⁷⁷ By engaging agency analysts early in agenda-setting, agencies can build long-term data-collection and research goals into their multi-year timelines. More broadly, agencies can coordinate across their research agendas and Learning Agendas, so that efforts build on each other and prioritization responds to not just internal needs but needs of other agencies as well. OMB Circular No. A-11 encourages agencies to use their Learning Agendas to help refine their estimates of costs and benefits, particularly through the development of retrospective review studies.⁷⁸

Significant evaluation questions are also identified each year in Annual Evaluation Plans, with due dates designed to dovetail with the budget process. Both Learning Agendas and Annual Evaluation Plans provide a framework to direct available research funding, grants, contracts, or institutional partnerships toward the goals identified by the agency. Agencies can use that framework to help reflect the goals of this Report in their budget priorities.

The Fiscal Year (FY) 2025 OMB and OSTP memorandum on research and development priorities reinforces several of the challenges highlighted in this Report, such as improving analysis for difficult-to-monetize or-quantify effects like ecosystem services; advancing health equity; and designing evaluations of how different approaches can help reach national goals more effectively and more equitably.⁷⁹ Agencies should work with OMB over the coming year to advance such research and development budget priorities.

Agencies should facilitate public engagement more broadly to support their efforts at quantification and monetization. For example, OMB Memorandum M-21-27 calls for agencies to engage with the public specifically on their Learning Agendas,⁸⁰ and OMB Circular No. A-11 further clarifies that agencies should “engage a diverse array of interested parties as they develop the Learning Agenda.” Agencies have

⁷⁶ Foundations for Evidence-Based Policymaking Act of 2018, Pub. L. No. 115-435, 132 Stat. 5529 (2019).

⁷⁷ See, e.g., U.S. Department of Transportation, *Strategic Plan FY 2022-2026* 37 (Apr. 2022), https://www.transportation.gov/sites/dot.gov/files/2022-04/US_DOT_FY2022-26_Strategic_Plan.pdf (“Improve program evaluation processes to better quantify the outcomes of programs and policies and establish outcome-based performance measures for all major programs.”).

⁷⁸ Office of Management & Budget, *Circular No. A-11, Preparation, Submission, and Execution of the Budget* 7 of Section 290 (Aug. 2023), <https://www.whitehouse.gov/wp-content/uploads/2018/06/a11.pdf>. Circular No. A-11 advises agencies that “[t]o support future cost-benefit analyses, agencies should include questions on their Learning Agendas related to the measurement and comparison of actual costs with anticipated costs prior to implementation of a regulation.” *Ibid.*

⁷⁹ Office of Management & Budget and Office of Science and Technology, *Multi-Agency Research and Development Priorities for the FY 2025 Budget* (Aug. 17, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/08/FY2025-OMB-OSTP-RD-Budget-Priorities-Memo.pdf>.

⁸⁰ Office of Management & Budget, *Evidence-Based Policymaking: Learning Agendas and Annual Evaluation Plans* 7 (June 30, 2021), <https://www.whitehouse.gov/wp-content/uploads/2021/06/M-21-27.pdf>.

sometimes issued *Federal Register* notices on their Learning Agendas and Strategic Plans, and agencies can also consider options to more directly engage researchers with expertise in relevant disciplines.

Executive Order 14094 advises agencies to consult, among other groups, “those with expertise in relevant disciplines,” to inform both the development of their semi-annual regulatory agendas and individual regulatory actions. OMB’s subsequent memorandum on *Broadening Public Participation and Community Engagement in the Regulatory Process* explains that public engagement can strengthen agencies’ understanding of both quantitatively- and qualitatively-assessed benefits and costs, as well as distributional analysis.⁸¹ The memorandum encourages agencies to seek early engagement in the rulemaking process and to use the semi-annual Regulatory Agenda to communicate about ongoing efforts at public engagement.

Agencies can also consider using specific public engagement strategies to fill in research gaps. For example, expert elicitations can help bridge gaps between existing evidence and quantitative estimates of probability distributions for key effects. More broadly, within available authorities, agencies can establish working partnerships with academics, researchers in local or Tribal Nations and Indigenous Peoples governments, or other outside researchers, to encourage research collaborations that will be relevant and applicable to important policy questions.

Some efforts to close data gaps may require agencies to conduct new surveys, which may fall under the *Paperwork Reduction Act of 1995* (PRA). OIRA heard from agencies that the PRA can be perceived as an obstacle to timely approval of stated preference surveys. The PRA requires certain information collection activities, including surveys conducted or sponsored by federal agencies, to be both made available for public comment and reviewed by OMB, to maximize the value of the information being collected and minimize the burden imposed on the public.⁸² Agencies may be able to use available flexibilities in the PRA process. In particular, in 2010, OIRA issued a memorandum on *Facilitating Scientific Research by Streamlining the Paperwork Reduction Act Process*.⁸³ That memorandum clarifies which collections may not be subject to the PRA (including collections that are neither “sponsored” nor “conducted” by the agency, and certain facts or opinions obtained from individuals under clinical examination); identifies streamlining procedures (including generic clearances to cover certain multiple collections using very similar methods); and advises early collaboration with OMB, including pre-submission consultation during the initial public comment period. Agencies should consult that memorandum, or confer with their OIRA desk officers, for more information on how to streamline reviews of collections related to efforts to expand quantification and monetization.

Opportunities for the Broader Research Community

Agency analysts see a number of ways that the broader research community could enhance the government’s efforts to expand quantification and monetization.

⁸¹ Office of Management & Budget, *Broadening Public Participation and Community Engagement in the Regulatory Process* 5 (July 19, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/07/Broadening-Public-Participation-and-Community-Engagement-in-the-Regulatory-Process.pdf>.

⁸² An important part of the PRA review process is to maximize the value of the information being collected. In addition to seeking flexibilities, agencies should also confer with OIRA early on best practices to ensure the reliability and robustness of their stated preference surveys. For guidance on designing robust stated preference surveys, see generally Office of Management & Budget, *Circular No. A-4, Regulatory Analysis* 34-37 (Nov. 9, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf>.

⁸³ Office of Management & Budget, Office of Information & Regulatory Affairs, *Facilitating Scientific Research by Streamlining the Paperwork Reduction Act Process* (Dec. 9, 2010), https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2011/m11-07.pdf; see also Office of Management & Budget, *Improving Access to Public Benefits Programs Through the Paperwork Reduction Act* (April 13, 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-10.pdf>.

- Incentivize More Replication and Benefit-Transfer Studies and Studies that Explore External Validity:** Studies that replicate, extend, or adapt already-published work to related contexts have tremendous value for policy analysis. Unfortunately, such replication research and other work deemed too “derivative and lacking in methodological and conceptual novelty”⁸⁴ often face barriers to publication: “funders [are] reluctant to fund it, journals [are] reluctant to publish it, and institutions [are] reluctant to reward it.”⁸⁵ If academic institutions, journals, research centers, and funders want their research to have policy relevance, they should explore ways to remove barriers to replication studies and to benefit-transfer studies that may extend or adapt published work to novel contexts. Before publication, researchers should generally explore the circumstances under which their findings are externally valid and thus generalizable to other settings, and should consider including any details necessary to facilitate the appropriate application of their results to other settings.
- Encourage Additional Research on Elasticities, Stated Preference, CGE Models, and Other Policy-Relevant Parameters:** Policy decisions often require modeling analyses that critically depend on context-specific parameters, such as demand elasticities, elasticities of substitution, and marginal costs. Other research topics that can be especially useful to policy analysis may have fallen somewhat out of favor over time among academics. For example, agency analysts mentioned a range of elasticities and stated preference surveys that, while once popular topics, seem to appear less often in published work. Moreover, agency analysts noted that key elasticities may be out of date or incomplete, especially for smaller markets; other elasticities are maintained only by virtue of cooperative agreements between agencies and researchers, perhaps reflecting a lack of independent academic interest. In addition to expanding these estimates, agencies note that academic programs may also not be developing a sufficiently broad talent pool in topics like CGE modeling to meet the government’s demand for new analysts.

In light of this, researchers should strive wherever possible to expand the scope of their work to speak to a range of specific and policy-relevant parameters. In addition, academic institutions and journals should explore ways to promote topics of study that will lead to policy-relevant work. Finally, research centers and funders may consider supporting the production of elasticities and stated preference studies that may be hard for academics to publish but still valuable for agency analyses.

- Prioritize This Report’s Focal Topics for Research and Funding:** Academic institutions, research-oriented foundations, and other funding sources should consider focusing on areas with policy relevance, especially this Report’s focal topics and cross-cutting issues. Outside researchers should also consult this Report’s Appendix for a more extensive list of topics.
- Engage Early with Agencies:** As OMB’s memorandum on broadening public participation in the regulatory process explains, “Broad public input is often most useful at an early stage,” when agencies are still choosing priorities and developing action alternatives.⁸⁶ There are several ways for outside researchers to engage both early and often as agencies develop their regulations, policies, and programs. For example, researchers can provide relevant studies, datasets, or other advances at any time to the general email address - Frontiers@omb.eop.gov. Agencies also publish twice each year an agenda of their upcoming regulatory priorities. Agencies’ preambles in the

⁸⁴ Maren Duvendack, Richard Palmer-Jones, and W. Robert Reed, “What Is Meant by “Replication” and Why Does It Encounter Resistance in Economics?” *American Economic Review* 107, no. 5 (2017): 47; *see also* Brian A. Nosek, Jeffrey R. Spies, and Matt Motyl, “Scientific Utopia: II. Restructuring Incentives and Practices to Promote Truth Over Publishability,” *Perspectives on Psychological Science* 7, no. 6 (2012): 615-31.

⁸⁵ Brian A. Nosek and Timothy M. Errington, “What is Replication?” *PLOS Biology* 18, no. 3 (2020): 7.

⁸⁶ Office of Management & Budget, *Broadening Public Participation and Community Engagement in the Regulatory Process* 10 (July 19, 2023), <https://www.whitehouse.gov/wp-content/uploads/2023/07/Broadening-Public-Participation-and-Community-Engagement-in-the-Regulatory-Process.pdf>.

Unified Regulatory Agenda may specifically call for general public comments; furthermore, each individual regulation listed for future action in the agenda also lists a specific agency contact for that agency item.⁸⁷ Agencies' Learning Agendas, which some agencies update either annually or in connection with their Strategic Plans, may also include either general or specific opportunities for comment.⁸⁸

- **Submit Public Comments:** Public comment periods, such as on proposed regulations, are another chance for the research community to engage with agencies. Comment periods can be an especially apt opportunity for researchers to direct agencies to relevant updated data and additional supporting literature. Though critiques and suggestions for improvement are always welcome as part of formal public comments, academics may not necessarily realize that submitting positive written comments and literature in support of the agency's analysis can also be valuable. Public comments can and have influenced agency analyses in significant ways. For example, the Department of Transportation prominently referenced public comments submitted by academic researchers, think tanks, and other sources, which had gathered updated data and literature on the price elasticity of vehicle sales, among its reasons for updating the estimate for that key parameter in its final regulatory analysis.⁸⁹ Useful comments can take a range of forms, from short, informal summaries of recent and ongoing research; to sign-on letters from a broad spectrum of academics; to more refined and detailed responses to specific calls for comments included by the agencies in their proposed rules. For additional background on the rulemaking process and how to submit effective comments, please see the links in the footnote.⁹⁰
- **Compile or Synthesize Available Resources:** Some challenges could be addressed by community efforts to compile or synthesize the state of the literature and other available resources. Specific opportunities include:
 - Cataloging willingness-to-pay evidence on value of information.
 - Compiling quantification and valuation studies on ecosystem services.
 - Conducting meta-analyses on the effectiveness of diverse investments in nature for a broader set of benefits.
 - Compiling available estimates or conducting new meta-analyses for non-fatal health effects.

⁸⁷ For the current version of the Unified Agenda of Regulatory and Deregulatory Actions, including an Introduction and Background section on "How to Use the Unified Agenda," see "Current Unified Agenda and Regulatory Plan," Office of Information & Regulatory Affairs, <https://www.reginfo.gov/public/do/eAgendaMain>.

⁸⁸ For Current Learning Agendas, see "Learning Agendas," Office of Management & Budget, <https://www.evaluation.gov/evidence-plans/learning-agenda/>. Public input can be submitted to evidence@omb.eop.gov.

⁸⁹ National Highway Traffic Safety Administration, *Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks*, 87 Fed. Reg. 25,710, 25,859 (May 2, 2022).

⁹⁰ For additional guidance on how to submit effective comments, see U.S. Department of Labor, *Making Your Voice Heard in the Federal Rulemaking Process* (July 2022), <https://www.dol.gov/sites/dolgov/files/OASP/Making-Your-Voice-Heard-in-the-Federal-Rulemaking-Process-v2.pdf>; U.S. Department of Health and Human Services, *How to Participate in the Rulemaking Process*, <https://www.hhs.gov/sites/default/files/regulations/rulemaking-tool-kit.pdf> (including examples of how public comments have influenced the development of rules); Office of the Federal Register, *A Guide to the Rulemaking Process* (Sept. 2013), <https://uploads.federalregister.gov/uploads/2013/09/The-Rulemaking-Process.pdf> (the *Federal Register* also publishes proposed rules open for public comment); "Learn About the Regulatory Process," General Services Administration, <https://www.regulations.gov/learn> (regulations.gov is where comments can often be submitted); General Services Administration, *Tips for Submitting Effective Comments*, <https://s3.amazonaws.com/prod-regulations-faq/pdf/Tips-For-Submitting-Effective-Comments.pdf>.

- **Develop New Data, Tools, and Methodologies:** The broader research community can address challenges highlighted in this report by:
 - Collecting frequently updated subsistence use data on a wide range of subsistence products, and differentiating use rates by various population groups.
 - Ensuring distributional data in published analyses is produced in ways that support re-use in various federal applications. For example, if a study analyzes income groups above and below the federal poverty line, consider also publishing data across the spectrum of income levels, in case agencies later need a different categorization (e.g., data by income deciles).
 - Aligning on standard ways to categorize groups for distribution analysis.
 - Developing large language modeling techniques to sort through large databases and extract details relevant to quantification.
 - Clarifying methods for estimating future benefits and costs of public benefit programs from estimates of historical changes,⁹¹ and connecting available literature on changes in earning due to program participation to valuations of benefits from those programs.
 - Advancing best practices for informing decisions on when evidence of causality (e.g., between exposures and health outcomes) is sufficient to support quantification at different levels of confidence. Binary interpretations of causal strength (i.e., only quantifying when causality is unambiguous, and so implicitly attributing no willingness-to-pay to avoid exposures with only suggestive evidence of causation) can create obstacles to fully representing health effects.
- **Conduct Behavioral Change Experiments:** The effects of various policy options have not been experimentally tested in a wide range of contexts that represent conditions that can be affected by federal actions. Additional field or lab experiments to explore behavioral responses would help address challenges related to, among other things:
 - How improvements in information, including mandatory information disclosures, product labeling, and reductions in asymmetric information, do or do not change consumer or producer behavior; and
 - How fishery catch allocations affect behavior of different types of fishers (e.g., recreational, commercial, subsistence, Tribal Nations and Indigenous Peoples).
- **Temporary Assignment to Government:** Several agencies report positive experiences with temporarily bringing in subject-matter experts through the Intergovernmental Personnel Act (IPA) from local governments, colleges, and federally-funded research centers.⁹² After their temporary federal assignment, IPA personnel return to their home institutions with a better understanding of the kind of data and support that federal agencies need to advance their analyses.

Emerging Frontiers

The frontiers of analysis will continue to evolve. Agency analysts are already beginning to confront the challenges of quantifying and monetizing costs and benefits of federal actions related to new consumer products and markets (like autonomous vehicles), evolving technologies (like artificial intelligence), and growing threats (like cybersecurity). In future Annual Reports, and through future public engagement, the

⁹¹ See, e.g., Nathaniel Hendren and Ben Sprung-Keyser, “A Unified Welfare Analysis of Government Policies,” *The Quarterly Journal of Economics* 135, no. 3 (2020): 1209-1318.

⁹² For more information on the IPA, see “Intergovernment Personnel Act,” U.S. Office of Personnel Management, <https://www.opm.gov/policy-data-oversight/hiring-information/intergovernment-personnel-act/>.

Subcommittee will continue to explore new frontiers and to help agencies and the broader research community collaborate on new paths toward expanded quantification and monetization—all with the goal of more transparent and robust federal decisions.

Appendix

Table 1. Non-Fatal Health Effects: Specific Effects Identified as Challenging to Fully Monetize

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Quantification of changes in non-fatal health impacts and subclinical impacts of emerging environmental contaminants	Described qualitatively	Estimated dose-response functions in the relevant range of human exposures – non-binary assessment methods
Valuation of non-cancer health impacts and subclinical impacts of environmental contaminants, including additional WTP	Described qualitatively	Lack of data about willingness-to-pay estimates for reduced risk of non-cancer health effects
National water quality benefits valuation accounting for heterogenous water resources, affected populations, and new/understudied pollution types	Estimated with meta-analysis	Research with broad geographic scope, especially related to how benefits vary based on distance from an improved water resource. Very little research focusing on highly urbanized areas, as well as health effects from reduced heavy metals, PFAS (Per- and polyfluoroalkyl substances), and algal blooms. Additionally, no research on how willingness-to-pay differs for iconic waterbodies.
Mental health effects of flooding and coastal storms	Sometimes Described qualitatively	Data on mental health impacts for events of different magnitudes or other variables and willingness-to-pay to avoid mental health effects
Impact on broader community of illness prevented	Not included	Data and methodology to measure broader impacts to community of illness
Welfare losses from illness	Partially quantified with Quality Adjusted Life Years (QALY)	Available studies on willingness to pay to avoid morbidity
Effects of a pandemic on society	Partially monetized	Data and methodology to quantify psychological and emotional impacts, long term effects of disruptions in education, economic stability, health care systems, and supply chain and production disruptions
Effects from preventing natural gas and other flammable, toxic, or corrosive gases leaks	Described	Data and methodology for forecasting effects based on retrospective leak incidence
Effects from accident avoidance, mitigating high-risk fatigue levels, fewer delays to passengers and freight	Described	Data on spillovers of safety measures

ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS

Safety effects from enhanced training requirements	Described anecdotally	Control groups to create studies and data on driver-specific attributes
Averting behavior for air pollution and drinking water	Not included	Resources and data
Changes in non-cancer health impacts and subclinical impacts of environmental contaminants quantification	Qualitatively described	Data on estimated dose-response functions and risk assessment methods beyond binary safety indicators
Effectiveness and impacts of personal protective equipment (PPE)	Partially quantified	Data on compliance, effectiveness, and worker productivity
Patient effects of illness and deaths prevented among health care workers	Qualitatively described	Data and approved methodology

Table 2. Ecosystem Services Effects: Specific Effects Identified as Challenging to Fully Monetize

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Habitat designation effects on commercial and recreational fishing	Partially monetized	Data on area of some habitats (e.g., deep water corals).
Habitat designation effects on species existence value	Described	Data on existence value estimates for specific endangered species (or clarity on how benefit transfer can be applied in these cases under A-4)
Habitat restoration effects on species existence values	Partially quantified (habitat area)	Data on existence values for specific species
Species recovery benefits	Described	Data on relationship between whale population changes and any benefits
Forest and other land-cover regrowth effect on climate mitigation values	Monetized (using large assumptions)	Data on long-term temporal changes in carbon sequestration as ecosystems recover from wildfire
Effects of antibiotic use on disease prevention, agriculture productivity, existence values	Partially monetized, described	Data on effects of various levels of antibiotic use on ecosystem changes related to disease prevention, agricultural productivity, species existence value
Flood/storm risk reduction effects from restored ecosystems	Described, Partially monetized	Sufficient certainty in relationship between restoration of various wetland features and flood risk Method to reflect benefit to vulnerable, lower-income neighborhoods
River or coastal management effects on loss of life from floods or storms	Not included	Relationship between river or coastal habitat management and indirect loss of life from floods or storms
Mental health effects of flooding or coastal storms	Described	Data on incidence of mental health effects from storm events of different magnitudes Valuation data on mental health impacts
Mental health effects of climate change anxiety	Not included	Data on incidence of mental health effects from climate change anxiety
Coastal habitat effects on existence value	Described	Data on existence value of coastal areas Time to conduct surveys, or need alternate method
Coastal ecosystem effects on recreational use values	Monetized (coarse data)	Regional data on coastal habitat (e.g., beach) use values Data on coastal ecosystem use values by income level

ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS

Coastal ecosystem effects on climate mitigation values	Partially monetized	Data on carbon storage and sequestration rates in various coastal habitat types, or estimation model to relate habitat changes to carbon changes
Coral reef effects on Tribal Nations and Indigenous Peoples use values	Described	Data on preferences for Tribal Nations and Indigenous Peoples cultural uses of coral reefs
Fishery or habitat management effect on subsistence fish use	Not included, or Described	Data on subsistence harvest levels (total and by cultural group) Consistent definitions and units across agencies
Effects of allocating catch between recreational and commercial fisheries	Partially monetized, Described	Cost data for some commercial fisheries Data on marginal net benefit of fish in non-ITQ managed commercial fisheries (require surveys) Data on marginal net benefit of fish in recreational fisheries (require surveys) Data on behavior changes in response to quota changes
Infrastructure or facility effects on recreation values	Partially monetized	Higher frequency, higher resolution visitation data Values associated with attributes of recreation experience (e.g., crowding, visual and physical amenities) Values for specific recreational opportunities (e.g., biking, hiking, canoeing, kayaking, horseback riding, climbing)
Tourism and outdoor recreation benefits	Partially monetized	Data and methodology to measure benefits of outdoor activities
Willingness to pay for cultural resource prevention	Not included	Lack of data on willingness to pay
Visitation estimates of outdoor spaces	Not included	Lack of data and resources to collect the data
Value of blue carbon in coastal wetlands	Partially quantified	Data on carbon content

Table 3. Wildfire and Extreme Weather Effects: Specific Effects Identified as Challenging to Fully Monetize

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Influence of wildfire characteristics on wildfire management costs	Not included	Data on costs at all phases (fuels treatment, readiness, fire suppression, post-wildfire recovery), disaggregated by source (e.g., federal, state, private) Data on relationship between wildfire characteristics (e.g., intensity, acreage, proximity to population centers and other values at risk) and costs (federal and non-federal) Data on relationship between wildfire characteristics and private recovery spending
Distribution of flood and coastal storm property damages	Described	Method to model effects on different segments of population (e.g., could weight valuation based on income, property values,)
Physical health effects of flood and coastal storm events	Not included, or Described	Data on incidence of health impacts from events of different magnitudes Data on valuation of health effects
Disruption of life effects from catastrophic weather events	Described	Data on educational disruptions post-event Data on value of community cohesiveness
Climate change risk reduction effects of protective measures for buildings	Described, Partially quantified	Data on levels of building protection sufficient to reduce climate-affected flood risks Certainty about future climate effects on floods and associated building risks
Social cost of greenhouse gas emissions	Partially monetized	Data on specific effects of greenhouse gases including extreme weather events and nongradual effects on natural or socioeconomic systems
Unit prices of wildland fire management methods	Partially monetized	Lack of data on costs associated with wildland fire management methods
Loss of life indirectly from floods and coastal storms	Not included	Data to create predictive estimates of potential indirect life loss
Historical value of structures projected by flood risk management projects	Partially quantified	Methodology to place value on historical significance

Table 4. Information and Transparency Effects: Specific Effects Identified as Challenging to Fully Monetize

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Societal benefits and cost of AI development technologies	Partially quantified	Current lack of data due to the newness of the technology
New compensation structures for broker-dealers	Described	Data on the proliferation and magnitude of the compensation changes and the effects on conflicts of interest
Reporting of employee benefit plan information	Described	Data on employee benefit plans and worker job choice
Estimating the value of consumer confidence in markets with organic foods	Fully monetized	Data on the amount of fraudulently labeled organic foods, consumer buying preferences, and methodology on forecasts for expected sales of organic products
Benefits of the Seafood Monitoring Program (SIMP) on controlling the amount of illegal, unreported, and unregulated (IUU) fish/fisheries in U.S. seafood supplies	Described	Data on the number of illegal fisheries and number of illegal fish entering the seafood market and consumer preferences
The balance between retirement investors getting advice that might be affected by conflict of interest and not receiving advice at all	Described	Up to date data on compensation of investment advisors and advice given to advisees
Providing information on specific risks to enhance public decision-making	Described	Methods and data for quantifying changes in information and how that affects behavior
Societal benefits of scientific discovery	Described, partially monetized	Current data on the societal benefits beyond economic growth, life expectancy, and other health measures
More transparency on poultry growers contract markets	Partially quantified	Methodology and data on the impacts on growers of improved market transparency
Effects of elimination of price transparency on consumers choice and potential “mistakes”	Partially monetized	Broad data on welfare (lack of consumer “mistakes”)
Firm compliance rate of price transparency regulations	Described, partially monetized	Data on firm compliance in all industries
Impact of quality standard to mitigate imperfect information	Partially quantified	Methodology for “rule of thumb” approach to imperfect formation

Table 5. Effects of Public Benefit Programs: Specific Effects Identified as Challenging to Fully Monetize

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Disentangling benefits and transfers of programs such as SNAP, WIC, and school nutrition programs	Not included	Data and methodology to measure changes in nutritional outcomes rather than just federal spending
Increased tax revenue from earnings effects of educational interventions	Not included	Data on earnings gains from increased education and model for federal income tax
Reduced financial strain on welfare programs due to the rural housing program	Partially quantified	Methodology on creating a value for reducing homelessness
Effects of welfare programs on beneficiaries' families	Not included	Data linking beneficiaries and their families and their families' outcomes
Impacts of wage target and non-wage compensation enhancement	Not included	Data on effects in all types of labor markets (well-function and not) and effects on high-skilled employees and employee retention
Externalities of education	Described Qualitatively	Data on effects on economic growth, productivity and innovation, health and well-being, etc.
Improved access to mental health resources and substance abuse disorders effects on health and employment outcomes	Described Qualitatively	Data on additional outcomes (health, employment, etc.)
Consumption value of education	Described Qualitatively	Methodology on measuring consumption value of education
Non-pecuniary benefits of education	Described Qualitatively	Not specified
Spillover effects of education	Not included	Methodology on measuring the spillover effects of education
Increased dignity from reducing barriers for immigrants to health care access, employment, or shelter. Increased speed of the asylum process	Described qualitatively	Data and methodology to measure the societal benefit of dignity
Postsecondary institutions improving performance	Qualitatively described	Lack of data on past efforts

Table 6. Distributional Analysis: Specific Challenges Identified

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Proper attribution of incidence of costs and benefits	Described	Consistent methodology for all government agencies to follow
Effects of improving public health rules	Qualitatively described	Methodology for weighting schemes within regulations
Tribal Nations and Indigenous Peoples impacts of regulation	Qualitatively described	Data and methodology to facilitate including Tribal Nations and Indigenous Peoples impacts in regulation analyses
Labor effects for immigrants' timing of entry into the labor market	Partially described	Data and resources to quantify impacts
Spillover effects of education	Described, partially monetized	Methodology for measuring impacts
Distribution of benefits of education	Not included	Data to measure long term effects on different populations
Take up estimates	Not included	Methodology to quantify take up rates
Forecasting product demand and employment in the future	Described	Methodology to deal with uncertainty
Distributional impacts of updating wage methodology for H-2b workers	Qualitatively described	Data and methodology
Distinguishing between cultural, ceremonial, and Tribal Nations and Indigenous Peoples and nontribal subsistence fishing and recreational fishing	Described and quantified in certain analyses	Data on the motivation for fishing (subsistence, commercial) which would likely require a survey and therefore PRA approval
Effects of climate change on baseline conditions	Partially described	Data on current baseline conditions and methodology to measure changes
Assessment of risks and impacts of exposures to multiple chemicals, and non-chemical stressors	Roughly quantitatively estimated	Methodology to account for interactions amount multiple chemicals and impacts of non-chemical stressors on health
Disease incidence by race and ethnicity	Qualitatively described	Data and approved methodology
Predicting how many states will implement drug testing and how broadly it will be implemented	Described qualitatively	Methodology and models
Health equity	Described qualitatively	Data on health care access and outcomes across different groups
Consumption value of education	Described qualitatively	Current methodology

ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS

Non-pecuniary benefits of education	Described qualitatively	
Private costs of student loan default	Partially quantified	
Costs and benefits of communities conducting their own benefit costs analyses	Not included	Methodology to measure impact of detailed Benefit-Cost Analyses
Increased knowledge and skills gained from additional education and training	Described qualitatively	
Equity from disaster related assistance and removing barriers to access	Described qualitatively	Data on characteristics of FEMA benefits recipients
Dignity and fairness for individuals with disabilities	Described qualitatively	Data and concerns about monetizing civil rights
Quality of life effects of water resource projects	Not included	Data and methodology to measure quality of life
Value of maintaining Tribal Nations and Indigenous Peoples activities	Partially quantified	Methodology to measure traditional activities
Cultural aesthetic and spiritual value of marine or other natural spaces	Described qualitatively	Methodology to measure aesthetic value of coral reefs to Tribal Nations and Indigenous Peoples and local populations other than payment by divers
Estimates of elasticities (price, supply, demand, etc.) for use in analysis	Partially described	Up to date elasticity estimates
Value of collecting demographic information	Costs monetized; benefits described qualitatively	Difficult to untangle causality between collecting information and improving outcomes based on the data

Table 7. Risk Analysis: Specific Challenges Identified

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Reduction in fear of terrorist attacks	Described qualitatively	Methodology to measure and quantify societal fear
Reduction in fear for persons seeking becoming legal permanent residents	Described qualitatively	Data on the affected population and any reduction in other programs used
Increased dignity, particularly that of immigrants	Described qualitatively	Data to measure society benefit of dignity
Effects from reduced bus and rail safety incidents and delays	Partially described	Subject matter expertise and survey methodology to elicit stakeholder input
Insurance value of expanding income-driven repayment plans	Not included	Research on benefits to borrowers of consistent monthly take-home pay that income-driven repayment plans allow
Reduced default of student loan borrowers	Described qualitatively	Data and methodology to study impacts of reduced default
Reduced risk of student loan delinquency and default	Not quantified	Research including delinquency and default under alternative student loan repayment plans
Preventing environmental disasters including chemical spills and climate adaptation	Described qualitatively	Data on probability distribution of high impact, low probability events
Improving data and cybersecurity	Not included	Data on baseline risks and data on understanding the impacts of incremental risk reduction
Risk premium used to analyze regulatory benefits depending on macroeconomic conditions	Not included	Research on how effects of regulations vary with macroeconomic conditions. It is especially important to consider counter-cyclical regulations and regulations with no correlation with the business cycle
Cybersecurity risks related to US transportation and critical infrastructure	Benefits only described. Costs mostly monetized	Data on current baseline practices of regulated entities. Previous attempts to collect data from the public were not informative enough; better survey methodology to collect data
Avoiding potential attacks and disruption to US information and communication technology and services	Described qualitatively	Data and methodology to quantify effects beyond narrative discussion of impacts
Uncertainty around potential antidumping and countervailing duties	Described	Data, time, and resources, uncertainty challenges, policy and legal issues
Incorporating climate model scenarios (uncertainty related to inputs)	Not included	Lack of methodology to deal with the uncertainty
Safety risks for people and property on the ground from orbital debris re-entering atmosphere	Described qualitatively	Data limitations

ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS

Safety risks to people at open air events/assemblies	Qualitatively described	Extremely uncertain and speculative to effectively quantify safety benefits
Mitigation/risk-reduction costs from safety management systems	Qualitatively described	Methodology to predict or estimate mitigation measures that will be adopted by operators
Implementation of safety management systems for firms of different sizes	Partially quantified	Data and subject matter expertise
Option Value, such as the value of waiting for more information about risk before extracting natural resources	Described qualitatively	Quantitative data and models for specific decision contexts.

Table 8. Other Effects. In addition to the focal effects discussed in this Report, agencies identified other effects that could benefit from expanded analysis. These effects are listed here.

Specific Effect	When not fully monetized, some agencies report including the effect as...	Specific Challenge: Lack...
Enforcement of laws prohibiting discrimination against protected classes and against those who disclose their pay	Described	Methodology and data to place market value on achieved program goals
Uncertainty in forecasting product demand and employment in the future	Described	Data and methodology to deal with the uncertainty
Transaction costs of searching and hiring a new asset manager if previous manager became ineligible	Not included	Data on transaction costs
Adjusting contracts in response to a regulatory change	Qualitatively described	Data on costs
Costs related to changing computer systems for updated rules related to pension and health plan disclosures	Qualitatively described	Data on costs
Impact of requirement on state workforce agencies to use merit staff for ES services	Partially Quantified	Limitations on the number of states that can be surveyed due to PRA
Efficiency impacts of modifying AEWR methodology in the H-2A program	Qualitatively described	Data on local labor market conditions and foreign labor supply curves
Electronic security bond acceptance	Qualitatively described	Methodology to measure the overview of cost savings
Effect of workforce training and development on productivity and retention	Qualitatively described	Data on productivity gains after the final rule for individual workers
Clarification of job quality	Qualitatively described	Information on what makes jobs “good”
Registered apprenticeship programs for small businesses	Not included	Data collection tools like surveys and focus groups
Changes in allocation and share prices in IFQ programs due to changes in commercial quotas	Qualitatively described Expectations	Enough data on allocation and share prices
Marginal net benefits of fish in each fishing sector	Not included	Data on costs for commercial fisheries and preferences and behavior in recreational fisheries
Effects of outdoor recreational experiences (crowding, visual amenities, parking, bathrooms, etc.)	Qualitatively and quantitatively described	Data and time and resources to measure benefits to people
Loans for cybersecurity equipment and effects of refinancing as a lower interest rate paid by borrowers	Not quantified	Data on the number of loans in the future

ADVANCING THE FRONTIERS OF BENEFIT-COST ANALYSIS

Changes in opportunities and incentives for innovation	Rarely qualitatively described	General guidance on how to measure this and data to do so
Turnover effects in the workplace and on wages	Partially monetized	Credible resources to access information
Comfort from using efficient equipment	Not included	Data and methodology on workers benefits from better equipment
Macroeconomic impacts from energy bill savings	Not included	Data and methodology to measure impacts
Harmonization of international standards related to public safety, trade, manufacturing and transportation of good and services	Qualitatively described	Data on harmonization
Reduction in premature deaths from opioids	Qualitatively discussed	Data and number of deaths and uncertainty regarding supply-side drug policies
Increased integrity in the worker program, strengthened protections for workers who expose program or labor law violations. Additionally, harsher consequences for employers charging prohibited fees	Qualitatively discussed	Uncertainty regarding reduction in disincentives
Worker dignity and voice	Not included	Data on worker dignity and challenges with methodology
Effects of basic research	Partially monetized	Data on research programs that is not retrospective and on other effects outside of economic (jobs, local economies, output)
Effects of development of technologies for digital asset and new digital products	Partially monetized	Regulation on existing assets
Benefits from enabling additional space launches due to improved debris management	Qualitatively described	Difficult to model additional economic
Savings and efficiencies from reduced operational costs across a variety of Uncrewed Air Systems (UAS) applications	Summary tables and some examples	Data on small applications and operations enabled
Long term community cohesion	Not included	Methodology to place value on community viability
Currency-undervaluation subsidies for imported goods can have annual duties imposed to offset them	Partially quantified	Uncertainty challenges
CHIPS incentive program funding restrictions enforcements	Described Qualitatively	Uncertainty challenges
Increased equity for those in confinement facilities from reduced sexual victimization and increased dignity	Described qualitatively	Lack of data to quantify the societal benefit of equity
Addiction/consumer welfare	Described qualitatively	Methods and updated literature on benefits to users and society