

REFORMING THE IPCC'S ASSESSMENT OF CLIMATE CHANGE ECONOMICS

GABRIEL CHAN^{*,†,‡}, CARLO CARRARO^{†,‡,§§}, OTTMAR EDENHOFER^{§,¶,||,¶¶},
CHARLES KOLSTAD^{**,,|||} and ROBERT STAVINS^{††,***}

**Humphrey School of Public Affairs
University of Minnesota*

301 19th Avenue South, Minneapolis, MN 55455, United States

†Fondazione Eni Enrico Mattei

Isola di San Giorgio Maggiore, 8, 30124 Venice, Italy

‡Ca' Foscari University of Venice, San Giobbe 873, 30121 Venice, Italy

*§Mercator Research Institute on Global Commons and Climate Change
Torgauer Straße 12-15, 10829 Berlin, Germany*

*¶Potsdam Institute for Climate Impact Research
Postbox 601203, 14412 Potsdam, Germany*

||Technische Universität Berlin

Straße des 17. Juni 145, D-10623 Berlin, Germany

***Stanford University*

366 Galvez Street, Stanford, CA 94305, United States

*††John F. Kennedy School of Government
Harvard University*

79 John F. Kennedy St., Cambridge, MA 02138, United States

‡‡gabechan@umn.edu

§§carraro@feem.it

¶¶ottmar.edenhofer@pik-potsdam.de

|||ckolstad@stanford.edu

****robert_stavins@harvard.edu*

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The Intergovernmental Panel on Climate Change (IPCC) is broadly viewed as the world's most legitimate scientific assessment body that periodically assesses the economics of climate change (among many other topics) for policy audiences. However, growing procedural inefficiencies and limitations to substantive coverage have made the IPCC an increasingly unattractive forum for the most qualified climate economists. Drawing on our observations and personal experience working on the most recent IPCC report, published last year, we propose four reforms to the IPCC's process that we believe will lower the cost for volunteering as an IPCC author: improving interactions between governments and academics, making IPCC operations more efficient, clarifying and strengthening conflict of interest rules, and expanding outreach. We also propose three reforms to the IPCC's substantive coverage to clarify the IPCC's role and to make participation as an author more intellectually rewarding: complementing the IPCC with other initiatives, improving the integration of economics with other disciplines, and providing complete data for policymakers to make decisions. Despite the distinct characteristics of the IPCC

that create challenges for authors unlike those in any other review body, we continue to believe in the importance of the IPCC for providing the most visible line of public communication between the scholarly community and policymakers.

Keywords: Scientific assessment; intergovernmental panel on climate change (IPCC); scientific communication.

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC), which completed its Fifth Assessment Report (AR5) in 2014, provides the only comprehensive review of climate change science, impacts, and mitigation that draws on a government-sanctioned international body of scholars. Because of its official status as a United Nations body and the key role the IPCC plays in building an accepted consensus around scientific findings, the IPCC enjoys a high degree of legitimacy among policymakers.

The size and scope of the IPCC has grown significantly since its inception in 1988, reflecting the growing body of academic literature on climate change (Grieneisen and Zhang, 2011), but this growth has rendered the IPCC process increasingly cumbersome. In this paper, we assess the scope of the IPCC and the procedural rules governing the drafting of its reports, which reflect the political complexities underlying many issues in climate policy, and which foster an inefficient process that leads to final products that are far from ideal. Because of the IPCC's public prominence and unique legitimacy among policymakers and the public, improving the IPCC process and its products can be of considerable social value. With the recent completion of AR5, this is a good time to examine opportunities and challenges for reform.

The IPCC's coverage of the literature on climate change mitigation (and economics) has been traditionally concentrated in IPCC Working Group III (WGIII). The authors of this paper have been involved in nearly all levels of activity of WGIII and in the preparation of AR5.¹ This paper draws in part on their personal experiences, assessing the literature on climate change economics (and closely related fields), but some observations and recommendations may also be relevant to the IPCC's coverage of other disciplines and broader issues in climate change science, impacts, and mitigation.

2. The IPCC's Structure and Process

The IPCC was established in 1988 by the World Meteorological Organization and the United Nations Environment Program to assess and synthesize scientific research on climate change, its impacts, and response options.² The IPCC has since developed

¹Chan was a Chapter Scientist and Contributing Author, Working Group III of the IPCC's Fifth Assessment Report (AR5 WG-III); Carraro was Vice-Chair, AR5 WG-III; Edenhofer was Co-Chair of AR5 WG-III; Kolstad and Stavins were Coordinating Lead Authors, AR5 WG-III. We have drawn, in part, on: Carraro et al. (2015), Carraro et al. (2015), Stavins (2014a), and Edenhofer and Minx (2014). The authors of the present paper bear sole responsibility for its content; it is not intended to reflect official positions of the IPCC.

²For detailed accounts of the IPCC's history, see Bolin (2007), and Hulme and Mahoney (2010), as well as the references therein.

detailed sets of principles and procedures for writing assessment reports (IPCC, 2013, 2015). The IPCC is governed by a Plenary (composed of representatives of member governments), Bureau, Executive Committee, and Secretariat, which have distinct roles to provide oversight, develop procedures, and facilitate operation. Coverage of the scientific literature is divided into three Working Groups that respectively assess climate change science, impacts and adaptation, and mitigation. Authors are nominated by national governments, and selected by the IPCC Bureau. Authors serve as Coordinating Lead Authors (CLAs), with responsibility for leading the writing of a chapter, or as Lead Authors (LAs), who serve on a chapter team and participate in the writing process. CLAs and LAs participate in numerous meetings held at diverse locations around the world. Other experts serve as Contributing Authors (CAs), but the process for nominating these contributors is less formal, and the CAs typically do not participate in meetings and deliberations.

The assessment cycle for each round of the IPCC begins with a scoping process, wherein government representatives, together with a large group of scholars and other interested parties, draft outlines of each chapter of the IPCC. Following the scoping process, the IPCC Plenary approves the outlines, sometimes after some modification. CLAs and LAs are then nominated and subsequently approved by the IPCC Bureau. CLAs and LAs serve as volunteer labor, though some have their travel expenses reimbursed. In the AR5 WGIII process, Lead Author Meetings (LAMs) were convened four times from July 2011 to July 2013 (in Changwon, Korea; Wellington, New Zealand; Vigo, Spain; and Addis Ababa, Ethiopia). Over the course of the LAMs, CLAs lead their chapter teams to review relevant literature and prepare chapter text, tables, and figures.

At three points during this process, external Expert Reviewers and government representatives submit detailed comments on drafted text. These comments, numbering in the many thousands in AR5, are made public following the assessment cycle, and are checked by appointed Review Editors, who confirm that authors reply to comments appropriately. After four drafting rounds, the Working Group reports are preliminarily finalized. Towards the end of the assessment cycles, authors of each Working Group, primarily CLAs, engage in writing two summary documents for each report, a Technical Summary (TS) and a Summary for Policymakers (SPM). Finally, concurrent with much of the chapter-drafting process, a subset of CLAs and LAs from all three Working Groups convene to draft the Synthesis Report (SYR) and its SPM.³

3. Reforming the IPCC Process

We propose four reforms of the IPCC process, which would lower costs for the best researchers to participate in the IPCC and would in this and other ways improve the quality of the final products.

³Four LAMs for the AR5 SYR were held from June 2012 to June 2014 in Geneva, Switzerland; Oslo, Norway; De Bilt, Netherlands; and Kuala Lumpur, Malaysia.

3.1. *Improving interactions between governments and academics*

The IPCC is a nearly universal intergovernmental organization that commissions scholars to assess, summarize, and synthesize available literature. Academics typically operate with few constraints, beyond those self-imposed by the standards and norms of their academic discipline. For many, working within any convening institution, especially a governmental institution that at times behaves politically, is uncomfortable. The IPCC has worked hard to limit the influence of politics on science, most importantly by formally prescribing that its reports be policy relevant, but not policy prescriptive. However, more can be done to ensure that the IPCC's assessments retain their scientific integrity.

Government representatives play important roles in the IPCC author-selection process. At the beginning of each assessment, selected experts are invited to a Working-Group Scoping Meeting, where outlines and titles for each of the report's chapters are drafted. Following the Scoping Meeting, government representatives convene and may make substantial changes to the drafted chapter titles and outlines, but there is no direct interaction between governments and experts during this process. Following the government approval of chapter outlines, governments engage with the assessment process only when they submit their comments on the "Second Order Draft," typically produced about two years after the Scoping Meeting. These comments must be addressed by authors, but authors are under no obligation to implement any suggested revisions.

Importantly, at the end of the assessment process, governments engage directly with authors during week-long Approval Sessions, which immediately precede the release of reports. At these meetings, governments play a crucial role; they must unanimously approve the SPM of each Working Group, line-by-line.⁴ (The Approval Session for AR5 WGIII was held in April 2014, in Berlin.) The underlying chapters of IPCC reports and the TS are *not* approved line-by-line, and require only a blanket (up or down) approval — again unanimous. The SYR and its SPM are also subject to government approval in separate sessions. (The AR5 SYR approval session was held in October 2014 in Copenhagen, Denmark.)

This process of engaging national governments with a large number of experts during the scoping process, receiving nonbinding comments in a one-way dialogue more than halfway through the drafting process, and then negotiating the SPM document at length creates a highly structured engagement of scientists with policy-makers. This dialogue could be improved, in order to make the final IPCC reports of greater policy relevance, while decreasing procedural burdens on IPCC authors.

First, the process used at the Scoping Meetings and prior to the finalization of chapter outlines merits reform. Following the government editing and approval of the outlines and before writing begins, the broad outlines of the IPCC chapters are largely fixed; after the plenary during which outlines are accepted by governments, making

⁴An exception to the unanimity rule exists at the IPCC approval session chair's prerogative, whereby individual countries' objections can be acknowledged in footnotes.

amendments to chapter outlines is exceptionally difficult, requiring approval from the IPCC's Bureau. Therefore, developing sound outlines of chapters at the beginning has important implications for the effort authors expend to manage redundancy and the quality of final reports. For example, in AR5, the coverage of climate finance was separated across four chapters during the scoping process with required section headings on climate finance appearing in the three WGIII chapters on mitigation policy in addition to a new independent chapter on "Cross-Cutting Issues on Investment and Finance." The scoping process locked-in this overlapping coverage of the issue of climate finance, making the writing process more challenging for authors who had to repeatedly communicate with authors from other chapters to determine where sub-issues would be covered. It follows that this division also made it more difficult for readers to gain a comprehensive understanding of climate finance, as they must search across four chapters.

The scoping process could engage a small group of scholars with broad disciplinary and substantive expertise prior to the formal Scoping Meeting, in order to facilitate progress during the larger scoping meeting. This process would include authors of previous reports and authors with expertise spanning the scope of the three Working Groups (Griggs, 2014). In particular, economists and other social scientists could participate to highlight issues at the frontiers of their respective fields. However, engaging a broader community of scholars is not sufficient. A more effective scoping process would force deeper engagement and communication between scholars and governments. This could help move the IPCC reports closer to policy-relevant questions, framed in ways that governments will understand, while simultaneously providing an opportunity for scholars to provide checks to government questions by expressing the limitations of what assessments of scholarly literature can reasonably answer.

In addition to reforming the scoping process, difficulties associated with problematic communication between policymakers and authors at the final stage of the process could be remedied by more interactions between policymakers and scientists throughout the writing process. But increasing the frequency of interactions would require careful planning. First, this will inevitably be time consuming. Second, interactions need to be structured to avoid inefficient or ineffective communication. Both authors and governments need to come to the process with clear understanding and agreement regarding their respective roles and responsibilities. One approach could be for governments to pose clear formulations of policy-relevant questions to authors at the earliest stage. These questions could be responded to with drafted text integrated into the chapters or could be made into specific boxes within the report. Authors could then respond with amendments to questions with potential framings of answers. Then, through an iterative process, policymakers and scientists could come to agreement on the key questions they should seek to answer and the format in which they should provide their answers for the greatest policy relevance. Remaining unanswered questions could be included in the final reports as "knowledge gaps" to help shape the scholarly community's research agenda going forward. Third, more frequent

interactions could create real or perceived biases in the scientific assessment process. These interactions should be monitored carefully by third parties, such as national academies of science or the InterAcademy Council, who can enforce the primacy of the scientific mission of the IPCC.

3.2. Making IPCC operations more efficient

Working in the IPCC is an immense time commitment for authors, who are uncompensated, motivated by a commitment to scientific rigor and a desire to better understand and communicate climate change and its implications. The IPCC reports are valuable public goods that can improve policymakers' understanding of climate change, but the burdens placed on authors make many in the climate economics community shy away from becoming LAs or CLAs. The IPCC is in jeopardy of losing the participation of the most competent scholars if it does not reform its operations.

The top scholars in any field do not necessarily make the best IPCC authors, because LAs must have broad knowledge of the literature of a field, as opposed to frontier expertise in a narrow area. Also, in the case of CLAs, the necessary characteristics include organizational skills and leadership ability. That said, the burdens imposed on IPCC authors detract from the institution's ability to attract those most suited to the tasks.

A key reform the IPCC could implement to improve its procedural efficiency is to strengthen the roles of the Technical Support Unit (TSU) and its Chapter Scientists. The TSUs should remain as centralized bodies that provide logistical support to each of the Working Groups, coordinating all logistical issues for the Working Group reports, helping to manage references and data sources, coordinating cross-chapter and cross-Working Group communication, supporting the development of summary documents, and managing relations with IPCC vendors (for example, graphic design, typesetting/publishing, and event organization). A better understanding of the role of the TSU as a support group within the IPCC would reduce the emerging concern that the TSUs were a source of regional bias. Proposals to create multiple TSUs (one in an industrialized country and one in a developing country) for each Working Group report would lead to less, not greater efficiency. Geographic balance in TSUs could be achieved instead through more expansive global recruiting of professional staff, to be housed at a single location.

AR5 implemented a new measure to reduce burdens on CLAs by creating a role for "Chapter Scientists," who assisted chapter teams in a variety of substantive and logistical ways. Funding for Chapter Scientists was very limited but in some cases raised by individual CLAs, leading to additional burdens and potential unfairness across chapters. Moving forward, the IPCC should support and expand the Chapter Scientist program by allocating funding for the program and encouraging them to participate in all meetings. Chapter Scientists could be recruited as graduate student research assistants or professional support staff (Schulte-Uebbing et al., 2015).

A major driver of the great burdens placed on authors is the series of LAMs. The entire set of LAs in AR5 WGIII convened four times for one week each over the course

of the writing process. In addition, many CLAs were invited as experts to the Scoping Meeting at the outset of the process and most convened for the Approval Session at the end of the process. IPCC author meeting locations were selected to be in geographically balanced locations (i.e., on a variety of continents and in developed and developing countries) and required the availability of a venue willing to support the large costs of hosting an IPCC meeting. As a result, IPCC leadership found it challenging to identify willing hosts and these meetings were almost all held in cities far from airline hubs, requiring long connecting flights for most participants — further increasing the opportunity cost of time associated with participation.

Chapter teams should be allowed, indeed encouraged to rely on digital collaboration and communication technologies, such as videoconferencing and digital collaborative writing platforms. For developing country authors without reliable access to some of these technologies, UN regional facilities could provide support. This would mean that the LAMs could be shortened to two or three days, and reduced from four in-person meetings to two or three. Further, the IPCC should redouble efforts to host LAMs in conference centers in closer proximity to international travel hubs, thereby reducing travel time and expenses.⁵

In addition, the IPCC should consider complementing the large full assessment reports with short, targeted reports on specific, timely issues, such as the economics of geo-engineering or the promise and challenges of climate clubs as a substitute or a complement to the negotiations carried out under the United Nations Framework Convention on Climate Change (UNFCCC) (Griggs, 2014; Hulme *et al.*, 2010; Nature, 2013). Moving towards a structure of targeted reports that could be written and published over much shorter timeframes would reduce the burdens on authors and improve the policy relevance of the IPCC by moving assessment writing closer in time to the discovery of new findings.

3.3. Clarifying and strengthening conflict of interest rules

The author selection criteria employed by the IPCC are subject to the IPCC's Conflict of Interest (COI) policy, which was implemented for the first time with AR5. Prior to AR5, the InterAcademy Council, in its review of the IPCC's processes and procedures, recommended that “the IPCC should develop and adopt a rigorous COI policy that applies to all individuals directly involved in the preparation of IPCC reports” (InterAcademy Council, 2010). In response, the IPCC adopted an official COI policy in November 2011:

A “conflict of interest” refers to any current professional, financial or other interest which could: (i) significantly impair the individual's objectivity in carrying out his or her duties and responsibilities for the

⁵The funds saved by reducing the frequency and length of LAMs could be used to support Chapter Scientists and travel for the TSU, which does require in-person collaboration.

IPCC, or (ii) create an unfair advantage for any person or organization. For the purposes of this policy, circumstances that could lead a reasonable person to question an individual's objectivity, or whether an unfair advantage has been created, constitute a potential conflict of interest. These potential conflicts are subject to disclosure. (IPCC, 2011)

This definition from the IPCC closely mirrors the policy of the U.S. National Academies of Science (U.S. National Academies of Sciences, 2003), which was highlighted in the InterAcademy Council report.

COI definitions are complex, particularly with regard to the distinction between COI and bias. The IPCC is explicit on this issue: "Holding a view that one believes to be correct, but that one does not stand to gain from personally is not a conflict of interest" (IPCC, 2011). This clarification does not make it clear whether personal advantages created for an author's affiliated institution or employer are equivalent to personal gains. Further, the ambiguous phrase "other interest" in the IPCC's COI definition poses challenges, particularly with respect to whether "other interests" include political interests of one's employer. Clarifying these ambiguities should be made a priority, as many IPCC authors are employed by organizations (political or otherwise) that aim to influence climate policy. While the IPCC has been criticized for including authors from industry and nongovernmental organizations (Edenhofer, 2011), there is also the issue of authors directly employed by governments and other politically vested organizations.

The IPCC recognizes that authors will not be able to divorce themselves fully from their personal biases. With this recognition, the IPCC has taken the position that the bias of authors can be mitigated by creating author and leadership teams that are balanced in their biases. The IPCC's approach to mitigating bias by creating author teams that represent a wide variety of biases is reflected in its operational practice to create chapter author teams that are balanced in terms of disciplinary fields, professional background (academia, industry, and NGOs), and geographic location. As an operating principle, geographic balance has been taken to mean that chapter teams should be composed of authors who are currently living in a wide range of geographic regions, with particular focus on developed versus developing countries. To more accurately account for the ways in which personal experiences contribute to individual biases, the IPCC could reform implementation of its geographic balance criterion to focus on authors' countries of origin (not current habitation). Further, the IPCC might consider how diversity in authors' locale of education could be incorporated in procedures to create geographic balance (Corbera et al., 2015).

In the face of COI definitional ambiguity and the strong desire to create author teams that are geographically balanced, the IPCC has faced considerable pressure to relax its COI policy. In part motivated by the priority it gives to geographic balance, the IPCC has gone one step further than many research organizations by explicitly

adopting the policy of allowing authors with clear COIs to continue participating as LAs under “exceptional circumstances . . . where the individual is deemed to provide a unique contribution to an IPCC product and where it is determined that the conflict can be managed such that it will not have an adverse impact on the relevant IPCC report” (IPCC, 2011).

The IPCC has an important role to play in informing climate change policies at the sub-national, national, and international levels. In AR5, the IPCC appointed several authors who also held official government positions, in most cases as members of their respective countries’ climate-negotiating teams (in the UNFCCC process). Under the IPCC COI policy, these authors were allowed to participate as LAs of policy chapters, even when those chapters were directly related to their professional responsibilities. This constitutes a COI that should be unacceptable in the IPCC process, and is one with which the IPCC will need to deal urgently moving forward.

Authors currently working for governments in nonobjective positions⁶ should be declared to have a COI. Unlike financial COIs, COIs that are rooted in one’s institutional affiliation, employer, or political organization are more complex to understand in terms of what types of biases authors will hold, and these biases can more easily infect the writing process. Unfortunately, as indicated above, implementing a strict COI rule based on one’s institutional or political affiliation could have the effect of reducing the pool of developing country authors. As a matter of practice, many scholars in developing countries have been appointed to domestic political positions. Because of this, the IPCC should redouble its recruitment of developing country authors (based on national origin, not current location) to maintain author teams that have a balance of geographically originating biases without COI. As an organization that seeks to create policy relevant reports that are not policy prescriptive, the IPCC must attune itself to COIs rooted in institutional and political affiliations.

3.4. Expanding outreach related to IPCC products, with improved communication of the merits of each IPCC product

Each IPCC assessment produces a number of written products, across which the length and communication style varies. With careful attention to the various purposes of these products, the IPCC could improve its outreach and communication of results and strengthen its impact.

First and foremost among the IPCC assessment outputs are the main reports. Each of the three IPCC working groups (Working Group I – The Physical Science Basis, Working Group II – Impacts, Adaptation and Vulnerability, and Working Group III – Mitigation of Climate Change) produce individual reports. In AR5, the reports of the three working group totaled 1190, 1652, and 1325 pages, respectively. These reports are the main focus of the work of IPCC authors and Review Editors during the

⁶By this we mean government organizations that shape or advocate on behalf of policy positions, not independent government research organizations, such as the National Center for Atmospheric Research.

assessment process and contain full citations to the underlying literature. The material from the three working group reports are integrated in the SYR (151 pages in length in AR5), which is written by a subset of CLAs from the three working groups.

Authors of the three Working Group reports also contribute to a “TS” of each report. Under current practice, CLAs have primary authorship responsibilities for the Technical Summaries, but LAs can also contribute. The Technical Summaries in AR5 totaled 83, 58, and 75 pages, for the respective three Working Groups.⁷ Technical summaries are intended to integrate the chapters into a coherent single document, with citations referring to the underlying reports. Integration across chapters is very challenging, because chapter teams work independently during the report writing process (outside of the structured “cross-cut” process around specific topics) and because the chapters adhere to clearly defined topical boundaries.

In addition to the Technical Summaries, each working group report is summarized even more briefly in its SPM.⁸ In AR5, the SPMs were 27, 32, and 30 pages, respectively, for the three working groups. The most important way in which the SPMs differ from the Technical Summaries is the degree to which they are influenced by the national governments which make up the IPCC.

As noted, among all IPCC products, the SPMs are the only documents that governments must approve line-by-line. After the completion of the writing and reviews of the reports by authors and editors, government delegates and authors (primarily CLAs) convene for the Approval Session, where delegates from nearly every country in the United Nations spend a week reviewing a draft of the SPM line-by-line in a large auditorium.⁹ During the Approval Session, the underlying chapters and TS are also accepted by delegates, but these approvals are carried out in aggregate, and no substantive review of the material occurs. In contrast, government delegates exert substantial influence on the SPM, though the SPM text remains scientifically accurate. Delegates can suggest text or raise objections to text. Authors are able to propose revisions and can accept or reject delegate suggestions for revised text.

Delegates and authors must collectively reach consensus on every word of the SPM. In some cases of the AR5 coverage of climate change economics, government delegates intervened more heavily in the text. Notably, in several sections, governments chose to remove large portions of text, including nearly all coverage of international cooperation, rather than craft language that would be both substantively meaningful and unanimously agreeable (Clark, 2014; Stavins, 2014a). Together, the various ways in which governments influenced the SPM led some observers to label the SPM, the “Summary by Policymakers” (Stavins, 2014b).

⁷Working Group II included “Cross-Chapter Boxes” in its report directly following the Technical Summary. These boxes summarized material that appeared across chapters organized by themes such as “Coral Reefs” and “Gender in Climate Change” and were written at a level of depth comparable to a Technical Summary.

⁸The SYRt has its own SPMs.

⁹For a first-hand account of the AR5 WGIII SPM Approval Session, see Broome (2014).

The various IPCC products could be presented to IPCC consumers in ways which would render them more useful. The TS could be strongly marketed as *the* IPCC summary document that the IPCC authors themselves have created. Moreover, to reflect its content more accurately, it should be renamed the “Executive Summary,” because “TS” suggests that it is not accessible to nonscientists, which is not really the case. However, to make it more accessible, the IPCC could hire expert professional science communicators to facilitate the writing process. The TS could also be summarized further in a short format, of similar length to the SPM.

Behind these proposals to reform the summary documents is the notion that the material of the IPCC should be conveyed to audiences in a manner that is not influenced by governments. This would likely strengthen the credibility of the IPCC process in the view of the media and the general public. Due to institutional constraints and its negotiated character, it is unlikely that the IPCC would be willing to jettison the SPM, but it may be feasible to supplement the government-controlled SPM with additional summaries that are immune to political influence and control.¹⁰

Another important objective is to achieve a better and simpler communication strategy. It is hard to summarize all the facts about climate in just a few easy-to-understand sentences, but it is important for the IPCC itself to make the effort to summarize and simplify: if the IPCC does not do it, others will. Government delegations, NGOs, think tanks, and journalists craft different summaries of the IPCC's products, some more accurate than others. If the IPCC fails to control the chain of communication of the key findings of their reports from the very first link, it will run the risk that some parts may be misrepresented and misunderstood. This is a particular challenge for the communication of the findings of the WGIII report on climate change mitigation and its coverage of climate change economics. Many of the findings from WGIII can be oversimplified and made misleading. Despite AR5's improvements to communication strategies with alternative media (e.g., the public dissemination of presentation slides and videos), more can be done with digital media and 21st century approaches to information dissemination.

4. Reforming the IPCC's Coverage of Climate Change Economics

Two measures could improve the substantive coverage of climate change economics in scientific assessments. Improving the communication of the economics of global climate change to broad audiences of decision makers could require looking beyond the IPCC and including complementary research outside of economics.

¹⁰In addition to improving communication through more accessible writing and more clearly designed summary documents, the IPCC could broaden its readership by more closely aligning the timing of its assessments with the political processes it is designed to inform, that is, the negotiations under the United Nations Framework Convention on Climate Change.

4.1. Complementing the IPCC with other initiatives

The IPCC's role is fundamentally limited, due to its origin and nature as an UN-commissioned body. For example, there is considerable skepticism that the IPCC could ever effectively review the scholarly literature on the economics of international climate cooperation and other politically sensitive climate economics topics in its SPM because of the consensus-based nature of IPCC government deliberations. While the IPCC has effectively highlighted several emerging issues, IPCC documents can frequently be out of date by the time of their publication due to the lengthy review process. More broadly, nonpeer reviewed literature and research in progress are additional sources of scholarly insight but are not readily captured in the IPCC's reports.

Because of these limitations, the IPCC's work should be complemented with other assessment processes. These other processes could include work by institutions that review nonpeer-reviewed literature and research in progress, as well as those that can review politically sensitive issues. These complementary review processes could build on existing networks of scientific institutions, such as the Inter-Academy Council, or could be newly established for this purpose. In this way, climate assessment products could collectively offer a more comprehensive survey of knowledge, while individually becoming more flexible under clarified divisions of responsibility. By recognizing the existence of these complementary processes, the IPCC's mission could be clarified and its work made more efficient.

In addition, the IPCC could strengthen its engagement with other relevant scientific bodies and research communities to initiate new research projects, potentially commissioning research to fill identified knowledge gaps. Commissioned research could be evaluated during the assessment process or could fill a complementary role outside of the IPCC's mandate, such as evaluating the Intended Nationally Determined Contributions (INDCs) submitted by nations under the UNFCCC.

Another area in which the IPCC could benefit from greater cooperation with other institutions is in the identification of potential new LAs by leveraging existing networks of other organizations. In most countries, government agencies manage the author nomination process. For example, in the United States, the State Department manages the author selection process. This could be expanded by enticing national academies and professional societies to play a role in the process. To create author teams that are scientifically expert while maintaining geographic balance, national academies further removed from politics could be the locus of the author nomination process within each country. The academies tend to be more familiar than governments with academic communities. Giving them greater authority and input into the author selection process would not only increase the quality and decrease the politicization of the author selection process, but their involvement could also help increase the disciplinary diversity and representativeness of author teams.

Finally, the IPCC could support complementary educational and training organizations that build scholarly capacity in developing countries. The IPCC itself does not

have the finances nor mandate to execute this mission, but satisfying the criterion of geographic balance of authors without relying on authors with COI problems will require the development of a greater pool of developing country authors. The IPCC could give its endorsement and nonfinancial support to other institutions that create scientific expertise in developing countries focused on the economics and other social dimensions of climate change.

4.2. The IPCC could improve the integration of economics with other disciplines

IPCC coverage of the social sciences requires deeper integration of economics with other social science and natural science disciplines. In the social sciences, such integration is needed prior to the scoping meetings, and could be achieved, in part, by organizing the scoping process around policy-relevant questions. By focusing on practical questions, scholars might be forced out of their disciplinary boundaries to seek appropriate insights from all available sources. The process of designing policy-relevant questions could also assist in identifying which types of questions are not amenable to positive (as opposed to normative) scholarly response, so that these limitations of academic inquiry could be made explicit to policymakers from the outset.

The dividing lines between academic disciplines reflect divisions that exist in most academic organizations. But for a body such as the IPCC, such divides can be problematic when policymakers seek to understand issues organized by policy responses, rather than by disciplinary approach. For example, on the issue of international cooperation, insights from economics, political science, international relations, and law can provide valuable insights. Organizing thinking about international cooperation by discipline can leave an incomplete picture. Integrating social science thinking by policy issues is particularly challenging for the IPCC because some social science disciplines have not organized in a fashion that is supportive of such work. For example, political scientists who study issues of international cooperation have not drawn many explicit links between international relations theory and practice in the sphere of climate change (Victor, 2015). Developing these deeper links across the social sciences will require changes not only in the IPCC process, but also within academic communities.

Greater coordination across the IPCC's working groups would also facilitate improved coverage of key questions. For example, input from natural scientists and economists who study climate damages should mesh with the work of other economists in developing assessments of the literature that consider tradeoffs between mitigation and adaptation, including integrated assessment models. The IPCC Chair and the TSUs should work to enhance this type of coordination across Working Groups at multiple stages of the assessment process. While cross-Working Group coordination was facilitated in AR5 around specific issues, more could be done to force deeper integration, particularly around the issues of mitigation-adaptation tradeoffs and co-benefits.

4.3. The IPCC should provide complete data for policy makers to make decisions

The IPCC wisely keeps to its charge of being policy relevant but not policy prescriptive. But policymakers should be able to find the relevant information in IPCC documents to facilitate making policy decisions regarding climate change mitigation. Unfortunately, that is not always the case, particularly when it comes to the economics of climate change. Although scenarios and forecasts of future greenhouse gas emissions inform a major part of the WGIII report, basic information on mitigation costs and the costs of inaction was not provided in ways that could best be used by policymakers.

For example, AR5 WGIII uses models to generate aggregate costs associated with different greenhouse gas concentration pathways, but the information that a policy-maker from a given country might need to determine the costs to his or her economy from different actions is unavailable. Similarly, AR5 WGII on climate change impacts includes a great deal of information on the physical dimensions of climate change impacts but scant information on the monetary equivalent of these impacts, information many policy makers need to justify taking costly mitigation actions.

5. Conclusions

It has been more than 25 years since the inception of the IPCC. With the completion of its Fifth Assessment Report, it is time to consider significant reforms for the IPCC's assessment of the growing literature on climate change economics and other social science aspects of climate change. In this paper, we have proposed seven areas for reform that emerge from our experience at nearly every level of organization in the IPCC's latest assessment round.

We can say — with no reservations — that working for the IPCC was at times enormously frustrating. As an IPCC author, scholars can at times feel as if they were *in* the policy process, being forced to respond directly to critical government comments based on political sensitivity or even directly negotiating text with professional climate negotiators during the SPM Approval Sessions. Nevertheless, despite these distractions, we believe that because of its broad legitimacy, the IPCC remains a critical institution in the communication of scholarly knowledge about climate change. Only after engaging with the IPCC for many years did each of us conclude that the IPCC is an important institution for governments to understand the findings of academics. Engaging governments in often detailed deliberations over climate science, economics, and policy helps build a broadly shared knowledge base. There is a further, deeper value to the IPCC in that it communicates to governments and the general public that all governments party to the UNFCCC have agreed to the IPCC assessments as scientifically valid. The process of consensus-building around the SPM and the work of the underlying chapters plays a key motivating role in driving international climate negotiations (e.g., under the UNFCCC).

Engaging with the IPCC as authors has created new platforms for us to communicate some of the most important findings of our academic field. We took on the

responsibility of presenting the best literature of our field in a way that was of greatest policy relevance. But if scholars with a sound and balanced understanding of the literature are deterred from participating as IPCC authors and surrender the process to quasi-academics with political motivations, the potential harm to the policy process and the reputation of academia could be very great. There is a two-part responsibility to prevent this from happening. On the one hand, the IPCC must reform its operational procedures so that some of the more qualified scholars perceive the time investment as authors to be worthwhile. The IPCC must also reform itself on substantive grounds, in part by leveraging the work of complementary institutions. On the other hand, if the IPCC holds up its end of the deal, scholars of climate change economics should not dismiss the opportunity to provide public service by volunteering for the IPCC in its future assessments.

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