How science shapes mitigation assessments

Emilien Ravigné[1,2,3,4]

[1]CMCC Foundation - Euro-Mediterranean Center on Climate Change, Italy
[2]RFF-CMCC European Institute on Economics and the Environment, Italy
[3]Institute for New Economic Thinking at the Oxford Martin School, University of Oxford, Oxford, UK
[4]Smith School of Enterprise and the Environment, University of Oxford, Oxford, UK

Abstract

In 2025, the International Court of Justice identified IPCC reports as the best available climate science grounding legal judgment. The studies it selects to cite therefore carry outsized weight, as will those of similar assessment bodies emerging across domains. Here, I analyse 24,000 references across two Working Group III assessment reports (AR5 in 2014, AR6 in 2022), that I combine with secondary citations drawn from the bibliographies of IPCC-cited papers. I show that IPCC citations are driven by topic fit and are dominated by specialised rather than generalist high-prestige journals. Yet high-prestige journals exert substantial indirect influence, appearing up to 70 times more often in the reference lists of IPCC-cited papers as conceptual and methodological foundations. Citation turnover is rapid by design: only 9% of references persist between cycles. Together these features misalign policy impact with academic reward, with consequences for which researchers, methods, and regions shape mitigation policy.

Every six to eight years, the Intergovernmental Panel on Climate Change (IPCC) distils tens of thousands of scientific studies about climate change physics, impacts, mitigation and adaptation into an assessment report. These reports are used as key reference points for both scientific research and climate policy [1, 2], especially in the growing climate literature [3–6]. In a recent advisory opinion, the International Court of Justice explicitly identified IPCC assessments as "the best available science" underpinning the legal interpretation of states' obligations with respect to climate change [7][1], elevating the IPCC reports from a scientific synthesis to a basis for international jurisprudence. This recognition implies that evidence assessed by Working Group III specifically regarding mitigation, covering technologies, policies, and socio-economic conditions, may acquire legal salience when the reports are invoked as authoritative scientific baselines. What is included and excluded from the assessment is thus consequential.

As this model spreads across policy domains, understanding how assessment bodies select and synthesise literature becomes a question not just for climate governance but for science-policy interfaces. The IPCC has become a template for similar institutions, including the

[1]Paragraph 74, p35, "The Court will consider these issues in more detail. In so doing, it will rely primarily on the IPCC reports, which participants agree constitute the best available science on the causes, nature and consequences of climate change. ", and further paragraphs 75 to 87 discussing IPCC findings as context to the ruling.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Intergovernmental Science-Policy Panel on Chemicals, Waste and Pollution, and recent UN and non-UN international panels on artificial intelligence [8–12]. Across domains, these bodies help determine which evidence becomes authoritative.

As the climate literature has expanded and diversified, assessment authors must select a limited subset of studies. Prior work has documented the rapid topical expansion of climate research [3–5], examined early IPCC citation patterns [13], and critiqued persistent disciplinary, regional, and gender imbalances among IPCC authors [14–19]. However, systematic analysis of which literatures gain visibility through IPCC citation remains limited. Which research communities and journals are amplified and which remain peripheral shape how climate-mitigation knowledge is produced, integrated, and used [20–22].

Here, I analyse 24,449 unique references cited across two IPCC Working Group III assessment cycles (Table 1) to study how climate-mitigation research is selected. I distinguish between primary citations, papers cited directly by the IPCC, and secondary citations, the literature cited within those papers. I track which references appear, persist or drop out across successive reports. This reveals a divergence between journal prestige and policy-facing visibility: *Nature*, for example, appears 101 times in IPCC reference lists but 6,732 times in the bibliographies of IPCC-cited papers. By linking these patterns to author publication footprints, I show how assessment processes create distinct pathways to influence, with implications for knowledge diversity, research incentives and the organisation of policy-relevant science.

Results

Specialised journals dominate IPCC citations

I scraped 15,643 unique references in AR6 Working Group III and identified journals for 10,905 papers across 1,334 journals (Table 1). In absolute terms, *Energy Policy* leads with 522 citations, followed by *Environmental Research Letters* (349), *Journal of Cleaner Production* (325), and *Nature Climate Change* (302) (Figure 1, left). These counts reflect both mitigation focus and publication volume.

To account for journal size, I normalised citations by publication output over 2005–2020 (Figure 1, middle). *Climate Policy* has the highest selection intensity: 18% of papers published over that period appear in the IPCC bibliography. *Nature Climate Change*, *Nature Energy*, and *Nature Sustainability* also show elevated rates (7–9%), whereas *Nature* and *Science* remain below 2% and high-volume sectoral journals (e.g. *Journal of Cleaner Production*) fall once scale is accounted for.

I adjusted for the share of climate-relevant articles in each journal's output (Figure 1, right). *Research Policy*, *Climate Policy*, *Nature Sustainability*, and *Nature Energy* rank highest. Field-specific journals such as *Ecological Economics*, *Energy Economics*, and *Applied Energy* show mid-range selection rates. For *Nature* and *Science*, climate-related content represents about 12–15% of output, but this barely changes their selection rates, suggesting that topic fit, not prestige, drives direct IPCC inclusion.

Among economics journals, *Energy Policy* dominates citations, consistent with its leading h-index in climate-mitigation research [23]. When adjusted for climate-relevant content, however, generalist economics journals (the *American Economic Review*, the *Quarterly Journal of Economics*,

Table 1: **Reference statistics for AR5 and AR6**. Non-unique references count repeated citations across chapters. DOI coverage is incomplete (e.g., books, reports, grey literature). Some journals could not be reliably matched. OpenAlex secondary references are incomplete. The Total column illustrate the scale of each report, and is the sum of AR5 and AR6, it does not remove references that appear in both reports.

Metric	AR5	AR6	Total
Non-unique references	9391	18047	27438
Unique references	8806	15643	24449
Unique refs with a DOI	4776	11371	16147
Unique refs with a recognised journal	5107	10905	16012
Unique journals	799	1334	2133
Unique journals ($\geq$ 5 citations)	182	331	513
Unique refs with secondary references		9800	9800

and the *Journal of Political Economy*) show high selection rates: roughly 30–40% of their limited climate output appears in IPCC references. It indicates that prestigious economics journals have a clear impact on the IPCC and literature at large when they engage about mitigation. However, their aggregate impact is limited as they represent less than 0.5% of AR6 references.

Citation patterns vary systematically across chapters

Individual IPCC chapters do not draw uniformly from the climate literature. I grouped journals into epistemic clusters defined by shared disciplinary and topical orientations (see Methods), showing that each chapter relies on distinct research communities (Figure 2).

Framing chapters (1–5) cite mainly Global Change and Environmental Science journals, including *Nature Climate Change*, *Environmental Research Letters*, and *Global Environmental Change*. Sectoral chapters (6–11) rely on more specialised outlets: *Journal of Cleaner Production* in Chapter 11 (Industry), *Transport Reviews* and *Applied Energy* in Chapter 10 (Transport), and *Energy and Buildings* in Chapter 9 (Buildings). Cross-cutting chapters (12–17) have broader citation profiles, combining Policy & Governance, Environmental Economics, and interdisciplinary journals.

Two patterns stand out. First, *Energy Policy*, *Nature Climate Change*, and *Environmental Research Letters* are the only journals cited substantially across all three report sections, reflecting their position between technical mitigation research and policy assessment. Second, policy-oriented journals cluster mainly in the cross-cutting chapters, suggesting that policy relevance is concentrated in specific parts of the report rather than distributed evenly across the assessment.

Prestige journals exert influence indirectly, through secondary citations

Every paper cited by the IPCC brings its own reference list. These "secondary" citations are the literature that underpin IPCC-cited works. They reveal the methodological and conceptual foundations that support the assessment. The hypothesis is that some works influence the assessment report without being cited directly in the IPCC bibliography. I recovered secondary references for 9,800 primary sources (Table 1), yielding 476,783 secondary citations (235,739 unique papers, averaging ~50 per primary source).

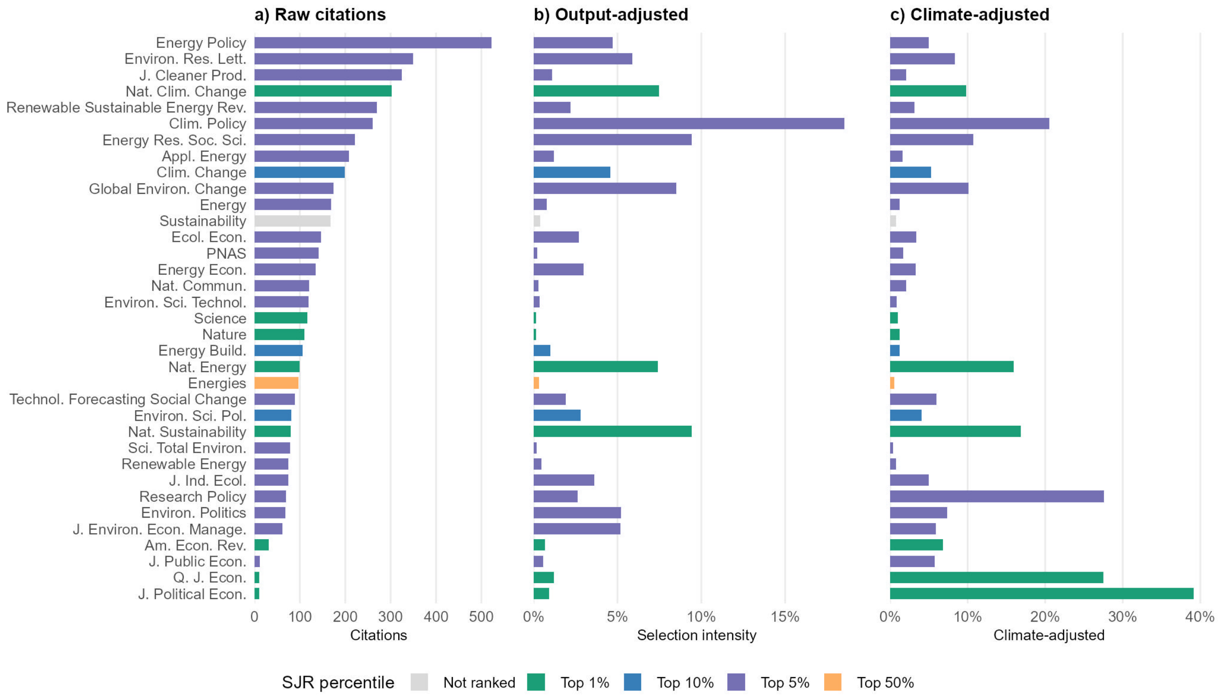


Figure 1: **Journal citation patterns in IPCC AR6 Working Group III.** Top 30 journals cited in AR6 WGIII, shown as absolute citation counts (**a**), normalised by average annual journal output (**b**), and normalised by average annual climate-relevant output (**c**). Colour indicates journal quality tier based on SCImago Journal Rank (SJR). The *Journal of Political Economy* and *Research Policy* achieve the highest selection intensity once corrected for climate output (resp. 40% and 27% of published papers cited), while generalist outlets (*Nature*, *Science*) exhibit rates below 2%. However, among economics journals, field-specific outlets (*Energy Policy*, *Ecological Economics*) substantially outperform traditional so-called "Top 5" journals in absolute citations.

The overall journal landscape is broadly consistent across the primary and secondary layers: most journals lie close to the 1:50 diagonal (Figure 3), which represents the average number of references per IPCC-cited paper. This suggests that their contribution to the report and the mitigation literature is stable whether assessed through direct IPCC citations or through the broader literature they support. *Energy Policy* dominates both axes, reflecting its central role in the mitigation literature at every level.

There are two systematic deviations from the relationship between the volumes of primary and secondary citations. *Nature* and *Science* have the highest secondary-to-primary ratios among high-volume journals. They appear far more frequently in the bibliographies of IPCC-cited papers than in the IPCC itself (a ratio of 1:70). This confirms that their influence is largely indirect, providing conceptual and methodological foundations. By contrast, *JEEM* and *World Development* fall below the diagonal, they are cited more often as primary sources by the IPCC than they are referenced secondarily. This indicates that their contributions tend to feed directly into assessments, with more limited diffusion of their contributions into the policy-oriented literature, or that they treat

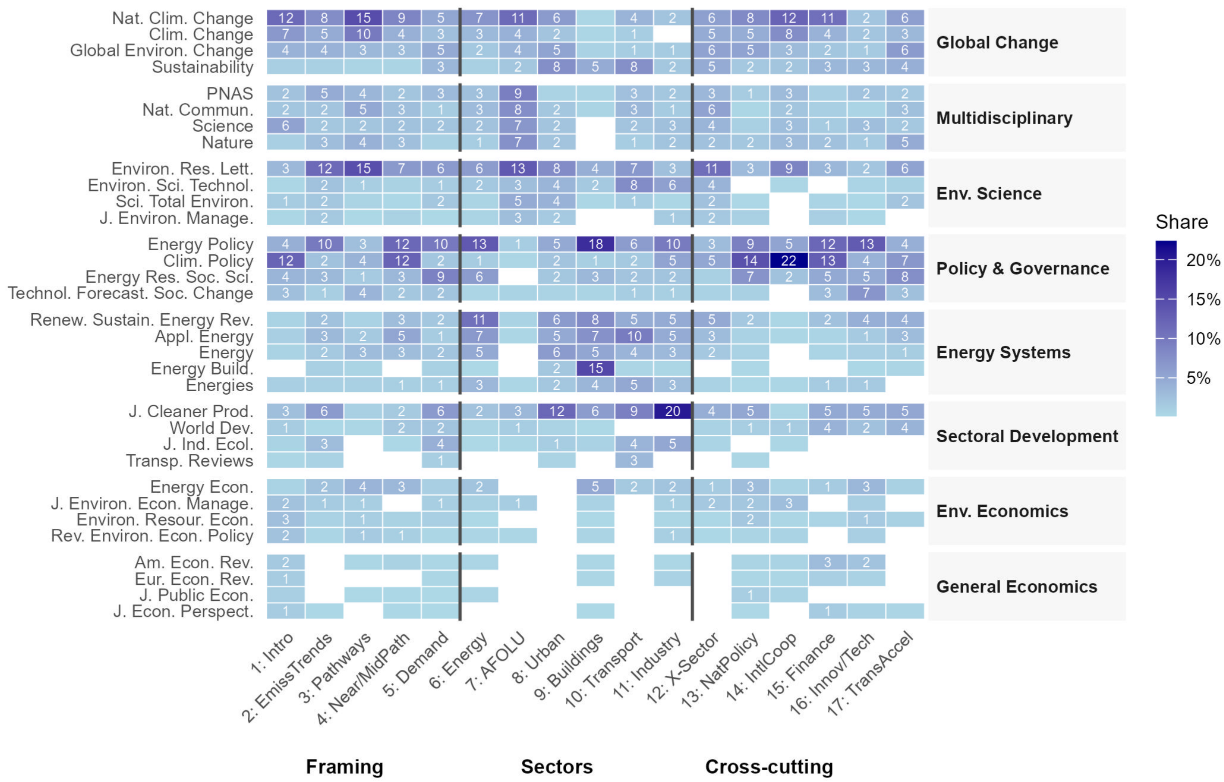
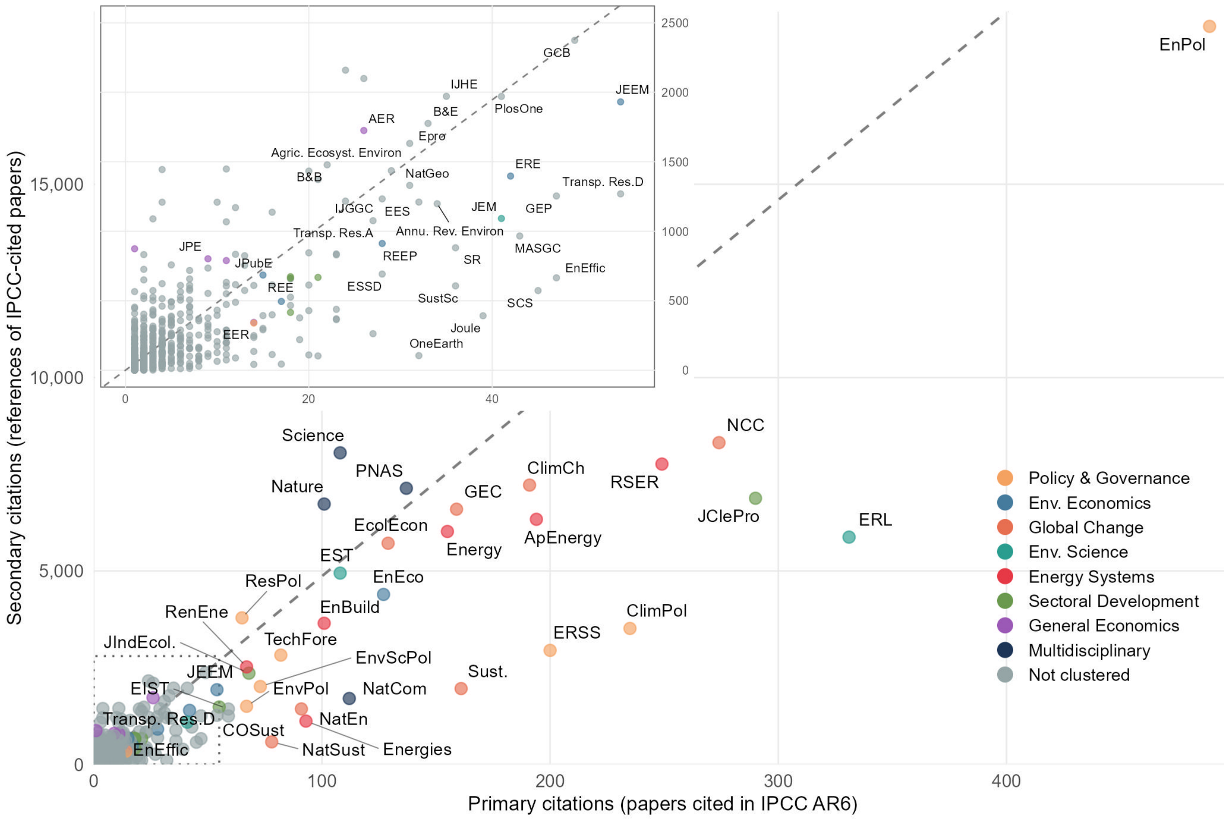


Figure 2: **Disciplinary specialisation of journal citations across IPCC chapters.** Share of citations from each journal cluster within each AR6 WGIII chapter, grouped into Framing (Chapters 1–5), Sectors (Chapters 6–11), and Cross-cutting (Chapters 12–17). Journals are organised into epistemic clusters based on shared disciplinary and topical orientations (see Methods). Shares sum to 100% within each chapter. Framing chapters draw predominantly on Global Change and Env. Science clusters, sectoral chapters on Energy Systems and Sectoral Development, and cross-cutting chapters show broader integration of Policy & Governance and economics outlets. *Energy Policy* appears across all three report sections, reflecting its cross-cutting role in the mitigation literature.

more applied questions.

The inset focuses on lower volume journals, especially economics journals (Figure 3, inset). *Econometrica* (ECMA) has only three primary citations in the IPCC corpus[2], yet appears 874 times as a secondary reference (352 unique papers), yielding one of the highest secondary-to-primary ratios in the dataset. A similar pattern holds for the *American Economic Review* with 39 primary citations (29 unique, 26 of which are matched to secondary references) versus 1,725 secondary mentions (578 unique), including 69 citations of a single paper, Acemoglu et al. (2012) [24]. These journals thus have methodological influence on the climate-mitigation literature but are not cited directly by the IPCC. Notably, econometrics and statistical journals are absent

[2] Of the three Econometrica papers cited by IPCC, I could only recover the reference list for one.



EnPol: Energy Policy; ERL: Environmental Research Letters; RSER: Renewable and Sustainable Energy Reviews; NCC: Nature Climate Change; JClePro: Journal of Cleaner Production; ApEnergy: Applied Energy; ClimCh: Climatic Change; ClimPol: Climate Policy; GEC: Global Environmental Change; GEP: Global Environmental Politics; ERE: Environmental and Resource Economics; GCB: Global Change Biology

Figure 3: **Primary versus secondary citation pathways in IPCC WGIII.** Each point represents a journal; the x-axis shows the number of times it is cited directly in AR6 WGIII (primary citations), and the y-axis the number of times it appears in the reference lists of IPCC-cited papers (secondary citations). The dashed line indicates a 1:50 primary-to-secondary ratio, which is an average of ~50 references per primary source. Journals above the line exhibit disproportionate secondary influence. Colours indicate epistemic cluster (see legend). Inset: zoomed view of the low-primary-citation region, where top economics journals (ECMA, AER, JPE) show elevated secondary-to-primary ratios despite minimal direct IPCC citation. Selected journal abbreviations are defined in SI Table A1.

from both layers. An analysis of methods used in economics confirms that causal inference which is the methodological signature of modern empirical economics remains under-adopted in environmental economics relative to other subfields [25].

Climate-mitigation research lacks canonical references

The most-cited papers in the AR6 WGIII corpus, as secondary references, appear in only 2–3%

of all references, so none can reasonably be described as a field anchor or canonical reference.[3] This contrasts with fields such as machine learning or statistical learning, where a small number of texts structure much of the literature.[4] Mitigation research lacks such reference points. Part of the reason is substantive: the field spans sectors, geographies and disciplines. But the pattern is also structural, since IPCC authors are encouraged to prioritise recent work rather than build a handbook. The result is rapid turnover between assessment cycles (Figure 4).

Ironically, IPCC reports themselves could play this anchoring role. The AR6 synthesis report [36] has accumulated more than 4038 citations, the technical report of the WGI has gathered more than 22,000 citations [37], and the Special Report on Global Warming of 1.5,°C [38] more than 3,900.[5] Yet the WGIII Summary for Policymakers [39] has received only about 400 citations, far fewer than the WGI contribution [40]. This asymmetry suggests that mitigation knowledge remains less organised around a single authoritative reference point, consistent with its interdisciplinary character [41].

The journal landscape is shifting, but a core persists

Between AR5 (2014) and AR6 (2022), the set of most-cited journals shifted considerably. Interdisciplinary journals made the largest gains. *Nature Climate Change* (founded 2011), *Nature Energy* (founded 2016), and *Nature Sustainability* (founded 2018) were either very new or nonexistent at the time of AR5 literature cut-off date. Their rapid rise reflects both their focus on IPCC-relevant issues and their position as high-level synthesis. Technical and specialised journals, (e.g. *Technological Forecasting and Social Change*, *Energy and Buildings*, *Renewable Energy*) also increased their presence (Figure 4b). A core set of energy and environment journals persisted across both cycles: *Energy Policy*, *Climatic Change*, *Climate Policy*, *Energy Economics*, and *Ecological Economics*. It highlights their centrality in the mitigation literature.

Only 8.8% of references cited in AR5 reappeared in AR6, reflecting rapid turnover in the assessed literature. The growing number of unique references, +77% between AR5 and AR6, means that only 3.6% of AR6 references had already appeared in AR5. This is by design, as authors are encouraged to focus on the literature published since the last report. Yet this low overall persistence conceals substantial heterogeneity across journals (Figure 4a). The most enduring references surviving eight years between assessment cycles tend to come from high-impact interdisciplinary journals (*Nature Climate Change*, *PNAS*, *Nature Geoscience*) and select economics and policy outlets (*Journal of Economic Literature*, *Review of Environmental Economics and Policy*, *Research Policy*), which show persistence rates of 20–40%. In contrast, the highest-volume journals in AR5, *Energy Policy*, *Climatic Change*, *Climate Policy*, show persistence rates of only 10–15%, indicating rapid replacement of their cited works between cycles.

This divergence suggests two distinct roles within the assessment. High-volume specialised journals supply the bulk of the evidentiary base but are quickly refreshed as the literature

[3] The five most-cited papers in the IPCC AR6 WGIII corpus are Riahi et al. (2017) on shared socioeconomic pathways (274 citations) [26], Smith et al. (2016) on negative-emission technologies (230) [27], Rogelj et al. (2016) on the gap between NDCs and the 2,°C target (227) [28], Geels (2002) on socio-technical transitions (222) [29], Unruh (2000) on carbon lock-in (191) [30] , Fuss et al. (2014) on negative emissions (189) [31], Rogelj et al. (2015) on the 1.5,°C target (184) [32], and O'Neill et al. (2014) on the SSP framework (182) [33].

[4] Such as Vaswani et al. (2017) [34] in machine learning (>180,000 citations), or Hastie (2009) [35] in statistical learning (>98,000).

[5] As of February 2026 using google.scholar.com.

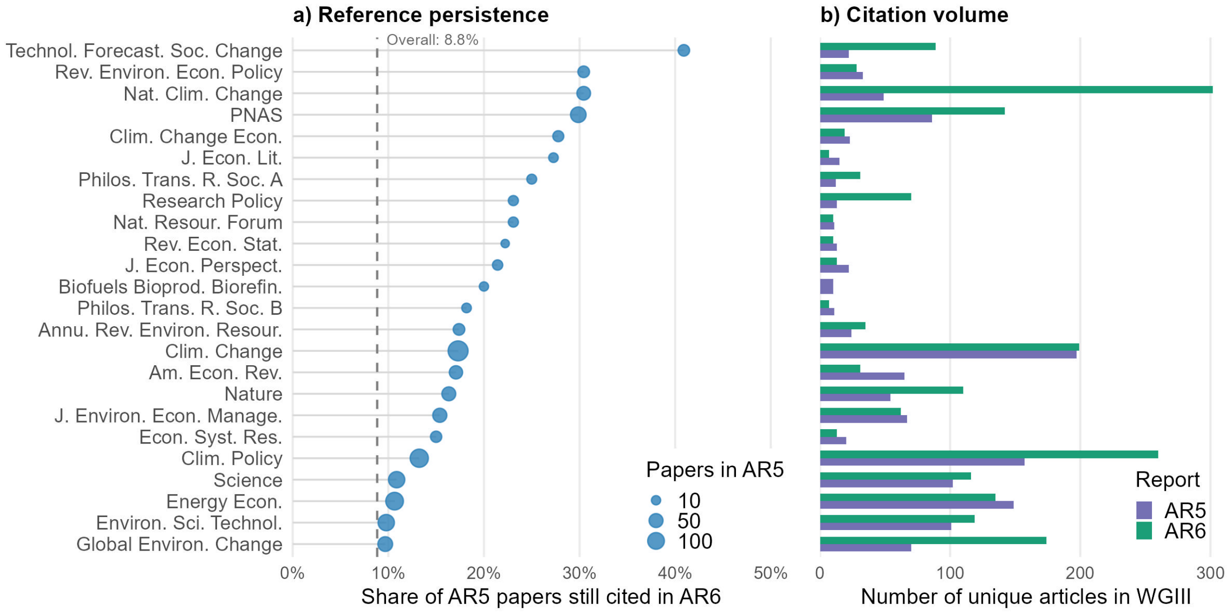


Figure 4: **Reference persistence and citation volume across AR5 and AR6.** (**a**) Share of AR5 references from each journal still cited in AR6, ordered by persistence rate. Bubble size indicates total AR5 references from that journal. The dashed line marks the overall persistence rate of AR5 to AR6 8.8%, reciprocally 3.6% of AR6 references were already cited in AR5. (**b**) Number of unique articles cited in WGIII from each journal in AR5 (purple) and AR6 (green). Interdisciplinary and Nature-branded journals expanded substantially between cycles, while a core set of energy-and-environment outlets maintained stable citation volumes.

advances. High-persistence journals contribute fewer but more durable references. They provide foundational works that remain relevant across assessment cycles and are used by papers cited directly by the IPCC. The relatively high survival of articles from economics and policy outlets may partly reflect longer review cycles in these fields: once published, such papers are less likely to be displaced by newer work within a single IPCC cycle.

Author publication footprints and strategic journal selection

The previous sections showed that topical fit, rather than journal prestige, drives IPCC citation. A related question is whether this selectivity simply reflects the publication habits of IPCC authors. I therefore examined the relationship between where AR6 WGIII authors published between 2000 and 2020 and which journals the report cites.

There is a strong correlation between the number of papers a journal has published from IPCC authors and the number of papers from that journal cited in the report (Figure 5a). About 94% of cited papers come from journals in which at least one AR6 author has published over the previous two decades. The remaining 6% spans fields such as biology, geoscience, law and engineering, suggesting selective interdisciplinary import rather than systematic reach beyond core communities.

Systematic deviations from proportionality, however, show that author presence alone does

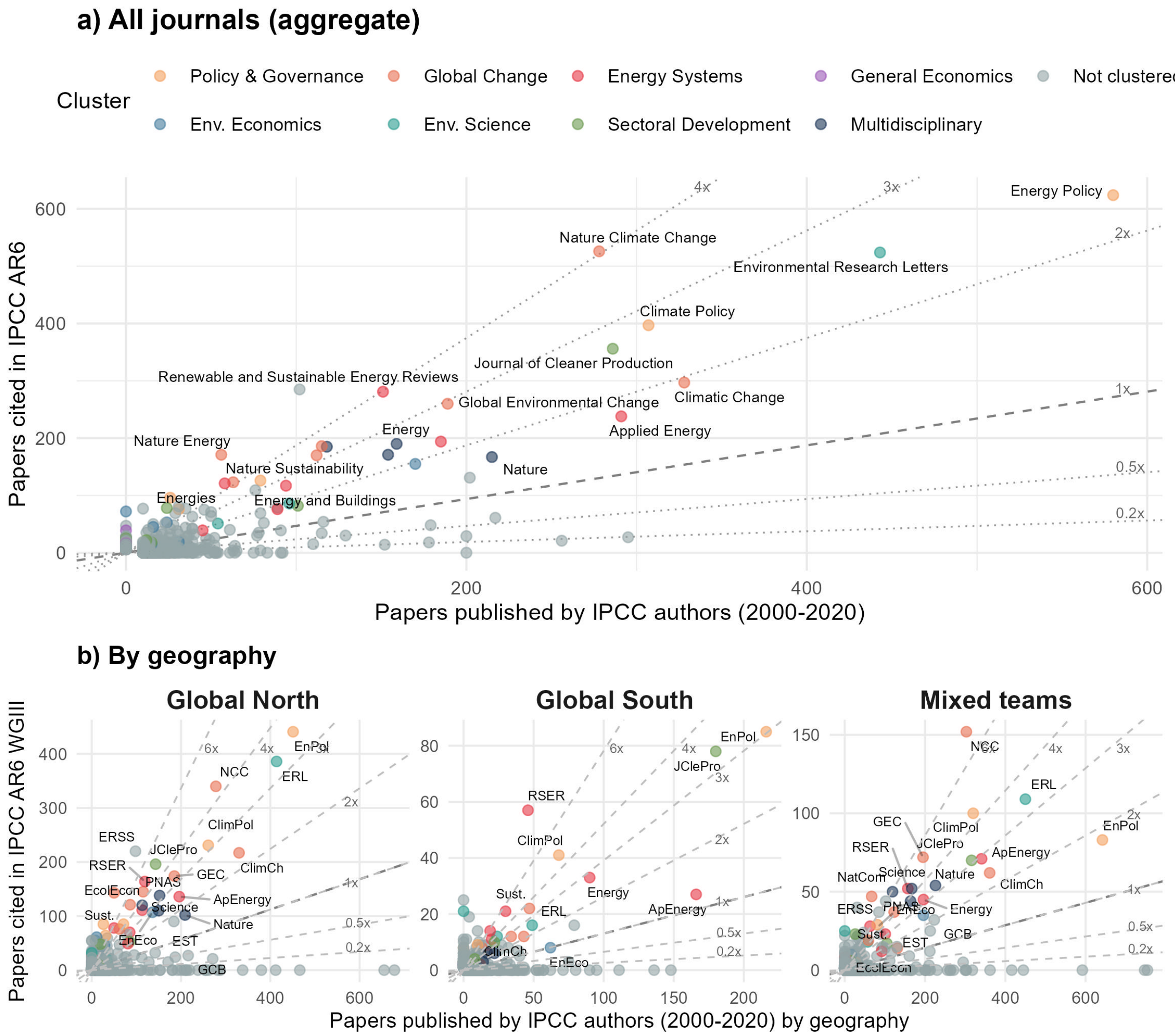


Figure 5: **IPCC citation intensity relative to author publication footprint.** **(a)** Papers published by AR6 WGIII authors (2000–2020) versus papers cited in AR6. The dashed line indicates the OLS fit (slope ≈ 0.41, $R^2 \approx 0.72$): journals above the 1× dotted line are over-cited relative to author presence. Dotted lines mark 0.2×, 0.5×, 2×, 3×, 4× citation-to-publication ratios. *Energy Policy* dominates both axes; synthesis-oriented outlets (*Nature Climate Change*, *Climate Policy*, *Environmental Research Letters*) are cited disproportionately, while economics journals (purple) cluster near or below the baseline. **(b)** Same analysis stratified by author geography. Panel definitions: Global North = x: pubs by GN IPCC authors, y: all-GN cited papers (all authors from Global North); Global South = x: pubs by GS IPCC authors, y: all-GS cited papers (all authors from Global South); Mixed teams = x: pubs by all IPCC authors (same as panel a), y: mixed GN-GS cited papers. Over-citation of Global South papers in *Renewable and Sustainable Energy Reviews* and *Climate Policy* suggests strategic geographic amplification.

not determine IPCC citation. The most IPCC-cited journals are cited more intensively than their share of IPCC-author publications would predict (above the 1× line in Figure 5a). *Nature Climate Change*, *Climate Policy* and *Environmental Research Letters* appear to serve synthesis and framing functions that the assessment draws on disproportionately. By contrast, more technical journals such as *Applied Energy*, *Energy Economics* and *Environmental Science & Technology* lie closer to the diagonal despite strong author engagement, indicating that they function primarily as publication outlets. *Energy Policy* occupies an intermediate position: it is the journal in which IPCC authors publish most, but it is still cited by the IPCC at more than twice the rate those publication counts alone would predict.

Not all high citation-to-publication ratios indicate selective quality-based import. In some high-volume gold open access journals (e.g. *Frontiers Climate Change*, *Frontiers in Energy Research*, *Palgrave Communications*[6]), such ratios are better explained by publication scale and selective uptake of individual papers than by stable reliance within the assessment process. By contrast, journals such as *Research Policy* and *Joule* appear to be selectively amplified relative to author publication footprints, suggesting targeted uptake of emerging interdisciplinary work in innovation and energy systems.

Prestigious generalist economics journals show a distinct pattern. They have a very high citation/publication ratio as only 2 IPCC AR6 authors had published in the *American Economic Review* in the last 20 years, while 39 papers are cited in the report, and no AR6 authors had published in the *Journal of Political Economy* (15 citations) or in the *Quarterly Journal of Economics* (12 citations). This suggests that when top economics journals engage directly with mitigation, their work enters the assessment on the basis of topical relevance rather than community ties.

Potential strategic geographic amplification

Structural barriers to publishing in high-prestige journals mean that Global South (GS) scholars are disproportionately represented in lower-ranked outlets [22, 42]. The disproportionate IPCC citation of some such journals (Figure 5a) may therefore be consistent with an effort to broaden the geographic diversity of cited work, although the evidence is indirect. To examine this, I classified cited papers as GS-only when all author affiliations are in GS countries, GN-only when all affiliations are in Global North (GN) countries, and mixed when affiliations span both. I then compared these citation patterns with the publication profiles of IPCC authors by geography, using the journal distribution of GS IPCC-author publications as a proxy for the broader publication opportunities and constraints facing GS scholars in this literature.

The evidence is mixed and journal-specific (Figure 5b). *Renewable and Sustainable Energy Reviews* and *Climate Policy* provide the clearest support for geographic amplification: GS-only papers are cited at rates above what their share of GS IPCC-author publications would predict. *Journal of Cleaner Production* mitigates this pattern. GS-only papers are cited well above the GS-specific proportionality baseline, but GN-only papers are even more strongly over-cited, and there are about twice as many GN-only as GS-only cited papers in the report. The journal therefore does amplify some GS scholarship, but its prominence in AR6 is driven more strongly by GN-authored work.

By contrast, high-impact journals such as *Nature Climate Change* and *Environmental Research Letters* are over-cited relative to publications by mixed and GN-only IPCC-author teams, reinforc-

[6] Now *Humanities and Social Sciences Communications* as of 2020.

ing the geographic concentration of citations. *Energy Policy*, the most cited journal and the main publication outlet for IPCC authors across all geographies, shows a broadly similar citation-to-publication ratio for GN, GS and mixed teams, offering no evidence of strategic amplification in either direction.

Overall, the results are consistent with limited geographic amplification. Over-representation relative to IPCC-author publication profiles appears confined to specific journals, and even there the cited literature remains dominated by Global North or mixed-author teams.

Discussion

The analysis shows that climate-mitigation research reaches IPCC Working Group III through two distinct pathways. Direct IPCC citations are shaped primarily by topic fit and policy relevance, whereas high-prestige generalist journals are cited less often in the report itself but exert influence indirectly through the conceptual and methodological foundations on which IPCC-cited papers rely. This means that if the secondary literature remains concentrated in Global North-dominated prestige journals, then broadening the IPCC bibliography would not substantially diversify the methods, frameworks and assumptions that structure the assessment. Meaningful diversification therefore requires stronger Global South presence not only in directly cited work, but also in the deeper conceptual and methodological layers of the literature.

These patterns also reveal a misalignment between academic reward systems and policy-facing scientific influence. Three types of outlet occupy distinct positions in this landscape. High-prestige interdisciplinary journals sit at the intersection: they are rewarded by university systems, generate broad visibility, and contribute durably to the assessed literature. Traditional top-tier disciplinary journals and methodological innovation command academic prestige and shape the secondary literature over long horizons [43]. Specialised, policy-adjacent journals do the heavy lifting in the IPCC assessment itself, supplying the bulk of the evidentiary base, yet they are less rewarded in conventional academic systems and do not offer as much visibility as the other types of publications.[7] For institutions, expanding what counts as "impact" to include assessment visibility, synthesis contributions, and cross-disciplinary engagement would realign academic incentives with the knowledge valued by policy assessment reports. For researchers, publication strategies aimed only at disciplinary prestige may therefore miss an important route to impact.

The correlation between authors' own publication venues and IPCC citations also points to a self-reinforcing dynamic: author selection shapes literature selection, helping reproduce established research communities [14, 15]. Although the IPCC has expanded commitments to diversity, this mechanism can still create blind spots where under-represented fields, methods or regions remain underweighted despite their relevance [44–47]. The pattern among top economics journals illustrates the selective expansion mechanism: when these journals engage about mitigation questions directly, their work enters the assessment. Meanwhile, economists' contributions to mitigation assessments remain limited, despite calls for deeper engagement of economic analysis [23, 48, 49]. Many biases in IPCC processes have been documented, and and

[7] See the French Research Centre (CNRS) ranking of journals (*Energy Policy* is 2/4). Most Economics department don't list *Energy Policy* at all (e.g. Lund Business School, LSE Economic department); the LSE ranking of journals for tenure at the department of Geography lists both *Energy Policy* and *Climate Policy* as third tier.

this has prompted calls and proposals for reforms, including broader collaboration with the public [44–47]. The IPBES has called for a higher engagement of the literature with transformation actions [50]. The IPCC has already committed significantly to diversity, ensuring a geographical and gender balance of authors on all chapters, and of the papers cited.

The practical implication for AR7 is that broadening literature coverage depends not only on citation practices, but also on broader diversity in authorship, disciplinary background and methodological orientation. Crucially, the IPCC cannot cite papers that do not exist. Geographic and methodological diversification of the assessment depends on journals, including prestigious journals, bearing the responsibility of actively publishing more diverse authors and approaches rather than leaving that burden to lower-ranked, policy-adjacent outlets.

If automated tools were to replace or augment human-led assessment, the feedback loop between author selection and literature selection might break, but so might the expert judgment that currently filters for rigour, policy relevance and novelty.

An assessment body like the IPCC is not merely synthesising a literature; it is building the field, defining and pushing its boundaries. In doing so, it occupies an uncomfortable space on a spectrum: from mirror, to amplifier of under-represented communities and disciplines, to gatekeeper. Where an assessment falls on this spectrum is not only a technical question but also a political one, because the consequences for knowledge visibility and policy salience are inherently political.

Methods

I analysed the full reference lists from two IPCC Working Group III assessment cycles: AR6 (2022) and AR5 (2014). References were linked to external bibliometric databases to characterise journal selection patterns, author publication footprints, and the secondary literature that underpins directly cited work. Full replication code and raw outputs are archived online.

Reference extraction

References were extracted from PDF bibliography sections using a custom parser (detailed in Supplementary Methods) that identifies author blocks, publication years, and journal titles. The parser reconciles the two-column format and handles formatting inconsistencies across reports. After extraction and manual verification of ambiguous cases, the final dataset contains 18,047 reference instances corresponding to 15,643 unique works in AR6, and 9,391 instances (8,806 unique) in AR5 (Table 1).

Secondary citations

To distinguish between journals directly cited by the IPCC (primary citations) and those cited within IPCC-referenced papers (secondary citations), I retrieved the full reference lists of all successfully matched AR6 sources via the OpenAlex "referenced_works" endpoint. This yielded 476,783 secondary citations (235,739 unique works) from 9,800 primary sources, averaging approximately 50 references per primary paper. Some papers could not be linked to reference lists, either because no reference list was available or because the metadata were incomplete. The sample for which I could retrieve secondary citations is representative of the whole sample in terms of journals and years. This two-layer structure reveals how high-prestige journals shape the assessment indirectly by providing methodological foundations for directly cited work.

Metadata matching

Metadata—publication years, citation counts, reference lists—were retrieved via two APIs: OpenAlex (open-source, providing citation coverage from 2012–2024) and Scopus (proprietary, 1970–present). Matching proceeded hierarchically: DOI-based lookups where available, followed by title-journal-year searches with Levenshtein similarity thresholds ($\geq$0.80), with remaining ambiguous cases resolved manually. For AR6, I used OpenAlex; for AR5, which predates OpenAlex's citation coverage, I relied on Scopus. Matching succeeded for 10,905 unique AR6 references, and 5,107 AR5 references.

Journal normalisation

Journal names were normalised to canonical forms using Web of Science and University of British Columbia abbreviation databases, supplemented by OpenAlex metadata retrieved via DOI lookups. The procedure, iterated across multiple rounds and detailed in Supplementary Methods, reconciled variants (capitalisation, abbreviations, punctuation errors introduced by PDF parsing) to a single standard form for each outlet.

Journal classification

To assign each outlet both an epistemic tag and a quality tier, I used the 2024 SCImago Journal Rank (SJR), collapsed to quartiles (Q1–Q4) and manually clustered top journals in Global Change, Energy Systems, Policy & Governance, Environmental Economics, and others—based on shared disciplinary and topical orientations, used in chapter-level citation analysis (Figure 2).

For select results normalised by climate-relevant output, I identified climate papers in generalist journals using OpenAlex topic classifications. A paper is classified as climate-related if at least one assigned topic contains keywords such as "Energy," "Environment," "Climate," "Emissions," "Sustainability," "CO_2," or "Carbon" (Supplementary Methods). For robustness, I used the same metric as [23], limited to climate and emissions, and restricted to economics journals. Results are similar.

Author publication footprints

IPCC author publication footprints were constructed by querying OpenAlex for all papers authored between 2000–2020 by 444 AR6 WGIII coordinating lead authors, lead authors, and contributing authors. These 444 individuals are drawn from a total of 483 IPCC authors; the remaining authors either had no publications prior to 2020 or could not be matched to an identifiable OpenAlex ID. Author name disambiguation required manual verification, as the OpenAlex API often returned the most-cited author with a given name rather than the correct IPCC contributor. After data cleaning, 44,809 unique publications were retained for analysis, corresponding to 57,058 paper–author pairs (reflecting cases in which multiple IPCC authors co-authored the same paper) . This dataset enabled testing whether citation patterns reflect author publication venues.

Persistence calculation
Persistence between AR5 and AR6 was calculated as the share of unique AR5 references that reappeared in AR6, identifying which journals contribute durable versus rapidly refreshed contributions to the assessed literature.

Limitations
Coverage varies by source: OpenAlex citation data begin in 2012, requiring Scopus for AR5 historical analysis. Reference extraction via PDF parsing is reliable but not exhaustive; visual inspection and manual correction addressed formatting anomalies, though residual errors may persist. The economics findings regarding selection rates for top journals (AER, QJE, JPE) are based on journal-level rather than paper-level matching to climate-relevant content and should be interpreted with appropriate caution.

Data Availability

Replication code and processed datasets are available at GitHub repository *Which science reaches IPCC*. Raw IPCC reports are publicly available at https://www.ipcc.ch/reports/.

Authors contributions

E.R. designed the study, collected and analysed the data, and wrote the manuscript.

Competing interest

The author declares no competing interests.

Acknowledgements

The author is grateful to Sam Fankhauser, Franck Lecocq, Céline Guivarch, Johannes Emmerling, Adam Ferris, Rick Von der Ploeg, Eugénie Joltreau, Valentina Bosetti, Massimo Tavoni and Linus Mattauch for helpful discussions and feedback, and to Loïc Henry for sharing his data on the share of works dedicated to climate in economics journals.

References

[1] Vasileiadou, E., Heimeriks, G. & Petersen, A. C. Exploring the impact of the IPCC Assessment Reports on science. *Environmental Science & Policy* **14**, 1052–1061 (2011). URL https://www.sciencedirect.com/science/article/pii/S1462901111001080.

[2] Doran, R., Ogunbode, C. A., Böhm, G. & Gregersen, T. Exposure to and learning from the IPCC special report on 1.5 °C global warming, and public support for climate protests and mitigation policies. *npj Climate Action* **2**, 1–9 (2023). URL https://www.nature.com/articles/s44168-023-00042-9. Publisher: Nature Publishing Group.

[3] Callaghan, M. W., Minx, J. C. & Forster, P. M. A topography of climate change research. *Nature Climate Change* **10**, 118–123 (2020). URL https://www.nature.com/articles/s41558-019-0684-5. Publisher: Nature Publishing Group.

[4] Grieneisen, M. L. & Zhang, M. The current status of climate change research. *Nature Climate Change* **1**, 72–73 (2011). URL https://www.nature.com/articles/nclimate1093. Publisher: Nature Publishing Group.

[5] Minx, J. C., Callaghan, M., Lamb, W. F., Garard, J. & Edenhofer, O. Learning about climate change solutions in the IPCC and beyond. *Environmental Science & Policy* **77**, 252–259 (2017). URL https://www.sciencedirect.com/science/article/pii/S1462901117305464.

[6] Haunschild, R., Bornmann, L. & Marx, W. Climate Change Research in View of Bibliometrics. *PLOS ONE* **11**, e0160393 (2016). URL https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0160393. Publisher: Public Library of Science.

[7] ICJ. Obligations of States in respect of Climate Change (Advisory Opinion) (2025).

[8] United Nations Environment Programme. Intergovernmental science-policy panel on chemicals, waste and pollution (ISPCWP) (2025). URL https://www.unep.org/isp-cwp. Accessed: 2026-02-17.

[9] United Nations. Independent international scientific panel on AI (2025). URL https://www.un.org/independent-international-scientific-panel-ai/en. Accessed: 2026-02-17.

[10] Gibney, E. Un creates new scientific ai advisory panel: what will it do? *Nature* (2026). URL https://www.nature.com/articles/d41586-026-00542-8. News article.

[11] Government of Canada. Mandate of the International Panel on Artificial Intelligence (2018). URL https://www.pm.gc.ca/en/news/backgrounders/2018/12/06/mandate-international-panel-artificial-intelligence. Accessed: 2026-02-17.

[12] Bengio, Y. *et al.* International ai safety report. *arXiv preprint arXiv:2501.17805* (2025).

[13] Bjurström, A. & Polk, M. Climate change and interdisciplinarity: a co-citation analysis of IPCC Third Assessment Report (2011). URL https://akjournals.com/view/journals/11192/87/3/article-p525.xml. Section: Scientometrics.

[14] Hughes, H. R. & Paterson, M. Narrowing the Climate Field: The Symbolic Power of Authors in the IPCC's Assessment of Mitigation. *Review of Policy Research* **34**, 744–766 (2017). URL https://onlinelibrary.wiley.com/doi/abs/10.1111/ropr.12255. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/ropr.12255.

[15] Hughes, H. & Vadrot, A. B. M. Weighting the World: IPBES and the Struggle over Biocultural Diversity. *Global Environmental Politics* **19**, 14–37 (2019). URL https://doi.org/10.1162/glep_a_00503.

[16] Corbera, E., Calvet-Mir, L., Hughes, H. & Paterson, M. Patterns of authorship in the IPCC Working Group III report. *Nature Climate Change* **6**, 94–99 (2016). URL https://www.nature.com/articles/nclimate2782. Publisher: Nature Publishing Group.

[17] Pollitt, H., Mercure, J.-F., Barker, T., Salas, P. & Scrieciu, S. The role of the IPCC in assessing actionable evidence for climate policymaking. *npj Climate Action* **3**, 11 (2024). URL https://www.nature.com/articles/s44168-023-00094-x. Publisher: Nature Publishing Group.

[18] Gay-Antaki, M. & Liverman, D. Climate for women in climate science: Women scientists and the Intergovernmental Panel on Climate Change. *Proceedings of the National Academy of Sciences* **115**, 2060–2065 (2018). URL https://www.pnas.org/doi/abs/10.1073/pnas.1710271115. Publisher: Proceedings of the National Academy of Sciences.

[19] Tandon, A. Analysis: How the diversity of IPCC authors has changed over three decades (2023). URL https://www.carbonbrief.org/analysis-how-the-diversity-of-ipcc-authors-has-changed-over-three-decades/.

[20] Amarante, V. *et al.* Underrepresentation of developing country researchers in development research. *Applied Economics Letters* **29**, 1659–1664 (2022). URL https://doi.org/10.1080/13504851.2021.1965528. Publisher: Routledge _eprint: https://doi.org/10.1080/13504851.2021.1965528.

[21] Baninla, Y. *et al.* An overview of climate change adaptation and mitigation research in Africa. *Frontiers in Climate* **4** (2022). URL https://www.frontiersin.org/journals/climate/articles/10.3389/fclim.2022.976427/full. Publisher: Frontiers.

[22] Aigner, E., Greenspon, J. & Rodrik, D. The global distribution of authorship in economics journals. *World Development* **189**, 106926 (2025). URL https://www.sciencedirect.com/science/article/pii/S0305750X25000099.

[23] Henry, L. Have economists really "let down the world"? A quantitative overview of the economic literature on climate change (2025). URL https://www.dropbox.com/scl/fi/6vtpt4gbn9h4ai7w9waim/CC_Econ_SystRev_WP2.pdf?dl=0&rlkey=7em0d97n0gtsj1px3gxhxkreu&st=3r9k2bgt.

[24] Acemoglu, D., Aghion, P., Bursztyn, L. & Hemous, D. The Environment and Directed Technical Change. *American Economic Review* **102**, 131–166 (2012). URL https://www.aeaweb.org/articles?id=10.1257/aer.102.1.131.

[25] Garg, P. & Fetzer, T. Causal Claims in Economics (2025). URL https://arxiv.org/abs/2501.06873v1.

[26] Riahi, K. *et al.* The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change* **42**, 153–168 (2017). URL https://www.sciencedirect.com/science/article/pii/S0959378016300681.

[27] Smith, P. *et al.* Biophysical and economic limits to negative CO2 emissions. *Nature Climate Change* **6**, 42–50 (2016). URL https://www.nature.com/articles/nclimate2870. Publisher: Nature Publishing Group.

[28] Rogelj, J. *et al.* Paris Agreement climate proposals need a boost to keep warming well below 2 °C. *Nature* **534**, 631–639 (2016). URL https://www.nature.com/articles/nature18307. Publisher: Nature Publishing Group.

[29] Geels, F. W. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy* **31**, 1257–1274 (2002). URL https://www.sciencedirect.com/science/article/pii/S0048733302000628.

[30] Unruh, G. C. Understanding carbon lock-in. *Energy policy* **28**, 817–830 (2000).

[31] Fuss, S. *et al.* Betting on negative emissions. *Nature climate change* **4**, 850–853 (2014).

[32] Rogelj, J. *et al.* Energy system transformations for limiting end-of-century warming to below 1.5 c. *Nature climate change* **5**, 519–527 (2015).

[33] O'Neill, B. C. *et al.* A new scenario framework for climate change research: the concept of shared socioeconomic pathways. *Climatic Change* **122**, 387–400 (2014). URL https://doi.org/10.1007/s10584-013-0905-2.

[34] Vaswani, A. *et al.* Attention is all you need. *Advances in neural information processing systems* **30** (2017). URL https://proceedings.neurips.cc/paper/2017/hash/3f5ee243547dee91fbd053c1c4a845aa-Abstract.html.

[35] Hastie, T. The elements of statistical learning: data mining, inference, and prediction (2009).

[36] Calvin, K. *et al.* IPCC, 2023: Climate Change 2023: Synthesis Report, Summary for Policymakers. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland. *IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland.* 1–34 (2023). URL https://scholar.google.com/scholar?cluster=11066816672331211247&hl=en&oi=scholarr. Publisher: Intergovernmental Panel on Climate Change (IPCC).

[37] Arias, P. *et al.* Climate change 2021: the physical science basis. contribution of working group i to the sixth assessment report of the intergovernmental panel on climate change; technical summary (2021).

[38] Masson-Delmotte, V. *et al.* *Global Warming of 1.5 C: IPCC special report on impacts of global warming of 1.5 C above pre-industrial levels in context of strengthening response to climate change, sustainable development, and efforts to eradicate poverty* (Cambridge University Press, 2022). URL https://dlib.hust.edu.vn/handle/HUST/21737.

[39] Shukla, P. R. *et al.* Climate change 2022: Mitigation of climate change. *Contribution of working group III to the sixth assessment report of the Intergovernmental Panel on Climate Change* **10**, 9781009157926 (2022). URL https://www.cambridge.org/core/services/aop-cambridge-core/content/view/70F7403D701D9CB8E27EA2CA4ABAFEF8/9781009157933pre1_i-ii.pdf/frontmatter.pdf. Publisher: Cambridge University Press Cambridge, UK.

[40] Masson-Delmotte, V. *et al.* Climate change 2021: the physical science basis. *Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change* **2**, 2391 (2021). URL https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FrontMatter.pdf. Publisher: Cambridge University Press Cambridge, UK.

[41] Mammola, S., Fontaneto, D., Martínez, A. & Chichorro, F. Impact of the reference list features on the number of citations. *Scientometrics* **126**, 785–799 (2021). URL https://doi.org/10.1007/s11192-020-03759-0.

[42] Demeter, M. *Academic knowledge production and the global south: Questioning inequality and under-representation* (Springer, 2020).

[43] Heckman, J. J. & Moktan, S. Publishing and Promotion in Economics: The Tyranny of the Top Five. *Journal of Economic Literature* **58**, 419–470 (2020). URL https://www.aeaweb.org/articles?id=10.1257/jel.20191574.

[44] Hermansen, E. A. T., Boasson, E. L. & Peters, G. P. Climate action post-Paris: how can the IPCC stay relevant? *npj Climate Action* **2**, 1–8 (2023). URL https://www.nature.com/articles/s44168-023-00058-1. Publisher: Nature Publishing Group.

[45] Carraro, C. *et al.* The IPCC at a crossroads: Opportunities for reform. *Science* **350**, 34–35 (2015). URL https://www.science.org/doi/full/10.1126/science.aac4419. Publisher: American Association for the Advancement of Science.

[46] Asayama, S. *et al.* Three institutional pathways to envision the future of the IPCC. *Nature Climate Change* **13**, 877–880 (2023). URL https://www.nature.com/articles/s41558-023-01780-8. Publisher: Nature Publishing Group.

[47] De-Gol, A. J., Le Quéré, C., Smith, A. J. P. & Aubin Le Quéré, M. Broadening scientific engagement and inclusivity in IPCC reports through collaborative technology platforms. *npj Climate Action* **2**, 1–9 (2023). URL https://www.nature.com/articles/s44168-023-00072-3. Publisher: Nature Publishing Group.

[48] Noy, I. Economists are not engaged enough with the IPCC. *npj Climate Action* **2**, 1–8 (2023). URL https://www.nature.com/articles/s44168-023-00064-3. Publisher: Nature Publishing Group.

[49] El Tinay, H. & Schor, J. B. Do economists think about climate change and inequality? Semantic analysis and topic modeling of top five economics journals. *Ecological Economics* **232**, 108548 (2025). URL https://www.sciencedirect.com/science/article/pii/S092180092500031X.

[50] Reyes-García, V. *et al.* Actions and actors driving transformative change for global sustainability. *Nature Sustainability* 1–9 (2026).