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Commentary

Unpacking plastic credits: Challenges to effective and just global plastics governance

Sangcheol Moon,[1,*] Neil Tangri,[2] Andrea Bonisoli-Alquati,[3] Rob Ralston,[4] Melanie Bergmann,[5] Kristian Syberg,[6] Tara Olsen,[7] Mengjiao Wang,[8] Arturo Castillo Castillo,[9] Gabin Colombini,[10] and Joseph Edward B. Alegado[11]

[1]Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley, CA 94720, USA
[2]Center for Environmental Public Policy, University of California, Berkeley, Berkeley, CA 94720, USA
[3]Department of Biological Sciences, California State Polytechnic University, Pomona, Pomona, CA 91768, USA
[4]School of Social and Political Science, University of Edinburgh, Edinburgh, UK
[5]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
[6]Department of Science and Environment, Roskilde University, Roskilde, Denmark
[7]Department of Food and Resources Economics, University of Copenhagen, Copenhagen, Denmark
[8]Greenpeace Research Laboratories, Department of Biosciences, University of Exeter, Exeter, UK
[9]Faculty of Geosciences, Utrecht University, Utrecht, the Netherlands
[10]IRD, Sorbonne University, Institute for Ecology and Environmental Science of Paris (iEES-Paris), Paris, France
[11]Department of Resources, Environment, and Development, Crawford School of Public Policy, The Australian National University, Canberra, ACT, Australia
*Correspondence: sangcheol_moon@berkeley.edu
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Plastic credits are marketed as an innovative solution to plastic pollution, yet they mirror the well-documented shortcomings of carbon credits and overlook the unique material complexities of plastics. Effective plastics governance must avoid fragmented, loophole-prone, and inequitable approaches to plastic pollution.

INTRODUCTION

The increasing political and environmental salience of plastic pollution has prompted the international community to explore various governance options. Since 2018, a United Nations (UN)-level consensus has emerged, stating that existing fragmented, downstream-focused regulations have major gaps (UNEP/EA.3/INF/5), leading to the initiation of negotiations in 2022 to develop a global plastics treaty. However, the ongoing negotiations have unveiled deep divergences within key areas, including the treaty's scope, primary plastic polymers, chemicals of concern, extended producer responsibility (EPR), and financing mechanisms.

Amid these divergences, plastic credits have gained traction as a potential instrument to address plastic pollution.[1] Despite lacking a formal definition, plastic credits, modeled on carbon credits, are broadly defined as measurable, transferable assets representing 1 tonne of plastic waste diverted or recovered from the environment.[2] Currently, two types of downstream activities are credited: collection and recycling. Collection involves removing plastic waste from the environment, including dumpsites, while recycling encompasses both mechanical and chemical recycling to convert plastic waste into secondary materials. Upstream activities, such as plastic production reduction, or reuse, are ineligible for credits under existing standards.[2]

Between 2020 and 2023, more than 75,000 plastic credits were issued through existing standards.[2] While companies use plastic credits to offset their plastic waste generation outside their production chains, plastic credits are also being integrated into regulatory frameworks in some countries, particularly within EPR schemes.[2] Several standard-setting organizations and registries—including those active in carbon credit markets—along with international financial institutions, are promoting plastic credits as "innovative" financing mechanisms, both in formal treaty negotiations and behind-the-scenes discussions.[1,2] However, the effectiveness of plastic credits in delivering real environmental and social improvements remains contested. Here, we outline the issues embedded in plastic credits, parallel to those in carbon credits, concerning their scientific credibility and market integrity. We also raise critical questions about whose interests these credits ultimately serve, whether they could contribute to the estimated $240 billion-per-year funding gap needed for plastic waste management by 2040,[2] or if they risk exacerbating fragmented regulation, social inequities, and environmental degradation.

DESIGN FLAWS IN PLASTIC CREDITS

At bottom, a serious challenge to plastic credit mechanisms lies in the lack of standardized plastics accounting at international, national, and corporate levels. This critically undermines the credibility of any efforts to measure and track both the plastic waste of crediting projects and the plastic footprints of participating organizations. Inconsistent scopes and metrics for plastics accounting limit comparability, fungibility, and transparency across different plastic credit programs. On top of that, plastic credits face significant issues in meeting key criteria for quality offsets—namely additionality, permanence, and the "no-harm" principle—further compromising the integrity essential for a market-based governance mechanism.

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Non-additional crediting in plastic credits

The central premise of crediting as a compensatory measure is "additionality," whereby polluters compensate for their own pollution by investing in crediting projects that represent genuine reductions beyond business-as-usual (BAU) conditions, rather than directly reducing their own pollution.[3] Ensuring additionality is critical, as making offsetting claims is the main economic driver for private actors to invest in credits. However, existing plastic credit standards diverge significantly on how to address additionality and lack rigorous methodologies to ensure additionality with scientific and market integrity. Some standards rely on positive lists, which automatically deem certain project types as additional. For instance, the Circular Credit Mechanism (CCM) grants automatic additionality to projects run by informal waste workers, while the Plastic Waste Reduction Standard (PWRS) does the same for projects in least-developed countries (LDCs) and Small Island Developing States (SIDS).[2] These positive lists include ongoing waste collection activities that would have occurred regardless of plastic credit incentives, implying non-additional crediting. As demonstrated in carbon credits, significant uncertainties in projecting counterfactual baselines—such as adverse selection risks—make *ex ante* precision scientifically unattainable, ultimately resulting in artificially maximizing creditable reductions.[4,5] Plastic credits face similar challenges, with existing standards failing to dynamically adjust baselines in response to a particularly fluid regulatory, technological, and normative landscape surrounding plastic waste management activities. Compounding this, plastic waste management involves widespread informality, where undocumented yet highly effective collection and sorting activities operate outside formal systems. Because these activities lack verifiable baselines but already contribute to waste recovery, they further complicate the development of robust methodologies to ensure additionality. More fundamentally, weak additionality standards do not just lead to over-crediting—they can create perverse incentives that delay direct pollution reduction regulation. Since any pollution reductions mandated by regulation are non-additional and thus do not qualify for offset credits, credit revenues create financial incentives for those benefiting from credit projects to resist direct pollution reduction regulations.[4,6]

The failure to discount for non-permanence

The science is clear: plastics, composed of thousands of chemicals and polymers derived almost exclusively from fossil fuels, persist in nature and society.[7,8] Given this persistence, plastic credits must guarantee equivalent permanence to justify their claims of mitigating plastic pollution. However, existing plastic credit standards allow various end-of-life pathways—such as recycling, waste-to-energy, and landfilling—raising concerns about the "permanence" criterion, as different pathways entail varying degrees of reversal risks. For example, recycling—despite its circular claims of looping plastic waste back into the value chain—does not permanently avoid plastic pollution; instead, it delays the timing of eventual plastic pollution. Plastics can only be recycled once or a few times, making true closed-loop recycling unachievable.[9] During recycling, polymer degradation from thermal-mechanical stress, oxidative breakdown, and hydrolysis weakens the integrity of polymer structure (e.g., tensile strength and molecular stability), limiting the number of times plastics can be recycled.[9] Once plastics reach their recycling limits, they ultimately reenter the waste stream—an unavoidable reversal risk. Compounding this issue, thousands of additives further restrict recyclability by introducing material incompatibilities and contamination risks, which compromise the quality of recycled materials.[7–9] The global plastic recycling rate remains dismally low at just 9%, reflecting the inherent challenges of achieving true circularity.[7,9] Even before plastics reach the limit of their recyclability, the recycling process itself introduces another reversal risk, as it releases significant amounts of micro- and nano-plastics into the environment.[10] The non-permanence issue in plastic crediting parallels the problem of temporary carbon storage in carbon crediting. When used as an offset, temporary carbon storage (e.g., forest carbon projects) ultimately leads to higher CO_2 concentrations once the storage period ends.[4,11] Likewise, non-permanent removal in plastic crediting leads to increased plastic pollution by merely complicating its re-entry into the environment, serving to defer rather than avert the crisis. Despite these limitations, none of the existing plastic credit standards provide rigorous counterfactual baselines to measure the permanence of a project's impacts or account for reversal risks; they assume 100% permanence without applying discounts or buffer pools, resulting in significant over-crediting.

Perfunctory safeguard mechanisms

Safeguards in credit standards, intended to protect local communities and ecosystems, are often perfunctory despite claims of meeting "no-harm" criteria. Numerous failures in carbon credit projects show that stakeholder consultations and feedback mechanisms do not ensure genuine engagement, particularly given literacy barriers in many local contexts.[6] Similarly, plastic credits, while claiming to provide new revenue streams for waste management communities, are prone to failure in preventing, mitigating, and redressing harm. For example, the Reciki plastic waste collection project in Indonesia began in May 2020 but has been on hold since May 2023, primarily due to severe health impacts on neighboring residents, who were poorly informed through indirect channels in English.[12] The validation and verification report cited only two corrective actions—non-compliant working hours and inadequate safety equipment for high-risk workers—without addressing consultation appropriateness.[12] Public comments included just three superficial remarks,[12] reflecting the broader inherent conflict in credit mechanisms where financial returns are prioritized over environmental and social outcomes. Auditors lack the power to sanction violators or mandate remedies for affected communities and have implicit incentives to judge leniently, as they are hired by project developers and motivated by the need to secure future work.[6] These dynamics often cause auditors to fail in ensuring reliable independent impact assessments or preventing harmful projects.

BEYOND TECHNICALITIES: FUNDAMENTAL ISSUES

The devil is not just in the technical details. A series of more fundamental, plastic-specific challenges prompts questions

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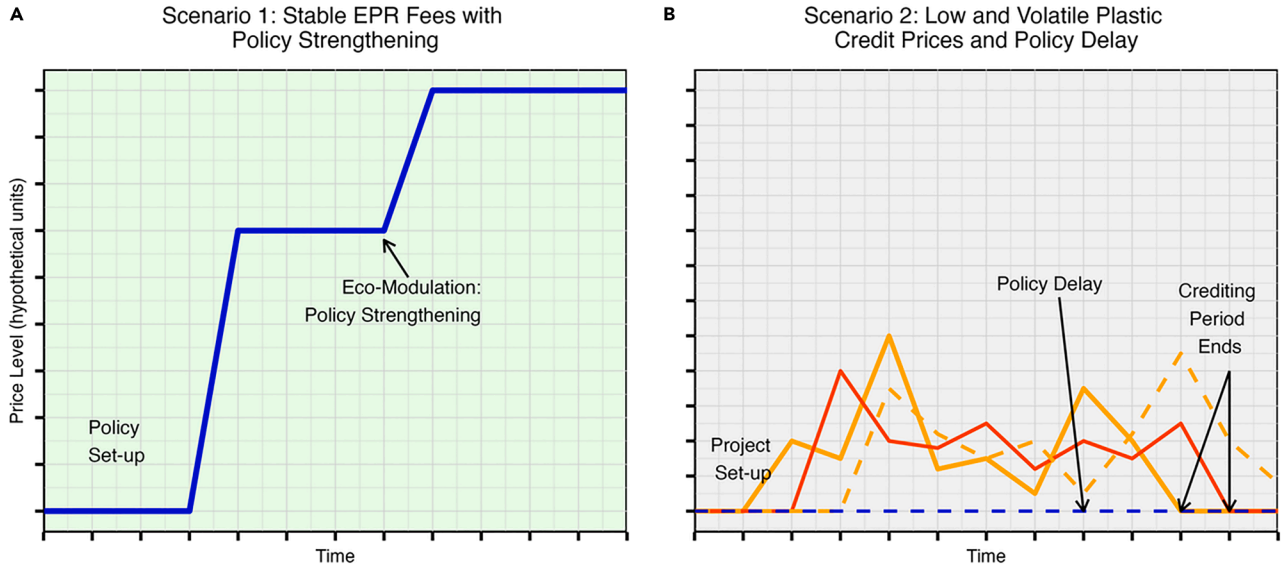

Figure 1. Price stability in EPR fees vs. price volatility in plastic credits

Extended producer responsibility (EPR) fees are set at a stable level and can be refined over time through mechanisms such as eco-modulation, thereby serving as a predictable funding source with public oversight for waste management pricing mechanisms (A). In contrast, plastic credit prices are determined through opaque mechanisms, resulting in price volatility and unpredictability that undermine their viability as a sustainable funding mechanism for waste management (B).

regarding the suitability of crediting mechanisms for governing plastic pollution.

The fallacy of "tonne-to-tonne" equivalence

The tonne-to-tonne equivalence in plastic credits fails to capture the complexities of plastics from the perspectives of chemistry, material science, and environmental toxicology.[8] Plastic offset credits operate on the premise of equating one tonne of plastic footprint with one tonne of plastics diverted from the environment. However, this approach overlooks the tremendous variability in plastic composition and its consequential environmental and health impacts.[8] Most greenhouse gases (GHGs) are well mixed in the global atmosphere over their long atmospheric lifetimes, meaning their overall climate impact does not significantly vary by emission source or location.[11,13] Given this, the global warming potential (GWP)/CO_2eq serves as a scientifically accepted metric to equate the climate impacts of physically distinct GHGs. In contrast, plastic pollution is not only a global commons issue but also a transboundary environmental problem and a local-cumulative issue with extremely localized spillover effects.[14] The harmful effects of different plastics cannot be captured by a single global metric. For example, one tonne of highly recyclable transparent polyethylene terephthalate (PET) bottles cannot be equated with one tonne of non-recyclable composite packaging or phthalate-heavy polyvinyl chloride (PVC) materials. Due to significant differences in characteristics such as toxicity and recyclability, no scientifically accepted universal metric exists for plastic pollution. A universal metric akin to the GWP for emissions may not only be scientifically untenable but also risks obscuring the highly material- and location-specific environmental harms plastics pose.

The pitfalls of linking plastic credits to EPR

Plastic credits, initially voluntary initiatives by private actors, are now being integrated into public policies as a compliance instrument under EPR, particularly in developing countries.[2] EPR policies aim to improve waste management and resource efficiency by shifting financial and operational responsibilities for end-of-life product management from municipalities to producers.[15] EPR regulations can apply broadly to various waste streams, from packaging to electronics, vehicles, and other durable goods. In holding producers accountable, EPR promotes design for environment (DfE) through eco-modulation—a pricing mechanism that adjusts fees based on product design attributes such as recyclability or the presence of hazardous materials.[15] While EPR typically mandates specific fee schemes for obligated organizations to achieve policy goals, a growing number of EPR policies on plastic packaging, such as those in the Philippines, require companies to meet offset targets with plastic credits as a replacement for EPR fees.[2] This shift, which dramatically expands the reach and impact of plastic credits, undermines the incentive structure of EPR in two significant ways. First, plastic credit prices are often low and volatile, set through various opaque ways across projects, making them unreliable as a stable funding source for waste management and resulting in a loss of public control over pricing and revenue management (Figure 1). Such weak price signals that lack eco-modulation and public oversight entice polluters to invest in plastic credits rather than in more effective DfE technologies or new business models, reinforcing BAU practices. Second, the material-specific scope of plastic credits is incompatible with the product- or sector-specific scope of EPR, which targets specific products such as plastic packaging (Figure 2). Plastic credit standards cover a wider range of plastic products, including not only packaging but also items such as auto parts and construction materials. This incompatibility risks creating loopholes in the implementation of

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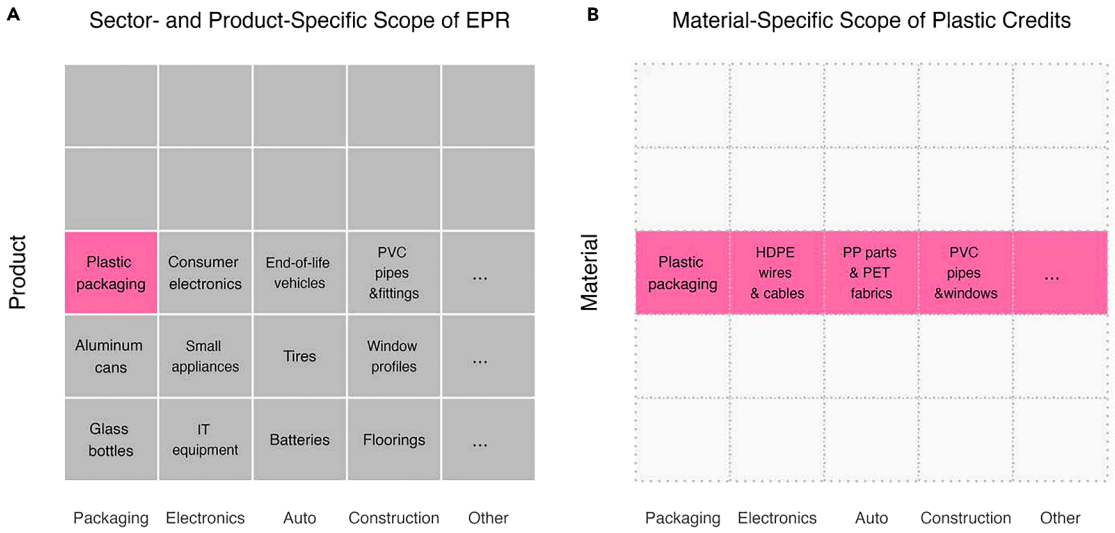

Figure 2. Scope misalignment between EPR regulations and plastic credits

EPR regulations are designed with a sector- and product-specific focus to promote design-for-environment (DfE) practices and ultimately reduce waste generation. While EPR schemes may cover multiple sectors and products (dark gray area), EPR for plastics specifically targets plastic packaging (pink area) (A). In contrast, plastic credit standards operate with a material-specific scope, encompassing a wide range of plastic products across different sectors without sector-specific differentiation (pink area) (B). The scope of plastic credits is thus by definition incompatible with the scope of EPR for plastic packaging, and when plastic credits are integrated into an EPR scheme, they distort the intended regulatory outcomes by replacing targeted, sector-specific interventions with a blanket material diversion approach.

EPR regulations on plastic packaging, diluting their targeted focus and undermining their primary objective—namely, incentivizing DfE practices within the packaging sector and ultimately reducing packaging waste generation.

Legitimation of waste colonialism

From a political-economy perspective, plastic credits epitomize the institutionalization of waste-based commodity frontiers, where waste management is turned into a profit-seeking enterprise rather than upheld as a public service, complicating equitable global governance for plastics. Plastic credits absorb informal waste work, conducted without legal labor protections and formal employment arrangements, into these frontiers through credit standards that codify informal labor into structured market activities. This process fuels "accumulation by inclusion," where informal waste work is financialized within neoliberal systems, often leaving waste workers more vulnerable to exploitative conditions.[16] Crediting organizations and registries serve as brokers, linking informal waste workers with global brands keen to make claims of plastic pollution reduction—or even plastic neutrality—or fulfill EPR obligations at lower costs. Meanwhile, these intermediaries also help de-risk investments for private and institutional investors by operating as *de facto* regulatory powers in signaling what is deemed worthy of a plastic-related investment. By instrumentalizing the labor and tacit experiential knowledge of informal waste workers and incentivizing activities at lower levels of the waste hierarchy—such as collection and recycling rather than waste prevention or reduction—plastic credits risk creating a systemic lock-in.[16] This lock-in allows credit-purchasing actors to financially benefit from externalizing pollution reduction activities and resist more effective interventions, such as plastic production reduction or alternative business models that could optimize plastic demand. This not only legitimizes ongoing waste generation but also entrenches exploitative practices, posing significant challenges to ending plastic pollution and to achieving a just transition.[8,17]

FROM CARBON TO PLASTIC: THE TROUBLING LEGACY OF CREDITS

History shows that carbon credits, while politically convenient, have failed to deliver substantial environmental benefits or generate meaningful revenue to finance climate solutions.[11,18] The assessment that "nearly everything about carbon credits must change"[11] serves as a cautionary lesson. We argue that plastic credits do not represent an innovative approach; instead, they risk replicating the same structural failures in climate governance, diverting resources away from more effective solutions and locking efforts into perpetual attempts to fix crediting methodologies.

While it is undeniable that there is a critical need for financial inflows to support the severely underfunded plastic waste management sector and that grassroots contributions to plastic waste management can be highly effective, plastic offset credits are not the right instrument to achieve these goals. Private actors promoting plastic credits have fundamental financial incentives to overstate environmental outcomes and to avoid stringent regulation or asset-repricing risks. It is time to revisit the lessons from carbon credits, where prices have consistently failed to reflect the true social cost of carbon and significant transaction costs have been channeled into private intermediaries.

The risk of plastic credits mirroring the compromises of the Kyoto Protocol is real, potentially leading to a diluted global plastics treaty. Integration of plastic credits into the treaty as a regulatory and financing instrument presents significant challenges to implementing effective and

justice-oriented solutions for ending plastic pollution.[8] To ensure the treaty's success, it is crucial to prioritize sector-specific plastic reduction strategies and establish stable funding sources that effectively close financing gaps (e.g., through polymer fees and the reorientation of perverse fossil-fuel-related subsidies). Directing financial flows to developing countries and waste workers through microfinancing or contribution-based crediting without offsetting[3] will uphold the polluter pays principle, rather than accommodate polluters.

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DECLARATION OF INTERESTS

The authors declare no competing interests.

REFERENCES

1. UNEP. (2024). Co-chairs' synthesis paper on finance. https://wedocs.unep.org/bitstream/handle/20.500.11822/46049/EG1_Synthesis_Paper.pdf.
2. World Bank. (2024). Unlocking financing to combat the plastics crisis: Opportunities, risks, and recommendations for plastic credits. http://documents.worldbank.org/curated/en/099062424112542582
3. Blanchard, L., Haya, B.K., Anderson, C., Badgley, G., Cullenward, D., Gao, P., Goulden, M.L., Holm, J.A., Novick, K.A., Trugman, A.T., et al. (2024). Funding forests' climate potential without carbon offsets. One Earth *7*, 1147–1150. https://doi.org/10.1016/j.oneear.2024.06.006.
4. West, T.A.P., Bomfim, B., and Haya, B.K. (2024). Methodological issues with deforestation baselines compromise the integrity of carbon offsets from REDD+. Glob. Environ. Change *87*, 102863. https://doi.org/10.1016/j.gloenvcha.2024.102863.
5. Swinfield, T., Shrikanth, S., Bull, J.W., Madhavapeddy, A., and Zu Ermgassen, S.O. S.E. (2024). Nature-based credit markets at a crossroads. Nat. Sustain. *7*, 1217–1220. https://doi.org/10.1038/s41893-024-01403-w.
6. Haya, B.K., Alford-Jones, K., Anderegg, W.R. L., Beymer-Farris, B., Blanchard, L., Bomfim, B., Chin, D., Evans, S., Hogan, M., Holm, J. A., et al. (2023). Quality assessment of REDD+ carbon credit projects. Berkeley Carbon Trading Project. https://gspp.berkeley.edu/assets/uploads/page/Quality-Assessment-of-REDD+-Carbon-Crediting.pdf.
7. Geyer, R., Jambeck, J.R., and Law, K.L. (2017). Production, use, and fate of all plastics ever made. Sci. Adv. *3*, e1700782. https://doi.org/10.1126/sciadv.1700782.
8. Brander, S.M., Senathirajah, K., Fernandez, M. O., Weis, J.S., Kumar, E., Jahnke, A., Hartmann, N.B., Alava, J.J., Farrelly, T., Almroth, B.C., et al. (2024). The time for ambitious action is now: Science-based recommendations for plastic chemicals to inform an effective global plastic treaty. Sci. Total Environ. *949*, 174881. https://doi.org/10.1016/j.scitotenv.2024.174881.
9. Singh, N., and Walker, T.R. (2024). Plastic recycling: A panacea or environmental pollution problem. Npj Mater. Sustain. *2*, 17. https://doi.org/10.1038/s44296-024-00024-w.
10. Brown, E., MacDonald, A., Allen, S., and Allen, D. (2023). The potential for a plastic recycling facility to release microplastic pollution and possible filtration remediation effectiveness. Journal of Hazardous Materials Advances *10*, 100309. https://doi.org/10.1016/j.hazadv.2023.100309.
11. Cullenward, D., Badgley, G., and Chay, F. (2023). Carbon offsets are incompatible with the Paris Agreement. One Earth *6*, 1085–1088. https://doi.org/10.1016/j.oneear.2023.08.014.
12. Verra (2022). Plastic waste reduction standard: Joint validation and verification report of the RECIKI project. Monitoring Period. https://registry.verra.org/app/projectDetail/PWRP/2648.
13. Gulev, S.K., Thorne, P.W., Ahn, J., Dentener, F. J., Domingues, C.M., Gerland, S., Gong, D., Kaufman, D.S., Nnamchi, H.C., Quaas, J., et al. (2021). Well-mixed greenhouse gases (WMGHGs). In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, V. Masson-Delmotte, P. Zhai, A. Pirani, S.L. Connors, C. Péan, and N. Caud, et al., eds. (Cambridge University Press), pp. 298–303. https://doi.org/10.1017/9781009157896.004.
14. O'Neill, K. (2017). Global environmental problems. In The environment and international relations, 2nd ed. (Cambridge University Press), pp. 28–50.
15. Laubinger, F., Brown, A., Dubois, M., and Börkey, P. (2021). Modulated fees for Extended Producer Responsibility schemes (EPR). OECD Environment Working Papers, No. 184 (Paris: OECD Publishing). https://doi.org/10.1787/2a42f54b-en.
16. Tucker, J.L., and Anantharaman, M. (2020). Informal Work and Sustainable Cities: From Formalization to Reparation. One Earth *3*, 290–299. https://doi.org/10.1016/j.oneear.2020.08.012.
17. Dauvergne, P. (2023). Governing plastics: The power and importance of activism in the global South. Environmental Science & Policy *147*, 147–153. https://doi.org/10.1016/j.envsci.2023.06.011.
18. Trencher, G., Nick, S., Carlson, J., and Johnson, M. (2024). Demand for low-quality offsets by major companies undermines climate integrity of the voluntary carbon market. Nat. Commun. *15*, 6863. https://doi.org/10.1038/s41467-024-51151-w.