PARTIAL ADDITIONALITY: THE BLUNT METRIC DISTORTING CARBON MARKETS

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INTRODUCTION

The widespread recognition that climate change presents an existential threat to humanity has spurred the development of numerous technologies, regulatory structures, and voluntary actions aimed to mitigate the pending disaster. For at least the last two decades,

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market mechanisms have played a central role in that climate policy debate.[1] In particular, the ability to generate and trade credits for CO_2 reductions has been recognized as an essential feature of any comprehensive global climate governance scheme. In the Kyoto Protocol, the parties to the United Nations Framework Convention on Climate Change (UNFCCC) established the Clean Development Mechanism (CDM) to facilitate the transfer of credit for emission-reduction activities in developing countries to developed countries who had made commitments to particular levels of overall reductions.[2] Almost twenty years later, in Paris, the parties agreed to allow bilateral and multi-lateral transfer of carbon credits from reduction and removal activities in order to meet their respective Nationally Determined Contributions (NDCs) under the overarching Paris Agreement framework.[3]

In international law, and in practice, carbon markets are evolving, and, in doing so, raising important questions of governance and accountability. The most important of those questions—economically and ecologically—deal with how to properly calculate carbon offsets.

This paper identifies for the first time a market distortion created by a particular subset of carbon offsets: projects that also

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[1] *See, e.g.*, American Clean Energy and Security Act of 2009, H.R. 2454, 11th Cong. § 701(b)(2) (2009) (also called "Waxman-Markey," this bill would have implemented a nationwide cap-and-trade system but failed to pass the Senate and ultimately died); Kyoto Protocol to the U.N. Framework Convention on Climate Change, *Report of the Conference of the parties on its Third Session*, U.N. Doc. FCCC/CP/1997/L.7/Add.1, 162, (Dec. 10, 1997) [hereinafter "Kyoto Protocol"] (including market mechanisms in the Clean Development Mechanism and Emissions Trading); Jonas Monast, *From Top-down to Bottom-up Climate Policy: New Challenges in Carbon Market Design*, 8 SAN DIEGO J. CLIMATE & ENERGY L. 175, 176 (2016) ("The climate policy debate underwent a profound shift between 2009–2016. Prior to that point, efforts at the domestic and international levels focused on broad, top-down strategies to reduce greenhouse gas (GHG) emissions, with market-based mechanisms expected to play a key role."); *see generally* Jonas Meckling & Bentley B. Allan, *The Evolution of Ideas in Global Climate Policy*, 10 NAT. CLIMATE CHANGE 438 (2020) (tracing the economic roots of climate policy and the evolution in thinking and proposals over time).

[2] *See Kyoto Protocol*, *supra* note 1, at Art. 12.

[3] *See* U.N. Framework Convention on Climate Change, Report of the Conference of the parties on its Twenty-First Session, U.N. Doc. FCCC/CP/2015/10/Add.1, Annex, art. 6 (Jan. 29, 2016) [hereinafter *Paris Agreement*].

generate revenue from sources other than the sale of offsets. The most prevalent example of this type of offset are those created by qualifying renewable energy projects and sold on markets to buyers seeking to reduce their net greenhouse gas footprint.[4]

Here, the term "carbon offset" refers to a reduction in greenhouse gas emissions or an increase in greenhouse gas storage.[5] The terms "carbon offsets" and "carbon credits" generally refer to the same thing[6]—one ton of CO_2-equivalent emissions ("CO_2e")[7]

[4] *See* Angelo Gurgel, *Carbon Offsets*, MIT CLIMATE PORTAL (Nov. 8, 2022), https://climate.mit.edu/explainers/carbon-offsets.

[5] *See id.*

[6] *Compare id. with* David L. Chandler, *Explained: Carbon Credits*, MIT CLIMATE PORTAL (Feb. 28, 2024), https://climate.mit.edu/posts/explained-carbon-credits; *see also What is a Carbon Credit?*, CARBON OFFSET GUIDE, https://offset-guide.org/understanding-carbon-offsets/what-is-a-carbon-offset/ ("The terms carbon offset credits, carbon offsets, offset credits or simply offsets may be used interchangeably, though carbon credits are the preferred technical term as the credit is what is used for compliance or voluntary reporting purposes, and carbon credits, as opposed to offset credits, are not readily confused with the verb "to offset" and the practice of offsetting.").

[7] Different greenhouse gases last for different amounts of time in the atmosphere and have varying levels of global warming potential (GWP). *See* Darkwah Williams Kweku et al., *Greenhouse Effect: Greenhouse Gases and Their Impact on Global Warming*, 17 J. SCI. RSCH. & REPS. 1, 6 (2018). Since 1990, the IPCC has been publishing GWP calculations for various greenhouse gases in its Scientific Assessment reports. *See* IPCC, IPCC FIRST ASSESSMENT REPORT: POLICYMAKER'S SUMMARY OF WORKING GROUP I 72(1990), https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report.pdf ("The concept of relative Global Warming Potentials (GWP) has been developed to take into account the differing times that gases remain in the atmosphere . . . This index defines the time-integrated warming effect due to an instantaneous release of unit mass (1 kg) of a given greenhouse gas in today's atmosphere, relative to that of carbon dioxide"). For example, CO_2 lasts for between 300 and 1,000 years in the atmosphere whereas methane only lasts for about 12. *See* Diane Mayerfeld, Will Fulwider and Alli Parrish, *Methane emissions from livestock and climate change*, UNIV. WIS. MADISON, https://cropsandsoils.extension.wisc.edu/articles/methane-emissions-from-livestock-and-climate-change/ (last visited Nov. 22, 2024). However, methane absorbs far more energy than CO_2 while it exists in the atmosphere, giving it a higher GWP. *See id.* To more easily communicate about the various policies that affect all GHGs and build effective models, all of the various gases are standardized into units called carbon dioxide equivalents (CO_2e), which are calculated by multiplying the amount of a greenhouse gas by its GWP. *See Eurostat Glossary: Carbon dioxide equivalent*, *EUROPEAN COMMISSION* https://ec.europa.eu/eurostat/statistics-

avoided or removed from the atmosphere. Some markets use the terms to distinguish between government-issued allowances and those later generated by private activity.[8] Unfortunately, such distinctions are employed in inconsistent and, worse, at times contradictory ways.[9] Consequently, throughout the rest of this paper we will somewhat begrudgingly use the terms "credit" and "offset" interchangeably to refer to a commodity representing one ton of greenhouse gas reductions or removals, regardless of how that instrument came into being or on what market it is traded.

Carbon offsets are created by activities that either (1) reduce greenhouse gas emissions or (2) actively remove carbon from the atmosphere.[10] Offsets from emissions reductions are generated by projects—like new renewable energy development, efficiency improvements, and electrification—that result in the combustion of fewer fossil fuels. In other words, reductions-based offsets derive from activities that decrease the overall demand for fossil fuels.[11] On the other hand, offsets from removals are generated by

explained/index.php?title=Glossary:Carbon_dioxide_equivalent (last visited Nov. 17, 2024) (citing IPCC Third Assessment Report, 2001).

[8] *See, e.g.*, *FAQs—Carbon Markets & Indices*, INTERCONTINENTAL EXCHANGE, https://www.theice.com/carbon-terminology-and-product-faq (last visited Dec. 2, 2024) (using "carbon credit" and "carbon allowance" interchangeably to refer to "a permit to emit" and defining "carbon offset" as "a certificate awarded for a proactive initiative which reduces or removes emissions").

[9] *See Carbon Offset vs. Carbon Credit: Understanding the Language of Climate Action*, TERRAPASS (Mar. 26, 2024), https://terrapass.com/blog/carbon-offset-vs-carbon-credit-understanding-the-language-of-climate-action/ ("In the fight against climate change, we often hear terms like 'carbon offset' and 'carbon credit.' While they are often used interchangeably, these two phrases actually have different meanings."); *Carbon Credits vs. Carbon Offsets*, CARBONCREDITS.COM, https://carboncredits.com/carbon-credits-vs-carbon-offsets-whats-the-difference (last visited Jan. 6, 2025) ("While the terms 'carbon credits' and 'carbon offsets' are often used interchangeably, they refer to two distinct products that serve two different purposes.").

[10] *See id.*

[11] *See* Julio Friedmann & Matthew D. Potts*, Removal, Reduction, and Avoidance Credits Explained,* CARBON DIRECT (Nov. 8, 2023), https://www.carbon-direct.com/insights/how-do-carbon-credits-actually-work-removal-reduction-and-avoidance-credits-explained ("Carbon reduction is an action that decreases the amount of greenhouse gas emissions, compared to prior practices. . . . Examples of carbon reduction credits include reducing fossil-fuel use by improving fuel efficiency, or programs that reduce the methane that is generated from farms or municipal waste processing.").

projects—like afforestation and carbon capture technologies—that take already emitted greenhouse gases out of the atmosphere.[12] In other words, removal-based offsets derive from activities that have no direct effect on the supply or demand for fossil fuels. Offsets of either type are valuable because they allow countries with commitments under international law (i.e., the Paris Agreement) to meet those commitments through a combination of domestic reductions and removals and the purchase of credit for reductions and removals conducted elsewhere. They are similarly valuable to corporations who have made pledges (e.g. "net zero by x date"), allowing them to report progress towards or achievement of such pledges without completely eliminating their own emissions.[13]

So, these sound great. Where can I get some? There are two primary types of carbon markets that facilitate the sale of carbon offsets: compliance markets and voluntary markets.[14] Both types of carbon markets allow their target customers, whether they be governments, companies, or individuals, to purchase carbon offsets to reduce their own carbon footprint or meet predetermined emissions goals or limits.[15] The World Bank, which has been tracking carbon markets for two decades, reports that in 2023 almost a quarter of global greenhouse gas emissions were represented by either an

[12] *See id.* ("Carbon removal is the process of removing carbon dioxide from the atmosphere and locking it away for decades, centuries, or millennia. . . Projects that remove carbon come from a diverse set of solutions, from nature-based solutions like reforestation, to engineered solutions such as direct air capture and storage.").

[13] *See* Varsha Ramesh Walsh & Michael W. Toffel, *What Every Leader Needs to Know About Carbon Credits*, HARV. BUS. REV. (Dec. 15, 2023), https://hbr.org/2023/12/what-every-leader-needs-to-know-about-carbon-credits ("These targets typically entail public commitments to reduce GHG emissions through measures such as process modification, product reformulation, fuel switching, shifting to renewable power, investing in carbon removal projects—and a pledge to zero-out their remaining emissions by purchasing carbon offsets, also known as carbon credits. Carbon credits are financial instruments where the buyer pays another company to take some action to reduce its greenhouse gas emissions, and the buyer gets credit for the reduction. As companies creep closer to their net zero target years, many have already begun purchasing carbon credits.").

[14] *See What Are Carbon Markets and Why Are They Important?*, U.N.DEV. PROGRAMME (May 18, 2022), https://climatepromise.undp.org/news-and-stories/what-are-carbon-markets-and-why-are-they-important.

[15] *See id.*

emission trading system or carbon tax scheme, generating revenues approaching one hundred billion dollars.[16] The value of carbon credits on global markets surpassed $900 billion in 2022 and is expected to continue its rise in the long-term.[17]

It should come as no surprise, then, that carbon markets have generated significant scholarly attention across a variety of disciplines. In recent decades, legal scholars and academics from various fields have developed a robust body of literature addressing many aspects of carbon markets and offsets.[18] Much of the literature, particularly early literature, espoused, or questioned, the theory behind market mechanisms as climate solutions.[19] As markets matured, so

[16] *See* THE WORLD BANK GROUP [WBG], STATE AND TRENDS OF CARBON PRICING 2023 (2023), https://openknowledge.worldbank.org/entities/publication/58f2a409-9bb7-4ee6-899d-be47835c838f.

[17] *See* Swati Verma & Nina Chestney, *Global carbon markets value hit record $909 bln last year*, REUTERS (Feb. 7, 2023), https://www.reuters.com/business/sustainable-business/global-carbon-markets-value-hit-record-909-bln-last-year-2023-02-07/; Rsch. and Mkts, *Global Carbon Credit Market 2023: Sector to Reach $2.68 Trillion by 2028 at a CAGR of 18.23%*, YAHOO! FIN. (Apr. 19, 2023), https://finance.yahoo.com/news/global-carbon-credit-market-2023-104800429.html#:~:text=The%20global%20carbon%20credit%20market,US%242.68%20trillion%20by%202028.

[18] *See, e.g.*, Ian Cuillerier & Edward So, *Legal Issues in Carbon Credit Markets and Trading*, 42 FUTURES & DERIVATIVES L. REP. 15 (2022) (outlining the broad legal issues that can arise in carbon market transactions); Maria Savasta-Kennedy, *The Newest Hybrid: Notes Toward Standardized Certification of Carbon Offsets*, 34 N.C. J. INT'L L. & COM. REG. 851 (2009) (arguing for standardized certification of offsets across markets); Thomas P. Healy, *Clearing the Air: Pursuing a Course to Define the Federal Government's Role in the Voluntary Carbon Offset Market*, 61 ADMIN. L. REV. 871 (2009) (arguing for the regulation of voluntary carbon markets to increase environmental integrity and economic efficiency); Juliet Howland, *Not All Carbon Credits Are Created Equal: The Constitution and the Cost of Regional Cap-and-Trade Market Linkage*, 27 UCLA J. ENV'T. L. & POL'Y 413 (2009) (discussing the Constitutional implications of linking or refusing to link regional carbon markets by analyzing California's cap-and-trade market under the Dormant Commerce Clause); Lisa Hodes Rosen & Adrienne Bossi, *Due Process Rights in the Carbon Markets*, 11 SUSTAINABLE DEV. L. & POL'Y 9 (2011) (discussing the due process components of appeals procedures in voluntary offset certifications).

[19] *See* Richard Schmalensee & Robert N. Stavins, *Lessons Learned from Three Decades of Experience with Cap and Trade*, 11 REV. ENV'T. ECON. & POL'Y 59, 59 (2016) ("Thirty years ago, many environmental advocates argued that government allocation of rights to emit pollution inappropriately legitimized

did the research studying them. Some of this recent literature raises serious, specific concerns regarding the credibility and environmental integrity of various carbon offsets.[20] None of the literature identifies, let alone attempts to solve, the problem exposed here.

One of the major theories underpinning carbon markets is that they leverage the capital of offset purchasers to incentivize actions that avoid CO_2 emissions or actively remove CO_2 from the atmosphere.[21] Central to the coherence of this theory is that for the incentive to be effective, the incentive must actually induce someone to avoid or remove carbon. If a project developer's choice to build a project is not influenced by the availability of a financial incentive in the form of carbon offsets, that project should not be funded by offsets because it would have taken place anyways. In other words, a project funded by offsets should be "in addition" to what would have happened without the financial incentive.[22] This is the concept of "additionality," and it is a core component of all carbon markets.[23]

environmental degradation, while others questioned the feasibility of such an approach"); Warwick J. McKibbin & Peter J. Wilcoxen, *The Role of Economics in Climate Change Policy*, 16 J. ECON. PERSP. 107, 107 (2002) (arguing "neither of the standard market-based environmental policy instruments is a viable approach: a tradable permit system would be inefficient, and an emissions tax would be politically unrealistic"); *see generally* James Gustave Speth, *The Market: Making It Work for the Environment, in* THE BRIDGE AT THE END OF THE WORLD 89–106 (Yale University Press. 2008) (describing how market-based environmental policies have grown in prevalence, how they work in theory and practice, and their features and shortcomings).

[20] *See, e.g.*, Robert Watt, *The Fantasy of Carbon Offsetting*, 30 ENV'T. POL. 1069 (2021) (arguing that the promises of carbon offsetting are unrealizable); Nicolas Kreibich & Lukas Hermwille, *Caught In Between: Credibility and Feasibility of the Voluntary Carbon Market Post-2020*, 21 CLIMATE POL'Y 939, 944–945 (2021) (discussing credibility and the problems of double-counting that arise when private actors' climate pledges and country's NDCs both rely upon carbon offsets); Michael J. Polonsky et al., *The New Greenwash? Potential Marketing Problems with Carbon Offsets*, 18 INT'L J. OF BUS. STUD. 49 (2010) (discussing potentially misleading carbon offset representations and the ensuing environmental pitfalls).

[21] *See What Are Carbon Markets and Why Are They Important?*, *supra* note 14.

[22] *See* discussion and notes *infra* Section IV.C.

[23] *See* discussion and notes *infra* Section IV.C.

While all carbon markets purport to require additionality for offset projects sold on their marketplaces, this requirement does not take into account the *proportion of additionality* of a given project.[24] Some projects only rely on offset incentives for a small portion of their financing because they generate other inherent revenue.[25] For example, many renewable energy projects generate significant revenue from selling energy to a grid, but use offsets as a supplemental income source to become financially competitive.[26] In such cases, even if the reliance on offset revenue only represents a small portion of the total funding, the requirement of additionality is met.[27] However, once met, the proportion of additionality is disregarded in the calculation of the number of offsets generated.[28]

This work exposes, explains, and attempts to solve a problem we have dubbed "partial additionality." Partial additionality describes the situation when projects producing offsets also generate revenue (most commonly, from the sale of energy). In such situations, the projects are largely financed by revenue generated outside of offset sales but can receive offsets calculated based on the entirety of their activity. In other words, some proportion of the

[24] *See* GHG Management Institute, *Additionality*, CARBON OFFSET GUIDE, https://offsetguide.org/high-quality-offsets/additionality/ (last visited Oct. 7, 2024) ("Carbon crediting programs must make binary determinations of additionality to decide the eligibility of proposed projects for crediting (i.e., a proposed GHG project is either additional or it is not).").

[25] This paper focuses on renewable energy projects that produce offsets because that situation presents most frequently and most straightforwardly. That is not to say, however, that other offset-generating projects might also generate inherent revenue. The analysis offered herein should apply with equal force in those hypothetical contexts. Currently, the only other established offset-producing projects that potentially generate revenue are technological removal projects which are funded (at least partially) by transferable tax credits. It is not clear that such tax credits count, legally or financially, as "revenue" in the same fashion as the sale of energy, and the answer would likely depend on accounting practices and tax law. Both of those subjects go beyond the scope of this work.

[26] *See* Christy Rivera & Adrienne Sebring, *Carbon offsets as a potential source of revenue*, NORTON ROSE FULBRIGHT (Feb. 28, 2022), https://www.projectfinance.law/ publications/2022/february/carbon-offsets-as-a-potential-source-of-revenue/ (A project finance trade publication reporting that "Renewable energy developers are showing more interest in the voluntary carbon offset market as a potential source of additional revenue for their projects.").

[27] *See* discussion and notes *infra* Section IV.A.

[28] *See* discussion and notes *infra* Sections IV.B, IV.C, V.A.

activity, if it could be practically (rather than just theoretically) isolated, would be profitable and thus non-additional; yet the entire project is included to calculate offsets. This phenomenon distorts the market for reductions-based credits in particular.

Treating additionality as a threshold matter—which is how all carbon markets currently operate—means that the incentive structure is partially decoupled from the number of offsets produced. For example, if a renewable energy project only relies on offset revenue for 50% of its financing, but 100% of the energy produced by the project is used to calculate the generation of offsets, 50% of the offsets that are created and sold could be considered non-additional. In other words, the company selling the offsets is able to sell offsets that did not need to be incentivized. If a project generates enough inherent revenue to make it 50% cost-competitive, 50% of the activity did not need to be incentivized, and therefore offsets generated by that 50% of activity fail to be truly additional.

There are a number of potential problems with this structure. First, when a government or private entity purchases non-additional offsets and uses them to meet international law obligations, net zero commitments, or carbon neutral goals, the purchaser receives a false impression of environmental benefit. Further, there is a limited pool of funds that are spent on offsets, so capturing those funds with offsets from projects that are partially non-additional undermines investments in other projects. In the end, this inefficient use of funds results in less actual avoidance and removal than would take place without the inefficiency. Finally, partially additional projects can distort market prices because their financial wellbeing does not entirely depend on capturing maximum value per offset sold. This unfair price competition may compound the first problem, resulting in even a greater percentage of non-additional offsets being purchased and even greater inefficiency.

As carbon markets grow in size and importance, pressure mounts on the parties to the UNFCCC to develop clear, accurate, and effective guidance for carbon transfers. Due to additionality concerns related to the accounting issue exposed herein, some markets have just decided to move away from credits based on most

renewable projects.[29] Stricter UN guidance, including more precise accounting methodologies for additionality like the one suggested in this work, might provide necessary assurance to voluntary carbon markets[30] to continue to include at least some renewable energy credits.

Such guidance must address the problem of partial additionality to properly calibrate the global carbon market. This paper explains why that is the case and proposes a technical framework, rooted in the concept of discounting, as a potential solution. We begin in the next part with a brief, but systematic, explanation of why functional carbon markets are a necessary part of the global climate governance regime under the UNFCCC. Part II examines existing carbon markets and, more importantly, explains the legal and practical significance of Article 6.4 of the Paris Agreement. Part III dissects the necessary elements to generate a carbon credit under accepted principles and highlights the importance of additionality as one of those elements. Part IV proceeds to unravel the relationship between additionality and a project's impact on greenhouse gas emissions, arguing that threshold additionality determinations result in partially additional offsets that distort carbon offset markets in three key ways. Finally, to address partially additional offsets, Part V presents a discounting-based solution for certain types of offset projects that could be incorporated into law through technical guidance pursuant to Article 6 of the Paris Agreement.

I. THE CLIMATE CRISIS AND THE MARKET

The importance of carbon offsets, and subsequently the importance of getting them right, stems directly from the urgent need

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[29] *See* Annalise Downey & Chris Eliis, *Renewable Energy Source (RES) Carbon Credits and Their Role in Combating Climate Change*, SYLVERA (Sept. 14, 2022), https://www.sylvera.com/blog/renewables-carbon-credits-framework ("[T]he two largest certifiers of carbon projects, Verra and Gold Standard, are no longer permitting grid-connected renewable energy projects in most countries, except for those defined as a "Least Developed Country" by the World Bank.").

[30] *See A Practitioner's Guide: Aligning the Voluntary Carbon Market with the Paris Agreement Test*, GOLD STANDARD (Jul. 3, 2024), https://www.goldstandard.org/publications/a-practitioners-guide-aligning-the-voluntary-carbon ("For the voluntary carbon market to ensure the continued integrity of the credits generated, issued and used, it will be essential that it aligns with the new context under the Paris Agreement and, where relevant, its new rules.").

to address the global climate crisis with any and all available tools. Climate change has been described as the "super wicked problem" facing international environmental governance.[31] One prominent reason for that distinction is a particularly thorny combination of at once having too many overlapping jurisdictions[32] and too few comprehensive international legal mechanisms and authorities.[33] Carbon markets that can transcend national borders are a key piece of any functioning global solution.[34] The reality of the last three decades of global efforts to mitigate planetary warming also evidences the prominent role for carbon markets, as the following brief historical and scientific tour explains.

In June of 1988, now famous scientist Dr. James Hansen testified before the United States Congress, warning that "global warming has reached a level such that we can ascribe with a high degree of confidence a cause and effect relationship between the

[31] *See* Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153, 1160 (2009) (describing "wicked problems" as those with "enormous interdependencies, uncertainties, circularities, and conflicting stakeholders implicated by any effort to develop a solution" and going on to note that climate change "has been fairly described as a 'super wicked problem' because of its even further exacerbating features. These features include the fact that time is not costless, so the longer it takes to address the problem, the harder it will be to do so.").

[32] *See id.* at 1207 (describing "the dizzying array of congressional committees with overlapping jurisdiction over climate change"); William Boyd, *Climate Change, Fragmentation, and the Challenges of Global Environmental Law: Elements of a Post-Copenhagen Assemblage*, 32 U. PA. J. INT'L L. 457, 458 (2010) (describing "the plural, fragmented nature of the international legal and political order" and how a "post-Copenhagen approach to the problem of climate governance that starts with the facts of globalization and its implications for law and legal order trains attention to new and different, and much messier, ways of coordinating efforts across jurisdictions and building enabling environments for collective action").

[33] *See id.* at 1161 ("[T]here is an absence of any global lawmaking institution with a jurisdictional reach and legal authority that match the scope of the problem.").

[34] *See* Majid Asadnabizadeh & Espen Moe, *A Review of Global Carbon Markets from Kyoto to Paris and Beyond: The Persistent Failure of Implementation*, 12 FRONTIERS IN ENV'T SCI. 1, 2 (2024), https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2024.1368105/full (reviewing the historical functioning and criticism of global carbon markets and identifying a lack of integration of markets across countries as one of the major shortcomings of existing infrastructure).

greenhouse effect and the observed warming."[35] The "greenhouse effect" to which he referred—the concept from which "greenhouse gases" get their name—is widely understood to be the primary phenomenon responsible for climate change.[36] Much like the covering of a greenhouse, greenhouse gases, once emitted into the atmosphere, trap the heat of the sun and warm the planet.[37] Scientists over the intervening four decades have identified specific greenhouse gases including carbon dioxide, methane, and nitrous oxide, among others.[38] The earth naturally emits and reabsorbs (sequesters) these gases as a part of biological cycles, but human activity has emitted vast amounts of greenhouse gases far faster than the earth is capable of naturally sequestering.[39]

The existence of climate change due to greenhouse gases is a settled matter. In the same year that Dr. Hensen testified before Congress, the international community founded the Intergovernmental Panel on Climate Change (IPCC) through the cooperation of the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO).[40] The UN General Assembly endorsed the establishment of the IPCC in 1988.[41] The IPCC's assessment reports have garnered respect and influence from its inception, with the First Assessment Report in 1990 motivating countries to come together to negotiate the UNFCCC in Rio in 1992.[42]

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[35] *Hearing Before the Committee on Energy and Natural Resources United States Senate on the Greenhouse Effect and Global Climate Change*, 100th Cong. 44 (1988) (statement of James E. Hansen).

[36] *See* Kweku et al., *Greenhouse Effect: Greenhouse Gases and Their Impact on Global Warming*, 17 J. SCI. RSCH. & REP. 1, 2 (2018).

[37] *See id.*

[38] *See id.*

[39] *See* Noelle E. Selin, *Carbon Sequestration*, ENCYC. BRITANNICA (Jul. 22, 2011), https://www.britannica.com/technology/carbon-sequestration.

[40] *See History of the IPCC*, IPCC, https://www.ipcc.ch/about/history (last visited Sept. 18, 2024).

[41] *See id.*; G.A. Res. 43/45, Protection of Global Climate for Present and Future Generations of Mankind (Dec. 6, 1988).

[42] *See History of the IPCC*, IPCC, https://www.ipcc.ch/about/history (last visited Sept. 18, 2024); *United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3–14 June 1992*, UNITED NATIONS, https://www.un.org/en/conferences/environment/rio1992 (last visited Oct. 22, 2024).

As the world approaches its thirtieth Conference of the Parties to that aspirational convention, the climate problem has by no means abated. The IPCC's most recent assessment report states clearly: "human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 [levels] in 2011–2020."[43] This has resulted in "widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere,"[44] ultimately leading to "widespread adverse impacts and related losses and damages to nature and people."[45] These widespread impacts, which include droughts, heat waves, extreme weather events, ocean acidification, biodiversity loss, and global sea level rise, are expected to increase as global average temperatures continue to rise.[46] The IPCC estimates that "3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change."[47] As the lives of these 3-billion-plus people are increasingly threatened by climate change, a global migration crisis is expected. Some estimates place the number of expected climate refugees at more than one billion by 2050.[48] If unmitigated, the confluence of the physical effects of climate change along with the impacts on humanity stands to reshape human society and the planet itself.

In this light, the primary question is no longer whether climate change will occur, but how to limit the change and its negative impacts. The 2015 Paris Agreement, reached at the twenty-first Conference of the Parties to the UNFCCC ("COP21"),[49] is the most

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[43] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), *CLIMATE CHANGE 2023: SYNTHESIS REPORT* 4 (2023), https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf.

[44] *Id.* at 5.

[45] *Id.*

[46] *See Causes and Effects of Climate Change*, UNITED NATIONS, https://www.un.org/en/climatechange/science/causes-effects-climate-change (last visited Sept. 23, 2024).

[47] *Climate Change*, UNITED NATIONS, https://www.un.org/en/global-issues/climate-change (last visited Sep. 20, 2024).

[48] *See* Helen Nugent, *The Number of People Fleeing Their Homes Has Doubled in a Decade. Why?*, WORLD ECON. F. (Jul. 5, 2022), https://www.weforum.org/agenda/2022/07/global-displaced-conflict-refugees/.

[49] Throughout the paper we will henceforth refer to Conferences of the Parties to the UNFCCC as "COP," followed by the number of the meeting.

comprehensive global effort to address the problem. The Paris Agreement sets the goal of limiting global temperature rise to 2°C with an aspirational goal of limiting the increase to 1.5°C.[50] The idea behind this goal is that while some warming appears inevitable, if warming is limited to 2°C (and especially 1.5°C) many of the major disaster scenarios may be averted.[51] The Paris Agreement aims to meet this goal by asking countries to voluntarily commit to restricting emissions of greenhouse gases. These voluntary commitments are called Nationally Determined Contributions (NDCs).[52] The NDCs are an imperfect tool to fight climate change: there is a significant gap between the pledges countries have made in their NDCs and the emissions reductions that must take place to keep warming under 2.0 or 1.5 ºC, and "[c]ountries are off track to achieve even the globally highly insufficient NDCs."[53] Recognizing the dangerous trajectory, many private actors have also committed to climate goals, such as the 45% of Fortune Global 500 companies that have made net zero pledges as of 2024.[54] More than 2,000 U.S. business owners and investors[55] signed on to a declaration that they would "continue to support climate action to meet the Paris Agreement" when the federal government indicated an intent to withdraw from that international commitment.[56] Staying below a 2°C temperature rise (the Paris Agreement goal) is looking increasingly difficult, but every incremental step towards less warming is important, and

[50] *See Paris Agreement*, *supra* note 3, art. 2 ¶ 1(a).

[51] *See id*.

[52] *See Paris Agreement*, *supra* note 3, art. 4 ¶ 2.

[53] UNITED NATIONS ENVIRONMENTAL PROGRAMME, EMISSIONS GAP REPORT 2022 XVI (Oct. 27, 2022), https://www.unep.org/resources/emissions-gap-report-2022.

[54] *See Fortune Global 500 Climate Commitments*, CLIMATE IMPACT PARTNERS (2022), https://www.climateimpact.com/news-insights/fortune-global-500-climate-commitments/.

[55] *See Who's In*, WE ARE STILL IN, https://www.wearestillin.com/signatories (last visited Dec. 2, 2024).

[56] *An Open Letter to the International Community and Parties to the Paris Agreement from U.S. State, Tribal, Local, and Business Leaders*, WE ARE STILL IN, https://www.wearestillin.com/we-are-still-declaration (last visited Dec. 2, 2024) ("Together, we will remain actively engaged with the international community as part of the global effort to hold warming to well below 2°C and to accelerate the transition to a clean energy economy that will benefit our security, prosperity, and health.").

given the uphill battle ahead, using resources as efficiently as possible is vital.

The Paris Agreement builds on its predecessors in relying upon market mechanisms to at least do some of the work of mitigation.[57] Among these market mechanisms is Article 6.4, which establishes a system for the international trading of verifiable carbon credits.[58] The international carbon market envisioned by Article 6.4 supplants the original Clean Development Mechanism (CDM) carbon market (agreed upon in the Kyoto Protocol at COP3).[59] That market began as a way for developing and developed nations to trade credits and ultimately opened to private purchasers.[60] That market ultimately never lived up to its potential,[61] prompting a redesign of the global trading mechanism in Paris. As the successor to the Kyoto Protocol, the Paris Agreement sets out the framework for an international

[57] Among these mechanisms is a provision that allows nations to trade emissions reductions actions to demonstrate compliance with their own NDCs, which deserves scrutiny in its own right but is outside the scope of this article. *See Paris Agreement*, *supra* note 3, art. 6 ¶ 2.

[58] *See Paris Agreement*, *supra* note 3, art. 6 ¶ 4.

[59] *See* UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, KYOTO PROTOCOL MECHANISMS 3–4 (2010), https://cdm.unfccc.int/about/cdm_kpm.pdf; *see also Article 6.4 Mechanism Newsletter*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (Jan. 24, 2024), https://myemail.constantcontact.com/What-s-next-for-Article-6-4-after-COP28-.html?soid=1117347475566&aid=g3yRTiw1tXc ("[The necessary work to operationalize Article 6 after COP28,] based on decisions made in Glasgow and Sharm-el-Sheik, includes . . . Processing over 1300 transition requests from CDM activities to Article 6.4.").

[60] *See United Nations Carbon Offset Platform*, UNITED NATIONS, https://unfccc.int/climate-action/united-nations-carbon-offset-platform (last visited Nov. 13, 2024) (this is the UN-run marketplace where individuals can purchase carbon offsets developed under the Kyoto Protocol mechanisms voluntarily).

[61] *See id.*; *see also* Kazunari Kainou, *Collapse of the Clean Development Mechanism Scheme Under The Kyoto Protocol and Its Spillover: Consequences of 'Carbon Panic,'* VOX EU (Mar. 16, 2022) https://cepr.org/voxeu/columns/collapse-clean-development-mechanism-scheme-under-kyoto-protocol-and-its-spillover#:~:text=Liquidation%20of%20the%20CDM%20scheme%2C%20which%20centred%20on%20the%20cancellation,was%20almost%20completed%20by%202020 (providing a timeline of the Kyoto protocol mechanisms and the transition to a voluntary marketplace).

carbon market in Article 6.4.[62] COP29 saw serious progress towards an operational Article 6.4 market, now dubbed the "Paris Agreement Crediting Mechanism."[63] In Baku, the parties officially endorsed the Supervisory Body's methodology standard.[64] Notably, the Baku agreement did not require CDM projects to be re-assessed on the basis of additionality to be eligible for transfer to the new Article 6.4 market.[65] Many more technical details concerning precisely how credits will be accounted for, verified, and traded remain to be addressed by the Supervisory Body.[66] What is clear, however, is that the international community is committed to a functioning carbon market as one primary component of a comprehensive climate solution.

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[62] *See* KAREN HOLM OLSEN ET AL., PROMOTING TRANSFORMATIONAL CHANGE THROUGH CARBON MARKETS 43 (Sept. 2022), https://unepccc.org/wp-content/uploads/2023/03/final-report-published-sep-2022.pdf.

[63] *See Paris Agreement Crediting Mechanism*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism (last visited Jan. 6, 2025).

[64] *See* Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement Sixth Session, *Rules, Modalities and Procedures for the Mechanism Established by Article 6, Paragraph 4, of the Paris Agreement and Referred to in Decision 3/CMA.3*, ¶ 2, U.N. Doc. FCCC/PA/CMA/2024/L.1 (Nov. 11, 2024) ("The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement . . . Takes note of the adoption by the Supervisory Body of the 'Standard: Application of the requirements of Chapter V.B (Methodologies) for the development and assessment of Article 6.4 mechanism methodologies'") (citing Supervisory Body document A6.4-SBM014-A05).

[65] *See* Khaled Diab, *COP29: Complex Article 6 rules pave way to unruly carbon markets*, CARBON MKT. WATCH (Nov. 23, 2024), https://carbonmarketwatch.org/2024/11/23/cop29-complex-article-6-rules-pave-way-to-unruly-carbon-markets.

[66] *See id* ("'Much lies in the hands of the Supervisory Body now,' said Federica Dossi, policy expert on global carbon markets. 'To show that it is ready to learn from past mistakes, it will have to take tough decisions next year and ensure that Article 6.4 credits will be markedly better than the units that old CDM projects will generate. If they are not, they will have to compete in a low-trust, low-integrity market where prices are likely to be at rock bottom and interest will be low. Such a system would be a distraction, and a waste of 10-years worth of carbon market negotiations at the UNFCCC.'").

II. TYPES OF CARBON MARKETS AND OFFSETS

Carbon markets currently are a vital tool that private actors and national governments are relying on to help mitigate catastrophic climate change. Almost all private industry net zero pledges[67] and many countries' NDCs depend upon using carbon markets to purchase offsets.[68] This reliance on carbon markets to meet global climate goals necessarily comes with an underlying reliance on the mechanisms that account for and govern their generation and exchange. Unfortunately, the current methods leave much to be desired. The confusing morass of conflicting standards and methodologies raises more questions than it answers. What uniform features exist across existing markets are inadequately defined or inconsistent. Furthermore, the commonly accepted definition of one of these features—additionally—distorts the global market, as described below. The situation would improve greatly with properly calibrated technical guidance from the governing United Nations body.

Carbon markets are best understood as trading systems that facilitate the sale of carbon offsets.[69] Carbon markets range in scope and size from industry-specific markets and subnational markets to full-spectrum global markets.[70] Of direct relevance to this work, the

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[67] *See* Anuj Saush et al., *The Role of Carbon Offsets in the Net-Zero Journey*, CONF. BD. 5 (Apr. 21, 2022), https://www.conference-board.org/topics/climate-change/the-role-of-carbon-offsets-in-the-net-zero-journey ("Realizing net-zero targets will require companies to use carbon offsets"); *Fortune Global 500 Climate Commitments*, *supra* note 54.

[68] *See Countries on the Cusp of Carbon Markets*, THE WORLD BANK (May 24, 2022), https://www.worldbank.org/en/news/feature/2022/05/24/countries-on-the-cusp-of-carbon-markets ("More than two thirds of countries are planning to use carbon markets to meet their Nationally Determined Contributions (NDCS) to the Paris Agreement").

[69] *See What Are Carbon Markets and Why Are They Important?*, *supra* note 14.

[70] *See The Untapped Power of Carbon Markets in Five Charts*, BLOOMBERGNEF (Sept. 16, 2022), https://about.bnef.com/blog/the-untapped-power-of-carbon-markets-in-five-charts/ (discussing subnational, national, and regional markets); *see, e.g., United Nations Carbon Offset Platform*, *supra* note 60 (global market); *Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, ICAO, https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx (last visited Oct. 22, 2024) (industry-specific market).

Paris Agreement set out to facilitate the development and operation of bilateral and multilateral markets.[71] Regardless of size and scope, any carbon market can be characterized as either a *compliance* mechanism or a *voluntary* mechanism.[72] While they operate slightly differently, the two mechanisms share an underlying structure and goal: using market systems to reduce atmospheric greenhouse gases in order to mitigate climate change.[73] The subsections that follow will detail how the two types of markets function, and then discuss the importance of the hybrid, UN-facilitated global market and the types of offsets traded on these markets.

A. *Compliance Carbon Markets*

Compliance carbon markets operationalize the greenhouse gas mitigation strategy commonly referred to as "cap and trade," as well as other regulatory schemes that impose particular limits on emissions, such as binding national or subnational net zero commitments. Governmental bodies establish compliance carbon markets in conjunction with statutory or regulatory limits on the amount of greenhouse gases that operators in the market can emit.[74] The government then sets the number of carbon credits available to operators equivalent to or within the limits.[75] Two of the best-known compliance markets are the European Union Emissions Trading Scheme (ETS) and the California Cap and Trade Program.[76] In these compliance markets, each carbon credit or offset represents an allowance of one ton of CO_2e emissions.[77] Over time, the number of carbon credits issued to operators decreases.[78] For instance, in the

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[71] *See Paris Agreement*, *supra* note 3, art. 6.

[72] *See The Untapped Power of Carbon Markets in Five Charts*, *supra* note 70.

[73] *See id.*

[74] *See What Are Carbon Markets and Why Are They Important?*, *supra* note 14.

[75] *See* INT'L ORG. OF SEC. COMM'NS, *COMPLIANCE CARBON MARKETS* 7 (Nov. 2022), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD719.pdf.

[76] *See id.*

[77] *See id.* at 1.

[78] *See, e.g.*, *Cap-and-Trade Program*, CAL. AIR RES. BD., https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/about (last visited May 13, 2023) (stating that California's cap and trade program "establishes a declining limit on major sources of GHG emissions").

current phase of the European Union ETS (2021–2030), the overall cap decreases by a linear reduction factor of 2.2% annually.[79]

To meet the decreasing allowance, operators can decrease their own emissions directly, or they can purchase carbon credits from other operators who have excess credits.[80] For instance, if Company Z is issued ten credits in a given year but increases its own efficiency so it only uses eight of those credits, it can sell the extra two credits to a company that would like to emit more than its credit allowance.

The primary tool compliance markets use to reduce emissions is incentivizing operators to increase their own efficiency to stay within the "cap."[81] However, for the purposes of this paper, increasing internal efficiency is largely irrelevant. What is more important is the final component of compliance markets: bringing new credits into the system. Beyond the allowance credits that are issued annually, in many compliance carbon markets new credits can be created by projects that reduce or remove emissions elsewhere.[82] Once created, those credits are used the same way as government-issued allowances and can be sold to companies to allow them to emit beyond the government-mandated limit.[83] In this way, compliance

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[79] *See* Eur. Comm'n, *Emissions cap and allowances*, EUR. COMM'N, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/emissions-cap-and-allowances_en (last visited Sept. 28, 2024) ("In phase 4 of the EU ETS (2021–2030), the cap on emissions continues to decrease annually at an increased annual linear reduction factor of 2.2%. The Union-wide cap for 2021 from stationary installations is fixed at 1,571,583,007 allowances. The annual reduction corresponding to the linear reduction factor is 43,003,515 allowances.").

[80] *See* INT'L ORG. OF SEC. COMM'NS, *supra* note 75, at 1.

[81] *See* MCKINSEY & CO., PUTTING CARBON MARKETS TO WORK ON THE PATH TO NET ZERO 17 (Oct. 2021), https://www.mckinsey.com/capabilities/sustainability/our-insights/putting-carbon-markets-to-work-on-the-path-to-net-zero#/ ("[R]eduction of companies' own emissions is the priority").

[82] *See* STEPHANIE LA HOZ THEUER ET AL., OFFSET USE ACROSS EMISSIONS TRADING SYSTEMS 11 (Jan. 2023), https://icapcarbonaction.com/system/files/document/ICAP%20offsets%20paper_vfin.pdf (explaining that many compliance markets have allowed the creation of new offsets at some point or reserve the addition of these credits in the future, including the EU ETS accepting credits produced under the Kyoto Protocol mechanisms up until 2021, and other markets, such as the California/Quebec Cap and Trade program, the Chinese ETS, the Korean ETS, and many others actively allowing the use of later-created credits).

[83] *See id.* at 7.

markets leverage private financing to fund projects that reduce or remove emissions elsewhere.

The ability to create new credits in compliance markets can increase the total efficiency of the system, but it also raises the risk that the "cap" can be thwarted if the new credits are overvalued or otherwise flawed. For example, some industries, such as cement production, face extreme difficulty in reducing emissions because of the chemical reactions specific to the production process.[84] While technology exists that can reduce emissions from cement production, it is excessively costly.[85] Therefore, it is more efficient to reduce the same amount of emissions elsewhere, receive credits for those outside emission reductions, and continue to produce cement. If the system operates effectively, the goal of reducing total emissions is still met, just at a lower cost than would be required if new offsets couldn't be created. However, if the new credits are created in a flawed manner and do not represent true reductions or removals, the entire system is undermined. In such cases, the emissions reductions that the cap-and-trade scheme shows on paper will not be reflected in reality, misleading policymakers, the public, and further contributing to rising atmospheric greenhouse gas levels.

The effect of credit availability on the price dynamics of compliance markets is illustrated by two examples: the European Union ETS, and the California Cap and Trade Program. On the European Union ETS, an allowance permitting one ton of CO_2e emissions (i.e. one carbon credit) was trading at a price between roughly sixty to seventy euros in the early months of 2024.[86] This price is down significantly from a 2023 high that peaked around one hundred euros.[87] According to analysts, "the market's weakness stemmed from a combination of bearish factors, including weak industrial output, a drop in power emissions and a shift away from carbon-intensive power generation, and the cost of improvement of solar and wind

[84] *See* Mario Honrubia, *Cement Manufacturing: Ways to Reduce CO2 Emissions*, ENNOMOTIVE, https://www.ennomotive.com/cement-manufacturing-emissions/ (last visited Feb. 15, 2024).

[85] *See id.*

[86] *See Carbon Price Viewer*, SANDBAG, https://sandbag.be/carbon-price-viewer/ (last visited Feb. 15, 2024).

[87] *See id.*

power."[88] Importantly, this data and analysis indicate that the availability of renewable energy puts downward pressure on the price of carbon offsets.[89] If renewable energy development also generates offsets that meet Article 6 criteria and are subsequently recognized as valid on the EU ETS, the additional supply created by those offsets would add more downward price pressure.

The California Cap and Trade Program operates in a bilateral market with the government of Quebec. The California Air Resources Board (CARB) and the Québec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) hold joint auctions of greenhouse gas allowances, totaling just over 205 million tons of CO_2e in 2024.[90] In 2023, a single allowance traded for between twenty-seven and thirty-nine dollars at auction.[91] California predicts the average price could modestly increase in 2024, depending on consumption.[92] However, analysts do not anticipate sharp price increases

[88] *See* Scott Chen, *Bearish EU carbon prices to continue in 2024 on lower power emissions, oversupply*, S&P GLOBAL COMMODITY INSIGHTS (Dec. 28. 2023), https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/122823-bearish-eu-carbon-prices-to-continue-in-2024-on-lower-power-emissions-oversupply.

[89] *See* Indigo Wyburd, *Hidden in Plain Sight: Flawed Renewable Energy Projects in the Carbon Market*, CARBON MKT. WATCH 3 (2024), https://carbonmarketwatch.org/publications/hidden-in-plain-sight-flawed-renewable-energy-projects-in-the-voluntary-carbon-market/ (describing credits from renewable energy as questionably additional or "surplus" and warning of the market "being flooded with more low-integrity, poor-quality carbon credits").

[90] *See* California Cap-and-Trade Program and Québec Cap-and-Trade System, *2024 Annual Auction Reserve Price Notice* (Dec. 1, 2023), https://ww2.arb.ca.gov/sites/default/files/2023-12/nc-2024_annual_reserve_price_notice_joint_auction.pdf; California Air Resources Board, *Cap-and-Trade Program: Allowance Distribution Factsheet* (Jan. 29, 2021), https://ww2.arb.ca.gov/resources/documents/cap-and-trade-program-allowance-distribution-factsheet.

[91] *See* California Air Resources Board, *California Cap-and-Trade Program: Summary Of California-Quebec Joint Auction Settlement Prices and Results* (Aug. 2024), https://ww2.arb.ca.gov/sites/default/files/2020-08/results_summary.pdf.

[92] *See* Energy Assessment Division, *Preliminary GHG Price Projections*, CALIFORNIA AIR RESOURCES BOARD (2017), https://efiling.energy.ca.gov/GetDocument.aspx?tn=216271 (projecting a price range from roughly $22/ton to $41/ton).

until supply is tightened, potentially in 2025 and beyond.[93] Over-issuance of new credits for renewable energy projects in other global markets[94]—like those approved by Article 6.4, or the influx of such credits from other carbon markets to the California market[95]—could counteract the effects, both in pricing and in emitter behavior, of tightening government supply.

B. *Voluntary Carbon Markets*

The other major type of carbon markets, voluntary markets, operate as their name suggests—voluntarily. There is no compliance benefit to purchasing offsets on a voluntary market and they are not government-backed or mandated.[96] Instead they are largely operated by non-governmental organizations seeking to be a part of the climate solution.[97] Similar to compliance markets, a voluntary offset also represents one ton of CO2e either avoided or removed. In practice, voluntary offsets often work as follows: if Company Y has set a carbon neutral goal, but still emits ten tons of carbon per year, it could purchase ten offsets, and report net-zero emissions.[98]

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[93] *See* Karrie Gordon, *California's Carbon Market Forecast for Supply Deficit by 2030*, VETTAFI (Jul. 20, 2023), https://www.etftrends.com/climate-insights-channel/californias-carbon-market-forecast-deficit-2030/.

[94] As the program currently operates, it strictly limits the new types of credits or offsets that can be generated. *See* California Air Resources Board, *ARB Offset Issuance Table*, https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program#:~:text=The%20Compliance%20Offsets%20Program%20is,Board%2Dapproved%20Compliance%20Offset%20Protocols (last visited Dec. 3, 2024) (listing the six categories of approved offsets as "1) U.S. Forest Projects (Forest), 2) Ozone Depleting Substance Projects (ODS), 3) Livestock Projects (Livestock), 4) Mine Methane Capture Projects (MMC), 5) Rice Cultivation Projects (Rice), 6) Urban Forest Projects (Urban)").

[95] The increased global reliance on Article 6 for Paris Agreement compliance may put pressure on compliance markets everywhere, including California and Quebec, to adopt rules that track Article 6 technical requirements and thereby allow for cross-market trading.

[96] *See What Are Carbon Markets and Why Are They Important?*, *supra* note 14.

[97] *See* Silvia Favasuli & Vandana Sebastian, *Voluntary Carbon Markets: How They Work, How They're Priced and Who's Involved*, S&P GLOBAL COMMODITIES (Jun. 10, 2021), https://www.spglobal.com/commodityinsights/en/market-insights/blogs/energy-transition/061021-voluntary-carbon-markets-pricing-participants-trading-corsia-credits.

[98] *See* Saush, *supra* note 67, at 6.

There are a number of key players that come together to make voluntary carbon markets work. There are offset producers, verification companies, marketplace operators, and the offset purchasers.[99] Producers of offsets can take numerous forms, including developers of clean energy generation projects, forest conservationists, and companies working on cutting-edge carbon removal technologies.[100] Verification companies and organizations ensure that the offsets created and sold represent true emission reductions or removals.[101] There is significant overlap between verification companies and marketplace operators, as the verifiers often also operate marketplaces. The major voluntary offset verifiers are the Voluntary Carbon Standard, Gold Standard, and the American Carbon Registry.[102] Each of these companies also operates a market to purchase carbon offsets, but offsets are sold in many other markets as well.[103]

Voluntary carbon markets exist because of the demand generated by private actors seeking to mitigate climate change. As mentioned previously, 45% of Fortune 500 companies have made net zero pledges, and almost all of them rely on carbon offsets purchased on voluntary marketplaces to get there.[104] In 2021, the voluntary carbon market was worth $2 billion, but it is expected to balloon to between $10 billion and $40 billion by 2030.[105] Prices in voluntary markets are generally much lower than in compliance markets, with peak offset prices not even clearing ten dollars.[106]

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99 *See* Si Chen et al., *Voluntary Carbon Offsets: An Empirical Market Study*, SOC. SCI. RSCH. NETWORK 1, 3–4 (Dec. 9, 2021), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3981914.

100 *See id*. at 7–8.

101 *See id*. at 4.

102 *See id*. at 9–10.

103 *See id*. at 9–10.

104 *See Fortune Global 500 Climate Commitments*, supra note 54; *see also* Saush, *supra* note 67.

105 *See* Anders Porsborg-Smith et al., *The Voluntary Carbon Market Is Thriving*, BOS. CONSULTING GRP. (Jan. 19, 2023), https://www.bcg.com/publications/2023/why-the-voluntary-carbon-market-is-thriving.

106 *See* Simon Jessop, *Carbon Offset Price of $25–$35/ton Would Boost Climate Action—ADB Climate Envoy*, REUTERS (Nov. 16, 2023), https://www.reuters.com/sustainability/climate-energy/carbon-offset-price-25-35ton-would-boost-climate-action-adb-climate-envoy-2023-11-16/.

Further, the prices on voluntary markets differ based on the underlying project generating the offset, with removal project offsets demanding a premium over avoidance project offsets.[107] The heavy reliance on carbon offsets to meet climate goals makes proper verifying and accounting procedures essential.

C. *United Nations Carbon Markets*

United Nations-sanctioned carbon markets operate in a space somewhere between compliance and voluntary markets, with the goal of bridging them all. The original Kyoto Protocol Clean Development Mechanism (CDM) carbon market was established as a compliance market to allow developed countries to purchase offsets to meet their emissions reduction goals.[108] However, as nation-state purchasers dwindled, the market eventually opened up to private voluntary purchasers and, as of now, the CDM is largely a voluntary marketplace.[109] As an interesting overlap, some compliance markets allow the use of CDM offsets to count as credits under the compliance schemes, further blurring the line between voluntary and compliance markets.[110] The successor to the Kyoto Protocol, the Paris Agreement, also includes provisions for a carbon market in Article 6.4.[111] The Article 6.4 market will supplant the CDM, but some technical details remain to be ironed out by the Supervisory Body

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[107] *See id.* ("The current cost of buying a credit in the voluntary market can be around $6–$8 a ton for sequestering carbon in forests, and less if a company is purchasing green power produced by solar energy or wind.").

[108] *See* UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, *supra* note 59, at 3, 4.

[109] *See* Kainou, *supra* note 61.

[110] *See* Jessica F. Green, *Blurred Lines: Public-Private Interactions in Carbon Regulations*, 43 INT'L INTERACTIONS 103, 104 (2016); *Carbon Mechanisms: the Voluntary Market*, GERMAN FED. MINISTRY FOR ECON. AFFS. AND CLIMATE ACTION, https://www.carbon-mechanisms.de/en/introduction/carbon-market-basics/translate-to-english-der-freiwillige-markt (last visited Nov. 13, 2024) ("The line between voluntary and compliance markets is becoming increasingly blurred. In many countries, it is now possible to use certificates from private certification schemes to meet obligations under public policy instruments—for example in Columbia.").

[111] *See* KAREN H. OLSEN ET AL., PROMOTING TRANSFORMATIONAL CHANGE THROUGH CARBON MARKETS 5, 43 (Sept., 2022), https://unepccc.org/wp-content/uploads/2023/03/final-report-published-sep-2022.pdf.

in 2025.[112] An open question remains as to the role of individual (non-nation state) purchasers on the market. Even if they are excluded, the CDM market may still play an important role as a global, UN-backed voluntary carbon market.

Even though global carbon markets run by the UN are often labeled as "compliance markets," they inherently differ from other national and regional compliance markets. In the global context, the body regulating the market (the United Nations) has little power to effectively sanction a country that is operating outside of compliance.[113] Even if all the parties agree to include some sanctioning provision (which is unlikely), a country can usually avoid it by simply removing itself from the agreement entirely.[114] Further, unlike traditional compliance markets, the United Nations does not issue allowance credits. It instead tries to standardize the methodologies for creation and sale of reduction and removal credits.[115] Consequently, UN-backed markets bridge compliance and voluntary markets and are a key part of the global strategy to mitigate climate change. It is essential that the offsets sold pursuant to the UN mechanism are calculated accurately to achieve the greatest possible environmental impact.

D. *Types of Carbon Offsets*

On any carbon market, each offset (or credit or allowance) represents one ton of CO_2e. However, especially on voluntary markets, offsets are often categorized by how they were created. The most common distinction is between offsets created from *avoidance*

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112 *See id.* at 43–44; *supra* notes 65–66 and accompanying text.

113 *See* Kathryn Tso, *How Are Countries Held Accountable Under The Paris Agreement?*, MASS. INST. TECH. CLIMATE PORTAL (Mar. 8, 2021), https://climate.mit.edu/ask-mit/how-are-countries-held-accountable-under-paris-agreement ("[T]here is no hard enforcement in the Paris Agreement.").

114 *See generally* Mario Larch & Joschka Wanner, *The Consequences of Unilateral Withdrawals from the Paris* Agreement (Kiel Inst. for World Econ., Working Paper No. 2236, 2022), https://www.ifw-kiel.de/fileadmin/Dateiverwaltung/IfW-Publications/fis-import/1946690d-eedf-48a9-bd45-7d4a4009cdd3-KWP_2236.pdf.

115 *See* U.N. Framework Convention on Climate Change, *Decision 3/CMA.3 Rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement*, U.N. Doc. FCCC/PA/CMA/2021/10/Add.1, Decision 3/CMA.3, (Mar. 8, 2022) [hereinafter *Paris Agreement CMA.3*].

activities as opposed to offsets created by *removal* activities.[116] The lines between these categories are not always clear, but understanding the general contours of each is valuable.

Avoidance activities either curtail emissions or protect natural carbon sinks. The first category, "avoided emissions," includes activities such as capturing methane from landfills or replacing fossil-fuel energy with renewable energy.[117] The second category, "avoided nature loss," includes such things as prevention of deforestation.[118] The vast majority of offsets on the market are derived from avoidance activities falling into these two categories.[119]

Avoided nature loss and avoided emissions operate on the underlying principle that there is a baseline trajectory of emissions over time. A project that "avoids" expected emissions lowers that trajectory and gets us closer to a path of sustainable levels of emissions.[120] An example of offsets created by an "avoided emissions" project could be a new solar array built on an energy grid where the typical energy production is fossil-fuel based. Because the emissions of the fossil fuels are avoided by creating the solar project, a carbon offset can be generated for those avoided emissions.[121] Similarly, an example of an "avoided nature loss" offset project could be an organization purchasing a forest that is at risk of development and putting it into conservation. By preventing the forest from being

116 *See* Av Kalle, *Different Kinds of Carbon Offsets—A Quick Guide*, GO CLIMATE (Mar. 18, 2021), https://www.goclimate.com/blog/different-kinds-of-carbon-offsets-a-quick-guide/.

117 *See Carbon Offsets Grow in Importance as Producers Target Net-Zero*, 46 OIL & ENERGY TRENDS 4, 4 (2021).

118 *See id.*

119 *See* Chen, *supra* note 99, at 8.

120 *See* TASKFORCE ON SCALING VOLUNTARY CARBON MKTS., FINAL REPORT 1, 58–59 (Jan. 2021), https://www.iif.com/Portals/1/Files/TSVCM_Report.pdf.

121 *See id.* It may be possible to model a future global energy system where the existence of "avoided development" credits results in a scenario where global CO2 emissions rise annually in reality but decrease annually on paper. That project is too large for this work; someone with more time and more expertise should pursue it.

developed, this would "avoid" releasing the emissions that are in the natural carbon sink and thus could create an offset.[122]

On the other hand, "removal" offsets are created by actively taking carbon out of the atmosphere through natural or technical means, without changing the trajectory of emissions.[123] The primary methods are nature-based sequestration and capture, a category including reforestation, afforestation, and other land use techniques in which carbon is absorbed by newly cultivated plant life.[124] There are also smaller removal techniques in development such as direct air capture and enhanced rock weathering.[125] This category of "direct removal of CO_2 from the atmosphere" encompasses all carbon removals outside of nature-based solutions (i.e. technology-based solutions).[126]

Researchers at the University of California, Berkeley's Carbon Trading Project maintain a comprehensive database of all carbon offsets from four voluntary markets, which together comprise nearly the entirety of global voluntary market offsets.[127] This data provides a useful illustration of the variety and relative distribution of offset project types. The graphic below, *figure 1*, shows the proportion of offsets by type issued between 2018 and 2022.[128]

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[122] *See id.* at 56. Because discounting in the forestry context would require an entirely distinct (and complex) calculation of the non-zero likelihood a particular forest may be subject to deforestation—a calculation with many scientific and political prediction variables—it is beyond the scope of this paper to propose a methodology to determine and correct for partial additionality in that space.

[123] *See* THE WORLD BANK GROUP [WBG], *supra* note 16, at 34.

[124] *See Taskforce On Scaling Voluntary Carbon Markets Final Report, supra* note 120, at 56.

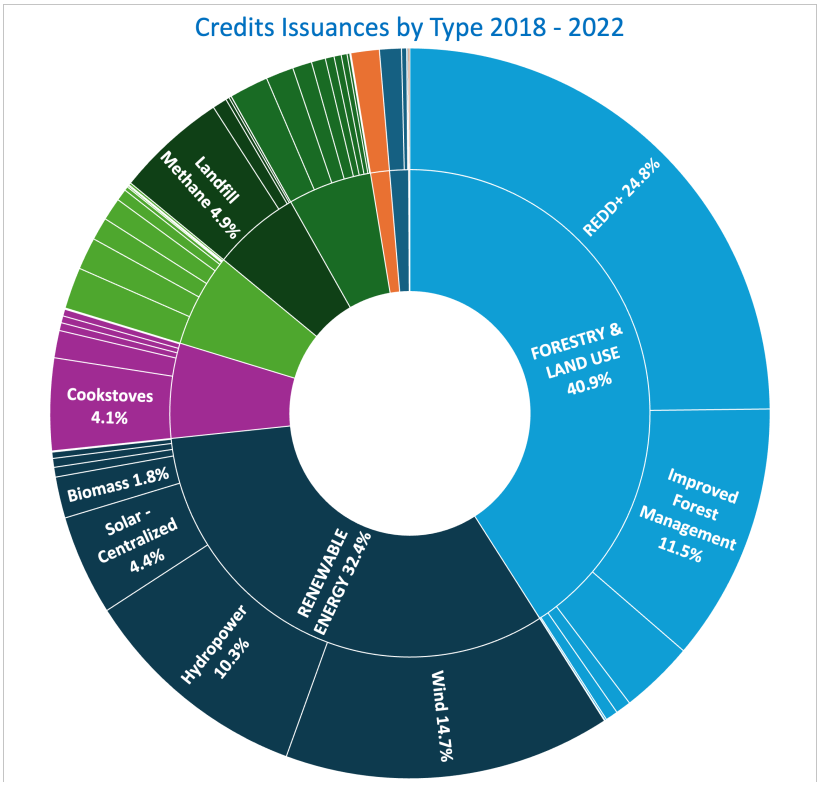
[125] *See id.* at 58.

[126] *Carbon Offsets Grow in Importance as Producers Target Net-Zero*, 46 OIL & ENERGY TRENDS 4, 4 (Aug. 17, 2021), https://doi.org/10.1111/oet.12876.

[127] *See Voluntary Registry Offsets Database*, GOLDMAN SCH. PUB. POL'Y, https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database (last visited Sept. 29, 2024).

[128] *See* IVY S. SO ET AL., VOLUNTARY REGISTRY OFFSETS DATABASE v7.1 (2023), https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database (scroll to "Version archive" and click "v7 – 2022 year-end version – with data through December 31, 2022") (pie-chart formed by manipulating the data in the "PROJECTS" tab to only include offsets issued in 2018–2022).

Figure 1



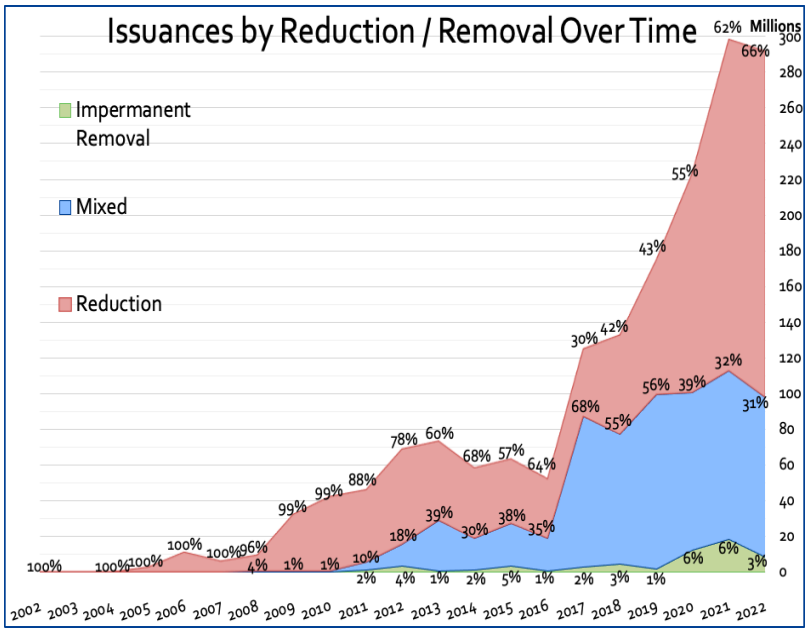
This graphic includes all the offsets created specifically for voluntary markets, as well as CDM offsets that have been transferred into voluntary markets. The graphic demonstrates that the two major categories of offset generation were "Forestry and Land Use" and "Renewable Energy," generating 40.9% and 32.4% of offsets issued in this period, respectively.[129] Renewable energy offsets are exclusively avoidance offsets, and forestry and land use encompasses some avoidance as well as removals. The smaller categories were "chemical processes," "industrial commercial," "household and community," "agriculture," "carbon capture and storage," and "waste management." Beyond merely the type of offset, the graphic below, *figure 2*, outlines what percentage of offset issuances on voluntary markets were reductions or removals.[130] In 2022, reduced or

129 *Id.*

130 *Id.* (chart formed without manipulating the data in the "PROJECTS" tab).

avoided emissions represented 66% of all offsets issued on voluntary carbon markets.

Figure 2



The heterogeneity of offsets available on carbon markets presents a couple of problems. Firstly, and foundationally, for a commodities market to function efficiently, the products traded on it must be fully substitutable. That is simply not the present case for carbon offsets. Different types of offsets command different prices, yet they are, in theory, all supposed to represent the same amount of benefit in terms of CO2e emissions. The product—the reduction in emissions—is a fully fungible commodity[131] and should trade as such. The difference in price, therefore, must reflect an underlying problem with the verification or calculation methodology, or both. Other traditional commodities markets—such as oil, coal, gold, and soybeans—maintain consistent pricing regardless of the methods

[131] *See* U.S. DEP'T TREASURY, VOLUNTARY CARBON MARKETS JOINT POLICY STATEMENT AND PRINCIPLES (May 2024), https://www.whitehouse.gov/wp-content/uploads/2024/05/VCM-Joint-Policy-Statement-and-Principles.pdf (referring to credits as "commodities").

used by the producer to bring the commodity to market.[132] Even a cursory examination of the carbon offset space reveals the challenge that contributes to this market inefficiency—it is nearly impossible to develop uniform criteria and methodology that ensure environmental integrity across all the various types of offsets. The project of Article 6 is in one important sense accomplishing exactly that herculean task on a global inter-market scale.[133] Without robust criteria and mechanisms for enforcing it, through the UNFCCC, for instance, purchasers of carbon offsets are forced to assess the environmental benefits of each offset themselves—a difficult project even for the most sophisticated companies.[134] Thus, a properly calibrated system, sanctioned by the UNFCCC, has the potential to effectuate a market correction, increase efficiency and reduce overall emissions.

III. OFFSET CRITERIA AND CALCULATION

While many of the details remain discordant or uncertain, across the major compliance and voluntary carbon markets a similar set of required attributes apply. To generate any offset (removal or avoidance), these common features must be provably present. These

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[132] *See Commodities*, TRADING ECON., https://tradingeconomics.com/commodities (last visited Sept. 29, 2024).

[133] *See* U.N. Framework Convention on Climate Change, *Matters relating to cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement*, U.N. Doc. FCC/PA/CMA/2023/Decision 6/CMA.4, ¶¶ 25–26 (Mar. 17, 2023) ("Requests the secretariat, as a matter of priority, to develop the centralized *accounting* and reporting platform and the Article 6 database referred to in decision 2/CMA.3, annex, paragraphs 32 and 35, on the basis of the relevant guidance contained in annex I, chapters II–III, and to make available a test version by June 2024 with a view to the first version being finalized by June 2025; Also requests the secretariat, as part of the implementation of the centralized accounting and reporting platform and the Article 6 database, to make the detailed requirements of the platform and database available to Parties before the fifty-eighth session of the Subsidiary Body for Scientific and Technological Advice to allow Parties to provide views thereon via the submission portal within four weeks of publication of the requirements.") (emphasis added).

[134] *See, e.g.*, Sheila Flynn, *Carbon Offset Programs of Companies Like Microsoft, BP Go Up in Smoke As Wildfires Decimate Forests*, INDEPENDENT (Aug. 4, 2021), https://www.independent.co.uk/climate-change/news/carbon-offsets-microsoft-bp-forests-wildfires-b1897012.html (discussing the challenges Microsoft and others have faced in purchasing offsets that have real environmental benefits, despite their best efforts).

high-level requirements include: permanence, avoidance of leakage, a measurable value calculated using a proper baseline, and additionality.[135] Importantly, the decision at Glasgow on Article 6.4 of the Paris Agreement (which remains the governing document for that vital instrument) incorporated some version of each of these requirements.[136]

A. *Permanence and Leakage*

Permanence requires that emissions reductions or removals are not quickly reversed.[137] Permanence is sometimes difficult to achieve because it relies on future action or inaction, and it is sometimes entirely out of the project creator's control. For example, if a project's objective is to plant new trees to sequester carbon, that project only works if the area turned into forest stays that way. If that forest burns down in a wildfire or is subsequently redeveloped, the environmental benefit is eliminated. Permanence is not often considered in its literal sense, but in relation to the carbon cycle. If a project is permanent enough—a common convention is 100 years—that will satisfy permanence.[138]

Leakage occurs when an offset project that avoids or removes emissions results in greater emissions elsewhere.[139] For instance, if a particular forest is put into conservation to prevent development, leakage would occur if a nearby forest was developed instead.[140] In

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135 *See* Andrew Steer & Craig Hanson, *Corporate Financing of Nature Based Solutions: What Next?*, WORLD RES. INST. (Apr. 5, 2021), https://www.wri.org/insights/corporate-financing-nature-based-solutions-what-next (other relevant concerns include: reducing measurement errors; preventing harm to communities and ensuring benefits are shared; and avoiding double-counting); *see also* IETA, IETA INPUT TO ARTICLE 6.4 SUPERVISORY BODY REQUIREMENTS FOR THE DEVELOPMENT AND ASSESSMENT OF MECHANISM METHODOLOGIES (Apr. 2023), https://unfccc.int/sites/default/files/resource/Methodologies_requirements_input_IETA.pdf (focusing on five sections, two of which deal with proper baselines, and the remaining three are additionality, leakage, and non-permanence).

136 *See Paris Agreement CMA.3*, *supra* note 115, Decision 3/CMA.3, Annex.

137 *See* DERIK BROEKHOFF ET AL., SECURING CLIMATE BENEFIT: A GUIDE TO USING CARBON OFFSETS 26 (2019), https://offsetguide.org/wp-content/uploads/2020/03/Carbon-Offset-Guide_3122020.pdf.

138 *See id.*

139 *See id.* at 23.

140 *See id*.

such a case, putting the original tract of forest into conservation did not result in avoided emissions because the pressure for development was just diverted, not stopped entirely. Leakage is very difficult to quantify, especially in avoided development projects, but preventing it is essential for the environmental integrity of carbon offsets.

B. *Baseline Calculations*

The number of offsets a given project generates is calculated using a "baseline" concept. The theory is that there is a baseline amount of atmospheric greenhouse gases that would exist or be emitted in a "business as usual" scenario. If a project results in fewer atmospheric greenhouse gases than the baseline, the difference between the two scenarios is the number of offsets created.[141] For removal projects, the number of offsets created is just the actual amount of CO_2e removed from the atmosphere and stored permanently (minus any emissions created by building and operating the project).[142] This is a relatively straightforward calculation. However, it becomes slightly more complicated in reduction or avoidance projects. For example, in the case of a renewable energy project, in simple terms, the number of offsets a given project generates is the amount of clean energy generated (that creates no emissions) multiplied by the tons of CO_2e typically emitted to generate energy on the relevant grid.[143]

To illustrate how baseline calculation works in practice, below is a tool generated by the UNFCCC to explain the process in the context of the Kyoto Protocol's Clean Development Mechanism

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[141] *See* TASKFORCE ON SCALING VOLUNTARY CARBON MKTS., *supra* note 120, at 118; *Additionality & Baselines*, CARBON MKT. WATCH (May 30, 2012), https://carbonmarketwatch.org/2012/05/30/additionality-and-baselines/.

[142] *See, e.g.,* UNFCCC Secretariat, *Information Note: Removal Activities under the Article 6.4 Mechanism (Ver. 04.0)*, U.N. Doc. A6.4-SB005-AA-A09, Chapters 2.1, 6.3 & 7.3, (May 17, 2023).

[143] *See, e.g.*, *How are carbon credits issued?*, DGB Grp. (Jul. 31, 2023), https://www.green.earth/blog/how-are-carbon-credits-issued ("An independent third-party auditor . . . assesses the project's emissions reduction claims by comparing project emissions to the baseline emissions. This step involves validating the project's baseline scenarios, monitoring processes, and methodologies for calculating emissions reductions.").

(CDM).[144] This process breaks CDM baseline calculations for clean energy avoidance offsets into six steps.[145]

Figure 3

Baseline methodology procedure

Project participants shall apply the following six steps:

(a)	**Step 1:**	Identify the relevant electricity systems;
(b)	**Step 2:**	Choose whether to include off-grid power plants in the project electricity system (optional);
(c)	**Step 3:**	Select a method to determine the operating margin (OM);
(d)	**Step 4:**	Calculate the operating margin emission factor according to the selected method;
(e)	**Step 5:**	Calculate the build margin (BM) emission factor;
(f)	**Step 6:**	Calculate the combined margin (CM) emission factor.

These steps are relatively transferable to the calculation of a baseline for the purposes of any carbon market. Steps one and two identify the power-generation plants that are included in the grid the project is being built in. Steps three and four calculate the baseline emissions of that identified grid. Step five calculates the emissions rate of the new offset-producing project, and step six determines the difference between the baseline emissions and the new project emissions. This difference is the number of offsets the project will create.

144 *See* UNFCCC, *The Clean Development Mechanism*, https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism#:~:text=UNFCCC%20Nav&text=The%20Clean%20Development%20Mechanism%20(CDM,reduction%20project%20in%20developing%20countries (last visited Oct. 8, 2024) ("The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries.").

145 *See* UNFCCC, TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM VERSION 0.70, 8, https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf (last visited Oct. 8, 2024).

C. *Additionality*

The final key component for any offset project is a demonstration of "additionality." Broadly speaking, additionality simply means that any reduction or removal of CO_2e by a project must be "in addition" to what would have occurred in a baseline scenario.[146] In legal terms, the ability to sell offsets (and the resulting financial gains) must be a but-for cause of a project and not a secondary benefit of the project.[147] A project must demonstrate both regulatory additionality (i.e. there exists no government regulation requiring the project) and financial additionality (i.e. the project would not be financed without the expected revenue from the sale of offsets).[148] Consequently, if the regulations of a given jurisdiction mandate that a climate mitigation activity must take place, that project is not additional because it would have taken place regardless of the incentive of offset generation. For example, in California, towns are required to capture landfill methane emissions.[149] As such, there is no benefit to providing California landfill operators with carbon offsets for the captured methane because the methane emissions will be captured regardless. However, in many states and countries such landfill methane regulations do not exist, so a major incentive for capturing the methane may be the generation of offsets.

While regulatory additionality is somewhat straightforward, it is sometimes harder to wrap one's head around financial additionality. In practice, it takes a number of forms, but is most easily understood in relation to clean energy development. In such cases,

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146 *See* TASKFORCE ON SCALING VOLUNTARY CARBON MKTS., *supra* note 120, at 118; *Paris Agreement CMA.3*, *supra* note 115, V.B.38 ("Additionality shall be demonstrated using a robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism, taking into account all relevant national policies, including legislation, and presenting mitigation that exceeds any mitigation that is required by law or regulation…").

147 *See* Michael Gillenwater, *What is Additionality? Part 1: A long standing problem* 3 (GHG Mgmt. Inst., Working Paper No. 001 Version 03, 2012) ("Overall, additionality is about assessing causation.").

148 *See* Annalise Downey, *Additionality Explained*, SYLVERA, Nov. 15, 2022, *https://www.sylvera.com/blog/additionality-carbon-offsets* (describing "Financial Additionality" as answering the question "Are project activities financially viable and attractive without carbon revenues?," and describing "Policy & Regulatory [Additionality]" as answering the question: "Are there regulations or incentives that enforce or encourage the project activity?").

149 *See* Cal. Code Regs. Tit. 17 § 95460 et seq. (2024).

additionality is only achieved when a clean energy project is made competitive in the market *due* to the revenue generated by the offsets created.[150] The assumption underpinning the requirement of financial additionality is that if a clean energy project would give the best return on investment regardless of offsets, it should not qualify for offsets because the project would be built anyways, and the financial incentive from offsets changes nothing.[151] Indeed, many clean energy projects in the United States now fit this description.[152] In contrast, if a clean energy project would be less financially viable than another type of power plant, the developer may choose to build the non-renewable power plant, so providing a financial incentive (in the form of offsets) to a renewable project makes sense.[153] In such a case, the renewable energy project would be "in addition" to what would have occurred in a business as usual scenario without the intervention of offset incentives.

To demonstrate how this works in practice, below is an additionality decision tree developed by UNFCCC for the Kyoto Protocol Clean Development Mechanism.[154] This decision tree has enjoyed widespread adoption by voluntary registries as well.[155] On the decision tree, "Step 2: Investment analysis" represents the component of financial additionality. If the proposed project is "unlikely to be the most financially attractive or is unlikely to be financially

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[150] *See Additionality*, CARBON OFFSET GUIDE, https://www.offsetguide.org/high-quality-offsets/additionality/ (last visited Oct. 8, 2024).

[151] *See id.*

[152] *See* Silvio Marcacci, *Cheap Renewables Keep Pushing Fossil Fuels Further Away From Profitability—Despite Trump's Efforts*, FORBES (Jan. 23, 2018), https://www.forbes.com/sites/energyinnovation/2018/01/23/cheap-renewables-keep-pushing-fossil-fuels-further-away-from-profitability-despite-trumps-efforts/?sh=75ade3536ce9 ("Rapid cost declines made renewable energy the United States' cheapest available source of new electricity, without subsidies, in 2017. . . . As renewable energy costs continue their relentless decline, they keep pushing fossil fuels further from profitability—and neither trend is slowing down.").

[153] *See Additionality*, *supra* note 150.

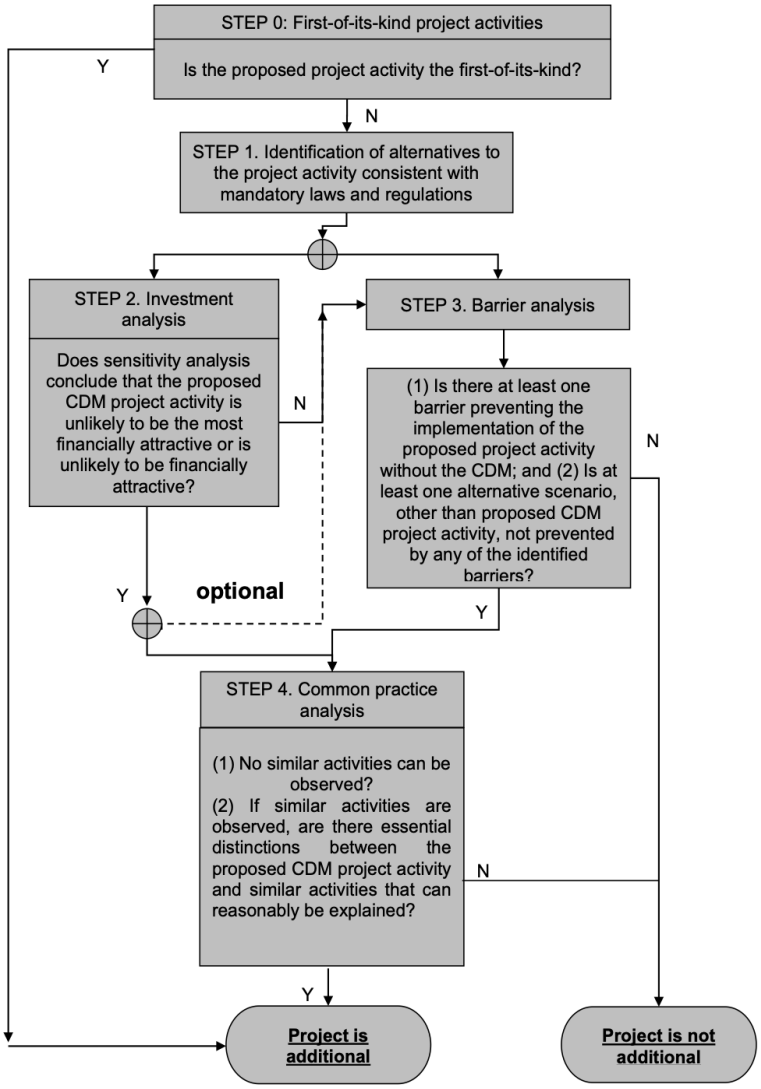
[154] *See* UNFCCC, TOOL FOR THE DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY VERSION 0.7.0.0 6, https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf (last visited Oct. 8, 2024).

[155] *See, e.g.*, KOSHER CLIMATE, 15 MW NAM HINBOUN DOWNSTREAM HYDROPOWER PROJECT 19–21, https://registry.verra.org/app/projectDetail/VCS/3662 (last visited May 13, 2023) (navigate to "VCS-JPDMR-15 MW Hydro-project.pdf") [hereinafter *Nam Hinboun Hydropower*].

attractive" without carbon credit sales, financial additionality is met.[156] Regulatory additionality is covered by "Step 1." Steps three and four cover the more amorphous concepts of barriers and common practice, which essentially mean that if a project is already financially attractive but is restricted by some other barrier, it can meet additionality, but if the project represents a common practice in an area, it cannot be additional.

[156] UNFCCC, TOOL FOR THE DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY VERSION 0.7.0.0, *supra* note 154, at 6.

Figure 4



IV. PARTIAL ADDITIONALITY: A THEORY AND CASE STUDY

As the world enters the next phase of carbon market development, relying on continued work of the Article 6.4 Supervisory

Body for much-needed technical guidance, it is worth noting that the generally accepted logic of the additionality requirement remains sound. While the methods of calculating permanence, avoidance of leakage, and baselines are all subject to significant critiques which must be addressed for carbon markets to work effectively, most of those are beyond the scope of this paper.[157] What unites these critiques is the principle that carbon offsets should not be generated by projects that should properly be factored into the baseline trajectory of emissions already. This paper identifies and attempts to solve a specific problem: the lack of differentiation between projects that meet the minimum requirements of additionality. The most significant distortion that we have identified (and dubbed "partial additionality") derives from the interaction of a binary decision on financial additionality with the reality of a more complicated scheme of revenue generation in the renewable energy sector.

A. *Partially Additional Offset Projects*

This paper is the first to identify and define the novel issue of "partially additionality" of offset projects. Under the current carbon offsetting regime, additionality is calculated as a binary matter—a project is either additional or it is not; there is no in-between or continuum. If a project meets the threshold for being additional, it meets the additionality requirement.[158] Once additionality is met, the calculation of the number of offsets generated by the project completely disregards how close (or not) the project was to being non-additional.[159] This is true for every current system of verification, including, importantly, those endorsed by the Article 6.4 mechanism. The parties to the Paris Agreement describe the

[157] *See, e.g.*, Barbara K. Haya et al., *Comprehensive Review of Carbon Quantification by Improved Forest Management Offset Protocols*, 6 FRONTIER GLOB. CHANGE 1 (Mar. 21, 2023) (arguing that forest carbon management protocols pervasively fall short of quality carbon accounting standards); Akshat Rathi et al., *Junk Carbon Offsets Are What Make These Big Companies 'Carbon Neutral'*, BLOOMBERG (Nov. 21, 2022), https://www.bloomberg.com/graphics/2022-carbon-offsets-renewable-energy (outlining the general carbon accounting failures of a significant portion of renewable energy offsets).

[158] *See* UNFCCC, TOOL FOR THE DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY VERSION 0.7.0.0, *supra* note 154.

[159] *See* UNFCCC, TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM VERSION 0.70, *supra* note 145 (the number of offsets is calculated entirely off the baseline concept which disregards additionality).

"demonstration of additionality" as a requirement for any mechanism generating a tradeable carbon offset, but do not describe a threshold level of additionality, treating additionality as a binary.[160] The Agreement also permits the use of "simplified approaches to additionality" for developing countries at the discretion of the Supervisory Body.[161] Such simplified approaches, to the extent that the Supervisory Body employs them, would make even the binary result less reliable because they would rely on more basic projections, such as the extrapolation of historic trends.[162]

The result of this binary determination, as opposed to a more dynamic calculation, is that renewable energy projects that produce the majority of their revenue from energy sales can end up with a relative glut of carbon offsets. By glut, we mean that the owners of these projects do not need to sell the offsets at full market price to report returns on investment at levels sufficient to satisfy creditors, allowing them to lower the price and undercut other sellers.

Put another way, a significant portion of the project did not need to be incentivized by the creation of offsets—it already made sense financially. However, all of the energy produced by the project was used to calculate the generation of offsets. This dynamic is in conflict with the entire theory of additionality, namely that if a project does not need to be incentivized, it is not additional. Therefore, offsets corresponding to the part of the project financed by selling energy to the grid could properly be classified as non-additional. Financial incentives, here the ability to earn revenue through voluntary or compliance carbon market trading, were unnecessary to the viability of at least a portion of the project. Admittedly, some projects could not feasibly be partially implemented in the real world; they are all or nothing propositions. Even in those instances, accounting for differences in additionality matters, if for no other reason than comparing projects all deemed "additional" in a binary sense. For instance, consider two projects—one dependent on offset

160 *See Paris Agreement*, *supra* note 3, CMA.3, V.B.38–39.

161 *See Paris Agreement*, *supra* note 3, CMA.3, V.B.39.

162 *See, e.g.*, Axel Michaelowa & Sonja Butzengeiger, *Ensuring additionality under Art. 6 of the Paris Agreement*, PERSP. CLIMATE RSCH. 3, 16 (2017), https://perspectives.cc/wp-content/uploads/2023/10/Ensuring_additionality_under_Art._6_of_the_Paris_agreement_Michaelowa_Axel__Butzengeiger_Sonja_2017.pdf.

sales for ten percent of its revenue and one dependent on offset sales for fifty percent of its revenue. The latter is demonstrably "more additional," but current metrics and methodologies cannot account for that.

Further, recall that a primary requirement for additionality is that the emissions-reducing activity (e.g. energy generation) would not occur absent the ability to trade offsets. Thus, the crude binary of additionality measures—as currently constituted—produces market imperfections that resonate across international borders, affecting removal and energy investment and policy decisions worldwide.

Contrast the partial financial additionality of renewable energy projects with the complete financial additionality of nature-based projects related to forestation. A removal project that plants trees (i.e. afforestation) generates no inherent revenue; in fact, such a project has significant costs and thus begins with a negative return on investment. No investor sets out to lose money. When afforestation generates carbon offsets, it enables revenue generation, thereby shifting the return on investment so that it may attract financing. No portion of the expected return would be created in the absence of offset trading. This complete financial additionality also holds for reduction projects that prevent deforestation. In that case, the inherent return on investment may be even more negative if the foregone development was expected to be particularly lucrative. When deforestation-based development is voluntarily stopped, the only financial incentive is the generated carbon offsets. Without the generation of offsets, one might expect levels of voluntary decisions to forgo deforestation at near-zero levels. The same can certainly not be said for renewable energy projects, many of which generate sufficient revenue to not require offsets, and all of which generate at least some inherent revenue.

B. *Case Study: Hydropower in Laos*

Energy projects in the developing world present perhaps the clearest examples of partial additionality currently existing. These projects produce and sell necessary electric power in regions with strong population and economic growth. As such, they inherently generate substantial revenues. However, the financing of these projects often depends on international institutions. These lenders, of which there are relatively few, demand high levels of return to

compensate for country-specific risk.[163] The additional revenue from offset trading can increase a project's return on investment in order to make it eligible for financing. The Nam Hinboun hydropower facility in Laos presents a typical example.

In 2022, construction was completed and the hydroelectric dam on the Nam Hinboun river in central Laos went into operation.[164] This project was verified and registered in the Verified Carbon Standard voluntary registry, and generated carbon offsets calculated using approved CDM methodologies.[165] The offset verification documents report the process for calculating financial additionality. The first step was to determine the rate of return an investor should receive for a project of this type. This was done by taking the investment risk profile of the country plus the rate of return of a baseline investment (a US bond). Under this procedure, it was calculated that the internal rate of return for a project built in Laos should be 14.68%.[166] Next, the expected internal rate of return of the project was calculated in the absence of offset generation. In this case, the rate of return by merely selling energy to the grid was 9.92%.[167] The difference between 14.68% and 9.92% was enough to satisfy financial additionality and allow the project to generate offsets.[168] Once additionality was satisfied, the amount of offsets the project was able to create and sell was calculated using the baseline method discussed above.[169] In this case, that meant taking the amount of clean energy generated by the new hydropower plant (KwH/year) multiplied by the amount of CO_2 emitted per KwH of energy generated on that grid. This came to 44,615 tons of CO_2 a year—in other

163 *See* WORLD BANK, FINANCING RENEWABLE ENERGY OPTIONS FOR DEVELOPING FINANCING INSTRUMENTS USING PUBLIC FUNDS 7 (2013), https://documents1.worldbank.org/curated/en/196071468331818432/pdf/765560WP0Finan00Box374373B00PUBLIC0.pdf (citing as examples of the cost of funding in developing markets where renewable energy projects might be built: "borrowing costs as high as 16–18 percent have been quoted for Nepal and . . . lending rates of 16.5 percent and 15.1 percent have been reported by the International Monetary Fund for Ethiopia and Honduras").

164 *See Nam Hinboun Hydropower*, *supra* note 155 at 3.

165 *See id.* at 18–24.

166 *See id.* at 26–27.

167 *See id.*

168 *See id.* at 27.

169 *See id.* at 23.

words, the project generated 44,615 offsets per year.[170] Nowhere in the calculation of the number of offsets was the fact that the project already generated a 9.92% internal rate of return discussed or considered.

Here, as in every example of partial additionality, treating additionality as a binary threshold creates a disconnect between the incentive structure and the quantity of offsets produced. With Nam Hinboun, the hydropower project only relied upon offset revenue to make up the difference between a 9.92% and a 14.68% internal rate of return. Energy sales to the grid accounted for two-thirds of the internal rate of return; thus two-thirds of the project could be considered non-additional from a financial perspective.

C. *Problems Created by Partially Additional Offsets*

At first pass, providing some non-additional offsets to a project that also produces perfectly legitimate offsets may simply seem useless, but may not seem to necessarily pose a problem. One could argue that providing excess offsets to these types of projects does no tangible harm, it merely provides a particularly good financial deal to developers of projects. This logic has initial, superficial appeal, but collapses under scrutiny, which exposes some significant issues with theoretically troubling implications.

It bears repeating here that this paper is the first to identify and define the problem of partial additionality. Consequently, very little quantitative research has to date been conducted on the practical magnitude of the negative effects theorized in the pages that follow. There has likewise been little research into the direct impacts of allowing projects that are largely financed by revenue generated outside of offset sales to receive offsets for the entirety of their environmental benefit. However, operating with basic economic principles and logical reasoning, it is evident that there are a number of harms that may arise from the sale of partially additional offsets.

First, the sale of non-additional offsets from such projects may result in less actual reduction and removal of greenhouse gases than would occur if they were not sold. For example, a company that purchases offsets to reduce its carbon footprint will use those offsets to reduce the amount of emissions the company is showing on paper. However, if those offsets are non-additional, purchasing them

170 *See id.* at 32.

does not provide any environmental benefit, so the company's belief in its reduced environmental impact is false. This false belief may induce passivity, making it less likely that the company will take other climate-mitigating actions such as reducing its own emissions. However, if the company did not purchase and use those offsets, it would still need to take action to meet its environmental goals and thus it may reduce its own emissions or potentially buy other offsets. Beyond this, there is some evidence that individual actors will respond to corporate carbon offset programs by increasing consumptive behavior.[171] If a corporation's offsets are non-additional (and thus without environmental benefit) and consumption rises because of the purchase of offsets, that would result in more emissions than would have occurred in the absence of the offset purchase.

Second, the sale of these non-additional offsets may also make the market as a whole less efficient at financing climate solutions. There are only so many corporations and individuals who choose to engage in carbon markets, and not every offset is purchased.[172] So when non-additional offsets are sold, they capture some of the limited capital that would otherwise be spent on other offsets. When this limited capital is bound up in non-additional offsets and removed from the market, the ratio of demand to supply is reduced. If the demand becomes low enough, many projects that produce offsets may be unable to sell them, or sellers may be forced to reduce prices below the expected sale price. The market price, especially for carbon offsets from renewable energy projects (all of which are only partially additional), thus becomes artificially distorted insofar as it does not reflect the value of one avoided ton of CO_2e emissions. Instead, the price reflects the value of something less, creating a discordance between what the offset instrument represents on its face

[171] *See* Sebastian A. Günther et al., *The Behavioral Response to a Corporate Carbon Offset Program: A Field Experiment on Adverse Effects and Mitigation Strategies*, 64 GLOB. ENV'T CHANGE 102123, 1 (2020) (discussing an increase in consumptive behavior by consumers when they were aware that the company was purchasing offsets to reduce environmental impact).

[172] *See* Micah Macfarlane, *Assessing the State of the Voluntary Carbon Market in 2022*, CARBON DIRECT (May 6, 2022), https://www.carbon-direct.com/insights/assessing-the-state-of-the-voluntary-carbon-market-in-2022 (showing that the supply of offsets is increasing faster than demand, demonstrating the limited pool of offset purchasers); *see also* Polly Evans, *Who Buys Carbon Offsets—and Why?*, CAP. MONITOR (Oct. 5, 2021), https://capitalmonitor.ai/sector/tech/who-buys-carbon-offsets-and-why/ ("36% of S&P 500 companies buy carbon offsets").

and what it represents to buyers. The fact that avoidance offsets currently disproportionality dominate the supply of all offsets and trade at the lowest prices of any type of offset is consistent with the presence of such a market distortion because many avoidance projects have other sources of income and are only partially additional. As such, these projects are more desirable, from a purely financial standpoint, and thus more prevalent. These projects then generate an over-abundance (in our view) of carbon credits, creating a cycle of market inundation. According to a Morgan Stanley analysis, "projects that focus on avoiding or reducing atmospheric emissions of carbon dioxide account for 82% of the offsets market."[173] While specific offset prices vary widely by exchange, avoidance credits consistently trade lower than removal credits across all exchanges, and technology-based credits trade lower than nature-based credits.[174] Even the Gold Standard pricing model, which seeks to correct prices for some of the differences in underlying offset-generating activity, sets minimum "fair" pricing at lower levels for renewable energy projects than forest management projects.[175]

As a result, the effect of partially additional offsets on the market is to deflate *all* carbon offset prices, as at their core they represent the same underlying asset—one ton of CO_2e emissions not contributing to climate change. Further, if one treats the price difference between types of offsets as a premium above the lowest priced offset that accounts for other distinguishing features and co-benefits, the artificial collapse of the bottom-priced offsets threatens the

[173] MORGAN STANLEY, *Where the Carbon Offset Market Is Poised to Surge* (Apr. 11, 2023), https://www.morganstanley.com/ideas/carbon-offset-market-growth.

[174] *See, e.g.,* Tabitha Whiting, *$500 vs $5 Carbon Credits—Why Does Cost Vary So Much in Carbon Offsetting?*, LUNE (Sept. 4, 2022), https://lune.co/blog/500-vs-5-carbon-credits-why-does-cost-vary-so-much-in-carbon-offsetting ("[Y]ou might notice that the project you found selling credits for $5 each is a renewable energy project, whereas the $500 per credit is a direct air capture project."); *Live Carbon Prices Today*, CARBONCREDITS.COM, https://carboncredits.com/carbon-prices-today/ (last visited Feb. 16, 2024) (reporting nature-based offsets trading on voluntary markets at almost twice the price of technology-based offsets).

[175] *See* GOLD STANDARD, *What is a carbon credit worth?* (Jul. 19, 2024), https://www.goldstandard.org/blog-item/carbon-pricing-what-carbon-credit-worth (setting minimum baseline—before a uniform premium—price at 8.10€/tCO2e for renewable energy and 13€/tCO2e for forest management).

continued functioning of the entire carbon market.[176] Basic market dynamics suggests that if the premium remains relatively constant but the bottom reference price (here, the price of partially additional offsets) deflates, the top of the market (here, fully additional removal offsets) will suffer along with the bottom. For some projects, importantly some projects that could be characterized as fully additional, the price distortion in the overall market may make it impossible to sell offsets at a high enough price to profitably continue operations. It would also signal to future developers that there is not a financially viable market to sell offsets, reducing the likelihood that future projects are built. In this way, selling non-additional offsets could decrease the total amount of removals and reductions, subverting the purpose of offset marketplaces.

A final issue that could arise is related to the price distortion discussed above. The existence of partially additional projects may further manipulate prices to favor offsets from projects that generate their own revenue. Put simply, lower carbon offset prices make inherent revenue generation an increasingly necessary feature of any viable offset-generating project. Because projects that inherently generate some revenue are not entirely dependent on selling carbon offsets for financing, they can sell their offsets at a lower rate compared to projects that are wholly reliant on offset revenues. Unfortunately, there is a lack of comprehensive data categorizing offset projects based on their ability to generate revenue and the offset sale price. However, the graphic below may provide some insight, indicating that renewable energy offsets, the ones that most clearly produce inherent revenue, are sold at a lower rate than most others.[177]

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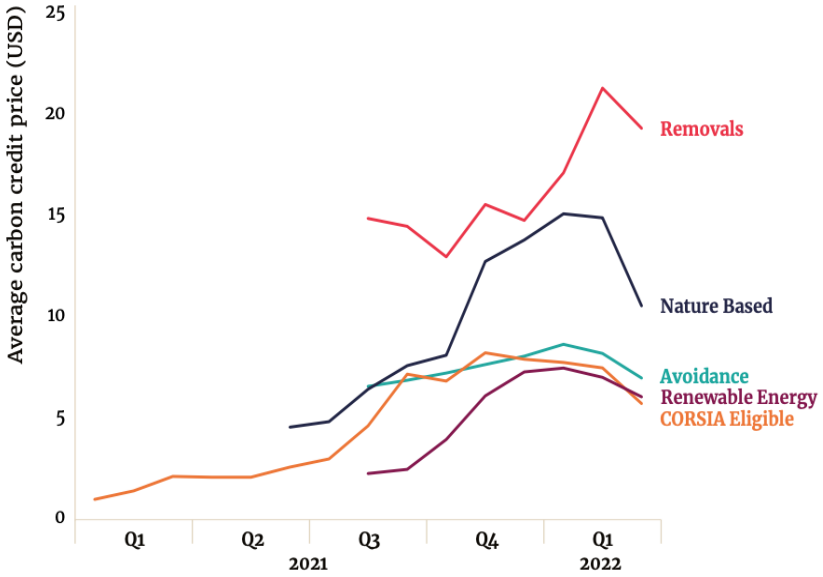
176 *Accord* Fiona Harvey, *Global Carbon Trading System Has 'Essentially Collapsed'*, OUR WORLD (Sept. 14, 2012), https://ourworld.unu.edu/en/global-carbon-trading-system-has-essentially-collapsed (describing how a drop in CDM pricing from $20 to less than $3 rendered "many potential projects [] not commercially viable" and "[f]inanciers and project developers [] abandoned the market in droves"). The market has since recovered, but such crises remain on the minds of many.

177 WORLD BANK, STATE AND TRENDS OF CARBON PRICING 2022 43 (May 24, 2022), http://hdl.handle.net/10986/37455.

Figure 5



The ability to sell at a lower cost per offset gives revenue-generating projects a competitive edge over projects that do not generate revenue. This may allow such projects to secure a greater share of offset investments, with the result that non-revenue generating projects are unable to secure funding.[178] This unequal price competition may exacerbate the initial problem, leading to an increased purchase of partially or non-additional offsets and thus amplifying overall ineffectiveness of carbon markets as a policy tool.

V. SOLUTION: APPLYING A DISCOUNT RATE TO OFFSET GENERATION

To address the inefficiencies and market distortions presented by the current system, this paper proposes applying a discount rate to the number of offsets a project generates. The discount rate would be in proportion to the financial additionality of the project as calculated by comparing the inherent return on investment for a project

[178] *See* Rathi, *supra* note 157 (describing how a significant portion of large companies purchase the cheapest offsets, often of dubious environmental quality, to make carbon neutral claims).

and a threshold return on investment necessary for financing. Discounting carbon offset generation has been discussed by various authors previously but has not been proposed as a solution to concerns regarding financial additionality.[179] Applied to financial additionality, the number of offsets a project generates would be discounted by a percentage of the total project cost that does not need to be incentivized to meet a benchmark internal rate of return. In other words, a project would only be allowed to generate and sell offsets for the portion of the project that was financed by offsets, but not for the part of the project that was financed by generating other revenues.[180]

A. *The Formula and Its Potential Application*

The discounting formula would operate as follows. First, an inherent return on investment for the project would be calculated based on other revenue sources—in most instances, sale of energy. We will call that figure ROI_{in}. Next, a target return on investment would be identified based on the financing institutions and instruments potentially available to the project; this would reflect the minimum return necessary to obtain financing. We will call this figure

[179] *See, e.g.*, Carson Warnecke et al., *Beyond Pure Offsetting: Assessing Options to Generate Net-Mitigation-Effects in Carbon Market Mechanisms*, 68 J. ENERGY POL'Y 413, 416 (2014) (proposing discount rates should be applied to the generation of CDM offsets to achieve a net mitigation effect as opposed to simply transferring mitigation responsibilities); Andrew Schatz, *Discounting the Clean Development Mechanism*, 20 GEO. INT'L ENV'T. L. REV. 703, 730 (2008) (arguing the discount rates should be applied to the CDM relative to marginal abatement costs of various mitigation technologies).

[180] Another way to think of the proposed solution is that there needs to be a limiting principle on the creation of offsets. Currently the limiting principle is that additionally, as a binary matter, must be satisfied. However, evidence suggest that limiting principle is flawed—at least based on the fact that offsets produced from revenue-generating projects sell for significantly less than others (which, as addressed in the paper makes little sense in a market for an ostensibly fungible commodity). Therefore, a new limiting principle is needed. The cleanest solution that we envision would be discounting based on return on investment (ROI). There may be another solution, possibly, for instance, when a project is under contemplation, the governing body of the carbon market looks at the "market price" or "target market price" (as set by the body) of offsets and allows the project in question to produce offsets up to the point at which the project generates the ROI needed to be built. However, a solution such as that is fairly heavy-handed and disregards that offset prices fluctuate significantly.

ROI_{target}. The difference between these two figures divided by the latter provides the discount rate, which we will call DISC. Finally, this calculated discount rate is multiplied by the tons of avoided carbon emissions, estimated as prescribed by Article 6.4 guidance and/or market requirements. We will call this figure $CRBN_{avoid}$. The result would then be the number of offsets (OFFSET) generated by the project. Here is the process as a mathematical expression:

$$(ROI_{target} - ROI_{in}) / ROI_{target} = DISC$$
$$DISC \times CRBN_{avoid} = OFFSET$$

Let's apply this to our case study. As discussed above, to be eligible for financing, the Nam Hinboun hydropower project needed to reach a benchmark of 14.68% internal return.[181] This establishes the ROI_{target} as 14.68. Given the sale of energy to the grid, the project inherently generates a 9.92% internal rate of return.[182] This puts the ROI_{in} at 9.92. Put in terms of expected revenue, the project needs to generate $5.61m a year, but already generates $4.04m a year. The resulting discount rate (DISC), per our proposed formula, would be 0.324.[183] The Nam Hinboun hydropower project avoids 44,615 tons of CO_2e emissions per year; absent discounting (i.e. under the current system), this is the number of carbon offsets generated by the project.[184] Applying the discount rate to this total yields a total of 14,455 carbon offsets per year.[185]

This relatively simple solution could be implemented by the governing body of any existing voluntary or compliance carbon market. Many of these markets lean heavily on the UN for technical rules regarding assessment of necessary characteristics, including additionality.[186] Consequently, the most impactful adoption of the

[181] *See Nam Hinboun Hydropower*, *supra* note 155.

[182] *See id*. at 27.

[183] (14.68 – 9.92)/14.68 = 0.324.

[184] *See Nam Hinboun Hydropower*, *supra* note 155 at 32.

[185] 0.324 x 44,615 = 14,455.

[186] *See, e.g., Methodologies*, VERRA, https://verra.org/methodologies-main/#vcs-program-methodologies (last visited Sep. 28, 2024) ("[P]rojects seeking registration in the [Verified Carbon Standard (VCS)] Program that comply with all VCS Program rules may use selected methodologies from other approved

discounting methodology would come through the work of the Article 6.4 Supervisory Body, which informs UNFCCC negotiations, and the resulting technical guidance. Article 6.4 established the framework for an international carbon crediting scheme and thereby, eventually, a global market. Importantly, Article 6.4 specifically tasked a Supervisory Body, accountable to the parties to the Paris Agreement, with operationalizing the framework agreement, including developing methodologies for verification and registration of both new activities and activities previously accredited through the Kyoto Protocol CDM mechanism.[187] Since that time, the Supervisory Body has met and set about accomplishing these tasks, although it proved difficult to achieve consensus.[188] In Baku, the work of the Supervisory Body on methodologies and on removals was endorsed.[189] As such, the Supervisory Body will turn to implementation and more detailed methodologies. Sticking points remain in designing the methodology for determining additionality of new projects.[190] The Supervisory Body could recommend, and the Parties adopt, methodologies that use a version of the discounting formula described here to address both new and CDM offsets. For newly generated offsets, reducing the total number of offsets per year in this manner would place revenue-generating projects on equal footing with non-revenue generating projects in the new

GHG programs, including Clean Development Mechanism (CDM) methodologies.").

187 *See Paris Agreement*, *supra* note 3, art. ¶ 4.

188 *See* UNFCCC, *Meeting of the Supervisory Body*, https://unfccc.int/process-and-meetings/bodies/constituted-bodies/article-64-supervisory-body/meetings-of-the-supervisory-body#__24-SB010—-SB013 (last visited Sept. 28, 2024).

189 Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement Sixth Session, *supra* note 64.

190 *See* UNFCCC, *Concept Note: Further Work on the Methodological Products for the Article 6.4 Mechanism (Ver. 01.0)*, U.N. Doc. A6.4-SB010-AA-A08 (Feb. 12, 2024) (describing as "[k]ey issues" both "[g]uidance/tools on additionality" and "clean development mechanism methodologies that may be prioritized for transitioning to the Article 6.4 mechanism"); *see also* UNFCCC, *Recommendation: Requirements for the Development and Assessment of Article 6.4 Mechanism Methodologies (Ver. 01.1)*, U.N. Doc. A6.4-SB009-A01 (Nov. 27, 2023) ("The Supervisory Body will develop further guidance and tools for the demonstration of additionality, including through a stepwise procedure . . . potential standardized performance-based approaches for determining additionality for application in methodologies that take into account best available technologies or an ambitious benchmark approach").

Article 6 global marketplace. For CDM-based offsets, a discounting methodology could correct for previously unaddressed partial additionality and thereby avoid overcompensating CDM projects with offsets. Together these steps would ensure that every individual offset available on Article 6.4 sanctioned markets needed to be financially incentivized, leveling the global market system and removing distortions created by partial additionality.

B. *Arguments Against Applying a Discount Rate*

While applying a discount rate may solve some of the problems addressed above, there are still arguments for continuing the system as-is. One of the strongest of these is that even though some projects may receive a significant portion of financing through inherent revenues, without the ability to generate offsets for all of the environmental benefit, the projects may not be financially viable. In other words, all of the offsets should be considered additional because all of them are required to make the project financially viable, and without the ability to generate all of the offsets, the projects may not be built. This counterargument has some merit, but may be applicable in fewer cases than expected because the inherent revenue of the projects, non-financial pressures (e.g. politics and environmental conditions), and the shifting carbon offset price will also influence project decisions. Even if some projects are not built, it is not clear that the application of a discount rate would result in fewer actual reductions and removals.

Furthermore, the discount rate could actually enable renewable energy projects to continue obtaining some offset revenue. As renewable energy becomes commonplace on a particular grid, it may be more difficult to establish that similar projects are additional. Using partial additionality and the discount rate—as opposed to a pure binary evaluation—could enable projects that generate nearly enough revenue to meet the target ROI to sell a limited quantity of offsets, perhaps enabling them to be more competitive with fossil fuel energy projects.

It is also worth noting that the price of offsets that may be factored into the calculation of a project's viability is not a stable number. Not only is this price subject to significant variation over time, but the application of the discounting system should positively impact the price that a project can demand. This is true for two related reasons. First, the price effect described above that results from, at

least in part, an oversupply of carbon offsets on the market would no longer occur. In other words, the overall supply of offsets would be lower due to discounting applied to all partially additional projects. A full economic analysis, which is beyond the scope of this paper, would be required to assess the impact of this supply reduction, but the basic principle of supply and demand suggests that if supply decreases, prices will rise. For some projects, this increase in price would likely mean they are financially viable even without the ability to sell the portion of non-additional offsets. Secondly, offsets currently sold on the market already range in price significantly.[191] Removal offsets are sold for nearly four times the price of renewable energy offsets.[192] The factors behind the price fluctuation are varied, but are at least partially based upon the perceived environmental integrity of various offsets.[193] In this light, if projects that generate inherent revenue were unable to sell non-additional offsets, it may substantially increase the perceived environmental integrity of the projects, allowing those projects to demand a higher price for each offset. The criticism of these projects from an integrity perspective has implicitly tracked the logic of partial additionality, without fully analyzing or naming the phenomenon. For example,

[191] *See* WORLD BANK, STATE AND TRENDS OF CARBON PRICING 2022*, supra* note 177 and accompanying graphic.

[192] *See id.*

[193] The effort to purchase removal offsets has been driven in part by the Oxford Principles for Net Zero Aligned Carbon Offsetting and SBTi, initiatives aimed at focusing on the highest environmental impact offsets. For a more complete understanding of those initiatives *see* SMITH SCHOOL OF ENTERPRISE AND THE ENVIRONMENT, THE OXFORD PRINCIPLES FOR NET ZERO ALIGNED CARBON OFFSETTING (2020), https://www.smithschool.ox.ac.uk/sites/default/files/2022-01/Oxford-Offsetting-Principles-2020.pdf; SCIENCE BASED TARGETS INITIATIVE, SBTI CRITERIA AND RECOMMENDATIONS FOR NEAR-TERM TARGETS (Mar. 2024), https://sciencebasedtargets.org/resources/ files/SBTi-criteria.pdf.

academic work[194] and national media[195] have questioned the additionality of certain types of renewable energy offsets, calling into question the value of the offsets they generate.[196] This higher price per offset may reduce the instances in which the inability to sell the non-additional offsets renders a project unviable.

Even in instances where the reduced number of offsets truly makes a project unviable and therefore prevents it from getting built, it is not clear that that will have an overall negative environmental impact. Operating under the assumption that offset markets are demand-driven, if a particular project is not built because of a lack of offsets, that does not reduce the purchaser demand for offsets or environmental action. In theory, that demand still exists and will incentivize the creation of another project, or possibly the purchaser's own reductions. In this way, it is not apparent that reducing the number of offsets a given project may be able to sell would reduce the system-wide emission reductions or removals. Instead, the funding would just be channeled to another project, creating the same environmental impact. Taken together, it appears that applying a discount rate to offset generation would prevent few emissions avoidance projects from being built. Furthermore, any emissions from projects unable to secure funding (i.e. unavoided emissions) would be canceled out by the improved efficiency in the carbon offset market, leading to emissions removed or avoided elsewhere.

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194 *See* MARTIN CAMES ET AL., HOW ADDITIONAL IS THE CLEAN DEVELOPMENT MECHANISM? 12–13 (2016), https://climate.ec.europa.eu/system/files/2017-04/clean_dev_mechanism_en.pdf ("Most energy-related project types (wind, hydro, waste heat recovery, fossil fuel switch and efficient lighting) are unlikely to be additional, irrespectively of whether they involve the increase of renewable energy, efficiency improvements or fossil fuel switch. An important reason why these projects types are unlikely to be additional is that the revenue from the CDM for these project types is small compared to the investment costs and other cost or revenue streams, even if the CER prices would be much higher than today."); Barbare Haya and Payal Parekh, *Hydropower in the CDM: Examining Additionality and Criteria for Sustainability* 33 (Energy and Res. Grp. Univ. of California, Berkeley, Working Paper No. ERG-11–001, 2011) ("Our analysis shows that the CDM's *Additionality Tool* is not effective at filtering out non-additional hydropower projects.").

195 *See* Brad Plumer, *Carbon Offsets, a Much-Criticized Climate Tool, Get Federal Guidelines*, N.Y. TIMES (May 28, 2024), https://www.nytimes.com/2024/05/28/climate/yellen-carbon-offset-market.html ("Some offsets help fund wind or solar projects that likely would have been built anyway.").

196 *See id.*

CONCLUSION

The recognition of climate change as an existential threat necessitates effective and efficient strategies for carbon offsetting. This paper has analyzed the potential distortions in carbon markets arising from partially-additional offset projects—those which are financed significantly by revenue generated externally, while still gaining offsets for their total environmental benefit. As the world debates how to structure the most substantial global trading mechanism in history through Article 6 of the Paris Agreement, it should consider the effect of partial additionality on carbon market effectiveness.

The current incentive structure of carbon markets inadequately addresses the proportion of additionality, leading to potential market inefficiencies and credibility issues. Specifically, projects requiring offset incentives for only a fraction of their financing generate the same amount of offsets as projects fully dependent on offset revenue. This situation could lead to non-additional offsets that offer false impressions of environmental benefit, thereby reducing market effectiveness and potentially distorting market prices.

To rectify these issues, this paper proposes that carbon markets adopt a discounting methodology. The Article 6.4 mechanism should lead in this new direction and provide guidance for a uniform method of discounting across compliance and voluntary markets worldwide. The number of offsets produced by a given project should be adjusted proportionally to the extent that the project relies on offset revenue. This strategy ensures that every offset purchased indeed represents an additional environmental benefit. It also guarantees that investments are directed to those projects that truly need them for incentivization, rather than those that generate some revenue of their own.

Effective climate change mitigation will require us to approach the problem from all angles and in the most efficient way possible. Addressing the distortions caused by partially additional carbon offset projects is a vital step towards a more robust, reliable, and efficient carbon market. By ensuring true additionality in our carbon offset projects, we can better leverage the power of markets to drive environmental change and progress toward our climate goals.