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Disentangling the "net" from the "offset": learning for net-zero climate policy from an analysis of "no-net-loss" in biodiversity

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Net-zero has proved a rapid and powerful convening concept for climate policy. Rather than treating it as a novel development from the perspective of climate policy, we examine net-zero in the context of the longer history and experience of the "no-net-loss" framing from biodiversity policy. Drawing on material from scholarly, policy and activist literature and cultural political economy theory, we interpret the turn to "net" policies and practices as part of the political economy of neoliberalism, in which the quantification and commodification of the environment, and in particular—trading through an offset market, enable continued ideological dominance of economic freedoms. This analysis highlights the ways in which the adoption of a "net" framing reconstructs the goals, processes and mechanisms involved. It is the neoliberal commitment to markets that drives the adoption of net framings for the very purpose of validating offsetting markets. Understanding the making of "net" measures in this way highlights the potential to disentangle the "net" from the "offset", and we discuss the various obfuscations and perversities this entanglement affords. We argue that the delivery of net outcomes might be separated from the mechanism of offsetting, and the marketization of compensation it is typically presumed to involve, but may yet remain entangled in neoliberal political ideology. In conclusion we suggest some conditions for more effective, fair and sustainable delivery of "net-zero" climate policy.

KEYWORDS

net-zero, climate policies, biodiversity policies, offsetting, neoliberalism

1. Introduction

In recent years, climate policy has seemingly coalesced around the goal of net-zero, the achievement of a global carbon-neutral situation in which any residual emissions of carbon are counterbalanced by additional anthropogenic removals, thus stabilizing the rise in global temperatures. In politics and scholarship, the emergence of net-zero as a central frame for climate policy has typically been treated as a *sui generis* event, a result of the convergence of increasing climate impacts, depleting carbon budget, and political demands for a "bottom-up" regime in which nationally determined contributions (NDCs) replaced the mandatory emissions cuts anticipated under the Kyoto Protocol. As a policy framing, net-zero has achieved a remarkable degree of convening power within international climate negotiations.[1] At last count 148 countries have adopted it as a goal, albeit in diverse formulations.[2]

1 See for example UK Government assessment of the outcomes of COP26. Available online at: https://ukcop26.org/wp-content/uploads/2021/11/COP26-Presidency-Outcomes-The-Climate-Pact.pdf.

2 From the "Net-Zero Tracker" Available online at: https://zerotracker.net/ (accessed June 12, 2023).

A mythic narrative of the origins of net-zero has emerged, attributing its emergence to backroom political pressure exerted by leading campaigners working with the UNFCCC's Christina Figures in 2013–15 to convince actors such as German Chancellor Merkel and World Bank President Jim Kim to support the goal of carbon neutrality at the Paris summit (Darby, 2019).[3] The net-zero framing drew much increased attention to techniques that would remove carbon dioxide from the atmosphere as a means to counter-balance residual, "hard-to-abate" emissions. Climate scientists have since highlighted the substantial requirement for development and deployment of such techniques in almost all pathways that meet the 1.5°C temperature target also adopted at Paris (Kriegler et al., 2018; Luderer et al., 2018).[4] Many entrepreneurs have entered this space typically seeking to raise finance for proposed carbon removal efforts against the promise of expanding carbon markets. While the bare facts of such an account are not in question, in explaining its emergence, more attention should be paid to the political economy of net-zero and its components. In particular, as we demonstrate here, net zero and its use of offsetting along with the wide promotion of policies and practices defined in net terms are a product of the neoliberal policy context. Scholars have explored the historical emergence of carbon removal approaches (Carton et al., 2020; Schenuit et al., 2021). But in the context of climate policy, there has been little attention given to the longer history of "net" framings and mechanisms in policy elsewhere. Tracing the origins of older net mechanisms, their operations, drivers and outcomes in different spheres can shed light on present questions around net-zero in climate policy. In this paper, by examining the history of a parallel neoliberal environmental policy instrument for the natural environment; "no-net-loss" (NNL) in biodiversity and its entanglement with biodiversity offsetting (BDO), we suggest that there are critical lessons that must be learned in climate policy if net-zero is to deliver on the expectations of the Paris Agreement.

1.1. The landscape of "net" policy

Although less widespread than net-zero today, with policies adopted in around 100 countries (and mandatory in 34) (zu Ermgassen et al., 2019), BDO and NNL have a significantly longer history. Biodiversity offsetting and no-net-loss policies are the mechanisms by which nature conservation governance seeks to compensate for development related impacts on wildlife habitats by quantifying and then delivering "equivalent" and sometimes additional biodiversity "values" or "units" elsewhere or in the future. While the terminology of "biodiversity offsetting" did not emerge until the early 2000s, offset mechanisms for habitats or species date to the 1970s, and "no-net-loss" as a goal to the late 1980s, preceding the adoption even of the first emissions reduction goals in climate negotiations (although contemporaneous with experimentation with "bubble policy" for some air pollutants under the US Clean Air Act). Subsequently NNL and BDO ideas were popularized by market-oriented think-tanks, notably the Washington DC-based Forest Trends and their subsidiary the Business and Biodiversity Offset Network (BBOP) as well as international institutions including multilateral development banks and the International Finance Corporation, which promoted them in the development projects they underwrote. Such proponents of offsetting promoted it alongside a "mitigation hierarchy" which suggests that projects should first avoid impacts, second minimize them in practice, third restore damage if possible, and only finally "offset" for any remaining impacts (Business and Biodiversity Offset Programme, (n.d.), 2009, 2012; International Finance Corporation, 2012).[5] For a brief overview of the policy landscape and extent of avoidance offsetting for both biodiversity and climate, see Table 1.

No-net-loss and biodiversity offsetting were controversial and contested from the start, and remain so (Sullivan and Hannis, 2015), with at best mixed evidence of effectiveness, and a range of problems arising in implementation (zu Ermgassen et al., 2019). As we will see in Section 2, problems and controversies arise at technical, political and philosophical levels. Many of these revolve around the concepts and practices of habitat creation or restoration. In a break with previous practice focused on preventing harm by protecting habitat, the NNL framing requires, and emphasizes the possibility of habitat *creation* or biodiversity *restoration*. On a technical level, besides a host of issues around measurement, maintenance, monitoring and more, this raises questions about the scientific validity of such promises (Maron et al., 2012). At the political level it opens debate about the appropriate policy mechanisms and in particular the role of offsetting (Benabou, 2014; Carver, 2021). And at the philosophical level it raises concerns about the ethics of putting a price on nature (McAfee, 1999) and the risk that the promise of restoration functions as a justification for further destruction (Katz, 2000).

The continued spread and adoption of BDO, NNL and more recently "net-gain" policies reflects a picture that looks familiar in climate circles. At a global level the loss of biodiversity continues, with well-grounded fears that critical thresholds of damage may already be passed (Rockström et al., 2009; IPBES, 2019). The drivers of biodiversity loss (in land-use change, agriculture, fisheries etc.) are seen as difficult to reverse, closely coupled to economic growth, and otherwise supportive of sustainable development in the global South (IPBES, 2019; Hahn et al., 2022). Finance for biodiversity protection or restoration is scarce (Waldron et al., 2013), and both states and voluntary organizations are grateful for the prospects of funding from offset schemes as sources of new and

3 The Paris Agreement wording does not include the explicit term net-zero, but the aim of achieving: "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty." (PA, 4.1)

4 Whilst holding temperature rises to no more than 1.5C requires (at least) net-zero emissions globally, achieving net-zero does not itself imply any particular temperature outcome, but would prevent any further rise above the level determined by extant atmospheric concentrations of greenhouse gases.

5 The high-profile adoption of the mitigation hierarchy by the IFC should not be understood purely as a progressive initiative, but also as an effort to defuse intensifying campaigns by both environment and development NGOs for stricter and more transparent standards for project finance in commercial and public banking (Wright, 2007).

supposedly additional investment into biodiversity programmes, even if the outcomes are patchy (Githiru et al., 2015). Promises of technological advances to enable future habitat restoration (in biotechnology, gene science and AI, for example) circulate in scientific and political settings (see e.g., Corlett, 2017).

These dynamics closely parallel the contemporary circumstances of climate politics: the carbon budget for 1.5°C is nearly, if not already exhausted (Peters, 2018; IPCC, 2021), yet emissions remain strongly linked to economic development, growth (and in some regions, poverty alleviation). Funding for mitigation, adaptation, and carbon removal remains insufficient despite shifts in public and private finance. Promises abound of carbon removal through novel technologies and techniques, including a range of "nature-based solutions" (Temple, 2021). Voluntary and commercial organizations supporting mitigation and removal techniques are grateful for offset funding (even though it is inadequate to deliver high quality removals). Reflecting the shift from no-net-loss to net-gain in biodiversity, climate advocates increasingly suggest future "net-negative" approaches that enable some form of overall "climate restoration" or repair are likely to be needed, beyond "net-zero" and the stabilization of temperatures. In both cases the shift moves from simply maintaining the contemporary baseline to account for prior historical environmental harms, in effect accepting that the current baseline is normatively too low.

1.2. Distinguishing policies and mechanisms

In this paper, we reflect particularly on the contiguity between NNL as a policy frame, and BDO as an implementation mechanism, noting they have generally functioned as interchangeable in practice (Carver, 2021) but need not necessarily be the same thing. They are tightly intertwined in the literature, as are net-zero, and carbon offsetting. But here we conclude that not only are extant "net" policies deeply imbricated with neoliberalism, but that *the net* (as an aggregate outcome), and *the offset* (as a mechanism) need not be inevitably linked. We argue that offsetting, as the direct one-to-one matching of harms and benefits within or outside of trading markets, is not a *necessary* tool to deliver a "net" outcome (a desired aggregate state), and that the two should not be conflated. We recognize that in common parlance, the balancing of harms and benefits in net policies could be termed an "offset". Others have already highlighted the distinction between such high-level balancing, and marketized offsetting (e.g., Asayama et al., 2021). Here we reserve the term "offsetting" for a process of one-to-one matching of units of harm and benefit in sequence, whether within a market or not (see Table 1). Understood in these terms, a net outcome can be delivered without an offsetting mechanism, and moreover an offsetting mechanism can exist without marketization and trading. For instance, a mandate for compensatory habitat creation can be established without creating tradable habitat destruction credits: this would be offsetting without marketization. And the balancing of the "net" might be achieved through state-level planning for aggregate environmental benefits and restoration, and not delegated to the corporate actors involved in polluting or habitat destruction: this would be "netting" without offsetting.[6] In contrast bringing netting and offsetting together requires a series of "makings" to construct targets, metrics, and commodities in particular ways, involving actors conceived in specific forms. The choices involved here are not a necessary consequence of a "net" policy goal, but of the political economy within which it is established and pursued.

That the obsession with offsetting, despite its patent shortcomings, is a product of the neoliberal policy context, in which the "potency and mobility of conceptual technologies and the [imbricated] logic of balance-sheet accounting" (Carver, 2021, p. 1) gain additional traction, is not a new insight. For example Dunlap and Sullivan (2019) describe both carbon and biodiversity offsetting as neoliberal policies, an aspect of "accumulation by alienation". Even if net outcomes could be delivered without offsetting, here we focus on the ways in which the popularity of "netting"—the promotion of policies and practices defined in "net" terms—also embodies the neoliberal turn. Contemporary net policies commodify and marketize environmental entities to manage the side-effects of contemporary capitalism. In the case of climate, net policies construct globalized corporate operations (offsetting practices) on a foundation of nationalistic sovereignty in the form of nationally determined contributions—the key innovation of the Paris climate accord of 2015. Whilst the market mechanism of offsetting is not a necessary consequence of a net framing, to the contrary there are good reasons to understand the choice of a "net" goal as—at least in part—an outcome of the extant market-based political economy, and thus to see the intertwining of "the net", the market and offsetting as a predictable, if problematic, configuration under neoliberal capitalism.

The paper continues with a brief review of NNL literature to highlight the concerns and issues arising in biodiversity "net/offsetting" policy (Section 2). It then examines and unpacks the steps in which the net and offsets are co-constructed (Section 3). In Section 4 it explores the parallels with climate policy and discusses implications for carbon removal practices, especially "nature-based solutions" (as the climate analog of habitat recreation). Finally in Section 5 conclusions are drawn and recommendations offered for future policy.[7]

2. The experience of no net loss

In contrast with net-zero as climate policy, no net loss (NNL) has a longer and richer experience. Wetland offsetting first emerged under the 1977 US Clean Water Act, with the approach developing iteratively in the late 1970s with the US

6 James Murray, of Business Green, suggests something similar—the creation of a publicly managed funding pool for carbon removals, paid into by corporations Available online at: https://twitter.com/james_bg/status/1616718977673138176?s=51&t=Fyjh_7NMnf45VrA4cttHcw.

7 Materials and methods: The paper analyses material derived from an online literature search for "no-net-loss of biodiversity" and cognate terms. It examines this literature to identify the key steps involved in the development of this policy approach, and to summarize philosophical, political and practical critiques found in the literature. The paper then utilizes the perspective of cultural political economy to unpack the processes involved in policy formation and the co-production of goals, measurability, equivalences, incentives, actors and expectations.

Environmental Protection Agency's experimental "bubble policy" local emissions trading schemes for particulates, sulfur dioxide and hydrocarbons under the Clean Air Act (Lane, 2012; Halvorson, 2019; Carver, 2021). The latter largely fell into disuse in the 1980s (Halvorson, 2019), but forms of habitat and wetland offsetting expanded, with no-net-loss entering the lexicon in the late 1980s when it was adopted in US wetlands policy in the GW Bush presidency. Subsequently, and particularly in the first decade of this century, NNL and BDO spread widely in international settings, in both the global North and South. Governments had (in the context of the UN Convention on Biological Diversity), committed to achieve, by 2010, "a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth". Netting and offsetting were heavily promoted to, and by, financial institutions in this period (Pricewaterhouse Coopers, 2010). This framing translated the policy goal of reducing biodiversity loss into both an intelligible risk management mechanism and an emerging market for financiers. As Benabou (2014, p. 110) notes, "The growing interest of corporate actors for biodiversity offsetting as a risk management strategy [was] largely fueled by its uptake by major financial institutions." Here we summarize literature that assesses and evaluates NNL and BDO policy, before interpreting the experience in the light of political economy (Section 3) and exploring its applicability to net-zero (Section 4). Before embarking on that process, we note that to illustrate, compare and contrast the construction of NNL and net-zero requires some consistent terminology. In Box 1 we translate the jargon used in climate and biodiversity policies into abstract terms that can be applied in either case, and more generally in cases of "netting" and "offsetting".

The NNL/BDO approach began with an aim of broadly halting biodiversity loss. It now typically imposes duties on project developers whose activities may cause harm to follow a "mitigation hierarchy" so as to minimize damage, and to compensate for any residual harm by preventing damage, or supporting equivalent habitat restoration elsewhere. In addition to such mandatory approaches, various actors and states have experimented with voluntary schemes in which those causing harms can pay other actors to protect or restore biodiversity elsewhere. Such activities can also generate credits which can be traded or banked for future use. The assumed equivalence of "avoided" loss (preventing harm) and new habitat creation is noteworthy. With limited technical possibilities to create new habitat, the prevention of loss (regardless of location) is indeed important. But the net result of such compensation is only to "stabilize the rate of loss", not to stabilize the total biodiversity resource at an ecosystem or territorial scale. As a result the counterfactual or baseline scenario has been one of the most debated issues in the biodiversity management literature (Bull and Brownlie, 2017; Maron et al., 2018; zu Ermgassen et al., 2019). In recognition that merely stabilizing the rate of loss against an already depleted resource level was inadequate (on top of the uncertainties around the policy actually stemming loss at all), some new policies aim to deliver "net gain" through additional habitat creation or restoration activities.

However, whether assessed against a goal of stemming the loss of biodiversity, or merely stabilizing the rate of loss to within a particular baseline or counterfactual, most evaluations of NNL reveal underperformance. Shortfalls against objectives have been recorded or projected in evaluations in multiple countries, including Indonesia, Brazil & Mozambique (Sonter et al., 2020), Australia (May et al., 2017; Sonter et al., 2020), France (Quétier et al., 2014), and Canada (Clare and Krogman, 2013). A recent global assessment (zu Ermgassen et al., 2019, p. 1) found that only about "one-third of NNL policies and individual biodiversity offsets reported achieving NNL." The best success rates were found for wetlands, whereas none of the two-thirds of all BDOs applied to forested habitats or species demonstrated successful NNL outcomes, and there was also zero success found where "avoided loss" offsets were used. Focusing on regional scale outcomes, Sonter et al. (2020, p. 1) found that "no policy achieves NNL of biodiversity in any case study", primarily due to practical limitations in the availability of suitable land. Such evaluations of NNL point to a range of serious problems. Here we summarize these at three broad levels: the philosophical, the practical and the political.[8]

TABLE 1 The broad landscape of NNL and NZ policies.

No-Net Loss of biodiversity goal	Net-Zero emissions climate goal
101 Countries that have NNL policies with established mechanisms	148 Countries that have policies or goals for *future* achievement of net zero
37 Countries that have mandatory NNL requirements, typically in environmental impacts assessment laws	34 Countries that have formal sectoral or regional compliance emissions trading schemes (27 are in the EU ETS)
$2.6–7.3 bn Estimated financial cost of biodiversity offsetting in 2016	$911 bn Estimated value of emissions trading ($909bn) and voluntary carbon market (VCM) trading ($2bn) in 2022
10 Countries that impose the mitigation hierarchy firmly, with effective guidance	22 Countries that met the UN "Race to Zero" procedural starting line standards in 2022 (Pledge, plan, act and monitor)
150,000 square kilometers Aggregate coverage of the total 12,983 completed or ongoing offsetting projects documented by GIBOP (in 37 countries). For comparison, global loss of forests alone since 2001 stands at 4.73 million km^2	2 giga-tons-CO_2 pa Estimated current removals (99.9% from land management). For comparison, marketed offsets total around 13 Gt, and annual emissions total almost 37 Gt.

Sources: Global Inventory of Biodiversity Offset Policies (GIBOP) 2019: https://portals.iucn.og/offsetpolicy/; State of Biodiversity Mitigation 2017: http://www.forest-trends.org/wp-content/uploads/2018/01/doc_5707.pdf; Net-Zero Stocktake, 2022: https://zerotracker.net/analysis/net-zero-stocktake-2022; 2023 data: https://zerotracker.net/; Reuters, 2023: https://www.reuters.com/business/sustainable-business/global-carbon-markets-value-hit-record-909-bln-last-year-2023-02-07/; Global Forest Watch, https://www.globalforestwatch.org/dashboards/global/; and State of CDR report, 2023: https://www.stateofcdr.org/.

8 Maron et al. (2018) suggest a four-fold categorisation of contestation over offsetting "ethical, social, technical, or governance challenges". Our three level categorisation divides social questions into philosophical (more than just ethical) and political issues, and splits governance questions into technical or political issues. In part our aim is to deliberately problematize the political dimension, in contrast with concepts of governance that can be technocratic and depoliticizing.

BOX 1 Terminology[a].

Additionality: a measure of whether a benefit has arisen as a direct consequence of a policy intervention and consists only of gains that would not otherwise have occurred (requires a counterfactual assessment).
Banking: the accumulation of a reserve of benefits (typically in the form of credits) that can be deployed to provide offsets for future harms. Breaks a temporal link between harm and benefit.
Baseline: a historic (or projected) state against which the level of the resource might be measured—(e.g., emissions in comparison to 1990 levels or biodiversity at site pre-impact level) c.f. reference scenario *qv*.
Benefit: the thing or activity that compensates, offsets or repairs harm.
Compliance market: a market for credits *qv* established by public authorities with mandatory participation. Typically relevant actors are required to procure permits equivalent to the harms they cause.
Commodification: making units of a thing uniform and consistent, and thus exchangeable for money based on a standard rate of exchange.
Desired state: the optimum absolute level of the resource (maybe termed as return to a particular historic level). Unlikely to be the same as stabilization *qv*.
Fungibility: describing equivalence and commensurability of units to enable exchange (e.g., the use of global warming potential (GWP) to make GHGs commensurable).
Harm: the thing or activity that is to be reduced, offset or compensated for.
Leakage: a harm arising outside of a regulated system, caused by an actor notionally included in that system (e.g., by relocation of a harmful development to an unregulated location).
Like for like: Harms and benefits that fall within comparable classes and are measured using the same metric (see fungibility *qv*).
Mitigation hierarchy: The operating rule by which, first, harms are avoided, then unavoidable impacts minimized, and only then are residual impacts offset.
No net loss: An outcome in which the total amount of some resource does not decline below the level expected under some counterfactual scenario (thus no-net-loss may not mean stabilization *qv*).
Offsetting: a one-to-one matching process, providing a benefit elsewhere to notionally balance a specific harm, typically financed by the entity causing the harm.
Permanence: a measure of how long a benefit is sustained over time.
Permit/credit: the authority to generate a specific amount of harm arising from the actual or notional creation of an equivalent benefit. Can be traded on markets for credits, but may also be auctioned or issued without payment by relevant authorities.
Quantification: establishing a numerical metric or units to make things comparable, and enable measurement of the quantity of harms and benefits.
Reference scenario: (sometimes "counterfactual" or "business as usual" scenario, c.f. "baseline" *qv*) the projected future state in the absence of intervention, also sometimes used for purposes of target-setting (e.g., "reduce harm by a certain level in comparison to business as usual").
Residual harm: a harm that cannot be practically eliminated, and thus to achieve a net balance, must be offset (c.f. mitigation hierarchy).
Resource: the underlying public good (hospitable climate, flourishing ecology) that is protected or sustained by the policy. In practice, typically a commons-based resource.
Restoration: providing a benefit to compensate for a historic/past harm (includes direct repair of past harms arising from a specific activity or project).
Stabilization: where the aggregate level of ongoing harm is fully balanced by aggregate additional benefits.
Voluntary market: a market for credits established by non-statutory actors to trade in credits generated outside of compliance markets.

[a]This glossary of terms derives in part from Maron et al. (2016). In offering this terminology we aim to enable comparison, not to establish "correct" definitions. As the paper reveals, the situated meanings of these terms are ideologically constructed in ways that may obscure the underlying processes they involve.

2.1. Criticisms of NNL

At the philosophical level we include questions of principle and of ethics. Concerns have been raised not only regarding the extent of equivalence and fungibility between different expressions of biodiversity, but also regarding the moral basis and unjust consequences of commodification of biodiversity in the first place. McAfee (1999, p. 133) argues that: "by valuing local nature in relation to international markets, denominating diversity in dollars, euros, or yen," such approaches abstract "nature from its spatial and social contexts" and reinforce "the claims of global elites to the greatest share of the earth's biomass and all it contains." Ives and Bekessy (2015, p. 568) argue that the utilitarian ethics of offsetting overlook multiple values of nature, and conclude that: "offsetting may exacerbate environmental harm because it erodes ethical barriers based on moral objections to the destruction of biodiversity." Spash (2015) similarly argues that offsetting erodes moral protections for nature and acts to help define nature in purely economic terms. This reinforces the risk of utilitarian justifications for continued damage, which as noted by Katz (2000) are enabled by (typically exaggerated) promises regarding the viability of later restoration, providing a "license to trash" (Koh et al., 2017, p. 186).

Practical challenges arise in the basic requirements of quantification and measurement to enable like-for-like compensation or comparison. They appear also in difficulties in ensuring additionality or permanence, avoiding leakage, and in basic physical challenges such as site availability. Even similar habitats may have divergent ecological values in different locations, or as they change over time. Newly created habitats can rarely substitute directly for established ones. In other words there is typically poor equivalence in the units of biodiversity involved in NNL practices (Lindenmayer et al., 2017). As a result, "many of the expectations set by current offset policy for ecological restoration … [are] unsupported by evidence" (Maron et al., 2012, p. 141) with notable technical limitations arising from time lags, uncertainty and problems with measurability of the value being offset. Creating credible metrics to make biodiversity fungible is therefore problematic (zu Ermgassen et al., 2019; Sonter et al., 2020). Over-simplified metrics in offsets miss "significant environmental and social welfare values across space, type and time" (Brownlie et al., 2013, p. 27). As Parson and Kravitz (2013) note for market-based instruments more generally, this spatial non-equivalence can have serious implications for environmental justice. And even if common metrics can be agreed that have sufficient scientific integrity, practical fungibility depends also on consistent monitoring, certification and transparency: all of which have been identified as inadequate (Bull et al., 2018; Kujala et al., 2022).

Concerns over additionality (whether the offset site would have been protected/restored regardless of the program) intersect with those of permanence (whether the offset site remains of equivalent biodiversity value into the long term). Additionality problems seem common amongst avoided loss offsets, where there may have been little risk to the specific site "protected" in the exchange (Thorn et al., 2018; Damiens et al., 2021). They also arise more generally where the long-term maintenance of the offset site is dependent on the diversion of conservation resources already allocated in the public or voluntary sector (Thorn et al., 2018; Damiens et al., 2021). While the use of already allocated public resources promotes permanence it undermines additionality. More generally there are widespread issues of leakage, from damage outside the NNL policy coverage, and practical limits to land availability for compensation. Sonter et al. (2020, p. 1) conclude that NNL "fails to slow regional biodiversity declines because

policies regulate only a subset of sectors, and expanding policy scope requires more land than is available for compensation activities."

The political dimensions of NNL are equally diverse and problematic. Effective mechanisms and institutions for planning and implementation are often lacking, weak or captured. Decisions on baselines and counterfactuals have impacts at multiple scales, including serious implications for the distribution of costs and benefits. And short-termism is endemic. May et al. (2017) highlight a lack of long-term and contingency planning, while Quétier et al. (2014) point at a broad lack of institutional mechanisms and science context. Offsets are deployed as a temporary fix by "institutions [that are] are structurally blind to long-term concerns" Damiens et al. (2021, p. 60). All these concerns are exacerbated by agency capture (Clare and Krogman, 2013). For example, in Alberta, in part as a product of goal ambiguity, agency capture led to a bias toward compensatory payments, rather than avoidance of damage; with compensation sites inappropriately located (Clare and Krogman, 2013). More generally, voluntary offsetting is widely promoted by private enterprises as a mechanism to frame or even deter future regulatory intervention (Benabou, 2014). The politics of capture mean that evidence of low success rates is widely ignored (Lindenmayer et al., 2017; May et al., 2017; zu Ermgassen et al., 2019), and without major governance shifts NNL cannot be expected to deliver (Damiens et al., 2021).

Amongst the most politicized decisions are those regarding baselines and counterfactuals. In many cases these accept a continued long-term decline of biodiversity as a product of continuing economic development. This fundamentally undermines the goal of NNL, while exacerbating the likelihood of non-additionality at a project level (Maron et al., 2018; Sonter et al., 2020). And at a grand-scale, governments often divert offset payments into meeting biodiversity targets to which they were already committed, rather than treating offsets as necessarily additional (Maron et al., 2015). Moreover, offset systems tend to conceal the extent of transfers between different interests, even as they alter the pattern of such transfers (Parson and Kravitz, 2013). For instance, "Project-based offset programs can transfer huge rents to project developers, depending on how baselines are defined" (Parson and Kravitz, 2013, p. 429). The interpretation, application and enforcement of metrics—which affect overall compensation costs for the developer—are also prone to politicization. What is sometimes called "moral hazard" in climate policy is found also in biodiversity NNL where the economic contexts or the interests of actors involved, including ecological consultants working for developers, can affect the calculations of proposed loss and biodiversity gain in ways that will ameliorate costs for the developer (Carver and Sullivan, 2017).

2.2. Improving NNL?

While the broad picture painted by the literature is negative, many scholars are concerned to suggest possibilities for improvement, and identify conditions under which BDOs can contribute to NNL or even net gain. The central condition appears to be that NNL and BDO should be placed within a national and regional regulatory framework for constraining and avoiding biodiversity loss (Simmonds et al., 2020). In this respect BDOs resemble other tradable permit policies, in which a binding overall cap is critical to effectiveness (Parson and Kravitz, 2013). The specifics of the policy also matter, and arguably the (relatively few) successes identified often occur *despite*, rather than *because of*, the existing framework of policy. BDOs are more often stimulated through a regulatory framework than by financial market trading (Bull and Strange, 2018), and the most commonly cited reason for success was where high offset multipliers were required, with large offset areas designated, relative to the impacted area (zu Ermgassen et al., 2019). According to Gibbons and Lindenmayer (2007) success is more likely where the habitats involved are relatively simple and common and offsets are well managed with high compliance rates. Koh et al. (2017) highlight the importance of clearly separating decision phases so that the initial acceptability of the development is decided without consideration of the possible or appropriate scope of compensation, so as to avoid the "license to trash" effect, understood as a moral hazard or mitigation deterrence risk in net-zero literature (McLaren et al., 2019). Koh et al. (2017) also recommend use of both quantitative and qualitative ecological valuation methods and social safeguards to prevent environmental injustice.

Despite the lack of evidence for NNL and BDOs, there are still many efforts in the literature to justify offsetting. These typically begin from a premise that offsets are necessary because of the lack of other incentives and values for biodiversity protection (e.g., Gibbons et al., 2016; Koh et al., 2019). We suggest that such discursive battles may not be a product of objective assessment, but of political presumptions (about baselines, feasible scenarios, effective incentives etc.) and cultural political economy more broadly. They reflect a world in which continued harm to biodiversity is seen as inevitable, with a baseline of decline in the absence of intervention, and despite the incommensurability of different forms of biodiversity, offsets are seen as a least-worst option, especially if used to promote net-gain, rather than merely NNL. Nonetheless, the literature is crystal clear that NNL/BDOs/ecological compensation cannot fulfill the central role in biodiversity policy, but rather, at best, could complement a strong legal framework, and territorial targets and measures. But the limitations of NNL are more often treated as reason to call for "net gain" outcomes rather than to revisit the choice of policy mechanisms. "Net-gain" (delivering more restoration benefits than harms), however, not only intensifies the existing challenges of NNL, but also involves new complexities especially regarding frames of reference, such as the state to be restored (Bull and Brownlie, 2017). Nonetheless, mainstream politics still persists in pursuing netting and offsetting. In the next section we explore some possible reasons why.

3. The neoliberal "makings" of net policy

Our literature-based review of NNL policy effectiveness in Section 2 not only reveals its very limited success, but highlights obstacles arising in the processes whereby a specific object or resource is made manipulable through policy intervention. In a Foucaldian tradition, Scott (1998) centers the concept of legibility,

materialized in monitoring, measurement and standardization processes that allow a state to govern territory and resources. Yet what we see in the construction of "biodiversity" as a resource goes beyond seeing like a state, to "seeing like a market" such that the biodiversity resource, as constructed or made in NNL and BDO policy becomes a tradeable commodity. In this section we unpack the multiple makings of net policy, demonstrating the depth of the co-productive or co-evolutionary processes (McLaren and Markusson, 2020) that develop between policy goals, framings, tools and actors, and highlight relationships with tenets of neoliberal ideology. To do so we draw on cultural political economy (Sum and Jessop, 2013) as an analytic approach which recognizes both the materiality of resources, and simultaneously, the potential for objects of policy to be culturally constructed and reconstructed.

As an ideology neoliberalism centers economic growth as the mechanism to deliver human progress, resisting state intervention in economic and social affairs, and promoting free markets, free trade and capital mobility on utilitarian efficiency grounds. The contemporary era of neoliberalism has been particularly marked by the growing role and power of finance (Kotz, 2010; Fine and Saad-Filho, 2016). So when it comes to "externalities" such as biodiversity loss and climate change, neoliberal policy aims to avoid any brake on growth (and entirely eschews the possibility of changing economic system), rejects regulatory constraints on individuals or corporations, instead developing complex systems of interventions to create new markets in novel commodities (and derivatives thereof), not only commodifying, but marketizing and even financializing the underlying resource (Fletcher, 2010; Pawliczek and Sullivan, 2011). In the case of BDOs this means "constructing [development-related] harm as a result of market failures, which [it is presumed] can be resolved through market solutions" (Sullivan and Hannis, 2015, p. 162).

These market solutions for NNL promise a new "restoration economy" in the form of habitat (re)creation as opposed to preventive constraints on harm to biodiversity. This too is rooted in neoliberal ideology about innovation, markets and growth, and in practice, in new alliances between financial capital, corporate governments, and cash-strapped conservation organizations (Fairhead et al., 2012). For Huff and Brock (2017) such alliances represent "a Faustian bargain" ridden with "precarious and crisis-laden … compromises." While appearing the only way to fund conservation, these alliances around NNL underwrite narratives of "green growth" (Carver, 2021) capital "accumulation by environmental restoration" (Huff and Brock, 2017) and "green capitalism" (Buller, 2022). Yet the model relies on the availability of conservation-ready land for investment, thus normalizing past degradation and justifying continuing unsustainable land use and development. Thus, alongside activities such as bioprospecting and ecotourism, BDOs enable the extraction of profits from nature. Huff and Brock (2017) argue that this sustains—or amplifies—a longer term "exclusionary, racist, and violent trajectory" in neoliberal conservation, or as Buller (2022, p. 87) puts it offsetting is "at its core a neo-colonial effort".

Biodiversity markets have been extended beyond offsetting, with the creation of financial derivatives based on the values attributed to biodiversity. Swiss Re, for example has established a "biodiversity index" to underpin insurance products- which as Buller (Buller, 2022, p. 248) recounts, required "several transformations, novel methodologies and conceptual shifts" to segment the natural world into "units whose value can be appraised and exchanged" in a new arena for profit accumulation. Financialization underpins neoliberal accumulation "articulated through the power of the state to impose, drive, underwrite and manage the internationalization of production and finance in each territory, often under the perverse ideological veil of promoting non-interventionism" (Fine and Saad-Filho, 2016, p. 688). BDO exhibits a similar apparent perversity, where complex interventions are required to enable an ideologically abstracted "non-interventionist, free market" approach to the management of externalities. The paradox is discursively resolved through the state intervening at an abstract level to establish the conditions for neo-liberal market competition, which while clearly reflecting the interests of a class or even sector of financial capital, does not (apparently) pick winners between the competing capitalist enterprises involved.[9]

It might seem ironic that the application of neoliberal ideology—which seeks to minimize and even deny the case for government intervention—by its rejection thereof, demands intervention to construct the very markets it wishes to keep free of interference. The BDO case makes the foundational role of the state in developing and defending markets excruciatingly clear. As Koh et al. (2019, p. 679) emphasize, "the government, contrary to received wisdom, plays a key role not just in enforcing mandatory policies but also in determining the supply and demand of biodiversity units, supervising the transaction or granting legitimacy to the compensation site."

3.1. Six dimensions of the "makings" of net policies

The BDO case also demonstrates the coproduction of particular forms of goals and particular forms of actors as a result of the integration of neoliberal ideology. Here we briefly describe six different dimensions which are remade in NNL that are resonant more broadly with other net policies, such as net-zero. Uncovering these dimensions of the "makings" of net policies is essential if we are to evaluate their effectiveness fully.

- **Making goals:** "net" policies or practices necessarily reshape our understanding of the goal or target involved. Rather than being framed in terms of reducing or eliminating harms, or rates of loss and damage, it is instead constituted as a "stabilization" of harm. In a net goal the overall quantity of damage is irrelevant, as long as it is balanced by an equivalent gain (Armstrong and McLaren, 2022). The move to net goals theoretically separates the "net" harm from the absolute number of potentially damaging activities or transactions: this facilitates not only a compensatory and often market-based response, but also the financial neoliberal desire to maximize the number of trades of the commodity

9 Maybe worth a footnote here on carbon prices, vs renewables (ROCs, FITs, etc) for a salutary lesson on how such abstraction runs counter to environmental needs.

or derivatives involved. From the neoliberal perspective, therefore, an outcome with many harms counterbalanced by many benefits is preferable to one with few harms and few benefits. Net goals defined in terms of stabilization require not just measurement, but quantification, baselines or counterfactuals, and in practice become "accounting" goals rather than "material" goals. Moreover, net goals, even "net-gain" goals, naturalize continuing incidents of harm (as the very mechanism to trigger gain or restoration activities), and more broadly therefore institutionalize the inevitability of development or economic activity and the harms arising from it, even if the net effect is—assuming successful implementation of the policy—a stabilization or overall improvement in the net state.

- **Making measurable:** "net" policies or practices demand that interventions produce measurable and quantifiable outcomes, because otherwise they can't be compared with one another. This is a break with qualitative assessment of biodiversity value. In modernism, quantification is a central feature of business and bureaucratic cultures that "manage only what is measured" (Ridgway, 1956). Under neoliberalism, measurability is an essential precursor to commodification and exchange. But the demand for measurability also creates pressures for simplification or abstraction, measuring only certain dimensions of the resource (such as the land area of habitat involved). This reframes nature as disaggregated and distinct units that can be exchanged across time and space to balance between ecological losses and gains, stripping away any value that cannot be so quantified, and abstracting nature "from location, ignoring broader dimensions of place and deepening a nature–culture divide" (Apostolopoulou and Adams, 2017, p. 23). Moreover, incentives are diverted to interventions that can be precisely measured and verified, as opposed to those with merely qualitative benefits.
- **Making equivalences:** net policies and practices demand not only measurability but equivalences, making possible fungibility between different things (e.g., wetlands and forests, lions, and butterflies) and different locations, quantities and timings. Buller (2022) highlights the adoption of habitat banking processes as a particular driver of constructions of equivalence, insofar as it broke any remaining link with early efforts to match compensatory sites on a "like-for-like" basis in a material or temporal way. Composite measures like "units of biodiversity" have been developed to enable comparison, and trading, bypassing philosophical questions about what a unit of biodiversity means and how it can be consistently measured. The quest for fungibility lies at the heart of economists' approaches to sustainability (Pearce and Turner, 1989) and simultaneously at the heart of neoliberal capitalism which seeks to reduce policy issues to choices in markets denominated in money and efficiency. The practical and philosophical challenges of making equivalences feature strongly in literature on NNL and BDO policy. Quétier and Lavorel (2011) for example, highlight that genuine equivalence requires attention not just to areas and species involved but also the time dimension. While "restoration science is representing entire ecosystems as abstract, mobile, and fungible entities" (Robertson, 2000, p. 463) the process of commodification of nature remains necessarily incomplete as a result of the complexity of these technical challenges, politicizing "crucial steps of abstraction and valuation … [as] negotiations between and within differentiated segments of the state and civil society" (Robertson, 2000, p. 463). Koh et al. (2019) suggest that there is only limited commodification because the value of offsets reflects the costs of restoration or management, not some measure of the intrinsic value of the biodiversity. Yet the stripping away of aspects of value in the process of commodification is one reason why it is problematic in such contexts.
- **Making incentives:** net policies and practices also construct and validate particular forms of incentive for action, especially through the link with offsetting mechanisms. The necessary incentive is generally presumed to be pecuniary, rather than legal (regulatory) or normative, even though such alternatives might be equally conceivable as a means to deliver net outcomes. Neoliberal principles of both deregulatory politics and private property rights are implemented in the move embedded in NNL and BDO: from a social or public obligation to protect the natural interest, toward a private right to development, which cannot be suspended, only made conditional upon the purchase of a compensatory offset. More specifically the standard model goes beyond mandating the protection or creation of compensatory habitat for a specific development, to the development of trading or offsetting markets in biodiversity credits, which in turn establish the commodity "price" and direct new (theoretically additional) flows of investment to the purpose of biodiversity protection. Yet in the exchange of credits, the value of non-human nature is made equivalent to its financial cost (an abstracted exchange value, rather than a use, or even production value), further abstracting it from other sources of value (Apostolopoulou and Adams, 2017).
- **Making actors:** net policies and practices also have implications for who is considered to have agency, and what sort of agency they enjoy (i.e., what sort of subjectivity is created or reinforced). It is inevitable in constructing incentives, that particular forms of actors are presumed. Consider the difference between policy goals that "protect and enhance biodiversity" through strict regulation of damaging activity even on private land, and those that seek NNL or net gain. The latter enables the marketization of biodiversity, and constitutes the actors involved as consumers and producers, rather than as citizens with rights and responsibilities. This is not to claim that the ultimate outcomes for biodiversity are necessarily worse in the latter framing, but to highlight that it not only presumes certain ideological preconditions, but also that it constitutes actors in distinctive ways. However, Parson and Kravitz (2013, p. 431) note that in environmental policy more widely, "either framing the decision situation as a market or increasing market-like attributes (e.g., anonymity, transience, social distance) induces more rent-seeking and other self-interested behavior than under alternative framings"—at both individual and community levels. Attaching NNL of biodiversity to

the development project, rather than a territorial scale, ignores diffuse harms to biodiversity (such as from pervasive chemical pollution), permits huge "leakage" by relocation of projects, and/or makes avoidance of damage by the foregoing of development that much less likely. But critically, with respect to the participants, it also reinforces the constitution of the corporate developer as the key actor and arbiter of conservation harm, rather than the community, the citizen or the regulator. This is the case, even as within offsetting schemes agency is transferred from the site managers at the practical ground-level to the traders and market managers who are also, in some case also the regulators. Moreover, NNL and BDO schemes have also re-positioned environmental NGOs: as participants or intermediates in such schemes, sometimes even providers or manager of offsets, they have been distanced from their conventional role in resisting ecologically harmful economic activity.

- **Making expectations:** net practices and policies (re)shape expectations at several levels. In particular they presume the existence, or creation, of restorative technologies (e.g., habitat recreation, de-extinction), and thus bear a particular relationship to the inevitability and desirability of innovation. More broadly they presume the continuation of development and growth (not only as a product of a continued innovation process, but as an inevitable source of demand for land-use change and offsets). Net approaches therefore defend the underlying model of economic growth through continued development, framing the cessation of biodiversity damage as implausible utopian thinking, not to be seriously entertained. But as Apostolopoulou and Adams (2017) suggest, by linking conservation to ongoing development and growth, and presenting offsetting as a technical issue, the problem of biodiversity loss due to development is depoliticized. The expectation that market-led innovation will provide solutions is another neoliberal article of faith reinforced by the net/offset combination. It is no surprise that entrepreneurs aim to apply in-vogue technologies (gene-tech, drones, and blockchain) to the emerging biodiversity markets: the model of seeking diverse applications for novel technologies is well established in neoliberal innovation financing (Goldstein, 2018). However, the introduction of such technologies in efforts as diverse as drone and blockchain tracking of wildlife to reduce poaching (Mitra et al., 2021)[10] and gene-manipulation for de-extinction (Adams, 2016) all contribute to ethical concerns that commodification is "de-naturing" biodiversity.

Across these six dimensions we see a consistent fingerprint of neoliberal ideology, both on what is made by the interventions, and in turn in how what is made reproduces or reinforces those ideologies, constituting a model in which abstract commodities are traded between private entities in line with profit motives, portrayed as success regardless of the empirical outcomes on the ground in the longer term. This helps keep the whole system unchallengeable in any substantive way. In other words, neoliberal policy options are not just adopted, but made. Their dominance reflects not an objective assessment of what might be effective at delivering goals, but a process of remaking of goals, metrics, equivalences, actors, incentives, and expectations recursively in line with ideological presumptions. In the neoliberal context then, net policies do not merely enable offsetting mechanisms, nor is it that the policies actually demand such measures; it is the neoliberal commitment to economic growth, markets and financialization that drives the adoption of net framings for the very purpose of validating offsetting markets. In the next section we consider whether we should expect the same in the introduction of net-zero to the climate policy arena.

4. Is climate policy different?

Here we summarize how net-zero reflects these six "makings", highlighting some critical themes for the future of climate policy, and discussing some key points where nature and climate "netting" intersect.

In respect of *goals,* the adoption of net-zero is a deliberate reframing of the climate target. It might appear that the novelty in net-zero resides with the "zero" rather than the "net". After all natural sinks have been a (controversial) part of climate policy since Kyoto, and emissions trading long established in several countries and regions. But at least until the Copenhagen COP failure in 2009, removals were treated as a relative minor issue—mainly one of accounting, rather than a manipulable component of the climate goal. And emissions trading was focused on shuffling the responsibilities to cut emissions between different actors. It is only in the Paris era, that the net—as an aggregate outcome achieved through balancing of sources and sinks—has moved to the center of policy. In part this is a product of the understanding that the carbon budget is on the brink of exhaustion, and thus "zero" is critical, but understanding the move to *net-zero* as simply about the rational tightening of the (net) emissions target to zero would be to miss the processes through which and the interests by which contemporary climate policy has been shaped.

Above we noted the use of the net-zero framing as a means of convening support for new action and elevating aspirations in the face of depleting carbon budgets and growing climate risks. This process paralleled a shift from top-down political targets under Kyoto to "nationally determined contributions", a growing role for non-state actors, and a revival of offsetting approaches (notably through the Taskforce for Scaling Voluntary Carbon Markets).[11] The consequence of such a neo-liberalization of environmental policy is not necessarily a weakening, but as with NNL, the reframing places the material outcomes of policy on a lower level of priority than the deployment of mechanisms that resonate with neoliberal ideology. And it combines more flexibility with a greater risk of overshoot. In particular the huge uncertainties associated with high dependence on speculative carbon removal (Anderson and Peters, 2016)—like those associated with habitat

10 Also see Available online at: https://cryptobriefing.com/blockchain-save-endangered-species/.

11 See: Available online at: https://www.iif.com/tsvcm.

recreation—are largely overlooked in the efforts to get corporate and financial actors involved. Critically however, in bringing fungibility and flexibility to the center of climate policy, the net-zero framing enables continued postponement of action, and risks further buck passing through offsetting.[12] Like NNL, the net-zero goal is an accounting goal. It promises expanding, perhaps even unlimited, markets for removal, and has reinvigorated offsetting claims, and the creation of voluntary carbon markets. Reinforcing the argument that neoliberal ideologies underpin net-zero, rather than the reframing as net-zero unintentionally enabling neoliberal measures, McLaren and Markusson (2020) identify the emergence of net and neutrality concepts enabled by hypothetical removal technology and a presumption of fungibility and trading (in models and politics) which *preceded* net-zero rhetoric by some years. Similarly, Schenuit et al. (2021) trace constructions of fungibility for nature-based carbon removals in countries like Australia back before Paris.

As with no-net-loss of biodiversity, climate net-zero has also shifted presumptions about the *baseline* for policy goals. In this case the move is to reorient the baseline entirely: targeting stabilization at a future date (typically 2050), rather than measuring emissions reductions against a specific past state (such as 1990 or 2005).[13] This might reduce confusion and contestation over different historic baselines for emissions, focusing attention instead on the degree and rate of future action. But whether considering the past, or the future, "global net-zero" (the implicit outcome of the "balance of sources and sinks" mandated by the Paris accord) thereby tends to erase questions of justice (Mohan et al., 2021). Differential responsibility for past emissions is swept away, while a common net-zero goal is treated too often as meaning every country (and indeed every corporate entity) should meet the same target over the same timescale: ignoring both differential responsibilities and differential capabilities to contribute. And whilst the commonly presumed baseline of net-zero by 2050 might seem clear about eliminating net emissions to the atmosphere, in a further echo of NNL challenges, the counterfactual projections of economic growth which feature in modeling pathways to net-zero strongly structure the scale of any requirement for carbon removal, much of which effectively is "needed" to compensate for residual emissions or emissions overshoot resulting from continued growth. The goals made in net-zero policy thus accommodate neoliberal expectations of continued economic growth, while also disavowing the additional responsibilities than might accrue to the states, institutions and companies driving neoliberalism for their historic climate liabilities.

In terms of *measurability* the adoption of net-zero does not require the same degree of change in measurement that was demanded by NNL (novel quantitative measures for qualitative concerns like situated and socially valued habitat features and ecosystems). However, "measuring" greenhouse gases remains complex, especially when seeking to account at the enterprise or national level (as opposed to simply recording global atmospheric concentrations). So while measuring the outcome might seem fairly easy, measuring the different components of emissions and sinks so as to implement net-zero policy is harder at this differential scale. Measurement is particularly difficult for natural sinks where uptake of carbon might be accelerated by enhanced weathering, ocean fertilization or alkalinisation, or soil carbon management for example. Assessments of such approaches" carbon uptake are already more model than measure, with, for example, measures of uptake in soil complicated by variability in baseline carbon content, seasonal variability in uptake, and losses in soil erosion events, amongst other factors. Measuring enhanced sink uptake typically relies on "accounting" for net effects. This holds also for other carbon removal techniques: while measuring the CO_2 piped into a store from direct air capture (DAC) or bioenergy with carbon capture and storage (BECCS) may be technically quite simple, accounting for all the consequential emissions and leakage from energy requirements, or in the material inputs is much more challenging. Yet precise measurement is presumed when carbon removal techniques are incorporated into neoliberal carbon markets and offsetting schemes.

In terms of *equivalence* and *fungibility*, again the transition to net-zero is not as radical a shift as that in NNL (where at an extreme, completely different species or habitats were made fungible). Yet again it would also be unhelpful to ignore the degree to which non-fungible aspects of GHG emissions are further collapsed in making them compatible with net-zero visions, or to disguise the political choices in making different sinks equivalent and fungible as technical accounting challenges (Carton et al., 2020). Where a purely scientific perspective might see carbon as fungible (arguing that a ton is a ton: no matter where or when emitted, or from what process, it will have the same impact on the climate), this is false. First, timing does matter with respect to the overall climatic impact, especially when considering techniques where removed carbon is not permanently stored and might be released by wildfires, for example. More broadly it is inappropriate to treat carbon in biological cycles as *fungible* with carbon in geological cycles (Carton et al., 2021). Efforts to construct equivalence for carbon removals began in the 2000s (e.g., Grönkvist et al., 2006), but have massively intensified in recent years. The European Union is seeking to agree a framework for carbon removal certification which enables fungibility between biological removals and geological (fossil) emissions. And the Article 6 Supervisory Body is working on accounting rules for removals under the UNFCCC. Such procedures have paid growing attention to questions of permanence but even that issue remains unresolved and contentious. Second, the assumption of perfect fungibility draws too tight a boundary around the carbon unit—different gases in different locations serve different social purposes and face different risks (Carton et al., 2021). Yet metrics for comparing emissions of different gases typically

12 See CSSN Net-zero working group paper. Available online at: https://cssn.org/wp-content/uploads/2022/06/Net-Zero-and-Carbon-Offsetting-Position-Paper.pdf.

13 This is not to say that countries have abandoned emissions reductions targets measured against historic baselines, but that such targets have largely become subsidiary to the future-oriented net-zero goal. In the UK for example, the Government maintains that it is on track to achieve net-zero, even as emissions increasingly exceed the budgets previously established in law to drive emissions reductions.

only consider physical and chemical characteristics.[14] And such questions are invisible at the enterprise accounting level, where the International Standards Organization (ISO) is working on a dedicated carbon neutrality standard, based on a British PAS standard devised in 2010. ISO already adopted emissions measurement and inventory standards. All these means of establishing fungibility rest on neoliberal preferences for market-based approaches and incentives.

Climate policy already involves neo-liberal *actors*, including technological entrepreneurs, industrial corporations and financial institutions. Yet net-zero has attracted new entrants especially in the entrepreneurial spaces around nascent carbon removal technologies, and in the associated and challenging spaces of measurement and tracking of emissions, with particular efforts to deploy blockchain solutions. It has also seen intensified financial sector interest. While multilateral bodies such as the IFC and World Bank have been long involved, the Glasgow Finance Alliance for Net-Zero now boasts "more than 450 member firms from across the global financial sector, representing more than $130 trillion in assets under management and advice",[15] including banks, asset managers, investment managers, insurers, financial services companies and financial consultants. In 2022 UN's "race to zero" campaign included over 5,000 businesses (alongside other institutional members, accounting for over 50% of global GDP),[16] and many businesses are now making their own net-zero declarations (even though net-zero makes sense theoretically only as a global goal, implemented by states).[17] This turn toward *privatization* of climate action might accelerate both emissions cuts and deployment of carbon removal, but it emphasizes an offsetting model of delivery, and also raises questions of distributive justice, especially where companies effectively stake a claim to limited carbon removal capacities (Armstrong and McLaren, 2022).

Similarly, the financialization of *incentives* involved in net-zero policies is not new (the EU emissions trading system was established in 2005), yet under net-zero there seems to be intensified interest in market making, including demands for either new markets for carbon removal, or efforts to incorporate them in existing trading mechanisms such as voluntary carbon markets, compliance market trading in the EU and New Zealand, or the emissions intensity calculations of the California Air Resources Board.[18] We are also seeing novel private sector "advance market commitments" for carbon removal orchestrated by entities such as digital payments company Stripe. And even if such measures were pursued only by states[19] this would not indicate a rejection of neoliberal ideology. State military procurement is an archetypical neoliberal model—maintaining private, "competitive", profit maximizing business as the productive actor, in contrast with models such as the "Green New Deal" (Galvin and Healy, 2020) which would revive Keynesian economic principles of state spending targeted at climate and broader environmental and social goals.

Specific *expectations* have also been established or solidified in the construction of net-zero. A fundamental presumption that some continuing harm is inevitable or necessary underlies the recognition of residuals that will have to be counterbalanced (as opposed to eventually eliminated) (Buck et al., 2023). Similarly as with the shift from NNL to Net Gain, the climate literature and commentary sphere is filled with debate over the need for a move to "net-negative" (beyond the accounting baseline) a global state in which atmospheric carbon dioxide levels are drawn down to some safe level, a form of climate repair or restoration[20], triggering contestation over what historic state to aim at (McLaren, 2018). But the most rapid and novel shifts in expectations have emerged around innovation and carbon removal, with not only anticipation of proliferation of carbon removal techniques through venture-capital driven innovation, but also a distinctive phenomenon in which technologies have been reframed or even evoked—*de novo*—through modeling. Carbon capture technologies such as mineralization and Carbon Capture and Storage (CCS), earlier treated as ways to abate fossil carbon flows in flue gases from combustion have transmuted into carbon removal technologies applied in the outside world, including enhanced weathering and ocean alkalinisation (in which carbon-absorbent minerals are spread in the environment, rather than reacted with flue-gas CO_2 in a pressure vessel) and Direct Air Capture (DAC) in which ambient air rather than flue gas is directed over reactive chemicals to strip out CO_2. The most extreme case is that of bioenergy with carbon capture and storage (BECCS), in which existing and emerging technologies of biomass combustion and carbon capture and storage were first combined as imaginaries in climate models, and still lack large-scale commercial demonstration in practice (Low and Schäfer, 2020). The net-zero imaginary follows neoliberal presumptions of inevitable growth, and associated harms being mitigated through market-led innovation.

4.1. More than parallels?

Overall there are clear parallels between the makings of NNL and those of net-zero. In many respects the neoliberal making of

14 The most widely used metric [Global Warming Potential (GWP)] dates back to 1990—but the net-zero era has spurred new efforts to incorporate short-lived gases in a GWP* (and criticism that this combines stock and flow pollutants inappropriately). These take into account the lifespan of the gases in the atmosphere, but not whether the original source is biological or geological.

15 See Available online at: https://www.gfanzero.com/about/.

16 From Available online at: https://unfccc.int/climate-action/race-to-zero-campaign (accessed March 22, 2022).

17 Partial adoption of net-zero cannot deliver the global goals set by Paris, and in practice if global net zero is achieved it will involve some sectors and some states still being net emitters and others being net removers. The drive to spread net-zero targets to as many countries and businesses as possible is only ever a proxy for the global net-zero goal.

18 See Available online at: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.

19 For example in Sweden, the state has allocated €3.8bn to procure BECCS removals to offset emissions in hard-to-abate sectors such as agriculture (Lundberg and Fridahl, 2022).

20 See, for example, Available online at: https://www.climaterepair.cam.ac.uk/.

net-zero began well before the policy discourse even emerged, but the processes have continued, intensified and solidified in ways that reflect neoliberal ideology. Yet in some spaces NNL and net-zero are not simply parallels, but are different attempts at commodifying the same natural resources: many carbon removal techniques have biological underpinnings and rely on the exploitation of biomass. There is a double intertwining of offsetting and "netting" then in the potential deployment of nature-based, or bio-based carbon removal to contribute to net-zero (Griscom et al., 2017). Here the driving forces of neoliberal environmentality (Fletcher, 2010) risk conflict between biodiversity and climate goals specifically because the complex and multi-faceted values of biodiversity and climate have been flattened and simplified into tradeable commodities. Exaggerated promises notwithstanding (Bastin et al., 2019; Lewis et al., 2019), interventions in ecosystems would appear to have more potential to support both net-zero and biodiversity goals if directed to integrated biodiversity ends, but as potentially creating conflict between the goals if driven by carbon metrics (Smith et al., 2022). The optimum policy approach to achieve this seems unlikely to involve offsetting mechanisms, yet proponents of carbon markets and nature-based solutions alike tend to present offsetting—and particularly carbon offsetting, because of the growing quantities of climate finance anticipated—as the only (or at least an essential) way to direct substantial funding into the development and deployment of such techniques. However, biological carbon removal techniques such as afforestation, BECCS, or kelp farming maximize carbon by maximizing *productivity*, which tends to undermine biodiversity. By contrast natural ecosystems tend to accumulate larger carbon pools (but at less rapid rates), but carbon removal techniques tend to suspend ecosystems in a particular productive state, rather than allowing for the evolution and development necessary both for biodiversity to adapt to climate change and to accumulate carbon in mature systems.

5. Conclusions

We have shown that both NNL and net-zero (and their mutual obsessions with offsetting as the central mechanism to implement these policies) are expressions of similar neoliberal presumptions and prescriptions about fungibility, financialization, economic growth and efficient markets. In turn both rely on a series of interventions or makings, in which policy goals, measurement and metrics, equivalences, incentives, actors and expectations are all (re)constructed in line with neoliberal ideologies. And, perhaps unsurprisingly, both areas experience similar problems and critique. Philosophical critique highlights the conversion of commons-based resources into forms of enclosed and commodified natural capital, and emphasizes ethical and justice implications of such a transformation. Politically they share concerns about the power of vested interests and the politicization of baselines and counterfactuals in line with ideological commitments to economic growth. And practically they raise similar concerns about the additionality, permanence and leakage of offsetting benefits, and about the expectations for greater availability of offsetting benefits than is socially or environmentally sustainable.

By surfacing and unpacking the neoliberal foundations of these policy models we can see ways in which weaknesses are magnified and possible reforms or alternative approaches are overlooked by the neoliberal gaze. Moreover, the principles inherent to net policies are built on accounting logics and "trust in numbers" that, although predicated on an established drive for objectivity shared in science and bureaucratic cultures, still often distort and pervert what is being measured for the sake of management (Porter, 1996). To make net policies effective in social and environmental terms begins with understanding their multiple entanglements with neoliberal presumptions, and specifically demands separating them from the mechanism of offsetting. We close with five principles for more effective net policy.

First to minimize the *need* for benefit restoration by prioritizing measures to minimize residual harms. This means adopting and firmly enforcing the mitigation hierarchy. This radically shifts *expectations* away from presumptions of inevitable continued development and damage, removing the perceived need for marketisation and offsetting mechanisms. Second establish clear, and accountable *separate* targets for harm minimization and benefit restoration to avoid a tendency toward moral hazards (c.f., McLaren et al., 2019). This not only begins to remake targets, but disrupts assumptions of equivalence, enshrining awareness of the difference and incommensurability of different benefits. Third, to establish and implement *targets at global or ecologically relevant territorial levels* through coordinated planning rather than attaching them to specific projects or businesses. This not only contributes to remaking the targets, attaching them primarily to the stability of the climate or biodiversity, rather than to the interests of the economy, but more importantly, remakes the actors, constituting them as collective, regional or global, rather than private and corporate. Fourth, to provide *direct funding support or mandates* for the provision of benefits to alleviate the demand for marketized offsetting as a source of finance. This remakes the incentives involved, and disconnects action from the neoliberal presumption that markets are best. Fifth, to construct policies and set targets with *attention to the multiple values associated* with the benefits concerned, particularly with respect to social justice. This is not just about remaking targets, but more importantly about disrupting equivalence, by attaching multiple variable values to the benefits and harms involved, and respecting the unmeasurable elements that are present, rather than narrowing everything down to those aspects that can be measured. Collectively, through the application of these principles the needs for long-term restoration could be detached from balancing residual harms; and the potential benefits of net policy making might be disentangled from the neoliberal mechanisms of offsetting.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

DM and LC jointly conceived, investigated, wrote and edited the work, and approved it for publication. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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