

ADVANCED REVIEW

Distributive justice and the global emissions budget

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Editor and Mike Hulme, Editor-in-Chief**Abstract**

In order not to significantly overshoot maximum levels of warming like the 1.5 and 2°C target we must stay within a fixed emissions budget. How to fairly distribute the entitlements to emit within such a budget is perhaps the most intensely discussed question in all of climate justice. In our review we discuss the most prominent proposals in moral and political philosophy on how to solve this question and put a special emphasis on scholarly contributions from the last decade. We canvass the arguments for and against emissions egalitarianism, emissions sufficientarianism, and emissions grandfathering as well as the debates surrounding them. These are how to deal with non-compliance, how to split emissions between producers and consumers, how to best account for terrestrial carbon sinks, and whether emissions from having children should be subtracted from parents' emissions budgets. From the viewpoint of justice, it matters not only that we act against climate change but also how we do so. This review aims to elucidate one of the major ways in which our reaction to climate change could be just or unjust.

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1 | INTRODUCTION

The debate on how to allocate emissions entitlements is one of the most extensive debates in climate ethics. But is it still relevant after the Paris Agreement? One of the key outcomes of the 2015 climate summit was that Nationally Determined Contributions (NDCs) replace the search for a single principle or set of principles on how to divide the remaining global emissions budget. To conclude from this that questions of distributive justice have lost their relevance would be a mistake, however. We must engage with them to evaluate the ethical adequacy of the individual NDCs. An unambitious contribution by one of the world's highest emitters may not be illegal under the Paris Agreement, but it may very well be immoral. To find out whether this is the case, we still need to lead the very debate that this paper will review. This is especially important because at present the sum of all NDCs is not sufficient to stay within the 2°C limit,

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never mind the 1.5°C limit (UNEP, 2021). In a world where voluntary emissions reductions of individual countries add up to a satisfactory collective mitigation ambition, there would perhaps be no need to talk about the distributive justice of emissions entitlements. But, as the last 8 years have clearly shown, this is not the world we live in. Hence, the question of who should be allowed to emit how much remains of supreme relevance.

In this article we review the debate around principles for the fair distribution of emissions entitlements. We summarize the arguments for and against the main contenders for such a principle and highlight important issues that arose in these discussions. Building on the seminal reviews by Gardiner (2010), Hayward (2012) and Moellendorf (2012), we focus on contributions from the last 10 years in particular.

We structure our review as follows: Sections 2–4 deal with the three most prominent proposals for how to fairly distribute emission entitlements: emissions egalitarianism, sufficientarianism and grandfathering. How to deal with the fact that some emit more than their fair share is the topic of Section 5. Finally, Section 6 covers three complexities involved in attributing emissions. Section 7 concludes.

2 | EMISSIONS EGALITARIANISM

2.1 | The view

The core thesis of emissions egalitarianism—also known as the equal-per-capita view—can be defined as follows:

The global emissions budget is fairly distributed if and only if each person is awarded an equal share of it.

Emissions egalitarianism proposes to divide the remaining emissions budget through the number of people currently alive. The resulting shares mark the quantity of emissions each person may still emit and are typically thought to be considerably smaller than current global average per-capita emissions (for proponents see Meyer, 1999, Attfield, 2003, Jamieson, 2005, Singer, 2010, Ott, 2012, Broome, 2012, Torpman, 2019, for a wider overview of broadly egalitarian views in climate justice see Grasso, 2012, 671).

Three things to note: first, what emissions egalitarianism aims to distribute are not literally emissions but emissions entitlements. “Emissions egalitarianism” is thus a shorthand for “egalitarianism regarding the entitlement to emit” (Torpman, 2019, 751). The moral entitlement to emit usually grounds institutionalized or legal entitlements, for example, within the context of an emissions trading scheme.

People are allowed to use their emissions entitlements to emit themselves or trade them for money (or leave them unused and unsold). Finally, proponents of emissions egalitarianism realize that literally awarding some physical or virtual permission to emit to all the people in the world would be impractical or impossible. For pragmatic reasons a common idea is thus to award states emissions entitlements based on their population size (while perhaps excluding some particularly corrupt regimes, Singer, 2010, 197). Subsequent principles assume this as well.

2.2 | The case in favor

The most fundamental reason speaking in favor of emissions egalitarianism is that it just seems “self-evidently fair” that people should have an equal entitlement to emit (Singer, 2010, 190, see also Gardiner, 2010, 58; Barry, 2005, 268). Everything else being equal, why should anyone be allowed to emit more than anybody else? This presumption in favor of equality is often underpinned by the following consideration: emissions entitlements can be seen as rights to use the atmosphere’s absorptive capacity. Since the atmosphere belongs to all of humanity, people’s claims to its absorptive capacity should be conceived of as equally strong. We are all said to “morally own” an equal part of the atmosphere and this ownership is reflected by the equal share of emissions entitlements we receive (Torpman, 2019, 753, see also Ott, 2010, 2012, Broome, 2012, 69; Vanderheiden, 2008, 223 but see Moellendorf, 2011, Blomfield, 2019, ch. 2; Posner & Weisbach, 2010, ch. 6 and Agarwal & Narain, 1991, 4).

The introduction of emissions egalitarianism plus emissions trading is expected to go along with a substantial transfer of wealth from wealthy high-emitters to poor low-emitters. In order not to ruin their economies, affluent countries will have to buy large quantities of permits from less affluent, low-emitting countries. This transfer of wealth can be

seen as a beneficial side-effect of emissions egalitarianism both from a utilitarian viewpoint (due to diminishing marginal utility, Torpman, 2019, 754) and for reasons of global justice (Roser & Seidel, 2017, 151).

One further thing to note is that emissions egalitarianism is not subject to a problem plaguing many other egalitarian views. By demanding that the whole emissions budget should be distributed and distributed equally, leveling down is blocked as a way to achieve the desired result.

2.3 | The case against

Principled objections to emissions egalitarianism can all be interpreted as having the following form: equal emissions entitlements may or may not be what we should strive for “everything else being equal”, but our world contains relevantly unequal features like different needs or wildly diverging past histories of pollution that emissions egalitarianism does not take into account—resulting in unfairness if it is implemented.

This criticism of emissions egalitarianism is emblematic of a more general worry about the search for a principle dealing with nothing but the just distribution of emissions entitlements. Principles like emissions egalitarianism, the worry goes, are problematically “atomist” or “isolationist” insofar as they try to identify fair distributions without taking into account other questions of climate justice or global and intergenerational justice more generally (See Caney, 2009, 2011, 2012, 2018, 2020, Bell, 2008; Roser & Seidel, 2017, 160 and Torpman, 2021, see McLaughlin, 2022 for a nuanced critique of this worry). One such “blind spot” of emissions egalitarianism is that it is not just the atmosphere, but also marine and terrestrial sinks that store the carbon from our emissions. If some countries maintain their carbon sinks better than others, should they not be awarded additional emissions entitlements? A debate around this question has begun in the last 10 years and we will review it in Section 6.2.

Another issue has resulted in arguably the most wide-ranging debate on emissions egalitarianism and concerns its initially ahistorical character. Our causal responsibilities for climate change are, to use the language of the United Nations Framework Convention on Climate Change (UNFCCC, 1992), “common but differentiated.” Those who argue in favor of the relevance of past emissions assert that ignoring these highly unequal histories of emitting when deciding how to distribute emissions entitlements would be unfair (Shue, 2015). It would be morally inadequate to treat climate change like a natural catastrophe that just happened without anybody violating any negative duties. Roughly speaking, climate change is something the Global North has done to the Global South while, on balance, benefiting from doing so (Shue, 2015, 17). Any fair distribution should reflect this and the justification underlying emissions egalitarianism does not. To the egalitarian's question “why should anyone be allowed to emit more than anyone else?” the critics respond “because some have emitted so much more in the past” (Caney, 2009, 132; Roser & Seidel, 2017, 118; Zellentini, 2015, Page, 2011, 414, Singer, 2002, 33–34; Thompson, 2017).

There is little resistance against the normative core of this line of criticism. Who caused a problem should indeed often play an important role in how to solve the problem. Accepting a less than equal emissions budget is one way historical polluters can contribute to a satisfactory response to climate change; another is to support mitigation, adaptation or addressing “loss and damage” in the Global South. A purely forward-looking emissions egalitarianism seems implausible and should only be defended on pragmatic grounds. However, there are open questions regarding the relevance of a subset of past emissions. Should countries with high historical emissions be awarded smaller future emissions entitlements even though many of these emissions were caused by people who are already dead (Berkey, 2017; Caney, 2005, 2006, 2009; Gosseries, 2004; Meyer, 2013; Meyer & Roser, 2010; Morrow, 2016; Moss & Kath, 2019; Shue, 2015)? And what about the emissions from those times when people were blamelessly ignorant concerning the harmful consequences of emitting (Bell, 2011; Butt, 2017; Caney, 2005, 2009; Gosseries, 2004; Heyd, 2017; Meyer, 2013; Meyer & Roser, 2010; Morrow, 2016; Moss & Kath, 2019; Page, 2011; Shue, 2015)?

There has been intense debate on these complications, pointing out, for example, continued benefits from past emissions as a reason for diminished future emissions entitlements or resource transfers (Baatz, 2013; Bell, 2011; Gosseries, 2004; Heyd, 2017; Lawford-Smith, 2014; Meyer, 2013; Page, 2008, 2012; Shue, 1999, 2015; Shue, 2019). But for the debate surrounding emissions egalitarianism the most important insight is this: these complications may limit the scope of history's relevance, but they are not suited to deny its relevance altogether. At least the emissions of the last three decades were emitted by non-ignorant actors who are mostly still alive (Kenehan, 2017; Moss & Kath, 2019; Roser & Seidel, 2017). Never mind whether one is convinced of the moral relevance of emissions from, say, the 1950s, there is a case for history-sensitive emissions egalitarianism.

It can be seen as a point in favor of emissions egalitarianism that it lends itself easily to such a modification: high past emissions (in the last 30 years) lead to deductions from the egalitarian baseline, low past emissions generate added emissions entitlements (Neumayer, 2000, Broome, 2012, 70). Approaches of this kind can be interpreted as endorsing an “overall” emissions egalitarianism that aims to distribute emissions entitlements equally across time. Countries with past high emissions will for a time be awarded lower emission entitlements per capita to make up for past high emissions (Torpman, 2019, 758; 2021, 363). The discussion about the role of history for a plausible version of emissions egalitarianism is emblematic for the attempt to make emissions egalitarianism less “atomist” or “isolationist”, that is, to formulate it in a way that incorporates wider considerations of climate justice or justice in general. Perhaps the single most fundamental defense of emissions egalitarianism against the charge of it being too atomist or isolationist, however, is a clarification regarding the role it should play. Torpman (2021, 372, emphasis in the original) argues that “the equal per capita view is a *local* rather than a *global* principle: It is not supposed to provide solutions to all the world's problems; it is only supposed to provide recommendations for how to distribute emissions permits.” Other principles and instruments can and should accompany it and seek to rectify the inequalities and injustices of our world, including past emissions (Batz & Ott, 2017). According to Torpman, a direct redistribution of money is a better means to address these issues because money is more easily converted into “capabilities or opportunities for well-being” (2021, 362, see also Posner & Weisbach, 2010, 4 and Torpman, 2019, 755). This reply can be interpreted as acknowledging the case for an integrated overall response to the world's problems, but maintaining that isolationist principles like emissions egalitarianism can play a part in it. For a rival approach that aims to spell out first a general theory of global, intergenerational and historical justice, and then deduce the correct allocation of emissions entitlements from it, see Caney (2012).

There is also a pragmatic case against historical emissions egalitarianism: the consequences of implementing it will be so burdensome for past high emitters as to make it unfeasible. High-emitting countries will never agree to it (Posner & Weisbach, 2010, 122, also Margalioth & Rudich, 2013, 194). It is admitted that emissions egalitarianism plus trading is less radical than emissions egalitarianism without trading (Gardiner, 2010, 59; Singer, 2010, 196), but the vast money transfers the former will go along with, the very feature highlighted as an advantage in terms of fairness, will never be accepted by high-emitting countries. There may thus be a pragmatic reason to favor emissions egalitarianism in its ahistorical form (Singer, 2010, 195). Furthermore, whether vast money transfers really decrease global injustice strongly depends on how such a scheme is designed and implemented.

3 | EMISSIONS SUFFICIENTARIANISM

3.1 | The view

The core view of emissions sufficientarianism can be described as follows:

A distribution of emission entitlements is fair only if everyone has a sufficiently large emissions budget.

All theories that can be classified as sufficientarianism about the fair distribution of emissions entitlements can be seen as subscribing to this formula. One thing to point out right away is that emissions sufficientarianism typically stops short of saying that everyone having enough emissions is also sufficient for a fair distribution of emissions entitlements. Questions of fairness arise even if everyone can emit enough.

What is called the “negative thesis” (Shields, 2020, 2) of sufficientarianism—that nothing but reaching the threshold of sufficiency matters from the viewpoint of justice—is, to our knowledge, a position that no one in the debate takes up in relation to distributing emissions entitlements. The demand that everyone should have enough emissions entitlements can thus be seen as a minimum requirement within a potentially more complex pluralist theory (Shields, 2020, 5; Roser & Seidel, 2017, 72–73; Vanderheiden, 2008, 226–227; Caney, 2009, 138; McLaughlin, 2019, 263; Grasso, 2012, 675).

A major source of differences between sufficientarian views lies in the fact that they can utilize vastly different thresholds of sufficiency. In practice, however, most of the proposals specifically referring to the question of emissions entitlements converge on some minimally decent standard of living as a threshold, if a threshold is specified at all (Shue, 1993; Caney, 2009, 139; Rao & Baer, 2012; Baer et al., 2010; Roser & Seidel, 2017, 70–71; Blomfield, 2019, ch. 8). Moellendorf provides an exception by arguing for a right to sustainable development until a “high” level of development according to the standards set by the United Nations Development Program is reached (2014, 135). However, even those views employing a relatively low threshold of sufficiency will in practice exhibit at least some egalitarian

tendencies because they will justify redistributions from those who have plenty to those who have too little (Caney, 2012, 263; Hayward, 2007, 450; Grasso, 2012, 672).

Within climate ethics, the historically most important reference to sufficiency is not a full-blown theory of distributing emissions fairly, but a conceptual distinction: Agarwal and Narain's (1991) and, building on their work, Shue's (1993) distinction between luxury emissions and subsistence emissions. The idea behind this distinction is the sufficientarian thought that it would be unfair for people not to have sufficient emissions for their subsistence while others may emit for luxury purposes (Shue, 1993, 56).

Finally, it must be noted that emissions sufficientarianism in and of itself provides no guidance on how to deal with cases in which not everyone can reach the threshold of sufficiency. What if there is so little to distribute that not everybody can have enough? Additional principles must be consulted in such cases, emphasizing the point that emissions sufficientarianism is best understood as a principle within a more complex pluralistic view on distributing emissions entitlements justly (Meyer & Roser, 2006, 235; Crisp, 2003, 757).

3.2 | The case in favor

Sufficientarianism in general and emissions sufficientarianism in particular can be seen as expressions of the underlying idea that the fate of badly-off people is of supreme moral importance (Meyer & Roser, 2006, 235). This thought, which is then expressed in the principle that “no one should need to forsake or be kept from attaining the emissions necessary for a minimally decent life while others emit for mere wants” is indeed a plausible one. No other view expresses it as clearly and directly as emissions sufficientarianism. This speaks in favor of the view.

What also speaks in favor of emissions sufficientarianism is that it can accommodate the fact that people have unequal needs for emissions (Caney, 2012, 264). Some people need substantial amounts of fuel for heating their homes, others could reach the sufficiency threshold on a very tight emissions budget. Emissions sufficientarianism does not demand that all of these people are allowed to emit the same. It is egalitarian only in an arguably more plausible way: everyone should at least reach the same threshold of sufficiency. How many emissions people need in order to do so can vary, and that need not be unjust.

3.3 | The case against

Most arguments against emissions sufficientarianism come in one of three forms: those identifying problems with the placement of the sufficiency threshold, those identifying problems with the very existence of the sufficiency threshold, and those pointing out the harmfulness of acting in accordance with specific variants of sufficientarianism. The first kind of criticism begins by reminding us of the great moral importance sufficientarianism attaches to the idea of a threshold of sufficiency. All sufficientarian views make the claim that a morally important “shift” (Shields, 2020, 2) happens once people reach the threshold. Given such prominence, a good justification must be given for the exact placement of the threshold or else sufficientarianism will fall prey to a problematic form of arbitrariness. The criticism states that no such justification can be given (Meyer & Roser, 2006, 236).

The second argument against emissions sufficientarianism is even more general: never mind where the threshold is placed, the very use of a threshold leads to implausible results. Meyer and Roser, for example, ask: “What if we had to choose [between] helping one person just below the threshold a tiny bit and helping millions of people just slightly above the threshold tremendously?” (Meyer & Roser, 2006, 236). It should be noted that sufficientarianism, just like many other nonutilitarian principles, might be most charitably interpreted as allowing for exceptions when dealing with cases in which very few are pitted against a great number of people. But the underlying point remains relevant: “our moral intuitions seem to exhibit a certain continuity, while sufficientarianism wants them to exhibit a strict kink at a certain point.” (Meyer & Roser, 2006, 236) There is a shift in the theory, but not in our intuitions, and that, the argument goes, leads to problematic results if we deal with people just above and just below the threshold.

One response that can be given to both these criticisms is that some currencies of justice naturally exhibit these kind of cut-off points (Shields, 2020, 3). Applied to the case of emissions distribution, one can argue that, for example, applying a threshold based on human rights or on Rao and Baer's conception of a “decent living standard” that includes access to “food, shelter, safe water and sanitation, health care, education, transportation, clothing, refrigeration, television and mobile phones” (2012, 657) is in line with our intuitions. We might still care about the justice of distributing

emissions entitlements not necessary for guaranteeing human rights or achieving a decent living standard, but there is a shift in relevance precisely at the point where these things are guaranteed. Furthermore, while it is indeed true that linking such a level of “personal sufficiency” to any level of emissions will remain difficult (Page, 2013, 236), a best effort to name such a point need not be arbitrary in any problematic sense (Shields, 2020, 3).

The third form of criticism can be understood not as an attempt to criticize emissions sufficientarianism as a whole but rather as an attempt to find its best sub-form. It starts with the observation that there is a tension “between measures to support sustainable development and measures to control climate change” (Shue, 2019, 251). Helping people to emit more so that they can reach the threshold of sufficiency may be a noble goal, but these extra emissions are bound to worsen climate change, thereby harming people. Defenders of emissions sufficientarianism have responded to this problem by emphasizing a duty on the side of developed nations to help those below the threshold of sufficiency to reach the threshold without having to emit more (Hayward, 2007, 441; Shue, 2019, 258; McLaughlin, 2020). “The Global North should provide free solar panels for the Global South” is thus the kind of slogan sufficientarians should embrace, not “the Global South should build more coal power plants.” Fittingly, recent research suggests that alleviating global poverty can be done with only very modest additional emissions (Bruckner et al., 2022).

4 | EMISSIONS GRANDFATHERING

4.1 | The view

Emissions grandfathering is the name of a family of proposals to distribute the emissions budget based on past emissions. What these proposals have in common is the view that:

Higher emissions in the past are a reason to award higher entitlements to future emissions.

Grandfathering can thus be understood as having the spirit of a direct inversion of the Polluter Pays Principle (Caney, 2011, 88). The latter holds that past emissions should lead to greater disadvantages in the fight against climate change, while grandfathering grants a specific form of advantage based on past emissions (Roser & Seidel, 2017, 118). Arguments in favor of grandfathering are usually either based on pragmatic considerations of political feasibility, because it might allow agreements in international climate negotiations that include high emitting countries, or on economic efficiency, whereas opposing arguments are based on distributive justice (Gosseries, 2005, 297, Caney, 2011, 88, Moellendorf, 2012, 137). We begin with the presentation of fundamental normative objections to grandfathering, followed by a review of arguments in its favor.

4.2 | The case against

It is a highly controversial view that past high emitters are entitled to high emissions in the future just because they caused high emissions in the past (Moellendorf, 2015, 177). Grandfathering is thus typically rejected as unjust. A particular criticism of grandfathering is that it rewards high emitters who did cause the problem of climate change with undeserved privileges and that it even compounds this injustice, as it contradicts egalitarian approaches to global justice (Caney, 2009, 128, Hayward, 2012, 843, Moellendorf, 2012, 137, Dooley et al., 2021, 301). A similar objection is that grandfathering perpetuates the historical injustices of colonial natural resource governance with regard to the use of greenhouse gas sinks (Blomfield, 2015). And finally, grandfathering is criticized because it locks developing countries into continuing poverty and underdevelopment and keeps them from functioning properly, as grandfathering ignores their need for an adequate amount of emissions (Caney, 2009, 128, 2011, 88).

4.3 | The case in favor

Generally speaking, philosophers do not defend grandfathering as an ideal principle to distribute emission entitlements. But scholars have recently begun to provide reasons in favor of a temporally qualified version of grandfathering. Some scholars support temporary grandfathering as part of an overall pluralistic view until a state of overall low emissions is

reached. The first prominent argument for temporary grandfathering is based on an analogy between Lockean appropriation of land and the appropriation of the absorptive capacity of the atmosphere (Bovens, 2011). Since there was a time when investments causing high emissions did not violate the enough-and-as-good condition of the Lockean Proviso, these previous investments should have moral weight in the distribution of the emissions budget today (Bovens, 2011, 134). This argument for temporary grandfathering has been rejected on the grounds that industrialized countries did not acquire emission entitlements in virtue of Lockean principles, as the enough-and-as-good condition was already violated in the early process of industrialization, given the very long time periods until the atmosphere recovers to absorb new greenhouse gases without thereby causing dangerous climate change (Schüssler, 2017, 147–150).

The second reason for temporary grandfathering is based on a broadly egalitarian view that declares equal losses in welfare to be fair in relation to climate change mitigation. Since the costs of mitigation during the transition to a lower level of emissions are higher for historical high emitters as their infrastructure has to change substantially to cause lower emission, these emitters should, at least on a temporary basis, be granted higher emission levels or else they will have to bear relatively larger losses in welfare (Knight, 2014, 571). This argument has been criticized as unjust because equal losses are simply not a just aim given the persistent background inequality in terms of capacities, needs and vulnerabilities (Dooley et al., 2021, 301). According to a second version of an egalitarian argument for temporary grandfathering, it came as a surprise to the Global North to learn around 1990 that their lifestyle causes dangerous anthropogenic climate change. To stop harmful emissions requires a massive societal and economic transformation involving huge burdens. Since this is a form of bad brute luck for which citizens of the Global North are not to blame, negative consequences of reducing emissions should be buffered for those people by temporarily providing them with additional emissions when developing a sustainable way of life (Schüssler, 2017, 157, 162). However, knowledge about anthropogenic climate change built up over several decades, starting in 1958 with Keeling's measure of atmospheric CO₂ concentrations and the publication of a number of scientific reports in the 1960s and 1970s (Anderson et al., 2017; Frumhoff et al., 2015; Mulvey et al., 2015). As most decision-makers in the Global North ignored, downplayed or ridiculed repetitive calls for mitigation measures in the 1980s and 1990s, the narrative that knowledge about the need for mitigation came as a surprise seems unconvincing.

The third reason for temporary grandfathering is based on legitimate expectations. People living in high emitting countries might have chosen life plans that depend on future high emissions, which are frustrated by a rapid shift to a low emission regime, thereby causing significant harm to these people (Meyer & Sanklecha, 2014, 369). One possible response is that such an approach also needs to feature the life plans of potential climate change victims. Very generally speaking, the harm associated with climate change impacts seem weightier than the harm—or drawbacks—associated with rapid decarbonization scenarios currently under discussion. (A structurally similar response can also be given to the previous argument about bad luck, see Gosseries, 2005, 307.)

In addition to the substantial reasons for temporary grandfathering discussed above, reasons due to practicability or political feasibility can also be seen as favoring temporary grandfathering. Temporary grandfathering might increase the likelihood of an agreement in international climate negotiations by accepting an ongoing entitlement of some states to high emissions (Moellendorf, 2012, 137). Better a climate treaty with grandfathering that is successful in at least slowing global warming because it has the support of the Global North than no climate treaty at all, the argument goes. Indeed, the combination of temporary grandfathering with emissions egalitarianism (as exemplified in the concept of Contraction and Convergence; Meyer, 1999) was a popular concept for many years, showing the right balance between being sufficiently feasible and just (Ott, 2021).

5 | NON-COMPLIANCE

So-called non-compliers exceed their entitlements implied by the principles on how to justly distribute the remaining emissions budget discussed above. An important question debated in the literature is whether non-compliance changes the entitlements of the compliers, that is those who did not overstep their initial emissions budgets. Say we assume emissions sufficientarianism, and face a situation in which the emissions budget is only big enough for everyone to just reach the threshold of sufficiency. If some non-compliers emit more than what is necessary to reach the threshold, are those that complied so far under a duty to emit even less and hence not even reach the threshold of sufficiency? Or do their entitlements remain unaffected? Situations of non-compliance are imaginable for all the principles discussed so far.

Opponents of such a duty to take up the slack point to the obvious unfairness vis-à-vis compliers (Cohen, 1981; Miller, 2011; Murphy, 2003). As fair shares of the overall emissions budgets will be comparatively small (See Section 2), meeting these will often be burdensome. In a situation of partial non-compliance, we already face an unfair situation where compliers shoulder much greater burdens than non-compliers. Further increasing this unfairness seems plainly wrong.

Proponents of a duty to take up the slack acknowledge the unfairness vis-à-vis the non-compliers but argue that it is outweighed by the duties of the compliers vis-à-vis the potential victims of climate change (Karnein, 2014). Scholars ground slack-taking duties in anticipated human rights violations (Hohl & Roser, 2011, 498), entitlements of people in dire need to be helped (Stemplowska, 2016, 596), or at least not to disregard their legitimate interests by letting them suffer from effects of climate change (Caney, 2005, 772). These potential moral wrongs justify even the high psychological costs of meeting strenuous moral requirements when others fail to do so (Stemplowska, 2016, 597). What seems in any case plausible is that the unfairness of slack-taking depends on the severity of the extra burdens compliers must bear. If slack-taking compliers can maintain a relatively high quality of life, the unfairness toward them seems easier to justify than when extra burdens push them below the threshold of sufficiency, like they do in our opening example.

A more practical objection points to the potential effectiveness of taking up the slack. If compliers make up for the mitigation failure of non-compliers, non-compliers might rely on the increased efforts of compliers and maintain or even increase their emissions levels. Slack-taking might thus incentivize non-compliers to comply even less (Hohl & Roser, 2011, 488). But if non-compliers do not (sufficiently) care about climate change or if their concern for the benefits of emissions dominates their reasons to act, the emissions levels of others are of little or no relevance to how much they emit. From a practical perspective, the question rather seems to be how relevant the debate on slack taking is at all. For it presupposes that there is a relevant number of agents that, first, stick to their fair share and, second, have such a high quality of life that it seems not wholly implausible to claim that they are morally required to do even more. And it is far from clear that such agents exist at present (Baatz, 2014). Other options to deal with non-compliance are therefore discussed (Caney, 2016): for example, what further efforts could be undertaken to make non-compliers comply and whether the victims of non-compliance are allowed to shift burdens onto non-compliers by means often thought to be illegitimate such as theft.

6 | ACCOUNTING FOR EMISSIONS

Having critically discussed three principles to distribute the emissions budget—emissions egalitarianism, emissions sufficientarianism and grandfathering—we will now turn to an issue that arises once we aim to actually apply them. If we want to know whether an actor complies with their budget, we need to know which emissions should be attributed to this actor. The attribution of emissions to a certain state, company or individual is not always obvious. We focus on three complexities. Two of these mainly arise if we ask which emissions should be attributed to what country: accounting for emissions based on production or consumption (Section 6.1) and accounting for carbon sinks (Section 6.2). A further complexity refers to individuals, namely how to divide emissions between parents and children given that the parents' decision to procreate causes additional emissions (Section 6.3).

6.1 | Production- and consumption-based accounting

In order to determine how much a country emits, different accounting methods are available. In the following we discuss the two most prominent approaches: production-based and consumption-based. In climate policy, the production-based approach dominates as it is employed in the guidelines of the IPCC, which are in turn used by the UNFCCC. According to production-based accounting, all greenhouse gases emitted within a country, and only those, count as that country's emissions (Rypdal et al., 2006, p. 1.4). The country that exports products is required to account for the emissions that are generated by producing the good and transporting it within its borders whereas emissions that are generated by using the final product have to be accounted for by the country where consumption takes place (Moss, 2015, 75). The accounting approach most diametrically opposed to production-based accounting is consumption-based accounting, where emissions have to be reported by the country where goods and services are consumed (Duus-Otterström & Hjorthen, 2018, 866). In a globalized economy, it will frequently be the case that the country of production is not the country of consumption. Why should one shift from production-based to consumption-based accounting?

Two criteria by which to assess accounting methods are commonly proposed: environmental effectiveness and justice (Duus-Otterström & Hjorthen, 2018; Steininger, Lininger, Droege, et al., 2015).

The criterion of environmental effectiveness is ultimately concerned with the question of how helpful these accounting approaches are in reducing emissions. One might think that the choice of accounting method has no impact on the overall volume of emissions reductions. But in a world in which countries have unequally stringent climate regulations that need not be true. This becomes evident if we consider carbon leakage, where efforts by one country to reduce “their” emissions lead to a shift of production to another country with less stringent regulations. Production-based accounting in particular has been seen as more vulnerable to this phenomenon than consumption-based accounting because production tends to be more mobile than consumption. However, whether this theoretical advantage of consumption-based accounting really translates into higher overall effectiveness under real-world conditions is said to be unclear (Duus-Otterström & Hjorthen, 2018, 871). We highlight two complexities: first, it is thought that consumption-based accounting will make producing countries reduce emissions even if they lack climate regulations themselves. After all, countries in which consumption takes place have an interest in low-carbon production. However, if the producing countries have no access to clean technologies, this supposed advantage of production-based accounting will fail to materialize (Steininger, Lininger, Droege, et al., 2015, 82). Second, and even more fundamentally, the additional burdens for developed nations with lots of consumption might be “a recipe for political deadlock” (Duus-Otterström & Hjorthen, 2018, 871), thus endangering overall progress on climate policy.

Scholars also discuss whether the shift from production- to consumption-based accounting can be justified based on principles of justice. However, the principle that those who contributed to the problem should bear the burden of dealing with its negative consequences is neither here nor there when it comes to these two accounting methods: There seems to be agreement that producers and consumers jointly bear causal and moral responsibility for the emissions that are associated with the creation (and use) of a good (Roser & Tomlinson, 2014, 238, Steininger, Lininger, Droege, et al., 2015, 79, Duus-Otterström & Hjorthen, 2018, 876). Neither do other prominent principles of justice favor a specific accounting method. Receiving benefits may provide a justification for a responsibility to bear burdens, but both consumers and producers benefit from the production of the good. The stance of a principle justifying greater responsibilities to bear burdens based on the sheer ability to pay for climate change is not obvious either. Our world is one with rich and poor producers and rich and poor consumers (Duus-Otterström & Hjorthen, 2018, 877–8).

Two further candidates for the accounting and reporting of emissions are the extraction-based and the income-based approach. The former pertains to the extraction of fossil fuels, where exporting countries are required to account for at least some of the emissions of the exported fossil fuels within their national emissions budget. This is to reflect the exporting countries' complicity in causing harmful climate change (Moss, 2019, 267). The income-based approach attributes emissions based on the proportion of the value added during production in the supply chain by using capital or labor (Steininger, Lininger, Meyer, et al., 2015, 35).

6.2 | Accounting for terrestrial sinks

The case in favor of emissions egalitarianism in particular (See Section 2) often begins with the premise that the good we distribute when we distribute emissions entitlements is the atmospheric capacity to absorb greenhouse gases. This premise is false (Blomfield, 2013, 2019). The atmosphere assimilated 41% of anthropogenic emissions from 1750 to 2019, whereas oceans assimilated 25% and terrestrial sinks assimilated 34% (Canadell et al., 2021, 5–34). As the oceans and terrestrial sinks also absorb greenhouse gases, there seems to no reason to ignore them. Furthermore, unlike in the case of the atmosphere, the further claim underlying emissions egalitarianism, that no one has a special claim to these sinks, is not obviously true for some of these sinks. Let us say, we endorse emissions egalitarianism and consider, for example, Brazil with its substantial carbon-sequestration capacity of the Amazon rainforest. Now the questions is whether Brazil has any special claims to the carbon-sequestration capacity of its sinks. And if so, should these special claims not be attributed to them and only to them?

It might be argued that atmospheric and oceanic sinks should be distributed equally, but that countries with terrestrial sinks within their territory should be allowed to deduct the sequestration capacity of their local sinks from their country's emissions (Agarwal & Narain, 1991), resulting in additional entitlements to emit greenhouse gases. This is in line with the principle of natural resource sovereignty, which is supported by political theory and international law, which says that the people of a territory have a justified exclusive claim to the natural resources within that territory (discussed in Blomfield, 2019, 34, see also Armstrong, 2017). Due to the fact that others cannot be excluded from the

use of domestic terrestrial sinks (you cannot stop the Brazilian rainforest from sequestering non-Brazilian emissions), use rights of terrestrial sinks would not imply an actual exclusive use right for these specific domestic terrestrial sinks, but a claim to emit additional greenhouse gases in line with the sequestering capacity of the domestic terrestrial sink (Vanderheiden, 2016, 2). Note that such arguments might likewise apply to oceanic sinks within a country's jurisdiction.

Arguments in favor of additional emissions entitlements for countries maintaining terrestrial sinks are based on attachment, self-determination, improvement, or reimbursement (Armstrong, 2015; Blomfield, 2013; Heyward & Lenzi, 2022; Vanderheiden, 2016). The attachment argument justifies a claim on terrestrial sinks as persons living in an area have a natural attachment to this place. The argument of self-determination claims that protecting terrestrial sinks is a form of collective self-determination. And, the typically Lockean improvement argument proposes that persons improving terrestrial sinks with their labor should have a claim on the increased sequestration capacity. However, it has been argued that while attachment to, say, a forest may generate special rights to access and use it, it is unclear why it should ground the right to exclusively benefit from its function as a carbon sink (Armstrong, 2015, 64; Heyward & Lenzi, 2022, 4). Similarly, self-determination should not be seen as a source of unlimited rights over the resources within one's borders, but only justifying those rights necessary for upholding said self-determination. Extra carbon credits gained by local carbon sinks will frequently fail to pass this test (Armstrong, 2015, 65). And as for improvement, most carbon sinks are naturally occurring and are thus not improved in any relevant sense. The relevance of the argument from improvement is therefore said to be marginal at the current time, but might increase when man-made carbon dioxide removal measures become more widespread (Armstrong, 2015, 66–68).

This leaves us with one further argument in favor of additional emissions entitlements: the one from reimbursement. Carbon sinks are frequently natural resources not just because of their carbon sequestration potential but for other reasons as well. Forests, for example, are resources because of the wood one could harvest. Doing so could, however, conflict with their carbon sink function. Because we think countries should forgo exploiting these resources in ways that conflict with their function as carbon sinks, there is a case for reimbursing them for this restriction on the use of resources located within their territory. Unlike with many other natural resources, they should not exploit them as they wish because of their relevance for us all. Additional emission entitlements are one way to reimburse them for this (Armstrong, 2015, 69; Vanderheiden, 2016). However, if reimbursements for foregone resource exploitation really are warranted, countries like Saudi-Arabia, should they opt to keep their oil in the ground, would qualify as recipients of such reimbursements. It seems doubtful whether paying these countries not to further contribute to climate change is morally warranted (see Broome, 2016 for the case that it might be the lesser evil). It might thus be reasonable to name further conditions for reimbursements, like poverty of the recipient or the existence of highly important additional benefits like biodiversity protection.

In closing, we want to highlight one further complexity: some terrestrial sinks, like the aforementioned Amazon rainforest, due to climate change no longer sequester more carbon than they emit, turning from a sink into a source (Gatti et al., 2021). But of course, they continue to hold massive (if shrinking) amounts of carbon—thanks to their maintenance or at least nonexploitation. The moral relevance of this situation should be discussed.

6.3 | Procreation and the emissions budget

What is uncontroversial is that adding new people to the planet will (for the time being) go along with additional emissions. Empirically, the amount of additional emissions due to an intercontinental flight or a long car drive are dwarfed by the emissions caused by the existence of an additional person (at least if this person lives in an industrialized country, see Young, 2001, 185; Jamieson, 2008, 189; Murtaugh & Schlax, 2009; Wynes & Nicholas, 2017). Based on this insight a debate has emerged on the morality of causing additional emissions through procreation and whether emissions of children should, at least partially, be subtracted from the emissions budget of their parents. If they should, parents would, for example, in practice have less than equal emissions budgets left for themselves under emissions egalitarianism, because some of their budgets would have to be used to account for some of the emissions of their children.

At the center of the discussion stands the “Moral Equivalence Thesis” (MET) (Young, 2001, MacIver, 2015, Burkett, 2021, Heyward, 2012 introduced the term). It states that voluntarily procreating is in a relevant sense morally equivalent to “eco-gluttony” (Young, 2001, 163), that is excessive consumption resulting in high emissions. The climate impact of emissions due to excessive consumption or procreation is (by definition) the same, and there are no

conclusive normative reasons for allowing one but not the other (Young, 2001, 186–189; MacIver, 2015, 114). And if additional emissions that result from procreation are morally equivalent to emissions from excessive consumption, they should come from the parents' emissions budget, just like emissions from excessive consumption do, the reasoning continues. Should the emissions budget of the parents not be large enough to accommodate their children's emissions, having children will typically be morally impermissible (Burkett, 2021; MacIver, 2015; Young, 2001).

Critics of the MET have tried to show that there are indeed reasons to treat procreation and consumption differently. First, whereas excessive consumption is a mere preference, procreative parenting is a valuable capability. This is said to make a moral difference. (Robeyns, 2022, 12–14). Second, and once again unlike excessive consumption, the “possibility of having and raising children is a universal and very deep aspect of our self-understanding [as humans]” (Robeyns, 2022, 15). One challenge for both arguments is whether they justify having more than one child (Conly, 2016). A practical problem is that accounting for children's emissions by subtracting them from their parents' emissions budget risks double counting (Pinkert & Sticker, 2021). Double counting occurs if the children's emissions are subtracted from both the children's budget and the budget of their parents. Possible responses to this problem are that children's emissions count as their parents' only if they are subsistence emissions or only as long as they happen before the children have become adults (MacIver, 2015, van Basshuysen, 2018, for rebuttals see Pinkert & Sticker, 2021, 303).

Authors questioning an unlimited right to procreation challenge their critics with the question of how they can reconcile their appreciation of parenting and children with the potentially disastrous future effects of additional emissions on precisely these things: future parents and future children threatened by climate change, fuelled, at least in part, by emissions created by those future children (MacIver, 2015, 121; Burkett, 2021, 798; Gheaus, 2016, 488). What should be far less controversial is the moral case to “make the kind of social investment necessary to try to accommodate any population growth without increasing [...] emissions” (Heyward, 2012, 720, emphasis removed). But, as Cripps points out, simply trusting that doing so will be sufficient, is a morally problematic gamble (2017, 30). How high the stakes in this gamble are has recently been questioned, though: total global population would increase even if the fertility rate were to drop from higher levels to replacement levels. Hence population policies would have only a limited effect on population size and expected levels of warming in the near-term future (Budolfson & Spears, 2021). What the debate on how to account for emissions due to procreation, and whether climate change might give us reasons to restrict procreative freedom, has in any case shown is that when it comes to our reaction to climate change, we are past the point where we can go without having to make any hard choices (Cripps, 2015).

7 | CONCLUSION

In summary, one can say that the debate on the just distribution of emissions entitlements has in the last 10 years focused on identifying and assessing the complexities involved in applying existing principles. Three prominent issues in the debate were the status and relevance of historical emissions, the plausibility of emissions egalitarianism, and the relevance of unevenly distributed greenhouse gas sinks.

We began this paper by defending the continued relevance of discussing the fair distribution of emissions entitlements. Even if, on the political level, we no longer search for a single principle on how to distribute emissions entitlements, Nationally Determined Contributions (NDCs) can and should still be subjected to moral criticism. What should be beyond doubt is that the debate must take into consideration developments both of climate change itself and of climate politics to retain its relevance.

In closing we want to highlight some of these developments: we are already witnessing the early stages of dangerous climate change. Whether thinking in terms of remaining budgets of permissible emissions is still morally adequate for all types of emissions seems doubtful (Tank, 2022). The distributive justice debate should therefore put a greater emphasis on how to allocate emissions entitlements under conditions of imminent dangerous climate change. And in terms of climate politics, the shortcomings and outright failures of the post-Paris world provide reasons to engage even more strongly with the ethics of mitigating climate change under conditions of wide-spread non-compliance. What if major global players continue to refuse to do anything close to their fair share? What are the moral demands to be placed upon a global “Climate Club” (G7, 2022)? Furthermore, how do novel climate policy options regarding Carbon Dioxide Removal alter distributive questions of the *net* emissions budget (Armstrong & McLaren, 2022; Fyson et al., 2020)? Engaging with questions like these will safeguard the relevance of the debate reviewed in this paper for the decades to come.

AUTHOR CONTRIBUTIONS

Alexander Schulan: Conceptualization (supporting); investigation (lead); project administration (lead); writing – original draft (lead); writing – review and editing (supporting). **Lukas Tank:** Conceptualization (supporting); investigation (supporting); writing – original draft (lead); writing – review and editing (lead). **Christian Baatz:** Conceptualization (lead); project administration (supporting); supervision (lead); writing – original draft (supporting); writing – review and editing (supporting).

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