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Perspective

Large inequalities in climate mitigation scenarios are not supported by theories of distributive justice

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ABSTRACT

Existing global climate mitigation scenarios perpetuate large inequalities in energy and income between countries and regions for the rest of the century, and modellers have recently begun to assess these dynamics in light of distributive justice theories. However, these theories are intended to describe inequalities within nations and cannot straightforwardly be applied to inequalities between nations or world regions. Indeed, an analysis of key distributive justice theories suggests that, in contexts of international or interregional inequalities, moral justifications for inequality cannot be sustained, while arguments in favour of egalitarianism become stronger.

1. Introduction

Existing climate mitigation scenarios and models tend to be designed in such a way that they perpetuate – or only partly mitigate – the large inequalities in income, energy consumption, and resource use that currently exist between countries and world regions [1–3]. However, the ethical legitimacy of these distributional dynamics has not been adequately explored in the modelling literature, particularly at different scales, leaving important justice-related issues underscrutinised [1–3].

To address this, climate mitigation scenario modellers are beginning to engage with theories of distributive justice, which deal with the question of how advantages and burdens should be shared across populations [4]. Various theories have been applied in energy-climate models to establish inequality parameters [3]. It is important to note, however, that these theories are built upon specific moral claims related to distribution between members of a given society [5], typically individuals within a nation. By contrast, climate mitigation models typically work with nationally or regionally aggregated data [1,6], and model inequalities between countries and world regions. This presents a problem, because distributive theories may not remain valid at the international scale.

Here we assess the legitimacy of applying distributive justice theories in global climate mitigation models. But first, we offer an important disclaimer. We recognise that the point of departure for climate modellers is our current highly unequal world [7–9], and that much scenario work aims to describe probable futures, not desirable ones [3]. And we recognise that scenarios which do tend towards more just futures often have long transition periods, due to assumed feasibility constraints (e.g., SSP1 [10]). We do not aim to criticise descriptive scenarios and – because distributive justice theories tend to describe just worlds, but not a 'just' pace of change to arrive there – we do not make strong claims about the justice of transition periods. Instead, our specific aim is to analyse the validity of the moral claims underpinning distributive justice theories when applied to international inequalities. We thus highlight which theories can inform the design of scenarios that genuinely respond to appeals for global justice, and which risk bringing in a partial, or even false sense of justice. This allows us to sketch out the contours of a fully-just global scenario.

To this end, we consider six important justice theories (Table 1). These view socio-economic inequalities either as legitimate (if certain conditions are met), illegitimate (always), or unimportant (if certain conditions are met). They have been fiercely debated and none are 'correct' [5]. However, we argue that while the moral claims they use to legitimise inequalities may have some validity *within* countries, all become difficult or even impossible to sustain in the context of inequalities *between* countries (or regions). Indeed, only one of these theories – egalitarianism – strengthens when scaled up in this way.

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Table 1
List of key distributive theories with their relationship to inequalities and central moral claims [5,14,15,24–26]. The four claims legitimising inequalities that are summarised in the main text are consolidations of those indicated in the right-most column in bold text (**C1**, **C2**, etc.)

Distributive theory	Distributive principle	View on inequalities	Moral claims/ conditions
Utilitarianism	Aggregate utility across society should be maximised and whatever distribution of resources achieves this should be sought	Legitimate (conditionally)	Increasing aggregate utility (pleasure, preference-satisfaction, and/or the absence of pain) is the most important goal of societies Inequality is legitimate provided it leads to higher aggregate utility (**C3**) Economic inequalities can create incentives that increase aggregate utility (**C4**)
Egalitarianism	There should be equality of outcomes	Illegitimate (always)	All people are morally equal and hence are equally deserving
Libertarianism	Property should be acquired and transferred through just principles	Legitimate (conditionally)	Property must be acquired by just means (e.g. mixing one's labour with 'unclaimed' natural resources; **C1**) Property transfers should be free and voluntary (**C1**)
Sufficientarianism	There should be universal access to a minimum, sufficient, level of goods and services	Indifference (conditionally)	All people are entitled to a minimum standard of living Our greatest moral concern is raising those below this minimum up to it Inequalities are unimportant provided this is achieved
Prioritarianism	Advantages in society should always flow towards the least advantaged	Indifference (conditionally)	Society should always prioritise improving the situation of the least advantaged Inequalities are unimportant provided this is occurring
Meritocracy	Inequalities in society should reflect 'merit' under a condition of strict equality of opportunity	Legitimate (conditionally)	Merit is a measurable concept, and all should have equal opportunity to develop and apply theirs (**C2**) Merit should be awarded proportionally, for reasons of moral desert (**C2**) Inequalities that reflect merit create incentives that make society wealthier (**C4**)

2. Moral claims that seek to legitimise inequalities

Distributive theories that seek to legitimise socio-economic inequalities include *utilitarianism*, *libertarianism*, and *meritocracy*. Numerous arguments have been made for and against them, but below we show how the latter strengthen considerably at international/inter-regional scales.

The six theories we consider offer four 'moral claims' to legitimise socio-economic inequalities (Table 1), i.e., conditional normative claims about how resources should be distributed. These are as follows:

C1. The libertarian claim that inequalities are just if arising from property that has been acquired and transferred through just principles [5,11];
C2. the meritocratic claim that inequalities are deserved if arising from proportional compensation for aptitude and hard work, under fair equality of opportunity [12,13];
C3. the utilitarian claim that inequalities are legitimate if this maximises welfare (aggregate utility) [14];
C4. the claim by meritocratic and utilitarian economists that inequalities are just if they create incentives that increase the welfare (aggregate utility) of society [15,16].

The first claim cannot be sustained at the international level. Geopolitical factors such as the unequal power relations that shape global supply chains and trade rules, primacy of the US dollar and military, and differences in exchange rates, work together to depress prices of resources and labour in low-income countries [17,18]. This allows high-income countries to net-appropriate trillions of dollars of energy, materials, land, and labour through unequal exchange. The value of this extraction far outstrips aid disbursements from the global North to the South, and adds to that previously appropriated under colonialism and neocolonial arrangements [17]. At the global level, the principles of libertarianism have been so thoroughly violated it is left with no ability to legitimise international or inter-regional inequalities.

The second claim scales up no better than the first, for the same reasons. Indeed, the global economy works contrary to the meritocratic notion that aptitude and hard work should be rewarded equally. Manufacturing relocates to countries where workers with the same skills can be paid lower wages to work longer hours in more dangerous conditions [19]. Equality of opportunity is edging closer within some countries, but it is orders of magnitude harder to achieve at a global level, and without this, meritocracy falls flat.

The third claim also does not scale up well, as key criticisms of utilitarianism may strengthen in the context of global inter-national/-regional inequalities. First is John Rawls' criticism [20], namely that, while it may be preferable for an individual to choose to accept burdens in order to increase benefits and hence maximise the aggregate utility across their life course, this is unacceptable between the individuals of a society, as it fails to recognise the distinctness of persons. This critique strengthens when utilitarianism is focused upon large aggregations of people at global scales. Second, utilitarianism is blind to injustices [5], such as widespread racist preferences or unfair historical accumulations of resources or wealth. Globally, the latter issue is critical, as it means that utilitarianism does not recognise that many country's current utility (typically expressed in climate models via a utility function that monotonically increases with income [21]) has been gained by systematically suppressing the 'utility' of other countries, via colonisation and now more subtle forms of labour [22] and resource extraction [17].[1] By seeking solutions to maximise aggregate utility from the starting

[1] The United Nations Framework Convention on Climate Change recognises the dominant historical role of developed countries in anthropogenic warming, and hence their greater responsibility to mitigate these. But it does not recognise this broader history of exploitation.

point of current inequalities, utilitarianism fails to correct these historical (and ongoing) injustices. While this objection is also relevant within-countries, it is far more considerable at the global level, where historical injustices are greater and redistributive mechanisms much weaker. Modifying utilitarianism to include a Pareto constraint [5] prohibiting changes that make any agent worse off addresses this first critique, but at the cost of considerably strengthening the second.

The fourth claim fails to scale-up for different reasons. There is a coherence to the argument that individuals within a country may be incentivised to work harder or develop new skills by observing their colleagues receive higher incomes. But no such incentive arises when Rwanda or Cambodia looks towards Switzerland or Norway. The logic of incentives is incoherent when talking of whole countries, so international/regional inequalities cannot be legitimised by claims these incentives increase the wealth of societies.

We must note that while many climate mitigation scenarios are utilitarian, none claim to be *libertarian* or *meritocratic*. Indeed many do not state what, if any, justice principles guide them [3]. So the discussion above is intended only to determine if the large regional inequalities that are currently perpetuated in most climate scenarios [1,23] have any support under any theory of distributive justice – we suggest that they do not. Finally, we also note that economists have offered various rationalizations for global inequalities, typically meritocratic-like arguments [17]. These are not strictly theories of justice, and there are historical, empirical, and ethical reasons they cannot be deemed just. We thus consider them beyond our scope here.

3. Sufficientarianism and prioritarianism

What can be said of *sufficientarianism* [24] and *prioritarianism* [26]? These regard inequalities not as legitimate, but unimportant, proposing only just processes for responding to them [27]. They are being applied in mitigation models [3,28], but there are issues here, too.

The first issue is the claim that inequalities are unimportant. It may be reasonable to abstain from moral judgement regarding inequalities between people within countries, instead leaving this for democratic societies to decide upon. People generally prefer some level of inequality[2] and will turn to various intuitions (meritocratic, libertarian, or utilitarian) to explain why [29,30]. But given the lack of *any* moral basis for inequalities between countries, this indifference becomes far more problematic. Second, planetary boundaries [32–34] such as climate change imply global limits on energy use, consumption and economic activity, so if the situation of the least advantaged is to be improved, inequalities must be considered.

This second issue is being addressed by the reinterpretation of sufficientarianism in environmental sciences literature, and it's expansion by some sufficientarian philosophers [35]. Traditionally, philosophical sufficientarianism literature has been concerned only with minimum thresholds that all should be raised to [24], while its 'negative thesis' claims that no distributional concerns exist beyond raising all to these minimum levels [27]. But environmental scientists have combined minimum thresholds with upper thresholds that no one needs to go beyond, as benefits for wellbeing are marginal (while environmental impacts are not). This suggests that thresholds are something people both below *and above* can move towards [36,37]. This is better referred to as *sufficiency*, and it allows sufficientarianism to be translated into contexts of planetary boundaries and consumption corridors [37,38], thus potentially addressing wellbeing shortfalls, planetary boundary overshoot, and intergenerational justice simultaneously (although intergenerational justice is beyond our scope here).

However, when sufficiency is applied in existing nationally- or regionally-averaged models, major justice concerns remain, and addressing these with sufficiency will require new modelling methodologies to be developed. Specifically, if a low-income country is allocated sufficient per-capita energy or material use [39–41] in a model, this does not mean all reach sufficiency. This is partly as within-country inequalities [7,42] put many well below the national average and hence below the sufficiency threshold, and also because unequal exchange leaves many countries net exporters of energy and materials [17,18] (see Fig. 1a). Therefore, if sufficiency thresholds defined at regional-levels are to be meaningful, they must account for subregional inequalities [43,44] and international trade in energy and resources.

Most importantly, however, when a sufficiency floor for energy use is applied in existing, regionally-averaged mitigation models, the danger is that poorer regions are placed at this floor, and richer ones at much higher consumption-levels determined by global carbon budget constraints, or simply business-as-usual growth [1,45]. This may represent an improvement in living standards for today's poorest, and it may also be 'sustainable'. But placing entire poor nations at basic sufficiency levels, while the rich nations historically most responsible for emissions consume an order of magnitude more goods and services [1], is the least fair manifestation of a consumption corridor imaginable. It leaves a considerable gap between the living standards of the global North and South, not due to any principle of justice, but simply as that gap exists today [23].

4. Egalitarianism

This leaves egalitarianism [5]. If we take this as advocating equality in living standards (rather than equal levels of consumption, or equality of opportunity), then this scales-up perfectly to inter-national/-regional levels. The egalitarian moral claim that all individuals are morally equal, which we interpret here as being entitled to the same quality of life, is if anything *more* convincing when applied to large groups of people. Consider that when an individual commits, say, a violent crime, even egalitarians may believe it acceptable for their living standards to be reduced at least temporarily. But such logic cannot be applied to entire countries or regions – indeed, this may constitute the crime of collective punishment. One could also argue that between countries, meritocracy tends to egalitarianism, as individual differences in 'merit' average out over large groups.

Overall, while strict egalitarianism between all individuals of a country is an unpopular proposition [29], it is arguably the most legitimate and practical principle of distributive justice when applied to large groups.

5. Inequalities within countries

Within countries, arguments about what distributive theories are most legitimate are far messier. On the one hand, many of the arguments made above against international inequalities apply also to subnational inequalities (due to social class, inherited wealth, etc.). On the other, arguments in favour of meritocracy, sufficientarianism, and other theories are stronger and more coherent sub-nationally. Our argument, therefore, is that while egalitarianism appears the most just theory in the context of international distributions, legitimate debates can be had over many distributive theories – both in favour and against inequality – regarding within-country inequalities.

Indeed, within-countries, egalitarianism may be too strict. Most people prefer 'fair' levels of inequality to equality [29], and many support the existence of a minimum living standard [46]. The levels of inequality people consider fair (on average) vary considerably across countries [47] and the underlying reasoning includes a mix of theoretical ideas – most commonly meritocratic-desert, but also utilitarian-

[2] Note, however, that the levels of inequality considered 'fair' vary dramatically across cultures [31].

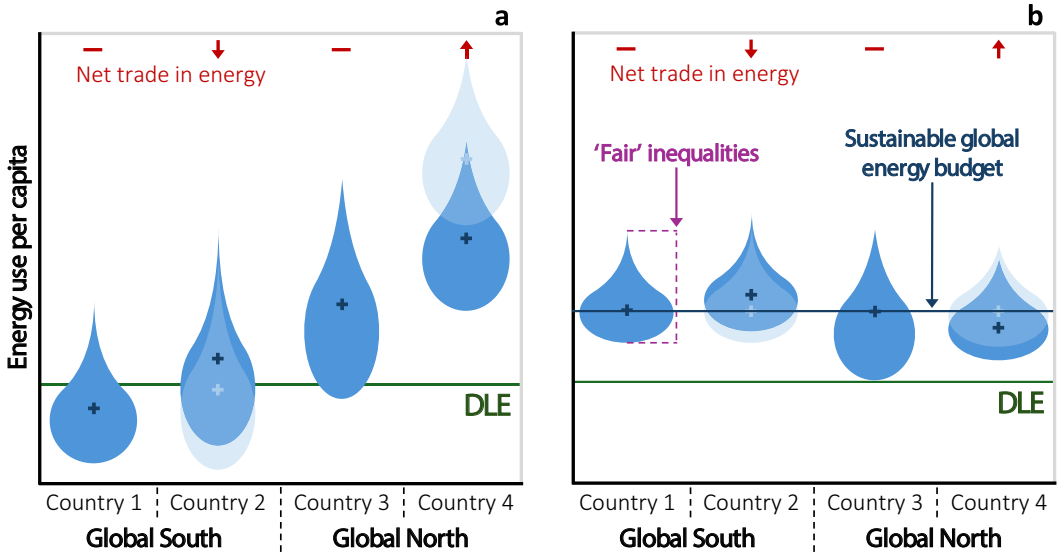

Fig. 1. Illustrations of the final energy use distributions within four stylised countries, (a) currently and (b) in a 'fully distributionally just' future scenario. Teardrops indicate the distribution of energy consumption, with the width illustrating the proportion of the population at each level and the crosses the mean consumption. Darker blue teardrops are for territorial energy and lighter drops show the shift when unequal exchange is accounted for (for simplicity, only countries 2 & 4 are shown to have an imbalance). A *decent living energy* threshold is shown, but note that in practice these vary across countries and through time [39]. The fully just scenario assumes convergence of nationally-averaged per-capita energy use adjusted for net trade (i.e. energy footprints), and within-country inequalities are reduced to 'fair' levels while also ensuring all are above a minimum threshold. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

efficiency [30,48].[3] People's notions of fairness may also be motivated to justify existing levels of inequality [49], although this is limited by endemic misperceptions of inequality [50]. In any case, the existing literature suggests that, across many countries, people's 'ideal' levels of inequality are an order of magnitude or more lower than current levels [47].

One may ask at this point why, when discussing sub-national inequalities, we have pivoted from theories of distributive justice to surveys of public values. We have done so precisely because there is no 'correct' theory to apply. In many countries, however, there are democratic processes (albeit far from perfect ones) for influencing inequalities. So for modellers aiming to build justice into their scenarios, we suggest the most appropriate approach is to prescribe 'fair' within-country distributions that well-functioning democracies would, hypothetically, arrive at – distributions that should be consistent with public ideals. Note that this highlights a further ethical justification for within-country inequalities that cannot be applied between-countries: Within democratic countries, people can influence rules regarding welfare, minimum wages, and income and wealth taxes, and they are (theoretically) free to move to regions where wages are higher. Globally, however, such processes and freedom of movement are unavailable.

6. Towards a fully just scenario

All this considered, we argue that a fully just climate scenario should be nothing less than egalitarian at aggregate levels, reaching full convergence in average living standards between countries and regions. Meritocratic, utilitarian, and libertarian theories cannot reasonably be used to justify international inequalities, although prioritarianism could be a useful principle for guiding a transition period towards international egalitarianism. Within countries, energy inequality should be consistent with public notions of fairness and the principles of sufficiency – the distribution should be bounded by a floor that provides enough energy use to meet human needs, and total energy use should be consistent with global sustainability. Note that, to be 'fully just' in a more holistic sense would require other forms of justice to also be considered – procedural and corrective justice, for example [3]. Therefore, the following is more accurately understood as a 'fully distributionally just' scenario.

In energy-climate models, per-capita final energy use could act as a useful proxy for living standards. Final energy convergence is preferable to convergence in primary energy or carbon emissions, as it is closer to measuring the goods and services that directly support human wellbeing [39].[4] In practice – and despite our arguments above regarding international egalitarianism – countries may require different levels of energy use to meet the same living standards,[5] and sectoral energy use may show larger variations. These differences can be minimised if advanced technologies are available to all [51] so we put them aside below, but their practical relevance should be noted.

Implementing the fully distributionally just global scenario we have outlined thus has four key requirements (Fig. 1b), in addition to country-

[3] Note that a notion of 'fair' international inequality could theoretically emerge from a similar survey approach undertaken internationally. Our view is that, while the meritocratic, utilitarian, and/or libertarian intuitions that underpin public notions of fair inequality may be legitimate within countries, these intuitions are not a legitimate way to think about inequalities between countries or regions – for precisely the reasons we discuss in the paper. There could be other intuitions underpinning public notions of 'fair internation inequality', but we consider discussion of these out of our scope due to the many contentious questions that may follow.

[4] Although where a model can represent wellbeing-relevant consumption specifically (e.g., residential floorspace) assuming international convergence in these measures may be preferable.

[5] Within-country requirements will vary further due to differing individual and household needs regarding consumption of heating, food, mobility, etc., but these differences may largely average out at the national or regional level.

level analysis of key indicators[6] (which presents a challenge for current, regionally aggregated, energy-climate models [52,53]):

> First is a sufficiency floor – specifically, the minimum energy needed to meet human wellbeing, such as *decent living energy* (DLE), which measures the final energy requirements of providing *decent living standards* [39]. The DLE literature has typically focused upon national [39] or regional-averages [54], but we suggest DLE thresholds should *only* be used to represent minimum energy levels that no individual in any country should fall below. DLE it is not a 'target' that low-consuming countries should aim to reach and then remain at (indeed, studies applying different methods suggest the energy requirements of wellbeing are higher [45,55,56]). Nor is it one that high-consuming countries should aim to descend to (although most could move in this direction without reducing wellbeing [55]).
> Second is an estimate of current within-country energy use inequalities, and how 'fair' levels may look in the future. Quantifying 'fairness' here is difficult and uncertain, due to patchy data that must be translated through multiple layers of assumptions before becoming appropriate to input into energy and climate models, but heuristic attempts have been made to apply these ideas in the literature [51,57].
> Third is a measure of net trade, or unequal exchange in energy use. This is crucial, as convergence in living standards is better represented by convergence in (per-capita) consumption-based energy and resource use than by territorial measures. Modellers could assume that wealthier countries do not retain the purchasing powers they currently use to extract low-wage labour (and other resources) from lower-income countries, so that unequal exchange reduces in the future.
> Finally, a fully just scenario requires a global sufficiency ceiling – specifically, a level of sustainable global energy use that does not rely upon the global North disproportionally appropriating land in the South to sequester its (higher) emissions [23]. In per-capita terms, this provides a level of energy use that national averages, corrected for unequal exchange, should converge at.

To our knowledge, such a scenario does not yet exist, and this leaves a critical gap in the existing literature.

Of course, to reiterate our opening disclaimer, we are not suggesting that other scenarios should not be explored – all foreseeable futures should be. We are only highlighting the risk of applying philosophical theories, typically developed by Western philosophers, in a global context they were not imagined for; the risk of creating a false sense of justice. This does not mean distributive justice theories have no value in climate modelling – applying principles such as prioritarianism or sufficientarianism to international inequalities may indeed lead to a modelled future that is *less unjust*. But where models retain international/regional inequalities beyond a transitional state, we must recognise that this is done only because such inequalities presently exist and, given the existing balance of forces, may persist throughout the foreseeable future.

[6] Downscaling the regional data of contemporary climate models to the country-level presents important technical challenges [52], which are amplified further by our suggestion to focus on country-level energy footprint data (or, at a minimum, make a correction for the energy use embodied in international trade). On the other hand, our argument that all countries should converge to similar levels of per-capita final energy use implies there should be negligible intra-regional variation, making downscaling (with respect to consumption) less of an issue. But country-level analysis of the *transition* to such a 'fully just' future state would remain challenging. A simple approach may exogenously define country-level trajectories of energy consumption that are consistent with international egalitarianism and intranational 'fair inequality', and then upscale these to regional trajectories that are suitable for either exogenous input into IAM models, or calibration of their outputs. However, we leave more detailed solutions to this challenge to future researchers (e.g., [53]).

CRediT authorship contribution statement

Joel Millward-Hopkins: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Conceptualization. **Yamina Saheb:** Writing – review & editing, Investigation, Conceptualization. **Jason Hickel:** Writing – review & editing, Writing – original draft, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

No data was used for the research described in the article.

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Corrigendum

Corrigendum to "Large inequalities in climate mitigation scenarios are not supported by theories of distributive justice" [Energy Res. Soc. Sci. 118 (2024) 103813]

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