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DISCUSSION

Climate justice and a fair allocation of national greenhouse gas emissions

Christian Azar and Daniel J. A. Johansson

Physical Resource Theory, Department of Earth Space and Environment, Chalmers University of Technology, Göteborg, Sweden

ABSTRACT

Rajamani et al. have presented estimates for a fair and equitable allocation of the remaining global greenhouse gas emissions that are compatible with meeting the temperature targets of the Paris Agreement. In this paper, we find that their approach yields a high emission allowance per capita to *currently* high-emitting countries such as Australia, South Africa, Saudi Arabia, Canada, and China. In fact, Rajamani et al. propose that these countries should get two to three times more allowances (emission space on a per capita basis) than for instance India and Ghana and they refer to this as a 'fair' allocation despite the fact that the latter countries have significantly lower per capita emissions, per capita income, and historical emissions. Furthermore, the allocation to several Western European countries, e.g. the UK and Sweden, is strongly negative. Hence, their approach tends to reward countries with high emissions and discriminate against countries with low emissions per capita despite the fact that Rajamani et al. argue that grandfathering cannot be seen as a fair principle for allocating emissions allowances. Our findings are not only of academic interest, but they carry important implications for the debates about climate litigation since several organizations have sued states based on essentially the same method as that used by Rajamani et al.

Key policy insights

- The allocation approach suggested by Rajamani et al. (2021) rewards high-emitting countries which undermines fairness principles like responsibility and equality.
- Generous allocations to high-emitting countries reduce available emissions space for developing countries and low-emitting wealthy countries.
- The suggested method by Rajamani et al. (2021) lacks transparency, making it difficult to justify why developing countries such as India and Ghana receive fewer allowances than the global average.
- The allocation method suggested by Rajamani et al. (2021) is likely inappropriate for policy or litigation purposes since it is unclear in what respect the results obtained should be considered fair.
- A complicated and non-transparent model is not a substitute for a democratic debate about different allocation approaches and the results they yield.

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CONTACT Christian Azar christian.azar@chalmers.se Physical Resource Theory, Department of Earth Space and Environment, Chalmers University of Technology, 412 96 Göteborg, Sweden

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1. Introduction

In a recent paper in *Climate Policy*, Rajamani et al. (2021) estimate fair national greenhouse gas emission shares for essentially all countries of the world. Their aim is to quantify a 'national fair share' of the global allowable emissions on a path towards meeting the temperature targets of the Paris Agreement.

The aim of their quantification is that it should be done based on commonly accepted principles of international environmental law and their focus is to estimate a fair emission allowance for each nation for the year 2030.

Their results are not only of academic interest. Rajamani et al. (p. 999) state that 'fair-share ranges determined in this manner provide a guide to national emissions allocations that are fair and adequate and anchored in international environmental law.' They also write (p. 983) that estimates of fair emission shares 'can inform climate litigation in which the adequacy of national contributions, and thus a state's fair share, is at issue.'

In line with that ambition, the paper and the underlying method play a central role in a lawsuit against the Swedish state. In the lawsuit, filed by the Swedish youth organization Aurora, it is argued that the Swedish climate (emission) targets need to be sharpened and that net emissions should become significantly negative by the year 2030 if Sweden is to do its 'fair share' of the global effort to meet the objective of the Paris agreement.[1]

The method by Rajamani et al. is also essentially the same as that used by Climate Action Tracker (CAT) in their work to assess countries' progress towards meeting the Paris targets.[2] The method has been used in other cases of climate litigation, e.g. by a group of Portuguese youth against 33 European countries before the European Court of Human Rights.[3] Hence, an analysis of the method used by Rajamani et al. (and thus implicitly also of the method used by CAT) is of relevance for several ongoing lawsuits.

As will be shown, their method tends to reward countries with currently high emissions per capita, for instance, Australia, Canada, China, Saudi Arabia, and Russia, and tends to discriminate against low-income and low-emitting countries (on a per capita basis) such as India and Ghana. This outcome runs against, as Rajamani et al. phrase it, 'widely accepted' fairness principles in the climate debate (such as an allocation based on per capita emissions, historical responsibility, or capability).

The aim of this paper is to assess the method used by Rajamani et al. and their results. We first present their method (section 2), and their findings (section 3), and then discuss their results in light of the fairness principles that Rajamani et al. subscribe to (section 4). We conclude the paper in section 5.

2. Method used by Rajamani et al.

When estimating the fair emission level (or budget) for an individual state, three key steps are needed:

- First, a global temperature target and the probability with which that target should be met need to be determined.
- Secondly, a global overall emissions pathway consistent with that target (given a certain probability) needs to be estimated.
- Thirdly, a method to allocate this allowable global emission pathway (budget) fairly to individual nations needs to be employed.

As for the first and second steps, Rajamani et al. assume that the world should aim for an ambitious interpretation of the Paris Agreement and they focus on the year 2030. They then assume that the overall global annual emissions level to be apportioned between states in 2030 is 32 $GtCO_2e$ for a 1.8°C scenario and 24 $GtCO_2e$ for a 1.5°C overshoot scenario. Here, we analyze the 1.5°C case.

The focus of the paper by Rajamani et al. is on the third (effort sharing) step. Rajamani et al. (2021, p. 985) identify the 'principles of international environmental law, as well as the normative pillars of the Paris Agreement in determining, interpreting and implementing national fair shares' and they then estimate fair emission levels for most countries of the world for the year 2030. They do that (see p. 985) by 'applying international environmental law principles on the quantification of fair share emission ranges for individual states by identifying, collating and curating the relevant literature.'

We agree with Rajamani et al. that it is a valuable scientific exercise to study different fairness principles and analyze the allocation outcome for individual countries that follow from each principle. Here scientists can provide a significant contribution to ongoing policy discussions.

Rajamani et al. assess existing estimates of fair emission shares and exclude those studies that do not comply with the stated principles, e.g. they claim to have excluded studies that use grandfathering as a method to generate the national shares of the abatement effort (see section 2.1 below for more details). Furthermore, Rajamani et al. (2021, p. 996) exclude studies that have used a least-cost emission pathway approach, since 'they are not relevant in the determination of fair shares'.

They derive their fair national shares based on results from 'over 40' published studies of national and global emission pathways compatible with the Paris target (Rajamani et al., 2021, p. 997). However, from these available studies and approaches, only those that provide robust and meaningful data input are selected, and studies that determine fair shares 'only on the basis of energy CO_2 and do not cover non-CO_2 emissions are excluded' (see p. 997).

Once they have selected the relevant studies, they get a range of fair emission shares for each country (that span the results from the individual studies assessed). A key question is which value (in this range) to choose for each individual country. If one for instance were to take the lowest estimate available for each country, then the allocated global emissions would be significantly lower than the estimated global emissions budget compatible with a particular target. Similarly, if one would take the highest fair share estimate for each country, then the global emissions would be too high. For that reason, Rajamani et al. devised a method to select a particular value from the range of values obtained from the underlying background studies. (For more details about specific assumptions in their method, see section 3.2 in Rajamani et al.).

2.1. Fairness principles for allocating the global emission space to individual countries

There are at least four commonly used fairness principles and, in parenthesis, common effort-sharing methods used to implement the principle[4]:

- Equality/emissions egalitarianism (Equal per capita emissions),
- Responsibility,
- Capability & basic human needs (e.g. ability to pay, GDP per capita), and
- Sovereignty (Grandfathering).

There are also hybrid approaches. The method 'Equal cumulative historical per capita emissions' is typically one way of implementing the principle of 'responsibility' combined with 'equality'. The effort-sharing method 'Contraction and convergence' starts with grandfathering and converges over time into an equal annual per capita approach by the end of a specified carbon budget period (Meyer, 2000), and Greenhouse Development Rights (GDR, see Baer et al., 2009; and Baer, 2013) focuses on capacity and responsibility.

These approaches are also prominently featured in the underlying background studies used by Rajamani et al. Our aim here is not to go into the details of each of these approaches. For the interested reader, we refer to van den Berg et al. (2020), Davidson (2021), Rajamani et al. (2021), and Schulan et al. (2023) for discussions and numerical estimates of these approaches.

The choice of effort-sharing principle typically has a strong impact on the amount of emissions being allocated to each individual country. For instance, it has been shown that the current Swedish emission target is roughly in line with Sweden doing its fair share of the global effort to meet the 1.5°C target of the Paris Agreement if an equal per capita approach is implemented but that the current Swedish emission target is far from that if a capability-based approach is used (Morfeldt et al., 2022).

Furthermore, the results are not only sensitive to the choice of fairness principle and effort-sharing method, but also to the assumptions made when implementing a particular method. For instance, if emission allowances are allocated using the method equal cumulative emissions per capita, then Sweden's target is in line with an ambitious interpretation of the Paris target (1.5°C with 50% probability) if the starting year is in the mid-1990s or later. However, if we go back to the 1970s, then Sweden has already exhausted its fair share of the global budget (Morfeldt et al., 2022).

Hence, the devil is in the details of how an analysis along the lines of a particular method is carried out. van den Berg et al. (2020) make similar observations for the methods they analyze.

2.2. Rajamani et al. and grandfathering

We would like to say a few words about grandfathering since Rajamani et al. make a specific case against this approach based on a justice perspective.

Grandfathering means that the allocation received by an individual country is proportional to its current or past emissions (van den Berg et al., 2020). Hence, using this approach, 'higher emissions in the past are a reason to award higher entitlements to future emissions' (Schulan et al., 2023). This approach has been used in many cap-and-trade schemes when allocating emissions to individual companies (e.g. in the US Clean Air Act and in the EU ETS, although this method is now gradually being phased out).

Grandfathering is, by many or most analysts, not considered fair because it rewards countries (or companies) that currently have high emissions. Rajamani et al. write that grandfathering 'finds *no justification* in the equitable principles of international environmental law.'

Rajamani et al. (p. 992) strengthen their case against grandfathering as an appropriate or fair allocation method by referring to several other authors:

> Grandfathering or maintaining constant emission ratios arguably creates 'cascading biases' against poorer states (Kartha et al., 2018), is not a 'standard of equity' (Dooley et al., 2021), and is indeed morally 'perverse' (Caney, 2011). It is also a well-established principle of common law that no person ought to profit from their own wrong (Dworkin, 1967).

3. Results: the proposed allocation by Rajamani et al.

Rajamani et al. present their results for the 'fair national shares' of the global emissions space in the year 2030 for each country as a percentage of that nation's emission level in 2010. Using this approach, they find that countries such as the US, Australia, Japan, and Western European countries have to reduce their emissions whereas India may increase its emissions (see Figure 5 in Rajamani et al.).

The required reduction rate in Rajamani et al. differs a lot between the industrialized countries with Western European countries such as the UK and Sweden having to reduce their emissions by 150–180% and the US by about 100%, whereas carbon intensive countries such as Australia, Canada and Russia have to reduce their emissions much less.[5]

Presenting the fair emissions shares as a percentage of the 2010 levels tends to obscure the absolute level of the emissions allowance and this makes it more difficult to assess the resulting allocation scheme across countries. Hence, here we use the results from Rajamani et al., but present the fair emission allocation on a per capita basis.

We select a few representative countries from the global North and the global South (some of which currently have relatively high per capita emissions, South Africa and China, and some have relatively low emissions, e.g. India). We use the UN Population (2022) medium fertility scenario for the year 2030.

In Figure 1, it can be seen that Australia, Canada, China, Russia, Saudi Arabia, and South Africa get a rather large 'fair' emission space, whereas Sweden and the UK get a negative allowance of around *minus* 5 ton CO_2e per capita in the year 2030. India and Ghana, which both have small historical emissions and a relatively low GDP/cap, get less than e.g. Australia, Russia, and South Africa.[6] The global average allocation is 2.8 ton CO_2e per capita per year.

For the sake of comparison, it may be noted that greenhouse gas emissions per capita in the year 2019 in the mentioned countries were[7]: USA 19.6 ton CO_2e, Sweden 5.0 ton CO_2e, UK 6.8 ton CO_2e, Australia 21.1 ton CO_2e, China 10 ton CO_2e, India 2.4 ton CO_2e, Russia 14.3 ton CO_2e, Japan 9.6 ton CO_2e, South Africa 9.5 ton CO_2e, Ghana 1.5 ton CO2e, Canada 19.6 and Saudi Arabia 19.1 ton CO2e.

Finally, we also carried out a more aggregate analysis. We analyzed the 20 countries with the highest per capita emissions in the year 2010 and found that the average allocation to these countries (i.e. the average of the per capita allocation to each country) for the year 2030 is 7.5 ton CO_2e per person, which is around 2.7 times the global average allocation.[8]

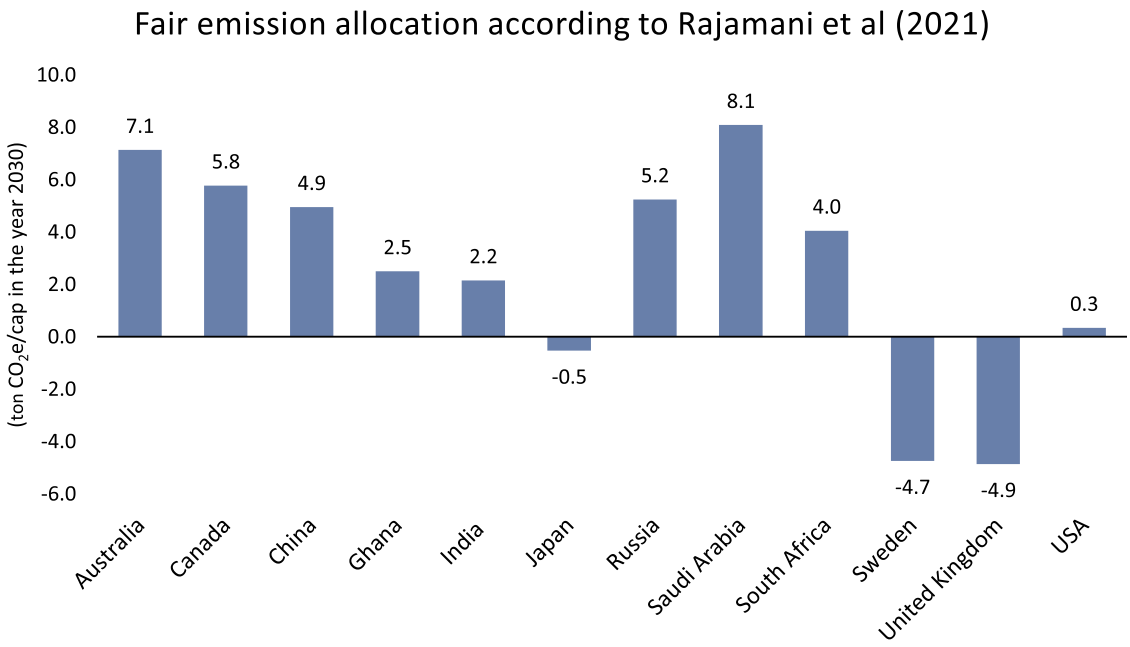

Figure 1. Fair emission space (tCO_2e per capita) in the year 2030 according to Rajamani et al. Data for the fair emission share is taken from Rajamani et al., and the population is taken from UN (2022).

This corroborates our finding that their approach tends to reward the top per capita emitters when allocating emission allowances for the year 2030. We find the same pattern when we analyze the allocation for the 1.8°C target that Rajamani et al. propose.

4. Discussion

The approach that Rajamani et al. and Climate Action Tracker use is rewarding some of the industrialized countries that have emitted the most. Given that their ambition is to find a fair allocation of a dwindling global emissions budget and that they claim to exclude grandfathering, one may wonder why they obtained such a result.

Specific questions include:

- Why are high emitting countries such as Australia, Canada, China, Russia, and Saudi Arabia allocated 2–3 times more emission space per capita than India or Ghana despite the fact that India and Ghana are poorer in terms of GDP per capita and that they currently as well as historically have significantly lower CO_2 equivalent emissions per capita?
- Why are India, Ghana, and a wide range of developing countries given a per capita allocation that is lower than the global per capita allocation?
- Why are almost all Western European countries, e.g. Sweden and the UK, given negative (or strongly negative) allowances, while the fossil fuel-intensive countries Canada, Australia, and Saudi Arabia (including many Gulf States) are given such generous allocations?

It is difficult to see how these results can be justified based on the fairness principles that Rajamani et (and Climate Action Tracker) put forward.[9] Rather, it seems as if at least some elements of grandfathering remain as a key driver of the allocation that they propose despite the fact that Rajamani et al. state that they have excluded studies that use grandfathering.

It would be interesting to hear Rajamani et al. explain (a) the key driver behind these results and (b) how the generous allocation to high per capita emitting countries is compatible with the basic principles of fairness they themselves put forward.

4.1. Methodological critique – transparency versus black box

Apart from our critique of their proposed allocation, one may also raise concerns about the method used by Rajamani et al. from another point of view. We believe that it is important that the allocation method used is transparent and that the results can be justified and explained from basic principles. In general, transparency facilitates (or is even a requirement for) discussions about the outcome of any allocation procedure and makes it possible to understand the results.

For instance, if one uses historical responsibility (equal historical per capita emissions), then a country such as Canada, would get an allocation that is lower than the global average, and a country that has emitted little historically, say Ghana, should get a per capita allowance that is higher than the global average. Finding out the actual number would require a detailed calculation, but the direction implied by each method is most often clear.

However, with the approach chosen by Rajamani et al., which relies on aggregating and weighting results from over 40 studies, it becomes difficult for the reader to understand their results, e.g. why developing countries such as India and Ghana should get an allowance that is lower than the available global per capita emission space.

For this reason, we would like to encourage the use of as clear and transparent methods as possible as it would facilitate a democratic debate about different allocation approaches and the results they yield.

4.2. Relying on results for individual countries?

In discussions with colleagues and climate-engaged persons, a common reaction to our findings has been that 'well ok, it really seems unfair that fossil fuel-intensive countries such as Russia, Canada and Saudi Arabia, etc. get conspicuously large allocations given that the aim is to meet a stringent climate target in a fair way'. But, they continue 'the results for say Western European might still be correct and useful'.

However, a key point to observe here is that sharing a global emissions budget is like sharing a pie at a dinner party. If one person gets more, it means that others get less. Hence, the generous allocation to Russia, Canada and Saudi Arabia, etc. means that there is less left to allocate to other countries, including wealthy Western European countries and poor and developing countries in the global South.

In other words, in the allocation by Rajamani et al., the most polluting countries get to emit more *at the expense* of say India and Ghana. It is for that reason *not* possible to select and rely on the results for only individual countries in their analysis, rather their method must be considered in its entirety.

4.3. The role of science in estimating fair shares

We also wish to make a more general remark related to the role of science when it comes to estimating 'fair allocations' to individual nations. As a general rule of thumb, science can be used to describe and understand the world, but not decide what we should do with it (this is a line of thought that goes back to David Hume and his is-ought distinction).

For this reason, science alone cannot say which allocation principle is correct and which is wrong, since that ultimately is a value laden question (Dooley et al., 2021). It also means that that science cannot provide value neutral and objective answers to questions about the fair emission space for individual countries, i.e. how one can break down a global target to individual nations.

An important role for scientists in this context is to estimate the allocation (emission space) to individual countries that follows from specific fairness principles. However, which fairness principle that society should ultimately use must be the subject for broader societal and democratic debates. Science alone cannot resolve that question.

5. Conclusions

Rajamani et al. (2021) have estimated fair national emission shares for the year 2030 that are in line with an ambitious interpretation of the Paris Agreement. In this brief paper, we analyze their results. We find that high emitting countries (on a per capita basis) such as Canada, Australia, Russia, and Saudi Arabia, are given

relatively large emission allowances for the year 2030 (around 5–8 ton CO_2e per capita), and low emitting countries such as India and Ghana are given a relatively low emissions allowance on a per capita basis (2.2–2.5 ton CO_2e per capita). Sweden and the UK are given strongly negative emission allowances for the year 2030 (around *minus* 5 ton CO_2e per capita), while the US is allocated close to zero CO_2e per capita.

This discussion about how the remaining global carbon budget may be allocated to individual countries is not only of academic interest. The study by Rajamani et al. forms the basis for a lawsuit by the Swedish youth organization Aurora against the Swedish state. Essentially the same method, developed by Climate Action Tracker, is also used in several other cases of climate litigation (see the Appendix to the Aurora lawsuit, written by Ganti et al., 2022). This latter approach results in similar allocations as the method by Rajamani et al.

The proposed allocation by Rajamani et al. does not seem to be consistent with the established fairness principles listed above (equality, responsibility, capability, and need). Furthermore, their method (combined with their underlying data set) tends to reward countries with high emissions per capita, an outcome that they themselves reject.

For that reason, we believe that the method used by Rajamani et al. (2021) is not likely appropriate to use in national debates and policy processes about fair national emissions targets nor in litigation processes, at least unless Rajamani et al. can give convincing arguments why it should be considered fair that heavily emitting countries should be given more allowances per capita than developing countries in the global South.

Notes

1. https://climatecasechart.com/non-us-case/anton-foley-and-others-v-sweden-aurora-case/
2. Climate Action Tracker is maintained by Climate Analytics and NewClimate Institute and their work is described here: https://climateactiontracker.org/. Ganti et al. (2022), for instance, refer to the paper by Rajamani et al. as an application of the framework adopted by Climate Action Tracker. Fyson et al. (2022), who represent Climate Analytics, the team behind Climate Action Tracker, write that the approach by Rajamani et al. 'relies on a similar methodology as set out in Chapter 5 of Climate Analytics (2022), which is also applied by the Climate Action Tracker.' See also Azar & Johansson, 2023, for a numerical comparison.
3. https://youth4climatejustice.org/wp-content/uploads/2020/12/Application-form-annex.pdf, paragraph 31.
4. See, for example, Höhne et al. (2014) and van den Berg et al. (2020).
5. For the sake of clarity: a reduction by 200% means that a country that emits say 5 ton CO_2 per capita year has to reach an emission level of *minus* (!) 5 ton CO_2. This could possibly be achieved through carbon dioxide removal or through paying for emissions reductions in another country.
6. Sudan even gets a (slightly) negative emission allowance and Cuba's fair share is *minus* 17 ton per capita in 2030. It is difficult to understand why these countries should be given a negative allowance.
7. Data for all countries refer to total emissions excluding land use, land use change and forestry (LULUCF) and were taken from Climate Action Tracker, www.climateactiontracker.org except for Ghana, were the emissions (total emissions excluding LULUCF) were taken from their Fifth National Greenhouse Gas inventory, available at https://unfccc.int/sites/default/files/resource/gh_nir5_15052022_final.pdf
8. The country average emission in the year 2010 is 27 ton CO2e per year for these twenty countries. Note also that this tendency, illustrated here, does not mean that it is always the case that high emitters are rewarded with a high allocation, as the near zero allocation to the US illustrates. Finally, looking at the average across countries, not weighted by population, gives a measure of how the method works for individual countries.
9. To be specific, individual results can be justified. For instance, with historical accountability, then one may certainly find that several western European countries should get negative allowances, but with this approach, also Canada and Australia, as well as the US should get negative allowances, so for the third bullet point above, it is not the absolute values, but the lack of consistency across countries that cause concern.

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References

Azar, C., & Johansson, D. J. A. (2023). Rättvist utsläppsutrymme för att nå 1,5 gradersmålet – En analys av metoderna som används i Auroras stämningsansökan (in Swedish, the English title reads: "Fair emissions space – an analysis of the methods used in the climate litigation by Aurora"). Report. https://research.chalmers.se/publication/534534/file/534534_Fulltext.pdf.

Baer, P. (2013). The greenhouse development rights framework for global burden sharing: Reflection on principles and prospects. *WIREs Climate Change*, *4*(1), 61–71. https://wires.onlinelibrary.wiley.com/doi/epdf/10.1002wcc.201.

Baer, P., Athanasiou, T., Kartha, S., & Kemp-Benedict, E. (2009). *The greenhouse development rights framework*. Heinrich Böll Foundation, Christian Aid, EcoEquity and the Stockholm Environment Institute. 147. www.gdrights.org.

Caney, S. (2011). Climate change, energy rights, and equality. In D. G. Arnold (Ed.), *The ethics of global climate change* (pp. 77–103). Cambridge University Press. https://ora.ox.ac.uk/objects/uuid:187d97ff-6b49-4a46-a01f-e07d3576afb9.

Climate Action Network. (2022). Methodology to determine the fair share allocation. Retrieved January 2, 2023 from https://climateactiontracker.org/methodology/cat-rating-methodology/fair-share/.

Davidson, M. D. (2021). How fairness principles in the climate debate relate to theories of distributive justice. *Sustainability*, *13*(13), 7302. https://doi.org/10.3390/su13137302

Dooley, K., Holz, C., Kartha, S., Klinsky, S., Roberts, J. T., Shue, H., Winkler, H., Athanasiou, T., Caney, S., Cripps, E., Dubash, N. K., Hall, G., Harris, P. G., Lahn, B., Moellendorf, D., Müller, B., Sagar, A., & Singer, P. (2021). Ethical choices behind quantifications of fair contributions under the Paris Agreement. *Nature Climate Change*, *11*(4), 300–305. https://doi.org/10.1038/s41558-021-01015-8

Dworkin, R. M. (1967). The model of rules. *The University of Chicago Law Review*, *35*(*1*), 14. http://dx.doi.org/10.2307/1598947

Fyson, C., Schleußner, C. F., Geiges, G., Ganti, G., Quill, E., & Lozada Gomez, M. (2022). Addendum to the report on Italy's climate targets and policies in relation to the Paris Agreement and global equity considerations. https://climatecasechart.com/wp-content/uploads/non-us-case-documents/2022/20220519_14016_na.pdf.

Ganti, G., Lozada, M., Menke, I., & Fyson, C. (2022). Determining Sweden's Fair Share Contribution under the Paris Agreement. Bilaga 2 till stämningsansökan. Inkom till Nacka tingsrätt 24/11 2022.

Höhne, N., den Elzen, M., & Escalante, D. (2014). Regional GHG reduction targets based on effort sharing: A comparison of studies a comparison of studies. *Climate Policy*, *14*(1), 122–147. https://www.tandfonline.com/doi/full/10.108014693062.2014.849452.

Kartha, S., Athanasiou, T., Caney, S., Cripps, E., Dooley, K., Dubash, N. K., Fei, T., Harris, P. G., Holz, C., Lahn, B., Moellendorf, D., Müller, B., Roberts, J. T., Sagar, A., Shue, H., Singer, P., & Winkler, H. (2018). Cascading biases against poorer countries. *Nature Climate Change*, *8*(5), 348–349. https://doi.org/10.1038/s41558-018-0152-7

Meyer, A. (2000). *Contraction and convergence: The global solution to climate change*. Global Commons Institute. Green Books.

Morfeldt, J., Azar, C., & Johansson, D. J. A. (2022). Nationella utsläppsmål utifrån Parisavtalet och internationella rättviseprinciper - analys av Sveriges territoriella klimatmål. Rapport för Mistra Carbon Exit. https://research.chalmers.se/publication/530543/file/530543_Fulltext.pdf.

Rajamani, L., Jeffery, L., Höhne, N., Hans, F., Glass, A., Ganti, G., & Geiges, A. (2021). National 'fair shares' in reducing greenhouse gas emissions within the principled framework of international environmental law. *Climate Policy*, *21*(8), 983–1004. https://www.tandfonline.com/doi/full/10.108014693062.2021.1970504.

Schulan, A., Tank, L., & Baatz, C. (2023). Distributive justice and the global emissions budget. *WIREs Clim Change*, *14*(5), e847. https://wires.onlinelibrary.wiley.com/doi/epdf/10.1002wcc.847.

UN. (2022). UN World Population Prospects, Medium fertility scenario. https://population.un.org/wpp/.

van den Berg, N. J., van Soest, H. L., Hof, A. F., den Elzen, M. G. J., van Vuuren, D. P., Chen, W., Drouet, L., Emmerling, J., Fujimori, S., Höhne, N., Kõberle, A. C., McCollum, D., Schaeffer, R., Shekhar, S., Vishwanathan, S. S., Vrontisi, Z., & Blok, K. (2020). Implications of various effort-sharing approaches for national carbon budgets and emission pathways. *Climatic Change*, *162*(4), 1805–1822. https://doi.org/10.1007/s10584-019-02368-y