

Financing negative emissions leads to windfall profits and inequality at net zero

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Funding large-scale negative emissions through a carbon market designed for traditional emission reduction strategies risks exacerbating long-term economic inequality. We suggest exploring alternative financing mechanisms that address this concern and that still ensure decarbonization at reasonable costs.

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The policy problem

Policymakers face the question of which policy instruments are suitable for financing negative emissions. For example, the European Union is discussing the opportunity of introducing negative emission technologies (NETs) into its emission trading scheme, the largest carbon market in the world. In the long run, the inclusion of carbon removal in a carbon pricing framework alongside other emission reduction methods, such as renewable energy, holds appeal: this approach theoretically allows for the achievement of emission reduction targets at the lowest possible cost. In a carbon market, however, the carbon price serves as a revenue for NET companies. Owing to technical progress, the average cost of carbon removal might fall well below the anticipated carbon price as emissions near zero. Consequently, owners of NETs might reap windfall profits, leading to a substantial increase in economic inequality if these technologies are privately owned.

The findings

We find that privately owned NETs integrated into a carbon market designed for emission reductions increases economic inequality. Within each country, three factors drive the severity of the inequality increase: (1) the profit margin of NET companies; (2) the concentration of ownership of NET companies towards the top of the income distribution; and (3) the amount of negative emissions in the market. Therefore, small economies with high carbon-removal potential, concentrated equity ownership and expensive mitigation options are particularly susceptible to the inequality risk. In our analysis, we model a single NET (direct air capture) and global climate policy in line with the Paris Agreement. However, our results generalize to other negative emission

options and to other climate policies (for example, net-zero pledges) whenever the above considerations apply and the technology value chain mostly benefits the rich.

The study

We carried out our analysis with an open-source integrated assessment model at high geographical resolution; we improved the numerical model with an explicit representation of income distribution, which allows the dynamics of both within-country and global inequality to be captured. We projected key variables over time, such as gross domestic product (GDP), emissions, baseline inequality, emission reduction costs, concentration of capital, and distributional incidence of climate policy and income taxes, assuming continuation of current trends. Our central scenario assumes a global uniform carbon tax consistent with the well-below 2 °C target embedded in the Paris Agreement. To identify robust insights, we carried out a large number of numerical simulations, varying international ownership of capital, international trade of negative emission permits, double markets for negative emissions and different interpretations of climate policies.

Recommendations for policy

- In a net-zero emissions world, NETs could become a trillion-dollar business globally.
- If financed through an unregulated carbon market, the owners of these companies would enjoy windfall profits, potentially leading to a large increase in economic inequality.
- Market regulation, such as profit caps, could reduce the inequality increase, but at the risk of stimulating too much or too little carbon removal — policymakers should be aware of this trade-off.
- Concentrating removal efforts in the Global North or transferring resources to the Global South could, to some extent, offset the increase in inequality at the global level.
- These dynamics mostly apply to a net-zero and post-net-zero world. The current priority of policymakers should remain to provide adequate resources to scale up NETs towards technology maturity.

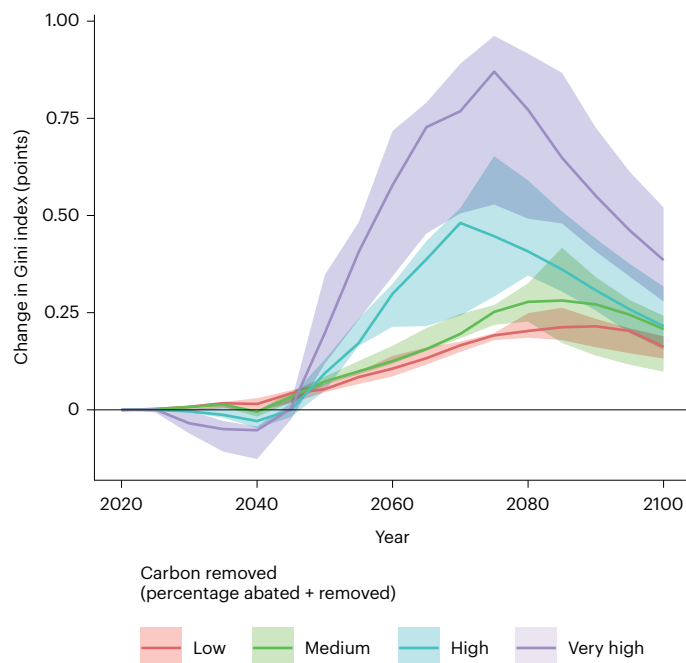


Fig. 1 | Countries with high and very high carbon-removal efforts experience a higher increase in income inequality around and after net-zero emissions.

The figure shows the within-country inequality increase expressed as the change of the Gini index for the income distribution (y axis) in a well-below 2 °C scenario, relative to the projected baseline of income inequality. Countries are clustered

into four groups according to cumulative negative emissions deployed over total mitigation effort (that is, emission reduction plus negative emissions). Lines represent the median and shading represents the confidence intervals within each group. Figure adapted with permission from P. Andreoni et al. *Nat. Clim. Change* <https://doi.org/10.1038/s41558-023-01870-7> (2023), Springer Nature Ltd.

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Further reading

1. Budolfson, M. et al. Climate action with revenue recycling has benefits for poverty, inequality and well-being. *Nat. Clim. Change* **11**, 1111–1116 (2021).
This paper provides a global analysis of the long-term distributional effects of climate policy and carbon taxes using a similar modelling framework.
2. Semieniuk, G. et al. Potential pension fund losses should not deter high-income countries from bold climate action. *Joule* **7**, 1383–1387 (2023).

This article discusses the international and within-country distributional implications of the propagation of losses related to fossil fuel stranded assets.

3. Gazzotti, P. et al. Persistent inequality in economically optimal climate policies. *Nat. Commun.* **12**, 3421 (2021).
This paper presents a model-based analysis of the between-country inequality consequences of climate policy and climate impacts.
4. Fyson, C. L., Baur, S., Gidden, M. & Schleussner, C.-F. Fair-share carbon dioxide removal increases major emitter responsibility. *Nat. Clim. Change* **10**, 836–841 (2020).

This paper quantitatively reflects on the role of equity principles in shaping the international distribution of carbon-removal efforts in deep mitigation scenarios.

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Competing interests

The authors declare no competing interests.