

Policy brief, for NCLIM-22040690

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Net zero emissions: Countries' long-term climate strategies fail to define residual emissions

## **Standfirst**

Achieving net-zero means balancing remaining emissions with carbon removal, and understanding the nature and scope of residual emissions is key to planning decarbonized energy and industrial systems. However, our analysis of long-term climate strategies shows many governments lack clear projections for residual emissions at net-zero.

## **The policy problem**

Many governments have announced net-zero targets in the past few years, and now face the task of laying out specific roadmaps to reach those targets. Realistic net-zero roadmaps, as well as financing and planning the technologies and infrastructure for deep decarbonization and carbon removal, require governments to be able to project the amounts of residual emissions that will remain at net-zero and understand what sectors will have remaining emissions. A mismatch between the amounts of residual emissions that countries expect and the available carbon removal capacity would jeopardize the goals laid out in the Paris Agreement. Thus, it is important to understand questions regard to how residual emissions are defined, what amounts are projecting, how they are distributed among sectors, and whether countries expect land-based or technological removals to compensate for these residual emissions.

## **The findings**

Our results show that most countries with quantified projections are projecting large amounts of residual emissions by 2050, and that significant carbon removal effort would therefore be needed. We found no consistent definition or use of the concept of residual emissions across the 50 long-term low-emissions development strategies (LT-LEDS) analyzed. A majority of the LT-LEDS did not mention the concept of residual emissions at all, despite having a net zero target. The Annex 1 country LT-LEDS that did quantify residual emissions at net zero projected significant levels; on average 18% of current emissions based on the lowest-level projections (Fig. 1). Agriculture and industry represented the largest sources of residual emissions in the 15 Annex I countries that included sectoral breakdowns. While some countries plan for land-based removals to compensate for their residuals, the biggest emitters' expected land-based removals fall far short of residuals, indicating a need for technological removal.

## **The study**

This study analyzed 50 of the 51 LT-LEDS that had been submitted to the UNFCCC as of mid-2022. We looked at LT-LEDS because other sources of comparable data on country projections, such as national strategy documents or Nationally Determined Contributions, tend to have shorter time horizons than would be relevant for net-zero goals. Importantly, most LT-LEDS present pathways, or what-if explorations of different scenarios for reaching desired targets. These scenarios and quantified projections inform the strategy, but are meant to be illustrative of possible futures rather than prescriptive. Right now, many of the countries who have submitted LT-LEDS are countries in the Global North. However, these countries are the first adopters of both LT-LEDS and net-zero targets, and their assessment and actions may set the tone for countries that follow.

## **4-5 messages for policy**

Current projections of residual emissions by 2050 by the countries that have quantified them indicate a need for high levels of removals, which risks compromising other sustainability goals.

Clear projections for the amount of residual emissions, sectoral and spatial distribution, and the types of greenhouse gases will help planning and investment for mid-century infrastructure.

Policymakers and researchers should develop standards for what can be reasonably deemed residual emissions, in order to avoid inflated expectations of emissions that cannot be compensated by removals.

Policymakers can support decarbonization planning by being explicit about whether residual emissions — and net-zero as a goal — are a temporary stopgap towards decarbonization, or a state to maintain.

Both international and national policy action is needed to solve the problem of ensuring that removals are compensating for emissions from sectors and activities that are truly hard-to-abate.

## Source research

Buck, Holly Jean; Carton, Wim; Lund, Jens Friis; Markusson, Nils. Why residual emissions matter right now. *Nature Climate Change*.

## Further Reading

Fankhauser, S. *et al.* The meaning of net zero and how to get it right. *Nat. Clim. Change* **12**, 15–21 (2022). <https://www.nature.com/articles/s41558-021-01245-w>

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Grassi, G. *et al.* Carbon fluxes from land 2000-2020: bringing clarity on countries' reporting. *Earth Syst Sci Data Discuss* **2022**, 1–49 (2022). <https://essd.copernicus.org/articles/14/4643/2022/>

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Luderer, G. *et al.* Residual fossil CO<sub>2</sub> emissions in 1.5–2 °C pathways. *Nat. Clim. Change* **8**, 626–633 (2018). <https://www.nature.com/articles/s41558-018-0198-6>

**The first analysis of key residual emissions determinants in modelled mitigation pathways.**

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Waisman, H. *et al.* A pathway design framework for national low greenhouse gas emission development strategies. *Nat. Clim. Change* **9**, 261–268 (2019).

<https://www.nature.com/articles/s41558-019-0442-8>

**A pathway design framework for national low greenhouse gas emission development strategies.**

## Figure

**Figure 1. Residual emissions versus 2019 emissions, Annex I countries.** *2019 emissions are from UNFCCC inventories, and show total GHG emissions without LULUCF.*

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## Competing interests

There are no competing interests to declare.