Deep Decarbonization Pathways

NDC INSIGHTS n°4

Can we tackle non-CO_2 emissions without compromising food security?

In this edition of NDC Insights, we dive into a critical but often overlooked dimension of climate action: non-CO_2 greenhouse gases—primarily methane (CH_4) and nitrous oxide (N_2O). Addressing these potent climate forcers is critical for limiting global warming in the next decades and for achieving ambitious long-term climate goals.

Why non-CO_2 emissions matter—and why they're so hard to reduce

Agriculture is the major single source of these two greenhouse gases. This sector is responsible for more than 30% of global methane emissions (mainly from livestock and rice cultivation) and over 50% of global nitrous oxide emissions (mainly from fertilizer use and manure). The evolution of these gases is therefore intricately tied to food systems and rural development.

Our analysis of national deep decarbonization pathways for Brazil, China, India, Indonesia, Mexico, Nigeria, South Africa, and the United States reveals that strategies focused solely on reducing CO_2 emissions are insufficient to tackle non-CO_2 emissions in agriculture. Unlike the energy sector, where fossil fuels are the primary sources of both CO_2 and non-CO_2 emissions, the agricultural sector requires tailored, transformative approaches. These approaches must simultaneously enhance mitigation efforts, build resilience, and support livelihoods. This underscores the need for a focused, agriculture-centered strategy that balances climate action with food security.

Figure: Indexed non-CO_2 emissions from energy and agriculture

Country snapshots: addressing non-CO_2 emissions in action

Examples from country analyses demonstrate that smart, locally adapted interventions can cut non-CO_2 emissions and support development goals - if supported by the right incentives, governance framework, and investment.

India

Agriculture dominates non-CO_2 emissions in India's decarbonization pathway, particularly methane from rice cultivation and livestock. India is piloting alternate wetting and drying (AWD) techniques in rice paddies to cut methane without lowering production. The DDP pathway shows that mitigation is possible without compromising yields, through:

- Expanding alternate wetting and drying in rice fields
- Promoting feed supplements and better herd management
- Investing in organic and biofertilizers to reduce nitrous oxide emissions

But the uptake of these strategies depends on education, financing, and ensuring that smallholders benefit. India's case highlights that climate mitigation in agriculture must be aligned with farmer livelihoods and food security, especially in vulnerable rural regions. However, their success relies on the availability of resources, knowledge transfer, and policies that support smallholder farmers in adopting these practices without compromising their economic stability or food security.

Mexico

Mexico's decarbonization pathway achieves marginal reductions in agricultural non-CO_2 emissions through more sustainable livestock practices, such as rotational grazing, improved manure management, and optimized feeding strategies, along with reduced fertilizer intensity. Key actions include:

- Breeding and feed improvements to cut enteric fermentation
- Promoting silvopastoral systems that combine trees and pasture
- Optimizing fertilizer use to reduce N_2O while maintaining yields

These strategies show that sustainable livestock systems can reduce enteric fermentation while improving productivity and farmer incomes. Climate mitigation and productivity can go hand in hand, especially when supported by comprehensive agricultural training, technical assistance, and rural development programs.

China

China's decarbonization pathway reduces nitrogen fertilizer use while maintaining yields, through precision agriculture and improved soil management, showing that significant cuts in N_2O are feasible through smarter fertilizer use and soil health practices. Between 2020 and 2050, nitrogen use drops while maintaining agricultural output, thanks to:

- Precision application of fertilizers
- Improved crop varieties and rotations
- Supportive policy incentives for nutrient efficiency

China's experience underlines that systemic change in farming practices is needed to align agricultural policy with climate and food goals.

What this means for NDCs

Most NDCs include some mention of non-CO_2 gases, but few offer detailed targets or strategies for agriculture. Yet, as our DDP pathways show, these emissions are critical to long-term climate success—and they won't fall without dedicated action.

To better reflect the role of non-CO_2 gases, future NDCs should:

- Include quantified mitigation targets for methane and nitrous oxide, especially from agriculture
- Develop sector-specific strategies that link emissions reductions with productivity, resilience, and rural development
- Support implementation through financing, technical assistance, and strong agricultural extension systems

Without attention to non-CO_2 emissions, NDCs risk missing a major share of mitigation potential—and a chance to support more sustainable, resilient food systems.

Next in NDC Insights

In our next edition, we'll look at the short-term actions countries can take this decade to stay on track for 1.5°C. From phasing out coal to cutting methane and scaling clean transport, we'll highlight practical steps national pathways show are both urgent and achievable.

Missed the last newsletters? Download:

"Beyond pledges: Are NDCs addressing the transformations we need?"

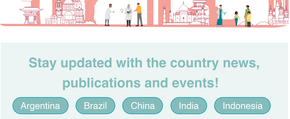
"What role for Carbon Capture and Storage?A measured look at its place in the transition"

"Can land use deliver on climate and development goals?"

About the DDP and why this newsletter matters

The Deep Decarbonization Pathways (DDP) initiative supports countries in designing strategies for deep emissions cuts aligned with development goals.

Since 2013, DDP has worked with local experts to build bottom-up, country-driven pathways that turn climate ambition into real, grounded action.



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