China's Non-CO_2 Emissions: Key Opportunities for Rapid Mitigation

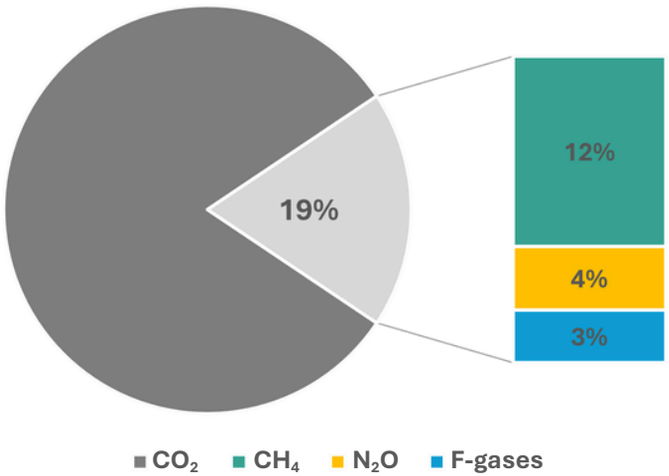
Although non-CO_2 greenhouse gases (non-CO_2 GHGs) account for about 25% of global anthropogenic GHG emissions, they are responsible for nearly half of historical warming. As climate change accelerates and extreme weather events intensify, addressing non-CO_2 emissions has become an urgent global priority.

China, as one of the world's largest emitters of non-CO_2 GHGs, plays a pivotal role in this effort. Advancing the control and reduction of these emissions is critical to achieving its carbon neutrality goal. With the country's low-carbon energy transition gaining momentum, stronger action on non-CO_2 GHGs will not only underscore China's leadership in global climate governance but also reaffirm its commitment to curbing overall emissions.

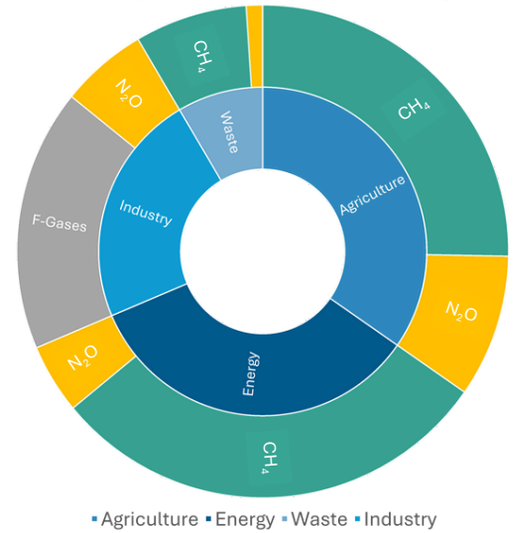
China's Non-CO_2 Emissions: Agriculture Leads, Energy Methane Dominates

- In 2021, China's non-CO_2 GHG emissions reached 2.686 billion tons of CO_2e, accounting for approximately 19% of the country's total GHG emissions (excluding LULUCF).
- In 2021, agriculture was the largest source of non-CO_2 emissions (34.7%), followed by the energy sector, where energy-related methane was the single biggest contributor.

China's Non-CO_2 GHG Share in Total Emissions (2021)



China's Non-CO_2 Emissions (by Sector, by Gas, 2021)

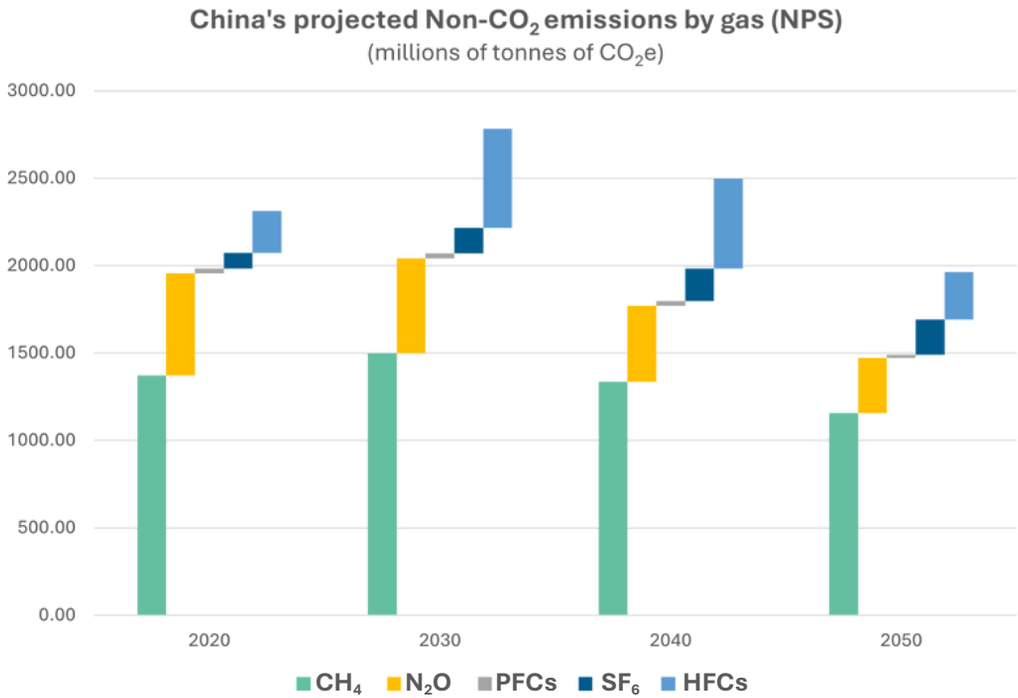


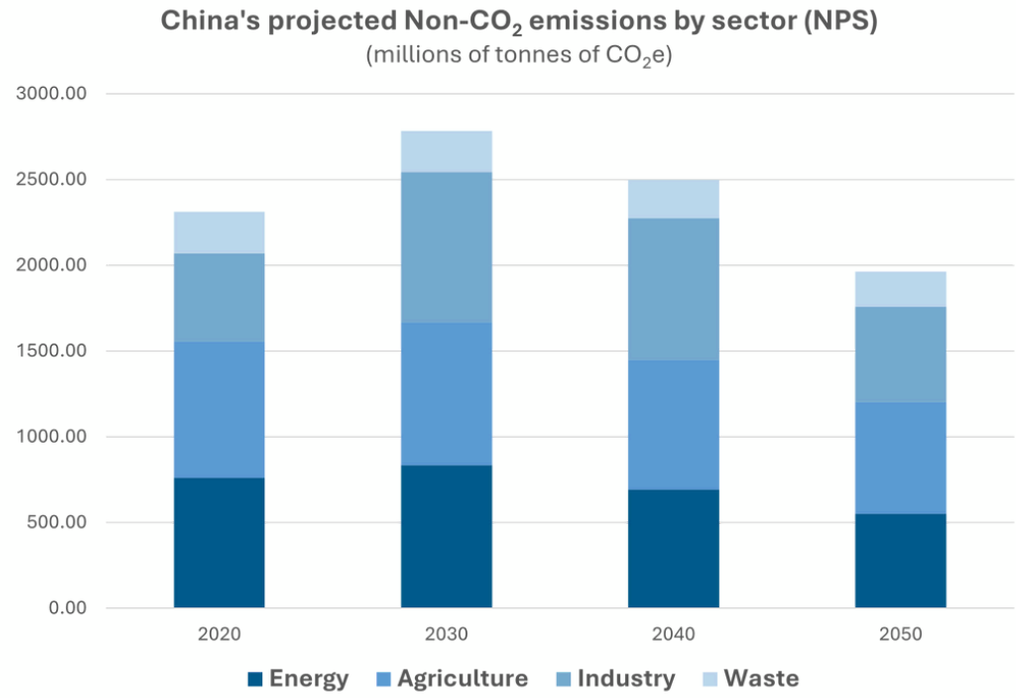
Data Source: People's Republic of China, First Biennial Transparency Report on Climate Change (UNFCCC submission).

Policy-Driven Progress on Non-CO_2 GHG Mitigation

Since the launch of China's "dual carbon" goals, a series of green and low-carbon policies have been driving non-CO_2 GHG mitigation. However, the timing of emission peaks varies by gas. For example, hydrofluorocarbon (HFCs) emissions may peak after 2030. The main reason is that, although production and consumption of controlled HFCs were frozen at baseline levels in 2024, the large stock of HFCs accumulated in existing equipment will continue to cause emissions growth for some time.

By 2050, methane will remain China's largest source of non-CO_2 GHG emissions, underscoring the need for continued and coordinated mitigation efforts. Meanwhile, sulfur hexafluoride (SF_6) emissions—widely used in power equipment—may continue to rise alongside the expansion of electricity infrastructure. Sectoral analysis by iGDP shows that China's green and low-carbon policies will drive reductions across multiple sectors, with **energy-related methane** achieving the most significant decline: **a 28% reduction from 2020 levels by 2050**.





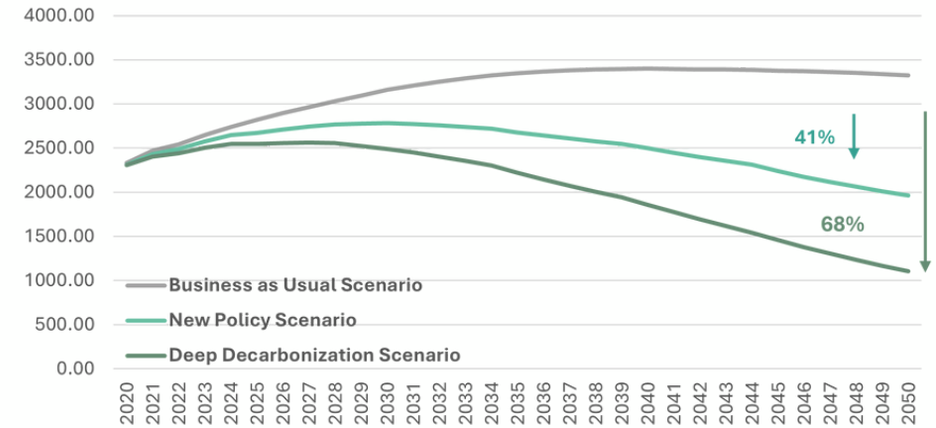
Data Source: iGDP calculations based on the New Policy Scenario (NPS), which reflects green and low-carbon policies implemented since China announced its "dual carbon" goals.

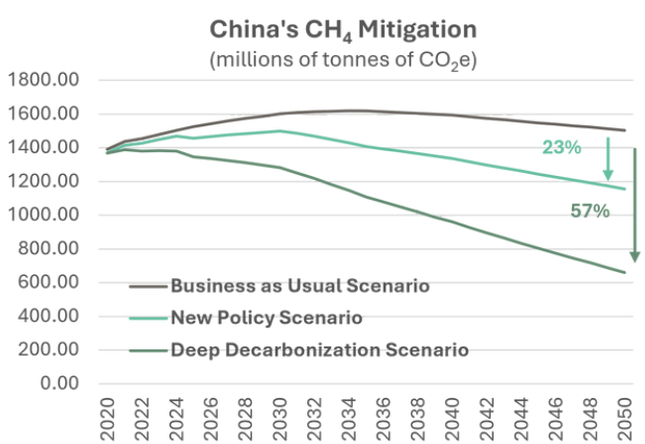
Since 2020, China has strengthened its actions to reduce non-CO_2 GHG emissions through polices such as the Methane Emission Control Action Plan, the Action Plan for the Control of Nitrous Oxide Emissions in the Industrial Sector, and full compliance with the Kigali Amendment. These efforts have accelerated progress on non-CO_2 GHG mitigation.

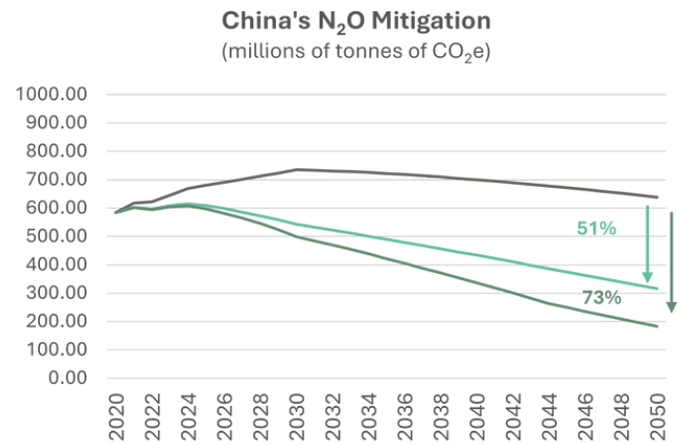
According to an iGDP scenario analysis, under a New Policy Scenario (NPS), total non-CO_2 emissions in 2050 are projected to be **41% lower** than in a Business as Usual (BAU) scenario. By gas, **reductions are estimated at 23% for CH_4, 51% for N_2O**, and **58% for F-gases** under the NPS.

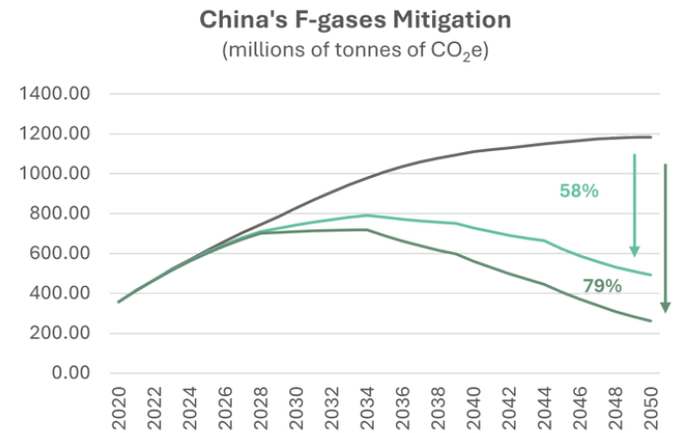
Scenario Setting:

- Business as Usual (BAU): Based on the emission trends under green and low-carbon policies introduced before 2020.
- New Policy Scenario (NPS): Reflects emission trends under green and low-carbon policies implemented since China announced its "dual carbon" goals in 2020.
- Deep Decarbonization Scenario (DDS): Builds on the NPS and assumes the adoption of global and domestic best practices to further accelerate emission reductions.





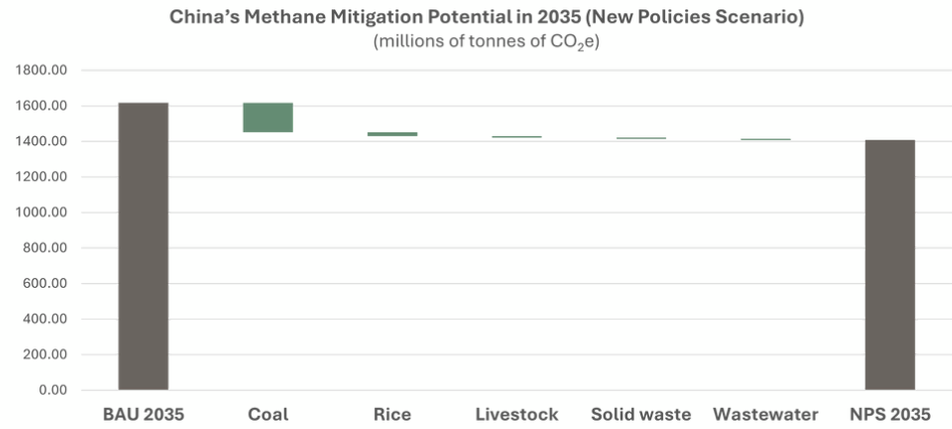


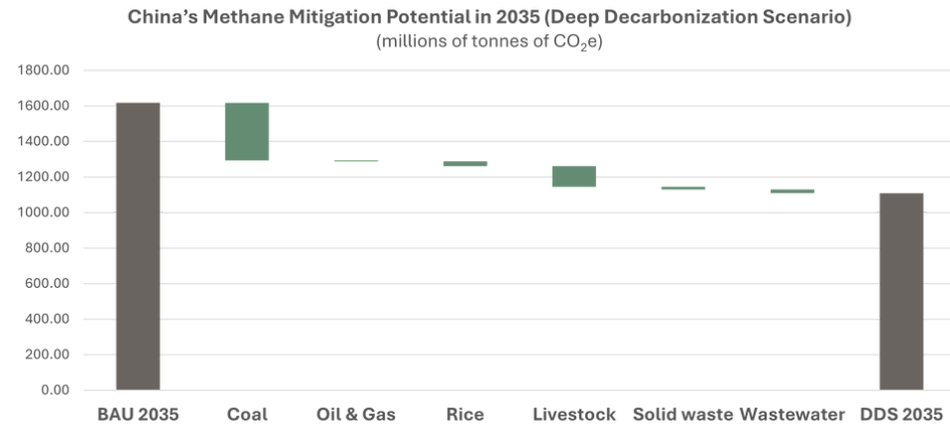


Data Source: iGDP analysis.

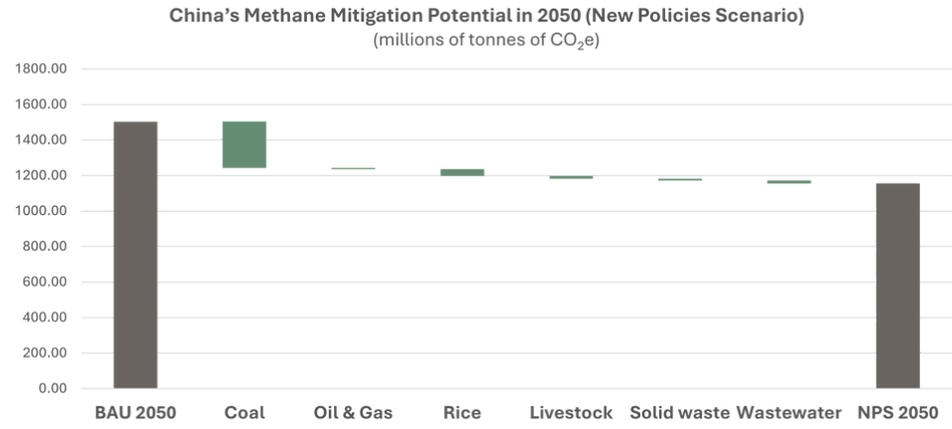
What It Takes to Achieve Deeper Methane Reductions

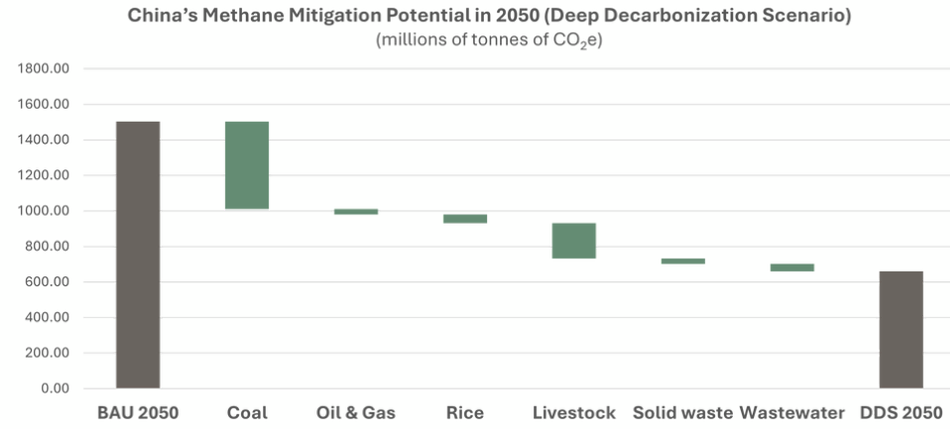
Based on iGDP analysis, China's existing green and low-carbon policies have delivered significant reductions in coal mine methane (CMM) emissions. Under the New Policy Scenario, **annual reductions from CMM** are projected to reach **166 million tons CO_2e in 2035** (left chart), primarily driven by the new Emission Standards for Coalbed Methane (Coal Mine Gas) and incentives for utilizing low-concentration and ventilation air methane (VAM) through CCER methodologies. Further progress can be achieved by scaling up methane mitigation practices across regions, particularly in coal mining, oil and gas operations, and livestock management—areas with the greater potential under the Deep Decarbonization Scenario by 2035 (right chart).





Overview of China's Methane Mitigation Potential Under Different Scenarios by 2050

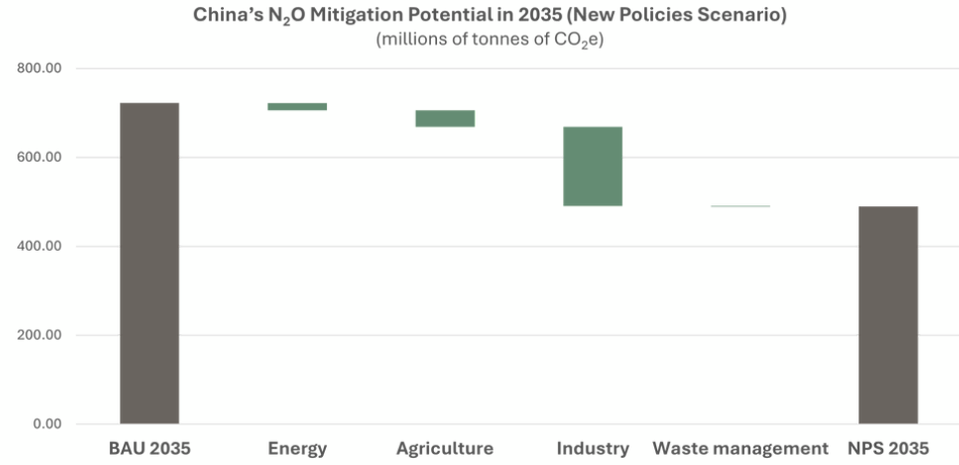


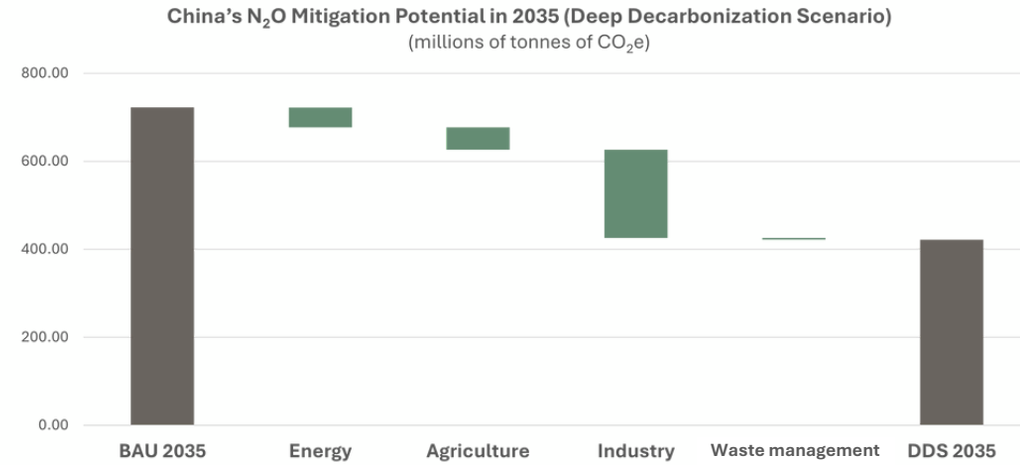


Data Source: iGDP analysis.

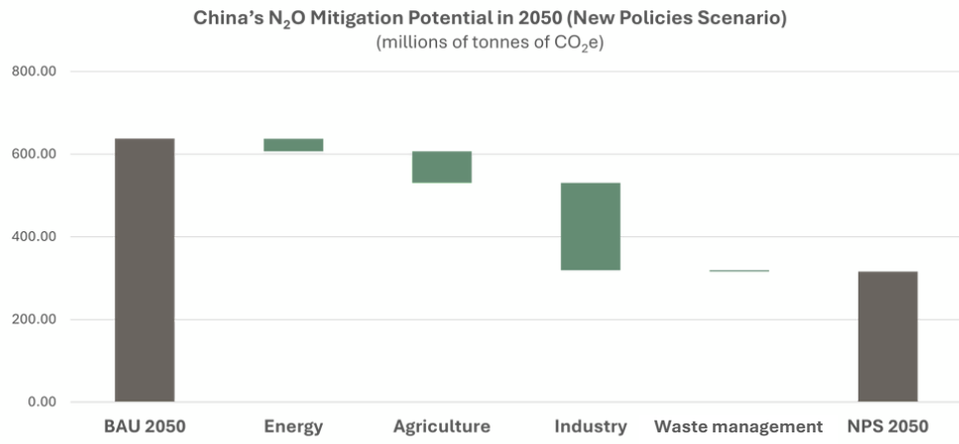
What It Takes to Achieve Deeper Nitrous Oxide Reductions

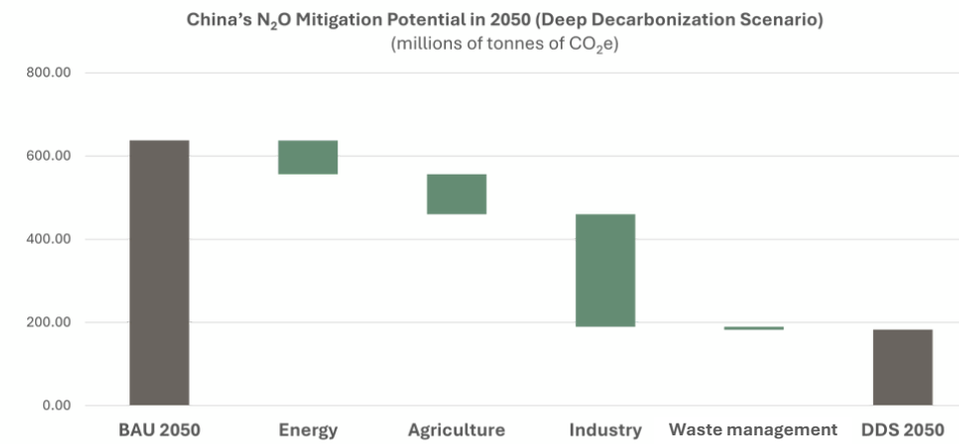
In 2035, under the NPS (left chart), **industrial N_2O mitigation** potential is projected to reach **177 million tons of CO_2e**, accounting for **76%** of total N_2O reductions that year. This progress is largely driven by China's newly introduced Action Plan for the Control of Industrial Nitrous Oxide Emissions. Under the DDS (right chart), additional reductions can be achieved through economic incentives that promote cost-effective technologies and practices, unlocking greater mitigation potential in both agriculture and industry.





Overview of China's N_2O Mitigation Potential Under Different Scenarios by 2050

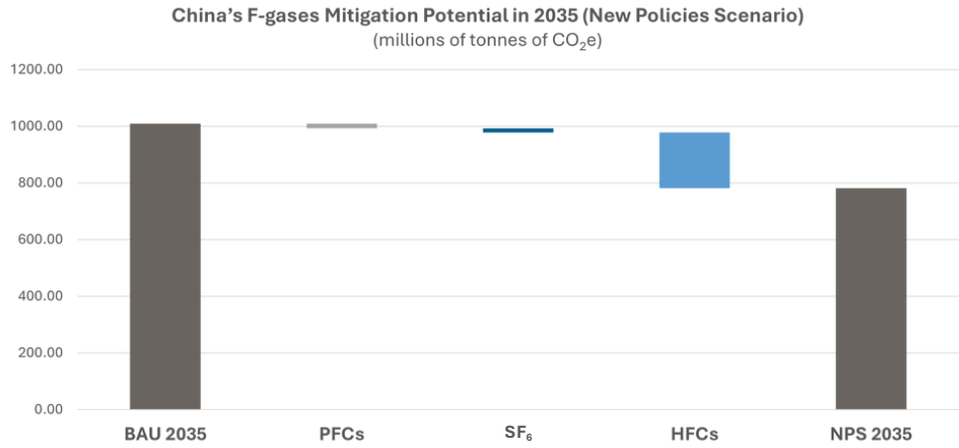


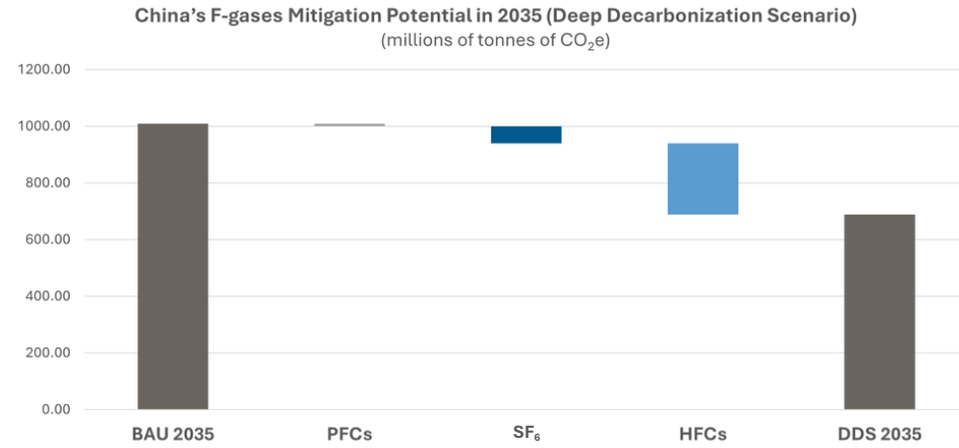


Data Source: iGDP analysis.

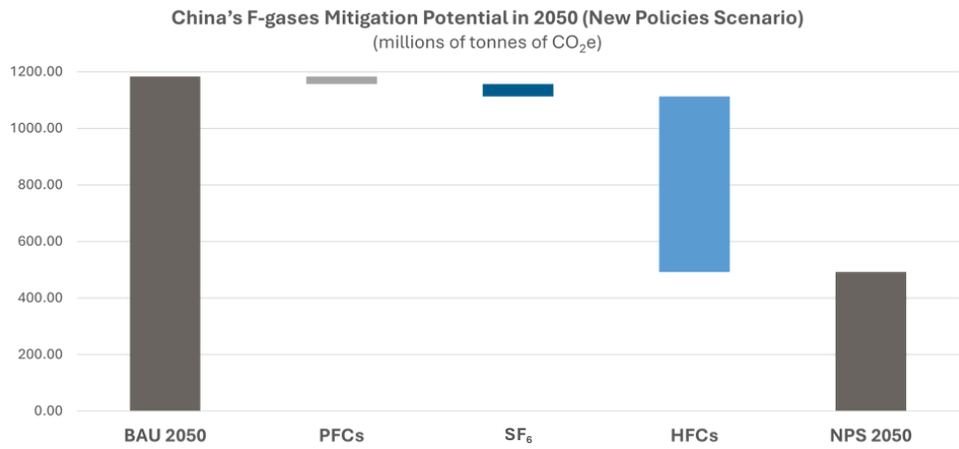
What It Takes to Achieve Deeper F-gases Reductions

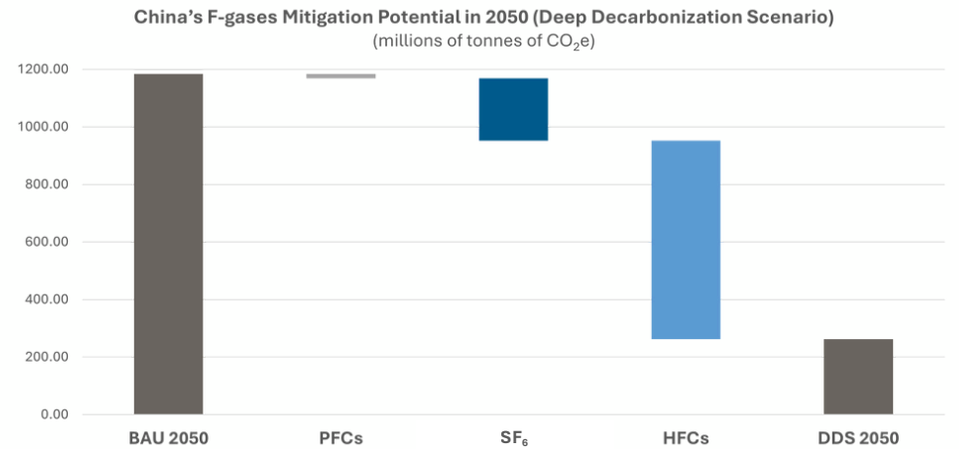
In 2035, under different scenarios, F-gases show varying mitigation potential. Compared to BAU, the NPS (left chart) delivers **the most significant reductions for hydrofluorocarbons (HFCs)**—the largest contributor among F-gases—**with reductions reaching 196 million tons of CO_2e**. This progress is primarily driven by China's compliance with the Kigali Amendment. Under the DDS (right chart), further potential can be achieved by accelerating HFC phase-down strategies and promoting alternatives to sulfur hexafluoride (SF_6).





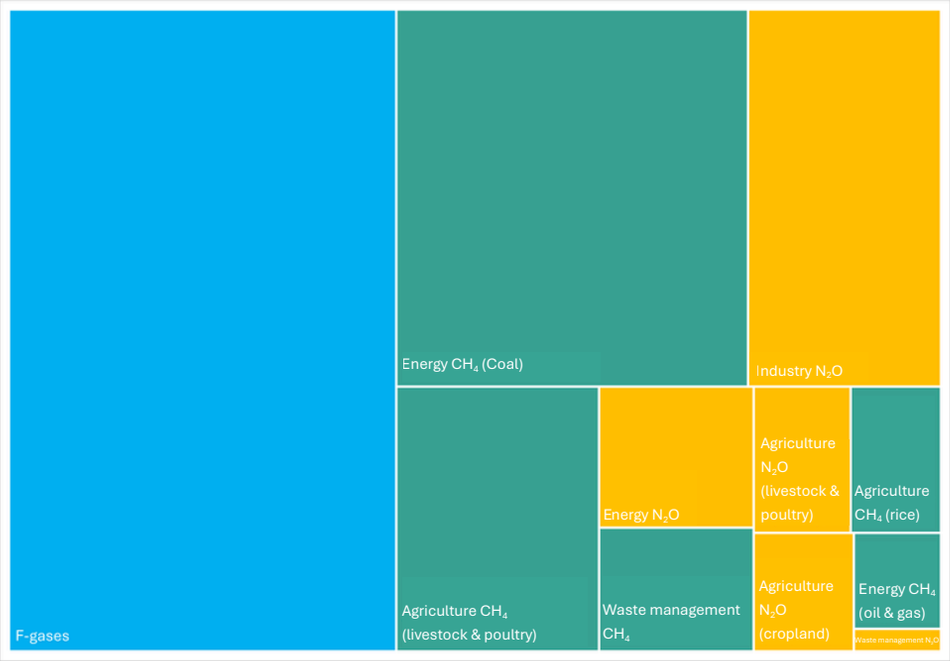
Overview of China's F-gases Mitigation Potential Under Different Scenarios by 2050





Data Source: iGDP analysis.

Delivering Deep 2050 Reductions: Essential Actions Across Key Measures



Data Source: iGDP analysis.

Under the *DDS* in 2050, **F-gas** measures account for **42%** of total mitigation potential—equivalent to a reduction of **920 million tons of CO_2e** compared to BAU. This is primarily driven by accelerated compliance with the Kigali Amendment and the resulting phase-down of HFCs.

Methane (CH_4) contributes **around 38%** of the mitigation potential in 2050. Compared to BAU, CH_4 from the **energy**, **agriculture**, and **waste** sectors declines by **520 million tons**, **250 million tons**, and **70 million tons of CO_2e**, respectively.

Nitrous oxide (N_2O) accounts for **nearly 20%** of the mitigation potential. Industrial process improvements in **adipic acid**, **nitric acid**, and **caprolactam** production could reduce emissions by **270 million tons of CO_2e**, while **agricultural measures**— such as reduced nitrogen fertilizer use—contributing an additional **100 million tons of CO_2e** in emission reductions.

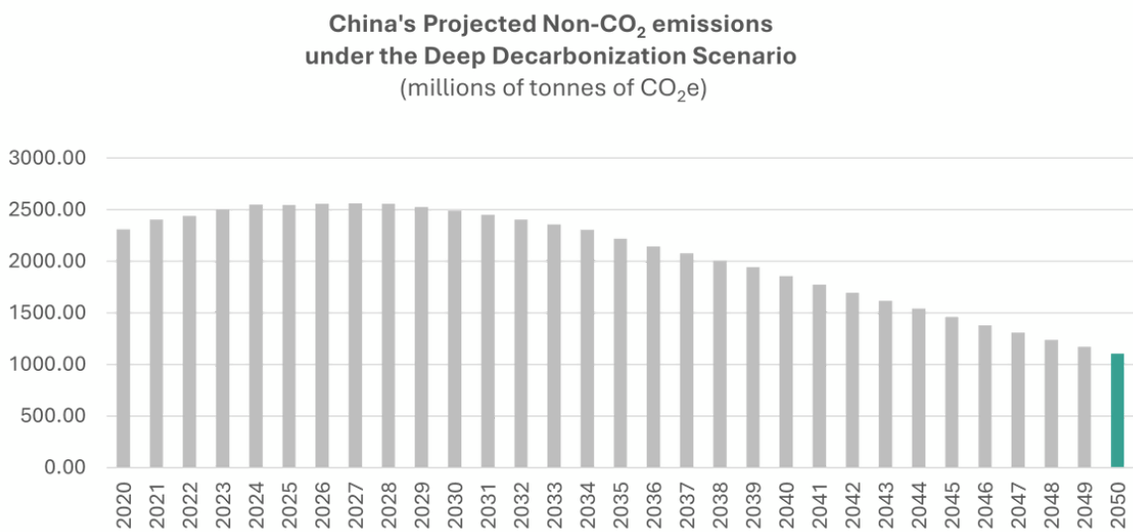
Gas	Major Mitigation Actions	Mitigation Potential (2050)
Methane (CH_4)	• Energy: Reduce coal consumption; strictly enforce new Emission Standards for Coalbed Methane; enhance recovery and utilization of ultra-low concentration CMM and VAM	**23%**
	• Agriculture: Optimize water management in rice paddies; promote high-yield, low-emission varieties, water-saving and drought-resistant varieties; apply biochar; enhance feed additives and livestock waste management; adjust dietary structure to reduce livestock product demand	**11%**
	• Waste: Strengthen waste sorting and recycling; enhance landfill methane capture and utilization; promote circular economy	**4%**
Oxide (N_2O)	• Agriculture: Reduce nitrogen fertilizer use; promote slow- and controlled-release fertilizers and organic fertilizers; improve livestock waste management	**4%**
	• Industry: Adopt catalytic decomposition technologies in the industrial sector to reduce emissions from nitric acid, adipic acid, and caprolactam production	**12%**
	• Energy: Reduce coal consumption and adopt low-emission combustion technologies	**4%**
Fluorinated Gases (F-gases)	• Refrigeration and cooling: Promote the use of low-GWP refrigerants in household air conditioning and cold chain systems; accelerate the implementation of the Kigali Amendment	**42%**

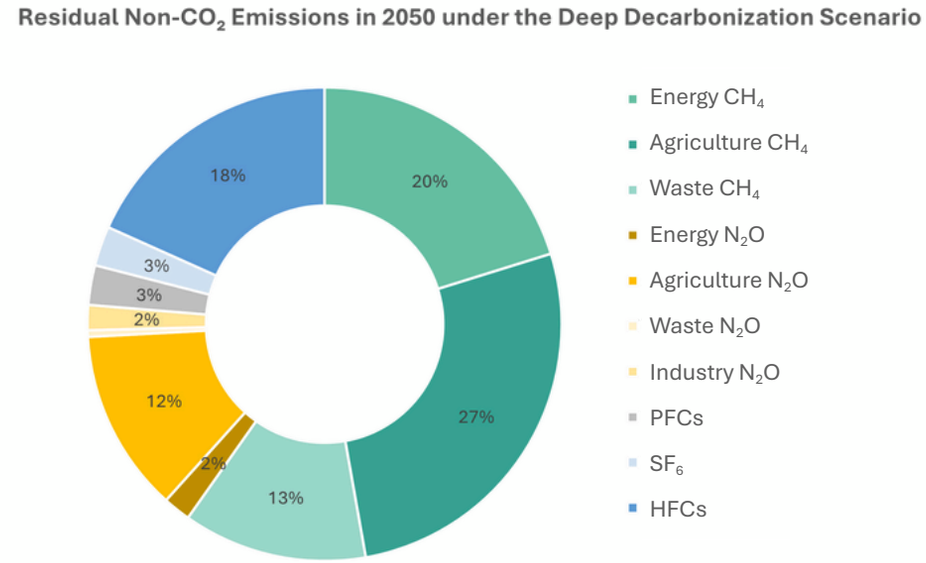
Accelerating Systemic Governance and Technological Innovation to Deepen Non-CO_2 GHG Mitigation

According to iGDP analysis, under the DDS, China's non-CO_2 emissions will still amount to 1.083 billion tons of CO_2e in 2050, with 65% concentrated in agricultural methane, energy-related methane, and industrial HFC emissions.

To achieve deeper reductions, China must accelerate systemic governance and technological innovation across key sectors:

- **Agriculture:** Promote integrated mitigation actions that align with national goals for food security and rural revitalization.
- **Energy:** Strengthen control and utilization of ultra-low concentration CMM and improve monitoring and management of abandoned mine methane (AMM) emissions.
- **Industry:** Accelerate HFCs phase-down through end-of-pipe treatment solutions and the adoption of updated product standards.





Authors: CHEN Meian, ZHU Tongxin, MA Yue, HU Min
Copy Editor: Diego Montero
Design and Layout: BAO Linjie
Recommended Citation: CHEN Meian, ZHU Tongxin, MA Yue & HU Min (2025). China's Non-CO_2 Emissions: Key Opportunities for Rapid Mitigation. Institute for Global Decarbonization Progress (iGDP).
Contact Us: igdpoffice@igdp.cn

Scan the QR code to learn more about iGDP's research on non-CO_2 GHG mitigation:

Prospects for Non-CO_2 Greenhouse Gas Mitigation Opportunities and Challenges Toward 2035

Methane Mitigation Efforts and Prospects

Nitrous Oxide Reduction Efforts and Prospects in China

F-Gases Reduction Efforts and Perspectives in China