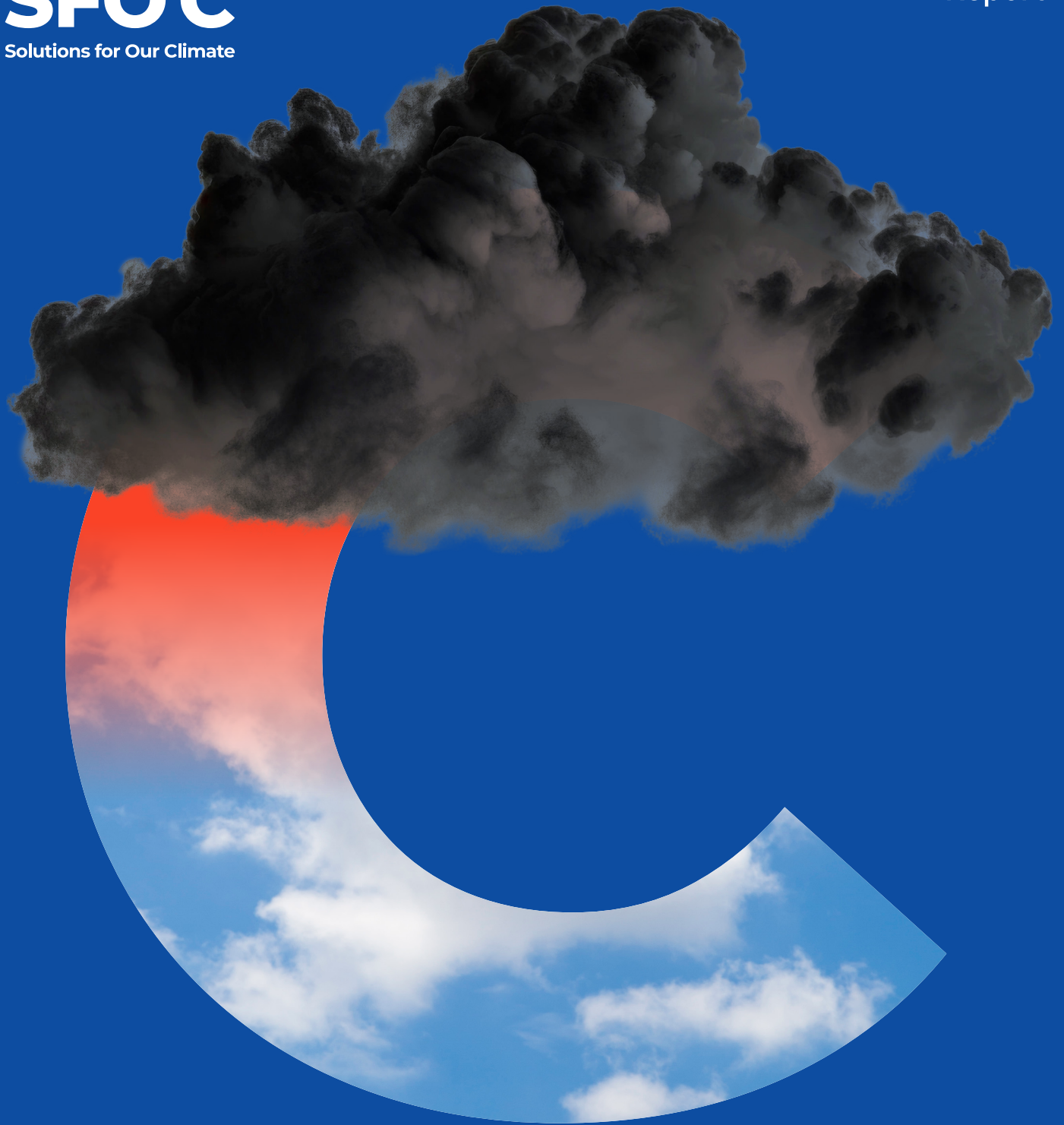




Korea's 2030 Methane Emissions Reduction Roadmap

A Suitable Pathway to 1.5°C?

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Summary

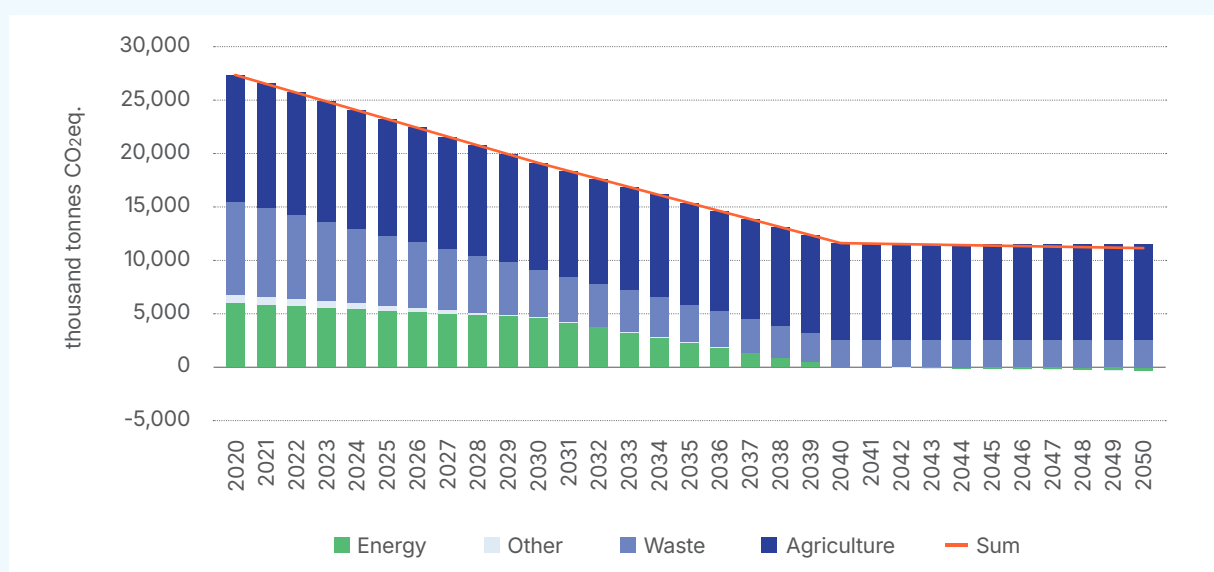
The Korean government released a methane reduction roadmap in November 2023, demonstrating alignment with global methane reduction initiatives. The roadmap establishes a 30% methane reduction target by 2030 from 2020 levels, with sector-specific reduction targets across waste (49%), agriculture and livestock (34.2%), and energy (22.7%). However, questions remain about the roadmap's alignment with Korea's long-term carbon neutrality goals and integration with existing national strategies, including the 2050 Carbon Neutrality Scenarios and the 2050 Carbon Neutral Strategy for Agriculture and Food. Solutions for Our Climate conducted an analysis¹ whether the government's methane reduction targets for the waste, agriculture, and energy sectors to meet the 30% reduction target in 2030 are feasible in the medium to long term through 2050.

Analysis of the sectoral pathways reveals the following:

- Based on the government's 2050 Carbon Neutrality Scenarios, the energy sector must achieve accelerated reductions, requiring negative emissions after 2040.
- The agriculture/livestock and waste sectors face inherent constraints on methane reduction beyond 2040, largely due to the difficulty of reducing livestock numbers and rice paddies.

These findings indicate that the current sectoral targets in the reduction roadmap may not be sufficient to meet Korea's 2050 carbon neutrality goals and warrant reassessment.

Sectoral Reduction Pathways Through 2050 to Achieve 30% Methane Reduction by 2030

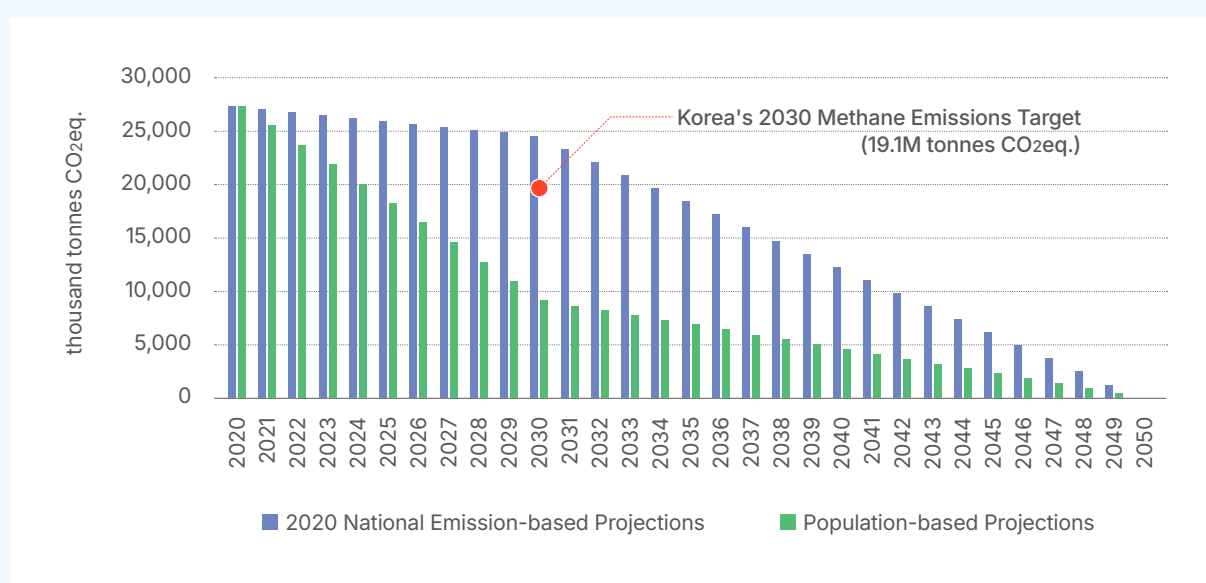


¹ Note: This analysis was constrained by data limitations, particularly regarding detailed government sector-specific methane reduction plans, which affected the bottom-up projection modeling of national methane reduction pathways.

Modeling pathways to zero methane emissions by 2050 follows three primary approaches: national emissions-based, population-based, and GDP-based projections. National emission-based projections were made from 2020 national data on methane emissions. Population-based projections were made from 2020 national population statistics, assuming equal per capita methane reduction commitments. GDP-based projections were made from countries' nominal GDP per capita. While Korea's 2030 target appears adequate under the national emissions criterion, a population-based analysis, which factors in methane contributions linked to international trade alongside territorial emissions, shows that the current methane reduction target falls short.

Solutions for Our Climate considers the population-based approach the most accurate in reflecting Korea's full methane reduction commitments, since Korea must take responsibility for the methane emissions coming from international trade as well as emissions from within the country. Given that the Global Methane Pledge frames the 2030 methane reduction target as "at least" 30%, these findings suggest Korea's current 2030 target requires upward revision.

Korea's Methane Reduction Pathways Through 2050 Based on National Emissions and Population



Based on these findings, Solutions for Our Climate anticipates the establishment of robust legislative and policy frameworks to achieve meaningful methane emission reductions and urges the following improvements to Korea's national methane reduction roadmap:

- Strengthen national methane reduction targets to align with the Paris Agreement's 1.5°C climate threshold by 2050;
- Enhance the energy sector's reduction targets to match the ambition demonstrated in other sectors, particularly agriculture and livestock.

1. Introduction: Background and Purpose

Methane is a greenhouse gas with a global warming potential of 28 times over 100 years, and approximately 80 times over 20 years to carbon dioxide. Therefore, rapid methane reduction represents one of the most effective pathways for mitigating global temperature rise. Recognizing this potential, the Global Methane Pledge was launched in 2021 under U.S. and European leadership to promote collective international action.

Korea joined the Global Methane Pledge, committing to a 30% reduction in methane emissions by 2030 compared to 2020 levels. In November 2023, two years after joining the pledge, the Presidential 2050 Carbon Neutrality and Green Growth Commission published Korea's 2030 Methane Emissions Reduction Roadmap, which set sector-specific targets: a 49% reduction (4.5 million tonnes CO₂eq.) emissions in the waste sector, a 34.2% reduction (9.9 million tonnes CO₂eq.) in the agriculture and livestock sector; and a 22.7% reduction (4.6 million tonnes CO₂eq.) in the energy sector.

[Table 1] Sectoral Methane Reduction Targets and Methods Under the 2030 Methane Emissions Reduction Roadmap

Units: 1,000,000 tonnes CO₂eq.

Sector	2020 Emissions	2030 Target	Reduction Methods
Waste	8.8	4.5 (↓49%)	- Reduction of organic waste - Expansion of organic waste biogasification - Improvement of unsanitary landfills
Agriculture & Livestock	11.9	9.9 (↓34.2%)	- Systematic paddy water management - Development of low-carbon feed - Improved livestock manure treatment and resource recovery
Energy	5.9	4.6 (↓22.7%)	- Development, management and regular monitoring of fugitive emissions - Reduction of fossil fuel use through energy mix transition and energy efficiency measures
Total	27.4	19.1 (↓30%)	-

Source: Presidential 2050 Carbon Neutrality and Green Growth Commission (2023)ⁱ; Ministry of Environment (2023)ⁱⁱ.

While Korea's 2030 Methane Emissions Reduction Roadmap published in 2023 represents significant progress, it faces several key limitations:

1. **Alignment with Global Targets:** The roadmap's compatibility with the Paris Agreement's goal to limit global temperature rise to 1.5°C above pre-industrial levels, which is the international community's critical threshold for averting the worst climate impacts, remains unclear.
2. **Lack of Annual Reduction Pathways:** The roadmap does not provide detailed year-by-year pathways necessary to achieve the 2030 targets.
3. **Insufficient Research on Sectoral Emission Reduction Potential:** The targets were largely based on the Global Methane Pledge, without sufficient analysis of sector-specific reduction potentials in Korea.

Notably, the IPCC's Sixth Assessment Report calls for a 34% reduction in global methane emissions by 2030 compared to 2019 levels to maintain the 1.5°C goal (IPCC, 2023)ⁱⁱⁱ, which exceeds the Global Methane Pledge's 30% reduction target by 4 percentage points.

This report aims to present Korea's methane reduction commitments and pathways required to meet the 1.5°C target by 2050. The research outlines Korea's long-term methane reduction pathways through 2050, evaluates the adequacy of the government's 30% reduction target for 2030 as a mid-term pathway within the broader context of the 2050 goals, and examines sectoral reduction pathways for waste, energy, and agriculture and livestock.

2. Analysis

2.1. Scenario Design

This study uses Shared Socioeconomic Pathways-Representative Concentration Pathways (SSP-RCP) scenarios² to project global methane emissions under the 1.5°C climate targets and determine Korea's maximum sectoral methane reduction potential. The scenarios were used to derive both global and Korean methane budgets.

The study employed a different approach from carbon budget calculations to assess Korea's methane budget. While carbon budgets typically allocate the total permissible greenhouse gas emissions among nations to stay within the 1.5°C warming limit, this study allocated reduction commitments based on specific target years and sectors to calculate methane budgets. The separate analysis of methane represents a methodological limitation as it diverges from conventional approaches that include methane as part of the overall carbon budget, where methane is typically considered an additional warming factor to carbon dioxide. Additionally, limited existing research on maximum sectoral methane reduction potential posed challenges in developing realistic sectoral reduction pathways. Given these constraints, the study applied a top-down approach to establish detailed reduction pathways by sector.

This study calculated Korea's methane reduction "effort-sharing" and sectoral reduction pathways based on the following socioeconomic factors from the SSP-RCP scenarios:

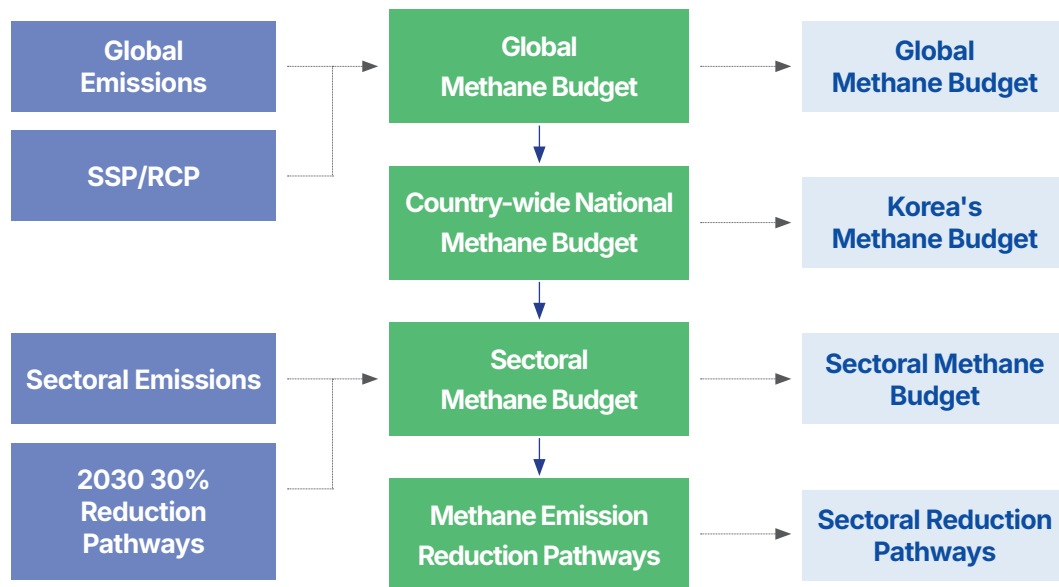
- 2020 National Methane Emissions: Global methane reduction commitments were allocated based on national emissions. Nations with higher methane emissions require greater reductions.
- Population: The global methane budget was allocated according to 2020 national population statistics, assuming equal per capita reduction commitments.
- Nominal GDP Per Capita: Methane reduction effort-sharing was allocated based on nominal GDP per capita, with nations having higher GDP per capita expected to bear greater reduction responsibilities.

The study referenced national greenhouse gas inventory statistics, the 2050 Carbon Neutrality Scenarios^{iv}, as well as government policies and roadmaps for each sector. In performing the

2 The SSP-RCP scenarios combine two previously separate frameworks into an integrated climate change scenario framework (Shared Socioeconomic Pathways).

analysis, natural methane emissions from sources such as wetlands were accounted for. The baseline year was set as 2020, with 2030 as a critical inflection point for determining methane emissions reduction pathways through 2050.

[Figure 1] Research Flow Chart



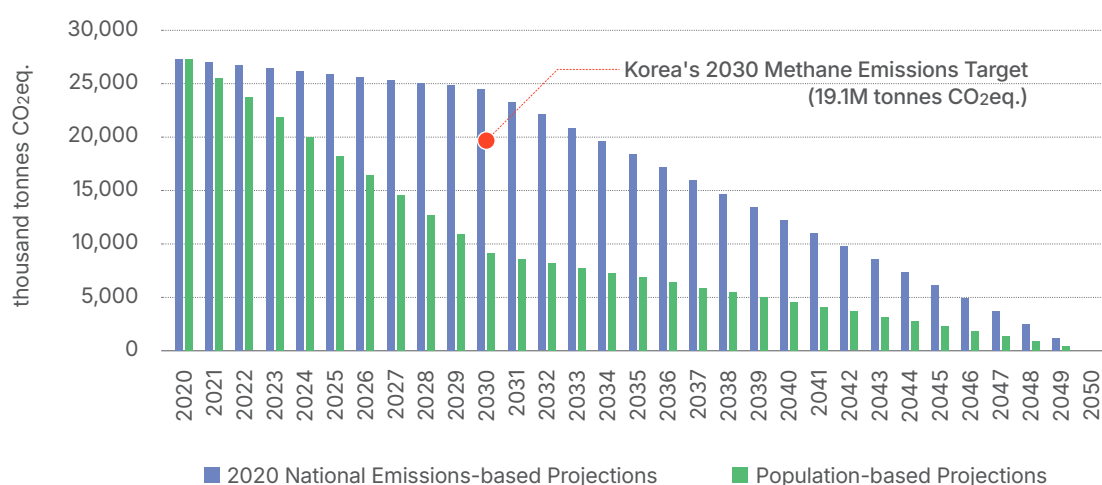
2.2. Analysis of Korea's Methane Reduction Pathway by 2050

2.2.1. National Methane Reduction Pathway

The SSP-RCP model analysis reveals varying reduction pathways across the three criteria. The population-based allocation indicates that Korea requires a steeper reduction pathway than the current 2030 Methane Emissions Reduction Roadmap targets (Figure 2). While Korea ranked approximately 50th globally in methane emissions in 2020, its population of 50 million ranks within the top 20 worldwide. This underscores the need for more aggressive and comprehensive reduction measures and policies to limit global temperature rise to 1.5°C than those currently outlined in the roadmap.

Based on 2020 national emissions, the reduction pathway shows a moderate decline until 2030, followed by an accelerated reduction thereafter. The allocation based on GDP per capita was excluded from the comparative analysis as it yielded negative methane budgets, which were deemed unrealistic.

[Figure 2] Korea's Methane Reduction Pathway through 2050 Based on 2020 National Emissions and Population



To meet the 30% reduction target by 2030 under the Global Methane Pledge and 2030 Methane Emissions Reduction Roadmap, Korea must reduce emissions by 8.3 million tonnes CO₂eq. from 2020 levels. Figure 2 shows that **the population-based allocation requires an 18 million tonnes CO₂eq. reduction by 2030**, while projections based on 2020 national emissions require 2.7 million tonnes CO₂eq. reduction by 2030—falling short of the Global Methane Pledge target of 30%.

Overall, the study's population-based analysis indicates that Korea should increase its methane reduction commitments beyond the current 2030 Methane Emissions Reduction Roadmap targets and must achieve at least 30% reductions by 2030.

2.2.2. Sectoral Methane Reduction Pathways

This study applied a top-down approach to determine Korea's maximum sectoral methane reduction pathways. This approach has limitations as it does not consider sector-specific reduction potentials and may yield different results from bottom-up approaches that are based on detailed sectoral measures.

Table 2 shows the two primary sources used in the SSP-RCP model analysis of maximum sectoral reduction commitments: the 2050 Carbon Neutrality Scenarios for the energy and waste sectors and the 2050 Carbon Neutral Strategy for Agriculture and Food^v for the agriculture and livestock sector.

[Table 2] Sources for the Maximum Sectoral Methane Reduction Analysis

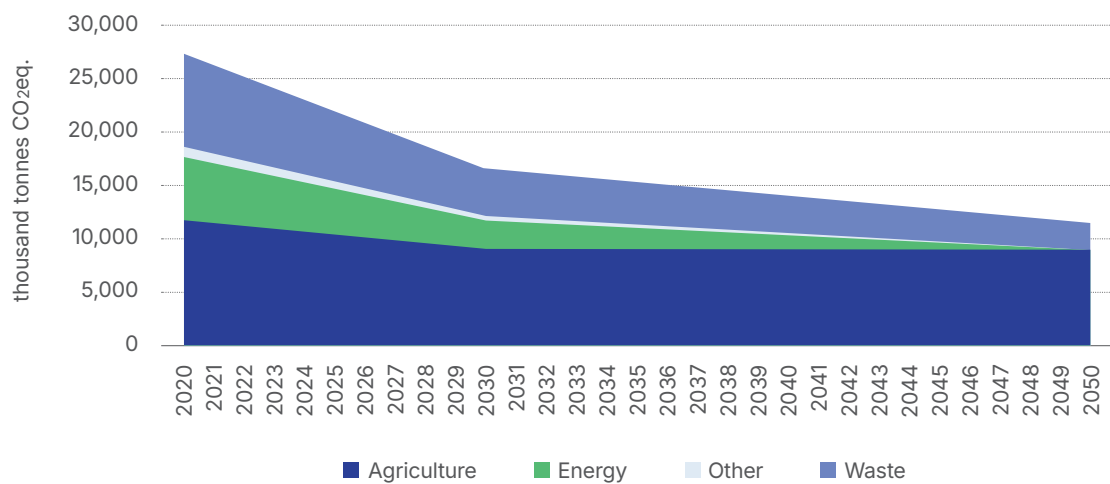
Units: 1,000,000 tonnes CO₂eq.

Sector	Sub-sector	Maximum Reduction Potential	Description
Energy	Fuel Combustion	1.9	Greenhouse gas emissions (including methane) from the energy sector are projected to reach zero by 2050, as specified in the 2050 Carbon Neutrality Scenarios.
	Fugitive Emissions	4.4	
Industrial Processes	Process Emissions	N/A	No reference available (zero emissions assumed by 2050).
Agriculture and Livestock	Enteric Fermentation	1.7	Applied reduction target of 3.755 million tonnes CO ₂ eq. by 2050, as specified in the 2050 Carbon Neutral Strategy for Agriculture and Food.
	Livestock Manure	0.4	Applied 11.4% reduction by 2050 from the 2018 baseline expected through the transfer of livestock manure to non-agricultural sectors, as specified in the 2050 Carbon Neutral Strategy for Agriculture and Food.
	Rice Cultivation	1.99	Applied projected greenhouse gas emissions of 4.31 million tonnes CO ₂ eq. from rice cultivation by 2050, as specified in the 2050 Carbon Neutral Strategy for Agriculture and Food.
	Burning Crop Residues	0	Zero emissions assumed by 2050).
LULUCF	LULUCF	N/A	No reference available (zero emissions assumed by 2050).
Waste	Landfill	6.2	Applied projected methane emissions of 1.6 million tonnes CO ₂ eq. by 2050, as specified in the 2050 Carbon Neutrality Scenarios.
	Wastewater Treatment	N/A	No reference available (zero emissions assumed by 2050).
	Other	N/A	No reference available (zero emissions assumed by 2050).

When allocating Korea's methane budget across sectors based on maximum reduction commitments, agriculture/livestock and waste sectors initially show significantly reduced obligations, while the energy sector requires more aggressive reductions. The agriculture and waste sectors face unique challenges in achieving rapid short-term reductions due to their connection to essential daily activities such as food consumption and waste generation. However,

these sectors offer substantial long-term reduction potential and should bear increased long-term reduction commitments as policy interventions can yield significant results over the medium to long term. The waste sector's primary focus should be achieving the 49% reduction target in the 2030 Methane Emissions Reduction Roadmap. After meeting this target, long-term reduction goals through 2050 should be established with a focus on source reduction of organic waste.

[Figure 3] Korea's Methane Reduction Pathway by Sector



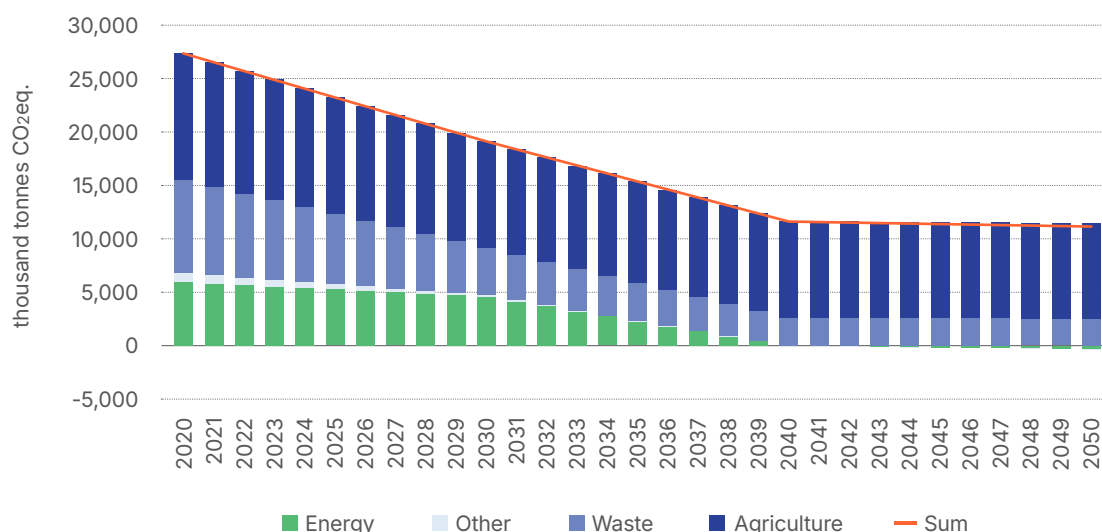
3. Conclusion: Recommendations for Achieving 2030 Methane Reduction Targets

3.1. Key Implications

The Korean government must clearly establish the rationale for its goal of reducing methane emissions by 30% compared to 2020 levels by 2030. A viable approach would be to first determine the total allowable carbon and methane budgets by 2050 and subsequently work backward to set appropriate 2030 targets. In other words, to align with the goal of limiting global temperature rise to 1.5°C above pre-industrial levels, the government should first identify the 2050 methane budget and use this to determine the necessary 2030 methane budget. As aforementioned, since the carbon budget centers on carbon dioxide to guide overall greenhouse gas reduction targets by the year 2050, the methane budget should be set similarly with 2050 as the target year.

This study allocated Korea's potential methane reduction pathways based on 2020 emission levels, targeting a 30% decrease by 2030. As Figure 4 illustrates, the reduction pace established through 2030 must continue beyond that year, with the energy sector achieving negative emissions after 2040. Given the inherent constraints on methane reduction in the agriculture and livestock sectors, the energy sector must pursue accelerated reductions. These efforts must extend beyond Korea's borders to address emissions from fossil fuel imports and transportation-related emissions from international trade.

Meeting energy sector targets requires reducing both domestic fugitive emissions (Scope 1) and emissions from overseas resource development projects (Scope 3), with the latter potentially contributing to Korea's overall methane reduction goals. This necessitates strengthened cooperation with exporting countries to reduce methane emissions from fossil fuel production for Korean imports.

[Figure 4] Projected Reduction Pathway to a 30% Methane Reduction by 2030

Korea must maintain accelerated reductions through 2040 to meet the 2050 methane budget, continuing beyond the 30% reduction target for 2030. This calls for not only rapid transitions in the energy sector but also increased R&D funding post-2030 to develop diverse reduction technologies for the agriculture and livestock sectors. Implementation must be strategic across sectors, with appropriate timing and methods to optimize methane reduction outcomes.

Clear medium to long-term targets and diversified reduction measures are essential for the agriculture and livestock sector to achieve its reduction goals. To this end, current greenhouse gas reduction strategies from the Ministry of Agriculture, Food and Rural Affairs—the 2050 Carbon Neutral Strategy for Agriculture and Food and the 2030 Livestock Sector Greenhouse Gas Reduction and Green Growth Strategy—require revision and strengthening, particularly as the latter lacks specified methane reduction targets. Success depends on quantifying and documenting the potential impact of key agricultural and livestock measures, including improved manure management, energy conversion technologies, and low-methane feed adoption.

3.2. Next Steps

Further research must address the limitations noted in this study's scenario design. Priority should be given to analyzing methane reduction technologies and their reduction potentials from a cost-effectiveness perspective within Korea's specific context. This analysis will facilitate the development of methane reduction pathways that align with the national carbon budget and support the 1.5°C temperature goal through coordinated methane-carbon reduction strategies.

References

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- iii IPCC. (2023, March 19). [Adopted Longer Report](#). In: *Climate Change 2023: Synthesis Report*. Sixth Assessment Report of the Intergovernmental Panel on Climate Change.
- iv 2050 Carbon Neutrality Commission. (2021). *2050 Carbon Neutrality Scenarios*.
- v Ministry of Agriculture, Food and Rural Affairs. (2021). *2050 Carbon Neutral Strategy for Agriculture and Food*



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Solutions for Our Climate(SFOC) is an independent policy research and advocacy group that aims to make emissions trajectories across Asia compatible with the Paris Agreement 1.5°C warming target.