iGDP
绿色创新发展研究院
Institute for Global Decarbonization Progress

Policy Brief Series

Methane Mitigation Efforts and Prospects in China

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1. The Importance of Methane Emissions Reduction

Methane (CH_4) is the second largest greenhouse gas after carbon dioxide (CO_2) and is growing at the fastest rate globally in decades,[1] with emissions reaching a record high in 2023.[2] According to *the IPCC Sixth Assessment Report* (AR6), human activities have caused global temperatures to rise by 1.07°C between 2010 and 2019, with 0.5°C attributable to methane.[3]

As a short-lived climate pollutant (SLCP) with a 12-year lifespan, methane mitigation offers rapid climate benefits.[4] The AR6 considers methane emissions reductions as one of the most efficient methods to curb global warming.[5]

Beyond addressing climate change, reducing methane emissions can improve environmental quality, public health, and food security. According to the *Global Methane Assessment* jointly released by the Climate and Clean Air Coalition (CCAC) and the United Nations Environment Programme (UNEP), a one-million-ton reduction in methane could prevent 1,430 premature deaths, 4,000 asthma-related medical treatments, 145,000 tons of ozone-induced loss in food production, and 4 million hours of work lost due to extreme heat per year.[6]

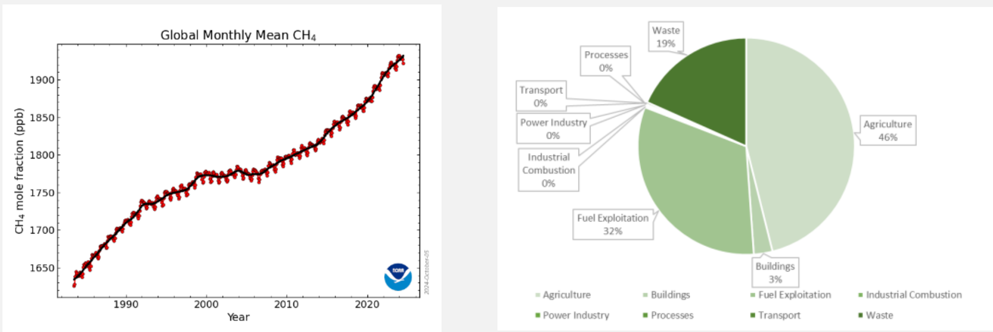
[1] Milman, O. (2024, July 30). Global methane emissions rising at fastest rate in decades, scientists warn. The Guardian. https://www.theguardian.com/environment/article/2024/jul/30/methane-emissions-study
[2] NOAA. (2024, August 22). International report confirms record-high global temperatures, greenhouse gases in 2023. https://www.noaa.gov/news-release/international-report-confirms-record-high-global-temperatures-greenhouse-gases-in-2023
[3] Shindell, D., Sadavarte, P., Aben, I., Bredariol, T. D. O., Dreyfus, G., Höglund-Isaksson, L., ... & Maasakkers, J. D. (2024). The methane imperative. Frontiers in Science, 2, 1349770.
[4] Climate and Clean Air Coalition. (2024). Methane. https://www.ccacoalition.org/zh-CN/short-lived-climate-pollutants/methane
[5] Min, H., Hong, L., Meian, Chen., Wanyi, W., & Haomiao, G. (2022). Methane Emission Reduction: A New Focus for Carbon Neutrality.
[6] United Nations Environment Programme and Climate and Clean Air Coalition (2021). Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions.

2. Status and Trends of Methane Emissions

2.1. Global Emissions

Data from the United States National Oceanic and Atmospheric Administration (NOAA)[7] shows methane emissions have risen steadily since 1980s (Figure 1, left). In 2023, agriculture was the largest source of anthropogenic methane emissions, responsible for 46% of global methane emissions, followed by the energy sector (nearly one-third), and waste management (19%).

Figure 1 Global methane emissions trends (left) and its emissions structure in 2023 (right)



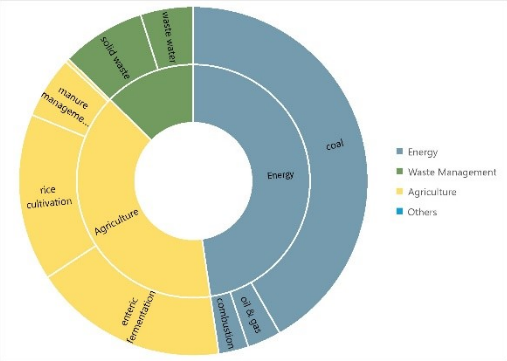
Source: The left graph is from NOAA and the right graph is made by iGDP based on information from the EDGAR Global Atmospheric Research Emissions Database.

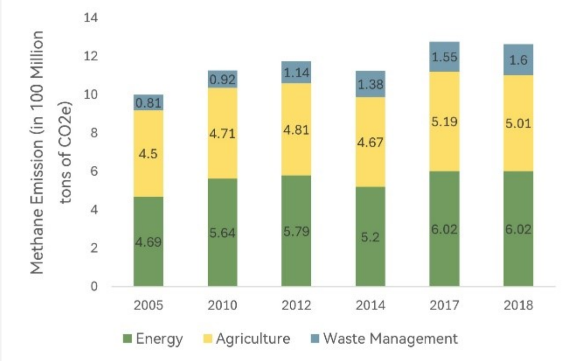
2.2. China's Emissions

According to China's *Third Biennial Update Report on Climate Change* (BUR3),[8] the country's methane emissions in 2018 (excluding LULUCF) totaled over 60 million tons. The largest source was energy activities, contributing 47.7%, primarily from fugitive emissions (44.9%) and a minority from incomplete fuel combustion (2.8%). This was followed by agriculture (39.7%), with key sources being enteric fermentation (18%) and rice cultivation (15.5%). Waste disposal accounted for 12.7% of emissions, while the industrial sector was less than 0.01%.

[7] NOAA. (2024). Global Monitoring Laboratory. https://gml.noaa.gov/ccgg/trends_ch4/
[8] Ministry of Ecology and Environment. (2023, December). The People's Republic of China Third Biennial Update Report on Climate Change. https://unfccc.int/sites/default/files/resource/China_BUR3_English.pdf

Figure 2 China's methane emission structure in 2018 (left) and historical methane emission trends (right)





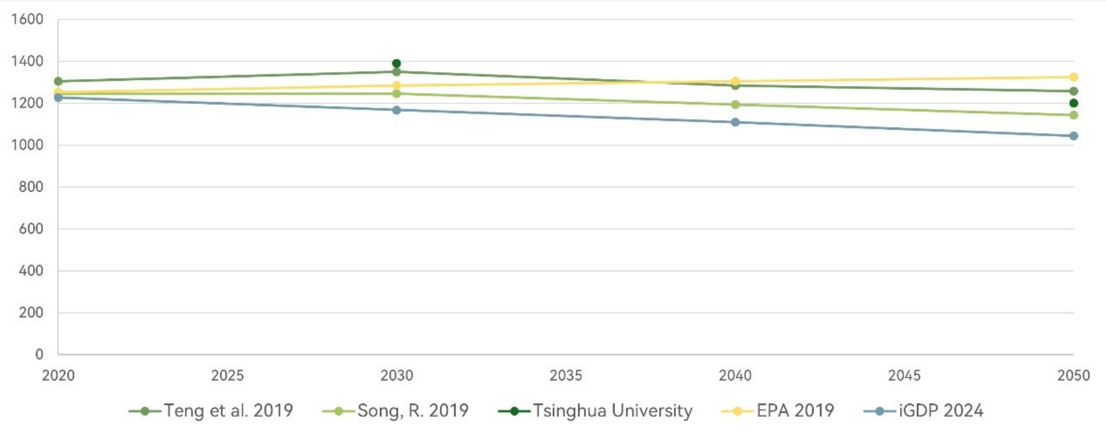
Note: Global Warming Potential (GWP) =21.

Source: iGDP, based on national greenhouse gas inventory data from China's *Second and Third Biennial Update Reports on Climate Change*, as well as the *Fourth National Communication on Climate Change*.

China's methane emissions showed a fluctuating upward trend from 2005 to 2018 (Figure 2 right). Emissions from energy activities increased before leveling off. Agricultural emissions fluctuated but eventually declined, while emissions from waste disposal steadily rose throughout the period.

Figure 3 Prediction of methane emission trend in China under different studies (million tons of CO_2e, GWP=21)

Source: Teng et al,. 2019[9]. Song, 2019[10]. EPA, 2019[11]. Tsinghua University, 2021[12]. iGDP, 2024[13].



[9] Fei, T., Xin, S., & Xin, W. (2019). Can China peak its non-CO2 GHG emissions before 2030 by implementing its nationally determined contribution? Environmental Science & Technology, 53(21), 12168–12176

[10] Ranping, S. (2019). Climate Change Mitigation Opportunities in China: Non-CO2 Greenhouse Gases.

[11] US Environmental Protection Agency. (2019). Global Non-CO2 Greenhouse Gas Emission Projections & Mitigation Potential: 2015-2050

[12] Institute of Climate Change and Sustainable Development, Tsinghua University. (2021). China's long-term low-carbon development strategy and transition pathway. China Environment Publishing Group.

[13] iGDP. (2024). Energy Policy Simulator. https://energypolicy.solutions/home/china-igdp/en

Studies show that China's methane emissions are expected to plateau during the 15th Five-Year Plan but could remain over one billion tons of CO_2 equivalent by 2050.

3. Methane Reduction Policy Environment

3.1. Global Policy

Global attention to methane reduction is growing, prompting countries and regions to roll out comprehensive strategies. The EU, U.S., Canada, and Brazil have developed plans targeting methane emissions in energy, agriculture, and waste management. These plans also aim to improve data collection for better tracking. Alongside fiscal measures, some countries are also using market mechanisms like carbon trading to drive methane reductions.

Methane reduction is now a key focus of global cooperation. At COP 26 in 2021, over 100 countries signed the Global Methane Pledge, committing to a 30% reduction below the 2020 level by 2030. In 2023, China and the U.S. reaffirmed this commitment in *The Sunnylands Statement on Enhancing Cooperation to Address the Climate Crisis*, aiming to include methane reduction targets in their 2035 Nationally Determined Contributions (NDCs). Both countries pledged to support local climate initiatives through policy dialogue and sharing best practices.[14]

[14] Ministry of Ecology and Environment. (2021, November 15). Xinhua News Agency: Sunnylands Statement on Strengthening Cooperation to Address the Climate Crisis. http://www.news.cn/2023-11/15/c_1129976165.htm

Table 1 Methane reduction strategies and plans issued by major countries

Country	Policy (Release time)	Areas of Focus	Key Actions and Objectives
United States	Methane Reduction Action Plan[15] (2021)	Comprehensive	• Rules to reduce methane and other pollution from **oil & gas** operations by nearly 80% from 2024 to 2038[16] • $11.3 billion for **abandoned mine** remediation and methane reductions • **Waste**: Landfill gas collection and combustion rate will reach 70%; 50% reduction in food loss by 2030 (vs. 2015) • **Agriculture:** 10% reduction in emission by 2030 (vs. 2019) through economic incentives-based measures and voluntary partnerships
Canada	Faster and Further: Canada's Methane Strategy[17] (2022)	Comprehensive	• Rules to reduce methane and other pollution from **oil & gas** operations by nearly 80% from 2024 to 2038[18] • $11.3 billion for **abandoned mine** remediation and methane reductions • **Waste**: Landfill gas collection and combustion rate will reach 70%; 50% reduction in food loss by 2030 (vs. 2015) • **Agriculture:** 10% reduction in emission by 2030 (vs. 2019) through economic incentives-based measures and voluntary partnerships
European Union	Methane Reduction Strategy[19] (2020)	Comprehensive	• **Energy:** Strengthen gas leak detection and repair • Promote waste-to-energy and low-emission agricultural practices • Improve **landfill** gas management for energy recovery
	EU New Methane Regulation[20] (2024)	Energy	• Establish **MRV** (Measurement, Reporting, and Verification) for emission sources • Enforce mandatory **leak detection and repair** of all oil & gas equipment • Ban conventional venting and flaring in oil & gas industry; limit non-routine flaring (e.g., due to technical failure) • By 2030, **methane intensity** of imported coal, oil, and gas must meet limits • Restrict venting from heating coal mines/abandoned mines by 2027/2030 • Create an **inventory** for mines closed since 1954 and monitor their methane emissions
Brazil	National Zero Methane Plan[21] (2022).	Comprehensive	• Encourage carbon markets, especially **methane credits** • Promote **biogas technologies**, such as biodigesters and biogas purification • Support methane reduction **R&D** • Promote **cooperation** on financing, capacity-building, development, transfer and diffusion of technologies

Source: compiled by iGDP.

[15] The White House Office of Domestic Climate Policy. (2021). The White House. https://www.whitehouse.gov/wp-content/uploads/2021/11/US-Methane-Emissions-Reduction-Action-Plan-1.pdf
[16] Environmental Protection Agency. (2023, December 2). Key Things to Know About EPA's Final Rule to Reduce Methane
and Other Pollution from Oil and Natural Gas Operations. https://www.epa.gov/system/files/documents/2023-12/key-things-to-know-about-epas-final-rule-for-oil-and-natural-gas-operations.fact-sheet.pdf
[17] Government of Canada. (2022). Faster and Further: Canada's Methane Strategy. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reducing-methane-emissions/faster-further-strategy.html
[18] Environmental Protection Agency. (2023, December 2). Key Things to Know About EPA's Final Rule to Reduce Methane
and Other Pollution from Oil and Natural Gas Operations. https://www.epa.gov/system/files/documents/2023-12/key-things-to-know-about-epas-final-rule-for-oil-and-natural-gas-operations.fact-sheet.pdf
[19] European Commission. (2020). EU strategy to reduce methane emissions. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0663
[20] The European Parliament and the Council of the European Union. (2024). Regulation (EU) 2024/1787 of the European Parliament and of the Council of 13 June 2024 on the reduction of methane emissions in the energy sector and amending Regulation (EU) 2019/942. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401787
[21] International Energy Agency. (2023, February 14). National Programme for the Reduction of Methane Emissions - Zero Methane. https://www.iea.org/policies/17045-national-programme-for-the-reduction-of-methane-emissions-zero-methane

3.2. China's Policy

As early as 2007, China's first *National Plan on Climate Change* had put forward methane emission reduction actions and coal mine methane (CMM) reduction targets. Since the 14^{th} Five-Year Plan and the dual carbon goals, China has intensified its focus on methane reduction, introducing several policies (Table 2). In November 2023, the *Methane Emission Control Action Plan* was issued, aiming to establish a methane supervision system to effectively and systematically control emissions.

Table 2 China's methane emission reduction policies released since "14th Five-Year Plan"

<table>
<tr><th colspan="2">Areas and Emission Sources</th><th>Policy Name</th><th>Specific Actions and Targets</th></tr>
<tr><td rowspan="2">Energy</td><td>Coal mining</td><td>• Methane Emission Control Action Plan,
• Notice on Further Strengthening the Management of Environmental Impact Assessment for Coal Resource Development</td><td>• Increase the extraction and utilization of coal mine gas, targeting 6 billion cubic meters by 2025
• CMM with a methane concentration of ≥8% should be utilized while safe and CMM with a methane concentration of 2%~8% is encouraged to be utilized</td></tr>
<tr><td>Oil and gas extraction</td><td>• Methane Emission Control Action Plan,
• The 14th Five-Year Plan for Modern Energy System</td><td>• Increase oil and gas methane recovery, aiming for international advanced levels by 2030
• Encourage associated gas and bleed air recovery, and reduces conventional flaring</td></tr>
<tr><td rowspan="3">Agriculture</td><td>Livestock and poultry</td><td rowspan="3">• Implementation Plan for Emission Reduction and Carbon Sequestration in Agriculture and Rural Areas,
• Methane Emission Control Action Plan,
• The 14th Five-Year Plan for Agricultural Green Development,
• Opinions on Further Strengthening the Conservation and Intensive Utilization of Water Resources</td><td>• Promote precision feeding techniques, low-protein diets and whole-plant silage
• Improves livestock varieties
• Rational use of plant-based feed additives and probiotics</td></tr>
<tr><td>Rice cultivation</td><td>• Promote water-saving irrigation
• Selectively breed and promote high-yield, high-quality, water-saving, and drought-resistant varieties
• Improve fertilization management, and promote organic fertilizer</td></tr>
<tr><td>Livestock and poultry manure management</td><td>• Improve manure storage and treatment facilities/equipment
• Promote closed manure treatment for gas collection, utilization or treatment
• Develop biogas digester and large-scale biogas/bio-natural gas projects
• Comprehensive utilization rate of livestock and poultry manure will exceed 80% and 85% by 2025 and 2030</td></tr>
</table>

Waste	Solid waste disposal	• *Methane Emission Control Action Plan*	• Waste reduction, sorting and recycling • Landfill gas recovery • By 2025, the waste utilization rate will reach about 60%
	Sewage treatment	• *Methane Emission Control Action Plan,* • *Implementation Opinions on Promoting the Synergy of Sewage Treatment, Pollution Reduction and Carbon Reduction*	• Harmless treatment and resource utilization of sludge • Encourage the use of anaerobic sludge digestion to produce and utilize biogas • Timely dredging and management of sewage pipes • Promote sludge biogas cogeneration
Other	Industry, transportation	• *Methane Emission Control Action Plan*	• Proper disposal of flammable gases containing methane from industrial production • Improve motor vehicle and ship power system technology to achieve synergistic control of pollutants and methane

Source: compiled by iGDP.

4. Opportunities and Challenges for Methane Emission Reduction in China

4.1. Energy Sector

Methane reduction in coal mines primarily involves capturing and utilizing fugitive methane. Utilization methods vary based on gas concentration, with higher concentrations offering better economic and technical feasibility.[22]

Table 3 Technical route for comprehensive utilization of coal mine gas

Methane Concentration	Primary sources	Usage	Characteristics	Economic Feasibility
> 90%	Surface coalbed methane + underground coal mine extraction	Civil, automotive fuel, etc.	Easy to store and transport over long distances	High, commonly used in China
30%~90%	Underground coal mine extraction	Civil use, power generation, chemicals, etc.		
8%~30%	Underground coal mine extraction	Mostly for power generation, with internal combustion engine generation and waste heat utilization	Sent to nearby pipeline or used for local power generation	Good, has been applied in many places in China and the operation is stable
1%~8%	Underground coal mine extraction	Catalytic oxidation or thermal oxidation for heat or power generation		Poor, high investment cost, still in demonstration stage
< 1%	Ventilation air from coal mines	Mainly utilized through blended oxidation and auxiliary fuel technology, and the rest is vented	Low concentration and large volume make it hard to use directly	Poor, the profitability depends on the carbon price and scale effect

Source: compiled by iGDP according to the Coalbed Methane (Coal Mine Gas) Emission Standard (*Revised GB 21522-2008*) Preparation Instructions.

Ventilation air from coal mines with methane concentrations below 0.75% accounts for 81% of methane emissions in China's coal mines.[23] Recently, the Ministry of Ecology and Environment developed the *Methodology for Voluntary Greenhouse Gas Emission Reduction Projects - Utilization of Low-concentration CMM and Ventilation Air Methane (VAM)* (hereinafter

[22] Shanxi Zhuoyue Gas Research Center. (2021). The China Center in Action. https://unece.org/sites/default/files/2021-10/22.%20ICE%20China%20-%20Workshop%20Poland.pdf
[23] Qu, P. (2023, November 20). The new methane emission control policy forces the utilization of low-concentration gas to speed up. China Energy News. http://paper.people.com.cn/zgnyb/images/2023-11/20/02/zgnyb2023112002.pdf

referred to as *the Methodology*) and revised the *Emission Standard of Coalbed Methane/Coal Mine Gas (Revised Draft)* (hereinafter referred to as *the Standards*). Public consultation was held, and *the Standards*—reviewed in September[24]—propose lowering the emission limit to 8%. This adjustment will promote resource recovery, control methane emissions, and combat climate change. *The Methodology* will also facilitate the transition of low-concentration CMM projects from early stages to large-scale development, creating opportunities for methane mitigation.

Box 1: Good practice of methane emission reduction in low-concentration coal mines in Shanxi

Located in Lüliang City, Shanxi Province, the 3MW low-concentration gas power generation project of Liulin Zhaiyadi Coal Mine is jointly operated by Shanxi Junliu New Energy Technology Co., Ltd. (hereinafter referred to as "Junliu New Energy") and Liulin Zhaiyadi Coal Mine. The coal mine provides the gas source, while Junliu New Energy provides the project's investment, construction, and operation. The approved production capacity of the Zhaiyadi Coal Mine is 1.75 million tons/year, and the gas concentration of the mine is 5%-8%.

Based on the gas source conditions of the coal mine, Junliu New Energy has developed a patented technology for the safe and stable combustion of low-concentration gas in coal mines, enabling comprehensive utilization. The project is equipped with 1×3MW steam turbine generator sets, which can supply about 19.2 million kWh of electricity to the coal mines every year, equivalent to saving 5,766 tons of standard coal. It also destroys 12 million cubic meters of methane annually, equivalent to reducing CO_2 emissions by 220,000 tons and roughly equivalent to the average annual CO_2 emissions of 30,000 people in China.

The revenue of the project is mainly composed of electricity sales and government subsidies. The electricity produced by the coal mine gas, except for a small part for self-use, is directly supplied to the Zhaiyadi Coal Mine to obtain power supply income. In addition, the project receives a subsidy for gas utilization every year according to the amount of use.

Source: Institute for Global Decarbonization Process. (2024). Analysis of good practices in gas emission reduction in low-concentration coal mines in China.

[24] National Center for Climate Strategy. (2024, September 20). The draft of the national standard "Coalbed Methane (Coal Mine Gas) Emission Standard" successfully passed the expert review. http://www.ncsc.org.cn/xwdt/zxxw/202409/t20240923_1086588.shtml

Methane from abandoned coal mines (AMM) contributes to overall emissions, but more research is needed to accurately measure emissions based on factors like abandonment time, residual gas content, and mine conditions.[25] In China, AMM emission reduction technology remains in the exploratory phase, with a limited number of specialized companies.[26] Further research and experimentation are essential to advance these efforts.

4.2. Agriculture

Methane emission reduction in agriculture is synergistic with important policies in circular economy, food security, and rural revitalization, and agriculture has long been a key opportunity for agricultural and rural carbon emission reduction and sequestration.

4.2.1 Livestock and Poultry Farming

Methane emissions from livestock and poultry are mainly due to ruminant fermentation and animal manure management. To address fermentation, the *Action Plan for Carbon Sequestration in Agriculture and Rural Areas* and the *Action Plan for Methane Emission Reduction* propose promoting technologies such as low-protein diets and whole plant silages. Rational use of feed additives based on plant extracts, probiotics and other technical means, and multi-functional nutrient licking bricks are also recommended.

[25] Liang, Y., Li, Z., Zhu S., Chen Q., Wang X., & Qin C. (2023). Research status and emission reduction countermeasures of methane emissions from closed/abandoned coal mines. Journal of China Coal Society, 48(4), 1645-1660.
[26] Zhu, Y. (2021, April 5). Methane emissions reduction is on the way. China Energy News. http://paper.people.com.cn/zgnyb/html/2021-04/05/content_2042088.htm

Adjust the feed structure: Methane emissions can be reduced by silage, microbial treatment or ammonization of roughage.[27] Methane emissions can also be reduced by adjusting the feed formulation, precise feeding, and optimizing the lean-to-gross ratio of the feed.

Addition of excipients to feed: Adding plant extracts such as tea saponin and allicin can reduce methane by regulating rumen microorganisms.[28] Adding yeasts and probiotics such as bacillus and lactobacilli can also regulate fermentation.[29]

China has been committed to improving the management level of livestock and poultry manure, while promoting resource utilization. *The Action Plan for Carbon Sequestration in Agriculture and Rural Areas and the Action Plan for Methane Emission Reduction* propose to improve livestock and poultry manure treatment facilities and equipment, and promote technologies such as closed manure treatment, gas collection, utilization or treatment to reduce methane emissions.

Optimize livestock and poultry manure management: Treating livestock and poultry manure through dry manure cleaning and manure-water separation reduces the total amount of organic matter entering the anaerobic environment and can reduce methane emissions.[30]

Fertilizer utilization of livestock and poultry manure: Methane emissions can be reduced by turning the pile and forced ventilation during aerobic composting, and methane emissions can be reduced by 19% simultaneously by adding biochar.[30]

Energy utilization of livestock and poultry manure: It mainly includes the construction of biogas projects, and the collected biogas is connected to the grid for power generation or made into bio-natural gas. Studies have shown that harvesting biogas from anaerobic fermentation of livestock and poultry manure can significantly reduce methane emissions.[5]

[27] Na, R., Dong, H., Chen, Y., & Zhou, Z. (2011). Effect of dietary lean-to-crude ratio on rumen fermentation characteristics. Chinese Journal of Animal Husbandry, 47(9), 49–54.

[28] Zou, X., Li, Y., Gao Q., Wan, Y., & Shi, S. (2011). Research and analysis of major greenhouse gas emission reduction measures in China's agricultural sector. Ecology and Environmental Sciences, 20(8/9), 1348–1358

[29] Gao, G., Shi, H., Liu, H., Cairang, N.i, Xu, H., Dingkao, R., Ma, G., Li, P., & Wan, M. (2022). Research progress on the effects of probiotics on ruminant production and methane emission reduction. Chinese Journal of Cattle Industry, 48(2), 67-72

[30] Zhu, Z., Dong, H., Wei, S., Ma, J., & Xue, P. (2020). Impacts of changes in livestock and poultry manure management on greenhouse gas emissions in China. Journal of Agro-Environmental Science, 39(4), 743–748

4.2.2 Rice Cultivation

Methane emissions from paddy fields can be controlled through water management, land management, and the promotion of rice varieties with high yields and low emissions. The *Action Plan for Carbon Sequestration in Agriculture and Rural Areas* and the *Action Plan for Methane Emission Reduction* propose to promote water-saving irrigation technology for paddy fields tailored to local conditions; breeding and promotion of high-yield and low-carbon rice varieties; improving the management of fertilization in paddy fields, and promoting organic fertilizer and returning of decomposed straw to the field.

Adjustment of irrigation patterns in paddy fields: Compared with long-term flooding, the method of medium-term drying can not only improve rice yield, but also reduce methane emissions by 20%~60%. [31] Wet and intermittent irrigation can also reduce methane emissions by 47% and 39%, respectively.[32]

Adjust farmland management measures: Less tillage and no-tillage can reduce methane production to a certain extent compared with tillage. Studies have shown that no-till paddy fields have about 30% lower methane emissions than conventionally tilled paddy fields. [33] The methane emission of returning decomposed straw to the field is about 1/3 of that of direct straw returning,[34] and emission can also be weakened by returning straw to the field after animal digestion or in the dry season.

High-yield and low-emission rice varieties: The breeding of high-yield and low-emission rice varieties can reduce methane emissions while maintaining high and stable yields during planting. Under the premise of ensuring food security, promoting this technology can achieve a methane emission reduction of 5%~10% in China's paddy fields.[35]

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[31] Wang, X., Li, J., Ye, L., & Lin, B. (2024). Mitigation of non-CO 2 greenhouse gas emissions in China's agricultural sector: Policy measures, technology applications, and future pespectives. Chinese Journal of Eco-Agriculture.
[32] Mi, S., Huang, Z., Zhu, Q., Huang, H., & Li, B. (2016). Cost-benefit analysis of greenhouse gas emission reduction in paddy fields. Journal of Zhejiang Agricultural Sciences, 28(4), 707–716.
[33] Zhao, X., Liu, S. L., Pu, C., Zhang, X. Q., Xue, J. F., Zhang, R., ... & Chen, F. (2016). Methane and nitrous oxide emissions under no-till farming in China: A meta-analysis. Global change biology, 22(4), 1372-1384.
[34] Shi, S., Li, Y., Liu, Y., Wan, Y., Gao, Q., & Zhang, Z. (2010). Integrated analysis of CH4 and N2O emissions and emission reduction in paddy fields in China. Scientia Agricultura Sinica, 43(14), 2923-2936.
[35] Research Group on the Development of Non-CO2 Greenhouse Gas Emission Reduction Technologies. (2022). Assessment and prospect of non-CO2 greenhouse gas emission reduction technologies. China Science and Technology Press.

Box 2: Climate-friendly rice cultivation in southwest China

In some villages in the mountainous regions of Yunnan and Sichuan, dry rice farming is carried out by ditching and ridge cultivation – rice is planted on top of long mounds (known as ridges) excavated in the leveled fields, and irrigation is carried out on the lower areas between the ridges (known as furrows), which can greatly reduce the time the paddy fields are in contact with water and thus reduce methane emissions.

In a village in Sichuan's Jianyang City, farmers are growing rice by combining no-till and ridge-furrow planting. They minimize soil disturbance with no-tillage, reduce the duration of flooding with furrowing. Meanwhile, rapeseed cake is used as fertilizer instead of chemical fertilizer, and local rapeseed husks are used as mulch to increase temperature and moisture.

In the mountainous region of Yunnan Province, a local team focus on agriculture and climate change has also experimented with direct seeding of rice to explore rice cultivation methods that can adapt to drought conditions. In cooperation with local agricultural technology extension centers and farmers, high-yielding and low-emission rice varieties are selected to experiment with direct seeding.

Source: Institute for Global Decarbonization Progress. (2023). Building Sustainability into China's Agri-food System – Fourteen Case Studies.

4.3. Waste Management

4.3.1 Solid Waste Treatment

Under national guidance, most provinces have put forward the goal of domestic waste resource utilization in their policy documents such as the *Implementation Plan for the Construction of Zero-waste Cities* and the *Implementation Plan for Carbon Peaking in the Field of Urban and Rural Construction*, which will be conducive to methane emission reduction in solid waste treatment.

Source reduction and waste classification: Firstly, reduce the amount of garbage generated in the process of production, circulation and consumption, and secondly, collect, sort, transport, and dispose of garbage. At present, China has implemented compulsory classification of domestic waste in 46 cities.

Anaerobic digestion of food waste: The use of microorganisms to convert organic matter into biogas and biogas residue biogas slurry in an anaerobic environment can achieve material and energy recovery. Biogas generates electricity and heat, and digestate slurry can be used to produce liquid manure or compost.[5]

Strengthen the recovery and utilization of landfill gas: The technology of using landfill gas for power generation and heating, or purification as natural gas for utilization is very mature, and has been applied in places including Shanghai, Tianjin, Guangdong, Shaanxi, Shanxi. In addition, landfill gas can be used to produce fuel for automobiles.[36]

Box 3: The practice of comprehensive utilization of landfill gas

The Xiaping Landfill in Shenzhen, Guangdong Province, has a landfill capacity of about 6,000 tons per day. Since 2007, the landfill has been collecting and destroying methane, with part of the gas utilized through a franchising model. The landfill gas collection system is government-funded, while enterprises pay a resource usage fee. The landfill gas power generation system, as well as the purification and utilization system are invested and operated by China Water Group.

Currently, the landfill gas collection system can collect 40,000 cubic meters per hour. Some of the gas is converted to electricity and fed into the grid, generating about 800,000 kilowatt-hours per day. A purification system has also been established with a processing capacity of 5,000 cubic meters per hour, or 60,000 cubic meters per day, while the remaining landfill gas is destroyed through a closed-flare system. The Xiaping Landfill was registered as a Clean Development Mechanism (CDM) project under the Kyoto Protocol in 2007, achieving a total emission reduction of 4.48 million tons of carbon dioxide equivalent.

Source: Institute for Global Decarbonization Process. (2021). Good Practice Guidelines for Municipal Solid Waste and Municipal Sludge Treatment in China.

[36] Zhang, X., Xiao, X., He, Y., Chen, J., & Yang, Z. (2006). Methane release from landfills and their emission reductions. China Biogas. 24(1), 3-8

4.3.2 Wastewater Treatment

China has always attached great importance to sewage treatment. The *Implementation Opinions on Promoting the Synergy of Pollution Reduction and Carbon Reduction in Sewage Treatment* and the *Methane Emission Control Action Plan* focus on reducing methane emissions in the anaerobic treatment process, as well as recycling and recycling methane at the end.

Dredging and management of sewage pipes: Regular dredging and maintenance of sewage pipe network can reduce the conversion of organic carbon in sewage into methane. At the same time, it can prevent low concentration of carbon sources at sewage treatment plants, which can reduce treatment efficiency.[37]

Install sludge anaerobic digestion system: Anaerobic digesters are used to treat sludge after aerobic wastewater treatment, which can produce biogas. The collected methane can be used as energy (injected into the natural gas grid or used for power generation, heating, etc.) to reduce emissions.[5]

Retrofitting existing open-pit anaerobic equipment: It may be more economical to close an existing wastewater treatment tank and extract biogas than to invest in a new centralized aerobic treatment plant.[5]

5. Methane Emission Reduction Outlook

China's methane reduction efforts are currently aligned with several existing policies, including initiatives such as Zero-Waste Cities, green agricultural and rural development, and synergistic reduction of pollution and carbon emission. These provide a foundation for further methane mitigation efforts.

To further support methane reduction in the energy sector, China has issued drafts for coalbed methane (mine gas) emission standards and related CCER methodologies for public consultation. Looking forward, the

[37] Liu, L. (2024, January 31). Calling sewage treatment enterprises: greenhouse gas emission control is coming, are you ready?|Sewage treatment with synergy of pollution reduction and carbon reduction (5). China Environment News. http://www.cenews.com.cn/news.html?aid=1111288

introduction of similar methodologies or standards in agriculture could leverage market mechanisms to incentivize emissions reduction. Subsides for green agricultural practices such as soil testing and formulated fertilization, organic fertilizer substitution, and livestock manure utilization have been promoted for years[38]. In addition, offering subsidies for low-carbon practices—particularly those with measurable, verifiable outcomes—would encourage farmers to adopt. Examples include intermittent irrigation, efficient fertilizers, and returning decomposed straw to fields, all of which could drive methane reductions in China's agricultural sector[39].

As the international community increasingly focuses on methane emission reduction, strengthening international exchanges and cooperation has become crucial. Engaging with the EU on emission monitoring, system design, and regulatory frameworks, as well as leveraging the experiences and technologies of the EU and United States in managing abandoned mine methane, will benefit China's methane control policies. It will accelerate China's development of regulatory standards, the construction of MRV system, and improvements in capacity building, such as statistical accounting, emission reduction technology innovation and progress.

In the agricultural sector, where methane emission sources are scattered, it is difficult to achieve effective MRV. The EU's experience suggests that strengthening life-cycle methane emissions accounting in agriculture is a good complement to MRV. Providing a list of leading best practices and technologies to reduce emissions can also play a significant role in promoting emission reduction technologies.[40]

[38] Qiao, J. (2023, January 17). How agribusiness can develop in a low-carbon manner. Economic Daily News. http://paper.ce.cn/pad/content/202301/17/content_267473.html

[39] Dong, W., Cai, A., Song, C., Liu, S., & Li, Y. Methane abatement in rice fields: technologies, challenges and strategies. Chinese Journal of Agricultural Resources and Regional Planning. 44(10):10-19. http://www.cjarrp.com/zgnyzyyqh/article/html/202310002.

[40] Dong, W., Sun, S., Li, T., Yang, X., & Li, Z. (2021). Implications of the EU Methane Emission Reduction Strategy for China's Carbon Neutrality. Environment and Sustainable Development, 46(2), 7.

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