How China Could Curb Its Coal Mines' Methane Emissions

With the right policies and subsidies, top methane emitter China can overcome the financial and technical challenges of capturing and utilizing coal mine methane.

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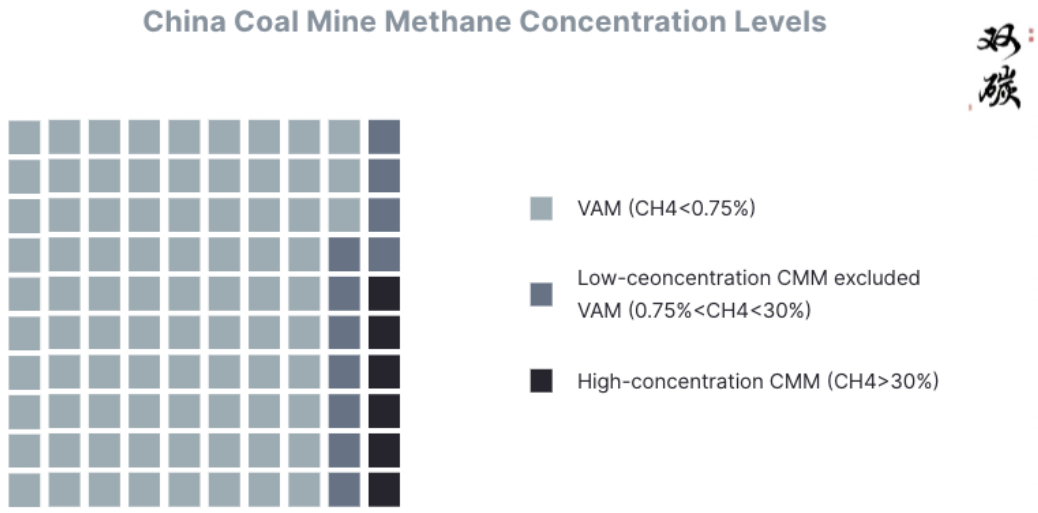
As countries fall behind on their mitigation commitments under the Paris Agreement, the climate community is turning its attention toward reducing non-CO2 greenhouse gases to slow global warming. Methane, the most abundant climate pollutant after CO2, is a top target. China is part of the global effort to reduce this potent GHG, but as always the devil is in the details.

A Leading Emission Factor

Coal mines are the main source of China's energy-related methane emissions. According to the latest data from China's national GHG inventory, China's methane emissions amounted to 64.11 million tons in 2018, the largest in the world. Forty-two percent of these emissions came from the energy system – 39% from coal mines and 3% from oil and gas. This is in stark contrast with developed countries: in Europe and the U.S., for instance, the largest sources of methane are the oil and gas industries.

Eighty percent of China's coal mine methane (CMM) comes from underground coal production, with the remaining coming from open-pit mines and post-mining activities. CMM is made up of more gases than just methane, and as such the methane concentration can differ, with each concentration level requiring different technical and policy responses. Ninety-four percent of China's CMM has a methane concentration of less than 30%. According to estimates, more than 83% of CMM is so-called ventilation air methane, or VAM, which is CMM diluted by a mine's ventilation system in order to avoid underground accidents. VAM's methane concentration is below 0.75%.



Source: *Fubao Zhou, et al. (2016), Recent developments in coal mine methane extraction and utilization in China: A review.*

VAM's extremely low methane concentration increases the technical challenges of its capture and utilization, which are compounded by inadequate policy support and a lack of cost-effective technologies. This also explains why China has missed targets for underground CMM utilization in its 11th, 12th, and 13th Five-Year Plans, covering 2006 to 2020.

CMM from coal mining activities is expected to decline once coal production in China decreases. However, studies indicate that the share of methane emissions from coal mining processes will remain significant, ranging between 39% and 44% of total methane emissions from 2015 to 2030. By 2050, this share is projected to still constitute a quarter of China's methane emissions.

These figures don't include abandoned coal mines. With China's transition to low-carbon energy, the number of abandoned coal mines will rise to an estimated 15,000 by 2030, and they will replace mining activities to become the primary source of CMM emissions. Recent research also indicates that methane emissions from abandoned coal mines have been greatly underestimated and could increase sharply without further policy intervention.

Costly Voluntary Utilization

In contrast to the magnitude of CMM emissions, coal mining companies have limited incentives to capture and utilize low-concentration CMM due to the absence of mandatory policy requirements and the significant safety risks involved.

China's current CMM emissions standard only regulates CMM with methane concentrations of 30% or higher, leaving low-concentration CMM unregulated and often discharged without consequence.

An additional complication is that CMM is explosive, further discouraging coal mining companies from capturing and utilizing it, as safety accidents could halt operations.

Consequently, it is often new energy companies that enter into contracts with coal mining companies to manage low-concentration CMM utilization. Current technologies are often not cost-effective, meaning their profits are heavily dependent on government subsidies, which vary by region and are vulnerable to policy changes. For instance, in Shanxi Province, the subsidy for electricity generation from CMM utilization decreased by one third from 2019 to 2021.

VAM utilization projects are particularly challenging to handle due to their low economic feasibility. In China, some new energy companies have adopted regenerative thermal oxidation (RTO), a technology that generates electricity from VAM that would be commercially viable with subsidy support. According to our June report, a 200 million RMB ($28 million) upfront investment was made to develop a 15 MW power project using RTO. The drawbacks were evident: the high initial costs and dependence on subsidies for profitability make VAM-powered electricity less attractive to investors compared to solar and wind energy.

There are, however, successful practices and cost-efficient technologies for utilizing low-concentration CMM, particularly with methane concentrations between 9% and 30%. We also documented technological innovations that can ensure the safe utilization of low-concentration methane in the range of 1% to 8%.

Seizing the Mitigation Opportunity

China's national methane plan, released in November 2023, provides overarching guidelines for different government agencies and local governments to create their own action plans. Although the plan does not set specific targets for methane mitigation, it shows that China's leaders are on the same page with the global community on the importance of reducing emissions of this powerful GHG. The U.S.-China Sunnylands Statement, released a week later, also identifies methane as a key area for collaboration between the two countries, providing a strong bilateral push in the right direction.

The national plan commits to "effectively enhance" monitoring and supervision systems for methane during the five-year plan through 2025, and to "substantially enhance" these systems from 2026 to 2030. It also aims to reduce flaring, the burning off of emissions at oil and gas wells, and to address methane leaks at coal mines.

But China's policymakers will have to dig deeper to create policies that address the specific technical and financial challenges in reducing CMM. Careful tailoring of policy to the unique features of China's CMM is what will ensure that China's methane reduction strategy is more than hot air.

Financial incentives are crucial when it comes to scaling up solutions. CMM utilization projects were once attractive investments primarily due to the support of the Clean Development Mechanism (CDM), an international carbon credit certification that allows industrialized countries to purchase reduced emissions from developing countries to meet their mitigation obligation under

the Kyoto Protocol. However, once the CDM scheme was phased out, such projects became less profitable.

New energy companies are hopeful that the relaunch of China's Certified Emissions Reduction (CCER), a voluntary carbon trading scheme, will provide financial incentives for VAM utilization and reduce upfront costs.

On July 30, China released a draft for consultation of the methodology for calculating the reduced emissions from CMM capture and utilization projects under the CCER. The new methodology, which focuses on VAM and CMM with methane concentrations below 8%, should enhance the integration of mitigation efforts for low-concentration CMM into the CCER scheme.

Beyond market-based incentives, differentiated CMM utilization subsidies can help alleviate the financial hurdles companies face in capturing and utilizing low-concentration CMM.

Finally, it is important to update CMM emissions standards in a way that reflects technological advancements. Regulators are heading in the right direction: last week, China unveiled a revised draft for consultation of the national standard for CMM emissions. The proposed standard aims to ban the discharge of CMM with concentrations exceeding 8%, a significant improvement compared to the current 30% limit. Once implemented, this new standard would require stricter measures to reduce methane emissions from coal mines.