Achieving Near-Zero Methane Emissions Coal Mining
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Abstract

Methane is a greenhouse gas (GHG) with a GWP of 28-34\textsuperscript{1} times that of carbon dioxide (CO\textsubscript{2}). Mitigation of methane emissions has become an important global policy priority driven by methane’s relatively short atmospheric life and its capacity to be productively used in many applications. Coal production ranks fourth among the major sources of anthropogenic CH\textsubscript{4} emissions, accounting for 9\% of global emissions, but the industry could realize significant emission reductions by employing projects integrating available technologies to achieve near-zero methane emissions mining, especially at very large, gassy underground mines. Release of methane, which is contained in both the pore space and in the free space of coal seams, is a historic problem for the coal mining industry. Methane-related explosions have resulted in injuries, fatalities, destruction of property and even permanent mine closure with disastrous economic consequences for mining communities. To address this threat to health and safety, methane is removed from the mine workings and emitted to the atmosphere through ventilation shafts and methane degasification systems. But this practice produces considerable GHG emissions. The United States Environmental Protection Agency (U.S. EPA) estimates that current global coal mine methane (CMM) emissions total around 640 million metric tonnes of CO\textsubscript{2} equivalent (MMTCO\textsubscript{2}e) using the GWP of 21 in the IPCC Second Assessment Report.\textsuperscript{2} This equates to 45 billion cubic meters of pure methane. At a GWP of 25 used in the Fourth Assessment Report, methane emissions total 761 MMTCO\textsubscript{2}e. Considering coal’s continued contributions to meeting primary energy demand, the impact of CMM emissions on the global environment, and the availability of technical solutions for CMM recovery and use, there is a very strong case to continue efforts to work constructively with the coal industry to achieve near-zero methane emissions mining. Some may contend that CMM emissions will decline as coal mines close and production declines. Even if coal production declines, coal is projected by many forecasts to continue as source of primary energy demand for the foreseeable future. In turn, the coal industry will continue to be a major source of methane emissions as the mining industry shifts from smaller mines to more efficient and cost-effective high-production longwall mines that account for the majority of methane emissions. In many countries, mining is also migrating to deeper and gassier coal seams as shallower reserves are mined out further contributing to higher emissions. Looking at methane emissions on a facility-basis, the potential impact is particularly striking. The largest underground mines have the potential to release between one and five MMTCO\textsubscript{2}e per year, and possibly more. The large volume of CMM emissions presents an opportunity, however. The Global Methane Initiative (GMI) has documented over 200 operating CMM projects around world demonstrating the technical and economic viability of CMM technologies and practices. Although wide-scale CMM project development cannot address all GHG impacts from coal production and

\textsuperscript{1}IPCC. 5th Assessment Report (AR5)
use, it can be an effective interim solution to reduce the carbon footprint of the coal industry. The technologies that are available and in use today, when integrated into a comprehensive project, could allow coal mines to achieve near-zero methane emissions mining. Moreover, CMM projects can achieve significant scale, and the largest CMM projects today are comparable to the first early-stage commercial CCS projects now in operation in the United States. However, there remain operational, technical and policy barriers to wider scale deployment of CMM projects. Among the more critical are the limited knowledge and application of best practices, scarcity of project finance, evolving markets for revenue generation, and unclear legal and regulatory frameworks. This paper will: (i) discuss the GMI’s support for CMM emission reductions and international CMM project development; (ii) present global CMM emissions with emphasis on those countries with the largest resources; (iii) discuss the potential scale of CMM projects comparing CMM emissions with emissions from other methane sources; (iv) review the near-zero methane emissions concept including best practices for methane drainage and use; (v) present a case study of a near-zero emissions mining project assessing project costs and benefits; and (vi) outline barriers to further implementation and present recommendations for overcoming those barriers.