In our "Tools for Decarbonization" series, we explore solutions and technologies that may not get the same level of attention as solar power or electric vehicles but have the potential to significantly reduce global greenhouse gas (GHG) emissions.

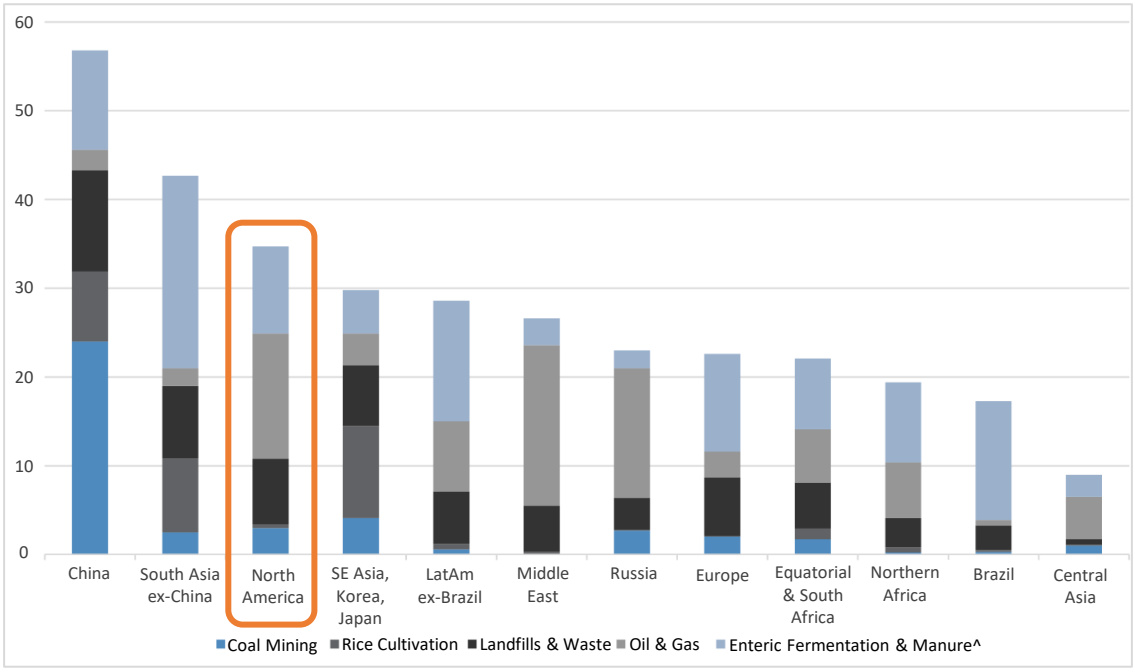
Part I covered Carbon Capture, Utilization, and Sequestration (CCUS), an expensive yet important technology that captures the carbon emitted from industrial processes before it enters the atmosphere. Among our key takeaways, we anticipate recent climate-related policies in the U.S. to help alleviate the elevated costs associated with CCUS and incentivize developers to invest in expanding their CCUS capabilities. Importantly, however, carbon removal solutions should not be viewed as an alternative to cutting emissions or used by companies as an excuse to delay their climate transition progress. There are many businesses and industries that will require significant structural changes in order to align with global climate ambitions, and as more companies reconsider their climate transition strategies, we will remain focused on understanding the potential investment and societal implications.

In Part II, we discuss the environmental risks and investment opportunities associated with methane.

Part II: Curbing Methane Emissions

Though many climate risk measures focus on carbon intensity, methane emission reductions are also crucial to meeting the world's climate change goals. Methane, which contributes ~17% of global GHG emissions, is produced both naturally and as a byproduct of various human activities. The latter, also referred to as anthropogenic emissions, account for 60% of global methane emissions.[1] The main sources of anthropogenic methane emissions include agriculture and livestock (40%), oil and gas operations (26%), waste and landfills (20%), and coal mining (11%).[2] By region, North America ranks third in methane emissions with oil and gas comprising the largest source (Exhibit 2).

Exhibit 1: Estimated Annual Anthropogenic Methane Emissions by Region and Sector, 2017



Source: JP Morgan. ^Enteric fermentation is a naturally occurring part of the digestive process in livestock (cattle, sheep, etc.).

Compared to carbon dioxide (CO_2), the global warming potential of methane (CH_4) is significantly higher – 86x upon emission and 25x when averaged over 100 years. Despite its higher intensity than CO_2, methane has an atmospheric half-life of just nine years (far lower than the 100+ years for CO_2).[3] This means that curbing methane emissions today can have more immediate positive impacts on global warming and climate-related disasters, and can result in significant progress toward achieving long-term global climate change ambitions.

Regulatory Environment

The Global Methane Pledge, launched by the U.S. and European Union last year, is an agreement that targets a 30% reduction in methane by 2030 relative to 2020 levels. The pledge has garnered over 122 countries accounting for ~50% of global methane emissions, but notably excludes China and Russia. It is estimated that the Global Methane Pledge could potentially reduce temperature warming projections by 0.2°C.[4]

In the U.S., policies announced at COP26 included new Environmental Protection Agency (EPA) initiatives on methane through the Clean Air Act; U.S. Department of Transportation proposals around pipeline leakage; and U.S. Department of Agriculture commitments to work with farmers on reducing emissions. More recently, the U.S. included methane emissions abatement measures in the Inflation Reduction Act of 2022 (IRA). The IRA includes both funding for methane leak detection and abatement in addition to fees on methane emissions.[5]

Potential Solutions to Reduce Methane Footprint

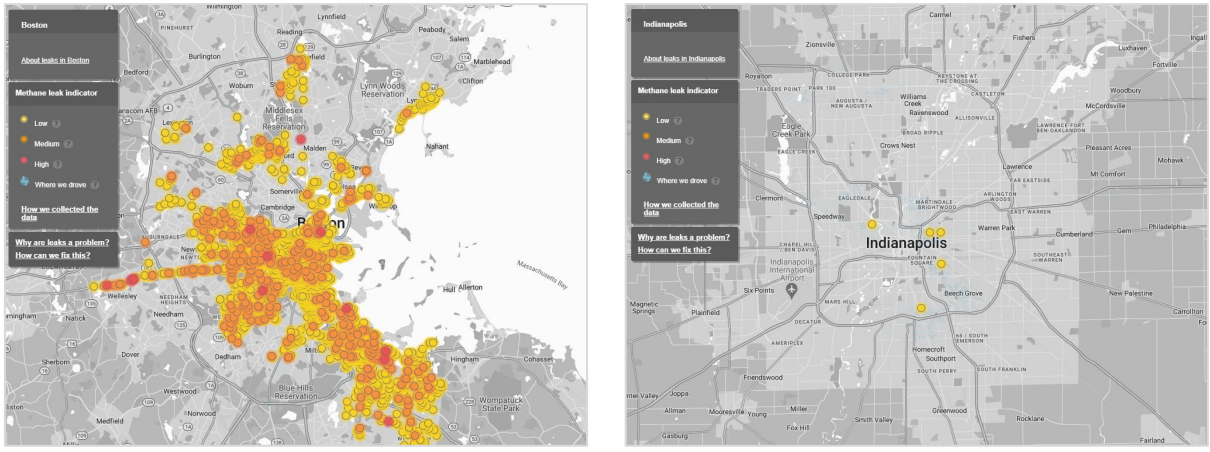
It is estimated that, since pre-industrial times, methane is responsible for 27% of the world's temperature warming.[6] The good news, however, is that nearly half of methane emissions can potentially be avoided simply by applying best practices in the oil and gas and waste management industries.

Oil and Gas

The oil and gas (O&G) industry accounts for 26% of methane emissions, of which oil production is 40% with the natural gas value chain making up the remaining 60%.[7] O&G methane emissions can be categorized as (1) vented emissions from intentional releases for safety and operational reasons, (2) incomplete flaring emissions of natural gas that cannot be sold or vented, or (3) fugitive emissions from unintentional leakages or pipeline explosions. The International Energy Agency forecasts that, under a net zero emissions by 2050 scenario, 75% of methane emissions in the O&G industry must be abated by 2030. This would require immediate and substantial investment from industry participants, as well as improved data measurement and monitoring technologies, in order to be achieved.[8]

Importantly, there is existing technology to detect and eliminate methane leaks from old O&G infrastructure. This provides a financial incentive for companies to leverage the technology – fewer leaks means more gas that can be sold to customers. Applying modern technologies can substantially limit methane leakage, particularly in cities with older infrastructure. Nearly half of Boston's pipes are made from corrosive materials like cast iron and are more than 50 years old, which makes them more susceptible to leaks compared to newer infrastructure in Indianapolis (Exhibit 2).

Exhibit 2: Methane leaks detected in Boston (left) and Indianapolis (right)



Source: Environmental Defense Fund. Data collected in 2013

The IRA's methane fee represents the first instance of a nationwide price on GHG emissions. Beginning in 2024, O&G operators emitting >25,000 tons of methane per year will be subject to a $900/ton fine. This steps up to $1,500/ton in 2026. Analysts estimate this fine will add ~$0.25-0.50 to breakeven costs per barrel, a figure viewed as manageable, but large enough to incentivize mitigation.[9] Regulators like the EPA have expressed a willingness to work collaboratively with the industry on methane detection and abatement. Even prior to the IRA's passage, many companies prioritized reducing methane emissions in line with their own sustainability targets.

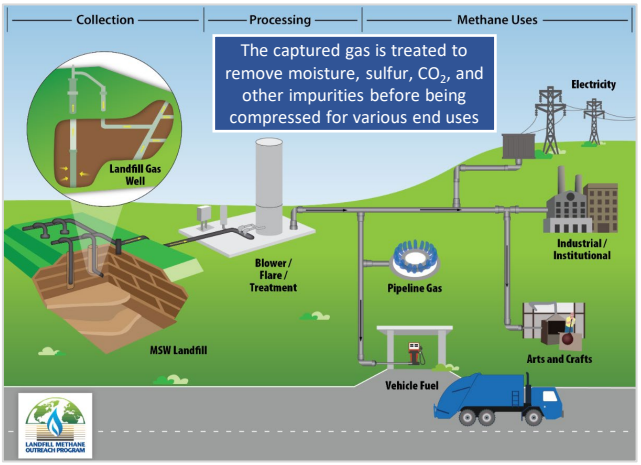
Waste Management Services

Methane is a natural byproduct of decomposing organic waste in landfills, which contribute 20% of global methane emissions. Importantly, methods currently exist to capture landfill-produced methane, convert it to gas, and reuse it as a source of energy (Exhibit 3).

Several large environmental services companies, such as Waste Management (WM), have invested heavily in landfill gas-to-energy projects. WM currently operates 144 of these facilities which generate electricity that can be sold to utility companies as well as renewable natural gas – an EPA-approved renewable fuel that can be used to power their vehicle fleet and to heat residential and commercial buildings.[10]

The Clean Air Act requires these processes at large landfills, and some states have adopted additional regulations supporting landfill gas (LFG) projects to encourage renewable electricity and fuel production. The up-front investment to build out these facilities would be offset by renewable energy revenues, reliability (LFG is a local and consistent source of energy), job creation, and significant net climate and health benefits over the long term.

Exhibit 3: Landfill Gas-to-Energy Process and Applications



Source: EPA, Landfill Methane Outreach Program

Agriculture

Responsible for 40% of methane emissions, the agriculture sector poses a larger challenge. The majority (90%) of agricultural methane is produced by livestock enteric emissions, from the mouths of cows, with few profitable or scalable solutions to capture these emissions (Exhibit 4). A small portion of methane emissions from manure can be captured and sold as renewable fuel, but the most logical solution to reducing agricultural methane would be to reduce demand for meat and dairy. Though unlikely to move the needle in the near term, plant-based meat alternatives have gained traction. Therefore, shifting from beef to poultry and fish (90% less methane-intensive) may be a more viable solution to reduce methane emissions, in addition to providing health and affordability advantages.[11]

Exhibit 4: Methane Mask Prototype

Source: Zero Emissions Livestock Project

As global policymakers battle high inflation and severe weather, food security remains an important priority. Solving for agricultural methane emissions while finding ways to sustainably increase production will likely remain a key challenge for the industry. Relatedly, biodiversity concerns have also been prioritized this year. Deforestation activities, which significantly reduce the world's natural GHG sequestration potential, is poorly disclosed by some of the largest agricultural companies. We think this could be an increasing area of focus from investors, particularly considering the Deforestation Pledge that was announced at COP26. We also anticipate emerging agriculture technology companies that enable more efficient land use and food growth to garner significant public and private capital going forward.

Coal Mining

Mining activities can cause methane from coal formations to be released into the atmosphere. Though the number of active coal mines in the U.S. has meaningfully decreased over the last decade, abandoned mines can still emit methane years after they are closed. While this represents an important opportunity to capture and reuse this methane to generate power, capturing coal mine methane (CMM) emissions has proved challenging because they are less localized. China, which relies on coal for 60% of its power generation, emits the majority of CMM, and despite having previously set CCM capture and use targets, they are currently not on track to achieve them. Amid the global energy crises, the potential for reduced methane emissions in the industry has become much more challenging.

Conclusion

Given the high global warming potential of methane and the urgency to address climate change, we expect regulators and businesses to increasingly focus on reducing methane emissions. In areas like waste management and O&G, businesses can take advantage of meaningful revenue opportunities while benefiting the climate. In agriculture and coal mining, further regulation and technological progress is still needed.

With several other global crises currently being prioritized, methane emissions reductions can be considered the "low hanging fruit" for countries with more limited resources to cut emissions quickly and economically. Conflict between the developed and developing world around culpability for climate change continues to dominate UN discussions. U.S. leadership, by reducing its own emissions as well as providing funding for emerging economies to address theirs, can lead to greater collective action on methane and global warming more broadly.

In Part III, we explore green hydrogen and its potential role in the clean energy transition.

Source Information

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