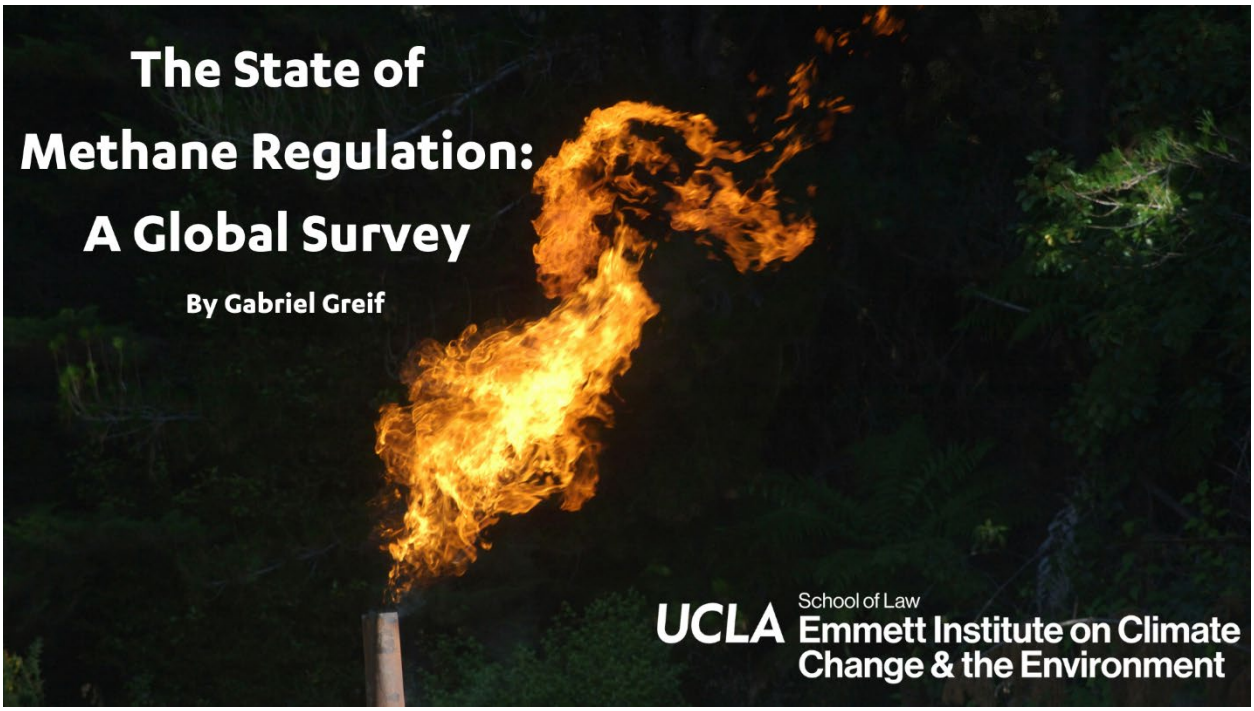

Controlling methane emissions is an urgent goal of governments around the world, but some jurisdictions are farther along than others. This policy brief is a global summary of existing and proposed regulatory approaches to controlling anthropogenic methane emissions from the highest-emitting sources, with two notable exceptions: rice cultivation and emissions from buildings or appliances.

The brief highlights a selection of international, national, and subnational methane emissions policies, with a particular focus on the European Union, the U.S. federal government, Canada, California, and Colorado. As jurisdictions finalize new rules, this document will be updated.

There remain significant open questions about the role of remote sensing technologies in existing and contemplated regulatory schemes. The ability to monitor and measure methane emissions is rapidly evolving and will continue to create new pathways for guiding and enforcing regulatory measures at every level of government. However, to understand how these technologies may fit into existing or proposed regulatory schemes, it is necessary to develop a deeper understanding of how methane is regulated across the globe. The briefing aims to help develop this shared understanding, while paying particular attention to any regulations or proposals that directly incorporate remote methane sensing technology.

This survey groups methane policies into three categories: 1) Cross-sector regulatory policies 2) Sector-specific methane regulations 3) Current or proposed policies that involve remote sensing technologies.

I. Cross-Sector Methane Policies

Cross-sector methane policies are those that regulate multiple sectors and sources of methane emissions. These policies can be divided into three categories, as follows: (1) jurisdiction-wide methane emissions reductions policies; (2) methane emissions inventory and reporting policies; and (3) market-based methane emissions policies.

a. Jurisdiction-Wide Methane Emissions Reductions Policies

In November 2021, more than one hundred countries signed onto the Global Methane Pledge at COP26 in Glasgow.[1] The Global Methane Pledge constitutes a non-binding commitment to achieve a 30 percent reduction in methane emissions from 2020 levels by 2030. The pledge's 30 percent methane reduction goal is collective and does not obligate any particular jurisdiction to any specific degree of reduction; it is also agnostic as to how signatories achieve these aggregate reductions.[2] Separately, the United States, European Union (EU), Japan, Canada, Norway, Singapore, and the United Kingdom released a Joint Declaration committing to advance new policies to achieve the methane reductions laid out in the Global Methane Pledge, particularly by reducing methane emissions throughout the fossil fuel supply chain.[3] Most recently, in anticipation of the upcoming COP28 conference, the governments of California; Queretaro, Mexico; Gauteng, South Africa; Espirito Santo, Brazil; Cross-River State, Nigeria; Yucatan, Mexico; and Delhi, India launched the Subnational Methane Action Initiative, which directs members to adopt methane action plans, set methane reduction goals, and establish methane inventories.[4]

Several jurisdictions have enacted or are developing methane policies that aim to fulfill the goals of the Global Methane Pledge. For instance, the EU—which may issue and enforce regulations that are binding in member states—reaffirmed its commitment to achieving reductions in methane emissions through proposed legislation ("EU Methane Proposal"), with a particular focus on the energy sector.[5] The EU Methane Proposal—originally proposed in

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[1] Global Methane Pledge (Dec. 2021), https://www.ccacoalition.org/sites/default/files/resources//Global%20Methane%20Pledge.pdf.
[2] *Id.*
[3] U.S. Dept. of State, Joint Declaration from Energy Importers and Exporters on Reducing Greenhouse Gas Emissions from Fossil Fuels (Nov. 11, 2022), https://www.state.gov/joint-declaration-from-energy-importers-and-exporters-on-reducing-greenhouse-gas-emissions-from-fossil-fuels/.
[4] Press Release, Office of Governor Gavin Newsom, California Enlists Governments Around the World to Fight Methane Pollution (Sept. 20, 2023), https://www.gov.ca.gov/2023/09/20/california-enlists-governments-around-the-world-to-fight-methane-pollution/.
[5] European Commission, Proposal for a Regulation of the European Parliament and of the Council on Methane Emissions Reduction in the Energy Sector and Amending Regulation, Accord 54 (hereinafter, "EU Methane Proposal"), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A805%3AFIN&qid=1639665806476; *see also* European Parliament, Fit for 55 Package: Reducing Methane Emissions in the Energy Sector (May 30, 2023), https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)729313 ("by 31 December 2025 the Commission would have to set a binding 2030 EU methane emissions reduction target covering all relevant emitting sectors.").

December 2021—has recently passed through European Parliament and is now in trilogue, an informal interinstitutional negotiation process for legislative proposals.[6] Because most of the EU's member countries do not produce significant quantities of fossil fuels, the EU Methane Proposal relies on the regulation of imported fuels, leveraging the EU's buying power to require extraterritorial importers to submit source-level monitoring, reporting, and verification (MRV) information and abide by leak detection and repair protocols.[7]

In September 2022, the federal Canadian government issued its own national methane emission strategy, entitled Faster and Further: Canada's Methane Strategy ("Faster and Further Strategy"), which outlines measures to reduce methane emissions across all sectors.[8] The Faster and Further Strategy estimates that Canada's existing and proposed regulations will reduce methane emissions to 35 percent below 2020 levels by 2030—five percent greater than the aggregate goals described in the Global Methane Pledge.[9] The Faster and Further Strategy focuses on: (1) improved monitoring of methane emissions; (2) the creation and increased stringency of direct methane regulations in fossil fuels, agricultural, and waste sectors; (3) technological development; and (4) continued international action.[10] The goals set out in the Faster and Further Strategy rely heavily on Canada's federal methane regulations that were originally published in 2018 and expanded in 2020, with new regulations expected to be published in 2023.[11] However, under Section 10 of the Canadian Environmental Protection Act of 1999 (CEPA), provinces may enter into Equivalency Agreements with the federal government, allowing those provinces to supplant federal methane regulations with their own, provided the federal government determines that the provincial regulations will achieve the same or better reductions than the federal regulations.[12] Thus, in provinces that have entered into Equivalency Agreements with the federal Canadian government, the federal government's role in regulating the subject matter of the Equivalency Agreement is limited to determining that federal and provincial regulations are "equivalent," or at least equally effective at abating emissions. Equivalency Agreements are automatically terminated after five years and either party may

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[6] European Parliament, Legislative Train Schedule, Reducing Emissions in the Energy Sector (Aug. 20, 2023), https://www.europarl.europa.eu/legislative-train/package-fit-for-55/file-reducing-methane-emissions-in-the-energy-sector.

[7] *See* May 2023 Amendments 001-267 to the EU Methane Proposal, https://www.europarl.europa.eu/doceo/document/A-9-2023-0162-AM-001-267_EN.pdf . *See also* EU Methane Proposal, *supra* note 6, accord 58; Tim Boersma & Robert Kleinberg, *Prospects for EU Extraterritorial Reduction of Methane Emissions From Its Natural Gas Supply*, Columbia Center of Global Energy Policy (June 15, 2023), https://www.energypolicy.columbia.edu/publications/prospects-for-eu-extraterritorial-reduction-of-methane-emissions-from-its-natural-gas-supply/.

[8] Environment and Climate Change Canada, Faster and Further: Canada's Methane Strategy (*hereinafter*, "Faster and Further") (Sept. 2022), https://publications.gc.ca/collections/collection_2022/eccc/En4-491-2022-eng.pdf

[9] *Id.* at 33

[10] *Id.*; *see* Int'l Energy Agency, Faster and Further: Canada's Methane Strategy (last visited Sept. 8, 2023), https://www.iea.org/policies/17015-faster-and-further-canadas-methane-strategy.

[11] Faster and Further Strategy, *surpa* note 9, at 2, 16.

[12] Canada Environmental Protection Act, 1999, S.C. 1999, c. 33 § 10(3), https://laws-lois.justice.gc.ca/eng/acts/c-15.31/FullText.html.

terminate Equivalency Agreements earlier, with three months notice.[13] Thus, where provinces do not comply with the terms of Equivalency Agreements, the federal government may exercise its right to unilaterally terminate the Equivalency Agreement and restore federal regulations. Currently, British Columbia, Saskatchewan, and Alberta are parties to Equivalency Agreements with the federal Canadian government.[14]

In 2021, the Chinese government—which is not a participant in the Global Methane Pledge—announced its intention to develop a National Methane Action Plan under the leadership of the Ministry of Ecology and Environment. This announcement follows the US-China Joint Declaration on Enhancing Climate Action at COP26, which included an increased emphasis on methane monitoring and abatement as a key strategy to reduce GHG emissions.[15] The proposed Plan will seek to monitor and control methane emissions by: (1) conducting research on methane emission controls; (2) establishing technology- and performance-based standards for methane emission reduction for energy, agriculture, and waste; (3) strengthening MRV systems for methane emissions in key areas; (4) encouraging voluntary methane emission reduction actions in key areas and promoting the development of technologies, equipment and industries related to methane utilization; and (5) strengthening international cooperation on methane control policies.[16] China's National Methane Action Plan is particularly focused on coal methane reduction and utilization, which is responsible for about 40 percent of China's methane total emissions.[17] China has yet to set numeric methane emission reduction targets.[18]

b. *Methane Emissions Inventory and Reporting Policies*

Nearly all countries and many subnational jurisdictions periodically issue greenhouse gas (GHG) emissions inventories that include methane. Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are required to report a GHG emissions inventory that provides an estimate of national emissions and removals of direct GHGs (including methane).[19]

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[13] Government of Canada, Equivalency Agreements under theCanadian Environmental Protection Act, 1999 2 (last visited Sept. 25, 2023), https://www.canada.ca/content/dam/eccc/migration/main/lcpe-cepa/1fe509f3-044d-4d17-90ff-5a7b36db8ccf/fs_fi-equiv.cfm.pdf.

[14] Faster and Further Strategy, *surpa* note [x], at 16.

[15] Press Release, US Dept. of State, U.S.-China Joint Glasgow Declaration on Enhancing Climate Action in the 2020s (Nov. 10, 2021), https://www.state.gov/u-s-china-joint-glasgow-declaration-on-enhancing-climate-action-in-the-2020s/.

[16] Int'l Energy Agency, National Methane Action Plan (Feb. 15, 2023), https://www.iea.org/policies/16940-national-methane-action-plan.

[17] David Stanway, *China Announces Plan to Curb Rising Methane Emissions But Challenges Await*, Reuters (Nov. 9, 2022), https://www.reuters.com/business/cop/china-announces-plan-curb-rising-methane-emissions-challenges-await-2022-11-09/.

[18] Valerie Volcovici & David Stanway, *China-US Climate Progress Could Hinge on Curbing of Methane*, Retuers (July 17, 2023), https://www.reuters.com/business/environment/china-us-climate-progress-could-hinge-new-methane-deal-2023-07-17/.

[19] United Nations Framework Convention on Climate Change, Reporting and Review Under the Convention (last visited Sep. 8, 2023), https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements.

For Annex I parties, these national inventories must abide by the 2006 IPCC Guidelines for National Greenhouse Gas Emissions Inventories.[20]

Under these guidelines, methane emissions inventories are generally produced using "bottom-up" emissions estimates, which are calculated by assigning emissions factors to activities that may release methane into the atmosphere (accounting for facilities, equipment types, production volume, herd sizes, and so on). While bottom-up estimates based on studies using direct observations of methane releases may produce accurate estimates of emissions from specific identified sources, they may also fail to account for variance or undetected leaks.[21] Further, emissions factors based on out-of-date or unrepresentative studies can be inherently unreliable. Due to these issues, methane emissions inventories that countries submit to the UNFCCC often report far lower emissions than the IEA estimates based on its data.[22] Discrepancies are especially apparent where National Emissions Inventories are compared against top-down methane measurements, in which atmospheric methane is detected using remote sensing technology to infer methane emissions. Top-down measurements generally estimate much greater methane emissions than bottom-up methods, particularly in the oil and gas sector. Canada's Faster and Further Strategy explicitly acknowledges prior underestimations for methane in its reported emissions inventories, noting that bottom-up inventories—which Canada uses to obtain source-specific estimates for its reporting—may underestimate methane emissions from the oil and gas industry by between 25 and 90 percent.[23]

Several jurisdictions have adopted or proposed more robust reporting and monitoring practices than the UNFCCC requires. For instance, the United States included new reporting requirements in Subpart W of its 2022 Supplemental Proposal to Reduce Methane and Other Harmful Pollution from Oil and Natural Gas Operations ("Supplemental Proposal"), which is discussed in greater detail in subpart II.a. If adopted, these reporting requirements could improve reporting from new emissions sources to include super-emitter events and align US inventories with levels 4 and 5 of the Oil and Gas Methane Partnership, the United Nations Environment Programme's most stringent tiers for classifying voluntary methane emissions reporting.[24] This framework would emphasize direct measurements of source-level emissions over bottom-up measurements.[25]

As noted above, recent amendments to the EU Methane Proposal would encourage extraterritorial methane monitoring, reporting, and verification (MRV) by requiring methane

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[20] Task Force on National Greenhouse Gas Inventories, 2006 IPCC Guidelines for National Greenhouse Gas Inventories (last visited Sep. 8, 2023), https://www.ipcc-nggip.iges.or.jp/public/2006gl/.
[21] https://www.pnas.org/doi/full/10.1073/pnas.1805687115
[22] *See* Int'l Energy Agency, Understanding Methane Emissions, https://www.iea.org/reports/global-methane-tracker-2023/understanding-methane-emissions; Penwadee Cheewaphongphan et al., *Exploring Gaps Between Bottom-Up and Top-Down Emissions Estimates Based on Uncertainties in Multiple Emission Inventories*, 11 J. Sustainability 2054 (Apr. 9, 2019), https://www.mdpi.com/2071-1050/11/7/2054.
[23] Faster and Further Strategy, *supra* note 9, at 11.
[24] Ben Cahill & Allegra Dawes, *Transatlantic Efforts to Cut Methane Emissions*, Center for Strategic & International Studies (June 23, 2023), https://www.csis.org/analysis/transatlantic-efforts-cut-methane-emissions.
[25] *Id.*

importers to hire accredited third parties to ensure conformity with EU MRV requirements.[26] These MRV requirements would require importers to provide verified emissions reports, data sources, methodologies, and documentation of methane control technologies that align with EU regulations.[27] As the world's largest importer of natural gas, the EU crafted the Methane Proposal to contribute to improved MRV practices in jurisdictions that have not yet adopted robust MRV requirements, particularly in reporting source-specific estimates.[28] However, these MRV rules remain under negotiation and may not remain in the final regulation.

c. *Market-Based Methane Emissions Policies*

Several market-based emissions trading schemes (ETS) control methane emissions, either directly (by requiring compliance obligations for methane emissions) or indirectly (by allowing methane-control projects to generate offsets). Permitted offset programs generally award credits—either to obligated or non-obligated parties—for voluntary methane emission reductions, including from agricultural and landfilling facilities.

California's ETS program (commonly referred to as cap-and-trade) covers a range of greenhouse gas emissions, including methane.[29] Covered sources, such as refineries and other large industrial facilities, must include methane emissions in their inventories and secure compliance instruments to cover those emissions. However, agricultural and landfilling facilities are not obligated parties under California's program.[30] And facilities producing biogas and biomethane are not subject to compliance obligations for those emissions.[31] Claimed methane emissions reductions from these projects, however, may be credited as offsets and transferred to (or used by) obligated parties to meet their compliance obligations.

In the EU ETS, methane emissions have not historically been covered, although recent amendments require the inclusion of methane emissions from the shipping sector beginning in 2026.[32] Recent non-binding directives from the EU Parliament have called for the European

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[26] Ben Cahill & Allegra Dawes, *Transatlantic Efforts to Cut Methane Emissions*, Center for Strategic & International Studies (June 23, 2023), https://www.csis.org/analysis/transatlantic-efforts-cut-methane-emissions. Third party accredited verifiers under the EU Legislative Proposal would be accredited by national governments under Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance.

[27] Press Release, European Parliament, Commission Proposes New EU Framework to Decarbonize Gas Markets, Promote Hydrogen and Reduce Methane Emissions (Dec. 15, 2021), https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6682

[28] Tim Boersma & Robert Kleinberg, *Prospects for EU Extraterritorial Reduction of Methane Emissions From Its Natural Gas Supply* (June 15, 2023), https://www.energypolicy.columbia.edu/publications/prospects-for-eu-extraterritorial-reduction-of-methane-emissions-from-its-natural-gas-supply/.

[29] 17 Cal. Code Regs. tit. 17, § 95802(a)(170), 95810Gr8; Katelyn Roedner Sutter, California's Cap-and-Trade Program Step By Step, Envtl. Def. Fund 2 (2018), https://www.edf.org/sites/default/files/californias-cap-and-trade-program-step-by-step.pdf.

[30] *See* 17 Cal. Code Regs. tit. 17, § 95811 (listing entities covered by California's cap-and-trade program).

[31] *Id.* § 95852.1.1(a).

[32] European Parliament & the Council of the European Union, Directive (EU) 2023/959 of the European Parliament and of the Council (May 10, 2023), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023L0959&qid=1693429745420.

Commission ("the Commission") to consider the feasibility of including methane emissions from landfilling within the scope of the EU ETS, yet no concrete regulatory proposals are under consideration by European Parliament.[33]

In addition to ETS programs, jurisdictions also incentivize methane emissions reductions using positive incentives (like subsidies or tax credits) or fees. As discussed above, projects to capture and utilize methane that could otherwise be vented into the atmosphere can be credited as offsets, or may benefit from feed-in tariffs that guarantee a price floor for biomethane.[34] Under the U.S. Inflation Reduction Act (IRA), passed in 2022, the federal government will charge a fee to producers of fossil fuels for methane emissions above certain intensity thresholds starting in 2025.[35] New rules concerning how to monitor and verify the emissions intensity of facilities subject to the fee are currently under development as part of the Supplemental Proposal.[36] However, operators will be exempt from these charges if all states (which are required to submit their own plan regulating existing sources) have adopted leak detection and repair standards that are at least as stringent as the US EPA's leak detection and repair guidelines, which are discussed in more detail below.[37]

II. Sector-Specific Methane Policies

This section describes jurisdictions' sector-specific regulatory policies, which are often designed to support the cross-sector methane strategies and goals discussed in Section I. Although this briefing mostly focuses on prescriptive regulatory measures, it also discusses informational, tax, and incentive-based policies where relevant. The highlighted measures are grouped into three sectors: (1) fossil fuel methane policies; (2) agriculture policies; and (3) waste and landfilling policies.

a. *Fossil Fuel Methane Policies*

According to the IEA, oil, coal, and natural gas operations accounted for more than 124 million tonnes of methane emissions in 2022, amounting to about a third of anthropogenic global

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[33] *See* European Parliament & Council, *supra* note [x] at accord 98 ("[c]onsidering the methane emissions from landfilling and to avoid creating an uneven playing field, the Commission should also assess the possibility of including other waste management processes, such as landfilling, fermentation, composting and mechanical-biological treatment, in the EU ETS, when assessing the feasibility of including municipal waste incineration installations.").

[34] *See*, *e.g.*, Feed-In Tariff Overview, Ontario Independent Electricity System Operator (last visited Sept. 25, 2023), https://www.ieso.ca/en/Sector-Participants/Feed-in-Tariff-Program/Overview.

[35] Clean Air Act, Section 136, 42 U.S.C. § 7436; Ben Cahill & Allegra Dawes, *Transatlantic Efforts to Cut Methane Emissions*, Center for Strategic & International Studies (June 23, 2023), https://www.csis.org/analysis/transatlantic-efforts-cut-methane-emissions.

[36] Romany Webb, *The New Methane Emissions Charge: One (Limited But Important) Stick in the Inflation Reduction Act*, Climate Law Blog, Sabin Center (Aug. 23, 2022), https://blogs.law.columbia.edu/climatechange/2022/08/23/the-new-methane-emissions-charge-one-limited-but-important-stick-in-the-inflation-reduction-act/.

[37] *Infra* Section III ; 87 Fed. Reg. 74702 et seq.

methane emissions.[38] Several jurisdiction-wide mandates exist to reduce emissions from this sector.

For example, the United States Environmental Protection Agency (US EPA) has incorporated the Global Methane Pledge Goals into its Supplemental Proposal to Reduce Methane and Other Harmful Pollution from Oil and Natural Gas Operations ("Supplemental Proposal"), with proposed language published in December 2022.[39] The US EPA's Supplemental Proposal is a package of technically-focused methane regulations setting standards for new oil and gas facilities and requiring states to submit plans to reduce methane from existing oil and gas sources. The Supplemental Proposal includes goals aiming to achieve an 87 percent reduction in methane emissions from covered sources[40] by 2030 through strengthened leak detection and repair, increasing emphasis on advanced leak detection methods, and increasing requirements for states to develop and enforce plans to reduce methane emissions from existing sources.[41] Although the Supplemental Proposal's draft language is currently available, the rule is not yet finalized or in effect.

The State of Colorado, which is the fifth-largest producer of oil and gas in the United States, recently adopted regulations requiring oil and gas producers to utilize direct monitoring instruments and submit detailed emissions inventories to the state, which will then be certified by an independent, state-accredited auditor.[42] This emissions inventory will then be used to calculate the operator's emissions intensity for each 1,000 barrels of oil equivalent (which may include oil or gas) and submit a plan to the state to meet decreasing carbon intensity goals. Colorado's emission intensity standards were originally adopted in 2021 and aim to reduce the amount of greenhouse gases emitted per unit of production, rather than on other technical criteria, such as facility size or components used.[43]

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[38] Intl. Energy Agency, Methane Tracker 2023 (updated Feb. 21, 2023), https://www.iea.org/data-and-statistics/data-tools/methane-tracker.

[39] 87 Fed. Reg. 74702 et seq., https://www.federalregister.gov/documents/2022/12/06/2022-24675/standards-of-performance-for-new-reconstructed-and-modified-sources-and-emissions-guidelines-for (Dec. 6, 2022).

[40] Covered sources under the Supplemental Proposal are oil and natural gas sources included in the EPA's New Source Performance Standards under Section 111(d) of the Clean Air Act, regulated in US EPA regulations as Subpart OOOO, including oil and natural gas well sites, natural gas gathering and compressing stations, natural gas processing segments, and transportation and storage sites. US Envtl. Protection Agency, Oil and Natural Gas Sources Covered by EPA's New Source Performance Standards and Emissions Guidelines, By Site (Nov. 2022), https://www.epa.gov/system/files/documents/2022-11/EPA%27s%20Oil%20and%20Natural%20Gas%20Supplemental%20Proposal.Table%20of%20Covered%20Sources.pdf.

[41] US EPA, EPA's Supplemental Proposal to Reduce Pollution from the Oil and Natural Gas Industry to Fight the Climate Crisis and Protect Public Health: Overview 3 (Nov. 2022), https://www.epa.gov/system/files/documents/2022-11/OIl%20and%20Gas%20Supplemental.%20Overview%20Fact%20Sheet.pdf.

[42] Steve Hanley, *Colorado Adopts New Rules To Curb Methane Emissions*, CleanTechnica (July 24, 2023), https://cleantechnica.com/2023/07/24/colorado-adopts-new-rules-to-curb-methane-emissions/.

[43] Colorado Dept. of Public Health & Environment, Oil and Gas Greenhouse Gas Emission Reduction Rulemaking (Dec. 2021), https://drive.google.com/file/d/1UPa0uZyRmU6HFM5PgYuxJpwSd3DM1QMD/view.

Other fossil methane policies generally regulate one of several sources of fossil fuel methane, including: (1) flaring and venting; (2) leak detection and repair; (3) orphaned and abandoned wells; and (4) coal and coalbeds. Regulations focusing on these categories are discussed, in turn, below.

i. Flaring and Venting

Flaring and venting regulations are commonly deployed in natural gas and oil-producing jurisdictions.[44] Flaring is the controlled combustion of produced methane; venting refers to the practice of releasing methane directly into the atmosphere without combustion.[45] The IEA has noted that preventing all non-emergency flaring and venting is the single highest-impact measure that jurisdictions can take to reduce methane emissions.[46]

The World Bank launched the Zero Routine Flaring by 2030 Initiative ("Zero Flaring Initiative"), which commits signatory governments and fossil fuel companies to ending the practice of routine flaring by 2030.[47] Thus far, the initiative has been endorsed by 35 national and subnational governments, including California, Colorado, the United States, Canada, and the United Kingdom.[48] The initiative defines routine flaring as the burning of gas during normal oil and gas operations in the absence of sufficient facilities to re-inject, utilize, or sell produced gas.[49] The Zero Flaring Initiatve further notes that venting is not an acceptable substitute for flaring. Routine flaring does not include emergency situations in which piping or equipment becomes over-pressured, causing special valves to release gas to a facility's flare stacks.[50]

Several endorsers of the Zero Flaring Initiative have adopted policies banning routine flaring and venting. Indeed, Norway—the first oil producing country to announce its support for the Zero Flaring Initiative—has banned the practice of routine flaring since 1971.[51] Denmark instituted a

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[44] Maria Olczak, Andris Piebalgs, & Paul Balcombe, *A global review of methane policies reveals that only 13% of emissions are covered with unclear effectiveness*, 6 One Earth R. 519 (May 2023), https://www.sciencedirect.com/science/article/pii/S2590332223001951?ref=pdf_download&fr=RR-2&rr=7fe2f2cfb80f2b96.

[45] US Dept. of Energy, Natural Gas Flaring and Venting: State and Federal Regulatory Overview, Trends, and Impacts (June 2019), https://www.energy.gov/fecm/articles/natural-gas-flaring-and-venting-regulations-report.

[46] Int'l Energy Agency, Global Methane Tracker 2023—The Case for Methane Policy and Regulation (last visited August 26, 2023), https://www.iea.org/reports/global-methane-tracker-2023/the-case-for-methane-policy-and-regulation.

[47] World Bank, Zero Routine Flaring by 2030 Initiative (last visited Sept. 1, 2023), https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030/about.

[48] World Bank, "Zero Routine Flaring by 2030" Initiative Endorsers (last visited Sept. 1, 2023), https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030/endorsers.

[49] World Bank, Global Initiative to Reduce Gas Flaring: Zero Routine Flaring by 2030 (last visited Sept. 25, 2023), https://thedocs.worldbank.org/en/doc/a903b5e6456991faf3b5e079bba0391a-0400072021/related/ZRF-Initiative-text-list-map-104.pdf.

[50] Ohio Envtl. Prot. Agency, Understanding the Basics of Gas Flaring (Nov. 2014), https://epa.ohio.gov/static/Portals/27/oil%20and%20gas/Basics%20of%20Gas%20Flaring.pdf.

[51] Mark Davis & John-Henry Charles, *Tackling Flaring: Lessons from the North Sea* (Aug 10, 2020), https://www.energyvoice.com/opinion/270340/tackling-flaring-lessons-from-the-north-sea/.

ban on routine flaring that took effect on July 1, 2023.[52] Colorado has instituted a similar policy banning routine flaring and venting and the release of raw gas, unless needed for well completion, during maintenance, or when operators make a positive showing that doing so will minimize adverse impacts to public health, safety, welfare, and environment.[53] The European Commission has tentatively agreed to support the Zero Flaring Initiative and will consider ending the practice of voluntary flaring across the fossil fuel supply chain, including for imports.[54] In the United States, the US Bureau of Land Management is expected to adopt—under the IRA—a separate rule designed to prevent methane waste at oil and gas lease sites on public lands, limiting flaring to predetermined amounts (based on well production), requiring pre-drilling planning for gas capture, and broadly limiting venting.[55]

Other jurisdictions have instead focused on phasing down routine venting and flaring by prescribing numeric limits on total quanitites of gas that operators may release or by regulating routine flaring short of a complete prohibition. For instance, in provinces that have not entered into an Equivalency Agreement with the federal government, the Canada Oil and Gas Drilling and Production Regulations (2009) require venting and flaring permits from federal energy regulators, except in emergencies.[56] As of January 2023, large facilities in these provinces must adhere to federal regulations limiting annual venting to 15,000 cubic meters of natural gas and limit the bleed rate of pneumatic controllers and pumps, and keep hatches and pipe openings closed.[57] The volume of flared and vented gas is reported using bottom-up measurements, accounting for stack height and diameter, exit temperature and velocity, and facility counts.[58] However, unlike flaring and venting regulations in other jurisdictions (including the United States),[59] Canadian venting and flaring limitations do not apply to methane released from

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[52] *See* International Energy Agency, Ban on Routine Gas Flaring to Reduce Methane Emissions (Jan. 18, 2023), https://www.iea.org/policies/16013-ban-on-routine-gas-flaring-to-reduce-methane-emissions.

[53] U.S. Dept. of Energy, Colorado Natural Gas Flaring and Venting Regulations (June 2022), https://www.energy.gov/sites/default/files/2022-06/Colorado-state-profile-2022.pdf.

[54] Press Release, World Bank, As part of a new methane reduction strategy, the European Union pledges to support gas flaring reduction (last visited Aug. 26, 2023), https://www.worldbank.org/en/programs/gasflaringreduction/brief/as-part-of-a-new-methane-reduction-strategy-the-european-union-pledges-to-support-gas-flaring-reduction (per the European Commisssion's strategy to reduce methane emissions: "The Commission will examine the options available in view of proposing legislation on eliminating routine venting and flaring in the energy sector covering the full supply chain, up to the point of production**").**

[55] Ban Cahill, *What's Next for Oil and Gas Methane Regulations*, Center for Strategic & International Studies (Mar. 22, 2023), https://www.csis.org/analysis/whats-next-oil-and-gas-methane-regulations. https://www.doi.gov/sites/doi.gov/files/uploads/methane_waste_prevention_rule_factsheet.pdf

[56] Canada Oil and Gas Drilling and Production Regulations (SOR/2009-315), Part 8, § 67.

[57] Envtl. & Climate Change Canada, Technical Backgrounder: Federal methane regulations for the upstream oil and gas sector (Apr. 27, 2018), https://www.canada.ca/en/environment-climate-change/news/2018/04/federal-methane-regulations-for-the-upstream-oil-and-gas-sector.html

[58] Envtl. & Climate Change Canada, Guide for Reporting the National Pollutant Release Inventory 2022-2024 129-33 (Jan. 2022), https://publications.gc.ca/collections/collection_2022/eccc/En81-1-2022-eng.pdf.

[59] 40 CFR Part 60, Subpart OOOOa, EPA Docket ID No. EPA-HQ-OAR-2017-0483 (April 12, 2018); *see also* US EPA, Oil and Natural Gas Sources Covered By EPA's Proposed New Source Performance Standards (NSPS) and Emissions Guidelines (last visited Sept. 22, 2023), https://www.epa.gov/system/files/documents/2022-11/EPA%27s%20Oil%20and%20Natural%20Gas%20Supplemental%20Proposal.Table%20of%20Covered%20Sources.pdf.

compressors and blowdowns or during well completion. Alberta, which is the largest producer of oil and gas in Canada, has entered into an Equivalency Agreement and adopted its own flaring and venting requirements with relaxed routine venting provisions.[60] Alberta's venting provisions apply only to facilities where total gas flaring exceeds an annual threshold of 670 million cubic meters.[61]

ii. Leak Detection and Repair

Leak detection and repair (LDAR) refers to measures designed to locate and address fugitive emissions—in other words, leaks—anywhere along a fossil fuel production pathway, from upstream sources (such as exploration, extraction, and processing operations) to downstream facilities (including transmission or distribution lines and power plants).[62] According to the IEA, LDAR measures have the second greatest methane abatement potential of any individual policy measure, following flaring and venting.[63] LDAR regulations may require facility operators to deploy specific methane monitoring techniques and technologies, inspect for leaks at particular time intervals, utilize certain equipment to prevent major leaks, and fix any leaks that occur within a certain timeframe following detection.

LDAR regulations commonly require the use of leak detection methodologies that meet technological or performance-based standards. The Canadian federal government, for instance, requires the installation of specific component parts and adoption of detection and repair activities to address leaks.[64] Canadian federal LDAR provisions are incorporated into the Canadian venting and flaring regulations and require operators and owners to implement and submit for approval an LDAR program for gas facilities.[65] Submitted LDAR programs require operators to utilize portable monitoring instruments that meet the Canadian Environmental Protection Agency's regulatory guidelines or, instead, utilize optical gas-imaging instruments. Operators must further conduct leak inspections three times yearly and repair leaks within

[60] Canada Environmental Protection Agency, Canda-Alberta Equivalency Agreement Respecting the Release of Methane From the Oil and Gas Sector (last visited Sept. 1, 2023), https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/agreements/equivalency/canada-alberta-methane-oil-gas.html. Canadian Environmental Protection Act Registry, Review of Canada's Methane Regulations for the Upsteam Oil and Gas Sector 5-6 (hereinafter, Canada Methane Regulations Review) (Dec. 2021), https://www.canada.ca/content/dam/eccc/documents/pdf/cepa/review-canada-methane-regulations-upstream-oil-gas-sector.pdf (download link).

[61] Alberta Energy Regulator, Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting § 2.1 (Apr. 6, 2022), https://static.aer.ca/prd/documents/directives/Directive060.pdf.

[62] Int'l Energy Agency, Global Methane Tracker (Feb. 2022), https://iea.blob.core.windows.net/assets/b5f6bb13-76ce-48ea-8fdb-3d4f8b58c838/GlobalMethaneTracker_documentation.pdf.

[63] Int'l Energy Agency, Global Methane Tracker Overview (Feb. 2022), https://www.iea.org/reports/global-methane-tracker-2022/overview

[64] Katherine Konschnick & Frances Reuland, *Canada steps up its efforts to reduce methane emissions*, Int'l Energy Agency (Feb. 17, 2020), https://www.iea.org/commentaries/canada-steps-up-its-efforts-to-reduce-methane-emissions.

[65] Canada Methane Regulations Review, *supra*, note 64 at 6. *See also* P.C. 2018-396 2018-04-03 Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds SOR 2018-66 (Upstream Oil and Gas Sector) § 29-33.

thirty days of detection.[66] Alternatively, operators may instead submit to CEPA a bespoke proposed LDAR program if it results in the same, or better, fugitive emissions reductions quantities than the regulatory LDAR program.[67] Other Canadian federal LDAR regulations require use or deployment of specific equipment.[68]

Other regulatory approaches to LDAR require operators to meet predetermined emissions reductions goals (Mexico) or assign a tax based on fugitive emissions (Norway).[69] Fugitive emissions in these jurisdictions are calculated based on a combination of components parts' standardized "leak potential" (the likelihood of a leak occurring) and leakage rates, and, sometimes, infrared cameras used to detect whether a leak has actually occurred in any of the component parts.[70]

The US EPA's proposed LDAR standards are set forth in the 2022 Supplemental Proposal, and are still under development. Pursuant to Section 111 of the Clean Air Act, the 2022 Supplemental Proposal strengthens methane LDAR requirements for new oil and gas production facilities and requires states to submit plans to establish, implement, and enforce performance standards for existing oil and gas facilities.[71] Notably, the Supplemental Proposal's expanded LDAR requirements for new sources would set a zero emissions standard for pneumatic pumps and controllers and would allow EPA-authorized third parties to report large plumes directly to operators through its proposed Super-Emitter Response Program, which would then trigger inspection and repair requirements.[72] The Supplemental Proposal further contemplates expanding approved methane detection technologies, with an emphasis on continuous monitoring.

Finally, to control methane emissions from oil and gas pipelines, the US has mandated—under Section 113 of the PIPES Act of 2020—that the US Pipeline and Hazardous Materials Safety Administration (PHMSA) promulgate rules minimizing the leakage of methane emissions from interstate pipelines.[73] In May 2023, PHMSA published proposed rules designed to fulfill this mandate and cut fugitive emissions from pipelines by 55 percent, but the rules have not yet

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[66] P.C. 2018-396 2018-04-03 Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds SOR 2018-66 (Upstream Oil and Gas Sector) § 30-33.
[67] *Id.* § 35(1).
[68] Konschnik & Reuland, *supra* note 69.
[69] Intl. Energy Agency, Guidelines for the prevention and comprehensive control of methane emissions from the hydrocarbons sector (Mexico), https://www.iea.org/policies/8685-guidelines-for-the-prevention-and-comprehensive-control-of-methane-emissions-from-the-hydrocarbons-sector-mexico;
[70] *See*, *e.g.*, Norway Oil & Gas, Handbook for Quantifying Direct Methane and NMVOC Emissions § 3.11 (Jan. 2022), https://offshorenorge.no/contentassets/cd872e74e25a4aadac1a6e820e7f5f95/revisjon-012022-ver20/guideline-044---appendix-b---handbook-voc-emissions---english-version--ver20-_january-2022.pdf.
[71] 87 Fed. Reg. 74721-22; Ben Cahill & Allegra Dawes, *Transatlantic Efforts to Cut Methane Emissions*, Center for Strategic & International Studies (June 23, 2023), https://www.csis.org/analysis/transatlantic-efforts-cut-methane-emissions.
[72] Ben Cahill, What's Next for Oil and Gas Methane Regulations, Center for Strategic and International Studies (Mar. 2023), https://csis-website-prod.s3.amazonaws.com/s3fs-public/2023-03/230322_Cahill_OilGas.pdf?VersionId=e6vyK6vFf.Yb0maSpltgpPF0XEDCR9FQ.
[73] H.R. 133, 116th Congress (Consolidated Appropriations Act, 2021), (codified at 49 U.S.C. § 60105 et seq.).

been finalized.[74] PHMSA's proposed regulatory package includes rules that would require new valve installation and minimum rupture detection standards and extending existing onshore natural gas gathering pipelines to previously underregulated rural areas.[75] These rules further specify the spacing and types of valves to be used at interconnection points, procedures in the event of pipeline ruptures, and regulations requiring the installation of automatic shut-off valves or equivalent technologies.[76]

California, through the California Air Resources Board (CARB), concurrently regulates LDAR at the facility level via its Oil and Gas Methane Regulation.[77] CARB's LDAR regulations apply to owners or operators of facilities that handle oil and gas production, storage, processing, and transmission, with exemptions based on facility throughput, technology usage, and facility size.[78] CARB also sets out timelines for leak screenings, requiring daily or continuous monitoring at injection/withdrawal wellheads, periodic inspections of component parts, and reporting requirements. For non-exempt facilities, CARB employs standards for use in component parts of natural gas and oil facilities.[79]

While the European Union is considering some LDAR requirements through its 2022 Methane Action Plan, it has recently weakened several of its LDAR proposals relative to both its prior proposals and those of other oil-producing jurisdictions. As an example, the European Commission changed its LDAR requirements for all relevant components—which originally required inspections every three months—to periods between three and thirty-six months.[80]

iii. Inactive Oil and Gas Facilities

Inactive oil and gas wells are the most poorly understood source of methane emissions from oil and gas operations.[81] This is partly because most orphaned and abandoned wells are not tracked and documented by regulators.[82] Wells often become orphaned when their operators go out of business or cannot otherwise be reached; other orphaned wells are legacy wells that were abandoned prior to the adoption of contemporary regulations on well decommissioning.[83]

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[74] US Dept. of Transportation, USDOT Announces Bipartisan PIPES Act Proposal to Modernize Decades-Old Pipeline Leak Detection Rules, Invests in Critical American Infrastructure, Create Good-Paying Jobs, and Improve Safety (May 5, 2023), https://www.phmsa.dot.gov/news/usdot-announces-bipartisan-pipes-act-proposal-modernize-decades-old-pipeline-leak-detection.
[75] 49 C.F.R. § 192, 195.
[76] *Id.* § 195; 49 U.S.C. § 60102(n).
[77] Cal. Code Regs., tit. 17, § 95665 et seq.
[78] *Id.* § 95666, 95668(a).
[79] *Id.* § 95668.
[80] *Cahill*, *supra* note 77, at 4 (depicting the frequency of both types of LDAR screening proposed under the EU Legislative Proposal).
[81] *See generally* Jade Boutot et al., *Documented Orphaned Oil and Gas Wells Across the United States*, 56 ACS Publications 14228 (2022), https://pubs.acs.org/doi/10.1021/acs.est.2c03268.
[82] *Id.* ("there are likely hundreds of thousands of orphaned wells, if not millions, in the U.S. alone that remain undocumented").
[83] American Ass'n For the Advancement of Sciences, Benefits to Safely Managing Orphaned Oil and Gas Wells (Apr. 2021), https://www.aaas.org/epi-center/management-of-wells.

In the United States, for example, there are around 120,000 documented orphaned wells (wells that have been abandoned with no responsible party), but estimates of additional undocumented orphan wells can be as high as several million.[84] Due to this uncertainty, there have been few reliable attempts to quantify global emissions from inactive oil and gas wells. As discussed below, orphaned and idle wells are often regulated through bond requirements put up by operators and technical closure requirements that go into effect when operators cease production at a well.

Emissions from inactive oil and gas wells may be abated by plugging, a process by which cement is placed in the wellbore or casing.[85] In California, orphaned and idle wells[86] are regulated by the California Geologic Energy Management Division (CalGEM), under Assembly Bill (AB) 2729, Senate Bill (SB) 724, SB 551, SB 84, and SB 47. To regulate the release of both criteria pollutants and methane, California requires oil and gas operators to post a cleanup bond up front when receiving a permit, although these bonds have largely failed to provide adequate funding for remediation of California's orphan and idle wells.[87] To address these and similar shortfalls, the United States Bipartisan Infrastructure Law establishes a federal program for plugging orphaned wells on federal land and a grant program for states and tribes to plug and remediate orphan wells within their borders.[88]

Other jurisdictions directly regulate the decommissioning of wells at the end of their lifetime. For instance, Energy Resolution 05/96 in Argentina requires operators to cement and plug wells after their effective date, providing a timeline for abandonment based on location, possible safety hazards, and other risk factors.[89] These plugging schedules may range from 5 to 15 years, which are published in an annual inventory.[90] The EU has proposed regulations under the EU Methane Proposal requiring member states to establish and publish an inventory of all recorded inactive wells, temporarily plugged wells, and permanently plugged and abandoned wells.[91]

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[84] Envtl. Def. Fund, Plugging Orphan Wells Across the United States (last visited Sept. 25, 2023), https://www.edf.org/orphanwellmap.

[85] California Dept. of Convservation, State Oil and Gas Well Plug and Abandonments (July 18, 2023), https://www.conservation.ca.gov/calgem/Pages/State-Abandonments.aspx

[86] In California, idle wells are those that have not produced oil or natural gas—and have not been used for injection––for six consecutive months of continuous operation over the last or more years. Cal. Pub. Res. Code § 3008(d). Orphan wells are idle wells that have no responsible party, leaving the state to plug and abandon it. *Id.* § 3206.3.

[87] Cal. Council on Sci. & Tech., Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities to Plug and Decommission Orphan Oil and Gas Wells 31-32 (2022), https://ccst.us/wp-content/uploads/CCST-Orphan-Wells-in-California-An-Initial-Assessment.pdf. It should also be noted that California fails to count orphaned and abandonded wells in its emissions inventories. *Id.*

[88] US Dept. of the Interior, Assessing Methane Emissions From Orphaned Wells: Federal Program Guidelines (Apr. 2022), https://www.doi.gov/sites/doi.gov/files/federal-orphaned-wells-methane-measurement-guidelines-final-for-posting-v2.pdf.

[89] Intl. Energy Agency, Energy Resolution 05/96 - Approve Rules and Procedures for the Abandonment of Hydrocarbon Wells (last visited Aug. 29, 2023), https://www.iea.org/policies/8841-energy-resolution-0596-approve-rules-and-procedures-for-the-abandonment-of-hydrocarbon-wells.

[90] *Id.*

[91] Press Release, European Council, Member States Agree On New Rules to Slash Methane Emissions (Dec. 19, 2022), https://www.consilium.europa.eu/en/press/press-releases/2022/12/19/member-states-agree-on-new-rules-to-slash-methane-emissions/.

Although the EU Methane Proposal largely leaves procedures for abandonment up to member states, the regulation would require member states to remediate and plug inactive wells, with the exception of certain offshore operations.[92]

iv. Coal and Coalbed Methane

Coal and coalbed methane emissions represent nearly a third of methane emissions from the oil and gas sector. These emissions come from both active and abandoned coal mines. Methane is released from coal mines when coal-bearing seams are disturbed during mining operations, allowing methane to be vented into the air from micropores in the coal.[93] Methane from underground mines is often collected and channelized by degasification systems for safety and environmental purposes and is then vented, flared, or collected and utilized; it is more difficult to channelize (and therefore abate) methane from open-pit or surface mining operations, although past projects have successfully abated surface mine methane by collecting gas using systems of water pumps and vacuum units.[94]

Coal mine methane regulations may address seepage from surface mines, ventilation or flaring from underground mines for safety, emissions during processing or transport, and mine closure requirements.[95] For instance, China—which produces and consumes nearly half of the world's coal supply—directly regulates coal mine gas through its Emission Standard of Coalbed Methane. This standard obligates certain underground coal mines to set up permanent surface gas drainage and methane concentration, flow, and pressure sensors if the mine's gas emission rate exceeds certain thresholds.[96] Further, China issued a 2020 notice that coal developments must improve the utilization rate of coal mine methane, setting out a requirement that operators must utilize coal mine methane where concentrations are above 8 percent.[97] China has also enacted policies to support coal mine methane collection and utilization projects through funding and technical support for smaller mines, and making abated coal mine methane eligible for offset credits under China's ETS.[98]

As another example, Germany—which phased out subsidies for coal operations in 2018—has deployed 35 abandoned mine methane projects, in part due to its Renewable Energy Sources

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[92] *Id.*
[93] *Id.*
[94] Intl. Energy Agency, 2023 Methane Tracker: Strategies to reduce emissions from coal supply (last visited Sept. 25, 2023), https://www.iea.org/reports/global-methane-tracker-2023/strategies-to-reduce-emissions-from-coal-supply; US Envtl. Prot. Agency, Case Study: Methane Reocvery at Surface Mines in the US (Mar. 2014), https://www.epa.gov/sites/default/files/2016-03/documents/cmop-methane-recovery-surface-mines-march-2014.pdf (describing open-pit methane recovery project).
[95] Int'l Energy Agency, Driving Down Coal Mine Methane Emissions 32, (2023), https://iea.blob.core.windows.net/assets/ab2115cd-2b04-4e66-9a71-ec2c14d13acf/DrivingDownCoalMineMethaneEmissions.pdf.
[96] Int'l Energy Agency, Emission Standard of Coalbed Methane/Coal Mine Gas (trial) (last visited Sept. 25, 2023), https://www.iea.org/policies/14961-emission-standard-of-coalbed-methanecoal-mine-gas-trial.
[97] *Id.*
[98] Keith Bradsher & Clifford Krauss, China Is Burning More Coal, a Growing Climate Challenge, N.Y. Times (Nov. 10, 2022), https://www.nytimes.com/2022/11/03/business/energy-environment/china-coal-natural-gas.html.

Act, which guarantees a feed-in-tariff for coal mine methane for 20 years from the date that a new source applies. Germany has also been credited for its Federal Mining Law, which provides details on license application procedures for coal mine methane, describes clear property rights for mine gas, and specifies the criteria under which an application may be rejected.[99]

Alternatively, some jurisdictions have chosen to focus on demand-side regulations, transitioning away from coal as a fuel. In jurisdictions that are currently transitioning away from coal, demand-reduction policies must be effectively paired with regulations designed to control emissions from inactive mines, which represent a growing share of coal mine methane emissions.[100] Aiming to mitigate methane emissions from abandoned mines, several jurisdictions have implemented specific policies to facilitate the capture and utilization of methane, including by: (1) enacting clear rules for obtaining ownership rights for mines that are already abandoned or closed; (2) allowing the transfer of methane rights from mines to third-parties; (3) offering reduced taxes or targeted financial incentives to projects designed to facilitate capture of methane from abandoned mines.[101] Although other strategies exist to abate emissions from abandoned coal mines (such as flooding underground mines), these solutions are often infeasible or inefficient.[102]

b. Agricultural Policies

Agriculture is the world's leading anthropogenic source of methane emissions, responsible for more than a quarter of total global methane emissions.[103] However, agricultural methane regulations are often less stringent than fossil fuel-focused methane abatement policies. Most policies that target methane from the agricultural sector utilize financial incentives and taxes or charges to abate agricultural emissions, rather than prescriptive controls.

This briefing organizes its discussion of methane goals and strategies as follows: (1) policies promoting digesters and biogas; (2) alternative manure management strategies; and (3) enteric emissions reductions.

i. Digester and Biogas Utilization

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[99] United Nations Best Practice Guidance for Effective Methane Recovery and Use From Abandoned Coal Mines 4 (2020), https://www.un-ilibrary.org/content/books/9789210044929/read.

[100] Nazar Kholod et al., Global methane emissions from coal mining to continue growing even with declining coal production, 256 J. Cleaner Production (May 2020), https://www.sciencedirect.com/science/article/pii/S0959652620305369 ("results show that emissions from the growing population of abandoned mines increase faster than those from active ones.").

[101] U.S. Envtl. Protection Agency, Legal and Regulatory Status of Abandoned Mine Methane in Selected Countries: Considerations for Decision Makers (Mar. 2019), https://www.epa.gov/sites/default/files/2019-03/documents/legal-regulatory-status-amm_epa.pdf.

[102] World Bank, Tell Me How: Tackling Methane Emissions from Abandoned and Active Coal Mines, https://www.worldbank.org/en/news/podcast/2022/03/02/tell-me-how-tackling-methane-emissions-from-abandoned-and-active-coal-mines.

[103] Intl. Energy Agency, Methane and Climate Change (last visited Sept. 25, 2023), https://www.iea.org/reports/methane-tracker-2021/methane-and-climate-change.

In many surveyed jurisdictions, agricultural methane policies focus on promoting the capture and utilization of methane produced through anaerobic digestion of manure, often through voluntary credit and incentive programs. These programs generally aim to incentivize the construction and operation of dairy digesters, which—due to economies of scale—are most effective on consolidated and concentrated animal feeding operations.[104] As such, digester and biogas are most commonly employed in jurisdictions that already host large agricultural operations.

In California—which leads US states in dairy cows—CARB has broad license to approve and implement comprehensive strategies to reduce emissions of short-lived climate pollutants (including methane), with the ultimate goal of achieving a 40 percent reduction in statewide methane emissions from 2013 levels by 2030.[105] However, pursuant to Senate Bill (SB) 1383, CARB is precluded from adopting prescriptive regulations to reduce dairy and livestock methane emissions until January 1, 2024.[106] Thus, while CARB is one of the few agencies across surveyed jurisdictions with forthcoming statutory license to directly regulate dairies, it is unlikely that any prescriptive rules will come into force for several years.

Due in part to this limitation, CARB instead largely encourages adoption of dairy digester infrastructure through its market-based Low Carbon Fuel Standard program, which awards credits to producers of biomethane collected by anaerobic digesters.[107] Under the LCFS program, producers of biogas from dairy digesters are eligible for credits that can be sold or transferred to obligated parties (producers of traditional transportation fuels), who may then use these credits to meet a declining average carbon intensity requirement for the fuels that they produce. Under LCFS regulations, biogas from dairy digesters are assigned a negative carbon intensity value, designed to reflect the assumption that manure would otherwise be anaerobically digested in lagoons and vented into the atmosphere.

Oher jurisdictions, such as Finland, have established feed-in tariffs—a system by which producers are guaranteed a fixed price for specific energy sources—for biogas-based power stations, under which they are awarded a subsidy accounting for the difference between the pre-set price and the market price for associated power.[108] Finland also affords domestic

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[104] Aaron D. Smith, *Are Manure Subsidies Causing Farmers to Milk More Cows*, UC Davis (Apr. 7, 2023), https://asmith.ucdavis.edu/news/are-digesters.

[105] Cal. Health & Safety Code § 39730, 39730.5(a); *see also* SB 605 (Lara, 2014) (adding Cal. Health & Safety Code § 39730); *see generally* Cal. Air Res. Bd., Short-Lived Climate Pollutant Reduction Strategy (Mar. 2017), https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.

[106] Moreover, under the framework of SB 1383, CARB must also affirmatively make findings related to technological and economic feasibility of agricultural methane emissions prior to adopting regulations. Cal. Health & Safety Code § 39730(b); 39730.7(b)(4).

[107] Cal. Code Regs., tit. 17, § 95488.9(f).

[108] Ministry of Economic Affairs and Employment of Finand, Feed-in Tariff for Renewable Energy (last visited Aug. 28, 2023), https://tem.fi/en/feed-in-tariff-for-renewable-energy. Conversely, several jurisdictions, like Germany, have recently ended their feed-in tariffs for biogas. Isabel Sutton, *Post Feed-In Tariff Futures for Pioneeer Renewable Plants: Biogas*, Clean Energy Wite (June 1, 2021), https://www.cleanenergywire.org/news/post-feed-tariff-futures-pioneer-renewable-plants-biogas; *see also* Tammy Klein, RNG in the EU, TransportEnergy Strategies (Jan. 2022), https://www.transportenergystrategies.com/wp-

renewable natural gas (pipeline-quality natural gas derived from organic sources) producers preferential access to system operators upon request and at reasonable cost, connecting to its network of renewable gas installations.[109]

ii. Alternative Manure Management Practices

Although many jurisdictions have promoted the use of anaerobic digesters to encourage the use of dairy methane, some jurisdictions have instituted complementary or alternative policies designed to promote other methane reduction strategies, particularly pasture-based or composting strategies. Rather than collect methane gas that forms from manure lagoons, these policies aim to encourage alternative pathways of manure decomposition that prevent the formation of methane in the first place. Like many surveyed policies related to anaerobic digestion, alternative manure management policies are largely incentive-based, rather than prescriptive.

The California Department of Food and Agriculture, for example, administers an Alternative Manure Management Program, which provides financial assistance for operators of agricultural operations to implement alternative manure management practices, including pasture-based management systems, composting, and solid separation of animal waste.[110] The Alternative Manure Management Program is funded through proceeds from California's cap-and-trade auction system and operates using a grant system.[111]

iii. Enteric Emissions Reductions

While enteric emissions——emissions that result from the digestion of feedstock from ruminants (such as cattle)—represent a larger share of agricultural regulations than animal waste, agricultural methane emissions policies largely do not target enteric emissions.[112] This is likely due to several factors, including a lack of technologies to utilize methane from enteric fermentation.[113] Other possible factors include a limited understanding of impacts on animal health or production from certain feed additives or dietary changes, as well as associated costs related to dietary changes or additives and rumen manipulation.

As such, most livestock-producing countries have instead focused their efforts on funding or otherwise supporting research related to enteric emissions reductions.[114] For instance, the Global Research Alliance on Agricultural Greenhouse Gases is an international research

content/uploads/sites/7/2022/01/TEO_MR_EU_RNG_Jan2022.pdf ("Germany is the largest player in the European RNG sector (close to 223 RNG plants), but growth levels had been flattening with the revision of FIT/subsidies for grid injection. New policies implemented over the last year (see below) are expected to change this.").

[109] *Id.* at 8; *see* Finland Natural Gas Market Act (587/2017).

[110] Cal. Dept. of Food & Agriculture, Alternative Manure Management Program (Aug. 2023), https://www.cdfa.ca.gov/oefi/AMMP/

[111] *Id.*

[112] Olczak, et al., *supra* note 49, at 525.

[113] *Id.*

[114] *Id.*

institution composed of 60 member countries focusing on enteric emissions research, such as feed and nutrition, selective breeding, and MRV efforts.

c. Waste and Landfilling Policies

Organic waste—particularly waste deposited in landfills—represents the third largest source of anthropogenic methane emissions.[115] Emissions from this sector are likely routinely underestimated because emissions models fail to account for underperforming gas collection systems, leaks, and incomplete flaring.[116] Much like dairy and livestock manure, methane is produced when organic waste decomposes anaerobically—outside the presence of oxygen—which typically occurs when waste is compacted at a landfill. Therefore, agencies generally regulate landfill methane through some combination of two strategies: (1) implementing methane mitigation and utilization strategies at landfills; and (2) reducing landfilling of waste and encouraging composting. A sampling of notable regulatory policies for each of these strategies is included below.

i. Landfill Gas Management and Utilization

Many surveyed jurisdictions have enacted combinations of incentive programs and direct regulatory measures designed to encourage the capture, utilization, or destruction of methane from landfills. The federal government of Canada has published a series of discussion papers considering proposed regulations on landfills to maximize methane recovery,[117] with a proposed regulatory framework published in May 2023.[118] The Canadian federal regulations would apply to (1) any landfill that has more than 450,000 tonnes of municipal solid waste; (2) open landfills with more than 100,000 tonnes of municipal solid waste-in-place; or (3) open landfills that have accepted more than 10,000 tonnes of municipal solid waste for disposal per year in any year following the implementation of the regulations. The framework would require regulated landfills to conduct a methane generation assessment to determine whether the landfill generates more than 664 tonnes of methane per year after that. If the landfill does (and no other exemptions apply), these regulations would require the landfill to implement methane controls between 1 year of the regulation coming into force and January 2029 (based on operation of methane control systems and provincial or territorial operating permits).[119] The

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[115] Intl. Energy Agency, Understanding Methane Emissions (last visited Sept. 25, 2023), https://www.iea.org/reports/global-methane-tracker-2023/understanding-methane-emissions.

[116] Ellie Garland et al., *Mitigating Landfill Methane*, Rocky Mountain Inst (June 9, 2023), https://rmi.org/wp-content/uploads/dlm_uploads/2023/06/landfill_monitoring_memo_series.pdf.

[117] Environment and Climate Change Canada, Faster and Further: Canada's Methane Strategy 19 (Sept. 2022), https://publications.gc.ca/collections/collection_2022/eccc/En4-491-2022-eng.pdf; Environment and Climate Change Canada, Reducing Methane Emissions From Canada's Municipal Solid Waste Landfills (Jan. 2022), https://www.canada.ca/content/dam/eccc/documents/pdf/cepa/2022reducingmethaneDD-eng.pdf.

[118] Environment and Climate Change Canada, Reducing Canada's Landfill Methane Emissions: Proposed Regulatory Framework (Feb. 2023), https://www.canada.ca/en/environment-climate-change/services/canadian-envi.ronmental-protection-act-registry/publications/reducing-landfill-methane-emissions.html.

[119] *Id.*

regulations would require the flaring, utilization, or biological oxidation of methane to achieve a 99% methane destruction efficiency, calculated on an annual basis.[120]

The US federal government also requires some landfills to capture and control their emissions with a gas collection system.[121] California and other subnational jurisdictions have driven further landfill emissions reductions through state-level construction and operating standards. For instance, to supplement California's waste diversion and recycling rules under SB 1383, California's Landfill Methane Rule requires owners and operators of landfills to monitor surface methane concentrations and other performance parameters, repair emission exceedances, source test, keep records, and report emissions leaks to CARB or regional air districts.[122] The state of Oregon, too, has similar requirements to install gas capture systems or inspect for and repair leaks.[123] In jurisdictions that levy a tax on acceptance of waste by landfills, several—including France and the United States—have set out lower tax rates for landfills that are equipped with biogas capture.[124]

ii. Waste Reduction and Composting

As noted by the Rocky Mountain Institute, preventing landfilling of organic waste is the most efficient means of reducing landfill methane.[125] In particular, composting, rather than disposing of organic waste in landfills, can be an effective strategy to abate methane emissions from organic waste. This is because composting both improves carbon sequestration in soil and prevents methane emissions from occurring, as organic waste instead decomposes aerobically.[126] As such, many jurisdictions have enacted regulatory programs and policies designed to encourage composting, as well as food recycling and diversion.

South Korea utilizes a mandatory composting scheme and a ban on sending food waste to landfills, which has been in place since 2005.[127] Under the South Korean scheme, residents pay a fee for food waste to be treated, and the waste is either converted into biogas or feedstock/compost.[128] Although the program was originally designed to address overcrowding

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[120] *Id.*
[121] US Envtl. Prot. Agency, Final Federal Plan Requirements for Municipal Solid Waste Landfills (May 2021), https://www.epa.gov/sites/default/files/2021-05/documents/landfills-fedplan-final-fact_sheet.pdf.
[122] Cal. Air Res. Bd., Landfill Methane Regulation (last visited Sept. 25, 2023), https://ww2.arb.ca.gov/our-work/programs/landfill-methane-regulation/about
[123] Oregon Dept. of Envtl. Quality, Landfill Gas Emissions, Ch. 340, Div. 239, https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=6533.
[124] *Id.* at 3; Megan Quinn, *Biogas Included in Investment Tax Credit Provisions of Inflation Reduction Act*, WasteDive (Aug. 2, 2022), https://www.wastedive.com/news/biogas-tax-credit-reconciliation-budget-senate/628639/.
[125] Ellie Garland & Olivia Alves, *Waste Methane 101: Driving Emissions Reductions from Landfills*, Rocky Mountain Institute (June 14, 2023), https://rmi.org/waste-methane-101-driving-emissions-reductions-from-landfills/.
[126] https://www.epa.gov/snep/composting-food-waste-keeping-good-thing-going
[127] John Yoon, *How South Korea Puts Its Food Scraps to Good Use*, N.Y. Times (June 14, 2023), https://www.nytimes.com/2023/06/14/world/asia/south-korea-food-waste.html.
[128] *Id.*

in landfills and coastal pollution, Korea has also effectively reduced its methane emissions from the waste sector.[129]

While this system has not been replicated on a national scale, subnational jurisdictions have sought to achieve methane reductions through similar waste diversion and composting strategies. For example, New York City recently approved a bill that will require residents of the city to separate their food waste from regular trash, starting in March 2024.[130] In California, landfill-based methane emissions are governed by SB 1383, which requires CARB and CalRecycle to meet food recycling and diversion targets—including a 75 percent reduction in the statewide disposal of organic waste from 2014 levels by 2025—starting in 2022.[131] Other jurisdictions aim to divert waste from landfills through establishment of landfill taxes. For instance, 23 EU Member States, as well as Switzerland and the United Kingdom, levy a landfill tax per ton of waste accepted.[132]

III. Current and Proposed Policies Contemplating Remote Methane Sensing

As remote sensing technologies continue to advance, governments have increasingly recognized their utility as a means of detecting and addressing methane emissions, particularly for high-emitting events. However, with a few exceptions, jurisdictions have largely not yet incorporated advanced remote-sensed data into prescriptive MRV or LDAR requirements.[133]

The regulatory use of methane remote sensing remains relatively undeveloped. The US National Aeronautics and Space Administration (NASA) has historically used methane detection instruments, including satellites and airplanes, to notify operators and authorities of large methane plumes. Indeed, as early as 2015-16, NASA employed satellites to detect gas during a major methane leak near Porter Ranch, California.[134] However, these activities were performed

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[129] Max S Kim, *South Korea Has Almost Zero Food Waste. Here's What the US Can Learn*, The Guardian (Nov. 20, 2022), https://www.theguardian.com/environment/2022/nov/20/south-korea-zero-food-waste-composting-system.
[130] Hilary Howard, *Mandatory Composting Is Coming to New York City: What You Need to Know*, The Guardian (Nov. 20, 2022), https://www.theguardian.com/environment/2022/nov/20/south-korea-zero-food-waste-composting-system.
[131] CalRecycle, California's Climate Progress on SB 1383 (last visited Aug. 28, 2023), https://calrecycle.ca.gov/climate/slcp/progress/. Cal. Health & Safety Code § 39730.6(a).
[132] The Confederation of European Waste-to-Energy Plants, Landfill Taxes and Restrictions Overview (Sept. 6, 2023), https://www.cewep.eu/wp-content/uploads/2021/10/Landfill-taxes-and-restrictions-overview.pdf.
[133] European Space Agency, Sentinel-5P data used in new methane detection system (Nov. 16, 2022), https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Sentinel-5P_data_used_in_new_methane_detection_system; Press Release, Government of Canada, Government of Canada supports world-leading Canadian satellite-based emissions detection system (Nov. 3, 2021), https://www.canada.ca/en/innovation-science-economic-development/news/2021/11/government-of-canada-supports-world-leading-canadian-satellite-based-emissions-detection-system.html.
[134] *See, e.g.*, Earth Observatory, Imaging a Methane Leak from Space (2016), https://earthobservatory.nasa.gov/images/88245/imaging-a-methane-leak-from-space; Earth Observatory, Mapping Methane Emissions in California (2020), https://earthobservatory.nasa.gov/images/148806/mapping-methane-emissions-in-california ("NASA's Airborne Visible Infrared Imaging Spectrometer–Next-Generation (AVIRIS-NG) instrument detected multiple plumes of methane arising from the Sunshine Canyon landfill near Santa Clarita, California. The plumes were large enough that researchers from the Jet Propulsion Laboratory (JPL) notified facility operators and local enforcement agencies about it.")

on an *ad hoc* basis, rather than pursuant to any regulatory or statutory mandate. In California, CARB has requested and received funds to deploy and utilize remote methane sensing satellites to "enforce and further inform" the state's existing methane regulations, a more formalized use of satellite sensing technology for enforcement than previously used by CARB.[135]

CARB's use of remote satellite sensing technology to enforce existing methane regulations was further formalized through its Proposed Amendments to the Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, which CARB approved in June 2023.[136] These regulations, which have been submitted to California's Office of Administrative Law for final approval, will allow CARB to notify operators of satellite monitoring data, provided that the satellite meets specified technical standards (including spatial resolution, speed of data availability after collection, and plume visualization).[137] Under these regulations, when CARB notifies operators of a methane leak, operators will have five days to inspect the facility for the leaks and must repair it, with repair timelines set based on methane concentration in the plume.[138] The EU has not yet developed provisions requiring LDAR based on satellite data.

As noted above, Colorado's Air Pollution Control Division announced a rule in late July requiring oil and gas production sites to directly perform on-site methane monitoring to calculate their GHG intensity to ensure conformity with Colorado's GHG Intensity Standards, which require oil and gas operators production facilities to reduce their GHG intensity each year.[139] Certain facility operators will further be required to use a third-party, certified auditor to review emissions reports. Although the Air Pollution Control Division has not yet developed a complete regulatory framework that details acceptable measurement technology, the rule explicitly requires the use of site-level direct measurement by operators and allows state air regulators to use surface, fixed-wing air, and satellite measures.[140]

Perhaps most notably, the US EPA has incorporated third-party monitoring provisions into its 2022 Supplemental Proposal through the contemplated Super-Emitter Response Program (SERP). The SERP would establish a program requiring oil and gas operators to respond to large methane plumes identified by EPA-approved third parties. Like the California remote sensing regulations, the SERP would allow US EPA to approve remote sensing operators based on specific technological standards and would require oil and gas facility operators to investigate

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[135] State of California, Cal. Air Res. Bd., Busget Change Proposal DF-46 (May 12, 2022), https://esd.dof.ca.gov/Documents/bcp/2223/FY2223_ORG3900_BCP5952.pdf.
[136] Cal. Air Res. Bd., Notice of Decision: Amendments to the Greenhouse Gas Emission Standards (June 28, 2023), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2023/oilgas2023/nod.pdf.
[137] 14 Cal. Code Regs. § 95669.1 (as proposed, June 28, 2023). "Remote monitoring data," per the Proposed Amendments, only includes remote sensing data obtained from satellites. *Id.* § 95667. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2023/oilgas2023/israppa1.pdf
[138] *Id.* § 95669(h).
[139] Colorado Dept. Pub. Health, Colorado adopts first-of-its-kind measures to verify greenhouse gas emissions from certain oil and gas sites (last visited Sept. 25, 2023), https://cdphe.colorado.gov/press-release/colorado-adopts-first-of-its-kind-measures-to-verify-greenhouse-gas-emissions-from.
[140] Mark Jaffe, *Colorado is First in the U.S. to Make Rules Tying Pollution Reduction to Oil and Gas Production*, Colorado Sun (July 21, 2023), https://coloradosun.com/2023/07/21/colorado-oil-and-gas-emissions-intensity-rule/.

leak reports within five days.[141] However, in contrast to the California regulations, the SERP would include a range of remote sensing technologies (rather than just satellites)[142] and would allow approved third parties to notify operators of leaks directly.[143] US EPA would allow third parties with expertise in continuous monitoring systems, satellite surveillance, and drone or airplane surveys to collect emissions data, inform owners and operators of methane leaks, and initiate investigation and monitoring efforts.[144] If authorized in the US EPA's final rules, the SERP would be the first regulatory program to allow third-party remote sensing operators to directly engage with regulated parties.

Conclusion

The approaches to methane emission regulations detailed above showcase several rapidly evolving policies at the intersection of law, policy, and technology. Many jurisdictions recognize that methane—due to its high warming potential, relatively short atmospheric life, and historic under-regulation—is a fruitful area of policy for combatting climate change. Moreover, per recent analyses, facility operators and institutional actors can implement many emissions reductions measures at little-to-no net cost.[145] But there remain significant open questions about the role of new remote sensing technologies in advancing methane policy efforts. In particular, the use of methane remote sensing data to advance implementation and enforcement of existing methane regulations and to provide a foundation for potential new forms of regulation remains underdeveloped.

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[141] Jennifer A. Dlouhy, *Biden's Civilian Oil-Well Patrol Plan Draws Industry's Ire*, Bloomberg Law (Feb. 13, 2023), https://www.bloomberglaw.com/bloomberglawnews/environment-and-energy/XBJT8N94000000?bna_news_filter=environment-and-energy#jcite; Envt'l Protection Agency, EPA's Supplemental Proposal to Reduce Climate- and Health-Harming Pollution from Oil and Natural Gas Operations: Fact Sheet for Communities 4-5 (Nov. 11, 2022), https://aboutblaw.com/6Zk.

[142] US Envt'l Protection Agency, Determination of Volatile Organic Compound and Greenhouse Gas leaks Using Optical Gas Imaging, Subpart W Appendix K (Nov. 2022), https://www.epa.gov/system/files/documents/2022-11/Appendix%20K%20supplemental%20proposal.pdf.

[143] Cahill, *supra* note [x].

[144] *Id.* ("The SERP would allow approved third-party organizations to identify these events (which the EPA defines as those emitting 100 kilograms of methane or more per hour), notify owners and operators, and prompt an investigation and remediation effort.").

[145] *See, e.g.,* Environmental Defense Fund & Dunsky Energy and Climate Advisors, Canada's Methane Abatement Opportunity (July 2023), https://www.edf.org/sites/default/files/2023-07/Canada Methane Abatement Opportunity.pdf (providing cost breakdown and methane abatement cost/production curves for various methane capture and control strategies).

Appendix—Resources & Policies Guide

International Methane Policy Data and Overviews

- IEA Policies Database for Methane Abatement
- Maria Olczak, Andris Piebalgs, and Paul Balcombe, A global review of methane policies reveals that only 13% of emissions are covered with unclear effectiveness (One Earth, May 19, 2023)

Interjurisdictional Methane Pledges and Initiatives

Global Methane Pledge—Collective agreement to reduce methane emissions across jurisdictions by 30 percent over 2020 levels (150 participants)

Joint Declaration from Energy Importers and Exporters on Reducing Greenhouse Gas Emissions from Fossil Fuels—Joint commitment to reducing methane and CO2 emissions across the fossil energy value chain (United States, European Union, Japan, Canada, Norway, Singapore, and the United Kingdom)

Subnational Methane Action Initiative—Joint commitment by subnational governments to collectively adopt methane action plans, set methane reduction goals, and establish methane inventory programs (California; Queretaro, Mexico; Gauteng, South Africa; Espirito Santo, Brazil; Cross-River State, Nigeria; Yucatan, Mexico; and Delhi, India)

World Bank Zero Routine Flaring by 2030 Initiative—2015 initiative commitment to ending the practice of routing flaring by 2030, as well as requiring endorsing governments and fossil companies to report their flaring and progress toward achieving this goal. (35 governments and 54 oil companies)

National Methane Strategies

Faster and Further: Canada's Methane Strategy—Cross-sectoral national methane strategy, focusing on improved monitoring, new prescriptive regulations, technological development, and international cooperation (Sept. 2022)

European Union Methane Action Plan—Cross-sectoral overview of existing methane sources and policies designed to reduce methane emissions (Nov. 2022)

United States Methane Emissions Reduction Action Plan—Cross-sectoral overview of regulatory programs to reduce methane emissions (Nov. 2022)

California Short-Lived Climate Pollutants Strategy—Statewide roadmap toward achieving a 40 percent methane emissions reduction over 2013 levels by 2030 (Mar. 2017)

Key Legislation and Summaries of Regulatory Proposal

Inflation Reduction Act of 2022 (136 Stat. 1818)—The Inflation Reduction Act of 2022 (IRA) is a major US law that includes tax and infrastructure incentives to reduce methane emissions, particularly from the oil and gas sector, including $1.55 billion to cut methane pollution from oil and gas industry operations.

The IRA also adds Section 136 to the Clean Air Act, which directs the US EPA establish a charge for methane emissions from oil and gas production facilities that emit more than 25,000 metric tons of CO_2 equivalent, starting in 2024. The charge will start at $900 per ton of methane and increase to $1,500 in 2026. This is the first time that the federal US government has directly imposed a charge on GHG emissions.

However, the IRA provides a conditional exemption from the methane emissions charge if subsequent Clean Air Act methane regulations, including the EPA's November 2021 proposed New Source Performances Standards regulations and Existing Sources Guidelines, and the November 2022 Supplemental Proposal (which updates and expands the 2021 rule), (1) are in effect in all states, and (2) will result in the same or greater emissions reductions than would be achieved under the November 2021 regulations. Thus, the IRA provides an incentive for industry to push states to adopt compliance plans quickly to avoid the methane fee. Because EPA estimates that the submission and approval process for state compliance plans will extend into 2026, the methane fee will likely remain in place for at least a year or more.

Supplemental Proposal to Reduce Methane and Other Harmful Pollution from Oil and Natural Gas Operations (87 Fed. Reg. 74702 et seq.)—The EPA's Supplemental Proposal is a package of methane regulations expanding EPA's prior, November 2021 proposal establishing New Source Performance Standards and Existing Sources Guidelines, discussed briefly above. The EPA has announced that it aims to adopt the Supplemental Proposal by the end of the year.

The Supplemental Proposal establishes ambitious standards for the Oil and Gas Production emissions source category, including zero-emissions standards for pneumatic pumps and controls, a 95 percent methane reduction standard for flaring, and routine leak monitoring at all well sites. The Supplemental Proposal also applies emissions standards to orphaned and unplugged wells, which were exempt from the previous iteration of the rule.

The EPA's Supplemental Proposal also includes new MRV requirements to improve data quality and expand reporting requirements to new emission sources, including storage and wellhead leaks. While these new requirements are not yet finalized, they could also increase emphasis on source-level and top-down estimates. In this same vein, the Supplemental Proposal also calls for the establishment of a Super-Emitter Response Program (SERP). While the EPA has not crafted all of the details on how the SERP will operate, the program would allow US EPA to approve operators of remote sensing technologies based on technological standards. Those EPA-approved remote sensing operators would then be authorize to directly alert oil and gas production facilities of leaks that they have detected, triggering requirements for oil and gas facilities to investigate those leaks within five days.

European Union Legislative Proposal On Methane Emissions Reduction in the Energy Sector (COM/2021/805 final)—The EU Legislative Proposal is a package of legislation that was introduced in December 2021 and agreed to by the European Council in December 2022. The proposal is now in trilogue, an interinstitutional negotiation process for legislative proposals. Thus, the final legislation is subject to change.

The most recent iteration of the EU Legislative Proposal includes source-level MRV requirements (many of which mirror those in the Supplemental Proposal) and requires component-specific LDAR inspection periods, ranging from 3-12 months, and monthly audio and visual inspections of flare stacks. Because most of the EU's member countries do not produce significant quantities of fossil fuels, the EU Legislative Proposal relies in part on imposing MRV and LDAR requirements on importers of natural gas into the EU. The EU Legislative Proposal would also require the European Commission to establish and maintain a methane transparency databased and global methane monitoring tool compiling satellite methane data from certified providers.