Co-authored with Gil Damon, CLEE Methane Research Fellow.

2022 proved to be a big year for methane—the flammable gas that accounts for 30 percent of Earth's anthropogenic warming. Methane forms when organic material decomposes in sealed spaces and is released in the agriculture, waste disposal, and energy sectors. In terms of warming, methane is a staggering 84 times more potent than carbon dioxide, over a 20 year period. However, because this gas has a relatively short atmospheric life, cutting methane emissions today can rapidly reduce the rate of warming, buying more time to complete the energy transition. In addition to its climate impact, methane harms human health as a primary contributor to the formation of ground-level ozone and often co-occurs with carcinogens like benzene.

Much of the 2022 momentum has grown from last year's United Nations Climate Change Conference (COP 26), which brought the Global Methane Pledge. At COP 26, over 100 countries joined this initiative, promising to cut global methane emissions by at least 30 percent by 2030, as compared to 2020 levels. In the last year, another 50 have joined.

Despite substantial progress in the policy sphere, methane continues to spew into the atmosphere at an astonishing rate. In its latest annual greenhouse gas index, the National Oceanic and Atmospheric Administration found that methane emissions are climbing faster than at any other time since observations began in 1983, with an atmospheric methane burden that is 162 percent greater than pre-industrial levels. Meanwhile, an exhaustive 2022 report underscored the danger of climate tipping points—temperature thresholds at which changes in the climate system become cascading and irreversible. Separate research shows that methane action is key to avoiding these runaway events.

In 2022, the Project Climate initiative at the Center for Law, Energy, and the Environment (CLEE) worked to accelerate a series of promising solutions in the top three methane-producing sectors: agriculture, energy, and waste disposal.

Here, we discuss a short selection of methane developments and Project Climate activities from the past year.

Major Developments Across Methane-Emitting Sectors

What Happened:

- **Inflation Reduction Act targets methane:** The Inflation Reduction Act (IRA) is the largest climate investment in American history, and it places a strong focus on

methane across sectors. For the oil and gas industry, it targets methane with the first-ever federal greenhouse gas emissions fee. In waste management and agriculture, it offers strong incentives to capture methane for use as a fuel. Meanwhile, the IRA supports a slate of research initiatives to better detect and measure methane emissions. Taken together, these actions could help bring about an economy that not only reduces the release of methane but also puts this gas to productive use.

- **California invests in methane monitoring satellite program:** Governor Newsom boosted methane research and monitoring through a $100 million investment to expand the number of satellites launched for methane observations. The new Methane Monitoring and Accountability Program is a blueprint to monitor and track methane emission sources through remote satellite monitoring. This will be accomplished through collaboration with public-private partnership organizations, allowing California to identify the source of emissions and hold emitters accountable.
- **California Scoping Plan maintains focus on methane**: In December, the California Air Resources Board adopted the 2022 Scoping Plan for Achieving Carbon Neutrality, placing a significant emphasis on methane. It highlighted the state's existing methane goals set by Senate Bill 32 (2016) of reducing methane emissions 40 percent below 1990 levels by 2030 through the Short-Lived Climate Pollutant Reduction Strategy.

Project Climate Highlights:

- **New resources for policymakers:** In October, CLEE's Project Climate unveiled an online repository to help policymakers design methane strategies: MethaneResources.org. This site, which is in beta version, includes the latest scientific research along with methane strategies from around the world. At its center is a series of "Methane Frameworks," which outline core principles for methane reduction in each sector.
- **Advancing methane action for cities and states:** Because many methane-emitting operations (e.g., farms, landfills, and some energy operations) are governed at the state and local level, subnational governments can play a key role in reducing emissions. To better equip policymakers to incentivize methane action, Project Climate has developed systems to help governments determine emissions baselines, compile emitter data, implement emissions reduction plans, and promote education about methane. As part of this effort, Project Climate's Ken Alex and Gil Damon engaged in high-level discussions at the UN-sponsored Global Methane Forum.

Oil and Gas Sector: About 30% of U.S. methane emissions.

What Happened:

- **Oil and gas methane fee introduced through Inflation Reduction Act:** The IRA introduced a charge on methane released by the highest emitting oil and gas facilities. by establishing the Methane Emissions Reduction Program. This represents the first federal fee on any greenhouse gas. At the same time, the IRA will provide up to $1.55 billion to the U.S. Environmental Protection Agency to provide technical assistance for methane abatement in the oil and gas sector.
- **Federal action on leaky, abandoned oil wells:** As part of the Infrastructure Investment and Jobs Act of 2021, $4.7 billion was allocated for grants to plug and cap leaky oil and gas wells. These "orphan wells" have been deserted, meaning that no party is liable for their decommissioning process. Millions of Americans live within a mile of an orphaned oil and gas well. States have indicated that there are over 10,000 high-priority well sites across the country ready for immediate plugging efforts, with more than 120,000 documented wells eligible for funding. The Department of the Interior awarded an initial $560 million to 24 states to begin plugging wells and increasing monitoring. California has developed a draft Orphan Well Screening Methodology to prioritize orphan wells that are closer to communities or water resources.
- **New rule targets flaring and venting on federal lands**: The Department of Interior has a proposed rule to limit the flaring and venting of natural gas on public lands, as Professor Dan Farber has discussed. The proposed regulations would replace the Bureau of Land Management's current requirements governing venting and flaring, which are more than four decades old.
- **Continued efforts to reduce methane gas from buildings:** Both the federal government and California advanced building decarbonization standards and goals. In early December, the White House announced the first-ever Federal Building Performance Standard, setting the goal of reducing energy use in buildings by 30 percent by 2030. Electrifying appliances will remove methane gas heaters, stoves, and dryers. New research found that gas stoves and other appliances routinely leak unburned gas even when they are off, emitting methane and hazardous toxic air pollutants like benzene and toluene.
- **Germany and Western Europe reduce reliance on Russian methane gas**: When Russia invaded Ukraine in February 2022, European countries had to contend with their heavy reliance on Russian energy. For example, Russian gas provided the bulk of Germany's supply. In response, Western European nations have enacted measures to cut back on energy usage, expanded renewable energy resources, and built Liquified Natural Gas (LNG) terminals to receive gas from the U.S. and other countries. For now, gas reserves are nearly full. However, next winter may bring a greater challenge, as European Union countries must refill their entire gas supplies without Russia.

Project Climate Highlights:

- **New report aimed at reducing residential gas infrastructure:** In early 2022, CLEE and the UCLA Emmett Center convened an expert panel of industry professionals, utilities, energy regulators, affordable housing providers, and environmental justice advocates to discuss barriers to deploying electric heat pumps to replace gas heaters and appliances, This discussion provided the basis for *Hot, Cold & Clean*, a report with recommendations to support the equitable and affordable adoption of heat pump retrofits in existing buildings.
- **Active participation in California's orphan well policy:** CLEE's Project Climate provided a public comment letter to the California Geologic Energy Management Division (CalGEM) on their Draft Orphan Well Methodology, advocating for (1) prioritization of wells leaking the highest levels of methane, (2) reducing costs as part of building public support, and (3) supporting environmental justice communities and their need for transparency.
- **Convening stakeholders to advance action and new technologies:** CLEE's Ross Zelen organized and moderated a panel entitled "Meeting the Methane Moment" at the VerdeXchange Conference in June 2022 featuring CalGEM Supervisor Uduak-Joe Ntuk as well as representatives from GHGSat and Project Canary. The conversation focused on market-based opportunities for eliminating wasted methane gas, utilizing new drone and satellite monitoring technologies, and creating job opportunities in California communities.

Landfills and Waste Management Sector: About 17% of U.S. methane emissions.

What Happened:

- **The Inflation Reduction Act adds waste sector incentives:** For landfill and wastewater operations, the IRA is more carrot than stick. It offers strong tax credits for low-carbon fuels, including those that can result from captured landfill gas, and offers both tax breaks and grants to build new landfill gas collection projects. Furthermore, the bill brings hefty research grants for additional landfill emissions research and could bring investment in projects that improve air quality for fenceline communities through the National Green Bank.
- **Satellites target landfills:** In 2022, landfills received renewed scrutiny from satellites, which showed that methane was released at a higher rate than previously thought. An August study, for instance, looked at four major cities in the Global South and found that emissions were 1.4 to 2.6 times higher than models showed. Next year's launch of several methane-sensing satellites will enable similar observations to

be made with greater accuracy and regularity.
- **Promising low-cost landfill covers:** While the best way to reduce landfill methane is to keep food and other organics out, cities have also employed sophisticated systems to capture or burn landfill methane. But in recent years, researchers have developed another solution: a living cover for landfills. Biocovers—which consist of compost spread across a landfill's surface—contain methane-gobbling microorganisms that regularly reduce methane emissions by well over 60 percent. While this was thought by many to be a temporary solution, a May study from the Technical University of Denmark found that landfill biocovers retain their efficacy after at least seven years, suggesting that this solution may hold promise for low-cost methane reduction.

Project Climate Highlights:

- **A new cross-Berkeley landfill partnership:** In November, Project Climate partnered with leading researchers at Berkeley's Department of Engineering and the Goldman School of Public Policy to begin a series of grant proposals. Through this unique interdisciplinary collaboration, we aim to develop low-cost landfill monitoring systems, then use them to create financial incentives for activities that reduce landfill emissions. We hope that this research ultimately contributes to an offset market that can reward methane actions at landfills worldwide.

Agricultural and Livestock Sector: About 35% of U.S. methane emissions.

What Happened:

- **Revisiting the manure digester paradigm:** For two decades, the dominant practice for reducing methane from cattle manure has been to capture it using "anaerobic digesters.". A suite of financial incentives has led to more than 100 digesters in California. In 2022, a range of voices, including environmental justice advocates and U.S. Senators, expressed opposition to the current digester paradigm. Vermont Law School's *Rethinking Manure Biogas* assessed the limitations and pitfalls of a digester-first approach. In March 2022, the California Air Resources Board published an analysis showing that the state is far behind its goal of achieving its 2030 goal of reducing dairy and livestock methane by 40%, compared to 2013 levels.
- **Feed additives approved in the European Union, Chile, and Brazil, among others:** Enteric fermentation takes place in the digestive systems of animals, generating emissions from animal burps. Enteric emissions are the single largest source of direct greenhouse gas emissions in beef and dairy value chains. In 2022, feed additives, which can meaningfully reduce emissions, were approved in the

European Union countries, as well as Chile and Brazil. In New Zealand, the government is studying the impact of feeding cows "Kowbucha" to reduce burps. The Kowbucha is a probiotic supplement that can be easily integrated into a calf's diet.

Project Climate Highlights:

- **Major convening and report on dairy and livestock emissions strategies:** Last spring, CLEE and the UCLA Emmett Center convened an expert panel of industry professionals, state regulators, and environmental justice advocates to discuss improvements in the state's dairy and livestock industry. This discussion provided the basis for *Ahead of the Herd*, a report to address methane emissions from California's animal agriculture and provide recommendations aimed at accelerating emissions reductions. The report looks at emissions from both manure storage and enteric fermentation (cow burps). Our report examines how California can continue to spearhead policies that reduce emissions by increasing research funding, accelerating approvals for feed additives like red seaweed and 3-NOP, and adopting an offset protocol under the state's cap-and-trade program.

While methane awareness is rising, so are methane emissions. 2023 will be a pivotal year for methane research, policy, and implementation. Check back in January for an overview of methane policies under consideration next year.