Impacts of methane and commercializing methane capture

July 7, 2023

By Anja Chalmin

Comparing anthropogenic influence on the two most important GHGs[i]

	Preindustrial atmospheric concentration never exceeded:	Atmospheric concentration in 2022:	Percentage increase:	Annual emissions prior to industrialization	Global annual emissions (2022)
Methane (CH_4)	790 ppb	1,908 ppb	242 %	~233 Mio t	~600 Mio t
Carbon dioxide (CO_2)	280 ppm	417 ppm	149 %	so low that CO_2 levels remained constant at ~280 ppm	36.8 Gt (36,800 Mio t)

Methane accounts for about 30 % of global warming since the Industrial Revolution. Compared to CO_2, methane remains in the atmosphere for a relatively short period. But over a two-decade period, it traps more than 80 times as much heat as CO_2. The increase in atmospheric methane concentrations has accelerated in recent years and is now about 2.5 times higher than before industrialisation. A study published in Nature Communications shows that rising temperatures contribute to the production of even more methane and weaken the natural oxidation processes that remove methane from the atmosphere.

According to the International Energy Agency (IEA), 60 % of methane emissions are caused by human activities. Most of it comes from agriculture and the energy sector (oil, gas, coal, biofuels). The IEA estimates that leaks from the oil and gas industry alone release more than 70 million tonnes of methane into the atmosphere each year worldwide, equivalent to 2,100 million tonnes of CO_2. A satellite analysis by the company Kayrros in 2022 confirmed a large number of methane leaks in the fossil fuel industry. Kayrros identified more than 1,000 super

emitter events in 2022, including 664 in oil, gas and coal fields. Most of the events occurred in the US, Russia and Turkmenistan.

There are a few companies at the forefront of methane capture research and commercialization. Most methane capture technologies focus on oxidizing the greenhouse gas. This article provides an overview of the different companies exploring methane capture.

gM-Engineering, Germany & Australia

The German company gM-Engineering, led by Franz Dietrich Oeste, has been working for about a decade on a proposal that combines methane capture with solar radiation management (SRM), and ocean fertilization. For example, iron-salt-aerosols (ISA) would be mixed with exhaust gases and released into the atmosphere. Injecting ISA into the troposphere (lower atmosphere) is intended initially to promote marine cloud formation by providing condensation nuclei. The company expects this to lead to more and brighter clouds, thereby reducing solar radiation in the Earth's atmosphere. At the same time, ISA is expected to trigger oxidation processes in the air that break down the greenhouse gas methane. Later, the iron-rich ISA will be flushed out of the atmosphere into the ocean, where it is supposed to stimulate the growth of marine algae through iron fertilization. According to a February 2023 press report, gM-Engineering has abandoned plans for a field trial of ISA in Bass Strait, a channel separating Victoria, Australia, from Tasmania. gM-Engineering staff said that plans would not be pursued "*because of concerns that it would be too difficult to attribute any observed changes in atmospheric chemistry to the [iron salt aerosol] activity, and that the overall political governance framework is not ready to support this form of geoengineering*". However, a company website still refers to the plans for the field trial. Franz Oeste also takes ISA research and field-testing plans to other continents, including China and France.

The ISA process has been patented by Franz Oeste (gM-Engineering). He has advised the two methane removal companies presented below and has a commercial interest in the patent: ""*Oeste says he has provided unpaid technical feedback so far, but he anticipates that a company would seek to license the technology if it chose to move forward. He says he co-owns a patent covering the method.*".

Blue Dot Change, USA

Silicon Valley based Blue Dot Change also aims to remove the greenhouse gas methane over the ocean by injecting iron-salt-aerosols (ISA) into the lower atmosphere. Ferric chloride ($FeCl_3$) particles are supposed to trigger oxidation processes that break down methane into CO_2 and water molecules. The $FeCl_3$ is expected to enter the atmosphere via ship exhaust. In February 2023, the company announced that it aims to deploy the process on a commercial scale within a year, and that it hopes to eliminate 100 million tonnes of methane annually by the end of 2027, which would require around 3,000 participating ships emitting $FeCL_3$.

AMR AG, Switzerland

AMR AG aims to destroy methane by releasing ferric chloride nanoparticles into the lower atmosphere. The Swiss company plans to release the particles from decommissioned oil platforms in the open oceans. The idea is to install 400-metre towers on the platforms. With 40 towers and a total of 1.8 million tonnes of ISA, AMR aims to remove half of the world's methane from the atmosphere each year. The proposed location for the dispersal towers is near the equator in the ocean, for example in the Pacific near Chile or in the Atlantic near Namibia. Starting in 2023,

AMR plans to measure the effects of ISA during a one-year test phase in the open ocean. There are no details yet on the exact timing, location, or funding. AMR also advocates for the creation of a methane credit market, similar to the carbon credit market, and has launched another website, Cool Planet Earth, to market its concept. Franz Oeste is a member of AMR's scientific advisory board.

Risks associated with the use of $FeCl_3$ particles[i]:

– The dark, iron-rich particles can have a warming effect on the planet;

– the ferrous dust can cause serious damage to sensitive marine ecosystems;

– the particles pose a direct risk to human health;

– chlorine is harmful to humans and animals in high concentrations.

Other approaches and projects for methane removal from the atmosphere (selection)

Methane removal with zeolites

This approach converts one greenhouse gas into another. Zeolite is a porous, clay-like mineral already used in products such as cat litter. Zeolite can trap methane in its tiny pores, oxidise it and then release it as CO_2. One of the research institutions working on this approach is the Massachusetts Institute of Technology (MIT) at the University of Cambridge in Massachusetts. The institute is working on a zeolite filter to convert methane to CO_2 in dairy farms and coal mines. In 2022, the US Department of Energy awarded MIT a two-million-dollar grant to advance the technology. The approach is made more difficult by the fact that the concentration of methane in the atmosphere is very low, at about 1.9 parts per million. By comparison, CO_2 has a concentration of about 416 parts per million.

Bluemethan: proof of concept in Lake Kivu, Rwanda

The Climate Policy Initiative and the Global Innovation Lab for Climate Finance are supporting the launch of a climate finance instrument, the Reservoir Methane Capture Mechanism. This instrument aims to scale up and commercialize methane capture technologies at hydropower plants. The methane from hydropower plants will be used to generate emission credits. The methane capture plant is being developed by Bluemethan. The development is being funded by Cranfield University and Green Future Investments. According to the company, a methane capture prototype was tested in December 2022 and will now be further optimized. In the summer

of 2023, a proof of concept will be carried out in Lake Kivu, Rwanda, in partnership with Shema Power Lake Kivu.

Coalbed methane emissions

Methane emissions from coal seams account for a large proportion of methane emissions from the fossil fuel sector. There are several research projects looking at methods of capturing methane from coal seams, including projects in China and India. In China, tests have been carried out with zeolite and activated carbon. The Indian project will be located in the Jharia coal field in the state of Jharkhand. It is a feasibility study funded by the US Trade and Development Agency and conducted by Virginia-based Advanced Resource International.

Methane removal study funded by ClimeWorks Foundation

Since spring 2023, US-based National Academics has been conducting an 18-month study to examine the need for methane removal from the atmosphere and viable options for removing methane from the atmosphere. A committee has been formed to examine the opportunities, risks and added value of different approaches to removing methane from the atmosphere and to make recommendations for further research. The study is funded by the ClimateWorks Foundation. The results of the study are expected in 2024.

Photocatalytic Methane Removal Processes

The Universities of Edinburgh and Wuhan are proposing to use existing infrastructure to remove methane. Titanium oxide or other photocatalytic coatings could be applied large-area structures in contact with large volumes of air to remove methane from the air by oxidation. The researchers cite windows or walls of large buildings as examples, but also airplanes and wind turbines. The university also proposes to generate carbon credits on this basis. In addition, it has been proposed to carry out methane removal by photocatalysis using solar updraft towers (SUT). SUTs are very large (coated) chimneys designed to process large volumes of air, e.g., 38,000 km^3 of air per year.

US-DOE funded research projects to reduce methane emissions

The US Department of Energy's REMEDY (Reducing Emissions of Methane Every Day of the Year) research programme started in 2021. This three-year, USD 35 million programme is conducting multiple research projects to reduce methane emissions from sources in the oil, gas and coal value chain.

Reducing methane emissions in livestock farming

Symbrosia and Siemens are carrying out projects to reduce methane emissions in livestock farming by using selected algae as feed additives.

Spark Climate Solution / Methan Action

Californian Methane Action aims to coordinate an international network of scientists to identify, evaluate and develop efficient methane capture methods. In February 2023, Spark Climate Solutions and Methane Action merged to form Spark. Together they now aim to advance research, development, policy and governance in the field of methane capture.

Global Methane Alliance

The Global Methane Alliance (GMA) aims to bring together governments, financial institutions, international organisations, NGOs and industry to achieve methane reduction targets for the oil and gas industry. The GMA was launched in 2019 by the United Nations Environment Programme and the Climate and Clean Air Coalition. Countries joining the alliance commit to include methane reduction targets for the oil and gas sector in their Nationally Determined Contributions. The goal of the GMA is to achieve savings of up to six gigatonnes of CO2e by 2030.

Methane removal: the most cost-effective way

According to the IEA, the most effective measure to reduce methane emissions from oil and gas facilities is to eliminate all non-emergency flaring and leaks. The IEA estimates that this could bring an additional 200 billion cubic metres of gas to the market. Capturing the wasted methane could bring in about USD 17 million a year – more than the cost of the repairs or investments needed to clean up methane leaks.

At the UN Climate Change Conference in Egypt in 2022, 150 countries pledged to cut methane emissions from oil and gas by at least 30 %. This includes most major oil producers, with the exception of Russia. China has not signed the agreement, but has agreed to reduce emissions.

---

[i] J. Temple (February 15,2023): These startups hope to spray iron particles above the ocean to fight climate change. https://www.technologyreview.com/2023/02/15/1068495/these-startups-hope-to-spray-iron-particles-above-the-ocean-to-fight-climate-change/amp/; Geoengineering Monitor (January 2021): Geoengineering Technology Briefing. Ocean fertilization. https://www.geoengineeringmonitor.org/wp-content/uploads/2021/04/ocean-fertilization.pdf

---

[i] **Sources:** American Chemical Society (June 2023): What are the greenhouse gas changes since the Industrial Revolution? https://www.acs.org/climatescience/greenhousegases/industrialrevolution.html; NOAA Global Monitoring Laboratory (June 2023): https://gml.noaa.gov/ccgg/trends_ch4/#:~:text=Global%20CH4%20Monthly%20Means&text=The%20Global%20Monitoring%20Division%20of,et%20al.,%201994; NOAA (June 2023): Climate Change: Atmospheric Carbon Dioxide, https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide; Max Planck Society (June 2023): Methane, Plants, and Climate, https://www.mpg.de/405362/methan-pflanzen-und-klima; International Energy Agency (March 2023):

CO_2 Emissions in 2022, https://www.iea.org/reports/co2-emissions-in-2022; NOAA (June 2022): Carbon dioxide now more than 50% higher than pre-industrial levels, https://www.noaa.gov/news-release/carbon-dioxide-now-more-than-50-higher-than-pre-industrial-levels