Levegő Munkacsoport

Reducing Methane Emissions:

Analysis, Impact and Global Strategies

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Photo on front page by Tim Hill from Pixabay[1]

[1] https://pixabay.com/photos/ferrybridge-power-station-5428427/

I. Problem definition

Methane (CH4) is a powerful greenhouse gas, second only to carbon dioxide in its overall contribution to climate change and responsible for about one-third of current climate warming. Although it remains in the atmosphere for a shorter period than CO_2 (10-12 years compared to hundreds of years), methane is a far more powerful climate forcer with a Global Warming Potential (GWP) 28 times that of CO_2 over 100 years and 80 times over 20 years).[2] In addition to the significant short-term effect on the climate, methane contributes to ozone formation, which is a potent local air pollutant that causes serious health problems, before oxidizing into carbon dioxide that continues to trap heat and affect the climate for a much longer timeframe. During their 10-12-year atmospheric lifetime, methane emissions from any country disperse and affect others, causing – in addition to their global warming effect –illnesses, premature deaths, and losses in agricultural harvests not only at the point of origin but on a much wider geographical scope.[3]

The amount of methane in the atmosphere has changed dramatically over the past four decades (1980-2020), this trend can be seen in Figure 1. It increased sharply in1980s but slowed to a near-constant level between 2000 and 2005 when emissions and sinks were roughly balanced[4]. However, atmospheric methane concentration has increased rapidly again over the past decade and in 2020 exhibited the highest growth rate in NOAA's 37-year record it refers to a particular measurement or observation that was tracked by the National Oceanic and Atmospheric Administration (NOAA) over a span of 37 years. In this context, "highest growth rate" means that in 2020, this measurement increased at a faster rate than in any other year since NOAA began recording this data 37 years ago.[5][6]These observations demonstrate that it is crucial to change the growth trajectory of this greenhouse gas emissions. They also show that atmospheric methane responds quickly to reductions in emissions, as shown by the negative growth rates in the early 2000s.[7]

[2] Climate Portal. 2024. Why do we compare methane to carbon dioxide over a 100-year timeframe? Are we underrating the importance of methane emissions? MIT Climate Portal

[3] International Energy Agency. Global Methane Tracker 2022. Methane and climate change. https://www.iea.org/reports/global-methane-tracker-2022/methane-and-climate-change

[4] Dalsøren, S. B., Myhre, C. L., Myhre, G., Gomez-Pelaez, A. J., Søvde, O. A., Isaksen, I. S. A., Weiss, R. F., & Harth, C. M. (2016). Atmospheric methane evolution the last 40 years. *Atmospheric Chemistry and Physics, 16*(5), 3099–3126. https://doi.org/10.5194/acp-16-3099-2016

[5] https://gml.noaa.gov/ccgg/trends_ch4/

[6] **National Oceanic and Atmospheric Administration (NOAA).** (2022). *Increase in atmospheric methane set another record during 2021.* Retrieved from https://www.noaa.gov/news-release/increase-in-atmospheric-methane-set-another-record-during-2021

[7] Methane and climate change – Global Methane Tracker 2022 – Analysis - IEA.

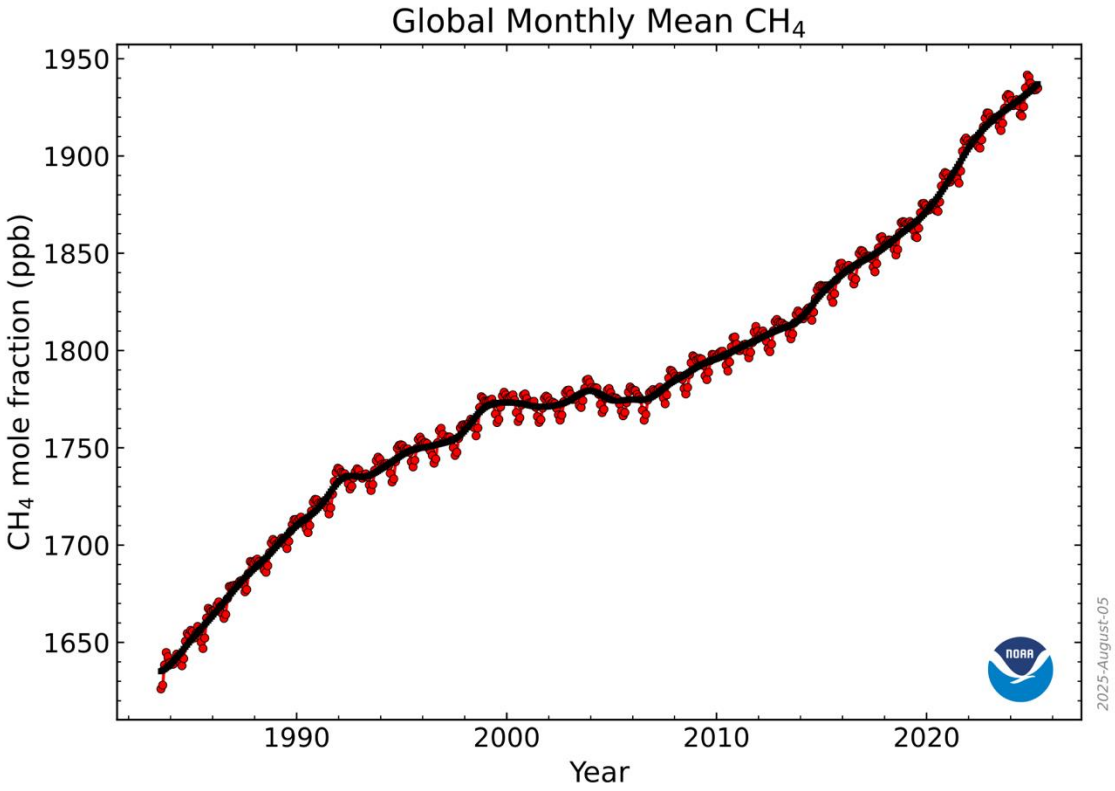


Fig. 1: Global mean methane concentration, 1984-2025, parts per billion[8]

The curve illustrates a consistent upward trend in average methane levels in the atmosphere over time, with data points plotted at various intervals. This trend suggests a concerning pattern of increasing methane concentrations, highlighting the significance of ongoing environmental monitoring and analysis. Such data underscores the need for proactive measures to mitigate methane emissions and address their impact on climate change[9].

[8] https://gml.noaa.gov/ccgg/trends_ch4/

[9] Ibid.

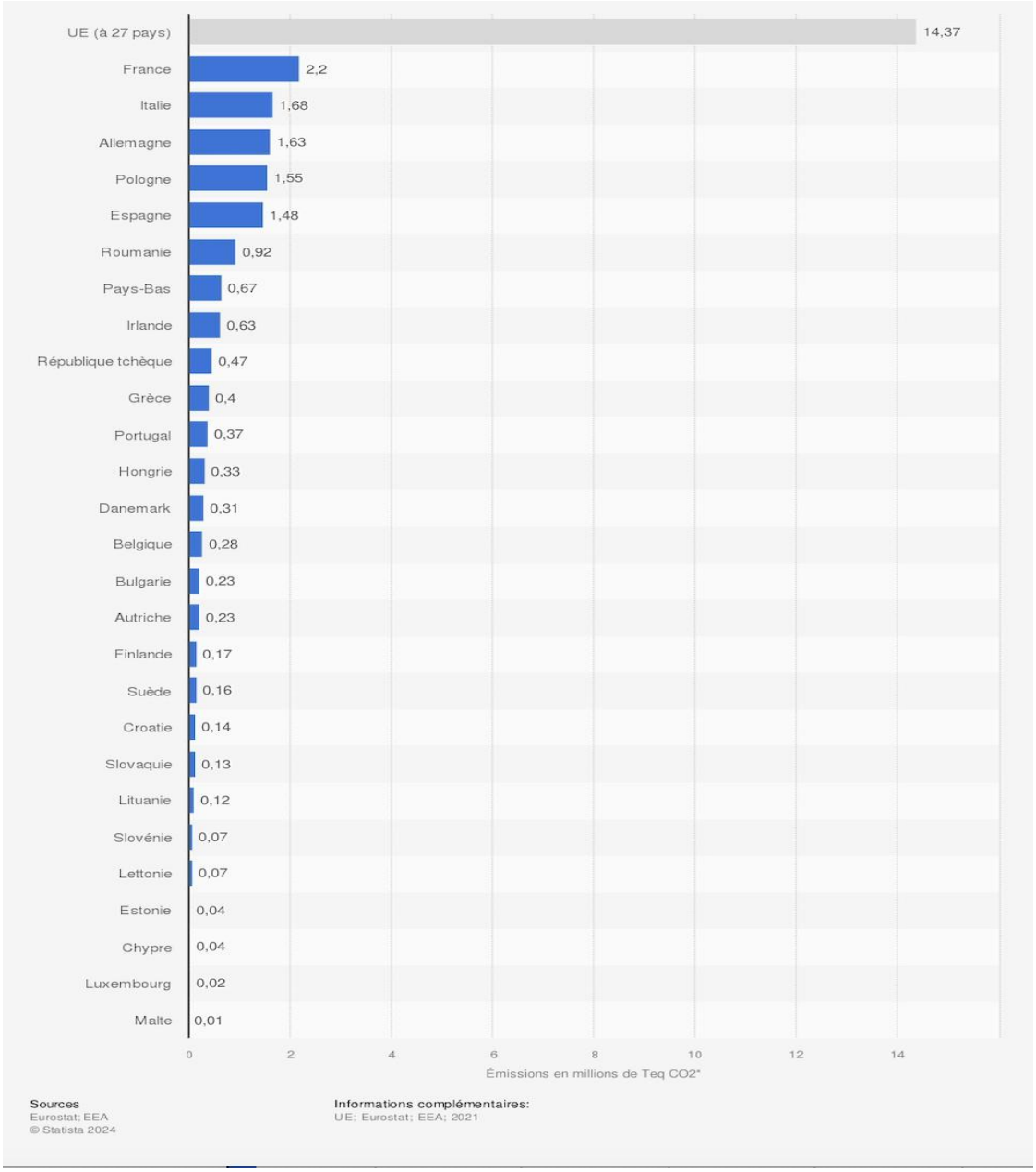


Fig. 2: Total methane (CH4) emissions in European Union (EU) member states in 2021[10]

This statistic illustrates the total volume of methane (CH_4) emissions in the member states of the European Union (EU) in 2021, in millions of tons. France was the biggest emitter of methane in 2021, with 2.2 tonnes of CO_2 equivalent emitted.

[10] Émissions totales de méthane (CH4) dans les États membres de l'Union européenne (UE) en 2021. https://fr.statista.com/statistiques/597196/emissions-ch4-methane-par-pays-ue/

II. Sources of Methane

1. Trends in methane emissions in the EU

Methane (CH_4) emissions come from natural sources as well as from human activity. Natural CH_4 is emitted from natural wetlands (main source of natural CH_4), termites, oceans, hydrates (CH_4 trapped in water at low temperature and under high pressure), forests, wildfires, wild animals, permafrost and geological sources. According to International Energy Agency estimates, annual global CH_4 emissions are about 570 million tones (Mt) and include natural sources (40% of emissions) and emissions from human activities (60% of emissions), also referred to as anthropogenic emissions (IEA, 2022). The energy, agriculture, and waste sectors are the largest sources of anthropogenic CH_4 emissions.[11]

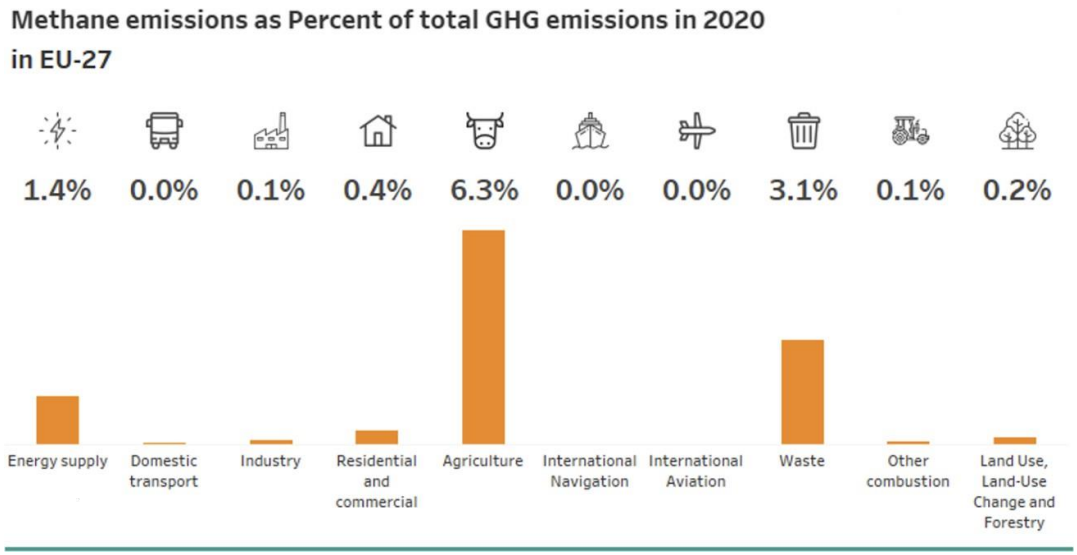


Figure 3: Total methane emissions by sector in the EU in 2020 (% of total emissions)[12]

The EU and its Member States, alongside with Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC) [13] , submit annual national greenhouse gas (GHG) inventories to the UNFCCC. This inventory includes all anthropogenic emissions and removals, excluding natural emissions. The EU was responsible for 379Mt CH_4 in carbon dioxide equivalents (CO_2eq) in 2020, in other words, 12% of total GHG emissions in that year, according to the 2022 EU GHG inventory. More than half of these CH_4 emissions originated from the agricultural sector. (Figure 4)[14][15].

The EU has experienced favorable emission trends over the past 30 years; in 2020, CH_4 emissions were 36% lower than in 1990. Figure 3 demonstrates that the energy supply, which comprises waste (-37%), agriculture (-21%), and energy industries and fugitive emissions (-65%), had the biggest reductions in CH_4 emissions in absolute terms. Of these, emissions from natural gas operations, waste disposal sites, coal mining and processing, and enteric fermentation from cattle (dairy and non-dairy) reduced the most.

[11] Methane emissions In the EU: the key to immediate action on climate change https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

[12] Ibid.

[13] https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states?field_national_communications_target_id%5B515%5D=515

[14] Ibid.

[15] https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

Overall, there have been notable decreases in CH_4 emissions, which can be attributed to a number of factors, including fewer livestock and more efficient farming practices; decreased coal mining and post-mining operations; better oil and gas pipeline systems; less land-based waste disposal; and increased recycling, composting, landfill gas recovery, and waste incineration with energy recovery. [16].

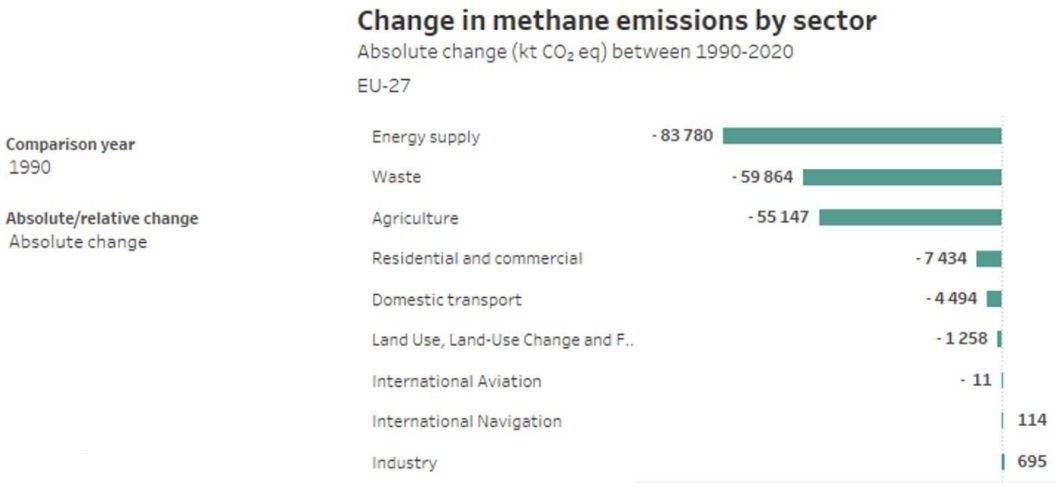


Figure 4: Change in total methane emissions by sector in the EU between 1990 and 2020[17]

Agriculture: The enteric fermentation and management of animal manure, specifically that of cattle (77%), sheep (7%), and pigs (10%), is the greatest source of CH_4 in the agriculture sector, according to the 2022 EU GHG inventory. 94% of the 206Mt CH_4 emissions in CO_2e from the agriculture sector in 2020 came from these three sources. In 2020, 69% of CH_4 emissions in the EU agriculture industry came from enteric fermentation from cattle alone. In the 1990s and 2000s, the sector's CH_4 emissions declined, but since 2010, they have remained relatively stable and even rose around 2015 (Figure 5)[18].

According to UNFCCC, controlling overproduction through milk quotas in the EU reduced the economic returns from cattle production and incentivized higher milk yields to sustain production levels with fewer cattle. A study agrees with this argument through its results that shows higher productivity is linked to lower GHG emission intensity, with a 1% productivity increase reducing emissions intensity by at least 0.26%.[19]. The milk quota system was abolished in 2015 as a result of the EU's 2009 health check of the common agriculture policy.. This abolishment led to a 40.6% increase in the number of dairy cows[20]. A key reason for its abolition was that EU producers were prevented from responding to the growing demand for dairy products. Expectedly, the abolishment was followed by the expansion of the sector and reduced milk prices. Despite a significant decline in CH_4 emissions from enteric fermentation in dairy cattle in the EU from 1990 to 2010 (-27.9Mt CO_2e), there was a net increase from 2010 to 2020 (+2.1Mt CO_2e).

[16] Ibid.

[17] Ibid.

[18] https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

[19] https://onlinelibrary.wiley.com/doi/10.1111/agec.12666

[20] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/agriculture/

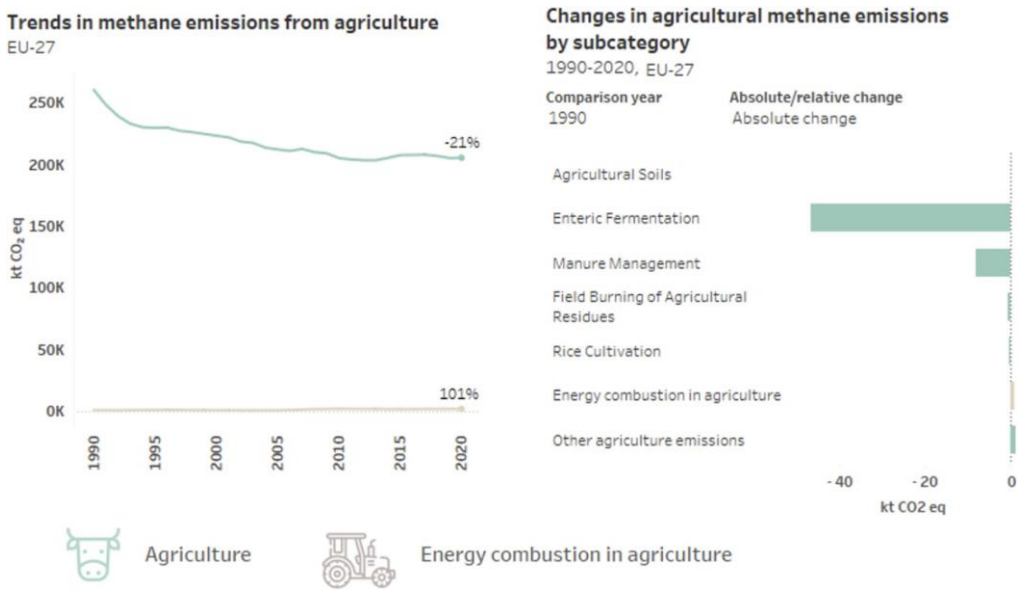


Figure 5: Trends in methane emissions in the agriculture sector in the EU between 1990 and 2020[21]

Waste sector: The most significant sources of methane (CH_4) in the waste sector are solid waste disposal (80%), residential and commercial wastewater treatment and discharge (15%), and, to a lesser extent, biological treatment of solid waste (4%)[22]. In the last two decades, the waste sector has seen a significant reduction in emissions from the disposal of solid waste and wastewater treatment. Other waste treatment techniques, like recycling and reuse, biological waste treatment, and trash incineration with energy recovery (for heat and electricity), have become more significant in EU member states, and the volume of municipal waste that is landfilled has significantly decreased. This reduction in the methane emissions from the waste management industry can be attributed to the Waste Framework Directive, the Landfill Directive, and circular economy policies and initiatives in the EU[2324]. (Figure 5)[25]

CE Delft's forecast based on business-as-usual scenario foresees a 33.1% reduction in methane emissions in the EU waste sector from 2020 to 2030. This significant decrease is anticipated given that the Waste Framework Directive, which is now in effect, mandates the separate collection of biowaste and that the 2018 amendment to the Landfill Directive aims to further divert municipal solid waste from landfills. The anticipated decrease would carry on the EU sector's downward trend in methane emissions, which began in 2005[26].

[21] https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

[22] https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

[23] https://www.eea.europa.eu/en/analysis/publications/methane-climate-change-and-air-quality-in-europe-exploring-the-connections?activeTab=4a75727f-4f3c-4b71-bbce-9a2481c20210

[24] https://www.eea.europa.eu/publications/capturing-the-climate-change-mitigation

[26] https://cedelft.eu/wp-content/uploads/sites/2/2022/06/CE_Delft_210502_Methane_reduction_potential_in_the_EU_Def.pdf

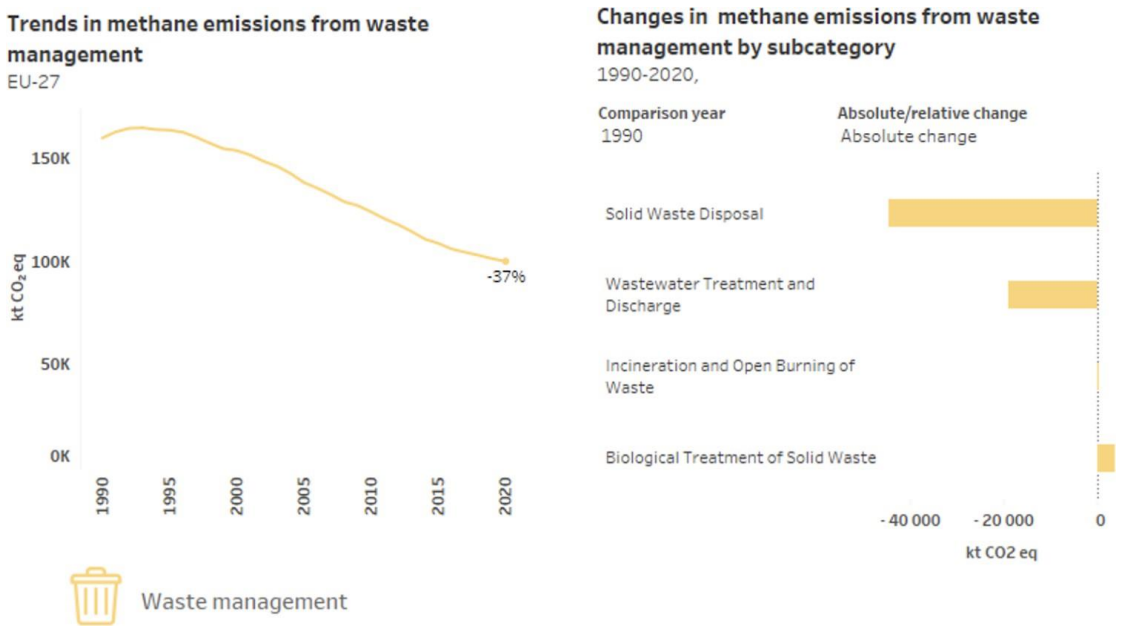


Figure 6: Trends in methane emissions in the waste sector in the EU between 1990 and 2020[27]

Methane discharged from the **fossil fuel industry** is attributed to oil and gas extraction, pumping, transport and use of fuels, altogether contributing to about 35% of total anthropogenic emissions[28]. Coal mining – including active and abandoned mines released another 12% as part of the total fossil fuel-derived emissions. Within oil and gas extraction, gas venting and fugitive emissions are the main causes of methane emissions. Gas venting is a practice that pumps out unwanted gas – a fossil fuel predominantly composed of methane – to maintain safe conditions in the oil and gas extraction process. While gas venting is a deliberate methane release, fugitive emissions are unintentional releases of gas across the fossil fuel supply system. The majority of the methane escape comes from downstream processes, which include refining, transmission, and distribution of gaseous products. [29]

The **geographical distribution of the emissions** varies across different sectors, where the fossil fuel and agricultural industries are prominent in particular regions. In the fossil fuel industry, China is the largest contributor to coal mining-related emissions, while Russia and North America constitute the biggest part of the oil and gas methane emissions. Within the agriculture sector, livestock emissions mainly originate from Latin America, followed by South Asia. Most of the emission from rice cultivation comes from Southeast Asia, Korea, and Japan, followed by South Asia and China. Methane emissions from the waste sector are more geographically distributed across the continents. [30] [31]

[27] Climate an energy in the EU https://climate-energy.eea.europa.eu/topics/climate-change-mitigation/greenhouse-gas-emissions-inventory/data

[28] https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions

[29] IEA. 2021. The case for regulating downstream methane emissions from oil and gas. The case for regulating downstream methane emissions from oil and gas – Analysis - IEA

[30] Sources of Greenhouse Gas Emissions https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

[31] Our World in Data. 2024. Breakdown of carbon dioxide, methane and nitrous oxide emissions by sector. Breakdown

2. Human sources of methane

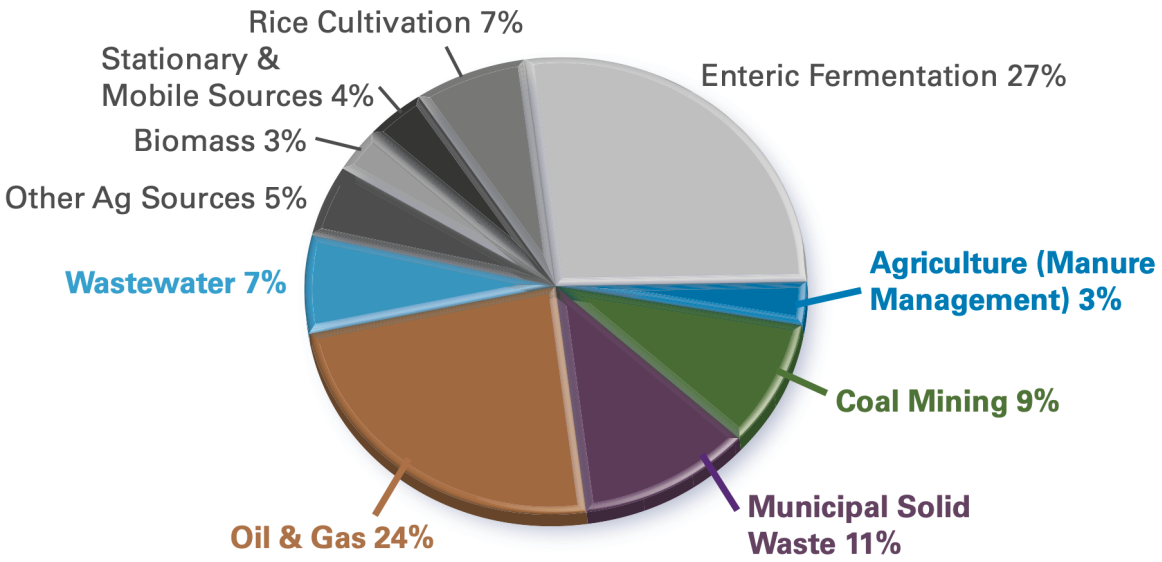


Figure7: The estimated global anthropogenic methane emissions by source, 2020[32]

Livestock Farming: An important source of methane emissions comes from enteric fermentation in farm animals. This methane emissions resulting from ruminant animals raised for their meat and milk is responsible for approximately 30% of global anthropogenic methane emissions[33]. Enteric methane is a by-product of the process called microbial fermentation of plant in the stomach of these ruminant animals, and this methane produced is either exhaled by the animal or released in the form of flatulence.[34] These emissions are anthropogenic since people raise these animals for food.

In 2021, enteric fermentation in cattle generated 73.5 million metric tons of methane globally. [35]. Livestock farming generates 90 million tones of methane annually on a global scale. Livestock-related emissions have increased mainly for two reasons. Firstly, global livestock production has increased significantly since the 1960s, and beef production has more than doubled over this period. Secondly, changes in natural feeding have impacted animal emissions. To reduce the amount of food needed for livestock, humans add nitrogen to the animals' feed to reduce their hunger[36]. The addition of nitrogen helps improve the efficiency of protein synthesis in the animals' digestive systems. As a result, the animals feel fuller with less food, which reduces their overall feed intake. This allows the animals to grow and maintain their health with less feed, which is economically beneficial for farmers. The added nitrogen benefits not only the animals but also

of carbon dioxide, methane and nitrous oxide emissions by sector - Our World in Data

[32] https://asm.org/articles/2023/june/ruminant-methanogens-as-a-climate-change-target

[33] https://www.ccacoalition.org/projects/enteric-fermentation

[34] Black, J. L., Davison, T. M., & Box, I. 2021. Methane emissions from ruminants in Australia: Mitigation potential and applicability of mitigation strategies. *Animals*, *11*(4), 951. **Animals | Free Full-Text | Methane Emissions from Ruminants in Australia: Mitigation Potential and Applicability of Mitigation Strategies (mdpi.com)**

[35] Statista. 2024. Emissions of methane (CH4) produced by cattle worldwide from 1990 to 2021. Global cattle methane emissions 1990-2021 | Statista

[36] SOURCES OF METHANE EMISSIONS https://www.socalgas.com/stay-safe/methane-emissions/sources-of-methane-emissions

the microbes present in their digestive systems, particularly in ruminants like cows. The rumen, a part of the stomach in ruminants, contains a diverse population of microbes that play a crucial role in breaking down food. The increase in nitrogen levels stimulates the growth and activity of these microbes, improving the efficiency of digestion and nutrient absorption. However, this process has an unintended consequence: an increase in methane emissions. The microbes in the rumen produce methane as a byproduct of digestion, particularly during the fermentation of food. With more nitrogen available, microbial activity intensifies, leading to higher rates of fermentation and, consequently, increased methane production. Methane is a potent greenhouse gas, and its increased presence in the atmosphere has significant environmental implications[37] .

Rice Cultivation: Another significant source of methane emissions comes from rice cultivation. Rice paddies are mostly man-made marshes. They are characterized by very high humidity, decreased oxygen content, and a lot of organic matter. This creates a favorable environment for methane-producing microbes that decompose organic matter. While some of the methane produced is absorbed by methane-consuming microorganisms, the vast majority is released into the atmosphere. An estimated 60 million metric tons of methane are released annually by the cultivation of rice paddies due to the marshy environment around them, according to the Intergovernmental Panel on Climate Change[38]. This makes rice cultivation responsible for 11% of anthropogenic methane emissions.[39]

Biomass Combustion: Consumption of biomass, which is the material from living or dead organic organisms, produces significant methane emissions, especially during large-scale incomplete combustion. Anthropogenic biomass burning accounts for around 5 % of human methane emissions on the global scale[40] and results in approximately 10 mt tones of methane together with biofuels, which is comparatively low when other sources of methane emissions are considered[41].

Biofuels: Biomass used for energy production for domestic, industrial, or transportation purposes is called biofuels, which led to methane production when go under the process of incomplete combustion. They account roughly for 3% of human methane emissions[42]. It is estimated that 80% of biofuels are used for domestic cooking, heating, and lighting mainly in open cooking stoves burning wood, agricultural waste, or manure. This is the largest contributing factor to overall biofuel emissions. Nearly half of the world's population, 2.7 billion individuals, use solid biofuels for cooking and heating their homes daily. Most of them are poor and live in developing countries. Eighteen percent of biofuels are used by low-tech, unregulated micro-enterprises such as brick or tile kiln businesses, restaurants, etc. The excess biofuel is used for transportation purposes.[43]

Bio methanation: Methanation is a process where biomass is degraded by microorganisms in fermenters in the absence of oxygen and at a temperature between 35 and 60°C. This produces biogas and a residue called digestate. The biogas contains about 55 to 70% methane. The biogas can be used directly to produce

[37] Management of Enteric Methane Emissions in Ruminants Using Feed Additives: A Review https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9774182/

[38] https://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch4ref5.pdf

[39] Nikolaisen, M., Hillier, J., Smith, P., & Nayak, D. 2023. Modelling CH4 emission from rice ecosystem: A comparison between existing empirical models. Frontiers in Agronomy, 4, 1058649. https://www.frontiersin.org/journals/agronomy/articles/10.3389/fagro.2022.1058649/full

[40] https://essd.copernicus.org/articles/17/1873/2025/essd-17-1873-2025.pdf

[41] https://www.iea.org/data-and-statistics/charts/sources-of-methane-emissions-2023-2

[42] https://essd.copernicus.org/articles/17/1873/2025/essd-17-1873-2025.pdf

[43] Ibid .

heat and electricity in cogeneration, or purified into biomethane which can be injected into the natural gas network or used as biofuel. The number of installations injecting biomethane into natural gas networks across Europe has been growing, showing the importance of biomethane in sustainable energy systems. France, particularly, has expanded its capacity for biomethane injection, with plans to connect 652 biomethane production sites to gas networks by 2024.[44]

Landfills and Waste: Another significant human source of methane emissions is the waste sector, which includes landfills and wastewater. Methane is generated primarily through the anaerobic decomposition of biodegradable organic matter in landfills, and also from human and animal waste streams in wastewater treatment. According to the UNEP Global Methane Assessment45, the sector is responsible for roughly 20% of anthropogenic methane emissions, equivalent to about 70 million tonnes of CH_4 per year.

Landfills and open waste dumps are filled with organic matter from our garbage (food scraps, newspapers, mowed grass, and leaves). Each time new waste arrives, it piles up on old waste already present. The organic matter in our waste is held in anaerobic conditions, i.e. there is no oxygen. This provides excellent conditions for the development of methane producing microbes, leading to significant methane emissions. Even after a landfill is closed, bacteria continue to decompose buried waste and produce methane for years. Domestic, municipal, or industrial wastewater can also produce methane emissions. As with landfills, if organic materials decompose under anaerobic conditions during any of these three stages, methane will be created. Even modest livestock farming requires dealing with manure created by animals daily. Manure is often subjected to extensive waste treatment systems and stored in storage tanks. In many of these systems, methane is produced due to their anaerobic conditions.[46]

[44] GRTgaz. 2023. European context 2023. https://grtgaz.com/sites/default/files/2024-04/presentation-rendez-vous-clients-2024-en.pdf

[45] https://www.ccacoalition.org/sites/default/files/resources/2021_Global-Methane_Assessment_full_0.pdf

[46] ibid.

3. Natural Sources of Methane

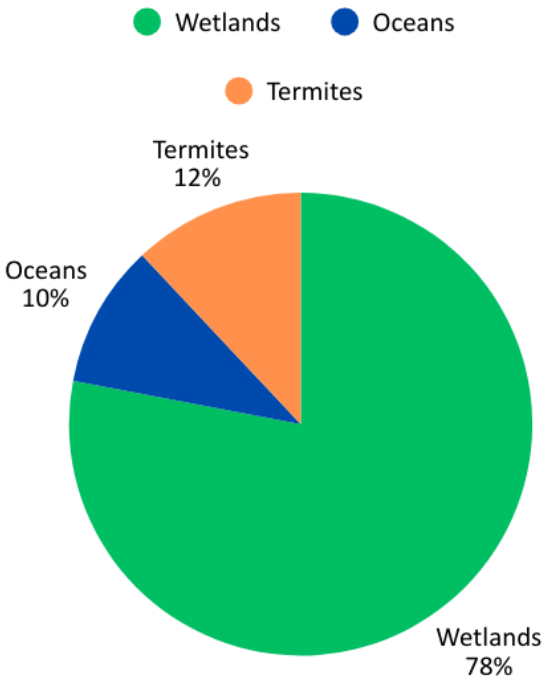


Figure 8: The Natural source of methane on a global scale (Own figure based on the information from GHGSAT) [47]

Wetlands: Wetlands are the most significant natural source of methane, producing 78% of natural emissions. These waterlogged areas are perfect for microbes that thrive in oxygen-deprived environments with abundant organic matter. While some of the emissions from wetlands are absorbed by methane-consuming microbes, a significant percentage escapes into the atmosphere. Wetlands create 147 million tonnes of methane each year.[48][49]

Termites: Termites are a significant source of methane. During a termite's normal digestion process, methane is produced. Termites consume cellulose but rely on microorganisms in their intestines to digest it, which produces methane in the process. Each termite produces small amounts of methane every day. However, when multiplied by the global termite population, their emissions amount to 20 million tonnes of methane per year[50].

Oceans: Another significant source of methane is the oceans. Methane-producing microbes living in the oceans generate these emissions. This accounts for 10% of natural methane emissions. In total, oceans create 19 million tones of methane annually[51].

[47] GHGSAT.2021. What is the largest source of methane? What is the largest source of methane? - GHGSat

[48] Ibid.

[49] GHGSAT.2021. What is the largest source of methane? What is the largest source of methane? - GHGSat

[50] GHGSAT.2021. What is the largest source of methane? What is the largest source of methane? - GHGSat

[51] GHGSAT.2021. What is the largest source of methane? What is the largest source of methane? - GHGSat

III.The Methane Cycle

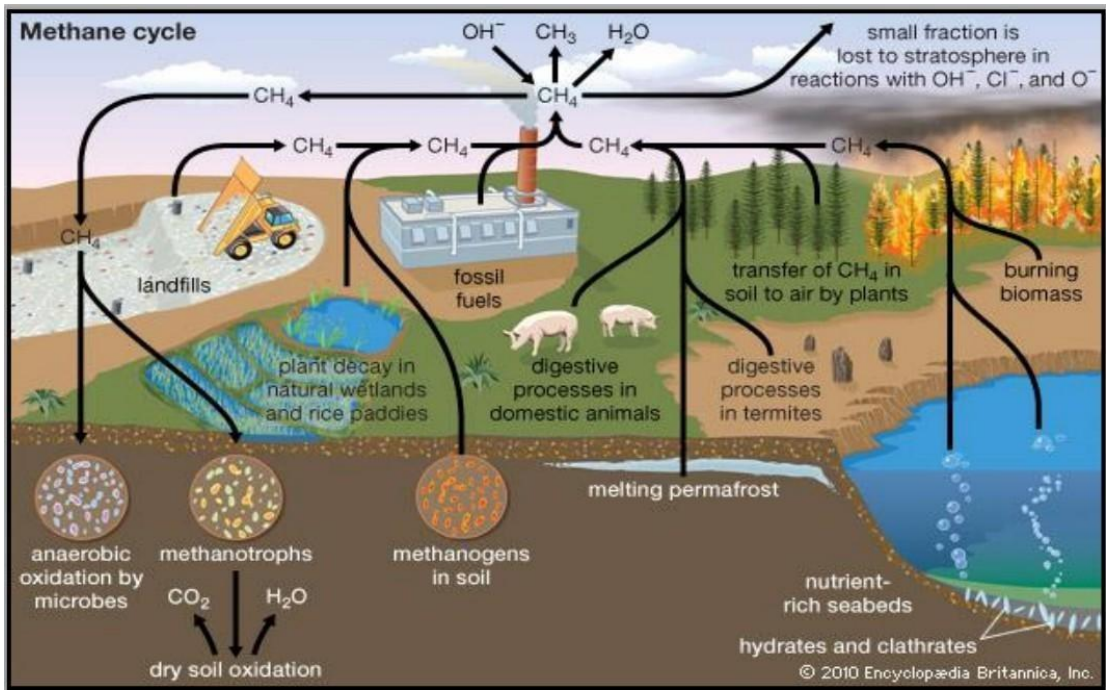


Fig. 9: The flow of methane from various sources into the atmosphere and the sinks that consume capture methane[52]

Most people are familiar with the water cycle, where water evaporates into the air, returns to Earth's surface as precipitation, and then evaporates again. Similarly, many other substances, including methane, cycle through the environment. Methane is released into the atmosphere from various sources and can also be trapped or broken down in different ways in the soil microbes produce methane gas. This soil methane is consumed by methanotrophs, microorganisms that feed on methane. Methanogens, another types of microbes, produce more methane than the methanotrophs can consume. Methanotrophs reside in the drier soil layers above the deep, wet, oxygen-poor soils of swamps. As methane bubbles up through these layers on its way to the surface, it serves as "food" for the methanotrophs. However, some methane escapes and is released into the atmosphere. This atmospheric methane then joins methane from other sources, such as landfills, livestock, and the exploitation of fossil fuels.[53]

IV. Emission estimates

As a party to the United Nations Framework Convention on Climate Change (UNFCCC)[54] and the Paris Agreement, the European Union and its Member States are required to provide annually an inventory report of anthropogenic greenhouse gas emissions. The EU's inventory constitutes an aggregate national greenhouse gas inventory of the Member States. The Governance Regulation requires Member States to establish national inventory systems to estimate the anthropogenic emissions of greenhouse gases (GHGs)

[52] Schematic diagram of SOC dynamics under climate change, ResearchGate https://www.researchgate.net/figure/Schematic-diagram-of-SOC-dynamics-under-climate-change-Note-1-the-y ellow-a rrow_fig4_373971502

[53] Ibid.

[54] United Nations Framework Convention on Climate Change (UNFCCC) https://treaties.un.org/doc/source/RecentTexts/unfccc_eng.pdf

and to report their national projections. This reporting is done using the Guidelines of the Intergovernmental Panel on Climate Change (IPCC)[55]and is often based on default emission factors rather than direct source level measurements, implying uncertainties regarding the precise origin, frequency, and magnitude of emissions, Therefore, it was deemed to be significantly underestimated by certain studies. In the most recent EU GHG inventory submission to UNFCCC, methane emissions in the EU energy sector are estimated at 3.1 million tones.

EU energy-related CH4 emissions		
Category	**Kt CH4**	**Share**
Incomplete combustion of fuels	974	31%
Coal	1002	32%
Leaks from oil	44	1%
Leaks from fossil gas	847	27%
Venting and flaring from oil	118	4%
Venting and flaring from fossil gas	24	1%
Biogas	75	2%
Other	32	1%
Total	**3116**	**100%**

Table 10: Split of energy-related methane emissions per sub-sector in the (based on 2019 data)

The most recent EU GHG Inventory submission to UNFCC was published by European Environment Agency in April 2023, under the name "Annual European Union greenhouse gas inventory 1990-2021 and inventory report 2023" *56*. According to the report, there has been a substantial reduction in CH4 emissions, reflecting lower levels of mining activities, lower agricultural livestock and improved waste management. The CH4 emissions accounted for 13 % of total EU GHG emissions in 2021 and decreased by 37 % compared to 1990 to 415 Mt CO2 equivalents in 2021.

[55] 2006 IPCC Guidelines for National Greenhouse Gas Inventories https://www.ipcc-nggip.iges.or.jp/public/2006gl/

[56] European Environment Agency. (2023). *Annual European Union greenhouse gas inventory 1990–2021 and inventory report 2023*. EEA Report No 05/2023. https://www.eea.europa.eu/en/analysis/publications/annual-european-union-greenhouse-gas-2

V. Methane impact analysis

Methane is a potent greenhouse gas, second only to carbon dioxide (CO_2) in its contribution to climate change. Due to the long atmospheric lifetime of carbon dioxide, the effects of actions taken to reduce CO_2 emissions will take longer to manifest. This makes methane emissions reduction a priority to dampen the rate of global warming and limit dangerous climate feedback loops, such as the melting of polar ice caps and sea level rise.[32]

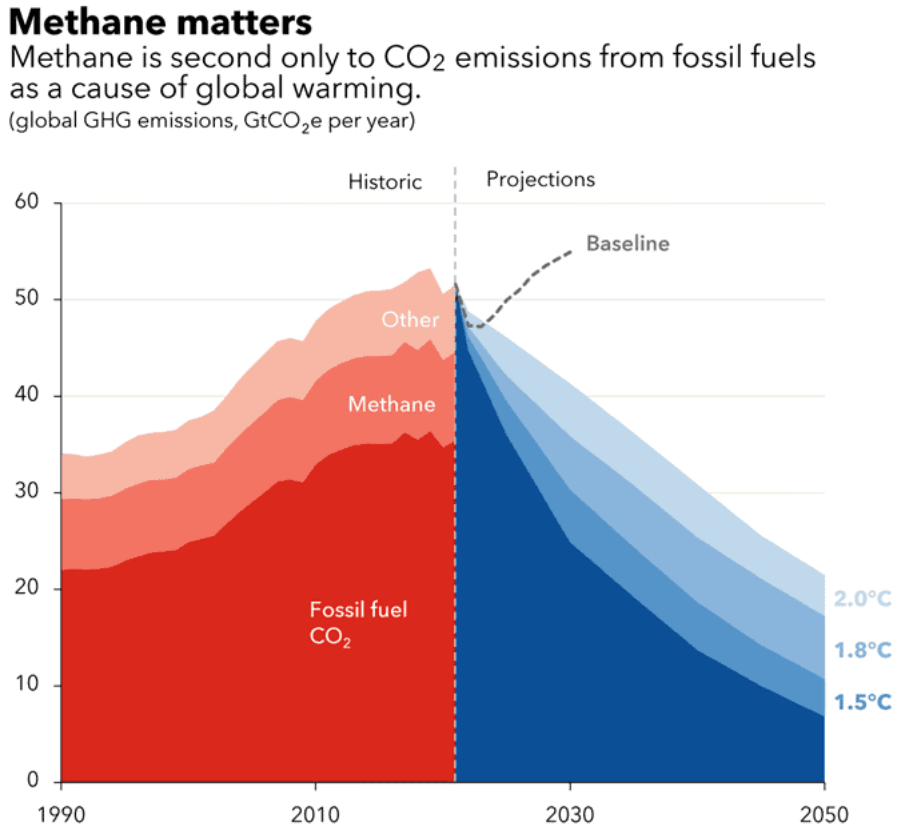


Figure11: Methane's Contribution to Global Warming[57]

Health Impacts: Methane acts as a precursor to a harmful air pollutant, tropospheric ozone. While methane itself does not directly harm human health, ozone is responsible for approximately 1 million premature respiratory deaths globally each year. Increased methane emissions are responsible for half of the observed rise in tropospheric ozone levels. [58]

the Council of the European Union dated December 15, 2021 https://data.consilium.europa.eu/doc/document/ST-15063-2021-ADD-2/en/pd

[57] Methane Emissions Must Fall for World to Hit Temperature Targets https://www.imf.org/en/Blogs/Articles/2022/11/02/methane-emissions-must-fall-for-world-to-hit-temperature- targets

[58] Beyond CO2 equivalence: The impacts of methane on climate, ecosystems, and health https://www.sciencedirect.com/science/article/pii/S1462901122001204

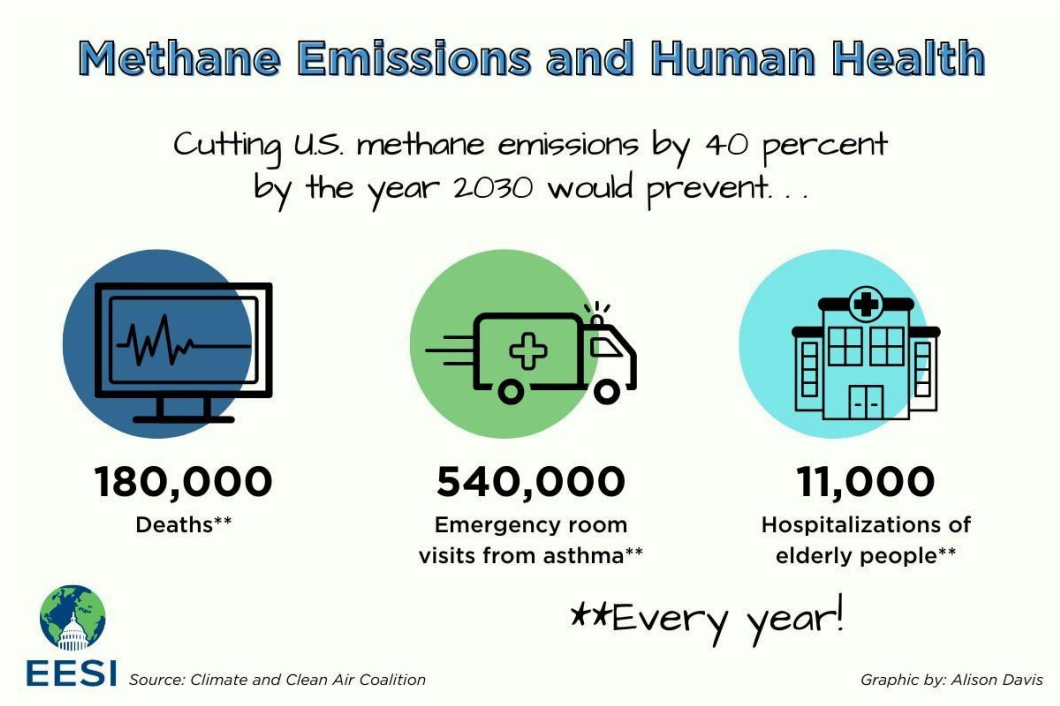


Figure 12: Methane emissions and Human Health [59]

Agricultural Impacts: Methane contributes to annual staple crop losses of up to 15% through its role in producing tropospheric ozone and increasing atmospheric temperatures.[60] Tropospheric ozone, formed through complex chemical reactions involving methane, detrimentally affects plant health by acting as a potent oxidizing agent, leading to reduced photosynthetic efficiency, stunted growth, and decreased crop productivity. Additionally, the elevated atmospheric temperatures resulting from methane emissions disrupt agricultural systems by altering plant development timing, shifting growing seasons, and exacerbating water stress, all of which negatively impact crop yields. These combined effects not only pose challenges to global food security but also have profound economic implications, including reduced incomes for farmers, increased food prices, and potential disruptions to global food supply chains [61].

Economic Impacts: The economic impacts associated with methane emissions are also significant. The effects of methane on climate change and public health result in an annual loss of roughly 400 million work hours globally due to extreme heat. This loss of labor is often tied to increasingly challenging working conditions in sectors such as agriculture, industry, and construction, where high temperatures due to climate change often render work physically unbearable or hazardous. Furthermore, it is noteworthy that most identified methane abatement controls are economically beneficial. Methane reduction measures, such as emissions capture at landfill sites or improving energy efficiency in industry, typically cost less than the societal benefits they provide. The social benefits of methane abatement measures are estimated to be around $4,300 per tons of methane reduction, far exceeding the costs associated with implementing these measures.[62] This highlights the significant economic potential of methane emission reduction, not only in mitigating climate and health impacts but also in boosting economic efficiency and overall productivity. By

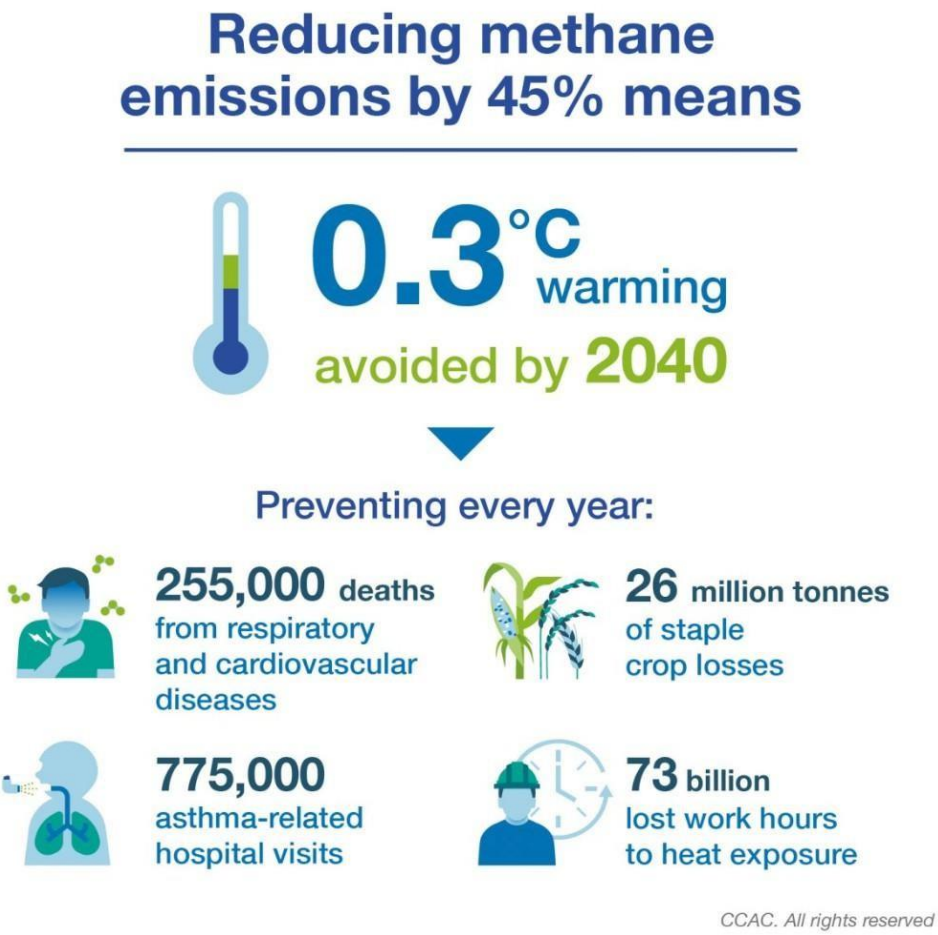
[59] Methane missions are driving climate change . Here's how to reduce them https://www.unep.org/news-and-stories/story/methane-emissions-are-driving-climate-change-h

[60] The Imperative for Methane Action | Global Methane Pledge

[61] Ibid.

[62] Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions - Focus Global Reporter

investing in strategies to reduce methane emissions, governments, businesses, and communities can not only safeguard the environment and public health but also spur economic growth and create sustainable jobs.[63]



Source: Climate and Clean Air Coalition

Figure 13: The Impact of Methane on Health[64]

[63] Methane and costs of mitigating methane emissions https://www.ccacoalition.org/content/benefits-and-costs-mitigating-methane-emissions

[64] GLOBAL METHANE ASSESSMENT https://www.ccacoalition.org/sites/default/files/resources/2021_Global-Methane_Assessment_full_0.pdf

VI. Why should the EU Act

1. Legal basis

The legal basis of methane reduction is Article 194 of the Treaty on the Functioning of the European Union, which empowers the EU to establish the measures necessary to achieve the objectives of the Union concerning policy on energy, in the context of the internal market and with regard for the need to preserve and improve the environment. Methane is a greenhouse gas and an ozone precursor that knows no borders. When emitted in one country, it will have a climate and air quality impact on others. The proposal "EU Methane Strategy" aims to create a new policy framework facilitating the reduction of methane emissions, which is key to achieving the EU's climate objectives and the zero-pollution ambition, building on and complementing existing EU law already partially regulating methane emissions from the energy system.[65]

The European Union (EU) has a robust legal framework that provides a solid basis for action on environmental issues, including the reduction of methane emissions and gas flaring. This framework is rooted in several key legal instruments and commitments[66].

a) A- Treaty on the Functioning of the European Union (TFEU)

Article 191 TFEU: Environmental Objectives

Article 191 of the Treaty on the Functioning of the European Union outlines the objectives of the European Union's environmental policy, which include preserving, protecting, and improving the quality of the environment. This objective emphasizes the necessity to maintain ecological balance and ensure the natural world remains unspoiled for future generations. Another objective under Article 191 is protecting human health[67]. This aspect underscores the link between environmental quality and public health, highlighting that a cleaner environment directly translates to better health outcomes for the population. Furthermore, Article 191 stresses the prudent and rational utilization of natural resources, promoting sustainable practices that ensure resources are available for future use without compromising current needs[68]. Lastly, the Article calls for promoting measures at the international level to deal with regional or worldwide environmental problems, particularly combating climate change. The reduction of methane emissions directly supports these objectives, particularly the fight against climate change and the protection of human health, given methane's significant impact as a greenhouse gas. Methane has a global warming potential that is more than eighty times greater than that of carbon dioxide over a twenty-year period, making its regulation crucial for meeting climate goals[69].

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[65] European Parliament resolution of 21 October 2021 on an EU strategy to reduce methane emissions https://www.europarl.europa.eu/doceo/document/TA-9-2021-0436_EN.html

[66] Consolidated version of the Treaty on the Functioning of the European Union - PART THREE: UNION POLICIES AND INTERNAL ACTIONS - TITLE XXI: ENERGY - Article 194 https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12008E194:EN:HTML

[67] EU environmental policy https://eur-lex.europa.eu/EN/legal-content/glossary/eu-environmental-policy.html#:~:text=The%20European%20Union's%20(EU)%20environmental,and%20to%20protect%20human%20health.

[68] Ibid.

[69] Opinion on the legal basis of the proposal for a regulation of the European Parliament and of the Council on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942 (COM(2021)0805 – C9-

Article 192(1) TFEU: Legislative Action

Article 192(1) of the Treaty on the Functioning of the European Union provides the basis for the European Union to decide on actions necessary to achieve the objectives listed in Article191. This Article includes adopting measures through the ordinary legislative procedure, which involves the European Parliament and the Council. This procedural framework ensures that any proposed regulations are thoroughly reviewed and democratically approved, providing a robust mechanism for enacting comprehensive and effective environmental legislation. The proposal to regulate methane emissions in the energy sector aligns with this framework as it aims to improve the accuracy of information on methane emissions. Accurate data collection and reporting are essential for understanding the scope of methane emissions and identifying areas for reduction. The proposal also aims to ensure the effective reduction of methane emissions across the energy supply chain. This includes measures to detect and repair leaks, reduce venting and flaring, and implement best practices in methane management. Additionally, the proposal seeks to enhance transparency and information availability to incentivize reductions in methane emissions from imported fossil energy. By making information on methane emissions more accessible, the European Union can encourage other countries to adopt similar measures and promote global efforts to reduce methane emissions[70].

Single Legal Basis: Article 192(1) TFEU

The proposal's primary aim is to reduce methane emissions to combat climate change, making it primarily an environmental measure. Although it affects the energy sector, its primary purpose remains environmental. Therefore, Article 192(1) of the Treaty on the Functioning of the European Union is the appropriate and sole legal basis, as it focuses on achieving the Union's environmental policy objectives[71]. This single legal basis ensures that the regulation is coherent and focused, streamlining the legislative process and providing a clear mandate for action[72].

Case Law Support

The Court of Justice of the European Union supports using a single legal basis when an act has a predominant purpose. In this case, the primary aim of the proposal is environmental, specifically to reduce methane emissions and combat climate change, aligning it with Article 192(1) of the Treaty on the Functioning of the European Union. Relevant case law includes the Court's emphasis that a measure should be based on a single legal basis if it pursues one principal objective, as seen in Case C-178/03, Commission v. Parliament and Council. The Court reiterated in Case C-411/06, Commission v. Parliament and Council, that the choice of legal basis must rest on objective factors, including the aim and content of the measure. Therefore, Article 192(1) of the Treaty on the Functioning of the European Union is the appropriate legal basis

0467/2021 – 2021/0423(COD)) https://www.europarl.europa.eu/doceo/document/JURI-AL-758222_EN.pdf

[70]DECISION (EU) 2022/591 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 April 2022 on a General Union Environment Action Programme to 2030 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022D0591

[71] Consolidated version of the Treaty on the Functioning of the European Union PART THREE - UNION POLICIES AND INTERNAL ACTIONS TITLE XX – ENVIRONMENT Article 192 https://eur-lex.europa.eu/eli/treaty/tfeu_2012/art_192/oj

[72] Ibid

for the European Union's proposed regulation on methane emissions, ensuring that the primary objective of environmental protection and climate change mitigation is effectively pursued[73].

a) B- Integrating Methane Emission Reduction into EU Climate and Energy Strategies

Climate and Energy Package

The European Union has established a comprehensive Climate and Energy Package that aims to reduce greenhouse gas emissions, increase the use of renewable energy, and improve energy efficiency. This package includes various directives and regulations that member states must implement. Measures to reduce methane emissions can be integrated into this existing framework, reinforcing the European Union's commitment to reducing its overall greenhouse gas emissions. By embedding methane reduction strategies within the Climate and Energy Package, the European Union ensures a coherent and coordinated approach to tackling climate change across all member states. This integration facilitates a uniform policy application, allowing for more efficient and effective management of methane emissions, which are crucial for achieving the Union's climate targets [74].

European Green Deal

The European Green Deal is the European Union's ambitious roadmap for making its economy sustainable by turning climate and environmental challenges into opportunities across all policy areas. The Green Deal aims to make the European Union climate-neutral by 2050, a goal that necessitates significant reductions in all greenhouse gases, including methane. Addressing methane emissions is a crucial part of this strategy, as methane has a much higher global warming potential than carbon dioxide in the short term. The European Green Deal sets out concrete actions and milestones to reduce emissions, promote clean energy, and foster green innovation, driving the European Union towards its climate-neutrality goal. By focusing on methane reduction within the Green Deal, the Union not only targets a potent greenhouse gas but also advances broader environmental and health objectives, ensuring a holistic approach to sustainability[75].

Paris Agreement Commitments

As a party to the Paris Agreement, the European Union is legally committed to taking measures to limit the global temperature rise to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit the increase to 1.5 degrees Celsius. Reducing methane emissions is critical to meeting these targets due to methane's significant impact on global warming. The European Union's legal obligations under the Paris Agreement provide a strong justification for taking proactive measures to cut methane emissions. By fulfilling its commitments under the Paris Agreement, the European Union not only contributes to global

[73] EU Court turn a deaf ear to citizens hit by the climate crisis https://caneurope.org/eu-court-turn-a-deaf-ear-to-citizens-hit-by-the-climate-crisis/

[74] Commission welcomes completion of key 'Fit for 55' legislation, putting EU on track to exceed 2030 targets https://ec.europa.eu/commission/presscorner/detail/en/IP_23_4754

[75] The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691

climate goals but also demonstrates leadership in international climate policy. This commitment underscores the Union's dedication to playing a pivotal role in global efforts to combat climate change, ensuring that it meets its international responsibilities and sets an example for other nations to follow[76].

The EU has established a comprehensive Climate and Energy Package that aims to reduce greenhouse gas emissions, increase the use of renewable energy, and improve energy efficiency. This package includes various directives and regulations that member states must implement. Measures to reduce methane emissions can be integrated into this existing framework, reinforcing the EU's commitment to reducing its overall greenhouse gas emissions. By embedding methane reduction strategies within the Climate and Energy Package, the EU ensures a coherent and coordinated approach to tackling climate change across all member states[77].

1. Subsidiarity: Necessity of EU action

Methane emissions in the energy sector are a transboundary problem and vary across national and regional levels of the EU. They are relevant in all Member States but to a varying degree, depending on their energy mix and natural endowments, e.g. how many underground coalmines are operated or sealed, and how much fossil gas is produced or transported. The scale of EU gas infrastructure demonstrates the Union-wide aspect, with roughly 190,000 km of transmission pipelines across all Member States. As highlighted above, the level of reporting of emissions differs by Member State and sector, with some Member States opting for the least effort approach, limiting the development of an accurate measurement basis for further action. While some Member States have already addressed methane emissions mitigation in specific sub-sectors, others do not have provisions in place or only private sector initiatives are addressing the issue. Private initiatives are however insufficient as the main instruments to address methane emissions due to limitations in scope, participation, and incentivization in case of non-adherence[78]. Diverse national approaches may lead to inconsistencies in regulatory treatment across Member States, increasing the administrative burden on companies operating in more than one Member State, potentially impeding the functioning of the internal market through the creation of barriers to operators, as well as complicating the collection of comparable data across the EU. While methane emissions are included under the Effort Sharing Regulation, they are one of several greenhouse gases, including CO2, nitrous oxide, and F-gases for which a collective reduction target is defined. The persistence of methane emissions in the energy sector within the EU over the last decade, along with the absence of concrete measures in a substantial number of Member States, even if cost-efficient, demonstrates that specific EU action can contribute to further and more rapid reductions. Conversely, such EU action to curb methane emissions in the energy sector will help Member States to achieve their Effort Sharing targets.[79]

[76] The Paris Agreement https://unfccc.int/process-and-meetings/the-paris-agreement

[77] Reducing carbon emissions: EU targets and policies https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vkmiobvzi1x7?ctx=vhsjgh0wpcp9

[78] The principle of subsidiarity https://www.europarl.europa.eu/factsheets/en/sheet/7/the-principle-of-subsidiarity#:~:text=In%20areas%20in%20which%20the%20EU%20does%20not%20have%20exclusive,States%2C%20but%20can%20be%20better

[79] Subsidiarity as a Principle of EU Governance https://www.cambridge.org/core/books/abs/globalisation-and-governance/subsidiarity-as-a-principle-of-eu-governance/7A646C95A13FC3CCCC3BE4B20DAC67F6

2. Subsidiarity added value of EU action

The reduction of methane emissions across the European Union would benefit from a homogeneous policy approach at the EU level given the strong interlinkage between Member States through cross-border infrastructure – in this context particularly gas infrastructure – and the integrated EU energy market. The impacts of measures aimed at methane measurement and mitigation and related effects on innovation, cost-effectiveness, and a level-playing field in the maintenance of a well-functioning internal market warrant coordination across Member State borders. Coordinated EU policies have a much higher chance of leading to further reductions in methane emissions in the energy sector. Coordinated action at the EU level furthermore facilitates the full consideration of the different capabilities to act among Member States and private entities. It also affords operators the benefits of a single regulatory regime, facilitating adherence and reducing administrative burden relative to the application of fragmented rules across Member States[80].

The EU and its Member States are part of a global oil market in which collective action carries more weight vis-à-vis exporters than individual national measures. The EU is also the biggest gas import market in the world and can thus influence global methane emissions through its purchasing power, providing a harmonized approach towards such imports. The EU gas market allows for flexible and short-term (spot) trading of gas. While long-term contracts with specific suppliers still exist, the 'hydrogen and gas market decarbonization package', which is part of the Fit-for-55 package, addresses such contracts and seeks to limit their duration to avoid locking in fossil gas use and to send a signal to decarbonize the gas sector in line with the European Green Deal. By working to develop legislation to minimize methane emissions in the energy sector, the EU is sending a strong political signal to external actors, increasing awareness of the harmful effects of methane emissions on the climate. This signal will not only encourage EU partners to address the problem of methane emissions in the energy sector but also lead to the creation of an international partnership and thus give the EU a leadership role in addressing methane emissions. The initiative is fully in line with Article 37 of the Charter of Fundamental Rights of the European Union, which requires that a high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured following the principle of sustainable development[81].

Measures taken by international institutions to reduce Methane emissions

1. European Parliament

Global methane emissions from oil, gas, and coal production had reached record levels by 2023: 120 million tones. Whether as a direct consequence or not, on 10 April 2024 Members of the European Parliament (MEPs) approved a text laying down stricter rules at the EU level: reducing member countries' methane

[80] Proposal for a Regulation of the European Parliament and of the Council on methane emissins reduction in the energy sector and amending Regulation (EU) 2019/942 https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2021:0460:FIN:EN:PDF

[81] Investing in a climate-neutral future for the benefit of our people https://www.enerdata.net/about-us/case-study/Investing%20in%20a%20climate-neutral%20future%20for%20the%20benefit%20of%20our%20people%20European%20Commission%20Communication.pdf

emissions by 30% (compared with 2020 levels) by 2030. This will enable them to meet the global commitments made at COP26 in Glasgow in 2021. This decision is part of the "Fit for 55" cycle of European climate policies.[82]

On the front line, the fossil fuel industries will be required to take additional action and make additional efforts. For example, operators of oil and gas wells and coal mines will have to inspect their equipment frequently to calculate the amount of methane emitted and apply measures to limit and repair any leaks of this greenhouse gas immediately. Another important measure is that the practice of flaring (burning off the gas leaving an extraction well) will be banned by 2027 for oil and gas platforms and 2031 for coal mines, except in the case of repairs or for safety reasons[83].

On April 10, 2024, the European Parliament's adoption of a new law represents a landmark achievement in the EU's efforts to tackle methane emissions from the energy sector. This legislation marks the EU's inaugural comprehensive initiative specifically targeting methane emissions, encompassing sectors such as oil, fossil gas, coal, and biomethane injected into the gas network. Methane, notorious for its potent greenhouse effect, significantly contributes to global warming, despite its shorter atmospheric lifespan compared to carbon dioxide[84].

The political consensus within Parliament, supported by a robust majority vote, underscores the widespread acknowledgment of the urgent necessity to address methane emissions. The regulation not only concentrates on domestic methane sources but also expands its scope to encompass methane emissions linked to fossil fuel imports. This broadened approach is crucial as it aligns with the EU's commitment to diminishing its overall environmental impact and bolsters global endeavors under initiatives like the Global Methane Pledge[85].

Jutta Paulus, co-rapporteur for the legislation, highlighted that reducing methane emissions is not solely a climate imperative but also pivotal for enhancing air quality and fortifying energy sovereignty within the EU. By comprehensively regulating methane emissions, including those from imports, the EU exemplifies leadership in fulfilling international climate obligations[86].

The next procedural steps entail the Council's adoption of the law, followed by its publication in the EU Official Journal and subsequent enforcement within 20 days. This regulatory pathway underscores the EU's steadfast dedication to promptly implementing measures that advance its climate agenda and meet public expectations for accelerated environmental action, as articulated in the conclusions of the Conference on the Future of Europe[87].

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[82] Methane: Parliament adopts new law to reduce emissions from energy sector ttps://www.europarl.europa.eu/news/hu/press-room/20240408IPR20309/methane-parliament-ado pts-ne w-law-to-reduce-emissions-from-energy-sector

[83] Ibid .

[84] Methane: MEPs set to adopt new law to reduce emissions from energy sectorhttps://www.europarl.europa.eu/news/en/agenda/briefing/2024-04-10/7/methane-meps-set-to-adopt-new-law-to-reduce-emissions-from-energy-sector

[85] Ibid.

[86] CATF Statement on EU Methane Regulation Advocacy https://www.catf.us/2023/03/catf-statement-methane-regulation-advocacy/

[87] Op.Cit. Methane: Parliament adopts new law to reduce emissions from energy sectorhttps://www.europarl.europa.eu/news/en/press-room/20240408IPR20309/methane-parliament-adopts-new-law-to-reduce-emissions-from-energy-sector

2. European Commission

The EU Methane Strategy, adopted on October 14, 2020, is a pivotal component of the European Green Deal, designed to combat climate change and improve air quality by targeting methane emissions. Methane, as the second largest greenhouse gas after carbon dioxide, contributes significantly to global warming and poses health risks through its role in tropospheric ozone formation.[88]

This strategy covers sectors responsible for approximately 95% of human-related methane emissions globally, focusing primarily on energy, agriculture, and waste management. In the energy sector, the strategy proposes stringent measures to reduce methane leaks from gas infrastructure. It emphasizes improved detection and repair standards to minimize emissions from production, transportation, and consumption of fossil gases. Legislative initiatives are being considered to prohibit routine practices like flaring and venting, which are major sources of methane emissions in this sector.[89]

Agriculture, another major contributor to methane emissions, is targeted through enhanced data collection and reporting mechanisms. The strategy promotes the adoption of best practices such as precision farming technologies, optimized animal diets, and innovative breeding management. By utilizing non-recyclable organic waste for biogas production, the EU aims to promote sustainable agricultural practices that simultaneously reduce methane emissions[90].

In the waste management sector, the strategy focuses on optimizing landfill gas management to capture methane for energy generation while minimizing emissions. Legislative reviews are underway to strengthen regulations governing landfill operations, ensuring compliance with updated emission reduction standards by 2024. These efforts underscore the EU's commitment to promoting a circular economy and reducing methane emissions from waste disposal processes[91].

Internationally, the EU Methane Strategy emphasizes the necessity of collaborative efforts to effectively address methane emissions beyond European borders. This strategy recognizes that methane, as a potent greenhouse gas with a global impact, requires coordinated action on a worldwide scale to achieve meaningful reductions and mitigate its contribution to climate change[92].

Central to the EU's approach is engagement with international partners through platforms such as the Climate and Clean Air Coalition (CCAC). This coalition brings together governments, international organizations, and non-governmental stakeholders committed to reducing short-lived climate pollutants, including methane. By participating actively in the CCAC and similar initiatives, the EU seeks to foster consensus on global methane reduction goals, harmonize methodologies for measuring and reporting emissions, and share best practices in mitigation strategies[93].

Technological innovation plays a crucial role in supporting these collaborative efforts. The EU leverages advanced satellite monitoring capabilities provided by its Copernicus program. These satellites enable real-time detection and monitoring of methane emissions worldwide, facilitating the identification of methane hotspots and super-emitters. Such precise data not only enhances the accuracy of emission inventories but

[88] Reducing greenhouse gas emissions: Commission adopts EU Methane Strategy as part of European Green Deal https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1833

[89] Ibid.

[90] Ibid.

[91] Methane emissions https://energy.ec.europa.eu/topics/carbon-management-and-fossil-fuels/methane-emissions_en#:~:text=At%20COP27%20in%202022%2C%20the,Singapore%2C%20and%20the%20United%20Kingdom.

[92] Ibid.

[93] Ibid.

also informs targeted mitigation efforts in regions where methane emissions are most concentrated and impactful[94]

Through these international collaborations and technological advancements, the EU aims to set unified standards and targets for methane reduction globally. This approach not only strengthens environmental governance but also supports sustainable development goals by mitigating the adverse effects of methane on climate change and air quality worldwide[95].

The EU Methane Strategy integrates methane reduction measures into existing regulatory frameworks such as the Effort Sharing Regulation and the Industrial Emissions Directive. Considerations are being made to expand their scope to include methane-emitting sectors currently not covered, thereby enhancing environmental and health benefits. By implementing these comprehensive measures, the EU aims to achieve significant reductions in methane emissions, contributing to its broader climate objectives while setting a precedent for global leadership in sustainable environmental practices[96].

[94] Satellite data in action: Key applications of the EU space programme https://data.europa.eu/en/publications/datastories/satellite-data-action-key-applications-eu-space-programme

[95] Op.Cit. Reducing greenhouse gas emissions: Commission adopts EU Methane Strategy as part of European Green Deal https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1833

[96] Ibid.

3. United Nations

The United Nations (UN) has established the International Methane Emissions Observatory (IMEO) as a critical initiative aimed at tackling global methane emissions. This observatory serves as a central hub for collecting, synthesizing, and disseminating comprehensive data on methane sources and trends worldwide. Through its Methane Science Studies, the IMEO collaborates with leading scientific institutions to conduct rigorous analyses that inform policy decisions and mitigation strategies. Additionally, the IMEO utilizes advanced satellite technology known as the Methane Alert and Response System (MARS) to provide real-time monitoring of methane emissions, enabling swift responses to significant methane releases and facilitating targeted interventions[97].

One of the IMEO's key partnerships is with the Oil and Gas Methane Partnership 2.0 (OGMP 2.0), where it works closely with industry stakeholders to enhance transparency and accountability in methane reporting from the oil and gas sectors. Participating companies commit to rigorous standards for measuring, reporting, and reducing methane emissions across their operations, thereby contributing to global methane reduction efforts[98].

The IMEO also plays a pivotal role in supporting the Global Methane Pledge, an international commitment led by 150 countries, including prominent actors like the EU and the US. This pledge aims to collectively reduce global methane emissions by 30% by 2030 compared to 2020 levels. The initiative is backed by significant financial commitments totaling $12 billion in public funding and $7.2 billion in private investments, demonstrating a robust financial backing to support methane mitigation projects and technological advancements[99].

Looking ahead, the IMEO plans to expand its focus beyond the fossil fuel sector to include other major methane-emitting industries such as agriculture and waste management. This expansion reflects a comprehensive approach to addressing methane emissions across diverse sectors globally. Moreover, the UN has introduced stringent regulatory requirements for the oil, gas, and coal sectors, mandating the implementation of mitigation measures to detect and repair methane leaks, reduce venting, and minimize flaring. These regulatory frameworks aim to enforce industry compliance and significantly curb methane emissions from critical sectors, aligning with global climate goals and promoting sustainable development practices worldwide[100].

4. Climate and Clean Air Coalition (CCAC)

Despite increased international attention to climate change, global greenhouse gas emissions have reached record levels. Limiting global warming to 2°C or less requires unprecedented and immediate action. Reductions in methane emissions from the oil and gas sector present a significant opportunity to enhance the ambition of emissions reduction commitments. The methane reduction strategy is crucial because methane is a potent greenhouse gas, with a global warming potential over 80 times that of CO2 over a 10 to 12-year lifespan. It is responsible for about a quarter of current global warming. Swift action

[97] International Methane Emissions observatory https://www.unep.org/topics/energy/methane/international-methane-emissions-observatory

[98] Ibid.

[99] New global methane pledge aims to tackle climate change https://www.unep.org/news-and-stories/story/new-global-methane-pledge-aims-tackle-climate-change

[100] Ibid.

to reduce methane emissions can quickly bend the curve of dangerous warming while offering air quality benefits. The management of methane is one of the fastest and most cost-effective ways to slow short-term climate warming while transitioning to cleaner energy forms.[101]

The Global Methane Alliance, initiated by the Climate and Clean Air Coalition (CCAC) and the United Nations Environment Programme (UNEP), brings together governments, financial institutions, international organizations, NGOs, and the oil and gas industry to support ambitious methane reduction goals in the oil and gas sector by 2030. Member countries commit to including methane reduction targets from the oil and gas sector in their nationally determined contributions (NDCs) as part of their overall greenhouse gas reduction goals. These targets can be absolute reduction goals or intensity-based goals, depending on the country's methane emissions and the level of development of its oil and gas industry. The Alliance sets absolute reduction targets of at least 45% by 2025 and 60% to 75% by 2030. Additionally, countries may opt for intensity-based goals aiming for methane emissions intensity close to zero, with a target of 0.25% or less. International organizations and NGOs provide technical assistance and policy support to countries pursuing these goals, while participating oil and gas companies share knowledge, technologies, and best management practices.[102]

The objectives of the Global Methane Alliance include supporting countries in achieving ambitious methane reduction goals in the oil and gas sector. Reductions in this sector could reduce global emissions by 6 gigatonnes of CO2e by 2030, contributing significantly to limiting global warming to 2 degrees Celsius. Efficient methane management can also support development goals by preventing the wastage of methane resources, which amounts to about $30 billion annually, and by improving air quality and other national priorities. The industry could reduce its global emissions by 75%, with up to two-thirds of these reductions achievable at no net cost. Through initiatives like the Oil and Gas Methane Partnership (OGMP) and the Methane Guiding Principles (MGP), organizations are working to reduce methane emissions from the oil and gas industry. These efforts include scientific research, technical assistance, and capacity-building activities to support countries in implementing methane reduction measures.[103]

Meetings organized by the Global Methane Alliance bring together government representatives, industry stakeholders, and civil society to discuss ambitious methane reduction goals and available support mechanisms. Progress to date includes commitments from countries like Nigeria and Côte d'Ivoire to include ambitious methane reduction targets in their NDCs through the Alliance. Capacity-building activities and regulatory developments in countries like Mexico and Colombia are also underway to reduce methane emissions from the oil and gas sector.[104]

5. The World Bank

The World Bank is one of the institutions that recognizes the importance of reducing methane emissions and taking responsibility accordingly. According to their statement in 2023, they had plans to initiate 15 country-led programs in the following 18 months, which were aimed at addressing 10 million tons of methane over the investment's lifespan. These programs were planned to focus on utilizing technology to reduce the methane emissions resulting from rice production, livestock, and waste management through

[101] Methane https://www.ccacoalition.org/short-lived-climate-pollutants/methane

[102] Ibid.

[103] Climate and Clean Air Coalition(CCAC)https://www.unep.org/topics/energy/methane/climate-and-clean-air-coalition-ccac#:~:text=Countries% 20signing%20the%20Global%20Methane,or%20update%20Methane%20Action%20Plans.

[104] Ibid .

improved water management of rice paddies and rice straw composting, advanced food practices, selective breeding, manure management, and diverting organic waste from landfills.

The World Bank also emphasizes that the financing of methane mitigation initiatives is considerably insufficient compared to those addressing carbon dioxide, which is less than 2% of global climate finance. Therefore, they intend to increase the financing for methane reduction significantly between 2024 and 2030.

In order to build on previous initiatives to reduce methane emissions throughout the whole energy value chain, the World Bank is collaborating with Germany, Norway, the US, the UAE, and the private sector. In connection with these initiatives, the World Bank is establishing two partnership platforms for accelerated methane action: the Global Flaring and Methane Reduction Partnership (GFMR), which aims to reduce methane leaks in the oil and gas industry, and the Global Methane Reduction Platform for Development (CH4D), which serves as a hub for methane abatement in waste and agriculture[105].

One of the key aspects of GFMRP has been its focus on data and reporting. The partnership has produced numerous reports and datasets that track progress in reducing gas flaring and methane emissions. For instance, the World Bank's Global Gas Flaring Tracker Report 2022 highlighted a 5% decrease in global gas flaring volumes from 2020 to 2021. These reports provide detailed data by country and identify areas where further reductions are needed. Such data-driven approaches ensure transparency and help stakeholders measure the effectiveness of their emission reduction efforts.[106]

In 2021, the Global Methane Pledge was launched at the COP26 climate summit. Supported by over 100 countries, this pledge aims to reduce global methane emissions by at least 30% from 2020 levels by 2030. While the pledge is a separate initiative from GFMRP, it aligns closely with the partnership's broader goals. The pledge has galvanized international efforts to tackle methane emissions, complementing the work done under GFMRP and reinforcing the global commitment to addressing climate change.[107]

Technological and policy advancements have been central to the success of GFMRP. The partnership has promoted the use of advanced technologies, such as satellite monitoring, to more accurately track flaring activities and methane emissions. These technological innovations have provided better data, enabling more effective regulation and enforcement. Additionally, GFMRP has supported the development of policies that incentivize or mandate reductions in flaring and methane emissions, fostering a regulatory environment conducive to achieving its objectives.[108]

Over the years, many countries have joined GFMRP, demonstrating a strong international commitment to reducing flaring and methane emissions. Notable participants include major oil-producing nations such as Nigeria, Russia, and the United States. These countries have implemented various measures to comply with the partnership's goals, resulting in significant emissions reductions. Through continued collaboration, technological advancements, and robust policy frameworks, GFMRP aims to make substantial contributions to global efforts in combating climate change.

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[105] https://www.worldbank.org/en/news/factsheet/2023/12/04/world-bank-steps-up-efforts-to-address-methane-emissions

[106] ibid

[107] The Global Methane Pledge **https://www.iea.org/reports/global-methane-tracker-2022/the-global-methane-pledge**

[108] Op.cit Global Flaring and Methane Reduction Partnership (GFMR) https://www.worldbank.org/en/programs/gasflaringreduction/methane-explained

VII. Measures taken by individual countries to reduce Methane emissions

1. European countries

a) France

"We know that our aim is to limit global warming to 1.5ºC. This was confirmed again by the

G20 in Rome. We know that we are not there yet because the latest UN report tells us that our current trajectories take us well over 2ºC. The key to our collective action is to accelerate efforts to define credible national strategies that will allow us to remain at a maximum of 1,5ºC. This implies reducing emissions of CO2, as well as the other greenhouse gases such as methane or HFCs." – **Emmanuel Macron, President of France**[109]

France has implemented a comprehensive set of measures to reduce methane emissions, particularly in the agricultural sector. Here's a summary of the key actions:

Agriculture:[110]

- Methane Energy and Nitrogen Autonomy Plan (2018): Aims to reduce emissions by minimizing input use and increasing organic fertilizer usage.
- Biogas Development: Financial incentives from ADEME and tax exemptions for biogas.
- Feed-in-Premiums (2016): Replaced feed-in-tariffs to make biogas more competitive.
- Connection Cost Rebate (2017): Up to 40% rebate for connecting biomethane facilities to networks.
- Plant Protein Plan (2017): Reducing protein dependency and improving livestock health.
- **MONDFERENT Project:** Enhanced emissions calculations for cattle.
- **National Low-Carbon Strategy (2015):** Targets a 12% reduction in agricultural emissions by 2030.
- **Feed-in-Tariffs (2011-2016):** For electricity from biogas using agricultural waste.

Waste Management:[111]

- Anti-waste Law (2020): Penalties for food destruction and measures for food donation quality.
- Multiyear Energy Programme (2020): Biogas to account for 7-10% of gas consumption by 2030 with significant subsidies.
- National Programme on Food and Nutrition (2019): Continues the fight against food waste.

Ibid .

[109] France https://www.ccacoalition.org/partners/france

[110] Ibid.

[111] Ibid.

- Agriculture Bill (2018): Expands food donation requirements and establishes waste reduction plans.
- Prohibition of Food Waste by Supermarkets (2016): First country to enact such a law.
- Universal Sorting of Household Organic Waste (2025): Goal set for waste sorting.
- Waste Management Enforcement Law (2012): Reduced organic waste sent to landfills.

Efficient Cooling:[112]

- France Relance Plan (2020): €6.7 billion for building renovation and insulation.
- Law on Energy and Climate (2019): Measures against thermally inefficient homes.
- Finance Bill (2019): Tax credits for HFC-free cooling equipment.
- Energy Transition Act (2015): Tax credits and loans for energy-efficient renovations.

Transportation:[113]

- Green Infrastructure (2020): France's Reliance plan includes provisions for cycling, public transit, and clean vehicles.
- Finance Bill (2020): Increased penalties for high-emitting vehicles.
- Orientation Law on Mobilities (2019): Target to end the sale of fossil fuel vehicles by 2040.
- Ecological Bonus Budget (2019): Funding for electric vehicle purchases.
- IMO Commitments (2017): Pledged to reduce black carbon emissions from ships.
- Energy Transition Law (2015): Authorized restricted traffic zones and incentives for clean vehicles.
- These measures reflect France's commitment to reducing methane emissions and transitioning to a more sustainable and environmentally friendly economy. The country's efforts align with global initiatives to combat climate change and promote renewable energy sources.

a) Germany

Between 1990 and 2021, Germany reduced its carbon dioxide emissions by 35.6%, methane emissions by 65.5%, and nitrous oxide emissions by 52%. Fluorinated greenhouse gases (F-gases), which have a very high global warming potential, represent only 1.5% of total greenhouse gas emissions. Emissions of F-gases have decreased by 32% since 1995.In 2023, Germany's greenhouse gas emissions dropped by 46.1% compared to 1990 [114][115]. It is worth mentioning that only in one year, Germany's carbon dioxide emissions decreased by 73 million tons in comparison to 2022.[116] Germany aims to reduce greenhouse gas emissions

[112] ibid

[113]32 France 2030" investment plan- Clean transport investment https://www.iea.org/policies/15027-france-2030-investment-plan-clean-transport-investment

[114] What is the German government doing for the climate? https://www.bundesregierung.de/breg-en/issues/climate-action/government-climate-policy-1779414

[115] Umweltbundesamt. 2024. Indicator: Greenhouse gas emissions. Indicator: Greenhouse gas emissions | Umweltbundesamt

[116] DW.2024. Germany 2023 emissions lowest in 70 years: study . Germany 2023 emissions lowest in 70 years: study –

by at least 65% by 2030 compared to 1990 levels.[117]

National Climate Target

Germany aims to become greenhouse gas neutral by 2045, with interim targets of reducing emissions by at least 65 percent by 2030 compared to 1990 levels and achieving an 88 percent reduction by 2040. These targets are part of the broader effort to mitigate climate change impacts and are supported by comprehensive legislation and policy frameworks designed to facilitate significant emissions reductions across various sectors.[118][119]

Regulation on Oil, Gas, and Coal Sectors

To address methane emissions specifically from the oil, gas, and coal sectors, Germany has introduced stringent regulations that require these industries to measure, report, and verify their methane emissions. These regulations mandate the implementation of mitigation measures to avoid methane emissions, including detecting and repairing leaks and limiting practices such as venting and flaring. This regulatory approach ensures that methane emissions are systematically monitored and reduced, contributing to the overall reduction of greenhouse gases.[120]

Support for Initiatives to Curb Methane Emissions

Germany actively supports international and national initiatives aimed at curbing methane emissions. The government has urged more countries and companies to take decisive action to reduce methane emissions, highlighting the importance of collaborative efforts in addressing this potent greenhouse gas. By advocating for global action, Germany aims to amplify the impact of its domestic policies and contribute to broader methane mitigation efforts[121].

Recommendations for Coal Mines

In response to recommendations from climate think tanks like Ember, Germany is considering measures to better manage methane emissions from coal mines. These recommendations include requiring surface mines to directly measure and model their current and future methane emissions, including emissions after mine closures. Additionally, there is an emphasis on avoiding the expansion of coal mines and prioritizing the phase-out of mines with the highest methane emissions. The implementation of methane mitigation strategies at both active and closed coal mines is also being promoted to reduce emissions effectively.[122]

Reducing Methane Emissions from Livestock

Germany is addressing methane emissions from the agricultural sector by improving the processing of manure from livestock. Enhanced manure management practices, including the use of biogas plants to

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DW – 01/04/2024

[117] Ibid.

[118] Ibid.

[119] Clean Energy Wire. 2024. Germany's greenhouse gas emissions and energy transition targets. Germany's greenhouse gas emissions and energy transition targets | Clean Energy Wire

[120] Germany https://www.ccacoalition.org/partners/germany

[121] Germany is a world leader in cutting emissions https://www.bmwk-energiewende.de/EWD/Redaktion/EN/Newsletter/2020/06/Meldung/direkt-answers-in fographic.html

[122] Urgency to update Germany's coal mine methane emission factor https://ember-climate.org/insights/in-brief/de-undermines-cmm-emissions/

convert manure into energy, help reduce methane emissions from agriculture. These practices not only lower emissions but also contribute to sustainable energy production, supporting Germany's broader climate goals.[123]

1. African Countries

a) A -Morocco

National SLCP Planning Process: Morocco has completed its National SLCP (Short-Lived Climate Pollutants) Planning process, which identifies priority mitigation measures to reduce methane emissions. These measures have been included in its revised Nationally Determined Contributions (NDC).[124]

- Global Methane Pledge: As a signatory to the Global Methane Pledge, Morocco has committed to reducing global methane emissions by 30% by 2030 compared to the 2020 level.[125]
- Development of a Methane Roadmap: Morocco is working on developing a methane roadmap, which will outline strategies and actions to reduce methane emissions across various sectors, including agriculture.[126]
- Assessment of Landfill Methane Capture: Morocco is assessing the methane capture and energy generation potential for three major landfills. This involves evaluating the feasibility of capturing methane emissions from waste and converting it into energy, thereby reducing emissions and generating renewable energy.[127]
- Integration of Methane Reduction Targets in NDC: Morocco plans to integrate methane reduction targets and mitigation measures for the agriculture sector in its 2025 NDC update. This will involve setting specific targets for methane emissions reduction and outlining the measures and policies to achieve them.[128]
- Capacity Building: Morocco is investing in building capacity for methane emissions inventory development. This involves training government entities in improved methods for estimating methane emissions, which can contribute to more accurate reporting under international frameworks like the UNFCCC.[129]

a) Ghana

- National Climate Targets: Ghana passed a law in 2020 that requires carbon-emissions reductions of at least 40 percent by 2030 compared with 1990 levels and becoming carbon neutral by 2050.[130]

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[123] Enteric methane emission factors, total emissions and intensities from Germany's livestock in the late 19th century: A comparison with the today's emission rates and intensities https://www.sciencedirect.com/science/article/pii/S0048969722048537

[124] MOROCCAN CLIMATE CHANGE POLICY https://www.greenpolicyplatform.org/sites/default/files/downloads/policy-database/Moroccan%20Climate%2 0Change%20Policy.pdf

[125] Ibid.

[126] Morocco - National Planning on short-lived climate pollutants https://www.ccacoalition.org/projects/morocco-national-planning-short-lived-climate-pollutants

[127] Ibid .

[128] Ibid.

[129] Ibid.

[130]

- Methane Assessments and Roadmap: Ghana has developed a national Short-Lived Climate Pollutants (SLCP) emission inventory and mitigation assessment that informed a national SLCP plan that was published in 2021. Ghana's key methane-emitting sectors include agriculture, oil and gas, and waste. Ghana has also signed the Global Methane Pledge and thus must create a roadmap to make reductions to contribute to the collective goal of reducing methane emissions by 30% of 2020 levels by 2030.[131]
- Ghana is actively working to reduce methane pollution in its agriculture and waste management sectors as part of its climate plan to enhance air quality, public health, carbon finance, and job creation. One of the main strategies being implemented is the Alternative Wet and Drying (AWD) method in rice farming. This innovative technique reduces methane emissions by promoting intermittent flooding of rice fields, contrary to the traditional practice of continuous flooding, thereby decreasing the methane produced by soil microbes.[132]
- Africa Project on Agroecology and Circular Economy (ACE4ES) : The ACE4ES project focuses on promoting agroecology and circular economy principles to reduce emissions in maize and rice production. Led by the Crop Research Institute, this initiative aims to introduce sustainable farming practices that minimize the environmental impact of agriculture. Techniques such as crop rotation, organic farming, and efficient water use are being promoted to enhance soil health and reduce greenhouse gas emissions. The project also encourages the use of agricultural residues for composting, reducing methane emissions from waste and improving soil fertility.[133]

2. Asian countries

a) A- China

To address methane emissions effectively, China has integrated methane mitigation efforts into its broader policy goals, such as building a circular economy and transitioning to green energy. The country aims to achieve carbon neutrality by 2060, covering all greenhouse gases, including methane. While methane is not explicitly included in China's nationally determined contributions (NDCs), the government has committed to taking policy and technical measures to control methane emissions from coal mining and oil and gas extraction. China's long-awaited Methane Emissions Control Action Plan, released in November 2023, marks a significant milestone in the country's efforts to address methane emissions.Jointly issued by the Ministry of Ecology and Environment (MEE) and ten other national ministries and agencies, the plan underscores the importance of interagency coordination for effective implementation.[134]

Key priorities highlighted

The Action Plan includes the improvement of the monitoring, reporting, and verification system for methane emissions, as well as mitigation actions in the energy, agriculture, and waste sectors. Notably, the plan aims to strengthen synergistic control of methane and other pollutants, such as volatile organic

[131] Development of Ghana's National Road Map on Methane Emissions https://www.ccacoalition.org/news/development-ghanas-national-road-map-methane-emissions

[132] GHANA Africa

[133] Op.Cit Ghana takes step to reduce methane pollution in agriculture, waste management **ttps://cmo.epa.gov.gh/index.php/2023/12/27/ghana-takes-step-to-reduce-methane-pollution-in-agriculture-waste-management/**

[134] National Methane Action Plan https://www.iea.org/policies/16940-national-methane-action-plan

compounds.[135]

The plan emphasizes the need for further improvement of coal mine safety regulations and methane emission standards for coalbed methane. Incentive mechanisms, such as promoting methane mitigation projects in the greenhouse gas voluntary emission trading system, are also highlighted. Furthermore, the Action Plan underscores China's commitment to international cooperation and exchanges on methane mitigation. This includes engagement through China's Climate-Change South-South Cooperation efforts and the Belt and Road Initiative [136]

a) United Arab Emirates[137]

- UAE Net Zero 2050 Strategic Initiative: The United Arab Emirates has launched a national initiative to achieve carbon neutrality by 2050, making it the first nation in the MENA region to do so. This initiative aligns with the Paris Agreement, which calls on countries to prepare long-term strategies for reducing greenhouse gas emissions.
- Investment in Clean Energy: The United Arab Emirates started financing clean energy projects more than 15 years ago and has invested more than 40 billion dollars in the sector to date. Current trends predict that the capacity of clean energy production, including solar and nuclear energy, will reach 14 GW by 2030.
- Commitment to the Global Methane Pledge: The United Arab Emirates has signed the Global Methane Pledge, committing to reduce global methane emissions by 30% by 2030 compared to 2020 levels.
- Reducing Emissions in Oil and Gas Operations: The United Arab Emirates aims to achieve near-zero methane emissions in operated oil and gas assets by 2030.
- Prohibition of Routine Methane Flaring: The United Arab Emirates and Saudi Arabia have taken measures to reduce emissions by prohibiting routine flaring of methane and other gases.
- Reducing Flare Gas Emissions: Between 1995 and 2010, the Abu Dhabi National Oil Company (ADNOC) reduced flare gas emissions by nearly 78%. It now has a strategic goal to achieve near-zero routine flaring.

b) South Korea

The Republic of Korea has taken significant steps to reduce methane emissions, an effort that aligns with its commitment to global methane emission reduction. The government has formulated the '2030 Methane Emissions Reduction Roadmap', which is a comprehensive strategy aimed at reducing methane emissions by 2030 across various sectors such as agriculture, livestock, waste, and energy[138].

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[135]36
China commits to methane emission control action plan https://english.www.gov.cn/news/202311/08/content_WS654b2640c6d0868f4e8e1125.html

[136] Op.Cit. National Methane Action Plan https://www.iea.org/policies/16940-national-methane-action-plan

[137] The UAE's Net Zero 2050 Strategy
https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/environment-and-energy/the-ua e-net-zero-2050-strategy

[138] Methane Reduction Strategies and Regulations in South Korea: Current Issues and Policy Recommendation

In the agriculture and livestock sector, Korea plans to systematically manage water in rice paddies and increase the use of low-methane feed. The goal is to achieve 30% utilization of these feeds by 2030, while also increasing the proportion of livestock manure purification. The use of Information and Communication Technology (ICT) equipment is also envisioned to enhance livestock productivity.[139]

Regarding waste management, the Korean government aims to limit food waste by revising relevant policies and developing the necessary infrastructure to reduce household food waste. Integrated biogas installation projects will be progressively expanded to promote biogas production from organic waste. Additionally, emphasis will be placed on landfill site renovations and the introduction of methane capture devices.

In the energy sector, Korea plans to periodically formulate the 'Fugitive Emissions Management Plan' to reduce fossil fuel usage and improve energy demand efficiency. These measures will contribute to a reduction in energy consumption and a transition to a cleaner energy mix.[140]

Finally, to ensure the implementation of these plans, the Korean government will enhance the Measurement, Reporting, and Verification (MRV) system for methane emissions and support research and development of methane mitigation technologies. Promoting international cooperation for methane emission reduction is also a key element of this strategy, with the development of new international public-private methane mitigation projects.[141]

By implementing these policies and deploying advanced mitigation technologies, Korea aims to reduce methane emissions by 34.2% in the agriculture and livestock sector, 49% in the waste sector, and 22.7% in the energy sector by 2030. This is expected to result in a significant reduction in total methane emissions, from 27.4 million tonnes in 2020 to 19.1 million tonnes in 2030.[142]

3. American countries

a) Canada

Canada has been actively implementing regulatory measures to address methane emissions, particularly in the oil and gas sector. In 2018, federal regulations were introduced aimed at reducing methane emissions from oil and gas operations. These regulations marked a significant step in Canada's climate action strategy, targeting a major source of methane, which is a potent greenhouse gas contributing to global warming and climate change. Recognizing the need for continuous improvement, Environment and Climate Change Canada released a draft of enhanced oil and gas methane regulations in 2023[143]. This draft

https://forourclimate.org/hubfs/%5B%EB%B3%B4%EA%B3%A0%EC%84%9C%5D%20%EC%97%90%EB%84%88%EC%A7%80%EC%9C%84%EA%B8%B0%EC%97%90%EC%84%9C%20%EA%B8%B0%ED%9A%8C%EB%A1%9C_ENG.pdf

[139] Republic of Korea's 2030 Methane Emissions Reduction Roadmap https://www.ccacoalition.org/policy-database/republic-koreas-2030-methane-emissions-reduction-roadmap

[140] Ibid.

[141] Ibid

[142] Op.Cit. Methane Reduction Strategies and Regulations in South Korea: Current Issues and Policy Recommendation https://forourclimate.org/hubfs/%5B%EB%B3%B4%EA%B3%A0%EC%84%9C%5D%20%EC%97%90%EB%84%88%EC%A7%80%EC%9C%84%EA%B8%B0%EC%97%90%EC%84%9C%20%EA%B8%B0%ED%9A%8C%EB%A1%9C_ENG.pdf

[143] Review of Canada's methane regulations for the upstream oil and gas sector **https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/review-methane-regulations-upstream-oil-gas-sector.html**

underwent a 60-day consultation period to gather feedback and refine the regulatory framework further. The 60-day consultation period in the context of Canadian regulatory processes refers to a structured period during which stakeholders and the public are invited to provide feedback and comments on proposed regulations or policy measures. This period serves as a crucial step in the regulatory development process, ensuring transparency, accountability, and inclusivity in decision-making[144].

During this consultation period, draft regulations or policy proposals are typically published by government agencies, such as Environment and Climate Change Canada in the case of methane regulations. Interested parties, including industry representatives, environmental groups, academics, and the public, are encouraged to review the proposed measures and submit their comments, concerns, and suggestions[145].

Canada's Methane Strategy outlines a comprehensive approach to further reduce methane emissions across the economy. Building on the country's progress and commitments since 2015, including the 2030 Emissions Reduction Plan, the Methane Strategy sets out specific pathways and actions to achieve ambitious reduction targets. These targets are aligned with Canada's broader climate goals, aiming for a significant decrease in greenhouse gas emissions to combat climate change effectively[146].

In November 2021, Canada joined over 100 countries in supporting the Global Methane Pledge, underscoring its commitment to global methane reduction efforts. The pledge aims to collectively reduce human-caused methane emissions by 30% below 2020 levels by 2030. Canada, in particular, set an ambitious target to reduce methane emissions from its oil and gas sector by 75% from 2012 levels by 2030, demonstrating leadership in methane mitigation on the global stage[147].

Addressing methane emissions from agriculture, Agriculture and Agri-Food Canada launched the Agricultural Methane Reduction Challenge in November 2023. This initiative focuses on reducing methane emissions produced by cattle, highlighting Canada's commitment to exploring innovative solutions and best practices in agricultural methane reduction[148].

Furthermore, Canada is advancing regulations to reduce methane emissions from landfills. In April 2023, Environment and Climate Change Canada released a proposed regulatory framework aimed at cutting methane emissions from landfills by 50% by 2030. This regulatory initiative underscores Canada's holistic approach to methane reduction, targeting emissions from various sources to achieve significant environmental benefits[149].

The 2030 Emissions Reduction Plan, launched in March 2022, serves as a cornerstone of Canada's climate strategy. It includes methane emission reductions as a critical component to achieving broader emission reduction targets of 40–45% below 2005 levels by 2030 and achieving net-zero emissions by 2050. This plan integrates methane reduction efforts into a comprehensive framework aimed at transitioning Canada

[144] Reducing methane emissions **https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reducing-methane-emissions.html**

[145] Ibid.

[146] Ibid.

[147] Canada confirms its support for the Global Methane Pledge and announces ambitious domestic actions to slash methane emissions **https://www.canada.ca/en/environment-climate-change/news/2021/10/canada-confirms-its-support-for-the-global-methane-pledge-and-announces-ambitious-domestic-actions-to-slash-methane-emissions.html**

[148] Ibid.

[149] Op.Cit Reducing methane emissions **https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reducing-methane-emissions.html**

towards a sustainable, low-carbon economy while mitigating the impacts of climate change[150].

a) United States of America

The Biden-Harris Administration has taken significant steps to address methane emissions from the oil and natural gas industry in the United States, aiming to curb greenhouse gases and improve air quality. The U.S. Environmental Protection Agency (EPA) announced a final rule that introduces stringent standards for reducing methane and other harmful air pollutants. These regulations are particularly focused on existing sources within the oil and natural gas sector, encompassing hundreds of thousands of facilities across the country[151].

The final rule mandates comprehensive measures to limit methane emissions from a wide range of equipment and processes within the industry. This includes requirements for leak detection and repair (LDAR) programs, enhanced monitoring protocols, and stricter operational practices aimed at minimizing methane leaks throughout the production, transmission, and storage phases of oil and gas operations[152].

The anticipated impact of these regulations is substantial. It is estimated that the rule will reduce methane emissions from the oil and gas sector by about 74% from 2024 to 2038. Methane, as a potent greenhouse gas with a much higher global warming potential than carbon dioxide over a shorter time frame, plays a significant role in climate change mitigation efforts. By reducing methane emissions, the Biden-Harris Administration aims to contribute to achieving ambitious climate targets and advancing environmental sustainability goals domestically and globally[153].

Furthermore, these regulations align with broader efforts under the Biden-Harris Administration to prioritize environmental stewardship and climate action. They underscore a commitment to leveraging regulatory frameworks to drive industry compliance with stringent emission standards while promoting technological innovation and best practices in methane mitigation.[154]

Methane Emissions Reduction Program: The Methane Emissions Reduction Program, an integral part of the Biden-Harris Administration's climate strategy, represents a comprehensive approach to tackling methane emissions from the oil and gas sector. With a budget exceeding $1 billion, this program is designed to provide substantial financial and technical assistance aimed at supporting industry efforts to reduce methane emissions effectively and efficiently. One of the key components of this program is the provision of multiple funding opportunities. These grants and financial incentives are intended to encourage the adoption of advanced technologies and best practices for methane emission reductions. The financial support is targeted at a variety of stakeholders within the oil and gas sector, including small and medium-sized enterprises that may otherwise struggle to implement costly emission reduction technologies. This ensures that even the smaller players in the industry can contribute to the overall reduction goals[155].

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[150] 2030 Emissions Reduction Plan – Canada's Next Steps for Clean Air and a Strong Economy **https://www.canada.ca/en/environment-climate-change/news/2022/03/2030-emissions-reduction-plan--canadas-next-steps-for-clean-air-and-a-strong-economy.html**

[151] Biden-Harris Administration Announces Final Rule to Cut Methane Emissions, Strengthen and Update Greenhouse Gas Emissions Reporting for the Oil and Gas Sector **https://www.epa.gov/newsreleases/biden-harris-administration-announces-final-rule-cut-methane-emissions-strengthen-and**

[152] Ibid.

[153] Ibid

[154] ACCELERATING PROGRESS: DELIVERING ON THE U.S. METHANE EMISSIONS REDUCTION ACTION PLAN https://www.whitehouse.gov/wp-content/uploads/2023/12/Methane-Action-Plan-2023-Topper.pdf

[155] Biden-Harris Administration Announces Availability of $350 Million in Grants to States to Cut Methane Emissions

In addition to direct financial assistance, the program also emphasizes technical support. This includes access to expertise, training, and resources that can help companies identify, monitor, and mitigate methane emissions more effectively. The aim is to create a collaborative environment where industry players can learn from each other and from experts, fostering a culture of continuous improvement in methane management practices[156].

A significant regulatory innovation introduced by the Methane Emissions Reduction Program is the establishment of the Waste Emissions Charge (WEC) for methane. This charge acts as a financial penalty for excess methane emissions, providing a strong economic incentive for companies to minimize their methane output. By tying financial costs directly to emission levels, the WEC encourages companies to invest in leak detection and repair technologies, as well as other mitigation measures that can reduce their methane footprint[157].

Furthermore, the program mandates that the U.S. Environmental Protection Agency (EPA) revise the Greenhouse Gas Reporting Program (GHGRP) subpart regulations specific to the oil and gas sector. These revisions are aimed at enhancing the accuracy, transparency, and comprehensiveness of methane emissions reporting. By improving the quality of data collected, the EPA can better track progress, identify areas needing improvement, and ensure that regulations are based on the most accurate and up-to-date information available.[158]**.**

investing in America Agenda: As part of President Biden's Investing in America agenda, the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE) announced a conditional commitment to 14 states to receive a total of $350 million in formula grant funding which is a method of distributing funds from a central government to smaller administrative units (such as states, counties, or municipalities) based on a predetermined formula. This formula typically takes into account various factors such as population size, demographic characteristics, economic conditions, or specific needs related to the grant's purpose. The goal is to ensure a fair and equitable distribution of funds according to objective criteria rather than competitive applications or discretionary decisions to help measure and reduce methane emissions from the oil and gas sector.[159]

U.S. Methane Emissions Reduction Action Plan: The White House Office of Domestic Climate Policy released the U.S. Methane Emissions Reduction Action Plan in November 2021. The plan outlines critical and commonsense steps to cut pollution and consumer costs while boosting good-paying jobs and American competitiveness.[160]

from Oil and Gas Sector **https://www.energy.gov/articles/biden-harris-administration-announces-availability-350-million-grants-states-cut-methane**

[156] Ibid.

[157] Methane Emissions Reduction Program **https://www.epa.gov/inflation-reduction-act/methane-emissions-reduction-program**

[158] Ibid .

[159] ACCELERATING PROGRESS: DELIVERING ON THE U.S. METHANE EMISSIONS REDUCTION ACTION PLAN https://www.whitehouse.gov/wp-content/uploads/2023/12/Methane-Action-Plan-2023-Topper.pdf

[160] Ibid.

VIII. Recommendations to reduce Methane emissions

The European Union will continue to monitor its economy-wide methane emissions following its commitments under the United Nations Framework Convention on Climate Change. The European Union and its Member States submit greenhouse gas inventories estimating anthropogenic greenhouse gas emissions and removals on an annual basis to the United Nations Framework Convention on Climate Change. Methane is one of the greenhouse gases for which reporting is mandatory. Member States estimate their greenhouse gas emissions and removals in accordance with the 2006 guidelines of the Intergovernmental Panel on Climate Change, which provide methodologies to be used for each (sub-)category belonging to a specific activity sector. The estimation methodology or tier to be applied per (sub-)category depends on various factors, including the level of emissions (key categories) and the information available. The 2006 guidelines of the Intergovernmental Panel on Climate Change include decision trees that help the inventory compiler navigate the guidance and select the appropriate tiered methodology. It is good practice to use higher tier methods for key categories, unless the resource requirements to do so are prohibitive. As national circumstances may differ across Member States, the tier methods used for each (sub-)category may differ across Member States[161].

1. Monitoring

A robust Monitoring, Reporting, and Verification (MRV) system is essential for ensuring compliance with climate legislation and achieving emission reduction targets. In the waste sector, however, specific monitoring of methane emissions is currently not foreseen. Despite positive trends in reducing emissions since the 1990s, additional focus on implementation and addressing the investment gap is crucial. Particularly, more efforts are needed on waste prevention, including food waste.[162]

Comprehensive Monitoring Framework

To address the gap in monitoring methane emissions, it is essential to develop a comprehensive monitoring framework. This framework should include standardized metrics and indicators for measuring methane emissions from waste. Consistency across the EU is crucial to ensure accurate reporting and comparison of data. Additionally, the use of advanced monitoring technologies such as satellite observations, remote sensing, and ground-based measurements can enhance the accuracy and real-time tracking of methane emissions.[163]

Transparent Reporting Mechanisms

Accurate reporting mechanisms are fundamental to a successful MRV system. Ensuring transparent data collection processes involves engaging multiple stakeholders, including local governments, private sector entities, and civil society. Establishing mandatory, regular reporting intervals for methane emissions within the waste sector can be integrated into existing reporting frameworks under the EU Governance Regulation. This approach ensures that data is consistently reported and allows for timely identification of trends and issues.[164]

[161] REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL **https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0805**

[162] Monitoring, reporting and verification of EU ETS emissions **https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification-eu-ets-emissions_en**

[163] Ibid.

[164] Ibid.

Rigorous Verification Processes

Verification processes play a critical role in the integrity of MRV systems. Implementing third-party audits and verification processes ensures the accuracy and reliability of reported data. Additionally, encouraging peer reviews among member states can help foster the sharing of best practices and identify areas for improvement in MRV systems. This collaborative approach not only enhances data integrity but also promotes continuous improvement in monitoring and reporting practices.[165]

2. Reporting

Effective reporting is a critical component of a robust Monitoring, Reporting, and Verification (MRV) system, ensuring transparency, accountability, and progress tracking in emissions reduction efforts. The ongoing review of the Gothenburg Protocol, a key international framework for air pollution control, underscores the importance of methane reporting. The European Union and its Member States are actively engaged in these discussions, awaiting the final agreement to determine the relevance and potential approaches to methane reporting.[166]

The Convention on Long-Range Transboundary Air Pollution, commonly known as the Gothenburg Protocol, serves as the primary international framework for cooperation and measures to limit and reduce air pollution. The current review of the Protocol is particularly significant as it addresses the potential role of methane. Methane is a potent greenhouse gas with a global warming potential significantly higher than that of carbon dioxide over a 20-year period. Its inclusion in the Protocol could enhance efforts to mitigate climate change and improve air quality.[167]

As the Gothenburg Protocol review progresses, several key considerations for methane reporting are being discussed. One major consideration is the relevance of methane to the Protocol's aims. Assessing the environmental impact of methane emissions, particularly their contribution to ozone formation and climate change, is crucial for determining their relevance to the Protocol's objectives. Additionally, understanding the health implications of methane-related air pollution, including respiratory and cardiovascular diseases, can reinforce the need for stringent reporting and mitigation measures.[168]

Another important aspect is the approach to methane reporting. One potential approach is the inclusion of methane emissions in national air pollution inventories, ensuring comprehensive tracking and reporting across all sectors. Developing standardized reporting formats for methane emissions can facilitate consistency and comparability across countries. This can include specific guidelines for reporting methane emissions from various sources, such as agriculture, energy, and waste.[169]

The European Union and its Member States are closely following the discussions around the Gothenburg Protocol review. They recognize the potential significance of methane in achieving the Protocol's aims but are careful not to pre-empt the final agreement. Their involvement in these discussions demonstrates a commitment to enhancing air pollution control measures and aligning with international standards.[170]

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[165] Ibid.

[166] Measurement, Reporting and Verification (MRV) of greenhouse gas (GHG) mitigation https://www.oecd.org/env/cc/measurementreportingandverificationofghgmitigation.htm

[167] Ibid.

[168] Gothenburg Protocol **https://unece.org/gothenburg-protocol**

[169] Ibid.

[170] Entry into force of amended Gothenburg Protocol is landmark for clean air and climate action

Proactive engagement by the EU includes involving various stakeholders, such as environmental agencies, industry representatives, and civil society, to gather input and build consensus on methane reporting approaches. Ensuring that EU policies and regulations are aligned with potential new reporting requirements for methane under the Gothenburg Protocol will be crucial for seamless implementation. Providing technical assistance and capacity-building support to Member States can help them develop and implement effective methane reporting systems. Investing in advanced data management systems to collect, analyze, and report methane emissions data accurately and efficiently is also essential.[171]

Enhanced reporting mechanisms for methane emissions are essential for comprehensive climate and air quality strategies. The ongoing review of the Gothenburg Protocol presents a critical opportunity to integrate methane into international air pollution control frameworks. The European Union's active engagement in these discussions underscores its commitment to improving reporting standards and aligning with global best practices. By focusing on comprehensive, transparent, and standardized reporting, the EU can significantly advance its efforts to mitigate methane emissions and protect the environment and public health.[172]

3. Methane Transparency Database

Ensuring that the Methane Transparency Database, which is an initiative aimed at collecting, storing, and making accessible data on methane emissions from various sources such as agriculture, industry, waste, oil and gas, among others. This database provides detailed information on methane emissions in different regions of the world, enabling researchers, policymakers, and the public to better understand and track trends in greenhouse gas emissions is freely accessible to the public, policymakers, researchers, and other relevant stakeholders is crucial for promoting transparency, accountability, and public engagement in addressing methane emissions.[173] A user-friendly interface is essential for easy navigation and data retrieval, allowing users of varying technical abilities to access and utilize the information effectively. Implementing open data standards ensures that the information is available in formats compatible with various data analysis tools, facilitating broader use and integration into different research and policy-making processes. Regular updates to the database maintain the relevance and reliability of the information, supporting informed decision-making. Public accessibility without paywalls or restrictive access controls democratizes access to vital information, enabling anyone interested to contribute to or learn from the data. Furthermore, engaging stakeholders through forums, feedback mechanisms, and collaborative tools helps refine the database, ensuring it meets the needs of its diverse user base. Providing educational materials and resources, such as tutorials, glossaries, and case studies, aid users in understanding and interpreting the data.[174]

https://unece.org/environment/press/entry-force-amended-gothenburg-protocol-landmark-clean-air-and-climate-action

[171] Environment policy: general principles and basic framework https://www.europarl.europa.eu/fact-sheets/en/sheet/71/environment-policy-general-principles-and-basic-framework

[172] Op.Cit Gothenburg Protocol **https://unece.org/gothenburg-protocol**

[173] Global Methane Initiative (GMI) Policymaker Framework for Addressing Methane Emissions https://global-methane.org/pmf/

[174] Ibid

4. Working with the supply chain

Companies can work with their suppliers to reduce methane emissions throughout the supply chain. To reduce methane emissions in their supply chain, companies can adopt several strategic measures. Firstly, establishing clear standards is essential. These standards, based on industry best practices or the company's specific goals for emissions reduction, should be communicated transparently to suppliers.[175]

Next, providing training and technical support to suppliers is crucial. Organizing training sessions, workshops, or webinars on best practices for reducing methane emissions can help raise awareness and equip business partners.[176]

To ensure compliance with these standards, implementing audit programs are recommended. These audits, ideally conducted by independent third parties, verify suppliers' compliance with established standards.[177]

Incorporating these standards into contracts with suppliers is also an important step. Specific contractual clauses can be included to ensure compliance with methane emissions reduction standards, with termination measures in case of non-compliance. Recognizing and rewarding suppliers making significant efforts to reduce methane emissions is also an encouraging practice. Companies can offer awards, positive publicity, or even preference in contract allocation to incentivize good environmental practices.[178]

5. Innovating in waste management

Companies can develop new methods to manage waste more efficiently, for example by using organic waste to produce biogas.

A key approach is to invest in **anaerobic digestion technologies.** This biological method breaks down organic matter in the absence of oxygen, transforming waste into biogas, a renewable energy source. By adopting this technology, businesses can not only reduce methane emissions but also reduce their dependence on fossil fuels. The anaerobic digestion process works like this: organic waste is placed in a sealed container without oxygen. Special bacteria break down this waste to produce biogas. This biogas can then be used as an energy source, while the remaining waste can be used as fertilizer or compost. This helps reduce methane emissions and valorize organic waste. Anaerobic digestion reduces methane emissions in several ways. Firstly, it captures methane produced during the process before it's released into the atmosphere. Secondly, the produced biogas can replace fossil fuels, thereby reducing the demand for these high-methane-intensity energy sources.[179]

Composting programs are another effective strategy. By setting up composting initiatives, businesses can transform their organic waste into compost, a valuable soil improver. This approach promotes sustainable agriculture while reducing the methane emissions associated with the decomposition of organic waste.[180]

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[175] [81] Supply Chain Emission Reduction – A Sustainable Approach https://circulartree.com/supply-chain-emission-reduction/

[176] Ibid.

[177] Ibid.

[178] Ibid.

[179] TOP TEN THINGS BUSINESSES CAN DO NOW TO LOWER THEIR EMISSIONS https://www.britishchambers.org.uk/news/2022/02/top-ten-things-businesses-can-do-now-to-lower-their-emis sions

[180] Composting: a Sustainable Way to Manage Organic Waste **https://green.org/2024/01/30/composting-a-**

At the same time, **investment in methane capture technologies** is essential for companies producing organic waste with a high methane content. These technologies can capture and store the methane emitted by the decomposition of waste, thereby reducing atmospheric emissions and helping to combat climate change.[181]

Waste recovery partnerships also offer significant opportunities. By working with other organizations, including biogas companies, businesses can transform their organic waste into a valuable resource, such as energy. These partnerships promote a circular economy and help to reduce methane emissions throughout the value chain.

Investing in research and development. Companies can invest in the research and development of new technologies to capture and use methane. Funding research is a crucial first step. Companies can allocate resources to **support research project**s focusing on methane capture technologies. This involves investing in research into new capture methods, improving existing technologies, or evaluating the effectiveness of different capture approaches.[182]

Close collaboration with universities and research institutes is also beneficial. By partnering with these institutions, companies can take advantage of the expertise and knowledge of researchers to develop new methane capture technologies. This collaboration encourages an exchange of knowledge and speeds up technological development processes.[183]

Once a new technology has been developed, **the development of prototypes** is essential to assess its effectiveness. Companies can invest in the creation of prototypes to test the performance of the technology on a small scale. This stage allows any problems to be identified and improvements to be made before the technology is deployed on a large scale.[184]

Investing in innovative start-ups is another promising strategy. Companies can provide financial support to start-ups dedicated to developing new technologies for capturing and using methane. By investing in these start-ups, companies can gain access to innovative technological solutions and help stimulate the development of these technologies in the market.[185]

Finally, **participating in government or international grant programs** is an additional opportunity. These programs offer financial support for the research and development of technologies to reduce methane

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sustainable-way-to-manage-organic-waste/

[181] Op.Cit TOP TEN THINGS BUSINESSES CAN DO NOW TO LOWER THEIR EMISSIONS https://www.britishchambers.org.uk/news/2022/02/top-ten-things-businesses-can-do-now-to-lower-their-emis sions Fact Sheet | Biogas: Converting Waste to Energy https://www.eesi.org/papers/view/fact-sheet-biogasconverting-waste-to-energy

[182] METHANE CAPTURE AT LANDFILLS AND WASTE DUMPS FOR ENERGY PRODUCTION https://tech-action.unepccc.org/wp-content/uploads/sites/2/2021/12/tna-technology-brief-ua-waste-mitigatio n-1-methane-capture-at-landfills-and-waste-dumps.pdf

[183] Strategies to reduce emissions from fossil fuel operations https://www.iea.org/reports/global-methane-tracker-2022/strategies-to-reduce-emissions-from-fossil-fuel-op erations

[184] Innovation needs in the Sustainable Development Scenario **https://www.iea.org/reports/clean-energy-innovation/innovation-needs-in-the-sustainable-development-scenario**

[185] Discover 5 Top Solutions for Methane Emissions Reduction **https://www.startus-insights.com/innovators-guide/discover-5-top-solutions-for-methane-emissions-reduction/**

emissions.[186]

6. Create partnerships with farmers

NGOs and companies can work with farmers to implement sustainable agricultural practices that reduce methane emissions. The first step is to establish partnerships between NGOs, companies, and local farmers. These collaborations enable a mutual exchange of knowledge and resources, encouraging the implementation of sustainable farming practices.[187]

Funding training programs is another important initiative. Partners can invest in training programs for farmers, focusing on best practices in manure and livestock feed management. Such training helps farmers to understand the impact of their practices on methane emissions and to learn how to reduce them effectively.[188]

In addition, providing farmers with practical tools and resources is essential. Partners can provide best practice guides, tools for calculating methane emissions, or even manure management equipment, making it easier to implement emission reduction practices. To encourage the adoption of these practices, incentives need to be put in place. Partners can offer subsidies or low-interest loans for the purchase of equipment, or pay farmers for each tone of methane avoided. These financial incentives encourage farmers to commit to reducing methane emissions.[189]

Finally, it is crucial to monitor and evaluate the progress made. Partners can set up monitoring and evaluation systems to measure reductions in methane emissions and ensure that practices are effectively implemented. This ensures that the efforts made are effective and that strategies can be adjusted if necessary to achieve the methane 93 Strategies to reduce emissions from fossil fuel emission reduction targets set.[190]

7. Raising public awareness

NGOs can play a key role in raising public awareness of the importance of reducing methane emissions. The first step is to establish partnerships between NGOs, businesses, and local farmers. These collaborations enable a mutual exchange of knowledge and resources, thereby promoting the implementation of sustainable agricultural practices.[191]

Financing training programs is another important initiative. Partners can invest in training programs for farmers, focusing on best practices for manure management and livestock feeding. These trainings help farmers understand how their practices contribute to methane emissions and how they can effectively

[186] Strategies to reduce emissions from fossil fuel operations

https://www.iea.org/reports/global-methane-tracker-2022/strategies-to-reduce-emissions-from-fossil-fuel-op

[187] EU methane policy recommendations

https://www.edfeurope.org/sites/default/files/2022-07/EDF_methane_policy_recommendations-2022.pdf

[188] Ibid.

[189] Harnessing Partnerships for Sustainable Agriculture: Embracing the SDGs https://linchis.com.ng/harnessing-partnerships-for-sustainable-agriculture/

[190] Ibid.

[191] Harnessing Partnerships for Sustainable Agriculture: Embracing the SDGs https://linchis.com.ng/harnessing-partnerships-for-sustainable-agriculture/

reduce them.[192]

Additionally, providing resources and practical tools to farmers is essential. Partners can offer best practice guides, methane emission calculation tools, or even equipment for manure management, making it easier for farmers to implement emission reduction practices.[193]

To encourage the adoption of these practices, the establishment of incentives is necessary. Partners can offer grants or low-interest loans for the purchase of equipment, or they can compensate farmers for each ton of methane they avoid emitting. These financial incentives motivate farmers to engage in methane emission reduction efforts.[194]

Finally, tracking and evaluating progress is crucial. Partners can implement monitoring and evaluation systems to measure methane emission reductions and ensure that practices are being properly implemented. This ensures the effectiveness of the efforts and allows for adjustments in strategies as needed to achieve the set goals for methane emission reduction.

However, fundamentally, it is crucial that international organizations and governments allocate more funding to non-profit organizations to enhance their public awareness efforts. Currently, NGOs face significant financial challenges that limit their ability to operate effectively. A number of environmental NGOs in Europe even may have to close as a result of planned budget reductions. The yearly LIFE program financing of €15.6 million is in jeopardy, potentially lowering operational subsidies for 30 NGOs by as much as 70%. This circumstance emphasizes how vital it is to have steady and more financing in order to maintain environmental activism and public awareness efforts[195]. Increased financial support would enable NGOs to launch broader and more impactful awareness campaigns, reaching a larger and more diverse audience [196].

Corporates, in collaboration with governments and international organizations, should also increase their financial support to NGOs. For example, an agri-food company could sponsor a training program on livestock waste management. Such programs could include practical demonstrations, online training sessions, and the distribution of educational materials. For example, Danone is in a collaboration with Environmental Defence Fund and farmers, aiming to reduce methane emissions from its fresh milk supply chain by 30% by 2030. The partnership focuses on deploying proven practices and technologies, improving herd, feed, and manure management, and advocating for supportive public policies to facilitate the transition to climate-smart agriculture[197]. By showing how a large corporation can lower dairy methane emissions and advance climate-smart agriculture, the Danone-EDF partnership increases awareness. It also educates the public and stakeholders about sustainable practices and promotes wider industry adoption through media coverage, farmer training, and the sharing of best practices.

Lastly, it is crucial to assess and monitor progress. With increased financial support, NGOs could invest in sophisticated monitoring and evaluation systems. These systems could utilize advanced technologies such as methane sensors and drones to measure emissions accurately and in real-time. The data collected

[192] Practices to Reduce Methane Emissions from Livestock Manure Management https://www.epa.gov/agstar/practices-reduce-methane-emissions-livestock-manure-management

[193] Ibid.

[194] Ibid.

[195] https://www.theguardian.com/world/2025/feb/04/rightwing-meps-threaten-huge-funding-freeze-for-environmental-ngos

[196] Ibid.

[197] https://blogs.edf.org/growingreturns/2023/01/17/danone-commits-to-cut-dairy-methane-emissions-in-partnership-with-farmers-and-edf/

would not only evaluate the effectiveness of ongoing initiatives but also allow for adjustments in strategies based on the outcomes. Ultimately, increased funding would enable NGOs to play a more central and effective role in combating methane emissions, thereby significantly contributing to the fight against climate change.

8. Adapting policies and regulations

Adapting existing policies and regulations is crucial for the European Union to effectively tackle the growing threat of methane emissions. Firstly, a comprehensive review of current regulatory frameworks is necessary to integrate specific targets and incentives aimed at methane reduction across key sectors such as agriculture, energy, and waste management. This could involve setting binding standards and introducing financial incentives like subsidies or tax exemptions to encourage the adoption of methane-reducing technologies and practices.[198]

Furthermore, enhancing coordination among EU member states is essential to ensure harmonization of methane emission reporting standards and methodologies. This harmonization would facilitate consistent and accurate data collection, enabling effective monitoring of methane emission reduction progress across Europe.

A critical step forward involves establishing mechanisms for regular review and assessment of policy effectiveness. These mechanisms should be flexible to adapt strategies based on emerging scientific evidence and technological advancements. Such proactive measures would ensure that methane reduction policies remain current and relevant in a rapidly evolving climate landscape.[199]

Simultaneously, engaging in ongoing dialogue with stakeholders—including local governments, private enterprises, and civil society—is essential. This consultative process would gather diverse perspectives and foster consensus on methane mitigation strategies. By incorporating a wide range of voices, the EU can enhance the legitimacy and acceptance of its environmental policies, facilitating their effective implementation at all levels.[200]

[198] European Union Methane Action Plan https://www.iea.org/policies/17024-european-union-methane-action-plan

[199] Climate change policies and agendas: Facing implementation challenges and guiding responses https://www.sciencedirect.com/science/article/abs/pii/S146290111931322X

[200] Ibid.