CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

a UNEP convened initiative

Guidance on Including Methane in NDCs

Delivering near-term climate, development, and economic benefits across the agriculture, energy, and waste sectors

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This Guidance draws from a broad scientific body of knowledge and extensive on-the-ground experience at the intersection of climate and air quality collected and assessed by the UNEP-convened Climate and Clean Air Coalition (CCAC), its Scientific Advisory Panel (SAP), the United Nations Environment Programme (UNEP), and other associated institutions. This knowledge base provides unequivocal evidence that integrated air quality and climate change policy, planning, and implementation lead to efficient use of resources and support countries in advancing toward their climate and sustainable development goals (SDGs).

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Authors: Nathan Borgford-Parnell (Science Affairs Lead, CCAC); Gregory Kohler (Agriculture Expert, CCAC); Donovan Storey (Waste Expert, CCAC); Ana Maria Kleymeyer (Climate Law & Policy Advisor); Scarlett Quinn-Savory (Science Affairs Consultant, CCAC), Sophie Bonnard (Methane Flagship Coordinator, CCAC).

Reviewers and contributors: Claudia Arndt (Senior Scientist, Mazingira Centre, International Livestock Research Institute); Bruno dos Santos Alves Figueiredo (Director of Sustainable Production and Irrigation, Ministry of Agriculture and Livestock, Brazil); Andrew Bisson (Senior Livestock Specialist, USAID); Harry Clark (Chief Scientist, NZAGRC); Fernanda Ferreira (Clean Air Task Force); Edward Garcia (International Livestock Research Institute); Bjoern Ole Sander (Country Representative - Thailand; Senior Scientist for Climate Change, International Rice Research Institute).

Terms and Definitions

Super Pollutants

Super pollutants are warming agents that are far more potent than carbon dioxide per ton. They include methane, tropospheric ozone, fluorinated gases (F-gases; such as HFCs), nitrous oxide, and black carbon.

Most super pollutants are greenhouse gases that trap Earth's heat in the climate (methane, tropospheric ozone, F-gases, and nitrous oxide). Some also affect the climate by increasing the amounts of other greenhouse gases through atmospheric chemistry. Black carbon (also known as soot), is not a gas but an aerosol, warming the climate by absorbing sunlight.

Many super pollutants are also relatively short-lived in the atmosphere (methane, tropospheric ozone, HFCs and BC), with lifetimes of days to decades. This is why super pollutants affect how fast the planet warms, whereas carbon dioxide affects the maximum extent of warming. Reducing emissions of *both* super pollutants and carbon dioxide is essential for establishing a safer climate during our lifetimes and for generations to come.

Non-CO2 Pollutants:

Non-CO_2 pollutants are substances other than carbon dioxide that significantly impact both climate, with many also contributing to poor air quality. These pollutants include a variety of gases and particulates such as methane (CH_4), nitrous oxide (N_2O), fluorinated gases, and black carbon, each of which contributes to global warming and deteriorate air quality.

- The non-CO_2 pollutants include all of the Short-lived Climate Pollutants (SLCPs) as well other potent GHG emissions, such as N_2O.

Non-CO2 Greenhouse Gases:

Non-CO_2 greenhouse gases (GHGs) are all GHGs other than carbon dioxide (CO_2) that contribute to the greenhouse effect by trapping heat in the atmosphere. They are crucial in discussions about climate change because they often have much higher global warming potential (GWP) than CO_2, meaning they can be more effective at warming the Earth. Non-CO_2 GHGs include:

- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs) and Sulfur Hexafluoride (SF_6)

Short-lived Climate Pollutants:

Short-lived climate pollutants (SLCPs) are a group of pollutants that remain in the atmosphere for a relatively short time (a few days to about 15 years) but have a significant warming impact during their lifespan. Many SLCPs contribute to both climate change and air pollution and reducing their emissions can lead to quick climate and health benefits. SLCPs include:

- Methane (CH_4)
- Black Carbon
- Hydrofluorocarbons (HFCs)
- Tropospheric Ozone (O_3)

METHANE (CH_4)

A potent greenhouse gas with a GWP many times greater than CO_2 that contributes to ozone formation and has a significant warming effect in the short term.

TROPOSPHERIC OZONE (O_3)

A secondary pollutant formed by the reaction of sunlight with air pollutants like volatile organic compounds (VOCs) and nitrogen oxides (NOx).

BLACK CARBON (BC)

A component of particulate matter from combustion processes, contributing to warming by absorbing sunlight and melting ice and snow.

NITROUS OXIDE (N_2O)

A GHG used in industry and agriculturea that depletes the stratospheric ozone layer and has a GWP approximately 298 times that of CO_2 over a 100-year period.

HYDROFLUOROCARBON (HFC)

Human-made gases used in cooling applications, with very high GWP but relatively short atmospheric lifetimes compared to CO_2.

PERFLUOROCARBON (PFC) SULFUR HEXAFLUORIDE (SF6)

Industrial gases with extremely high GWPs and an atmospheric lifetime of several thousand years.

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01 The Basis for Including Methane in NDC 3.0

A. Why Mitigate Methane

Methane is a highly potent, short-lived climate pollutant (SLCP) that is the second largest contributor to warming after carbon dioxide (CO2). Methane accounts for a third of global warming since the Industrial Revolution and has a warming effect nearly 80 times that of CO2, over a 20-year period.

Globally, the three main sectors for methane emissions are **agriculture, energy and waste,** although each country will have different emissions and mitigation potentials in these three sectors.

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As a global strategy, ensuring that all countries include ambitious methane mitigation measures in the NDC 3.0 is the main available opportunity to slow global warming in the next few critical decades and keep the long-term 1.5°C temperature goal.

If additional action is not taken during the NDC 3.0 period, global anthropogenic methane emissions could rise by up to 13% between 2020 and 2030 and are expected to increase by 24–30% by 2050.

The IPCC 6th Assessment Report states that:

> ***"Deep GHG emissions reductions by 2030 and 2040, particularly reductions of methane emissions, lower peak warming, reduce the likelihood of overshooting warming limits and lead to less reliance on net negative CO_2 emissions that reverse warming in the latter half of the century… (high confidence)."***
>
> - IPCC AR6, WGIII, C.2

In addition to climate benefits, methane mitigation can deliver significant benefits for human and ecosystem health, food security and the global economy. This is because methane is a primary precursor gas for tropospheric (ground-level) ozone, a powerful greenhouse gas as well as an air pollutant. Globally, the increase of methane emissions since preindustrial times is responsible for half of the increase of tropospheric ozone concentrations. Tropospheric ozone is estimated to cause approximately one million premature deaths globally every year. Tropospheric ozone also harms ecosystems and crops by damaging plants and suppressing growth and is responsible for the loss of 5-7% of staple crops annually (GMA 2021).

According to the 2021 CCAC-UNEP Global Methane Assessment, full implementation of key available targeted methane measures, together with additional measures that contribute to priority development goals, by 2030 could annually prevent 255 000 premature deaths, 775 000 asthma related hospital visits, 73 billion hours of lost labour from extreme heat, and 26 million tonnes of crop losses globally. (CCAC GMA, 2021)

Moreover, many methane-cutting interventions deliver major development benefits: capturing wasted gas boosts energy security; increasing livestock productivity and cutting food waste boosts food security and accelerates economic growth; and improved waste management delivers health and air quality benefits.

Reaping these multiple benefits from rapid methane mitigation can be done through fast implementation of readily available and proven mitigation measures. These include measures in the three main methane emitting sectors, energy, waste and agriculture. Many of these can be done at low-cost or are even economically beneficial, especially where their implementation creates new revenue streams from the use of methane collected, e.g. to generate electricity.

A compelling reason to include specific, ambitious, and targeted methane mitigation measures in an NDC is to attract financial, technical, and capacity resources from both climate and health financing sources. To be eligible for funding or to present a project proposal, many financing institutions and funding partners, including the Global Climate Fund, Global Environment Fund, bilateral donors, and philanthropic foundations, either require or strongly encourage countries to have clear pledges in their NDC that align with the project proposal or funding request.

For these reasons, establishing clear and targeted methane mitigation measures in the NDCs is one of the most important and powerful tools that countries have for increasing their mitigation ambition while simultaneously delivering tangible domestic public health and economic co-benefits.

The 2021 CCAC-UNEP Global Methane Assessment found that least-cost scenarios for limiting warming to 1.5°C require methane emissions reductions of about 60% from fossil fuels, 30-35% from waste, and 20-25% from agriculture by 2030, relative to 2020 emissions.

- Readily available targeted, behavioural measures could reduce emissions from these major sectors by approximately 180 Mt/yr, or as much as 36% below 2020 levels, by 2030.
- Roughly 60%, (around 75 Mt/yr) of available measures are low cost, and just over 50% of those have negative costs.

B. The UNFCCC Mandate for Methane Mitigation

Methane is a greenhouse gas covered by the United Nations Framework Convention on Climate Change (UNFCCC) (Article 1.5) and the Paris Agreement (Decision 18/CMA.1, para. 48). At COP28 (2023), during the 1st Global Stocktake to assess collective progress towards achieving the purpose of the Agreement and its long-term goals, Parties recognized:

> "the need for deep, rapid and sustained reductions in greenhouse gas emissions in line with 1.5°C pathways and calls on Parties to contribute to the following global efforts…. [including, specifically] accelerating and substantially reducing non-carbon-dioxide emissions globally, including in particular methane emissions by 2030." (Decision 1/CMA.5, para 28(f))

To "operationalize" - or set the Paris agreement in motion towards its implementation – Parties designed the Katowice Climate Package. The Package includes key information about mitigation and other climate goals and activities that governments will provide in their NDCs.

As detailed in the Introduction Chapter of this Guidance, in accordance with the Katowice Climate Package, each economy-wide mitigation target should encompass countries' pledged methane mitigation measures, as well as those of the other greenhouse gases, and be expressed as a single quantified target.

Together, the Convention, Paris Agreement, and the Katowice Guidance, chart the path for countries to include specific goals and measures relating to the mitigation of all greenhouse gases – and therefore methane - as part and parcel of a country's economy-wide target in their NDC 3.0.

Notably, as discussed in the Introduction to this Guidance, the Paris Agreement requires countries to accompany their NDC 3.0 with reporting measures through the Biennial Transparency Reports (BTRs) in support of the Enhanced Transparency Framework (EFT). The "modalities and procedures" for the Transparency Framework guiding BTRs also specify that methane actions should be one of the well-designed reporting approaches in each sector.

Photo: Radub85/Adobe Stock

The Global Methane Pledge

Global and regional efforts to reduce methane emissions include a variety of international, regional and national initiatives and agreements targeting climate change or specific to the energy, agriculture, and waste sectors.

The Global Methane Pledge (GMP), launched at COP26 (2021) by the European Union and the United States, now includes 157 countries plus the European Union (as of July 2024). Under the pledge, participating countries agree to collectively cut global methane emissions by at least 30% from 2020 levels by 2030.

When joining the GMP, countries commit to:

- Take comprehensive domestic action to achieve the global methane reduction target;
- Move towards using the highest tier IPCC good practice inventory methodologies to quantify methane emissions and work to continuously improve the accuracy, transparency, consistency, comparability, and completeness of national greenhouse gas inventories;
- Maintain up-to-date, transparent, and publicly available information on their policies and commitments; and
- Support existing international methane emission reduction initiatives to advance technical and policy work that will serve to underpin participants' domestic actions.

The GMP core implementers, the Climate and Clean Air Coalition (CCAC) and the International Methane Emissions Observatory (IMEO), provide critical support in operationalisation of the GMP. In addition to its core implementers, the GMP is supported by a broad range of international partners such as the Global Methane Initiative, the World Bank, including through its CH4D programme and Global Gas Flaring and Methane Reduction Partnership, UNECE, WMO, IEA, FAO, etc.

For more information, please visit: https://www.globalmethanepledge.org/

C. State of Play of Methane in Current NDCs

Since 2016, there has been marked progress by countries on methane ambition, yet there is still significant room for improvement. The number of countries that include methane in the list of gases addressed by their overall mitigation target has risen from 78% in first NDCs to 95% in second NDCs. (UNFCCC 2019) However, only 20%[1] (approximately 40 countries) assess methane's mitigation potential at any level (economy wide, by sector or for specific measure(s)).

Despite the near-universal inclusion of methane in economy-wide targets, only slightly more than 60% of countries include information specifying ambition or specific actions to mitigate methane at a sectoral or project level. Among the three main sectors for methane emissions (agriculture, fossil fuels and waste), slightly more than half (51%) of current NDCs include measures which target methane from the waste sector. In the agriculture sector, 36% of countries specify measures which target methane emissions.[2] Only 19% of current NDCs specify methane mitigation actions in the fossil fuel sector.

[1] As of 31 December 2023.
[2] Targeted methane measures identified by the Global Methane Assessment (2021). Note that these measures do not need to mention the methane by name.

Methane measures in NDCs

TECHNICAL TARGETED MEASURES AVAILABLE TODAY

FOSSIL FUEL SECTOR (OIL, GAS, AND COAL)

- **Upstream and downstream leak detection and repair**
- **Recovery and utilization of vented gas:** capture of associated gas from oil wells; blowdown capture; recovery and utilization ofvented gas with vapor recovery units and well plungers; installation of flares.
- **Improved control of unintended fugitive emissions from the production of oil and natural gas:** regular inspections (and repair) of sites using instruments to detectleaks and emissions due to improper operations; replace pressurized gas pumps and controllers with electric or air systems; replace gas-powered pneumatic devices and gasoline or diesel engines with electric motors; early replacement of devices with lower-release versions; replace compressor seals or rods; cap unused wells.
- **Coal mine methane management:** pre-mining degasification and recovery and oxidation of ventilation air methane; flooding abandoned coal

19%
of countries

60%
of emissions
(EDGAR, 2023)

WASTE SECTOR

- **Solid waste management:** (residential) source separation with recycling/reuse; no landfill of organic waste; treatment with energy recovery or collection and flaring of landfill gas; (industrial) recycling or treatment with energy recovery; no landfill of organic waste.
- **•Wastewater treatment:** (residential) upgrade to secondary/tertiary anaerobic treatment with biogas recovery and utilization; wastewater treatment plants instead of latrines and disposal; (industrial) upgrade to two-stage treatment, i.e., anaerobic treatment with biogas recovery followed by aerobic treatment.

51%

AGRICULTURE

- **Improve animal health and husbandry:** reduce enteric fermentation in cattle, sheep and other ruminants through feed changes and supplements; selective breeding to improve productivity and animal health/fertility
- **Livestock manure management:** treatment in biogas digesters; decreased manure storage time; improve manure storage covering; improve housing systems and bedding; manure acidification.
- **Rice paddies:** improved water management or alternate flooding/drainage wetland rice; direct wet seeding; phosphogypsum and sulphate addition to inhibit methanogenesis; composting rice straw; use of alternative hybrids species.
- **Agricultural crop residues:** prevent burning of agricultural crop residues.

36%

02 Best Practice Guidance for Addressing Methane in the NDC 3.0

Best practice for addressing methane in an NDC, based on the mandate of the Paris Agreement as well as actual country experience, ensures that methane-related goals and measures are ambitious, actionable, and transparent. An ambitious NDC will include clear, quantified, mitigation goals and measures for all relevant methane emitting sectors and sub-sectors.

An actionable NDC will communicate costs, benefits and means of implementation for mitigation goals and measures. And a transparent NDC will be accompanied by reporting and information that validates those goals and measures to ensure collective progress towards achieving the goals of the Paris Agreement.

NDC Spotlight: Côte d'Ivoire.

Includes methane reduction in overall GHG reduction target.

Describes mitigation measures to reduce methane emissions in the Agriculture, Waste and Fossil Fuel sectors *and*

Reports expected methane reductions alongside measures:

> *E.g. Reduce fugitive methane emissions from oil and gas by 50% by 2030**

Includes specific methane reduction goal:

> *The revised NDCs should make it possible, compared to the reference scenario, to reduce methane (CH_4) emissions by 30% in 2030.**

*Translated from French

Côte d'Ivoire's update NDC also:

- **Includes measures and targets for black carbon and methane.**
- **Estimates the health co-benefit as result of the implementation of mitigation measures.**
- **Links to other plans and policies including their National SLCP plan and commitment under the Kigali Amendment to the Montreal Protocol.**

In following the Katowice Guidance, countries should include information necessary for clarity, transparency and understanding (ICTU) in their NDC. Therefore, in the context of methane mitigation measures that contribute to achieving an economy-wide target, an ambitious NDC would include ambitious goals and delineate specific initiatives and activities in support of all three of the above categories.

By including specific information detailing the level of mitigation ambition at a sector level or specific methane mitigation projects, countries can increase transparency and clarity on how their overall economy-wide GHG reduction target will be achieved. Doing so also helps to account for the different effects that methane has on climate compared to long-lived GHGs, as well as for the air quality co-benefits of methane mitigation. Clear and transparent inclusion of methane mitigation ambition in NDCs will also support the tracking of progress under the Global Methane Pledge (GMP).

Improved data collection and reporting is critical for the NDC 3.0. Incorporating input from relevant line ministries can ensure use of uniform protocols and consistent metrics for tracking methane emissions based on the 2019 IPCC Guidelines.

A standardised process for biennial transparency reports (BTRs) streamlines data submission and review. For example, in the agriculture sector, centralised databases of farm-level data can improve data management on livestock numbers, livestock feed rations, manure management practices, and rice production practices.

Engagement with stakeholders from relevant government agencies at national and local level, civil society, and academia is important to ensuring a comprehensive framework that categorises mitigation measures for each sector in detail and ensures data accessibility through public platforms. Inclusion of relevant stakeholders can also help identify data gaps and develop plans to enhance data collection.

The following sections are divided into the three main methane emitting sectors and offer good practice examples and templates by sector including a wide variety of options for specific methane approaches and elements that countries may consider including in their NDC. The sector-specific guidance tables include additional elements beyond those outlined in the Katowice Package that optimize the co-benefits of an integrated air quality approach, where applicable, and strengthen implementation.

Photo: CCAC

A. Energy (Fossil Fuels) Sector Guidance

The Energy sector activities that generate methane emissions include oil and gas extraction, refining, processing and distribution as well as coal mining. Together, these activities contribute an estimated 35% of anthropogenic methane emissions (25% from oil and gas and 12% from coal).

While the specific mitigation options, potentials, economic and development co-benefits will vary by country, addressing methane emissions from all relevant sources in the fossil fuel sector can deliver meaningful and significant near-term mitigation, at low cost.

To be consistent with IPCC 1.5°C scenarios, methane emissions from the sector should be reduced by approximately 60% below 2020 levels by 2030 and nearly 80% by 2050. (CCAC 2023)

According to the International Energy Agency, cutting methane emissions from fossil fuels by 75% by 2030 is feasible with existing technology and is one of the most "pragmatic and lowest cost options" to reduce GHG to limit warming to 1.5°C. (IEA Global Methane Tracker 2024). Analysis conducted for the 2021 Global Methane Assessment finds even higher mitigation potential for the fossil fuel sector within this decade, with 80% of oil and gas methane abatement measures and up to 98% of coal measures implementable at a negative or low cost.

The following tables includes draft text, good practice examples, resources and tools to help countries consider options and opportunities to include sectoral and sub-sectoral methane mitigation ambition in the NDC 3.0.

1. Minimise venting, flaring and fugitive emissions from oil and gas sector

The Oil and Gas Methane Partnership identified 9 core methane emission sources in the oil and gas sector for which they also describe the options available for mitigation. These sources are:

- **Natural Gas-Driven Pneumatic Controllers and Pumps:** 'Low bleed' pneumatic controller installed (bleeds), natural gas emissions are routed to productive use, pneumatic controllers and pumps are powered by compressed air instead of natural gas.
- **Fugitive Component and Equipment Leaks:** Inspection programme to identify leaking components, components found to be leaking repaired within 12 months.
- **Centrifugal Compressors with 'Wet' (Oil) Seals:** Seal oil is degassed and the gas is recovered and routed to productive use, wet oil seal is replaced by a mechanical dry seal.

- **Reciprocating Compressors Rod Seal/Packing Vents:** 'Distance piece' or packing case vents are replaced at least every 26,000 hours or 3 years, annual emission measurement around rod seal, leak indicating device fitted to distance piece or packing case, vents are routed to recovery units and not to the atmosphere.

- **Glycol Dehydrators:** Dehydrator has a flash tank separator to direct gas to productive use, dehydrator has all vents routed to a flare, dehydrator uses no stripping gas

- **Unstabilised Hydrocarbon Liquid Storage Tanks:** Tank vapours are recovered by routing to a Vapour Recovery unit, Stabilisation Towers installed ahead of tanks, tank vapours routed to a flare/combustion unit.

- **Well Venting/Flaring During Well Completion for Hydraulically Fractured Gas:** During completion of hydraulically fractured gas well, reduced emission completing is implemented and flowback gas is routed to sales

- **Casinghead Gas Venting:** Route for sale or on-site use or to a flare by recovering casinghead gas with wellhead compressor/vapour recovery unit

POLICIES FOR IMPLEMENTATION

- Regulations in the oil and gas sector to ensure best practise techniques in each of the 9 major leakage areas are in place
- Regular leak detection and repair programme using approved technologies
- Effective reporting and monitoring of compliance with regulations requiring reduced emission practices are implemented.
- For countries with national oil companies: Ensuring sufficient budget for implementation of methane emissions reduction interventions

AIR QUALITY AND DEVELOPMENT BENEFITS

Reducing methane emissions would reduce levels of ground-level ozone air pollution, which affects respiratory health and reduces yields of key agricultural crops (rice, wheat, maize and soy).

SDG Goals that this measure can contribute to achieving (Source: Haines et al., 2017):

Goal 7.3: Double the global rate of improvement in energy efficiency
Goal 8.4: Improve progressively global resource efficiency in consumption and production and
endeavour to decouple economic growth from environmental degradation
Goal 9.2: Promote inclusive and sustainable industrialization
Goal 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency
Goal 12.4: Achieve environmentally sound management of chemicals and wastes throughout their life cycle

RESOURCES FOR FURTHER INFORMATION

The Oil and Gas Methane Partnership has produced 9 technical guidance documents for each of the major methane emission sources in the oil and gas sector described above. These Technical Guidance Documents provide information on the mitigation options available, methods for quantifying emissions from the oil and gas sector and the economic costs of the proposed mitigation options. The Technical Guidance Documents can be accessed here: http://ccacoalition.org/en/content/oil-and-gas-methane-partnership-technical-guidance-documents

Global Methane Initiative ON TIME tool summarises the control technologies available across the oil and gas production, transmission and distribution systems: https://www.globalmethane.org/m2mtool/index.html

2. Minimise methane emissions from coal mining through pre-mine degasification and recovery and oxidation of methane from ventilation air

Methane is released in coal mines when coal seams are disturbed. When methane makes up 5-15% in air it is an explosive risk, as well as being a potent GHG. Capturing the methane before it enters the atmosphere means that it can be used for economic and productive purposes such as power generation, while also reducing risk of explosions and accidents.

The mitigation measures that can reduce methane emissions from coal mines are:

- Installing methane drainage systems to capture gas before it enters the mine airways and utilising the captured gas for a productive purpose (e.g. electricity generation)
- Installing thermal oxidation technologies to capture methane in ventilation air at more dilute concentrations than at the mine seam.

POLICIES FOR IMPLEMENTATION

- Put in place robust safety regulations for methane ventilation and recovery systems in mines
- Develop robust enforcement mechanism to ensure safety regulations are adhered to
- Put in place underground methane release prediction systems to minimise frequency of unexpected emission events
- Develop regulations and incentives for mine operators to install thermal oxidation technology to capture methane in ventilation air
- Develop financial incentives and markets to encourage cost-effective capture and utilisation of coal mine methane

AIR QUALITY AND DEVELOPMENT BENEFITS

Reducing methane emissions would reduce levels of ground-level ozone air pollution, which affects respiratory health and reduces yields of key agricultural crops (rice, wheat, maize and soy).

In addition, the measures to capture and utilise coal mine methane would also reduce the risk of explosions and accident in the mines, and can produce economic benefits from the utilisation of the methane for productive purposes (e.g. electricity generation).

SDG Goals that this measure can contribute to achieving (Source: Haines et al., 2017):

Goal 7.1: Ensure universal access to affordable, reliable and modern energy services
Goal 8.4: Improve progressively global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation
Goal 8.8: Promote safe and secure working environments
Goal 9.2: Promote inclusive and sustainable industrialization
Goal 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency
Goal 12.4: Achieve environmentally sound management of chemicals and wastes throughout their life cycle

RESOURCES FOR FURTHER INFORMATION

UN Economic Commission for Europe Report: Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines:
http://www.unece.org/fileadmin/DAM/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf

United States Environmental Protection Agency Report: Status of CMM Ownership and Policy Incentives in Key Countries: Considerations for Decision Makers:
https://globalmethane.org/documents/CMM-ownership-policy_march-2019.pdf

Global Methane Initiative Coal Mine Resources:
https://globalmethane.org/sectors/index.aspx?s=coal

Indicative examples of Energy Sector Methane emissions reductions in previous NDCs include:

Country	Goal	**Details**
1. South Sudan	Sectoral – energy intensity	South Sudan pledges to maintain its current level of energy intensity by reducing emissions from flaring and venting of gas by developing measures to either capture of reduce the amount of gas flared.
2. Cote d'Ivoire	Sectoral – percentage reduction	Cote d'Ivoire includes a quantified and time-bound pledge to reduce fugitive emissions from the oil and gas sector by 50% by 2030.
3. Angola	Sectoral – unit reduction	Angola includes conditional and unconditional pledges to reduce gas flaring by million standard cubic feet per day (MSCF/day), including cost estimates for both the conditional and unconditional targets.
4. Turkmenistan	Specific actions	Turkmenistan articulates a set of actions to monitor and reduce emissions in the energy sector including: • Use of automatic systems for detecting emissions leaks; • Reduction of leaks and gaps in the main oil and gas pipelines; • Reduction of leaks in low and medium pressure gas distribution networks; • Timely repair and replacement of equipment for infield and main oil and gas pipelines; • Modernization of flare facilities, introduction of new equipment and technologies for utilization of associated gases in oil fields, including for own needs of enterprises
5. Oman	Sectoral	Oman identifies reducing methane and fugitive emissions as part of its upstream oil and gas carbon reduction plan.

TRANSPARENCY AND REPORTING

Reporting on methane mitigation from fossil fuels for BTRs will benefit from coordination among government branches (energy, climate change, and finance ministries and departments), as well as with industry and other private sector partners. Research institutions, non-state actors, and labor unions or groups are also important stakeholders to involve in discussions, information gathering, and analysis.

Indicators for tracking progress on goals and measures included in the NDC in the oil, gas, and coal emissions are also useful for BTR reporting. Defining targets in terms of total methane emissions, methane yield, and methane intensity can help measure progress and define priorities going forward.

Processes and evaluation to support a just transition in this sector have been identified as useful for the success of mitigation goals and measures. Stakeholder participation plays an important role in supporting the discussions and practical pathways to successful mitigation, identifying and addressing obstacles and challenges early.

B. Agriculture Sector Guidance

Key sources of methane emissions in the Agriculture Sector include enteric fermentation and manure management from livestock (about 120 Mt/yr, 32% of anthropogenic methane emissions) and rice cultivation (about 30 Mt/yr, 8% of anthropogenic methane emissions). Agriculture both contributes to climate change and is highly vulnerable to its effects. Without serious reduction efforts, methane emissions from the agriculture sector are expected to increase by as much as 16% over 2020 levels by 2030. This is almost entirely due to increases in livestock emissions (CCAC 2021).

To be consistent with IPCC 1.5°C scenarios, methane emissions from the agriculture sector should be reduced by approximately 20-25% below 2020 levels by 2030. According to the 2021 Global Methane Assessment existing targeted measures in the sector could reduce methane emissions by around 30 Mt/yr by 2030. Methane emissions from rice cultivation could be reduced by 6–9 Mt/yr. The targeted mitigation potentials from livestock are less consistent, ranging from 4–42 Mt/yr. Average cost estimates vary across the available analyses. Some measures related to productivity improvements would increase farm profitability (CCAC 2021).

In addition to targeted technical measures, behavioural change measures at the farmer and consumer level are particularly important for reducing the sector's methane emissions. Together, three behavioural changes could reduce methane emissions by 65–80 Mt/yr over the next few decades: 1) reducing food waste and loss (addressed in the Waste Sector Guidance below), 2) improving livestock management practices, and 3) the adoption of healthier, plant-rich diets in line with WHO healthy diet recommendations (CCAC 2021).

NDCs reviews should use a bottom-up approach to identify key mitigation actions. Stakeholder consultations with technical experts from ministries of agriculture, producers' associations, and farmer organisations can help map the country's production systems and methane emissions by region. These mapping exercises are critical to identifying priority actions to improve agricultural production technologies and practices. Technologies should be selected using a systems approach that considers upstream and downstream emissions of all GHGs, as well as water use, biodiversity, nutrition, rural development, and equity.

While the specific mitigation options, potentials, economic and development co-benefits will vary by country, addressing methane emissions from all relevant sources in the agriculture sector has the potential to deliver meaningful and significant near-term mitigation strategies, at low cost, with simultaneous benefits for public health and agricultural production.

1. Control of methane emissions from livestock production

The mitigation measures to reduce methane emissions from livestock enteric fermentation are:

- **At animal level:** ensuring adequate animal feed availability; optimizing feed quality and availability, balancing and fine-tuning feed rations; integrating methane inhibitors, such as 3-NOP, into feed rations in no-grazing systems; promoting better animal health and welfare; and breeding for traits that lower methane emissions and improve productivity.

- **At herd/flock level:** reducing the ratio of animals dedicated to reproduction to animals dedicated to production; reducing time to slaughter; genetic selection for productivity by culling less productive livestock; switching production to non-ruminant livestock, such as poultry.

- **At production unit level:** improving pasture composition and grassland management in grazing systems to increase feed quality and productivity; incorporating forages with known anti-methanogenic properties into grazing systems; improving the quality, treatment, storage and usage of crop residues as fodder.

The mitigation measures to reduce methane emissions from manure and animal residuals requires that manure management practises are integrated into livestock systems. The mitigation measures that could be integrated include:

- **Housing:** implement management and housing systems that ensure manure from animal housing is removed in a minimum time after excretion. Implement practices for rapid removal and management of dead animal carcasses during the production process.

- **Manure Treatment:** anaerobic digesters (while ensuring proper digestate management and digester maintenance to prevent leaks), solids separation, aeration, and acidification.

- **Manure Storage:** decreasing storage time, storage cover with straw, natural or induced crust, aeration during liquid manure storage, composting, litter stacking, and storage temperature.

POLICIES FOR IMPLEMENTATION

- **Research and Development:** Support research into animal breeding, animal health, methane inhibitors, and anti-methane vaccines, while taking a systems approach that looks at downstream and upstream emissions from all GHGs. Develop standardised regulatory frameworks for bringing innovations, such as methane inhibitors, to market.

- **Behaviour Change:** Repurpose existing livestock subsidies to incentivize methane-reducing production practices; support farm transitions to low-emissions production practices, which can require high upfront costs, through grants, loans, and financial guarantees.

- **Capacity Building:** Strengthen extension services, public and private, to increase farmers' knowledge of low-emissions production practices; develop training programmes and pilot farms for manure management, improved feeding practices, animal health, and genetic selection for higher productivity and lower methane emissions.

- **Regulation:** Develop guidelines for management practices that will decrease enteric fermentation emissions (including emissions intensity of animal products) and emissions from manure management systems; strengthen livestock permitting processes with a focus on manure management.

- **Data collection:** Define targets in terms of total methane emissions, methane yield, and methane intensity. Develop system-specific monitoring frameworks for each of the selected mitigation measures.

AIR QUALITY AND DEVELOPMENT BENEFITS

Reducing methane emissions would reduce levels of ground-level ozone air pollution, which affects respiratory health and reduces yields of key agricultural crops (rice, wheat, maize and soy).

SDG Goals that this measure can contribute to achieving (Haines et al. 2017):

Goal 2.4: Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity
Goal 7.1: Ensure universal access to affordable, reliable and modern energy services
Goal 8.4: Improve progressively global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation
Goal 9.2: Promote inclusive and sustainable industrialization
Goal 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency
Goal 12.4: Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle

RESOURCES FOR FURTHER INFORMATION

FAO Mitigation of Greenhouse Gas Emissions in Livestock Production Report:
http://www.fao.org/3/i3288e/i3288e.pdf

CCAC Global Assessment of Manure Management Policies and Practices:
http://edepot.wur.nl/335445

Climate and Clean Air Coalition Agriculture Initiative:
http://www.ccacoalition.org/en/initiatives/agriculture

FAO Livestock and the Environment site: http://www.fao.org/livestock-environment/en/

2. Control of methane emissions from rice paddy fields

When rice is cultivated in rice paddy fields that are continuously flooded, the anaerobic conditions produce substantial emissions of methane to the atmosphere. It is important to consider that many intermittent aeration practices (including alternate wetting and drying) can increase nitrous oxide emissions. Implementation of all measures should incorporate technical expert consultations to analyse impacts on downstream and upstream GHG emissions, such as nitrous oxide. Practices to reduce methane emissions from rice production include:

- Improved cropping practices: Alternate wetting and drying (AWD) of rice paddy fields, other intermittent aeration practices, direct dry seeding of rice.
- Additives/inputs: Increased application of sulphate-based fertilizers, biochar application, biological soil amendments.
- Residue management: Off-field use of rice straw, mulching, composting, use of microbes to accelerate straw decomposition, early incorporation of straw.
- System-level interventions: Intercropping paddy rice with azolla and converting rice paddies to higher value crops.
- Varieties: Use of short-duration varieties, breeding for low-emitting varieties, use of higher-yielding varieties to reduce rice growing area.

POLICIES FOR IMPLEMENTATION

- **Research and Development:** Undertake assessment of areas where intermittent aeration, such as AWD, and direct seeding rice are appropriate management practises within a country and where alternative crops would provide more value to farmers. Support research into alternative uses of rice straw, methane inhibitors, and breeding rice varieties that emit less methane.
- **Behaviour Change:** Develop approaches to promote AWD conversion, intercropping of rice with azolla, and direct seeding rice and demonstrate benefits of approach to farmers compared to traditional farming practises.
  - Develop water pricing frameworks that incentivize water conservation on farms and repurpose existing water subsidies to incentivize methane-reducing production practices.
  -
- **Capacity Building:** Develop training programme for farmers on applying different methods of intermittent aeration, intercropping rice with azolla, biochar production, switching from rice to alternative crops, and/or direct dry seeding rice.

- **Infrastructure Investment:** Develop the canalisation and water pumping infrastructure needed to apply intermittent aeration. Support farmer adoption of mechanised implements to collect, bail, and dry rice residues (straw and husks).

- **Data collection:** Develop system-specific monitoring frameworks for each of the selected mitigation measures.

AIR QUALITY AND DEVELOPMENT BENEFITS

Implementing the AWD practise has multiple benefits beyond the reduction in methane emissions. It reduces water use in rice cultivation (water saving potential of 15-40%), reduces the impact of droughts, reduces pumping costs, and reduces breeding grounds for mosquitos.

SDG Goals that these measures can contribute to achieving (Haines et al., 2017):

Goal 2.3: Double the agricultural productivity and incomes of small-scale food producers
Goal 2.4: Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity
Goal 12.4: Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle

RESOURCES FOR FURTHER INFORMATION

Climate and Clean Air Coalition Paddy Rice resource page:
http://www.ccacoalition.org/en/activity/paddy-rice-production

International Rice Research Institute: http://ghgmitigation.irri.org/technologies/awd

https://ccafs.cgiar.org/blog/10-best-bet-innovations-agriculture-national-adaptation-plans

Photo: Ducvien/Adobe Stock

Indicative examples of Agriculture Sector Methane emissions reductions in previous NDCs include:

Country	Type of Target	Details
1. Burundi	Sectoral – Conditional - percentage reduction of methane	Burundi established a conditional methane reduction pledge to reduce methane emissions from enteric fermentation by 3% below 2015 levels by 2030. The pledge also estimates a mass unit reduction in 2030 of 22.6 Gg of methane.
2. Bangladesh	Sectoral – Conditional and Unconditional – number of animals	Bangladesh pledged to reduce methane emissions from enteric fermentation by replacing low-productive animals with high producing crossbred cattle and feed improvements. Unconditional and conditional pledges are based on the number of head of large and small ruminants effected.
3. Guatemala	Sectoral – quantified CO2-eq target	Guatemala pledged to reduce 0.6370 million tonnes of CO_2-eq through specific categories of mitigation activities in the agriculture sector with success indicators for each. For example – the adoption of intensive rotational grazing practices and improvement of pastures, at least 40 000 ha.

TRANSPARENCY AND REPORTING

Reporting on agriculture for the BTR will benefit from coordination between the climate and agriculture branches of the government. A coordination unit involving key technical experts from the agriculture ministries at national and regional levels, agricultural research institutes, agricultural producers' organisations, farmer associations, the finance ministry, and the climate ministry is a useful institutional mechanism to support policy development, project implementation, and reporting. Reporting methodologies should take a systems approach that considers upstream and downstream emissions of all GHGs, as well as water use, biodiversity, nutrition, rural development, and equity.

Indicators for tracking progress on goals and measures included in the NDC relating to livestock and rice production are important for BTR reporting. Defining targets in terms of total methane emissions, methane yield, and methane intensity will help measure progress and define priorities going forward. Given the diversity of agricultural production systems, developing system-specific monitoring frameworks for each of the selected mitigation measures is also key to measuring progress. Coordination with technical experts will again help define the country's production systems and methane emissions by region.

Stakeholder engagement for information gathering and assessment is critical when providing information for the BTRs. A vision and strategy for engagement that signals/requests stakeholder involvement early on will help BTR preparation teams.

C. Waste Sector Guidance

The Waste Sector includes municipal and industrial solid waste as well as wastewater. Together these activities contribute approximately 20% of global anthropogenic emissions. The waste sector is the fastest growing source of anthropogenic emissions today, and therefore represents a critical reporting sector for NDCs. The volume of waste will present a significant challenge for many countries in future and source of methane emissions. Municipal solid waste generation is predicted to grow from 2.1 billion tonnes in 2023 to 3.8 billion tonnes by 2025, almost half of which is 'uncontrolled' waste (Global Waste Management Outlook 2024). To be consistent with IPCC 1.5°C scenarios, global methane emissions from the waste sector should be reduced by approximately 30-35% below 2020 levels by 2030. According to the 2021 Global Methane Assessment existing targeted measures in the sector could reduce methane emissions by up to 36 Mt/yr by 2030. While costs and mitigation potentials will vary, globally as much as 60% of waste-sector targeted measures have either negative or low cost.

Landfills alone constituting 11% of global menthane emissions, managing organic waste in particular is an urgent need. The solid waste sector also represents a significant source of black carbon, with an estimated 40% of waste openly burned. Better waste management could mitigate between 15-25% of global greenhouse gas emissions. Organic and food waste continues to represent a dominant source of overall solid waste, especially in developing and emerging economies, and drives methane emissions overall. Source separation remains an important goal in managing waste, in order to extract value to support circular economies and mitigate emissions and pollution. If well managed, organic waste can be an essential resource for compost, biogas and business development such as Black Soldier Fly (BSF) technologies. Given the essential role of the informal sector and small businesses in waste streams, the sector also presents significant opportunities for job creation and just transitions for many countries.

Minimise methane emissions from solid waste at landfills sites and divert organic waste from landfills

Methane is produced in landfill sites through the decomposition of waste under anaerobic conditions. The options available to reduce methane emitted to the atmosphere from landfill sites include:

- Avoid waste being sent to landfill sites through reduction in consumption and waste, especially in support of policies and initiatives to reduce food loss and waste.
- Efforts to valorize and divert waste from landfills, such as through increased recycling and composting, vermiculture and black soldier fly technologies, diversion of organic waste for anaerobic digestion and recovery of methane produced.
- Adopt measures to capture, reduce and use methane from landfills, such as through landfill gas capture and biocovers.

POLICIES FOR IMPLEMENTATION

- Include waste sector measures and quantify emissions reduction potential, including through avoidance and methane recovery.
- Set minimum targets and ambitious goals for waste diversion and recycling and implement robust monitoring systems to measure against targets.
- Avoid waste being sent to landfill sites through reduction in consumption, increased recycling and composting, and diversion of organic waste for treatment and use (such as anaerobic digestion, black soldier fly technologies, composting etc).
- Develop policies and measures to prevent and reduce food loss and waste. These can include establishing policies that facilitates safe food recovery and redistribution, encourage the use of suitable food scraps for animal feed and promote the treatment of organics for the generation of renewable biogas and compost. These policies should be accompanied by policies to reduce or eliminate subsidies on chemical fertilizers and fossil fuel energy generation, as well as increase uptake of renewable energy sources.
- Set goals or policies to significantly reduce, or ban, organic waste from landfills, and invest in infrastructure (such a Material Recovery Facilities) that divert and treat waste away from high-emission pathways and unmanaged locations.
- Enable municipalities to access climate and other sources of finance to fund and invest in waste management services and systems, including both capital and operational costs, that enables long-term planning for infrastructure and operations.

AIR QUALITY AND DEVELOPMENT BENEFITS

Reducing methane emissions would reduce levels of ground-level ozone air pollution, which affects respiratory health and reduces yields of key agricultural crops (rice, wheat, maize and soy).

If measures which reduce the volume of waste generated and sent to landfill also reduce the waste openly burned, then these measures would lead to additional reduction in air pollutant emissions, and associated health impacts.

SDG Goals that this measure can contribute to achieving (Haines et al., 2017):

Goal 7.3: Double the global rate of improvement in energy efficiency
Goal 8.4: Improve progressively global resource efficiency in consumption and production and
endeavour to decouple economic growth from environmental degradation
Goal 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency
Goal 11.3: Enhance inclusive and sustainable urbanization
Goal 11.6: reduce the adverse per capita environmental impact of cities

RESOURCES FOR FURTHER INFORMATION

Climate and Clean Air Coalition Municipal Solid Waste Knowledge Platform: http://www.waste.ccacoalition.org/

World Bank/Climate and Clean Air Coalition Report on Sustainable Financing and Policy Modules for Municipal Composting: http://documents.worldbank.org/curated/en/529431489572977398/Sustainable-financing-and-policy-models-for-municipal-composting

World Bank Report 'What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050': https://openknowledge.worldbank.org/handle/10986/30317

Upgrade wastewater treatment plants with methane gas recovery

The Global Methane Initiative has outlined different mitigation options to recover methane from wastewater treatment plants and avoid the methane being emitted to the atmosphere, including:

- Installing anaerobic sludge digestion to process wastewater biosolids and produce biogas
- Installing biogas capture system at existing open-air anaerobic lagoons
- Installing centralised aerobic treatment facilities or covered lagoons
- Installing degassing devices at the effluent discharge of anaerobic municipal reactors
- Optimise existing facilities and implement effective operation and maintenance programme.
- Once systems have been implemented to capture the methane and produce biogas, it can be used for different purposes including electricity and/or heat generation on site, sold to industrial user or electric power producer.

POLICIES FOR IMPLEMENTATION

- Establish regulations for minimum technical standards at wastewater treatment plants
- Provide financial incentives to overcome capital costs of installing anaerobic digesters and other systems.
- Build local capacity and knowledge on methane mitigation methods from wastewater sector.
- Design policies to promote renewable electricity generation and provide incentives for wastewater treatment plant operators to sell electricity generated to the grid.

AIR QUALITY AND DEVELOPMENT BENEFITS

Reducing methane emissions would reduce levels of ground-level ozone air pollution, which affects respiratory health and reduces yields of key agricultural crops (rice, wheat, maize and soy). Improving waste management systems would also reduce recourse to the open burning of waste, which contributes to black carbon emissions.

SDG Goals that this measure can contribute to achieving (Haines et al., 2017):

Goal 6.3: Improve water quality by reducing pollution, halving the proportion of untreated wastewater and substantially increasing recycling and safe re-use globally
Goal 9.2: Promote inclusive and sustainable industrialization
Goal 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency
Goal 11.3: Enhance inclusive and sustainable urbanization
Goal 11.6: reduce the adverse per capita environmental impact of cities
Goal 12.4: Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle

RESOURCES FOR FURTHER INFORMATION

Global Methane Initiative Wastewater Treatment Factsheet:
https://www.globalmethane.org/documents/ww_fs_eng.pdf

Global Methane Initiative Wastewater Treatment Resources:
https://www.globalmethane.org/sectors/index.aspx?sector=ww

Indicative examples of Waste Sector Methane emissions reductions in previous NDCs include:

Country	Type of Target	Details
1. Bhutan	Specific action	Bhutan pledged to explore the feasibility of a utility-scale waste to energy plant to convert organic waste to energy and reduce landfill emissions.
2. Indonesia	Industrial Waste Sector – CO2e and methane ton reduction	Indonesia pledged to implement methane capture and utilization (biogas) actions for industrial wastewater and processing emissions from the palm oil, pulp and paper, fruits/vegetables and juices processing, and other relevant industries. The pledge establishes a million ton CO_2 -eq reduction target (26 million) and communicates the equivalent tons of methane (1.2 million). To communicate progressively strengthened ambition, Indonesia's NDC also notes the previous NDC target of 3 million ton CO_2-eq.
3. Albania	Sectoral – percent reduction	Albania pledges to increase the amount of composted waste by 85% between 2009 and 2020 and then an 3% increase per year until 2030.
4. UAE	Sectoral – percentage reduction	UAE includes quantified and timebound action for mitigation of methane in the food systems sector through its National Food Loss and Waste initiative Ne'Ma, launched in 2022, which aims to reduce food loss and waste across the entire value chain by 50% by 2030.

TRANSPARENCY AND REPORTING

Transparency is enhanced in BTRs when Parties provide information which makes understanding the methodology and assumptions made on emission calculations from waste and waste treatment clear. This includes documentation and data sources from a broad range of stakeholders including municipal and private service providers, landfill operators and even households and commercial sites. Such data includes both volume of waste and its composition, in order to assess and report GHG emissions and its sources.

Methods used should be clear, and aspire to higher-tier country-specific data over time. Treatment of waste, including whether in unmanaged or managed landfills, as well as composted and treated waste (e.g. anaerobic digestion) and that which is openly burned, should be reported engaging all stakeholders as part of quality assurance. Energy produced from waste, such as biogas, should be reported under energy.

Key questions to ask are:

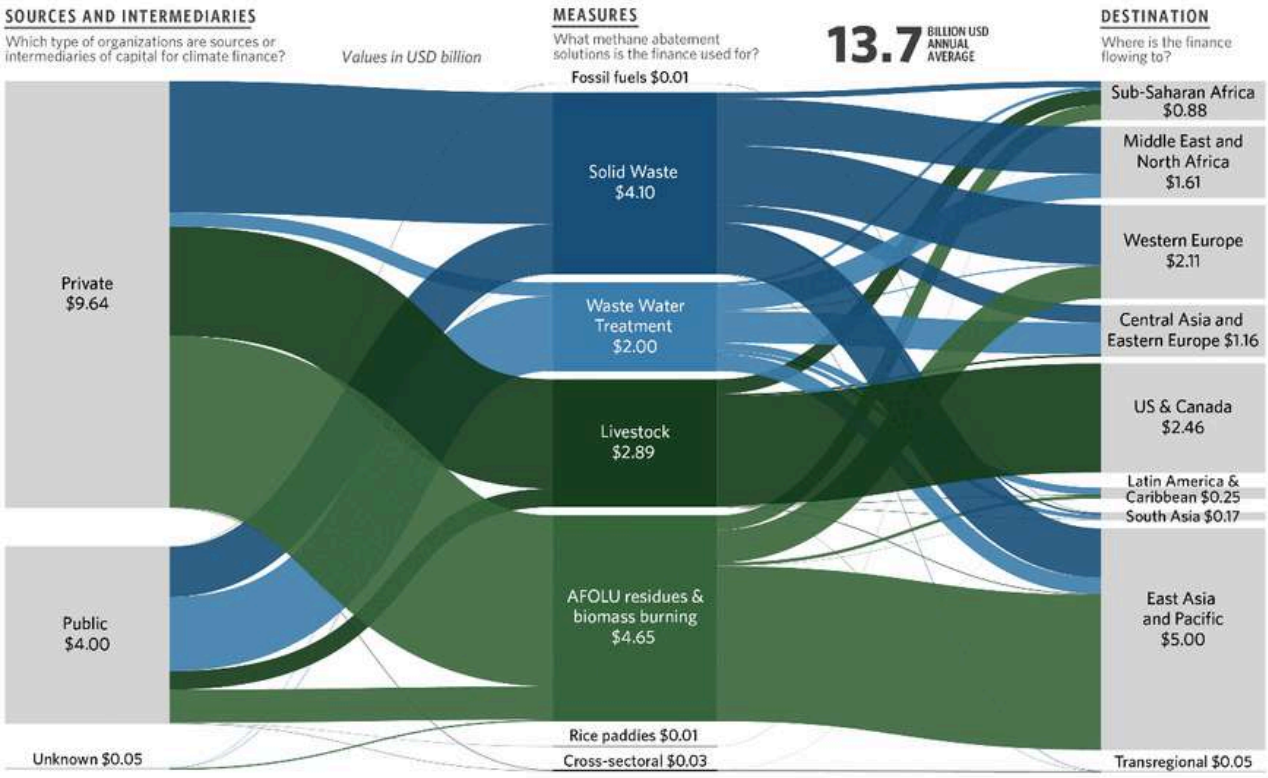
- Is all relevant information reported or accessible in documents referred to?
- Is the model used to quantify and report on waste, and waste-related emissions, clear and reasonable?
- Is the time series on amounts of waste disposed in all types of solid waste disposal sites clearly described?
- Are assumptions on waste composition clear, including parameters used?
- Does the Party recover CH4 and, if so, is this quantified?

03 Financing Considerations for Methane Mitigation

Currently (2024) at 13.7 billion, methane abatement finance is at its highest level yet, but annual flows need to be at least 3.5 times larger until 2030. Current funding levels are far below the global estimated needs of USD 48 billion annually by 2030.

According to the Climate Policy Initiative's detailed analysis of methane abatement financing, financing is not flowing proportionately to sectors with the highest abatement potential. For a detailed view of current financing flows by sector and region, see the CPI's Landscape of Methane Abatement Finance (LMAF).

As part of your NDC planning process to incorporate methane, it is useful to gather specific information on the current status of financing to your country. For information of financing flows in your country to each sector, specifying funding source and target areas, visit the Data Source of CPI's LMAF.
Equally important is to analyse opportunities for new financial sources, by developing a list of public and private partners. As the graphic below shows, the largest percentage of funding originates in the private sector where methane abatement can even provide financial benefits.



When evaluating the national sources of finance, including national budgets and private sector actors, it is equally important to take a broad perspective within each subsector, evaluating all stakeholders. The health sector is a powerful and often overlooked partner in methane mitigation. The integrated approach contained in this guidance will enable governments to coordinate across sectors to both improve efficiency and access greater resources.

In April 2021, to spur higher levels of financing towards methane, several major economies and entities, including the World Bank and the Global Methane Hub launched the Methane Finance Sprint. The goal was to mobilize $200 million by COP28 for methane abatement activities, but the outcome surpassed expectations, with over $1 billion in new grant funding committed, including support for initiatives like the World Bank GMFR and the Enteric Fermentation Accelerator. In addition, the IMF and World Bank established the Climate Advisory Group to address climate-related engagements and incorporate climate considerations into their frameworks, recognizing methane emissions' importance in stabilizing the global climate. The IMF's creation of the Resilience and Sustainability Trust (RST) aimed at providing long-term financing for low-income and vulnerable countries to tackle climate challenges, with over $42.8 billion pledged by various countries and institutions. Although the RST does not specify methane emissions, its broad framework could accommodate such efforts. Private investment is also playing a crucial role, with initiatives like Alterra aiming to raise and invest up to $250 billion by 2030 in climate solutions, including methane emissions reduction. Furthermore, financial institutions and countries are exploring mechanisms like climate-resilient debt clauses and leveraging IMF SDRs for climate and development, indicating a growing recognition of the need for financial instruments to address climate challenges comprehensively.

Photo: Vadim/Adobe Stock

04 Integrated Assessment and Reporting

Quantifying non-CO2 and air pollutant emissions alongside GHGs can help countries prepare comprehensive BTRs. Reporting teams can consider applying a common set of activity data, and consistent methodologies with well-focused default and country specific emission/removal factors to develop integrated GHG, non-CO2, and air pollutant, emission and removal analyses.

Notably, this sector-specific guidance does not replicate the description of emission inventory methodologies that are readily available from the IPCC Guidelines and EMEP/EEA Guidebook.

The table below highlights sector-specific activity data that can be used to quantify GHG and air pollutant emissions using Tier 1 methodologies.

SECTOR	GHG / non-CO2 / Air Pollutant Requirements
Energy	
1A – Stationary combustion	Fuel consumption split by sector and fuel type
1A – Mobile combustion	Fuel consumption split by transport mode and fuel type
1B – Coal mines	Raw coal production, number of coal mines
1B – Oil and gas	Oil and gas production statistics
Industrial Processes and Product Use	
2A – Industrial processes	Production statistics
2B – Product use	Product sales
Agriculture, Forestry and Other Land Use	
3 - Agriculture	• Livestock populations, typical livestock mass, use of manure management systems • Fertiliser application and nitrogen applied to soil • Application of lime • Application of urea • Crop Production
4 – Land Use, Land Use Change and Forestry	• Areas of different land types Production import and export of solid wood products • Biomass burned
Waste	
5 – Waste	• Solid waste disposed Organic waste composted Waste incinerated or open burned Organics inwastewater

05 Scientific, Financial and Technical Support

Many readily available technical assistance and support mechanisms exist to help countries identify efficient and ambitious national actions to reduce methane emissions. These support mechanisms span across policy advisory, technological innovations, capacity building, financing, and international cooperation. The following summarizes some support mechanisms currently available to help countries mitigate methane emissions.

CCAC Support

The UNEP-convened Climate and Clean Air Coalition (CCAC) has a comprehensive system to help countries deliver on methane abatement, from policy support, institutional strengthening, sector transformation, to policy-relevant research and analysis. Information is available on the Methane Technical Assistance Portal. CCAC provides:

- **Targeted expert assistance:** CCAC matches governments with external experts on specific methane mitigation requests for assistance in the Agriculture, Fossil Fuel and Waste sectors.

- **National planning support:** CCAC supports the development/enhancement of national planning frameworks such as SLCP national plans, national methane roadmaps, or NDCs, through work on emissions inventories, mitigation options and implementation pathways, and monitoring and evaluation frameworks.

- **Policy & mitigation action support:** CCAC supports policy and regulation design and implementation as well as demonstration of available solutions through targeted activities such as regulatory analysis, cost-benefit analysis, capacity building and peer-to-peer exchanges, technology demonstration, etc.

- **Communities of practice on Agriculture, Fossil Fuels, Waste, and National Planning:** the CCAC's topic-specific "Hubs" bring together countries and experts to share best practices, forge collaboration, and develop a community of practice for guidance and assistance on technological options, mitigation measures, funding opportunities, application of measurement tools, and policy development.

- **Methane Benefits Online Calculator:** The Assessment of Environmental and Societal Benefits of Methane Reductions tool displays analyses from the Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions, which provides an in-depth analysis of opportunities to reduce methane emissions from all sectors and regions as well as the associated costs and the benefits to human health, crops and the economy.

Methane Roadmap Action Programme (M-RAP)

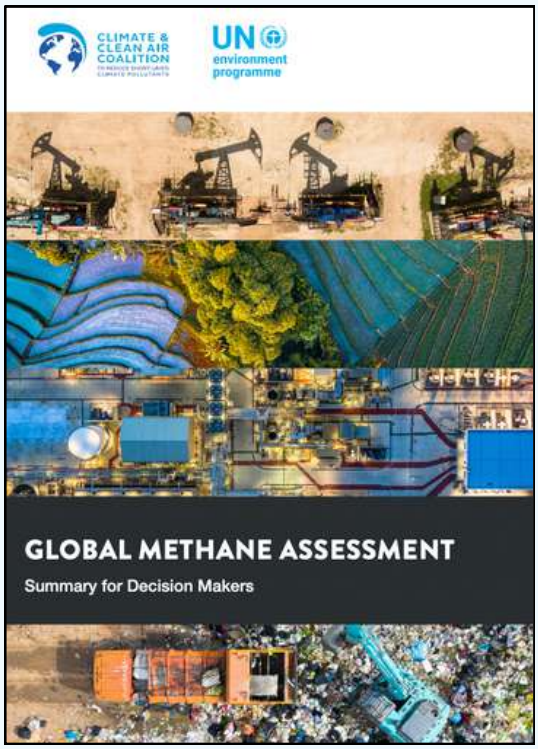
The CCAC also provides secretariat services to the Global Methane Pledge (GMP). A core component of the CCAC's support for GMP partners is the Methane Roadmap Action Programme (M-RAP). Over 75 countries have engaged in the Climate and Clean Air Coalition's Methane Roadmap Action Programme (M-RAP) which supports them to develop and implement of transparent and consistent national methane roadmaps. All GMP countries are eligible to receive funding from CCAC to develop their methane roadmap.

The MRAP programme supports countries efforts on NDC enhancement and BTR, including Resources for Filling Gaps in National Data.

CCAC is currently supporting over 30 countries to develop their roadmaps. GMP partners are eligible for various forms of assistance in developing their roadmaps including tools, expert consultations, national planning support and policy & regulatory support. To find out more about how to access this support: bit.ly/MethaneTA

GLOBAL METHANE ASSESSMENT

The CCAC-UN Environment Programme Global Methane Assessment reports that human-caused methane emissions can be reduced by up to 45% this decade and identifies measures to target emissions cost effectively and with immediate benefits to society. Get the assessment and web tool below.



Other Resources

CCAC has also compiled a comprehensive list of Methane Technical Assistance sources, which include useful information from leading institutions supporting methane research and project implementation by sector.

Other Institutions

UNEP International Methane Emissions Observatory (IMEO)

The International Methane Emissions Observatory, a UNEP initiative, provides the means to prioritize actions and monitor commitments made by GMP participants through open, reliable, and actionable emissions data.

IMEO maintains a global public dataset of empirically verified methane emissions integrated from four key streams:

- **Satellite remote sensing:** IMEO draws on the existing suite of Earth Observation satellites to detect emissions, trace them to their source, and quantify them across the globe.
- **Scientific research:** IMEO commissions methane science studies to fill knowledge gaps and help governments, industry, and other stakeholders to prioritize action to reduce emissions.
- **Company reporting:** through the Oil and Gas Methane Partnership 2.0 companies commit to transition towards empirical emissions monitoring, reporting, and verification and share their data with IMEO.
- **Government inventories:** IMEO enables countries to incorporate direct measurement data into national emissions inventories and correlates this data with additional sources.

In addition, IMEO operates the Methane Alert and Response System (MARS), which harnesses satellite remote sensing data in near real-time to notify governments and companies of major emissions events to enable swift action in support of the GMP target.

The Global Methane Hub is a philanthropic organization dedicated to reducing methane emissions globally and significantly boost philanthropic resources allocated specifically to methane reduction. Last year, the Hub donated $10 million dollars to the Climate and Clean Air Coalition (CCAC) in an effort to financially assist 30 countries with developing plans to reduce their methane emissions. These plans include technical support to estimate emissions, identify mitigation options, and design policies to meet these goals. In addition, through this initiative, the Hub supports and funds technical experts on methane to be embedded in ministries to increase capacity in the long term.

The 2023 EMEP/EEA air pollutant emission inventory Guidebook supports reporting of air emissions data under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and EU National Emission reduction Commitment Directive. It provides expert guidance on how to compile an atmospheric emissions inventory.

References

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3. IPCC (2023) Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

4.UNEP (2024) Global Waste Management Outlook 2024.

5.UNEP CCAC (2021) Global Methane Assessment.

6.UNEP CCAC (2023) Global Methane Assessment: 2030 Baseline Report.

7.UNFCCC (2020) 2019 stocktake on pre-2020 implementation and ambition.

The UNEP-convened Climate and Clean Air Coalition (CCAC) is a voluntary partnership of over 160 governments, intergovernmental organizations, and non-governmental organizations working to reduce powerful short-lived climate pollutants (SLCPs) – methane, black carbon, hydrofluorocarbons (HFCs), and tropospheric ozone – that drive both climate change and air pollution. The CCAC works to reduce global warming in the near-term to achieve Paris Agreement goals and support economic development, improved health, and environmental and food security benefits.

The CCAC has encouraged and directly supported the inclusion of SLCPs in Nationally Determined Contributions (NDCs) since 2014. Stemming from the work of the Coalition with member countries, countries have included references to SLCPs to varying degrees. As understanding and capacity increases throughout UNFCCC countries and teams developing the new rounds of NDCs, the inclusion of SLCPs has become more specific and ambitious. Likewise, CCAC has broadened the scope of its support, in line with the best available science emerging from the IPCC and beyond, as well as UNFCCC decisions, for countries to strengthen their attention to non-CO_2 emissions, including SLCPs, in their NDCs.

The current Practical Guidance publication builds upon the CCAC's 2017 guidance document "Opportunities for Increasing Ambition of Nationally Determined Contributions through Integrated Air Pollution and Climate Change Planning: A Practical Guidance Document" and is designed to support countries preparing the next iteration of their NDC due in 2025.