Before the

INTER-AMERICAN COMMISSION ON HUMAN RIGHTS

Amicus curiae submission by the Scientific Advisory Panel of the Climate & Clean Air Coalition on the role of short-lived climate pollutants particularly methane to address the climate emergency.

WRITTEN COMMENTS OF AMICUS CURIAE

SCIENTIFIC ADVISORY PANEL OF THE CLIMATE AND CLEAN AIR COALITION

October 19, 2023

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STATEMENT OF INTEREST OF AMICUS CURIAE

The members of the Scientific Advisory Panel (SAP) of the Climate and Clean Air Coalition (CCAC) have the honour to submit this amicus curiae brief for the request for an advisory opinion on the Climate Emergency and Human Rights submitted to the Inter-American Court of Human Rights (IACHR) by the Republic of Colombia and the Republic of Chile on January 9, 2023.

The Climate and Clean Air Coalition is a voluntary partnership of over 160 governments, intergovernmental organizations, and non-governmental organizations.[1] Founded in 2012, the CCAC is the only international body working to reduce powerful but short-lived climate pollutants. The Coalition supports the achievement of transformative actions, policies, and regulations that lead to substantial reductions in these pollutants.

The CCAC SAP is comprised of renowned scientists representing various fields of atmospheric and environmental science and policy. The SAP advise the Coalition on scientific matters related to SLCPs, air pollution, and near-term climate change.

OBJECTIVE OF THE AMICUS CURIAE

The objective of this submission is to contribute to the Court's better understanding of the science on short-lived climate pollutants and on the cost and benefits of their mitigation, with particular emphasis on possible remedies to slow the rate of warming in the near-term.

[1] www.ccacoalition.org

1. INTRODUCTION

Speed is crucial in the fight against climate change. The planet has already warmed more than 1 °C. According to the Intergovernmental Panel on Climate Change (IPCC), warming above 1.5-2 °C would have devastating consequences in many places across the world, with potentially significant and irreversible impacts for society, infrastructure, the cryosphere, oceans and global climate.[2] These include negative changes in agricultural production, marine and terrestrial ecosystems, increases in some forms of extreme weather events, an increased rate of sea-level rise and higher cumulative sea-levels, and an increased risk of passing thresholds for irreversible climate impacts.[3]

While there are many paths the world can take to achieve our collective temperature goals, only those paths which maintain global temperature below 1.5 °C throughout the century, or limit temperature overshoot, are consistent with maximizing broader sustainable development objectives. In 2018, the IPCC 1.5 °C Special Report concluded that reaching a sustainable mitigation pathway to 1.5 °C can only be achieved with deep and simultaneous reductions of carbon dioxide (CO_2) to near-zero and all non-CO_2 climate forcing emissions, including short-lived climate pollutants like methane, hydrofluorocarbons and black carbon.[4]

Emissions of these pollutants can be avoided using available technologies or efficient policies. Both have the potential to deliver significant additional benefits for human health, crop yields, and economies.

2. DEFINITION OF SHORT-LIVED CLIMATE POLLUTANTS AND THEIR IMPACTS

Short Lived Climate Pollutants (SLCPs) are a subset of short-lived climate forcers (SLCFs), specifically those that cause warming rather than cooling.[5] The main SLCPs are methane, ground-level ozone (O_3), hydrofluorocarbons and black carbon. SLCPs and co-emitted pollutants have important impacts on the climate system and the air quality.

SLCPs are many times more powerful than carbon dioxide per unit mass and are considered 'short-lived' because they have a much shorter residence time in the atmosphere than CO_2.[6] Combined, SLCPs are responsible for up to 45% of global warming to date (net warming due to all warming agents; approximately 30% of gross warming considering only warming climate forcers).[7]

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2 Forster, P. *et al.* (2021). The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. *et al.*(eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054. doi:10.1017/9781009157896.009.

3 Forster, *supra* note 2.

4 Intergovernmental Panel on Climate Change (2018). Global Warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte *et al.* (eds.)]. Cambridge, UK and New York, NY, USA: Cambridge University Press. doi:10.1017/9781009157940.001.

5 Szopa, S. *et al.* (2021). Short-Lived Climate Forcers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 817–922, doi:10.1017/9781009157896.008.

6 Forster, *supra* note 2.

7 Intergovernmental Panel on Climate Change (2021). Summary for Policymakers. *In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte *et al.*(eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3−32. doi: 10.1017/9781009157896.001; *see also* Szopa, S. *et al. supra* note 5.

SLCPs are naturally removed from the atmosphere in periods ranging from days to 15 years.[8] This means that reducing emissions of SLCPs can result in relatively faster near-term climate benefits than equivalent reductions in CO_2 emissions, which can take multiple decades to accrue.[9]

Many SLCPs are, or can form, air pollutants that are harmful to people, ecosystems, and agricultural productivity. Both black carbon, which is a component of fine particulate matter ($PM_{2.5}$), and ground-level ozone contribute to air pollution being the leading environmental cause of premature deaths worldwide, causing approximately 6.7 million and up to 1 million deaths annually respectively.[10] Air pollution is a leading cause of death, of all types, for women & children in many developing nations.[11] It is also important in developed nations, for example, the United States suffered an estimated 135,000 (55,000-210,000; 95% confidence interval) premature deaths; 180,000 (70,000-270,000) non-fatal heart attacks; 150,000 (60,000-120,000) hospitalizations for respiratory & cardiovascular disease; 130,000 (65,000-210,000) emergency room visits for asthma; 18,000,000 (15,000,000-20,000,000) lost workdays and 11,000,000 (4,500,000-16,000,000) missed school days annually as a result of poor air quality in 2010.[12]

SLCPs can also have adverse impacts on agriculture through temperature and rainfall extremes as well as through damage by tropospheric ozone, which is phyto-toxic to plants. Unlike CO_2 which has some positive impacts through fertilization – enhancing growth rates and in turn offsetting some of the adverse impacts from temperature extremes – tropospheric ozone has no beneficial effect for plants. A recent study showed that ozone pollution across India is adding an additional $US 3.64 to 4.19 billion to the government's annual food welfare bill.[13] It is likely that similar economic impacts are occurring in other agriculturally important regions that suffer from high ozone pollution around the World.

The contribution of SLCPs to anthropogenic climate change, alongside their impact on air quality, means that they pose a direct threat to human rights; including the right to access a standard of living adequate for health and well-being,[14] including food for nutrition, and the right to a clean, healthy and sustainable environment.[15]

2A. Methane & Tropospheric Ozone

Methane is a powerful greenhouse gas, with a warming effect over 80 times stronger than CO_2 over 20 years. According to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC), human-caused methane emissions have caused 0.51 °C of warming of the total observed 2010-2019 warming relative to 1850-1900.[16] About 60% of methane is emitted via

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[8] United Nations Environment Programme and World Meteorological Organization (UNEP-WMO) (2011). *Integrated Assessment of Black Carbon and Tropospheric Ozone*. Nairobi, Kenya.

[9] UNEP-WMO, *supra* note 6.

[10] World Health Organization (2016). *Air pollution: A global assessment of exposure and burden of disease*. Geneva: World Health Organization.

[11] Global Burden of Disease Collaborative Network (GBD) (2019). *Global Burden of Disease Study 2019 (GBD 2019) Results*. Seattle, WA, US: The Institute for Health Metrics and Evaluation. Available at: https://ghdx.healthdata.org/.

[12] Fann, N. *et al*. (2012). Estimating the national public health burden associated with exposure to ambient $PM_{2.5}$ and ozone. *Risk Analysis: An International Journal*, 32(1), pp.81-95.

[13] Pandey, D. *et al.* (2023). 'Assessing the costs of ozone pollution in India for wheat producers, consumers, and government food welfare policies'. *Proceedings of the National Academy of Sciences of the United States of America*, 120(32). doi:10.1073/pnas.2207081120.

[14] UN General Assembly (1948). Article 25. Universal declaration of human rights (217 [III] A). Paris.

[15] UN Human Rights Council (2021). The human right to a clean, healthy and sustainable environment: resolution / adopted by the Human Rights Council on 8 October 2021. 48th Session. Geneva.

[16] IPCC, *supra* note 5.

human activities such as leakage from natural gas systems and livestock production.[17] Overall, methane's impacts on climate change and public health contributes to a yearly loss of roughly 400 million hours of work globally due to extreme heat.[18]

Methane is a key precursor of tropospheric ozone, a major air pollutant and greenhouse gas. Tropospheric ozone is not directly emitted but is formed by the interaction of sunlight with methane and emissions of other ozone precursors (NO_x, NMVOCs and CO) from vehicles, fossil fuel power plants, and other industries. Globally, increased methane emissions are responsible for half of the observed rise in tropospheric ozone levels.[19] Tropospheric ozone is a key component of smog. It can worsen bronchitis and emphysema, trigger asthma, and permanently damage lung tissue. Ozone-related deaths are assessed to be 5–20% of all those associated with air pollution.[20] According to the Global Burden of Disease, in 2019 tropospheric ozone was responsible for 365,000 respiratory deaths globally.[21]

Tropospheric ozone is also a highly reactive oxidant that significantly reduces crop productivity as well as the uptake of atmospheric carbon by vegetation. Its effects on plants include impeded growth and seed production, reduced functional leaf area and accelerated ageing. Studies have shown that many species of plants are sensitive to ozone, including agricultural crops, grassland species and tree species. These effects damage important ecosystem services provided by plants, including food security, carbon sequestration, timber production, and protection against soil erosion, avalanches, and flooding. The 2021 Global Methane Assessment found that every million tonnes of methane emissions contribute to losses of 145,000 tonnes of wheat, soybeans, maize and rice through its contribution to ozone levels.[22]

2B. Black Carbon

Also known as soot, black carbon is a product of incomplete combustion of fossil fuels, biofuels and biomass. It is a component of fine particulate matter ($PM_{2.5}$) air pollution and typically emitted along with organic carbon and carbon monoxide. $PM_{2.5}$ is a one of the leading environmental causes of ill health and premature death. In 2019, long-term exposure to $PM_{2.5}$ contributed to more than 4 million deaths globally.[23] $PM_{2.5}$ is associated with large adverse health impacts, warming, disruption of traditional rainfall patterns, and increases in the melting rate of snow and ice.

The climate impacts of black carbon are highly regionalised. For example, black carbon in the lower atmosphere has been shown to disturb rainfall and regional circulation patterns, such as the Asian Monsoon, with effects on regional precipitation that are disproportionately large relative to its

[17] United Nations Environment Programme and Climate and Clean Air Coalition (UNEP & CCAC) (2021). *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions.* Nairobi: United Nations Environment Programme. ISBN: 978-92-807-3854-4

[18] UNEP & CCAC, *supra* note 15.

[19] United Nations Environment Programme (UNEP) (2011). *Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers*. Nairobi, Kenya: UNEP. 78 pp.

[20] Anenberg, S. C. *et al.* (2009). Intercontinental impacts of ozone pollution on human mortality. *Environmental Science & Technology,* 43 (17), 6482–6487. doi:10.1021/es900518z; Lin, Y. *et al.* (2018). Impacts of O_3 on premature mortality and crop yield loss across China. *Atmospheric Environment,* 194, 41–47. doi:10.1016/j.atmosenv.2018.09.024; *and* Silva, R. A. *et al.* (2013). Global premature mortality due to anthropogenic outdoor air pollution and the contribution of past climate change. *Environmental Research Letters* 8 (3). doi:10.1088/1748-9326/8/3/034005.

[21] GBD, *supra* note 9.

[22] UNEP & CCAC, *supra* note 15.

[23] GBD, *supra* note 9.

effect on global mean annual average temperatures.[24] In glaciated and polar regions, black carbon darkens the surface of snow and ice, increasing the absorption of sunlight and exacerbating melting.[25]

2C. Hydrofluorocarbons (HFCs)

Hydrofluorocarbons (HFCs) are factory-made chemicals produced for use in refrigeration, air-conditioning, insulating foams, fire extinguishers, solvents and aerosol propellants.[26] HFCs are powerful greenhouse gases and account for ~1.5% of global anthropogenic GHG emissions. These pollutants are present in the atmosphere for a few days up to a few years.[27]

Since their introduction in the early 1990's as replacements for ozone-depleting substances (ODSs), emissions of HFCs have grown rapidly. While emissions of HFCs are currently small, they were projected to rise and reach levels equivalent to 7 to 19% of CO_2 emissions by 2050 prior to the Kigali Amendment to phase-down the production and use of HFCs.[28] While efficient implementation of the Kigali Amendment could avoid up to 0.1 °C by 2050, faster phasedown beyond the schedule agreed in the 2016 Kigali Amendment could avoid as much as an additional 0.1 °C.[29]

3. FAST SLCP MITIGATION CONTRIBUTES TO CLIMATE AND DEVELOPMENT GOALS

The shorter atmospheric lifetime of SLCPs compared to CO_2 means that they can be removed from the atmosphere much more quickly by reducing their emissions. They therefore provide the strongest plausible leverage to reduce the rate of warming over the next few decades.[30] The speed at which SLCPs can be removed from the atmosphere presents an opportunity not only for quick, coordinated action to address global warming but also to achieve immediate benefits for development and human health.

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[24] Xie, X., *et al.* (2020). Distinct responses of Asian summer monsoon to black carbon aerosols and greenhouse gases. *Atmospheric Chemistry and Physics*, 20, 11823–11839, 2020; *and* Shindell, D. T. *et al.* (2023). The important role of African emissions reductions in projected local rainfall changes. *npj Climate and Atmospheric Sci*ence, 1-8. doi:10.1038/s41612-023-00382-7.

[25] Kang, S. *et al.* (2020). A review of black carbon in snow and ice and its impact on the cryosphere. *Earth-Science Reviews,* 210, 103326. doi: 10.1016/j.earscirev.2020.103346.

[26] Institute for Governance & Sustainable Development (IGSD) (2018). *Primer on HFCs.* Available at: http://www.igsd.org/wp-content/uploads/2018/01/HFC-Primer-v11Jan18.pdf

[27] Szopa *et al. supra* note 5.

[28] UNEP (2011). *HFCS: A Critical Link in Protecting Climate and the Ozone Layer – A UNEP Synthesis Report.* Nairobi, Kenya: United Nations Environment Programme.

[29] Purohit P., Borgford-Parnell N., Klimont Z. and Höglund-Isaksson L. (2022). Achieving Paris climate goals call for increasing ambition of the Kigali Amendment. *Nature Climate Change,* 12, 339-342; *see also* Liang Q *et al.* (2022) *Chapter 2: Hydrofluorocarbons (HFCs)*. In: Scientific Assessment of Ozone Depletion: 2022. Geneva: World Meteorological Organization. Available at: https://ozone.unep.org/sites/default/files/2023-02/Scientific-Assessment-of-Ozone-Depletion-2022.pdf.

[30] UNEP and CCAC, *supra* note 15; *see also* Dreyfus *et al.* (2022). Mitigating climate disruption in time: A self-consistent approach for avoiding both near-term and long-term global warming. *Proceedings of the National Academy of Sciences of the United States of America,* 119(22), e2123536119. doi:0.1073/pnas.2123536119

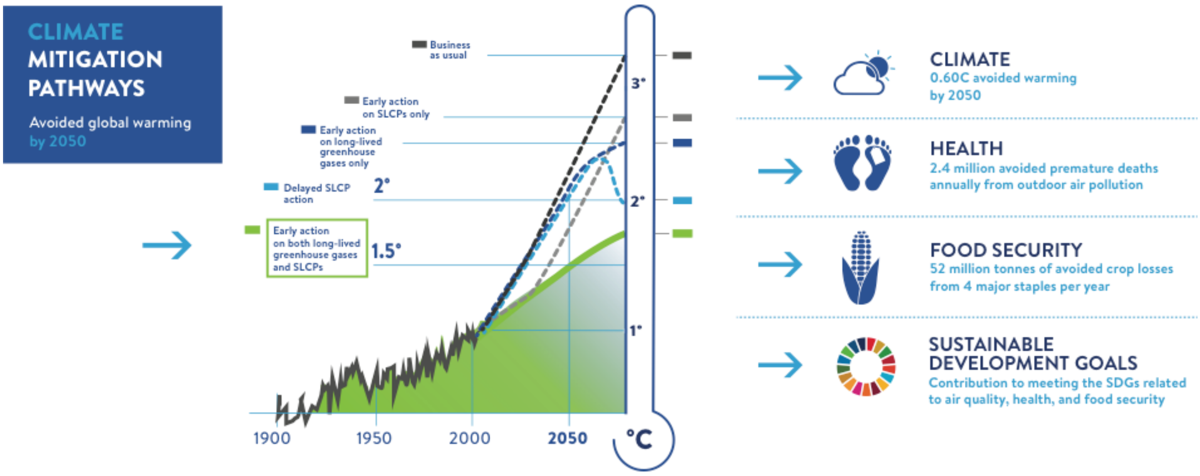

Figure 1. Warming trajectories associated with various SLCP and long-lived greenhouse gas controls (credit: CCAC).

Although there are many paths we can take to reach the Paris Agreement temperature targets, the path we choose will determine if we will avoid an irreversible climate crisis. Simultaneous mitigation of SLCPs and CO_2 is the best possible scenario for achieving the Paris Agreement target.[31] Delayed action on CO_2 or SLCP control measures will have significant, and potentially irreversible, negative impacts on temperature, cumulative sea-level rise, and human well-being (Figure 2).[32]

Fast and immediate action on SLCPs can avoid around 0.6 °C of warming by 2050.[33] It will also avoid over 50% of predicted warming in the Arctic by 2050 and significantly reduce the risk of triggering dangerous climate tipping points, like the release of carbon dioxide and methane from thawing Arctic permafrost. Because some processes of the climate system, especially melting of the large land ice sheets of Greenland and Antarctica, have a nearly unstoppable momentum once begun, even with aggressive CO_2 and SLCP mitigation two-thirds of predicted sea-level rise is likely to be inevitable. But early mitigation could reduce its rate by up to one half, which would reduce vulnerability by giving coastal communities and low-lying states additional time to adapt.[34]

There are also multiple health, social and development benefits to action to reduce SLCPs. These benefits can be perceived almost immediately where action has been taken. For example, dramatic improvements to indoor air quality has been seen in developing countries as a result from increased access to modern energy instead of traditional use of biofuels or coal for cooking and/or heating[35] (indoor air pollution also killed approximately 2 million in 2019).[36]

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[31] Scovonick, N. *et al.* (2015). Reduce short-lived climate pollutants for multiple benefits. *The Lancet,* 386(10006), E28-E31. doi: 10.1016/S0140-6736(15)61043-1

[32] Scovonick *et al. supra* note 29.

[33] UNEP-WMO, *supra* note 6; Shindell D. *et al*. (2012). Simultaneously mitigating near term climate change and improving human health and food security, *Science*, 335(6065):183-189.; *and* Xu, Y., Zaelke, D., Velders, G.J. and Ramanathan, V. (2013) The role of HFCs in mitigating 21st century climate change. *Atmospheric Chemistry and Physics*, *13*(12), pp.6083-6089.

[34] Hu. A. *et al*. (2013). Mitigation of short-lived climate pollutants slows sea-level rise. *Nature Climate Change,* 3, pp730-734.

[35] World Health Organization, *supra* note 8.

[36] GBD, *supra* note 9.

Early mitigation of SLCPs *helps to meet SDGs* and, within the goal of climate action:[37]

- Reduces damages due to climate change over the next few decades, including those dependent upon the pace of climate change such as biodiversity losses.
- Slows amplifying feedbacks such as snow/ice-albedo that are highly sensitive to BC.
- Reduces the risk of potential non-linear changes such as release of carbon from permafrost or ice sheet collapse.
- Increases the chance of staying below 2 °C through mid-century.
- Reduces long-term cumulative climate impacts.
- Reduces costs of meeting temperature targets.
- Stimulates progress toward the long-term 2 °C target through achievement of near-term benefits.

Comparing strong and immediate reductions in SLCPs against waiting 20 years, Schmale *et al.* reported that immediate action would avoid ~45 million premature deaths (Figure 3) and ~1 billion tonnes rice, wheat, soy & maize relative to delayed action.[38]

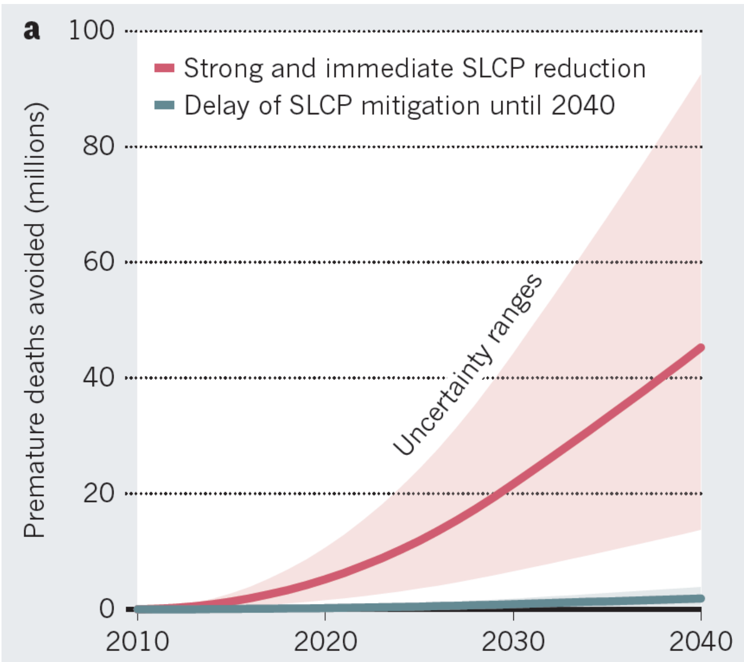

Figure 2. Adapted from Schmale et al. 2014[36]

Without action, emissions of methane will continue to grow. Atmospheric concentrations of methane are at an all-time high,[39] a trend that is driven by human-caused emissions.[40] Under current trajectories, total methane emissions from human activities could rise by up to 13% between 2020

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[37] Shindell, D. (2016). Crop Yield Changes Induced by Emissions of Individual Climate-Altering Pollutants. *Earth's Future*, 4, 373-380. doi:10.1002/2016EF000377.

[38] Schmale, J. *et al.* (2014). Clean up our skies. *Nature,* 515, 335-337.

[39] Lan, X. *et al.* (2023). *Trends in Globally-averaged CH_4, N_2O, and S_F6 Determined from NOAA Global Monitoring Laboratory Measurements.* doi: 10.15138/P8XG-AA10.

[40] Skeie, R.B *et al.* (2023). Trends in atmospheric methane concentrations since 1990 were driven and modified by anthropogenic emissions. *Communications earth & environment.* 4(317). doi:10.1038/s43247-023-00969-1.

and 2030.[41] In a scenario that limits warming to 1.5 °C, emissions need to fall by 30% to 60% over this timeframe.[42]

4. HOW TO GET SLCP REDUCTIONS

In many cases, greenhouse gases and air pollutants are emitted from the same sources, and SLCPs like black carbon, methane, and tropospheric ozone all contribute to the dual crises of climate change and air pollution. Through integrated climate and clean air action to reduce SLCPs, we can therefore simultaneously achieve near-term climate mitigation along with co-benefits for development. UNEP and the World Meteorological Organization (WMO) have identified a package of control measures to reduce short-lived climate pollutants that can achieve 90% of the total potential emission reductions potential for black carbon, methane, and HFCs. Many of these measures involve cost-effective technologies and practices that already exist. Note that as some air pollutants cause cooling not all air pollution control measures lead to the mitigation of warming. For this reason, SLCPs have been carefully defined to be only those air pollutants that do lead to warming.

4A. Mitigation Measures for Methane & Tropospheric Ozone

While the amount of methane in the atmosphere is increasing at record-high rates, the Global Methane Assessment described how **t**here are technical targeted control measures available today that could reduce methane emissions by 30% of projected 2030 anthropogenic emissions (or ~120 Mt per year).[43] Methane mitigation is very likely the strategy with the most potential to decrease warming in the next 20 years. Most of the methane mitigation from technical control measures over the next decade come from the fossil fuel sector (reducing intended and inadvertent emissions during extraction, storage and long-distance transport of coal, and oil and gas). Waste and rice production also provide opportunities via improved waste management and alternate growing techniques, while reductions from the livestock sector are less consistent across available analyses.

Current targeted solutions alone, however, are not enough to achieve 1.5 °C consistent mitigation by 2030. To achieve that, additional measures must be deployed, which could reduce 2030 methane emissions by another 15%, about 60 Mt/yr.[44] Examples include decarbonization measures – such as a transition to renewable energy and economy-wide energy efficiency improvements. Behavioural change measures and innovative policies such as reducing food waste and loss, improving livestock management, and the adoption of healthy diets, are particularly important to prevent emissions from agriculture.

The benefits of a 45% reduction in methane emissions would be 0.3 °C avoided warming by the 2040s and the prevention of 255,000 ozone related premature deaths from respiratory and cardiovascular diseases, 775,000 asthma-related hospital visits, 26 million tonnes of staple crop losses and 73 billion lost work hours due to heat exposure (Figure 4). Avoided warming and labour losses occur in the 2040s, other impacts are annual values beginning in 2030 that would continue thereafter.[45]

More than 60% of the strategy control measures have low or negative costs. The greatest potential for negative cost abatement is in the oil and gas subsector where captured methane adds to revenue instead of being released to the atmosphere.

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[41] United Nations Environment Programme/Climate and Clean Air Coalition (2022). *Global Methane Assessment: 2030 Baseline Report*. Nairobi. ISBN No: 978-92-807-3978-7

[42] UNEP and CCAC, *supra* note 15.

[43] UNEP and CCAC, *supra* note 15.

[44] UNEP and CCAC, *supra* note 15.

[45] UNEP and CCAC, *supra* note 15.

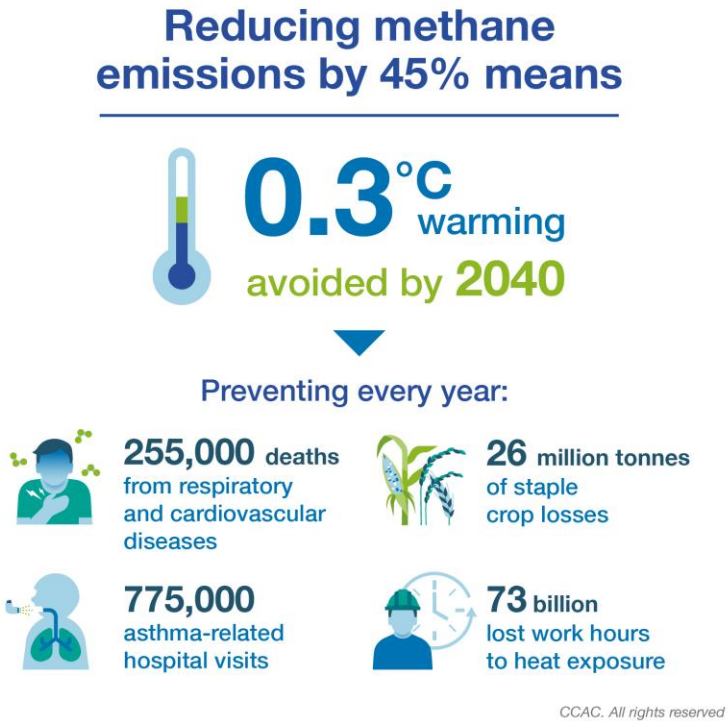

Figure 3. Benefits of methane emissions cuts (credit CCAC; based on the CCAC/UNEP, Global Methane Assessment 2021).

4B. Mitigation Measures for Black Carbon

There are many existing options to reduce emissions of black carbon and co-emissions (e.g., Organic Carbon, Carbon Monoxide). Industrial sector emissions could be reduced by more than 75% by deploying measures such as improved brick kilns and coke ovens. Emissions from households could be reduced by 60% by improving traditional biomass cooking and heating stoves, converting to LPG, and eliminating the use of coal stoves and kerosene wick lamps. Transport sector emissions could be reduced by 50% by phasing out high-emitting diesel vehicles through electrification and the application of EURO-VI diesel vehicle emissions standards. Emissions from burning of municipal solid waste and agricultural residue could be eliminated entirely.[46]
Specific mitigation measures include:

- A modal shift to more sustainable transport (e.g., active travel, electrification)
- Replacing coal in residential stoves
- Replacing residential wood burning in Industrialized countries
- Switching to clean burning cookstoves in developing countries
- Modern brick kilns
- Modern coke ovens
- Banning the open burning of agricultural and municipal waste
- Replacement of kerosene lamps

[46] UNEP-WMO, *supra* note 6; *and* Shindell *et al*. *supra* note 31.

4C. Mitigation Measures for HFCs

The production and use of HFCs is currently managed through the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer.[47] Full global compliance with the Kigali Amendment will reduce global consumption and production of HFCs by 85% by the late 2040s.

However, an estimated 3.6 billion cooling appliances containing HFCs are currently in use globally and could grow to 14 billion by 2050 when the phase-down is complete.[48] These 'banks' of HFCs will eventually be emitted into the atmosphere through regular equipment leakage, poor maintenance and improper end-of-life controls. Establishing end-of-life controls and strengthening systems for maintenance and repair could provide significant additional mitigation and development benefits.

5. CONCLUSIONS

All global modelled pathways that limit warming to 1.5 °C involve rapid, deep, and immediate greenhouse gas emission cuts in all sectors this decade.[49] SLCPs are responsible for 45% of current warming, and while they stay in the atmosphere for a much shorter period than carbon dioxide, their potential to warm the atmosphere is many times greater.

Speed is crucial in the fight against climate change, and we must tackle both near-term and long-term climate change simultaneously. Since SLCPs can be removed from the atmosphere in periods ranging from days to 15 years, reducing their emissions can make quick headway on slowing global warming. These pollutants can be significantly reduced using technologies available today, and actions to reduce them have the potential to deliver significant additional benefits for human health, crop yields, and economies. If quickly implemented, these measures can cut the amount of warming that would occur over the next few decades by as much as 0.6 °C, while avoiding 2.4 million premature deaths from outdoor air pollution annually by 2030 and preventing 52 million tonnes of crop losses per year. Reducing SLCPs will also help those already suffering from the impacts of climate change, prevent biodiversity loss, and provide additional time for adaptation.

The planet has already warmed more than 1 °C. According to the Intergovernmental Panel on Climate Change (IPCC), warming above 1.5-2 °C would have devastating consequences worldwide. The only way to avoid passing this threshold - and the most dangerous impacts of climate change - is by reducing SLCPs together with deep and persistent cuts in carbon dioxide (CO_2). This is critical for future generations – for our children and grandchildren's generations.

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[47] Kigali Amendment to the Montreal Protocol on Substances the Deplete the Ozone Layer, 15 October 2016, C.N.872.2016.TREATIES-XXVII.2.f.

[48] United Nations Environment Programme and International Energy Agency (UNEP & IEA) (2020). *Cooling Emissions and Policy Synthesis Report*. UNEP, Nairobi and IEA, Paris.

[49] Forster, *supra* note 2.

ANNEX 1: SIGNATORIES

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