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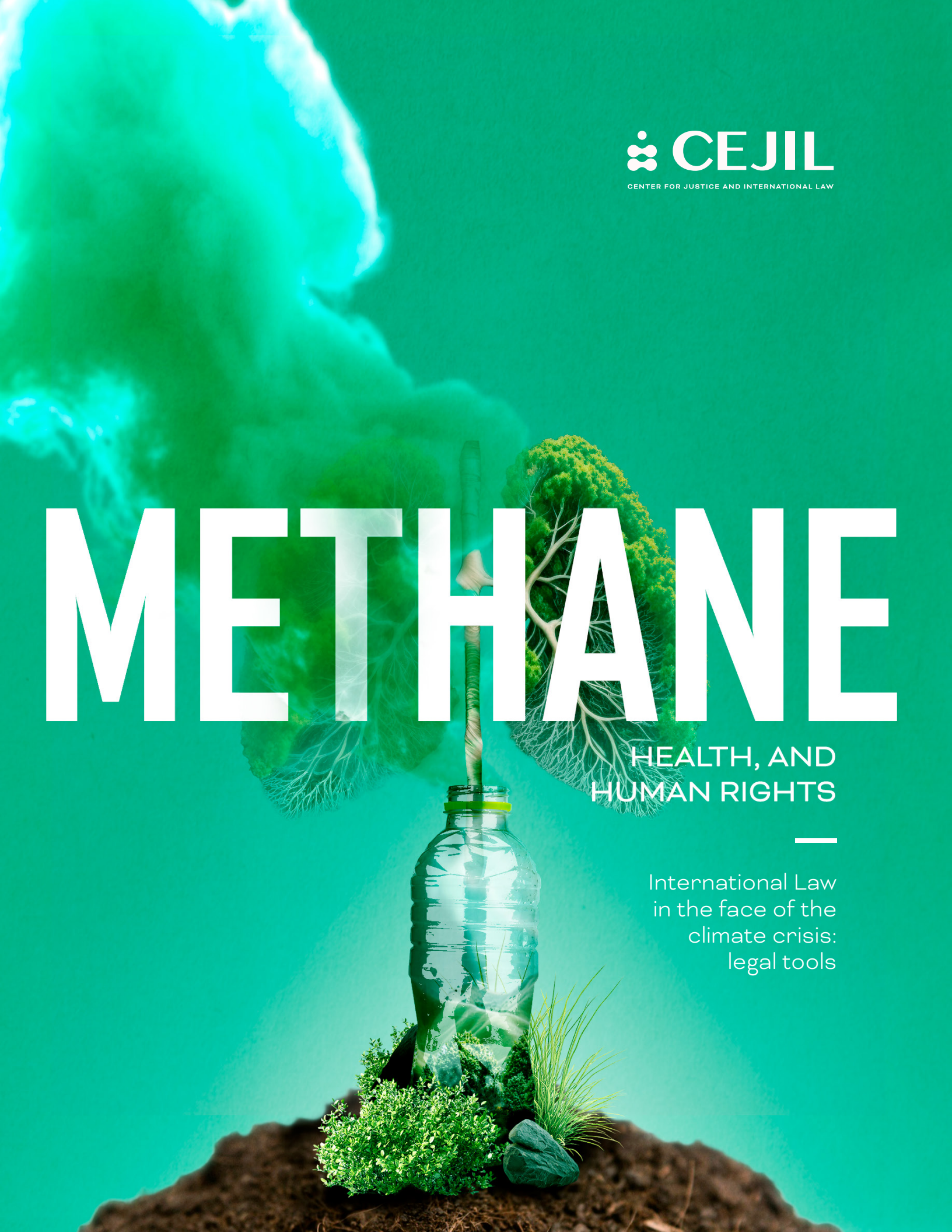
METHANE

HEALTH, AND HUMAN RIGHTS

International Law in the face of the climate crisis: legal tools



METHANE, HEALTH, AND HUMAN RIGHTS:

June 2025
Prepared by: CEJIL

The Center for Justice and International Law (CEJIL) is dedicated to contributing to the full enjoyment of human rights through the effective use of the Inter-American Human Rights System (IAHRS) and other international protection mechanisms.

We would like to thank Franco Albarracín, an attorney specializing in climate change and human rights, along with the CEJIL team members who contributed to the preparation of this document. We also extend our gratitude to the Institute for Governance & Sustainable Development (IGSD), particularly Sebastián Luengo, Ph.D., for his technical collaboration, and independent researcher Rodrigo Villagra, whose valuable comments and expertise enhanced the content of this report.

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CEJIL. Methane, Health, and Human Rights. June 2025.

ISBN: 978-987-23854-6-0

Presentation

This publication explores the health impacts of methane, a topic of growing concern in the context of the climate emergency, environmental pollution, and their interaction with human rights and constitutional law. It is part of a series of CEJIL publications examining the intersection between human rights and environmental protection, aimed at fostering more robust interdisciplinary and intradisciplinary approaches.

As methane concentrations continue to rise, so do the risks of further increases in global temperatures and serious threats to human health—ranging from respiratory and cardiovascular diseases to psychological and mental health effects.

This publication provides a comprehensive perspective, grounded in the best available science, on the current evidence base required to safeguard the right to health, with particular emphasis on the most disadvantaged communities.

We express our gratitude to the Institute for Governance & Sustainable Development (IGSD) for its unwavering support of this research and its commitment to fostering interdisciplinary dialogue on this consequential issue. We also thank CEJIL's institutional donors for making this work possible. Our sincere appreciation goes to the IGSD scientists who reviewed an early draft of this document, as well as to Rodrigo Villagra, a lawyer and anthropologist, for his valuable comments. Finally, we acknowledge Franco Albarracín, a CEJIL lawyer, who authored this document.

Viviana Krsticevic
Washington DC May 2025

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1.

Short-Lived Climate Pollutants, Air Quality, and Public Health

Scientific consensus indicates that reducing short-lived climate pollutants (SLCPs)—such as black carbon, tropospheric ozone, and methane—is essential to improving air quality and safeguarding public health[1].

According to the World Health Organization (WHO), nearly the entire global population breathes air that exceeds the limits set in its Air Quality Guidelines[2]. Poor air quality causes millions of premature deaths each year, primarily due to cerebrovascular diseases, cardiovascular disease, and respiratory conditions such as bronchitis, asthma, and chronic obstructive pulmonary disease (COPD), according to recent estimates[3].

Among the most harmful pollutants is black carbon[4], which has been associated with neurological damage, cardiovascular and respiratory difficulties, and an increase in premature mortality[5]. Chronic exposure to black carbon—for example, via diesel engine emissions—can trigger pulmonary inflammation, heart attacks (myocardial infarction), asthma attacks,

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1. Climate and Clean Air Coalition. Contaminantes climáticos de vida corta y salud. Available at: https://www.ccacoalition.org/es/content/short-lived-climate-pollutants-and-health, last accessed: May 19, 2025. **2.** World Health Organization. WHO Air Quality Database 2022 Update: Status Report. Geneva: WHO, 2023. Pg. 9; World Health Organization. Billions of people still breathe unhealthy air: new WHO data, 2022. Available at: https://www.who.int/news/item/04-04-2022-billions-of-people-still-breathe-unhealthy-air-new-who-data, last accesed: May 26, 2025. World Health Organization (WHO). Ambient Air Pollution: A Global Assessment of Exposure and Burden of Disease. Available at: https://www.who.int/publications/i/item/9789241511353, last accessed: March 19, 2025. . **3.** GBD 2015 Risk Factors Collaborators. "Global, Regional, and National Comparative Risk Assessment of 79 Behavioural, Environmental and Occupational, and Metabolic Risks or Clusters of Risks, 1990–2015: A Systematic Analysis for the Global Burden of Disease Study 2015." The Lancet 388 (10053): 1659–1724. 2016. Available at: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)31679-8/fulltext, last accessed: May 20, 2025. **4.** Climate and Clean Air Coalition (CCAC). Integrated Assessment of Black Carbon and Tropospheric Ozone. Available at: https://www.ccacoalition.org/en/resources/integrated-assessment-black-carbon-and-tropospheric-ozone, last accessed: April 18, 2025. **5.** Ibid; Calderón-Garcidueñas, L. et al. Urban air pollution: Influences on olfactory function and pathology in exposed children and young adults. Environmental Health Perspectives, 116(9), 1283–1289, 2008. Available at: https://pubmed.ncbi.nlm.nih.gov/19297138/, last accessed: April 28, 2025; Barraza-Villarreal, A. et al. Air pollution, airway inflammation, and lung function in a cohort study of Mexico City schoolchildren. Respiratory Research, 12(1), 74, 2009. Available at: https://pmc. ncbi.nlm.nih.gov/articles/PMC2430242/, last accessed: April 16, 2025.

and a range of respiratory symptoms[6]. The World Health Organization (WHO) has also recognized associations between black carbon exposure and an increased risk of developing lung and bladder cancer[7].

Ground-level (tropospheric) ozone—formed in part from methane as a precursor—exacerbates diseases such as bronchitis and emphysema, triggers asthma attacks, and can cause permanent lung tissue damage[8]. Long-term exposure to tropospheric ozone has been associated with an increased incidence of cardiovascular disease and stroke[9]. Among children, inhalation of high levels of air pollution can impair lung development and increase mortality from respiratory infections[10].

6. United Nations Environment Programme (UNEP) & World Meteorological Organization (WMO). Integrated assessment of black carbon and tropospheric ozone: Summary for decision makers, 2011. Pgs. 6 and 16. **7.** World Health Organization (WHO). Ambient (outdoor) air quality and health. Disponible en: https://www.who.int/es/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health, last accessed: May 19, 2025; World Health Organization (WHO). Types of pollutants and their health impacts. Available at: https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants, last accessed: May 19, 2025; International Agency for Research on Cancer (IARC) – World Health Organization. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 93: Carbon Black, Titanium Dioxide, and Talc. Lyon, Francia: IARC, 2010. Pgs. 186, 187 y 191. **8.** Climate and Clean Air Coalition. Ozono troposférico – Contaminantes climáticos de vida corta. Available at: https://www.ccacoalition.org/es/short-lived-climate-pollutants/tropospheric-ozone, last accessed: May 19, 2025; Bell, M. L., Samet, J. M., & Dominici, F. (2004). Ozone and Short-term Mortality in 95 US Urban Communities, 1987-2000. Journal of the American Medical Association, 292(19), 2372–2378. https://doi.org/10.1001/jama.292.19.2372. **9.** Shuru Liang, Yumeng Chen, Xiaoli Sun, Xiaomei Dong, G. He, Yudong Pu, Jingjie Fan, Xinqi Zhong, Zhiqing Chen, Ziqiang Lin, Wenjun Ma, Tao Liu. Long-term exposure to ambient ozone and cardiovascular diseases: Evidence from two national cohort studies in China, 2024. Available at: https://www.sciencedirect.com/science/article/pii/S2090123223002266?via%3Dihub, last accessed: May 20, 2025. **10.** United Nations Children's Fund (UNICEF). Clear the Air for Children: The Impact of Air Pollution on Children. Executive summary, 2016. Pgs. 2, 3 and 4

2.

The Impact of Methane on Public Health and Food Security

Methane is a potent greenhouse gas—not only because of its capacity to accelerate global warming with significant consequences, but also due to its public health impacts. Indirectly, methane acts as a precursor to ground-level (tropospheric) ozone, a highly harmful air pollutant that degrades air quality and exacerbates respiratory, cardiovascular, and neurological diseases[11].

Moreover, its potent climate forcing exacerbates systemic risks linked to global warming. This, in turn, translates into more frequent and intense extreme weather events, the destabilization of food and water systems[12], biodiversity loss, and growing pressures on global public health[13]—all of

11. Centro por la Justicia y el Derecho Internacional y Global Action Plan & Kyklos (Chile). Amicus Brief: Children's Rights: Q IV.C(1). Global Action Plan y Kyklos (Chile), 2023. Pg. 6. This document is part of the compilation of written observations and expert evidence submitted by the Center for Justice and International Law (CEJIL) and Doughty Street Chambers to the Inter-American Court of Human Rights in the International Law (CEJIL) and Doughty Street Chambers before the Inter-American Court of Human Rights in the context of the request for Advisory Opinion OC-32 on Climate Emergency and Human Rights. Available at: https://corteidh.or.cr/sitios/observaciones/OC-32/4_kyklos_otros.pdf, last accessed: May 10, 2025. Pgs. 3, 9 and 19; Shuru Liang, Yumeng Chen, Xiaoli Sun, Xiaomei Dong, G. He, Yudong Pu, Jingjie Fan, Xinqi Zhong, Zhiqing Chen, Ziqiang Lin, Wenjun Ma, Tao Liu. Long-term exposure to ambient ozone and cardiovascular diseases: Evidence from two national cohort studies in China, 2024. Available at: https://www.sciencedirect.com/science/article/pii/S2090123223002266?via%3Dihub, last accessed: May 20, 2025. **12.** UNICEF. La crisis climática es una crisis de los derechos de la infancia: Presentación del Índice de Riesgo Climático de la Infancia. New York, 2021. Pgs. 10, 11 and 12; Climate and Clean Air Coalition. Contaminantes climáticos de vida corta y salud. Available at: https://www.ccacoalition.org/es/content/short-lived-climate-pollutants-and-health, last accessed: May 19, 2025. **13.** Ibid

which profoundly affect human rights. This is particularly concerning given that, despite its relatively short atmospheric lifetime, methane is responsible for approximately one-quarter of the observed increase in global temperatures and has a 20-year global warming potential (GWP20)

that of carbon dioxide. Recent studies estimate that tropospheric ozone formed from methane causes approximately one million premature deaths annually[14].

14. Grupo Intergubernamental de Expertos sobre Cambio Climático (IPCC). Cambio Climático 2021: Bases físicas. Contribución del Grupo de Trabajo I al Sexto Informe de Evaluación del IPCC. Capítulo 7, Tabla 7.15, 2021. P. 1019; Climate and Clean Air Coalition. Metano – Contaminantes Climáticos de Vida Corta. Available at: https://www.ccacoalition.org/es/short-lived-climate-pollutants/methane, last accessed: May 16, 2025; Murugesan Sobanaa, R. Prathiviraj, J. Selvin, Munisamy Prathaban. A comprehensive review on methane's dual role: effects in climate change and potential as a carbon–neutral energy source, 2023. Available at: https://link.springer.com/article/10.1007/s11356-023-30601-w, last accessed: May 16, 2025; U.S. Environmental Protection Agency (EPA). The Importance of Methane, 2025. Available at: https://www.epa.gov/gmi/importance-methane#:~:text=Methane%20is%20 the%20second%20most,trapping%20heat%20in%20the%20atmosphere, last accessed: May 20, 2025; Bosede Ngozi Adeleye, Aviral Kumar Tiwari. Empirical assessment of methane emissions, socioeconomic factors, and infant mortality in Europe, 2024. Available at: https://onlinelibrary.wiley.com/doi/ epdf/10.1111/1477-8947.12385, last accessed: May 20, 2025.

A 30% reduction in methane emissions is projected to prevent more than 200,000 premature deaths[15], while also improving access to clean water, air quality, and food security[16]. In the agricultural sector, methane-induced tropospheric ozone has been shown to significantly reduce global yields of staple crops such as wheat, soybean, maize (corn), and rice, thereby directly impacting global food security[17].

Currently, nearly 18 million people in the United States—including more than one million children under five—live within one mile of active oil and gas wells, exposing them to risks associated with methane-related emissions[18]. This problem is also critical across Latin America. In the Ecuadorian Amazon, for example, numerous communities—including children and adolescents—live in direct proximity to gas flares from the oil industry and face the impacts of their emissions[19]. Similar situations have been documented in oil-producing areas of Venezuela[20], Mexico[21], and Argentina[22], where exposure to emissions associated with oil and gas wells can affect disadvantaged communities, generating impacts on human health and the environment.

It has also been estimated that methane-induced tropospheric ozone reduces global agricultural productivity—wheat (-7.1%), soybean (-12.4%), maize/corn (-6.1%), and rice (-4.4%)[23] —and is therefore linked to increased food insecurity.

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15. Staniaszek, Z., Griffiths, P.T., Folberth, G.A. et al. The role of future anthropogenic methane emissions in air quality and climate, 2022. Available at: https://www.nature.com/articles/s41612-022-00247-5, last accessed: May 20, 2025; West, J., Fiore, A., Horowitz, L., Mauzerall, D., & Hansen, J. Global health benefits of mitigating ozone pollution with methane emission controls. Proceedings of the National Academy of Sciences of the United States of America, 2006. Available at: https://www.pnas.org/doi/full/10.1073/pnas.0600201103, last accessed: May 19, 2025 **16.** Climate and Clean Air Coalition. Time to Act to Reduce Short-Lived Climate Pollutants. Segunda edición. París: United Nation Environment Programme (UNEP), 2014. Pgs. 9, 15, 33 and 37.. **17.** Ibid. **18.** Jeremy Proville et al., The Demographic Characteristics of Populations Living Near Oil and Gas Wells in the USA, Population and Environment 44, 2022. Pgs. 1, 2 and 7. **19.** Amnistía Internacional. ¡Arde la Amazonía, arde el futuro! Jóvenes activistas que defienden la Amazonía ecuatoriana de los mecheros que amenazan los derechos en el presente y el futuro. Índice: AMR 28/8280/2024, 2024. Pgs. 5, 6, 10, 50, 51, 65 and 67. **20.** Ibid. Pgs. 9 and 26; Banco Mundial. Global Gas Flaring Tracker Report 2023. Global Gas Flaring Reduction Partnership (GGFR), 2023. P. 7.. **21.** Llano Vázquez Prada, Manuel; Flores Lot, Carla. Impactos al desarrollo fetal por proximidad a pozos de gas "natural" (fósil): anomalías congénitas y genéticas en recién nacidos en la provincia petrolera de Burgos 2017-2021. Centro Mexicano de Derecho Ambiental (CEMDA) y Cartocrítica, México, 2023. Pgs. 5 and 16. **22.** Cabrera Christiansen, Fernando; Cané, Santiago. Radiografía de Vaca Muerta: megaproyecto de energía fósil y fracking en Argentina. Fundación Heinrich Böll. Available at: https://co.boell.org/es/2020/04/16/radiografia-de-vaca-muerta-megaproyecto-de-energia-fosil-y-fracking-en-argentina, last accessed: May 19, 2025. United Nations Environment Programme y Climate and Clean Air Coalition, Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions, Nairobi: UNEP, 2021. Pgs. 21 and 68. **23.** United Nations Environment Programme y Climate and Clean Air Coalition, Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions, Nairobi: UNEP, 2021. Pgs. 21 and 68

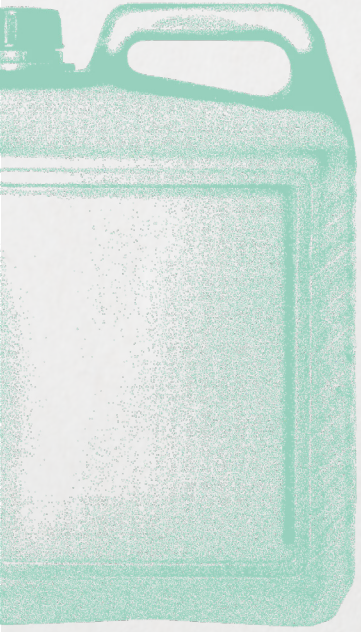
There are concrete, low- or no-cost solutions that could reduce more than

of anthropogenic methane emissions, especially in the fossil fuel, waste, and agriculture sectors—offering an immediate and effective opportunity to reduce warming and its consequences[24].

24. International Energy Agency (IEA), The imperative of cutting methane from fossil fuels: An assessment of the benefits for the climate and health, en colaboración con el Programa de las Naciones Unidas para el Medio Ambiente (PNUMA) y la Climate and Clean Air Coalition (CCAC), Paris, 2023. Pgs. 3 and 10; NEP y CCAC, Global Methane Assessment, 2021. Pgs. 10 and 13

3.

Physical and Mental Health: Impacts of Climate Change and Methane Emissions on Vulnerable Groups



The groups most affected by short-lived climate pollutants (SLCPs) are indigenous peoples[25], children and adolescents[26], older persons[27], and low-income communities[28]. These groups face greater exposure and reduced adaptive capacity in the face of climate pollutants.

A. Direct Health Impacts on Vulnerable Groups: Exposure to Methane and Associated Co-Pollutants

Direct exposure to methane emissions and the air pollutants generated from them disproportionately affects disadvantaged groups, increasing the frequency of respiratory diseases[29]. The principal pollutants implicated in these direct impacts include ground-level (tropospheric) ozone (O3)[30] —formed from precursors such as methane—fine particulate matter (PM2.5)[31] (including black carbon), and various volatile organic compounds (VOCs)[32].

The danger posed by these pollutants arises in everyday activities and industrial practices linked to methane. For

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25. Lebel, L., Paquin, V., Kenny, T., Fletcher, C., Nadeau, L., Chachamovich, E., & Lemire, M. Climate change and Indigenous mental health in the Circumpolar North: A systematic review to inform clinical practice. Transcultural Psychiatry, 59, 312 - 336. 2022. Available at: https://journals.sagepub.com/doi/10.1177/13634615211066698 **26.** J. White-Newsome, P. Meadows and C. Kabel. "Bridging Climate, Health, and Equity: A Growing Imperative.." American journal of public health, 108 S2 (2017): S72-S73. Available at: https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2017.304133 **27.** Ibid **28.** Ibid **29.** UNICEF. The climate crisis is a child rights crisis: Presentation of the Children's Climate Risk Index. New York, 2021. Pg. 21. **30.** Climate and Clean Air Coalition. Metano – Contaminantes Climáticos de Vida Corta. Available at: https://www.ccacoalition.org/es/short-lived-climate-pollutants/methane, last accessed: May 16, 2025. **31.** National Center for Biotechnology Information. Environmental exposures and adverse pregnancy outcomes: a review of the science. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC3385429/, last accessed: May 16, 2025. **32.** Alianza Global para el Clima y la Salud y Abt Associates. Mitigación del metano: Una estrategia global de salud — Informe general. GCHA, 2023. Pg. 8

example, the combustion of natural gas (primarily methane) in household appliances can generate indoor benzene concentrations that significantly increase the risk of leukemia, with children being disproportionately affected[33]. Similarly, gas flaring and venting in the oil and gas industry not only release methane directly into the atmosphere due to inefficient combustion[34], but have also been associated with hundreds of premature deaths and tens of thousands of pediatric asthma exacerbations annually among exposed populations[35].

These activities can have significant adverse impacts on the rights of neighboring communities, including their right to health and to a healthy environment, as documented in various contexts—for example, in the Ecuadorian Amazon[36]. At the household level, natural gas combustion is also a relevant source of indoor air pollution from compounds such as benzene, a recognized carcinogen that poses particular risks to child health[37]. Exposure to air pollution linked to methane and its secondary products during childhood—including both outdoor (ambient) air pollution and indoor air pollution—amplifies a range of public health problems. Globally, an alarming share of children and adolescents—estimated at about 90%—face at least two overlapping environmental and climate hazards[38]. These may include, for example, exposure to high levels of ambient air pollution combined with water scarcit[39], or recurrent heatwaves together with flooding[40]. Such multiple (co-)exposures significantly increase the risk of mortality, the development or exacerbation of respiratory infections, and may contribute to renal and cardiac complications, among other serious long-term health outcomes[41].

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33. Garg, Anchal, Kashtan, Yannai, Nicholson, Metta, Finnegan, Colin J, Lebel, Eric D, Michanowicz, Drew R., Shonkoff, Seth B.C., Nadeau, Kari C., Jackson, Robert B. "Exposure and health risks of benzene from combustion by gas stoves: A modelling approach in U.S. homes." Journal of Hazardous Materials, vol. 492 Elsevier, artículo n.º 137986, 2025. Pgs. 2 and 9. **34.** Tran, Huy; Polka, Erin; Buonocore, Jonathan J.; Roy, Ananya; Trask, Beth; Hull, Hillary; Arunachalam, Saravanan. Air Quality and Health Impacts of Onshore Oil and Gas Flaring and Venting Activities Estimated Using Refined Satellite Based Emissions. GeoHealth, vol. 8, n.º 3, 2024. Pgs. 2 and 3; Amnistía Internacional. ¡Arde la Amazonía, arde el futuro!, 2024. Pgs. 21, 24 and 25. **35.** Tran, Huy et al., cit., pg. 11 **36.** Amnistía Internacional. ¡Arde la Amazonía, arde el futuro!, 2024. Pgs. 8, 9, 41 and 77. **37.** Garg, Anchal et al. Exposure and health risks of benzene from combustion by gas stoves, 2025. Pgs. 2 and 9. **38.** UNICEF. The climate crisis is a child rights crisis: Presentation of the Children's Climate Risk Index. New York, 2021. Pgs. 13 and 56; CEJIL y Global Action Plan & Kyklos, Amicus Brief: Children's Rights. P. 35 **39.** UNICEF. The climate crisis is a child rights crisis: Presentation of the Children's Climate Risk Index. New York, 2021. Pg. 10 **40.** Ibid. Pgs. 10 and 54 **41.** CEJIL y Global Action Plan & Kyklos, Amicus Brief: Children's Rights. Pgs. 3 and 35.

B. Indirect impacts on the health of groups in vulnerable situations.

Beyond its direct effects, methane makes a substantial contribution to global warming, thereby exacerbating climate change. This, in turn, generates a series of indirect impacts that severely affect the physical and mental health of disadvantaged groups. Recent research highlights that more frequent heatwaves and extreme temperatures increase infant mortality and pregnancy complications[42], and also facilitate the spread of vector-borne infectious diseases such as malaria, dengue, and Zika[43]. Likewise, climatic changes degrade food systems and reduce access to safe drinking water, worsening undernutrition and diarrheal disease[44].

The psychological effects of climate change on children and adolescents are equally alarming. Extreme weather events—such as floods, droughts, and storms—significantly increase the prevalence of post-traumatic stress disorder (PTSD), depression, anxiety, and cognitive difficulties[45]. Slow-onset environmental changes, including rising temperatures and biodiversity loss, also generate chronic anxiety, depression, and behavioral problems[46]. In addition, indirect consequences—such as forced displacement, educational disruptions, family breakdown, and violence—further heighten their emotional vulnerability[47].

Lastly, constant exposure to information about the future risks of climate change induces persistent feelings of hopelessness and helplessness, increasing the incidence of disorders such as generalized anxiety and major depression. These effects worsen considerably if global temperature exceeds the critical 1.5 °C threshold, since failure to maintain this limit is communicated and perceived as a path toward much more severe and irreversible climate impacts—which can intensify among children and adolescents the sense of a profoundly threatened future and the distress stemming from perceived inaction by adult generations[48].

42. Ibid. Pg. 2 **43.** Ibid. Pg. 4 **44.** UNICEF. The climate crisis is a child rights crisis: Presentation of the Children's Climate Risk Index. New York, 2021. Pgs. 10, 11 and 12 **45.** CEJIL y Global Action Plan & Kyklos, Amicus Brief: Children's Rights. Pgs. 17, 33 and 34 **46.** Ibid. Pgs. 18, 24 y 34 **47.** Ibid

The impacts on Indigenous communities and peoples are severe, yet often rendered invisible despite the robust evidence available. Indigenous health—mental, physical, spiritual, and collective—is deeply tied to relationships with territory and land-based cultural practices[49]. Climate change directly affects this essential relationship, altering the climatic and ecological cycles that govern mobility, food systems, hunting and fishing, and a range of spiritual and ritual practices.

These disruptions undermine food security[50], generate interpersonal stress, and trigger crises of cultural identity[51]. The restriction of physical and symbolic access to territory produces a sense of spiritual and emotional loss, weakening community resilience and increasing vulnerability to physical and psychological disorders[52].

The connection to the natural environment is not only physical but also spiritual, cultural, and emotional for Indigenous communities[53]. This profound relationship is conceived as body–territory (cuerpo-territorio): a vital connection in which the land is understood as an extension of the self[54]. As climate change radically transforms these environments, vital cycles and essential celebrations—such as agricultural festivals and rites of passage—are disrupted, affecting emotional balance, collective identity, and holistic health[55]. This situation heightens anxiety, stress, and depression arising from the rupture with their environment and traditional practices[56], undermining both individual and collective well-being[57].

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48. Ibid. Pgs. 26 y 27. **49.** Ibid. Pgs. 27 and 38; Middleton, Jacqueline; Cunsolo, Ashlee; Jones-Bitton, Andria; Wright, Carlee J.; Harper, Sherilee L. Indigenous mental health in a changing climate: a systematic scoping review of the global literature. Environmental Research Letters, vol. 15, n.º 5, 2020. Pgs. 9, 11 and 12 **50.** Middleton, Jacqueline; Cunsolo, Ashlee; Jones-Bitton, Andria; Wright, Carlee J.; Harper, Sherilee L. Indigenous mental health in a changing climate: a systematic scoping review of the global literature. Environmental Research Letters, vol. 15, n.º 5, 2020. Pgs. 9 and 10; Fundación Saldarriaga Concha. Salud mental en las comunidades indígenas. Available at: https://www.saldarriagaconcha.org/salud-mental-en-las-comunidades-indigenas/, last accessed: May 19, 2025 **51.** Ibid. Pgs. 9, 10, 11 and 12; Lebel, Laurence, Vincent Paquin, Tiff-Annie Kenny, Christopher Fletcher, Lucie Nadeau, Eduardo Chachamovich, and Mélanie Lemire. "Climate Change and Indigenous Mental Health in the Circumpolar North: A Systematic Review to Inform Clinical Practice." Journal of Indigenous Studies 10, no. 2, 2022. Available at : https://journals.sagepub.com/doi/10.1177/13634615211066698 **52.** Germán Ramírez Guzmán, Salud mental y comunidades indígenas. Una aproximación desde los profesionales de la salud mental de Alto Bío Bío. Tesis de Magíster en Psicología Clínica Adulto, Universidad de Chile, 2012. Pgs. 43, 44, 45 and 106; CEJIL y Global Action Plan & Kyklos, Amicus Brief: Children's Rights. Pgs. 27 and 28; Fundación Saldarriaga Concha. Salud mental en las comunidades indígenas. Available at: https://www.saldarriagaconcha.org/salud-mental-en-las-comunidades-indigenas/, last accessed: May 19, 2025 **53.** Ibid **54.** Ramírez Guzmán, Salud mental y comunidades indígenas. Pgs. 44 and 118 Ramírez Guzmán, Salud mental y comunidades indígenas. Pgs. 44 and 118 **55.** Zaldivar, Trinidad, y Martin Inthamoussu. "Patrimonio, cultura y cambio climático." Blog del BID – Sostenibilidad, August 24, 2023. Available at: https://blogs.iadb.org/sostenibilidad/es/patrimonio-cultura-y-cambio-climatico/, last accessed: May 19, 2025; ANF, Cambio Climático afecta directamente a rituales ancestrales de los kallawayas. Available at: https://www.noticiasfides.com/nacional/sociedad/cambio-climatico-afecta-directamente-a-rituales-ancestrales-de-los-kallawayas--370793, last accessed: May 21, 2025 **56.** Ninomiya, Melody E Morton et al. Indigenous communities and the mental health impacts of land dispossession related to industrial resource development: a systematic review. The Lancet Planetary Health, Volume 7, 2023. Available at: https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(23)00079-7/fulltext, last accessed: May 20, 2025; Lebel, Laurence, Vincent Paquin, Tiff-Annie Kenny, Christopher Fletcher, Lucie Nadeau, Eduardo Chachamovich, and Mélanie Lemire. "Climate Change and Indigenous Mental Health in the Circumpolar North: A Systematic Review to Inform Clinical Practice." Journal of Indigenous Studies 10, no. 2, 2022. Available at: https://journals.sagepub.com/doi/10.1177/13634615211066698, last accessed: May 20, 2025. **57.** Ibid

4.

Explosion and Fire Hazards

A. Confined-Space Explosion and Fire Hazards

Methane is a highly flammable gas. When mixed with air at concentrations between 5% (LEL) and 15% (UEL) by volume, it forms explosive mixtures . This makes it a critical hazard in confined or poorly ventilated spaces—such as basements, tunnels, subways, or mines—where inadvertent accumulation and the presence of an ignition source can trigger sudden fires or devastating explosions[59]. Such events can cause loss of life and severe damage to infrastructure and the environment, underscoring the need for adequate ventilation, continuous monitoring, and gas detection in high-risk areas.

58. A. Duda and G. F. Valverde. "Environmental and Safety Risks Related to Methane Emissions in Underground Coal Mine Closure Processes." Energies, 2020. Available at: https://www.mdpi.com/1996-1073/13/23/6312, last accessed: May 20, 2025. **59.** Ibid; ao Wang, You Zhou, Zhen-min Luo, H. Wen, Jing-yu Zhao, Bin Su, F. Cheng and Jun Deng. "Flammability limit behavior of methane with the addition of gaseous fuel at various relative humidities." Process Safety and Environmental Protection, 2020. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0957582020304274?via%3Dihub, last accessed: May 20, 2025.

B. Hazards in Mining and Industrial Settings

Mining settings—especially coal mines—face elevated risk due to methane releases during extraction operations[60].

IN ENCLOSED WORKINGS METHANE ACCUMULATIONS

within the explosive range, combined with ignition sources, can lead to catastrophic explosions if not controlled through robust ventilation, methane drainage/degassing, and early detection (fixed and portable gas detectors)[61]. Historically, methane-related incidents have been a leading cause of mining disasters and industrial shutdowns, highlighting the importance of sector-specific safety protocols and rigorous compliance.

60. A. Duda and G. F. Valverde. "Environmental and Safety Risks Related to Methane Emissions in Underground Coal Mine Closure Processes." Energies, 2020. Available at: https://www.mdpi.com/1996-1073/13/23/6312 **61.** D. Palka, Jarosław Brodny, M. Tutak and D. Nitoi. "The role, importance and impact of the methane hazard on the safety and efficiency of mining production." Production Engineering Archives, 28, 2022. Available at: https://sciendo.com/article/10.30657/pea.2022.28.48, last accessed: May 20, 2025

C. Hazards in Residential Settings

Methane also poses hazards in residential settings, entering dwellings via natural gas leaks, contaminated groundwater/soil gas intrusion, sewer systems, or nearby wells and pipelines[62]. In poorly ventilated spaces (e.g., basements or sealed rooms), accumulation can significantly increase the risk of explosions[63]. However, this danger can be mitigated through proper ventilation, the installation of combustible gas detectors calibrated for methane (CH_4), timely leak detection and repair, and adherence to building and gas safety codes to protect residents[64].

62. E. Lebel, Colin J Finnegan, Z. Ouyang and R. Jackson. "Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes.." Environmental science & technology (2022). Available at: https://pubs.acs.org/doi/10.1021/acs.est.1c04707, last accessed: May 18, 2025; S. Osborn, A. Vengosh, N. Warner and R. Jackson. "Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing." Proceedings of the National Academy of Sciences, 2011. Available at: https://www.pnas.org/doi/full/10.1073/pnas.1100682108, last accessed: May 20, 2025 **63.** Ibid **64.** Ibid **65.** Ibid

5.

Methane and Landfills

The accumulation of methane in landfills—particularly those with deficient management and operation—can lead to explosions, posing a serious risk to life, human health, and surrounding infrastructure. This hazard is heightened when gas concentrates in confined or poorly ventilated spaces within or around final disposal sites[65].

Beyond explosion risks, the accumulation of methane and other landfill gases (LFG) can also compromise slope and overall structural stability, increasing the likelihood of catastrophic slope failures. Uncontrolled methane generation, combined with leachate accumulation, can destabilize landfill slopes[66]. Internal gas pressure—in the absence of adequate venting and collection systems—further aggravates ground instability, raising the risk of landslides and accidents with consequences for life, health, and property[67].

These impacts do not occur in isolation; they disproportionately affect rural communities, populations living adjacent to landfills—which in many countries are low-income—as well as internally displaced persons, migrants, and historically discriminated groups, who face greater risks and impacts on their human rights[68].

66. Ibid **67.** Lozano López, Juan Diego. Análisis de Riesgo por Deslizamiento en el Relleno Sanitario Doña Juana en Bogotá. Tesis de maestría, Universidad Nacional de Colombia, 2024. Pgs. 44, 110 and 130; Cárdenas Valbuena, Rocío del Pilar, Germán Alberto López Quemba, Deisy Talero Moreno, Andrea Paola Cely Grijalba, Liz Marivel Murillo Naranjo, y Grised Andrea Velasco Quiroga. Impacto ambiental y riesgos potenciales generados en los rellenos sanitarios: revisión narrativa de la literatura. Revista de investigación en salud. Universidad de Boyacá, 2022. Pgs. 1, 10, 11 and 12; Yang Gao, Yue-ping Yin, Bin Li, Kai He and Xueliang Wang. "Post-failure behavior analysis of the Shenzhen "12.20" CDW landfill landslide." Waste management, 83, 2019. Available at : https://www.sciencedirect. com/science/article/abs/pii/S0956053X18306780?via%3Dihub, last accessed: May 19, 2025. **68.** Ibid **69.** Greenpeace Colombia. Estimación de la generación, captura y emisiones de metano del relleno sanitario Doña Juana en Bogotá, Colombia, 2024. Pgs. 7, 8 and 13

6. *Conclusions*

Methane emissions pose a serious threat to the global climate and public health—not only because of their potent capacity to accelerate global warming, but also due to methane's role as a precursor to ground-level (tropospheric) ozone, an air pollutant that is highly harmful to human health and ecosystems. Addressing methane emissions therefore transcends the climate and environmental sphere and becomes a critical human rights issue, with direct implications for the rights to health, life, and a healthy environment.

The scientific evidence compiled in this report clearly shows that methane emissions substantially undermine global food security and increase the prevalence of respiratory, cardiovascular, and neurological diseases, severely compromising air quality in both urban and rural settings. An immediate and significant reduction in these emissions could prevent hundreds of thousands of premature deaths each year while protecting agricultural productivity essential to human subsistence.

However, the burden of these impacts is not distributed equitably. Historically disadvantaged groups—including Indigenous peoples, children and adolescents, older persons, and low-income communities—face disproportionate risks, not only physical but also psychological and cultural. These populations experience profound emotional harms—from chronic anxiety and post-traumatic stress disorder (PTSD) to loss of cultural identity—as a result of environmental degradation linked to climate change.

Additionally, the flammable and explosive nature of methane makes it a significant technological hazard, with the potential to cause severe accidents in industrial, mining, and residential contexts. This risk is especially acute in places with deficient environmental management, such as landfills, endangering human life and critical infrastructure.

In light of this well-established scientific reality, addressing the methane crisis with urgency is not only a technical and environmental priority but also an ethical and legal obligation in pursuit of climate justice and human dignity. The principal emitting sectors—waste management, the fossil fuel industry, and agriculture—already have technically feasible, low-cost, and immediately effective solutions whose implementation would drastically reduce emissions in the short and medium term. Acting decisively on methane will not only protect our climate and ecosystems but also advance the realization of human rights, strengthening the path toward a sustainable, just, and dignified future for all communities.

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Clean Air Task Force: https://www.catf.us/

Climate and Clean Air Coalition. (CCAC): https://www.ccacoalition.org/

The Global Methane Hub: https://www.globalmethanehub.org/


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