The 2023 Report of The *Lancet* Countdown on Health and Climate Change

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List of Abbreviations

A&RCC – Adaptation & Resilience to Climate Change

CDP – Carbon Disclosure Project

CFU – Climate Funds Update

CO_2 – Carbon Dioxide

CO_2e – Carbon Dioxide Equivalent

COP – Conference of the Parties

ECMWF – European Centre for Medium-Range Weather Forecasts

EE MRIO – Environmentally-Extended Multi-Region Input-Output

EH – Extreme Heat

EJ – Exajoule

EM-DAT – Emergency Events Database

ERA – European Research Area

ETS – Emissions Trading System

EU – European Union

FAO – Food and Agriculture Organization of the United Nations

GBD – Global Burden of Disease

GDP – Gross Domestic Product

GHG – Greenhouse Gas

GNI – Gross National Income

$GtCO_2$ – Gigatons of Carbon Dioxide

GW – Gigawatt

GWP – Gross World Product

HAP – Household Air Pollution

HDI – Human Development Index

HHA – Heat-Health Alert

HNAP – Health National Adaptation Plan

IEA – International Energy Agency

IHR – International Health Regulations

IO – International Organisations

IPC – Infection Prevention and Control

IPCC - Intergovernmental Panel on Climate Change

IRENA - International Renewable Energy Agency

LPG – Liquefied Petroleum Gas

LT-LEDS – Long-term Low Emissions and Development Strategies

MODIS – Moderate Resolution Imaging Spectroradiometer

MRIO – Multi-Region Input-Output

Mt – Metric Megaton

$MtCO_2e$ – Metric Megatons of Carbon Dioxide Equivalent

NAP – National Adaptation Plan

NASA – National Aeronautics and Space Administration (US)

NBS – Nature-based solutions

NCDs – Non-communicable diseases

NDCs - Nationally Determined Contributions

NDVI – Normalised Difference Vegetation Index

NHS – National Health Service

NO_x – Nitrogen Oxide

OECD – Organization for Economic Cooperation and Development

O&G – Oil and Gas

$PM_{2.5}$ – Fine Particulate Matter (less than 2.5 micrometres in diameter)

PV – Photovoltaic

SCA – South and Central America

SDG – Sustainable Development Goal

SDU – Sustainable Development Unit

SPEI – Standardised Precipitation Evapotranspiration Index

SSS – Sea Surface Salinity

SST – Sea Surface Temperature

tCO_2 – Metric tons of Carbon Dioxide

tCO2/TJ – Total Carbon Dioxide per Terajoule

TJ – Terajoule

TPES – Total Primary Energy Supply

TWh – Terawatt Hours

UN – United Nations

UNEP – United Nations Environment Programme

UNFCCC – United Nations Framework Convention on Climate Change

UNGA – United Nations General Assembly

UNGD – United Nations General Debate

US$ – 2022 United States Dollars (unless clarified in the text)

WHO – World Health Organization

WMO – World Meteorological Organization

WNV – West Nile Virus

Executive Summary

The *Lancet* Countdown is an international research collaboration independently monitoring the evolving impacts of climate change on health, and the emerging health opportunities of climate action. In its eighth iteration, this 2023 Report draws on the expertise of 114 scientists, and practitioners from 52 research institutions and UN agencies around the world to provide its most comprehensive assessment yet.

In 2022, the *Lancet* Countdown warned that people's health is at the mercy of fossil fuels, and stressed the transformative opportunity of jointly tackling the concurrent climate change, energy, cost of living, and health crises for human health and wellbeing. This year's report finds few signs of such progress. At the current 1.14°C mean heating above pre-industrial levels, climate change is increasingly impacting the health and survival of people worldwide, and projections show these risks could worsen steeply with further inaction. However, with health matters gaining prominence in climate change negotiations, this report highlights new opportunities to deliver health-promoting climate change action, and deliver a safe, thriving future for all.

The rising health toll of a changing climate

In 2023, the world saw the hottest global temperatures in over 100,000 years, and heat records were broken in all continents through 2022. Adults over 65 years of age and infants under one year old, to whom extreme heat can be particularly life-threatening, are now exposed to twice as many heatwave days as they would have experienced in 1986-2005 (indicator 1.1.2). Harnessing the rapidly advancing science of detection and attribution, new analysis shows that over 60% of the days which reached health-threatening high temperatures in 2020 were made more than twice as likely to occur due to anthropogenic climate change (indicator 1.1.5); and heat-related deaths of people over 65 years increased by 85% compared to 1990-2000, substantially above the 38% increase that would have been expected had temperatures not changed (indicator 1.1.5).

Simultaneously, climate change is damaging the natural and human systems upon which people rely for good health. The global land area affected by extreme drought increased from 18% in 1951-1960 to 47% in 2013-2022 (indicator 1.2.2), jeopardising water security, sanitation, and food production. A higher frequency of heatwaves and droughts in 2021 was associated with 127 million more people experiencing moderate or severe food insecurity compared to 1981–2010 (indicator 1.4), putting millions at risk of malnutrition and potentially irreversible health effects. The changing climatic conditions are also putting more populations at risk of life-threatening infectious diseases such as dengue, malaria, vibriosis, and West Nile virus (indicator 1.3).

Compounding the direct health impacts, the associated economic losses increasingly harm livelihoods, limit resilience, and restrict funds available to tackle climate change. Economic losses from extreme-weather events increased by 23% between 2010-2014 and 2018-2022, amounting to US$264 billion in 2022 alone (indicator 4.1.1), while heat exposure led to global potential income losses worth US$863 billion (indicators 1.1.4 and 4.1.3). Labour capacity loss affected low and medium Human Development Index (HDI) countries most, exacerbating global inequities, with potential income losses equivalent to 6.1% and 3.8% of their Gross Domestic Product (GDP), respectively (indicator 4.1.3).

The multiple and simultaneously rising risks of climate change are exacerbating global health inequities and threatening the very foundations of human health. Health systems are increasingly strained, and 27% of surveyed cities declared concerns over their health systems being overwhelmed by the impacts of climate change (indicator 2.1.3). Often due to scarce financial resources and limited technical and human capacity, the countries most vulnerable to climate impacts also face the most challenges in achieving adaptation progress, reflecting the human risks of an unjust transition. Only 44% and 54% of low and medium HDI countries, respectively, reported high implementation of health emergency management capacities, compared to 85% of very high HDI countries (indicator 2.2.5). Additionally, low and medium HDI countries had the highest proportion of cities not intending to undertake a climate change risk assessment in 2021 (12%) (indicator 2.1.3). These inequalities are aggravated by the persistent failure of the wealthiest countries to deliver the promised modest sum of 100 US$ billion annually to support poorer countries in climate action. Consequently, it is those countries that have historically contributed the least to climate change that are bearing the brunt of its health impacts – both a reflection and a direct consequence of the structural inequities that lie within the root causes of climate change.

The human costs of persistent inaction

The growing threats experienced to date are early signs and symptoms of what a rapidly changing climate could mean for the health of the world's populations. With 1,337 tonnes of CO_2 emitted each second, each moment of delay worsens the risks to people's health and survival.

In this year's report, new projections reveal the dangers of further delay in action, with every health dimension tracked worsening as the climate changes. If global mean temperature continues to rise to just under 2°C, annual heat-related deaths are projected to increase by 370% by mid-century, assuming no substantial progress on adaptation (indicator 1.1.5). Under such a scenario, heat-related labour loss is projected to increase by 50% (indicator 1.1.4), and heatwaves alone could lead to 524.9 million additional people experiencing moderate to severe food insecurity by 2041-2060, aggravating the global risk of malnutrition. Life-threatening infectious diseases are also projected to spread further, with the length of coastline suitable for vibrio pathogens expanding by 17%-25%, and the transmission potential for dengue increasing by 36%-37% by mid-century. As risks rise, so will the costs and challenges of adaptation. These estimates provide some indication of what the future could hold. However, lack of accounting for non-linear responses, tipping points, and cascading and synergistic interactions could render these projections conservative, disproportionately increasing the threat to the health of populations worldwide.

A world accelerating in the wrong direction

The health risks of a 2°C hotter world underscore the health imperative of accelerating climate change action. With limits to adaptation drawing closer, ambitious mitigation is paramount to keep the magnitude of health hazards within the limits of the capacity of health systems to adapt. Yet, years of scientific warnings of the threat to people's lives have been met with grossly insufficient action, and policies to date put the world on track to almost 3°C of heating,.

The 2022 Lancet Countdown report highlighted the opportunity to accelerate the transition away from health-harming fossil fuels in response to the global energy crisis. However, data this year shows a world often moving in the wrong direction. Energy-related CO_2 emissions grew 0.9% to a record 36.8 Gt in 2022 (indicator 3.1.1), and still only 9.5% of global electricity comes from modern renewables (mainly solar and wind energy), despite their costs falling below that of fossil fuels. Concerningly, driven partly by record profits, oil and gas companies are further reducing their compliance with the Paris Agreement: the strategies of the world's 20 largest oil and gas companies as of early 2023 will result in emissions surpassing levels consistent with Paris Agreement goals by 173% in 2040 – up by 61% from 2022 (indicator 4.2.6). Rather than pursuing accelerated development of renewable energy, fossil fuel companies allocated only 4% of their capital investment to renewables.

Meanwhile, global fossil fuel investment grew 10% in 2022, reaching over US$ 1 trillion (indicator 4.2.1). The expansion of oil and gas extractive activities has been supported through both private and public financial flows. Across 2017-2021, the 40 banks that lend most to the fossil fuel sector invested collectively US$489 billion annually in fossil fuels (annual average), with 52% increasing their lending since 2010-2016. Simultaneously, in 2020, 78% of the countries assessed, responsible for 93% of all global CO_2 emissions, still provided net direct fossil fuels subsidies totalling US$305 billion, further hindering fossil fuel phase out (indicator 4.2.4). Without a rapid response to course-correct, the persistent use and expansion of fossil fuels will lock-in an increasingly inequitable future that threatens the lives of billions alive today.

The opportunity of a healthy future

Despite the challenges, data exposes the transformative health benefits that could come from the transition to a zero-carbon future, with health professionals playing a crucial role in ensuring that these gains are maximised.

Globally, 775 million people still live without electricity, and close to one billion people are still served by healthcare facilities that lack reliable energy. With structural global inequities in the development, access, and use of clean energy, only 2.3% of electricity in low HDI countries comes from modern renewables (against 11% in very high HDI countries), and 92% of low HDI country households still rely on biomass fuels to meet their energy needs (against 7.5% in very high HDI countries) (indicators 3.1.1 and 3.1.2). Against this backdrop, the transition to renewables can enable access to decentralised clean energy and, coupled with interventions to increase energy efficiency, can reduce energy poverty and power high quality health-supportive services. By reducing the burning of dirty fuels (including fossil fuels and biomass), such interventions could help avoid a large proportion of the over 1.8 million deaths occurring annually from dirty fuel-derived outdoor air borne particulate matter pollution ($PM_{2.5}$) (indicator 3.2.1), as well as a large proportion of the 78 deaths per 100,000 inhabitants associated with exposure to indoor air pollution (indicator 3.2.2). Additionally, the just development of renewable energy markets can generate net employment opportunities with safer, more locally-available jobs. Key to maximising health gains is that ensuring countries, particularly those facing high levels of energy poverty, are supported in the safe development, deployment and adoption of renewable energy, thus preventing unjust extractive industrial practices that can harm the health and livelihoods of local populations, and a widening of health inequities.

With fossil fuels accounting for 95% of road transport energy (indicator 3.1.3), interventions to enable and promote safe active travel and zero-emission public transport can further deliver emissions reduction, promote health through physical activity, and avert many of the 460,000 deaths caused annually by transport-derived $PM_{2.5}$ pollution (indicator 3.2.1), and some of the 3.2 million annual deaths related to physical inactivity. People-centred, climate-resilient urban redesign to improve building energy efficiency, increase green and blue spaces, and promote sustainable cooling, can additionally prevent heat-related health harms, avoid air conditioning-derived emissions (indicator 2.2.2), and provide direct physical and mental health benefits.

Turning to food systems, these are responsible for 30% of global greenhouse gas (GHG) emissions, with 57% of agricultural emissions in 2020 derived from the production of red meat and milk (indicator 3.3.1). Promoting and enabling equitable access to affordable, healthy, low-carbon diets that meet local nutritional and cultural requirements can contribute to mitigation, while preventing many of the 12.2 million deaths attributable to sub-optimal diets (indicator 3.3.2).

The health community could play a central role in securing these benefits, by delivering public health interventions to reduce air pollution, enable and support active travel and healthier diets, and promote improvements in the environmental conditions and commercial activities that define health outcomes. Importantly, the health sector can lead by example and transition to net-zero emission, sustainable, and resource-efficient health systems, thereby preventing its 4.6% contribution to global greenhouse gas emissions, with ripple effects to the broader economy (indicator 3.4).

Some encouraging signs of progress offer a glimpse of the enormous human benefits that health-centred action could render. Deaths attributable to fossil fuel-derived air pollution have decreased by 16.7% since 2005, with 80% of this reduction the result of reduced coal-derived pollution. Meanwhile the renewable energy sector grew to a historical-high of 12.7 million employees in 2021 (indicator 4.2.2); and renewable energy accounted for 90% of the growth in electricity capacity in 2022 (indicator 3.1.1). Supporting this, global clean energy investment grew 15% in 2022, to US$1.6 trillion, exceeding fossil fuel investment by 61% (indicator 4.2.1); and lending to the green energy sector rose to US$498 billion in 2021, approaching fossil fuel lending (indicator 4.2.7). Scientific understanding of the links between health and climate change is rapidly growing, and, while coverage lags in some of the most affected regions, over 3000 scientific articles covered this topic in 2022 (indicators 5.3.1 and 5.3.2). Meanwhile, the health dimensions of climate change are increasingly acknowledged in the public discourse, with a record 28% of all climate change newspaper articles in 2022 referring to health (indicator 5.1). Importantly, international organisations are increasingly engaging with the health co-benefits of mitigation (indicator 5.4.2), and governments increasingly acknowledge this link, with 95% of updated Nationally Determined Contributions under the Paris Agreement now referring to health - up from 73% in 2020 (indicator 5.4.1). These trends signal what could be the start of a life-saving transition.

A people-centred transformation: putting health at the heart of climate action

With the world currently heading towards 3°C of heating, any further delays in climate change action will increasingly threaten the health and survival of billions alive today. If meaningful, the prioritisation of health in upcoming international climate change negotiations could offer an unprecedented opportunity to deliver health-promoting climate action, and pave the way to a thriving future. However, delivering such ambition will require standing up to the economic interests of the fossil fuel and other health-harming industries, and delivering science-grounded, steadfast, meaningful, and sustained progress to shift away from fossil fuels, accelerate mitigation, and deliver adaptation for health. Unless such progress materialises, the growing emphasis on health within climate change negotiations risks being mere healthwashing; increasing the acceptability of initiatives that minimally advance action, and which ultimately undermine – rather than protect – the future of billions alive today, and of generations to come.

Safeguarding people's health in climate policies will require the leadership, integrity and commitment of the health community. With its science-driven approach, that community is uniquely positioned to ensure that decision makers are accountable, and foster human-centred climate action that safeguards human health above all else. The ambitions of the Paris Agreement are still achievable, and a prosperous and healthy future still lies within reach. But it will take the concerted efforts and commitments of health professionals, policy makers, corporations and financial institutions to ensure the promise of health-centred climate action becomes a reality that delivers a thriving future for all.

Introduction

Due to human activity, global mean temperature reached 1.14°C above pre-industrial levels in 2022,[1] triggering global climate and environmental changes that pose an unequivocal, immediate and worsening threat to the health and survival of people worldwide.[2] The past eight years were the warmest ever registered,[3] record-breaking extreme weather events occurred in every continent in 2022, and July 2023 was the hottest month ever registered, with detection and attribution studies showing the influence of climate change in making many of these more severe or likely to occur.[4–16] A record hot summer caused almost 62,000 deaths in Europe in 2022;[17] extreme floods affected 33 million people in Pakistan and 3.2 million people in Nigeria; [16,18,19] A record drought in the Greater Horn of Africa,[20] made more severe by climate change, contributed to worsening local food insecurity, which now affects 46.3 million people;[21] wildfires scorched parts of Europe,[22,23] South America,[24,25] and China;[4,26] while less noticeable but deeply damaging slow-onset climate-related events are altering infectious disease distribution, affecting food security, impacting essential infrastructure, and undermining the socioeconomic determinants of health.[2,27–31] As a result, the impacts of climate change on physical and mental health are rapidly growing. While no region is unaffected, the most vulnerable and minoritised populations, which often contributed least to climate change, are disproportionately affected – a direct consequence of structural injustices, and harmful power dynamics both between and within countries.[2,32–34]

Although in the 2015 Paris Agreement countries committed to pursuing "efforts to limit the temperature increase to 1.5°C above pre-industrial levels", greenhouse gas (GHG) emissions reached record levels in 2021, and again in 2022.[35,36] Unless urgently rectified, current policies will lead to potentially catastrophic 2.7°C [2.2°C – 3.4°C] of heating by 2100.[37] Last year, the 2022 report of the *Lancet* Countdown found that global health lies at the mercy of fossil fuels,[38] and with the threat of climate change increasing, further delays put the world at risk of missing "a rapidly closing window of opportunity to secure a liveable and sustainable future".[39,40]

Putting health at the centre of climate change action

Averting the worst impacts of climate change requires profound and immediate systemic changes, many with the potential to improve the health profile of world populations.[41] To enable a healthy future, these changes must go beyond treatment of the health symptoms of climate change, to put particular focus on primary prevention, rapidly accelerating mitigation efforts across all sectors, to ensure that climate change impacts stay within the bounds of the adaptive capacity of health and health-supporting systems (Panel 1).

Panel 1: Eleven priorities to deliver a healthy, thriving future

Data in this report underscore the health imperative for accelerated action to limit climate change and its health impacts. Numerous previous efforts have laid out roadmaps and policy recommendations to meet the goals of the Paris Agreement.[39,40,42,43] Building on them, the recommendations below identify priorities to maximise the benefits of climate change action to people's health and wellbeing. As such, they are intended to shape the priorities of international organisations, national or sub-national decision makers, business, financial institutions, and health systems, as they implement the policies needed to meet their commitments under the Paris Agreement. In all cases, regular monitoring and course-correcting is crucial to ensure benefits to health and wellbeing are achieved and that social and health inequities are reduced through their implementation.

Accelerate fossil fuel phase-out, prioritising energy-sector and food system interventions with health co-benefits

1. **Promote a health-centred energy transition that maximises health gains.** Ban, and cease funding, all new oil and gas projects. Prioritise actions that both accelerate the transition away from fossil fuels, and that can deliver health co-benefits and reduce socioeconomic and health inequities. While context-dependent, such interventions could include reducing or banning the burning of fossil fuels in urban centres and banning flaring, therefore contributing to reducing air pollution; promoting and enabling shifts to safe active travel modes including through urban redesign and the provision of safe, attractive and accessible active travel alternatives; increasing availability and access to safe greenspaces; increasing energy efficiency and improving building energy performance that can support healthy indoor temperatures; and prioritising the deployment of sustainable cooling over energy-intensive cooling alternatives. In all cases,

put robust regulations in place to prevent renewable energy-related extractive processes from harming the health of local populations and exacerbating health and socioeconomic inequities (indicators 2.2.2, 2.2.3, 3.1.1-3.2.2, 4.2.6).

2. **Reduce the health harms of energy poverty by supporting a just zero-carbon transition:** Empower countries with high reliance on dirty fuels (fossil fuels, particularly coal, and biomass) and high levels of energy poverty to locally develop, deploy, maintain and use modern renewable energy sources, and to develop autonomous energy systems. In doing so, and through knowledge and technology transfer programmes and financial support, support the development of local skills and promote local healthy employment, including through knowledge and technology transfer programmes and financial support. Prioritise interventions that deliver energy to energy-poor regions, focusing on electrifying homes and healthcare facilities, and enabling access to quality health-supporting services (indicators 3.1.1, 3.1.2, 4.2.1, 4.2.2, 4.2.7 and panel 5).

3. **Accelerate mitigation in food systems through support for, and promotion of, healthier low-carbon diets**. Support investment in climate smart-horticulture, through, for example, and where locally relevant, research and development, subsidies, improved extension services, and better market access. Support consumers through policies that improve equitable access to affordable, culturally relevant, low carbon plant-forward diets that meet nutritional needs, through, for example, integration into social programmes including maternal and child health initiatives and safety nets; targeted subsidies; support to reduce food waste; and improved public health messaging; in addition to regulating against the production, sale and promotion of unhealthy foods (indicator 3.3.1 and 3.3.2).

Promote the health sector's leadership by delivering health-promoting climate change action

4. **Deliver public health programmes that simultaneously improve public health and reduce greenhouse gas emissions**, considering the risks, needs, culture, and preferences of local communities. These could include policies to tackle air pollution by rapidly phasing out polluting fuel burning especially near vulnerable populations (e.g., around hospitals, schools and care facilities, and inside people's homes); supporting, facilitating and enabling a transition to healthy, affordable, low-carbon diets; enhancing green prescribing; supporting locally-tailored and sustainable heat-coping behaviours that protect health; and promoting, enabling, and facilitating increased physical activity, including for travel (indicators 1.1.2, 1.1.5, 2.2.2, 2.2.3, 3.2 and panel 4).

5. **Lead by example, building sustainable, efficient, net-zero emission health systems** in alignment with the ambitions of the COP26 Heath Programme. Prioritise clean energy, energy efficiency, and resource stewardship. Foster safe replacement of high-carbon resources by low-carbon alternatives (including anaesthetics gases and inhalers). Promote transparency on climate change impacts, and decarbonisation of suppliers (indicator 3.4).

Accelerate climate change adaptation for health.

6. **Accelerate the development of climate-resilient health systems,** in agreement with the COP26 health programme. Scale up technical and financial support at the national and local level, particularly in low and medium-HDI countries, to conduct thorough national and sub-national health and climate change risk and vulnerability assessments and Health National Adaptation Plans (indicators 2.1.1-2.1.3 and 2.2.4).

7. **Increase the capacity of health systems to prepare for, and respond to, climate-related health risks**, including through the implementation of climate-informed health surveillance and early warning and response systems for key health risks threatening local populations. Ensure adequate technical and financial

support, and increased alignment between health and meteorological services, including by establishing formal collaboration between these sectors[44] (indicators 2.2.1 and 2.2.5).

Transform financial systems to support a healthy, sustainable future

8. **Increase climate finance to promote a healthy, just transition**, including through the UNFCCC's financial mechanisms and funding provided by multilateral development banks. Increase the allocation of funds to support health-related adaptation, and equitable global access and deployment of renewable energy technologies, particularly in low and medium HDI countries, prioritising local job generation, skills development, and improved socioeconomic determinants of health (indicators 3.1.1, 3.1.2, 2.2.4, 4.2.1, 4.2.2).
9. **Rapidly phase-out all subsidies, lending to and investment in oil and gas,** including their exploration and extraction. Redirect financial support towards developing, up-scaling and deploying healthy, zero-carbon energy and energy efficiency, and to activities that simultaneously improve the health, wellbeing, and livelihoods of all populations, particularly those communities most vulnerable to the withdrawal of subsidies. Increase investment in zero-carbon energy and energy efficiency, and accelerate divestment from fossil fuel funding (indicators 4.2.1, 4.2.3, 4.2.5 and 4.2.7).

Increase resources and support to continue expanding the knowledge base, understanding, and engagement of key actors in health and climate change

10. **Strengthen global capacity for health and climate change research and knowledge generation,** focusing on identifying and informing effective and cost-efficient public health and climate change adaptation and mitigation interventions, and on monitoring these to reduce health burdens and inequities; as well as on characterising the health impacts of the commercial activities of the fossil fuel and other carbon-intensive industries, and of interventions to prevent them. In doing so, promote and facilitate active involvement of young people and minoritised groups, to identify health and climate change solutions that minimize or eliminate health inequities and foster learnings from those in the front line of climate change impacts, putting particular focus on harnessing and capturing the knowledge of indigenous communities through meaningful engagement (Indicator 5.3).
11. **Increase support to maintain and strengthen health and climate change monitoring** at global, regional, and national levels. Monitor the health benefits and any unintended harms delivered through climate action within the UNFCCC's Global Stocktake and Global Goal on Adaptation. Establish national observatories on health and climate change, using standardized frameworks and indicators to evaluate progress and inform decision-making (panel 2).

A zero-carbon transition will not only avoid the worst health impacts of climate change, but can simultaneously deliver major health and socioeconomic co-benefits. Health-centred adaptation efforts are equally necessary to minimise the impacts of now inevitable temperature rise on human health and survival and, by strengthening health and health-supporting systems, would have rippling benefits to public health. However, realising these health gains requires human health and survival to be a central consideration in how international organisations, governments, corporations, and individuals understand and address climate change.

COP28 will be the first COP to feature health as a core theme – a significant step forward advancing health-centred climate change action (Panel 2). The renewed demand for health-centred climate change action reflects years of engagement and continuous efforts of the scientific and health community, and offers a unique opportunity to build a healthy future for all. However, this opportunity will turn to hazard if short-term health promises are used as a screen to divert attention from the imperative need to limit temperature rise to 1.5°C, transition away from fossil fuels, and deliver transformational benefits to global health.

A health stocktake for a thriving future

Ensuring that health-promoting climate action is delivered at the necessary speed and scale requires a regular exercise of stocktaking and monitoring. To fulfil this purpose, the *Lancet* Countdown: Tracking Progress on Health and Climate Change was established as a multidisciplinary, international collaboration that works to annually take stock of the evolving links between health and climate change. Providing the most up-to-date assessment of the links between health and climate change, its findings are published ahead of the United Nations Climate Change Conference, focused on identifying the changing health impacts of climate change, and keeping countries accountable for their progress. Building on eight years of iterative improvement of the monitoring framework, this year's findings inform recommendations for key actions to enable a healthy, thriving future for all (Panel 1).

Panel 2: UN climate negotiations for a healthy future

The 2015 Paris Agreement was ratified by 195 countries. Legally binding and science-driven, it commits governments to pursue efforts to limit global mean temperature rise to 1.5°C, and protect the human right to health; prevent harm; and promote the right to a clean, healthy, and sustainable environment.[45,46]

The Paris Agreement's potential to deliver immediate health benefits and avoid the threat to human survival posed by climate change prompted it to be labelled as potentially the most important public health agreement of the 21st century.[47] Delivering such ambition requires placing health protection and promotion at the heart of climate negotiations, with many of its negotiation areas offering opportunities to achieve this, as laid out below.

Mitigation

Mitigation ambition and implementation must be urgently scaled up in this critical decade to improve and protect global health and equity.[48] Acknowledging common but differentiated global responsibilities, Nationally-Determined Contributions (NDCs) and Long-term Low Emissions and Development Strategies (LT-LEDS) offer the possibility for countries to put forward their climate plans, and could offer a platform to ensure these maximise health benefits while minimising trade-offs. Ongoing UNFCCC negotiations on response measures also provide a mechanism to encourage governments to quantify and maximise the health co-benefits from climate change actions.[49]

Adaptation

Placing public health at the centre of transformational adaptation targets can help ensure that people's health, and particularly that of the most vulnerable groups, is protected.[50] COP28 will finalise the work programme on the Global Goal on Adaptation (GGA).[51] Positioning health and wellbeing as a core pillar of adaptation within the GGA could foster actions to protect the health of world populations from rising climate change-related health risks.

Loss and Damage

The health impacts of climate change represent the human face of non-economic Loss and Damage. COP27 established a new fund, expected to be operationalised by COP28, to help what the UNFCCC refers to as "developing countries" respond to losses and damages caused by climate change. This includes loss of life and damage to health and health systems.[46]

Economics and finance

Negotiations to transform the global financial system are taking place in 2023.[46] COP28 offers an opportunity to make finance flows "consistent with a pathway towards low GHG emissions and climate-resilient development".[45] This includes delivering on the 2009 Copenhagen Accord commitment to mobilise US$100 billion per year to support countries classified as "developing" within the UNFCCC in their climate transition and to double adaptation finance.[52] This offers an opportunity to eliminate harmful finance flows, including as fossil fuel subsidies, and to support a healthy future by redirecting funds to interventions that protect and promote equity, health, and survival.

Food and agriculture

The role of the global food system in responding to climate change is organised under the Sharm el-Sheikh joint work programme (2023 – 2026).[46] This mandates governments to strengthen the role of food systems in nurturing human health and wellbeing, including through the safeguarding of food security and ending hunger, improving nutrition security, and building inclusive, sustainable and climate-resilient agricultural systems. Realising these ambitions could provide major health benefits to global populations, particularly those suffering from food insecurity and malnutrition.

Stocktaking and monitoring

The first Global Stocktake, concluding at COP28, will assess global progress against the delivery of the goals of the Paris Agreement. Considering public health, wellbeing, and survival as primary goals against which to monitor progress can ensure countries' actions are tailored and refined to maximise the health benefits of climate action as they work to deliver the ambitions of the Paris Agreement.

The 2023 report of the *Lancet* Countdown represents the efforts, expertise and dedication of 113 researchers from 52 academic and UN institutions worldwide from all continents but Antarctica, and guided by the Lancet Countdown's Scientific Advisory Group and High-Level Advisory Board.[53] Its data are the product of eight years of iterative improvements of 47 indicators (Panel 3), built on the priorities identified through a global consultation amongst experts and policy makers.[54] Following strict criteria of quality, scientific rigour and relevance,[53] *Lancet* Countdown indicators are periodically refined, with existing indicators improved and new indicators introduced as the availability of data and methods evolves (Panel 4).[53] An independent quality improvement process provides rigour and transparency to the collaboration's data, incorporating input from independent experts on all new or substantially improved indicators to complement the *Lancet*'s peer-review.[53] While methodological constraints and limits in the availability of data with adequate geographical and temporal coverage impedes the capacity to address persistent gaps in the *Lancet* Countdown's indicator suite, the *Lancet* Countdown continues to work to address these gaps, welcoming contributions from fellow researchers for indicator improvement and development (for further details visit https://www.lancetcountdown.org/our-science).

In this year's report, the methodologies and temporal and/or geographical coverage of most indicators has been substantially improved. New metrics now provide improved attribution of impacts to climate change, project future risks, and better account for health co-benefits of climate change action and a zero-carbon financial transition. Complementing this report, data are presented in higher geographical and temporal detail in the *Lancet* Countdown's freely available online data visualisation platform (https://www.lancetcountdown.org/data-platform/). Methodological details and further findings are presented in the Appendix, alongside a description of the caveats and limitations of each indicator – making the Appendix an essential companion to fully interpret the findings in this report.

Panel 3: The indicators of the 2023 report of The Lancet Countdown

Section	Indicator	
1: Health Hazards, Exposures, and Impacts	1.1: Health and Heat	1.1.1: Exposure to Heating
		1.1.2: Exposure of Vulnerable Populations to Heatwaves
		1.1.3: Heat and Physical Activity
		1.1.4: Change in Labour Capacity
		1.1.5: Heat-Related Mortality
	1.2: Health and Extreme Weather-related Events	1.2.1: Wildfires
		1.2.2: Drought
		1.2.3: Extreme Weather and Sentiment
	1.3: Climate Suitability for Infectious Disease Transmission	
	1.4: Food Security and Undernutrition	
2: Adaptation, Planning, and Resilience for Health	2.1: Assessment and Planning of Health Adaptation	2.1.1: National Assessments of Climate Change Impacts, Vulnerability and Adaptation for Health
		2.1.2: National Adaptation Plans for Health
		2.1.3: City-level Climate Change Risk Assessments
	2.2: Enabling Conditions, Adaptation Delivery, and Implementation	2.2.1: Climate Information for Health
		2.2.2: Air Conditioning: Benefits and Harms
		2.2.3: Urban Green Space
		2.2.4: Global Multilateral Funding for Health Adaptation Programs
		2.2.5: Detection, Preparedness, and Response to Health Emergencies
	2.3: Vulnerabilities, Health Risk, and Resilience to Climate Change	2.3.1: Vulnerability to Mosquito-borne Disease
		2.3.2: Lethality of Extreme Weather Events
		2.3.3: Migration, Displacement, and Rising Sea Levels
3: Mitigation Actions and Health Co-Benefits	3.1: Energy Use, Energy Generation and Health	3.1.1: Energy Systems and Health
		3.1.2: Household Energy Use
		3.1.3: Sustainable and Healthy Road Transport
	3.2: Air Pollution and Health Co-benefits	3.2.1: Mortality from Ambient Air Pollution
		3.2.2: Household Air Pollution
	3.3: Food, Agriculture, and Health Co-benefits	3.3.1: Emissions from Agricultural Production and Consumption
		3.3.2: Diet and Health Co-Benefits
	3.4: Healthcare Sector Emissions	
4: Economics and Finance	4.1: The Economic Impact of Climate Change and its Mitigation	4.1.1: Economic Losses due to Weather-related Extreme Events
		4.1.2: Value of Losses Due to Heat-related Mortality
		4.1.3: Loss of Earnings from Heat-related Labour Capacity Reduction
		4.1.4: Costs of the Health Impacts of Air Pollution
	4.2: The Economics of the Transition to Zero-Carbon Economies	4.2.1: Clean Energy Investment
		4.2.2: Employment in Renewable Energy and Fossil Fuel Industries
		4.2.3: Funds Divested from Fossil Fuels
		4.2.4: Net Value of Fossil Fuel Subsidies and Carbon Prices

		4.2.5: Production-based and Consumption-based Attribution of CO_2 and $PM_{2.5}$ Emissions
		4.2.6: Compatibility of Fossil Fuel Company Strategies With the Paris Agreement
		4.2.7 Fossil Fuel and Green Bank Lending
5: Public and Political Engagement in Health and Climate Change	5.1: Media Engagement in Health and Climate Change	
	5.2: Individual Engagement in Health and Climate Change	
	5.3: Scientific Engagement in Health and Climate Change	5.3.1: Scientific Articles on Health and Climate Change 1990-2022
		5.3.2: Scientific Engagement on the Health Impacts of Climate Change
	5.4: Political Engagement in Health and Climate Change	5.4.1: Government Engagement
		5.4.2: Engagement by International Organisations
	5.5: Corporate Sector Engagement in Health and Climate Change	

Panel 4: The *Lancet* Countdown's evolving monitoring system

The *Lancet* Countdown was established in 2016 to offer an independent, rigorous and comprehensive assessment of progress on health-promoting climate change action. The indicator domains covered in its monitoring system are the product of eight years of iterative improvements. In its initial phase, indicator domains were selected through a consultation amongst a variety of experts and policymakers, and subsequently refined by the *Lancet* Countdown's academic working groups at a series of multidisciplinary workshops throughout 2016.[54] With the publication of its inaugural report in 2016, the *Lancet* Countdown initiated an open consultation to further refine the indicator domains and metrics.[54] Yearly thereafter, its suite of indicators was iteratively improved through internal consultation within the academic working groups of the *Lancet* Countdown, and complemented by an ongoing and inclusive process of engagement with the broader scientific community. With that purpose, the *Lancet* Countdown maintains an open approach, and continues to invite direct input on the content, methods, and data of its indicators, as well as proposals for new indicators and indicator domains, through its website (https://www.*Lancet*countdown.org/our-science/).[53]

To ensure the relevance and quality of its metrics, all proposals for new indicators or indicator improvements (both those made by members of the *Lancet* Countdown as well as those proposed by other colleagues) are evaluated through an independent assessment process, in which external experts evaluate their quality and fit, providing rigour and transparency to the collaboration's data.

Each indicator in the *Lancet* Countdown's assessment must comply with the following criteria:

- Track an aspect of the relationship between health and climate change, well evidenced in the literature and not adequately covered through other indicators in the report.
- Utilise data from a reliable source, available at adequate temporal and spatial scales to enable trends to be observed at a global level.
- Be updatable periodically, ideally annually or more regularly.

The indicators must also be:

- ***Meaningful***: Track an aspect of the relationship between health and climate change that is well evidenced in the literature, and relevant at a global level
- ***Relevant***: The area being tracked by the indicator must be of relevance to policy and decision makers, and/or represent an important contribution to the field of science of climate change and health
- ***Scientifically sound and reproducible***: The indicator must use a well-established, internationally accepted, and ideally previously published scientific methods
- ***Temporally representative***: The indicator should provide annual data for the recent past and to a year as recent as possible. It must be available across an adequate timescale to allow for attribution to climate change, where relevant
- ***Geographically representative***: The indicator should be ideally available at a country, or higher level of resolution. Its geographical coverage should be enough for global trends to be observed, covering at least 40 countries evenly distributed across the four World Bank income contexts, the four Human Development Index Groups, and the five WHO regions initially, with possibility of expansion to 150 countries at least. In the case of indicators tracking aspects relevant to restricted locations, over 80% of relevant countries must be covered by the indicator
- ***Reliable and use updatable***: The indicator should use data from a reliable source, fit for its purpose. Publicly available databases, and especially those developed by international organisations, governmental bodies or academic institutions, are preferred. Data sources must be regularly updated.

Abiding by these criteria enables a globally representative, annually updateable, and relevant monitoring system. However, these criteria also pose restrictions, limiting the possibility of capturing aspects for which comprehensive data coverage is not available globally, not regularly updated, or not quantifiable. As a result, some important gaps still remain in the *Lancet*

Countdown' monitoring system, including the mental health impacts of climate change, the links between climate change, migration and health, the health benefits of shifts to active travel, the economic losses associated to the health impacts of climate change, and other areas more broadly neglected within data collection and research efforts. Importantly, the scarcity of data disaggregated by gender, race, Indigeneity, socioeconomic position, religion, nationality, or other minoritised characteristics restricts the capacity of the indicators to capture the inequities that underpin climate change impacts and climate change action.

As it enters a new phase, the *Lancet* Countdown will revisit its indicator domains, and focus efforts in guiding the collection of data that can support an increasingly relevant, comprehensive and actionable monitoring system.

Elevating regional perspectives

Local contexts define the health impacts of climate change and the opportunities for climate change action, and must be understood to ensure climate change actions protect health, reduce inequities, and maximise associated health co-benefits. To this end, the *Lancet* Countdown has established Regional Centres around the world, to generate regionally-led policy-relevant evidence on the local links between health and climate change. The Centres in Asia (Tsinghua University, China),[55] South America (Universidad Peruana Cayetano Heredia, Peru),[56] Europe (Barcelona Supercomputing Center, Spain),[57] and Oceania (Macquarie University and the University of Sydney, Australia)[58] have well-established networks of regional researchers producing indicator reports for their respective regions or key countries within them. The growing Small Island Developing States (SIDS) centre (University of the West Indies, Jamaica) will publish their first report in 2024, while efforts are underway to launch develop a new African centre.

Driven by the expertise of the Regional Centres, a new section in this report provides a global comparison of the health impacts of climate change, and progress, opportunities and constraints for climate change action across world regions (Section A). This section complements the more detailed regionally-focused analysis in the *Lancet* Countdown's regional indicator reports due to be published in upcoming months, which will cover in more detail the regional, national and in occasions sub-national progress on health and climate change.

An ambitious new phase to match the urgency of action

The path to a liveable future is becoming steeper with every moment of inaction. In 2024, the Lancet Countdown will increase its ambition, with further resources to monitor and inform an urgent and healthy transition. Efforts will focus on addressing persistent research gaps (including links with mental health, migration, and the disproportionate impacts on minoritised communities), and supporting decision-makers and international negotiations to enact policies based on this evidence. Across these activities, the Lancet Countdown will deepen its strategic efforts to increase representation, equity, and inclusion in global and regional efforts. In its new phase, the *Lancet* Countdown will continue to welcome input from researchers worldwide to develop increasingly refined and globally-representative metrics.[53] By doing so, it will continue to foster a global and interdisciplinary collaboration working to produce timely and actionable evidence to support health-promoting climate change action, and a thriving future for all.

Part A: Evolving Regional Progress and Inequities in Health and Climate Change

Climate change impacts are experienced locally, and a comprehensive assessment of the links between health and climate change requires local perspectives, experience, and knowledge. Harnessing the expertise of the *Lancet* Countdown's regional centres, this part of the report draws on the findings of the indicators presented in Part B, to provide an assessment of the climate change risks, responses, and opportunities across world regions. This section will be complemented by upcoming reports of the *Lancet* Countdown's regional centres, which will explore in further detail the evolving health profile of climate change in each region, including wherever possible highlighting in-country inequities, through local high-quality data. More information on the *Lancet* Countdown's regional groupings and indicator findings is provided in the Appendix (pp 2-6).

The Unequal Health Impacts of Climate Change

Climate change is impacting people unequally around the world.[59] Annually in 2018-2022, people in SIDS, Africa, South and Central America (SCA), and Asia experienced the highest number of days of health-threatening temperatures attributable to climate change (103, 78, 72, and 47 days per person respectively) (indicator 1.1.5). With more frequent health-threatening temperatures and a growing over-65 population, Africa experienced the biggest increase in heat-related mortality rate since 1992-2000. However, Europe had the highest rate of heat-related mortality in recent years (indicator 1.1.5).

Heat exposure limits labour productivity, undermining livelihoods. In 2013-2022, it resulted in 189 potential labour hours lost annually per worker in Asia and 161 in Africa (indicator 1.1.4). As a result, Africa also saw the highest relative potential income loss in 2022, equivalent to 4.1% of its GDP, with 81% of potential income losses falling on the generally poorer and least protected agricultural workers (indicator 4.1.3). In addition, Africa and the Western Pacific had higher proportions of outdoor workers (32.1% and 29.8%, respectively), placing them at particularly heightened risk from climate hazards (indicator 1.1.4).

Compounding rapidly rising temperatures, droughts increasingly affect global food security (indicator 1.4), water security, sanitation, supply chains and energy generation.[27,60,61] Africa was region most affected by droughts too, with 64% of its land area affected by at least one month of extreme drought per year on average in 2013-2022, up from 9% in 1951-1960. In the Horn of Africa, some areas experienced a full 12 months of drought in 2022, pushing millions to the brink of famine.[21,23,62,63] Mostly reflecting Australia's record 2017-2020 drought, Oceania was the second most affected region, with 55% of its land area experiencing extreme drought in 2013-2022 (up from 14% in 1951-1960).[64,65] In SCA, 53% of land area was affected in 2013-2022, including year-round droughts in parts of central Brazil's Amazon rainforest, increasing risks of forest die-back (indicator 1.2.2).[66] Rising sea surface temperatures also threaten marine food yields.[67] European and North American coasts saw the largest increases in sea surface temperature in 2022, compared to 1981-2010 (+0.83°C and +0.73°C, respectively) (indicator 1.4). As a result, many fishing communities, including Arctic Indigenous communities in North America, face rising food insecurity.[68–72]

In addition, heating seas and melting ice bodies increase sea level rise hazards.[2] Asia, SIDS, and Europe have the largest proportions of population settled less than one metre above current sea level (2.8%, 2.0%, and 1.5%), which translates to areas facing risks of coastal erosion, floods, and salinized land and water resources (indicator 2.3.3). The hotter seas are also making coastal brackish waters increasingly suitable for the transmission of some Vibrio pathogens: from 1982 to 2022, Europe experienced the biggest increase in the length of coastline suitable for Vibrio at any one time in the year (+142km annually, reaching 17% its coastline). Meanwhile, an additional 83km of coastline became suitable for Vibrio annually in Asia, reaching 17% of its coastline in

2022, and leading to an estimated increase of 5,000 cases of vibriosis annually, reaching some 421,000 cases in 2022 (indicator 1.3).

The transmission potential for dengue is also increasing, contributing to its rapid global expansion.[73] From 1951-1960 to 2013-2022, SIDS and Oceania had the biggest increases in its transmission potential (R0), up by 1.65 and 0.84 (indicator 1.3). Meanwhile, the transmission season for malaria is lengthening in many regions, with the biggest increase in African highlands for *P. falciparum* (+0.61 months), and in South and Central America (SCA) highlands for *P. vivax* (+0.8 months). The transmission season lengthened by at least a week in North American lowlands and SCA highlands for both parasites, and in both highlands and lowlands in SIDS.

As climate change-related health risks increase, effective local adaptation, informed by an in-depth understanding of local vulnerabilities and hazards, is essential to protect human health and survival and reduce health inequities. However, measures to prepare and respond to health emergencies are lagging in all world regions (indicator 2.2.5). Moreover, while health system strengthening has reduced the vulnerability to severe outcomes from mosquito-borne diseases in Africa, SCA, and SIDS since 1990, urbanisation is now increasing vulnerability worldwide (indicator 2.3.1).

With 55% of the world population living in urban centres, city-level interventions hold enormous potential and must be informed by in-depth understanding of local risks and vulnerabilities. In 2022, between 80 and 92% of surveyed cities in Oceania, Europe, and North America reported that they had completed a climate risk and vulnerability assessment. However, the proportion was considerably lower in Africa (62%; 43/69), SCA (56%; 149/268), and Asia (51%; 117/231) (indicator 2.1.3), regions in which climate hazards are rapidly accelerating, and are most unprotected.

The Regional Health Inequities of an Unjust Transition

Energy-related emissions are the biggest single contributor to climate change, but these emissions vary greatly amongst world regions. In 2020, the regions with the highest average per-person energy sector emissions were Oceania (13.4 tCO_2/person on average, mostly driven by Australia), and North America (12.9 tCO_2/person), regions where low political engagement on climate change resulted in insufficient, and often negligible, climate change action.[74] Per-person emissions in Oceania were 14 times higher than in Africa (0.97 tCO_2/person), and 3.4 times higher than in Asia (3.9 tCO_2/person; 7.4 tCO_2/person in China). However, with 61% of the world's population, Asia contributed 59% of all global energy-related CO_2 emissions in 2020 (17.7 $GtCO_2$, 57% of regional emissions from China) (indicator 3.1.1).

Although renewable energy generation is increasing in all regions, it has not substantially replaced fossil fuels: North America reduced the carbon intensity of its energy sector by 15% between 1992 and 2020 – a trend which the US Inflation Reduction Act of 2022 seeks to accelerate.[75] However, at its 2011-2020 decarbonisation pace, it would take North America 82 years to fully decarbonise its energy sector. Similarly, the carbon intensity of Europe's energy system decreased 22% between 1992 and 2020, would take 80 years to fully decarbonise at the current pace (indicator 3.1.1). As countries seek new energy sources amidst the current energy crisis, the situation could worsen, including by the US's approval of the oil drilling Willow Project in Alaska and coal phase-out deceleration in European countries.[76,77]

Renewable investment is also unequally distributed. Only 1% of renewable energy investments in 2022 were in Africa.[42] Despite plentiful renewable energy resources, clean renewables accounted for just 1.0% and 0.4% of the energy supply in Africa and SIDS in 2020, respectively, compared with 2.4% in North America, 2.7% in Asia and SCA, 3.0% in Europe, and 6.0% in Oceania (indicator 3.1.1).[78] This situation perpetuates reliance on polluting fuels, particularly in energy-poor regions. In 2020, biomass and waste burning still contributed to 84% of the household energy consumption in Africa, 46% in SIDS, 33% in SCA, and 32% in Asia, against 5% to 11% in North America, Oceania, and Europe. (indicator 3.1.2). The global energy and economic crisis means investment and access to non-polluting household energy could decrease further.[79] The highly unequal use, deployment of, and access to renewable energy across world regions contrasts starkly with the availability of the natural resources that energy technologies require, and results from – and perpetuate – harmful global power dynamics.[80]

Air pollution from the energy sector continues to generate long-lasting health impacts in every region, particularly in urban centres. Of all global deaths attributable to fuel-derived particulate matter less than 2.5 micrometres diameter ($PM_{2.5}$) , 77% occurred in Asia (1.3 million). With coal still contributing 43% of its total energy, Asia had the highest mortality from coal-derived $PM_{2.5}$ amongst all regions, at 11 deaths per 100,000 (indicator 3.2.1). In Europe, air quality control measures coupled with a 5.2 percentage point reduction in the share of coal-derived energy since 2005 contributed to a 36% decrease in ambient $PM_{2.5}$-related mortality, 44% of which was due to reduced coal-related pollution. Despite this, Europe still had the highest death rate from outdoor $PM_{2.5}$ (69 deaths per 100,000), as well as from dirty fuel (fossil fuels and biomass)-derived $PM_{2.5}$ (38 deaths per 100,000), in 2020 (indicators 3.1.1 and 3.2.1). Moreover, through imports, 33% of the $PM_{2.5}$ emissions induced by European consumption contaminates the air in other world regions (indicator 4.2.5).

Despite these health harms, governments continue to hamper the transition to clean, renewable energies by subsidising fossil fuels.[81,82] Of the 87 countries analysed (Appendix pp 189), which contribute 93% of global GHG emissions, all countries in Africa (eight) and SCA (nine) still provided net subsidies to fossil fuels, and had the lowest median net carbon prices of all regions in 2020. In contrast, the highest median net carbon prices (lowest effective subsidies) were in Europe (34 countries) and North America (two countries), with the latter the only world region with net fossil fuel taxes, of 0.9 $/t (indicator 4.2.4). While fossil fuel subsidies can improve energy access, they are inefficient and often regressive.[83] Those funds could be redirected to promoting access to clean renewable energy, or to improving health and wellbeing, delivering net health benefits forging a liveable future.[84]

Delayed mitigation in the food sector has also come at a high health cost. Oceania and North America, with high levels of red meat consumption, and SCA, with carbon-intensive meat production systems, had the largest per-person emissions from red meat consumption in 2020, representing 86%, 70%, and 81% of their agricultural emissions, respectively. Emissions in these regions were 4.2 (Oceania), 2.3 (North America), and 2.6 (SCA) times higher than per person emissions in SIDS, the region with the lowest per-person emissions from red meat consumption (indicator 3.3.1). Shifting towards more affordable and accessible plant-based diets can reduce these emissions, simultaneously delivering substantial health benefits. This is particularly true for populations in North America, Europe, and Oceania, which have the highest mortality from excess consumption of red and processed meat, and from insufficient consumption of fruits, vegetables, legumes, and whole grains (indicator 3.3.2).

These data reveal the deep global inequities that underpin delays in climate change mitigation, and underline the health imperative for building just, equitable, and environmentally-sustainable systems for extraction, access, and use of energy and natural resources,[78] that leaves no one behind. To achieve this, the transition to a zero-carbon, healthy future must avoid reproducing harmful extractive practices that disproportionately harm the health of minoritized groups, including those living in lower HDI countries, rural communities, and Indigenous Peoples.[34,80]

Growing but Unequal Engagement on Health and Climate Change

To maximise the benefits to human health and survival, climate change action must be informed by evidence, understanding and engagement with the local interactions between health and climate change, and harnessing the knowledge of Indigenous Peoples and other communities at the frontline of climate change impacts. However, the generation of scientific evidence is uneven across world regions. The region most studied in 2022 was Asia, with 1,095 peer-reviewed articles exploring the links between climate and health. The majority of these (59%) focused on China and India. North America and Europe followed, with 398 and 305 studies, respectively. With only 51 articles, SIDSs was the least studied region, emphasising the urgency to expand research on health and climate change in these vulnerable states (indicator 5.3).

References to health in the first round of Nationally Determined Contributions (NDCs) were common in the most vulnerable regions, with 84% to 100% of countries in SCA, Africa, Asia, and SIDS referring to them, but substantially less so in North America, Oceania, and Europe (50%, 33%, and 14% of NDCs, respectively). This changed in the second round of NDCs, in which all SCA, SIDS, and North American countries; 97% of African countries; and 92% of European NDCs mentioned health. The trend was only reversed for Oceania, where no country mentioned health (indicator 5.4.1).However, the average proportion of countries referencing the climate-health nexus in the UN General Debate in 2018-2020 was the lowest in SCA (18.7%), Asia (22.8%), and Africa (26.7%) – regions that bear much of the brunt of climate impacts.

Conclusion

Climate change is placing human health and survival at risk in every world region. However, these threats vary widely: while climate hazards are determined by wide-ranging climates and topographies, vulnerabilities depend on highly unequal local epidemiological and socioeconomic characteristics. As a result, the most underserved countries and communities are currently disproportionately affected. A just transition that minimises global inequities and avoids negative impacts and that ensures no one is left behind, is essential to a healthy future.[85] However, countries that have historically contributed the least to climate change often lack resources and lag in the implementation of adaptive solutions, further amplifying health inequities. Inadequate funding has been a major barrier to a just transition, aggravated by the undelivered Copenhagen Accord commitment of mobilising US$100 billion annually to support climate change action in countries labelled as “developing” in the context of the UNFCCC.[86]

Mitigation efforts have likewise been woefully inadequate and inequitable. Although the regions with the highest per-person emissions (North America, Europe, and Oceania), are accelerating decarbonisation efforts, the current pace falls far short of Paris Agreement ambitions.[40] Beyond exacerbating climate risks, this inaction has come at substantial health costs for local populations, with high mortality rates from fuel-derived air pollution. Meanwhile, countries in Africa, Asia, SCA, and SIDS are being left behind in the transition to non-polluting energy, despite plentiful natural renewable energy resources. The resulting high levels of dirty fuel use, household air pollution, and limited energy access in these regions expose the health costs of unjust climate change action – stressing the need to foster equity in the access and use non-polluting energy technologies to support sustainable development, improve health, and reducing global inequities.[87,88]

To be effective, the transition to clean, zero-emission energy must be enabled through financial mechanisms and importantly, equitable. As such, it must ensure that lower HDI countries are empowered and enabled – including through financial and technical support – to develop and deploy local renewable energy technologies by (amongst other means) implementing robust policies and regulations that prevent the replication of harmful extractive industrial models that widen health inequities and disproportionately affect the health of populations in resource-rich, lower HDI countries.[89]

Realising the transformative public health opportunities of just and urgent climate change action requires a deep understanding of the links between climate and health at a local level. To support this, the Lancet Countdown's regional centres are working to produce locally-relevant scientific evidence, led by local researchers. Upcoming regional reports will enhance the evidence provided in this section, to support decision makers in a healthy transition to a net-zero future. The extent to which scientific evidence is collectively acted upon will ultimately define the global health profile for generations to come.

Part B: Taking Stock of Progress on Health and Climate Change

The following sections present the eighth annual update of the *Lancet* Countdown's indicators, which monitor global progress on health and climate change. Indicators have been substantially improved this year, providing an increasingly comprehensive and relevant global stocktake. Indicators tracking health hazards, exposures, and impacts now better distinguish the influence of changing climate from other drivers and, in a major shift, now also include projections whenever possible, building on an effort commissioned and supported by the Climate Vulnerable Forum for its third Climate Vulnerable Monitor.[90] Newly introduced indicators and sub-indicators monitor high temperatures attributable to climate change, the environmental suitability for West Nile virus transmission, household air pollution, bank lending for fossil fuel and clean renewable energy industries, and the scientific assessment of extreme events' health impacts, focusing on detection and attribution studies. A full account of these changes, alongside more detailed descriptions of findings, are provided in the Appendix.

Section 1: Health Hazards, Exposures, and Impacts

Climate change is already affecting the physical, environmental, and socioeconomic conditions on which human health and survival depend.

Section 1 tracks the health hazards, exposures, and impacts of climate change globally. The first group of indicators tracks the multidimensional effects of heat on health. The second group tracks the health threats and impacts of extreme weather and weather-relate events. The two final indicators track slower onset events: the climate suitability for infectious disease transmission, and the effects of the changing climate on food insecurity. Most indicators track spatiotemporal changes in weather and climate, integrating demographic data to track health-related outcomes in exposed populations.[91,92] New data track the health-threatening hot days attributable to climate change; the climate suitability for West Nile virus transmission; and the number of outdoor workers who are most exposed to climate hazards. As a major addition this year, this section builds on contributions to the third Climate Vulnerable Monitor,[93] now including projections under a scenario in which action is taken to limit global mean surface temperature rise to 2°C, stabilising at 1.8°C by 2100 (SSP1-2.6), and under one that assumes no further mitigation, in which heating reaches 3.6°C above pre-industrial levels by 2100 (SSP3-7.0).[94] These projections show the risks of climate inaction and stress the urgency for accelerating mitigation efforts to limit global mean surface temperature rise to 1.5°C, and urgently increasing adaptation to ensure a liveable future.

1.1 Heat and Health

Heat exposure can result in heat-related illness, exacerbate underlying health conditions, and lead to mental ill-health and adverse pregnancy and birth outcomes.[95–102] High temperatures also affect people's capacity to work and willingness to undertake physical activity.[103–105]

Indicator 1.1.1: Exposure to Heating

Headline finding: from 1986-2005 to 2022, populations were exposed to an average increase in summer temperature three times the global mean.

Land areas, and particularly urban areas, are heating up faster than the global average.[106,107] This indicator tracks the population-weighted change in global summer temperatures and shows that humans experienced triple the mean global temperature increase between 2022 and the 1986-2005 baseline (0·9°C population weighted compared to 0·3°C).

Indicator 1.1.2: Exposure of Vulnerable Populations to Heatwaves

Headline finding: in 2013-2022, infants and people over 65 experienced, on average, 108% more days of heatwave per year than in 1986-2005.

Infants and older adults are particularly vulnerable to adverse health effects from heat exposure.[99,108] This indicator monitors the exposure of these highly-vulnerable age groups (under 1 and over 65 years of age) to heatwaves days (defined as a period of 2 or more days where both the minimum and maximum temperatures are above the 95th percentile of 1986–2005).[109,110]

Compared to 1986-2005, the number of heatwave days during 2013-2022 increased 94% globally. This increase resulted in each child under the age of one being exposed on average to 110% more days of heatwave, on average, in this time period (4.0 days in 1986-2005, increasing to 8.4 days in 2013-2022), while each person over 65 years of age was exposed on average to 96% more days each (increasing from 5.0 to 9.8 days). Combined with demographic changes, the total person-days of heatwave exposure increased 134% for under-1s, and 228% for over-65s.

Projections estimate a 1120% increase in heatwave exposure of people over 65 under by 2041-2060 compared to 1995-2014 in a scenario compatible with limiting global temperature rise to 2°C, rising to a 2,510% increase by 2080-2100. Under a scenario of no further mitigation, the projected increases are even higher, rising to 1670% by mid-century, and 6311% by 2080-2100.

Indicator 1.1.3: Heat and Physical Activity

Headline finding: in 2013-2022, compared to 1991-2000, there were 241 additional hours annually, during which ambient heat posed a moderate or higher risk of heat stress during light outdoor physical activity.

Regular physical activity provides health benefits throughout the lifecourse,[111,112] and represents an effective, low-cost, and low-emission intervention for reducing the risk of non-communicable diseases and healthcare demand.[113,114] However, heat be a motivational barrier to engage in physical activity; and can increase heat illness risk for those who do.[115]

This indicator incorporates temperature, humidity, and solar radiation to estimate the hours during which ambient conditions present a heightened heat stress risk if undertaking outdoor exercise.

Compared to 1991–2000, the hours of at least moderate heat stress risk for light outdoor physical activity (e.g., walking) increased by an average of 241 hours per person (20·1% increase) annually during 2013–2022. For moderate intensity activity (e.g., jogging, cycling) there was an increase of 253 hours (19·0% increase) (Figure 1).

Under a scenario compatible with limiting global temperature rise to 2°C, an additional 426 hours per person would pose at least a moderate heat stress risk during light physical activity on average annually by 2040-2060 compared to 1995-2014. This would rise to 596 hours per person under a scenario with no further mitigation. By the end of the century (2080-2100), the annual average number of hours per person that pose at least a moderate risk of heat stress would increase slightly to 451 under a 2°C-compatible scenario; under a scenario with no further mitigation these would increase sharply to 1,124 hours per person each year.

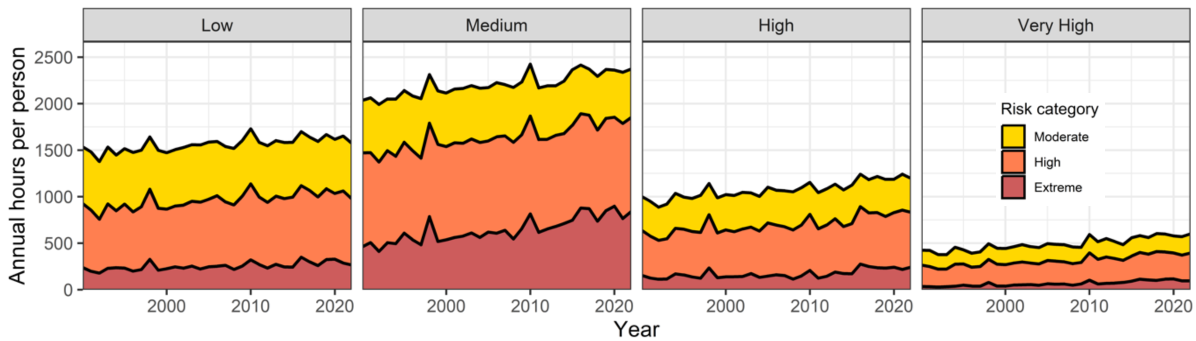


Figure 1: Average annual hours per person that light physical activity entailed at least a moderate, high, or extreme heat stress risk by HDI country grouping (Low, Medium, High, Very High), 1991–2022.

Indicator 1.1.4: Change in Labour Capacity

Headline finding: heat exposure led to the loss of 490 billion potential labour hours in 2022, a nearly 42% increase from 1991–2000.

Heat exposure reduces labour productivity and puts workers' health at risk, particularly those undertaking physically strenuous labour, working in not-cooled environments, or working outdoors.[103] The resulting loss of labour capacity undermines livelihoods and the socioeconomic determinants of health.[116]

This indicator monitors potential work hours lost as a result of heat exposure, by associating temperature, humidity, and solar radiation (via Wet-Bulb Globe Temperature) with the typical metabolic rate of workers in specific economic sectors.

In 2022, heat exposure resulted in a loss of 490 billion potential labour hours, 42% more than the annual average in 1991–2000. On average, each worker in the world lost 143 potential hours of labour capacity. Over 1.3 billion workers, 39% of the global workforce, experienced losses greater than that, and 80% of these were from low or medium HDI countries. In contrast, 87% of workers experiencing losses below the average lived in high or very high HDI countries. By 2041-2060 and without further adaptation, a scenario compatible with limiting temperature rise to 2°C would result in 62% more potential labour hours lost annually than in 2022. In a scenario with no further mitigation,88% more hours lost are projected. By the end of the century, losses relative to 2022 would increase to 68% and 328%, respectively.

New to 2023, the number and percentage of working-age, outdoor workers, the group most affected by heat-related labour capacity loss and heat-related health risks, was estimated for 195 countries/areas, using UN estimates of occupational sunlight exposures and working-age populations.[117,118] Globally, in 2022, an estimated 1.6 billion paid workers – 26.4% of the working-age population – worked outdoors. Males (38.4% of all males) and young or middle-age groups (33.4% of people aged 25-54) are overrepresented, although un-paid labour, to which women often dedicate more time than men, is not accounted for in these figures.[119] Between 2000 and 2022, there were reductions in both the number of outdoor workers (-0.2 billion) and the percentage of working-age people who worked outdoors (-15·3%).

Indicator 1.1.5: Heat-related Mortality

Headline finding: in 2018-2022, people experienced on average 86 days of health-threatening high temperatures annually. 60% of such temperatures were made more than twice as likely to occur by human-caused climate change.

The aging population, increased NCD incidence, and urbanisation are increasing populations' vulnerability to extreme heat. Compounding with rising temperatures, this is driving a rapid increase in heat-related deaths globally, one-third of which are attributable to anthropogenic climate change.[120]

The first part of this indicator identifies days in which temperatures exceed a conservative threshold over which heat-related deaths are likely to increase (above the 83.6th percentile of temperatures in 1986-2005), and calculates the extent to which human-caused climate change increased their likelihood. It finds that people were exposed, on average, to 86 days per year of health-threatening high temperature in 2018-2022 (Figure 2), 60% of which were made more than twice as likely due to anthropogenic climate change.

The second part of the indicator combines the exposure to temperatures above this threshold with an exposure-response function to model the change in heat-related mortality in people older than 65 years of age.[121] In 2013-2022, compared to 1991-2000, the estimated average annual heat-related mortality increased by 85%, driven by both warming and changing demographics. A counterfactual simulation keeping temperatures unchanged from baseline values shows that demographic changes alone would have resulted in just a 38% increase in mortality in 2013-2022, compared with 1991-2000.[122]

Annual heat-related mortality of people over 65 years of age is projected to increase by 370% above 1995-2014 levels by 2041-2060 under a scenario compatible with limiting global temperature rise to 2°C, and by 433% under scenario in which no further mitigation occurs, assuming no further adaptation. By 2081-2100, these are projected to be 683% and 1537%, respectively.

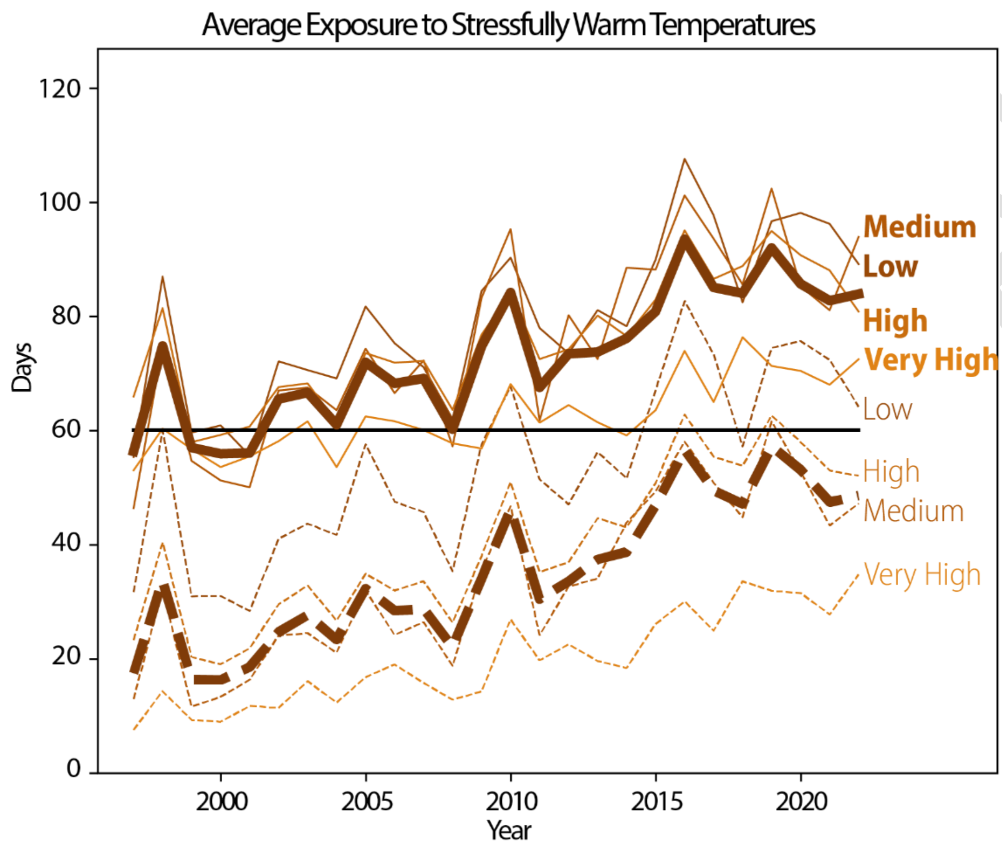


Figure 2 Population-weighted exposure to temperatures above the 84th percentile for 1986-2005. In a climate with no anthropogenic climate change, this value would be expected to be close to 60 days (black line). The number of days HDI country groups are displayed as solid lines, and the heavy line is the global average. The number of days of exposure to warm temperatures made at least twice as likely by climate change are plotted as a dashed orange lines.

1.2 Health and Extreme Weather-related Events

Climate change-driven increases in temperature and changes in rainfall patterns are increasing the frequency, intensity, and duration of life-threatening extreme weather and weather-related events.[123] These events pose direct and indirect risks to physical and mental health.[50,98,100–102,124–141] The indicators below track the changing incidence of key health-threatening extreme events. Efforts are ongoing to better capture the changing risk of floods, a crucial gap which will be addressed in upcoming reports.

Indicator 1.2.1: Wildfires

Headline finding: The number of days in which people were exposed to very or extremely high fire danger increased in 57% of countries between 2003–2007 and 2018–2022. However, exposure to wildfires decreased in 56 countries and increased in only seven during this period.

Rising temperatures and incidence of drought increase the risk of wildfires, which affect health through thermal injuries, smoke exposure, loss of essential and health-supporting physical infrastructure, and impacts on mental health.[142–144]

Population data and a Fire Danger Index which captures meteorological fire risk,[145,146] suggest that, on average, people globally were exposed to six more days of very high or extremely high wildfire danger in 2018-2022 compared with 2003-2007, with an increase observed in 57% of countries and no change or a decrease in the rest. However, potentially due to wildfire management and control, reduced availability of vegetation or other forms of fuel following previous fires, land use change (including urban expansion), or rural-urban migration continuing to concentrate populations in cities, 56 countries saw a statistically significant reduction in the days each person was exposed to active wildfires annually in 2018-2022 compared to 2003-2007, whereas only seven saw a statistically significant increase. During 2003-2022, global average wildfire smoke concentrations, as estimated using the SILAM chemistry transport model and active-fires satellite observations,[147–150] did not change significantly. However, there was a statistically significant increase in wildfire smoke concentrations in Eastern Siberia, Western US, Canada, and India. In 2018-2022, low and medium HDI countries were affected by 1.6 times higher wildfire smoke concentrations than high and very high HDI countries.

Compared to 1995-2014, the number of days of exposure to very high or higher wildfire risk is projected to increase by approximately 9 extra days per person (11% increase) by the middle fo the century, both in a scenario compatible with limiting global temperature rise to 2°C, and in a scenario in which no further mitigation occurs. Towards the end of the century, a scenario with no further mitigation is projected to result in three times more days of exposure (27 more days than in 1995-2014), than in a 2°C-compatible scenario(9·6 more days than in 1995-2014). Likewise, the global mean fire-related $PM_{2.5}$ concentration would be 5% higher in the no-further-mitigation scenario than in a 2°C-compatible scenario by 2041-2060, but 50% higher by 2081-2100 assuming no further adaptation.

Indicator 1.2.2: Drought

Headline finding: the global land area affected by extreme drought per year increased from 18% in 1951-1960 to 47% in 2013-2022.

In 2022, extreme drought affected every continent. Impacts on crop yields and loss of livestock worsened food insecurity, and water shortages affected water security in vulnerable areas.[20,21,23,64]Low river flows hampered electricity generation and fluvial transportation, affecting energy access and economic activity.[23,25] Women and girls, who are those charged with water collection and distribution in many water-insecure settings, are likely to be increasingly exposed to gender violence and physical harms as they have to travel longer distances to collect water, or as they are unable to fulfil these domestic tasks.[151]

Accounting for precipitation and heat-driven evapotranspiration,[152] this indicator reports that the global land area affected annually by at least one month of extreme drought increased from 18% in 1951–1960, to 47% in 2013–2022 (Figure 3). Year-round drought affected many vulnerable areas in 2022, including the Horn of Africa, the Western Sahara, and the southern Amazon region of Brazil.

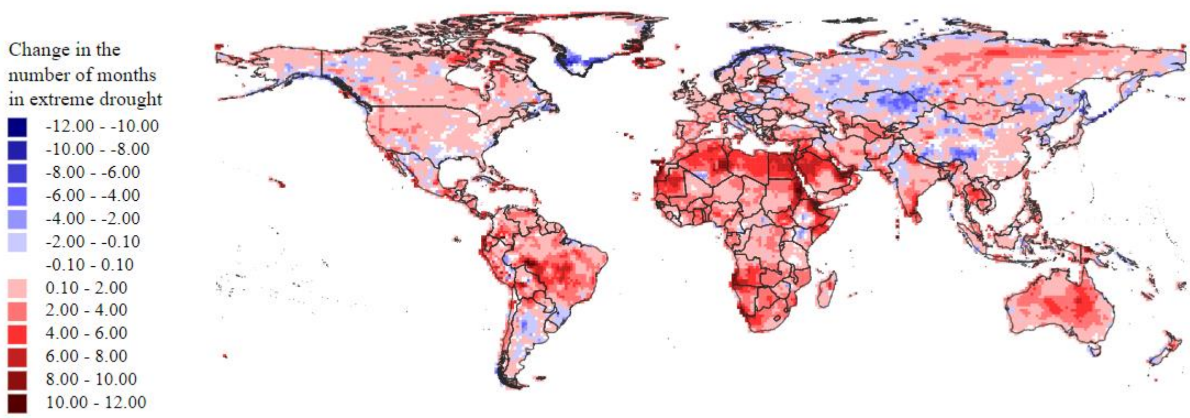


Figure 3: Change in the number of months per year in extreme drought from 1951-60 to 2013-22.

Indicator 1.2.3: Extreme Weather and Sentiment

Headline finding: extreme weather in 2022 was associated with a record 0·53 percentage point reduction in online positive sentiment expression during heatwaves, and a 0·31 percentage point reduction in positive sentiment expression during extreme precipitation days.

Extreme weather events, including heatwaves and extreme precipitation, can affect people's mental wellbeing.[131,140,153] This indicator uses a multivariate fixed-effects panel regression to monitor the effects of heatwaves and extreme precipitation on expressed online sentiments (as the share of tweets reflecting positive or negative expressions), adjusting for date, location, seasonality, and meteorological conditions.[153–156] The lexical content of 8·2 billion tweets from 190 countries and ~44,000 localities was analysed. Of note, social media use is more common in wealthier countries that also have greater ability to adapt to heat stress and other climate-related factors, compared to poorer countries. Thus, these estimates likely underestimate the true global impacts of environmental stressors on sentiment (see appendix pp 61).

Over the past eight years, the adverse impact of heatwaves on both negative sentiment and positive sentiments increased in magnitude. Days with extreme precipitation had an increasingly negative impact on online positive sentiment expression between 2015 and 2022, whereas there was no noticeable trend for the impact on negative sentiment. Extreme weather in 2022 was associated with a record 0·53 percentage point reduction in online positive sentiment expression during heatwaves, and a 0·31 percentage point reduction in positive sentiment expression during extreme precipitation days.

Indicator 1.3: Climate Suitability for Infectious Disease Transmission

Headline finding: the annual average climatic suitability of West Nile Virus (WNV) transmission increased by 4·4% from 1951-1960 to 2013-2022; the transmission potential for dengue by Aedes aegypti and albopictus increased by 42.7% and 39.5%, respectively; and the coastline suitable for Vibrio transmission increased by 329 km annually since 1982.

Changing climatic conditions are altering the transmission potential of many vector-, water-, food-, and air-borne infectious diseases.[157–159] This indicator monitors the changing climatic suitability of West Nile virus (WNV), dengue, zika, chikungunya, malaria, and non-cholera *Vibrio* pathogens.

WNV is a climate-sensitive mosquito-borne disease that circulates in birds and can spill over to humans via *Culex* (*Cx.*) mosquitoes.[160–163] It can cause rare but severe illness involving the central nervous system.[164] Over the past two decades, it has emerged in the Americas and expanded in Europe, where it is becoming a public health concern.[165,166] This new sub-indicator leverages experimentally-established vector-pathogen-temperature relationships to track temperature-induced changes in the relative basic reproduction number (R0) for WNV (WNV-R0), in regions where three relevant *Culex* vectors are present.[160,167] The WNV-R0 was on average 4·4% higher in 2013-2022 compared to 1951-1960, with an increase in the very high (+7·7%), high (+6·6%), and medium (+4·1%) HDI country groups, and a slight decrease in the low HDI country group (-0·7%).

Driven by climatic changes, urbanisation, and human movement, cases of dengue have doubled every decade since 1990, and almost half of the world population is now at risk of this life-threatening disease.[73,168] Using a mechanistic model that accounts for changes in temperature and precipitation, this sub-indicator shows that, relative to 1951-1960, in 2013-2022, the average R0 for dengue transmission by *Aedes aegypti* and *Aedes albopictus* increased by 42.7% and 39.5%, respectively. Other arboviruses are showing similar trends: the R0 for the transmission of chikungunya by *Ae albopictus* increased by 39.5%, and that for the transmission of Zika by *Ae aegypti* increased by 43.5% during the same time period. The length of the transmission season increased for these arboviruses by between 24.3 and 30.3%. The suitability for dengue transmission is expected to increase under all future scenarios of planetary heating. By mid-century, a scenario compatible with limiting global temperature rise to 2°C would see an increase in R0 of 19% for Ae aegypti, and 21% for Ae albopictus from 1995-2014 levels, whereas a scenario in which no further mitigation occurs would see increases of 27% and 30%, respectively. By the end of the century, R0 for Ae aegypti would increase 20%, while Ae albopictus would increase 22% under the 2°C-compatible scenario. Under the scenario with no further mitigation, Ae aegypti would increase 38% and Ae albopictus by 47%.

Fluctuations in the length of the malaria transmission season is inferred using environmental and climatic requirements of the vector (*Anopheles* mosquitoes), and *Plasmodium* parasites.[169] Overall, 9.85% of the land without suitable conditions for transmission of *P. falciparum* in 1951-1960 became suitable by 2013-2022, while 17.34% became suitable for *P. vivax*. Under a scenario compatible with limiting temperature rise to 2°C, 23% of areas not suitable for malaria transmission between 1995-2014 are projected to become suitable in 2041-2060. However, under a scenario in which no further mitigation occurs, this figure rises to 26% in 2041-2060.[170] By the end of the century, although the amount of newly suitable areas would not expand further in the 2°C-compatible scenario, it would increase to 38% in a scenario with no further mitigation.

Vibrio pathogens are ubiquitous in coastal brackish waters, and can cause severe and sometimes life-threatening wound, ear, and gastrointestinal infections in those who come into direct contact with them.[171] This indicator uses a threshold-based model to monitor the suitability for the transmission of pathogenic *Vibrio* species (excluding *V. cholerae*) in global sea coastlines, this year better accounting for salinity. The total coastal area environmentally suitable for Vibrio transmission increased by 329 km annually since 1982. In 2022, the coastline suitable at any one point was 12·7% higher than in 1982-2010, reaching 9.9% of the global coastline (third highest level after 2018 and 2008). A record 81 countries showed suitable areas for Vibrio through 2022. The total population living within 100km of areas with Vibrio suitability, and therefore at risk of transmission, reached a record 1.4 billion people in 2022, 28% above the 1982-2010 average, leading to a record 609,900 estimated vibriosis cases. Under a scenario compatible with limiting temperature rise to 2°C, suitable coastal area is projected to increase by 17-25% and lead to 23-39% more cases by 2041-2060. Under a scenario with no further mitigation, the suitable coastline would be 30-34% higher and lead to 45-46% more cases than in baseline years. By 2081-2100, the suitable coastal area is projected to grow by 10-35% under a 2°C-compatible scenario and 64-84% under a scenario with no further mitigation. Correspondingly, the number of cases would increase by 2-22% and 102-140%, respectively.

Indicator 1.4: Food Security and Undernutrition

Headline finding: the higher frequency of heatwave days and drought months in 2021 compared to 1981–2010, is associated with 127 million more people experiencing moderate or severe food insecurity.

Globally, 735 million people faced hunger in 2022 and 3.1 billion people (42%) were unable to afford a healthy diet in 2021.[172] Through multiple and interconnected pathways, climate change is exacerbating food insecurity: by undermining crop yields; affecting labour capacity of agricultural workers; threatening food security for populations dependent on marine resources, through coastal sea surface temperature elevation, reduced oxygenation, ocean acidification, and coral reef bleaching;[173–175] disrupting supply chains; and reducing food access.[176,177] Minoritised communities, including Indigenous Peoples and subsistence farmers, are particularly affected, as their access to primary and traditional food sources may be compromised, resulting in poorer health outcomes.[178–180] Increased food insecurity can also contribute to malnutrition, which can have irreversible negative impacts on child health and development.

The first part of this indicator combines data from the FAO Food Insecurity Experience Scale (FIES)[181] from 122 countries (up from 103 in the 2022 Report of the Lancet Countdown) with the frequency of heatwave days and drought months (SPEI-12) during the growth seasons of maize, rice, sorghum, and wheat, using a time-varying panel regression. Compared to 1981–2010, a higher number of heatwave days was associated with 4.03 percentage-points higher moderate or severe food insecurity (as defined by FIES) in 2021, while increasing frequency of droughts resulted in food insecurity being 1.78 percentage-points higher, equivalent to approximately 127 million more people experiencing food insecurity (Figure 4). Under a scenario compatible with limiting temperature rise to 2°C , and assuming no further adaptation, 524.9 million additional people are projected to experience food insecurity by 2041-2060 compared to the 1995-2014 baseline. The global health co-benefits of a 2°C-compatible scenario rather than a scenario in which no further mitigation occurs are projected to include 530 million fewer people experiencing food insecurity by 2041-2060, and 1·1 billion fewer food insecure people by 2081-2100.

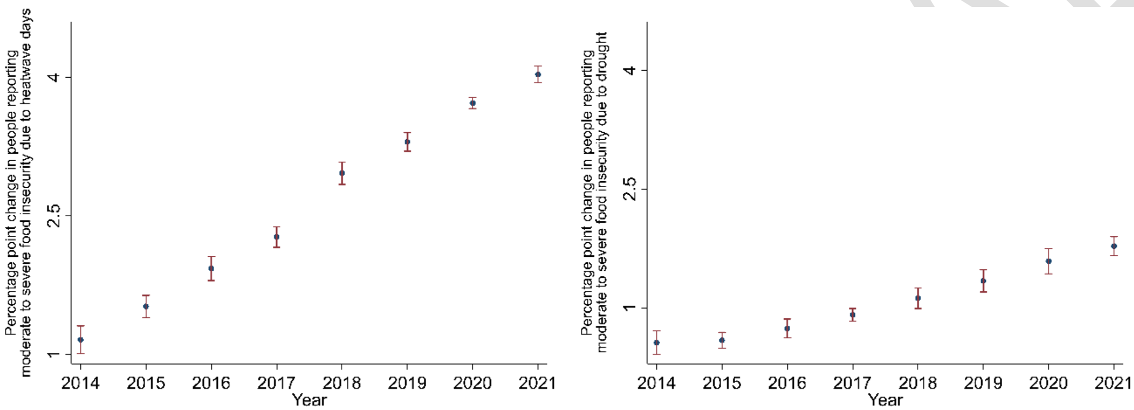


Figure 4: Change in the share of the population (percentage point change) reporting moderate or severe food insecurity (as defined by FIES) due to heatwave days (left-panel) and frequency of drought months (right-panel) occurring during four major crop (maize, rice, sorghum, and wheat) growing seasons.

Marine food yields are threatened by sea surface temperature elevation through reduced oxygenation, ocean acidification, coral reef bleaching, and reduced primary productivity.[182–184] An increase in sea surface temperature (SST) is threatening marine food productivity and the livelihoods of many coastal populations.[185] The second part of this indicator monitors changes in SST, this year with improved geographical and temporal coverage.[186] The SST in global coastal areas increased by 0·51°C in 2020–2022 compared to 1981-2010. SST is projected to increase by 0.99°C by mid-century and by and 1.23°C by the end of the century in a scenario compatible with limiting global mean atmospheric heating to 2°C. SSTs are projected to rise even further under a scenario in which no further mitigation occurs, reaching 1·15°C by mid-century and 2.64°C by the end of the century.[187]

Conclusions

Exposure to climate-related health risks and their impacts are increasing, including from extremes of heat (indicators 1.1.1-1.1.5), wildfire danger (indicator 1.2.1), environmental suitability for infectious diseases (indicator 1.3), and fewer safe hours to work or exercise outdoors (indicators 1.1.3-1.1.4). Populations are increasingly exposed to a multitude of greater climate risks that lead to worsening health outcomes. The inclusion of projections for the first time in this year's report makes clear the potential benefits of more rapid mitigation to limit temperature rise to 1.5°C, and the clear need for – and importance – of increasing adaptation efforts, underlining the health harms that can be avoided by meeting the goals of the Paris Agreement. Ongoing efforts are focused on improving climate change attribution of observed changes.

Despite efforts to develop an increasingly comprehensive assessment of the evolving threats and impacts of climate change on human health, limitations in data availability and modelling mean that multiple gaps still remain. Previous Lancet Countdown reports covered the link between climate change and mental health within panels, but efforts are still ongoing to advance the development of an indicator to cover this critical aspect. In addition, the scarcity of data disaggregated by gender, ethnicity, race, Indigeneity, migrant status, and other characteristics limits the capacity to track the impact of climate change on vulnerable and minoritized groups; and, as a consequence the capacity to assess and address the growing health inequities. Given the current disproportionate impact of climate change on these groups,[34,188] reflecting these inequities is a challenge that the *Lancet* Countdown will continue to pursue.

Due to the complexity of systems modelling, the indicators in this section do not examine the potential negative impacts of interactions and synergies amongst impacts, or social and climate tipping points, which could considerably increase negative effects on human health. Avoiding these extreme risks requires urgent measures to tackle the health harms of climate change by rapidly accelerating both mitigation and adaptation, as non-exclusive and essential interventions.

Section 2: Adaptation, Planning, and Resilience for Health

Section 1 shows that health is already impacted by climate change, and related hazards will worsen with further climate change. Protecting people against rising risks requires increasing adaptation of health and health-supporting systems, while simultaneously reducing GHG emissions to keep climate change within the limits of adaptive capacity.[39] To be effective, adaptation measures should be informed by climate change-health risk assessments, their implementation adequately funded, and their effectiveness in reducing climate change risks evaluated and iteratively improved. With the understanding, conceptualisation, and definition of a path to achieving the Paris Agreement's Global Goal on Adaptation being set in 2023 as the two-year Glasgow-Sharm el-Sheikh work programme comes to a close,[189] prioritising health in these considerations will ensure people are protected in a heating world.

The first group of indicators in this section monitors progress on assessment and planning of health adaptation; the second group assesses the enabling conditions for health adaptation; and the last set tracks vulnerabilities, risk, and resilience to climate change.[190]

2.1: Assessment and Planning of Health Adaptation

To be effective, adaptation plans must be informed by an in-depth understanding of the health risks of climate change across demographics and populations. Indicators in this section monitor how risks are being assessed, and health adaptation planned at national and city-levels.

Indicator 2.1.1: National Assessments of Climate Change Impacts, Vulnerability, and Adaptation for Health

Headline finding: In 2022, 11 of the 64 countries that committed to building climate-resilient health systems through the COP26 Health Programme reported having completed a vulnerability and adaptation assessment.

The COP26 Health Programme was established in 2021, supporting countries in developing climate-resilient and/or low-carbon health systems. Within it, countries commit to conducting climate change and health vulnerability and adaptation assessments (V&As), using them to inform health national adaptation plan (HNAPs) and facilitate access to climate change funding for health.[44,190] The Alliance for Transformative Action on Climate and Health (ATACH), led by the WHO, supports countries with their implementation. To date, 64 countries have committed to building climate-resilient health systems through this Programme. A baseline review indicates that 11 health V&As had been completed between January 2020 and December 2022. These assessments identify a range of key health risks, with infectious and respiratory diseases most common.

Indicator 2.1.2: National Adaptation Plans for Health

Headline finding: Between 2020 and 2022, 4 out of 64 countries that made COP26 commitments developed or updated Health National Adaptation Plans.

HNAPs are a key mechanism for health systems to prepare for the growing climate burden. Adaptation priorities outlined in HNAPs should be informed by V&As and integrated into National Adaptation Plans (NAPs). HNAPs aim to mainstream climate resilience across health governance, service delivery, health workforce, finance, health information systems, and essential medicines and technologies.

Of the 64 countries making COP26 commitments, only 4 developed or updated HNAPs between 2020 and 2022, with funding remaining a key limitation. In response, ATACH established a Financing Working Group to address this barrier. Progress on funding for the implementation of COP26 commitments will be tracked in future reports.

Indicator 2.1.3: City-level Climate Change Risk Assessments

Headline finding: in 2022, 94% of cities (848/898) reported they had completed or were undertaking a city-level climate change risk assessment, up from 713 in 2021.

Urban centres are home to 55% of the world's population.[191] City-level interventions therefore hold much potential to prevent climate change-related health impacts. This indicator evaluates progress in assessing city-level climate change-related health risks using data reported to the CDP.[192]

The number of cities reporting that they have completed, are in the process of undertaking, or intend to undertake a climate change risk assessment within two years increased from 713 in 2021 to 848 in 2022 (94% of 898). Of the 6% (50/898) that reported they were not undertaking a risk assessment, 22% (11/50) indicated that this was due to lack of financial capacity, 24% (12/50) due to lack of technical capacity, and 40% (20/50) due to both.

Amongst respondents, 67% (351/525) declared concern over climate change impacting public health outcomes, and 27% (141/525) over their health systems being overwhelmed.

The most frequently identified hazards were extreme heat (72%, 378/525), heavy precipitation (39%, 205/525), and urban flooding (38%, 200/525).

Low and medium HDI countries had the highest proportion of cities not intending to undertake a climate change risk assessment (12%, 12/100), with financial constraints and/or lack of technical skills as key contributing factors.

2.2: Enabling Conditions, Adaptation Delivery, and Implementation

Adaptation measures must protect populations most at risk, must be integrated across sectors, and must avoid unintended harms. The following indicators monitor health adaptation and adaptation-enabling conditions, highlighting areas of plausible improvements.

Indicator 2.2.1: Climate Information for Health

Headline finding: in 2022, 81% (157/193) of WMO's 193 Members report working with the health sector. The most frequent type of service provided is data (74%; 143/193).

Climate services for health are essential to help the health sector conduct research and make-climate informed decisions for planning, preparedness, and response to climate-sensitive diseases and extreme weather (panel 5). This requires close cooperation between meteorological and health services, and also support for health services to be able to access, understand, and act upon health-relevant meteorological information.[44] In 2022, 81% (157/193) of WMO's 193 Members report working with the health sector. Of those providing services, the most frequent types of service provided are data (74%; 143/193); climate monitoring (61%; 117/193); climate analysis (59%; 114/193), climate prediction (51%; 99/193), and tailored products (50%; 96/193). Relationship and capacity building between the health and climate sectors needs further investment and development.

Panel 5: Early-warning systems for heatwaves: protecting people's health from a heating climate

During the summer of 2022, England saw deadly, record-breaking heatwaves, with temperatures of 40.3°C prompting the first ever Level 4 Heat-Health Alert (HHA) and Red Extreme Heat (EH) weather warning. To understand and inform measures to reduce health impacts from heatwaves, the United Kingdom Health Security Agency (UKHSA) routinely assesses and reports all-cause excess mortality during episodes of heat.[193] In 2022, observed excess mortality was calculated accounting for COVID-19 deaths. In addition, a novel analysis was performed to model the mortality which would have been expected based on the relationship between temperature and mortality, and using multiple lines of evidence to assess seasonal impacts. While the confidence intervals of each estimate overlap, the observed excess mortality associated with 5 extreme heat episodes in 2022 (2,985) was 23% below the mortality modelled (3,889) based on observed temperatures across England. This difference increased further to 32% during the heat episode when the Level 4 HHA and Red EH weather warning were issued (1256 observed; 1852 modelled).

The relationship between heat and mortality, and particularly assessing the impact of implemented interventions on reduced mortality is extremely complex, particularly considering uncertainty in estimates and other challenges regarding attribution. However, the UK Meteorological Office customer research suggests that 98% of the public took some level of action following the Level 4/Red EH warnings, and it is likely that warnings, clear heat messaging, public buy-in, and a joint meteorological and public health communication effort contributed to a lower observed mortality than that predicted through modelling. Heatwaves in the summer of 2022 in England could have had a more disastrous effect, but hundreds of lives were potentially saved through interventions. Further work is needed to reduce heat-related mortality, as highlighted by the 2,985-excess heat-related deaths that occurred. During the late season heat episode, the observed excess mortality was higher than that expected . Factors that may have contributed to this include the fact that the alert level was not as high as in previous episodes (Level 3 HHA), which may have led to a lower perceived risk by the public and therefore a decrease in health-protective action.[193] UKHSA's next phase will move towards impact-based alerting, using maximum and minimum temperature thresholds to guide a dynamic risk assessment process. It is anticipated that this added level of detail and flexibility in the alerts themselves will provide additional information to make more informed decisions. Through additional assessments of humidity, cloud cover, wind, and access to cooling mechanisms there can be a more complex understanding of heatwave health impacts globally.

As reported in indicator 2.2.1, many other countries are beginning to integrate meteorological efforts into health-based warning systems, with city-level actions tending to dominate. Within Central and South America, only Argentina, Chile, and Uruguay discuss implementing heat early warning systems in their NAPs. Of these three countries, only Argentina has additionally expanded out of non-urban contexts. Increasing the effectiveness of heatwave early warning systems requires interdisciplinary approaches, using meteorological services to provide advanced weather forecasts and public health communication along with mechanisms for monitoring and evaluation. In addition, tailoring definitions of heatwaves and their thresholds, specifically to each region can ensure that early warning systems are most effective in protecting people's health during extremes of heat.

Indicator 2.2.2: Air Conditioning: Benefits and Harms

Headline finding: in 2021, air conditioning provided cooling in one-third of households but consumed about 1900 TWh of electricity – approximately the total electricity consumption of India and Brazil combined.[194]

Air conditioning (AC) can prevent heat-related illnesses and death.[195] However, it is energy-intensive and can exacerbate climate change, air pollution, urban heat islands, energy poverty, and health inequities.[196,197] According to International Energy Agency data, between 2000 and 2021, the proportion of households with AC increased by 70%, reaching one-third of households. In 2021, AC consumed about 1900 TWh of electricity, over twice the consumption in 2000, and approximately the total electricity consumption of India and Brazil combined.[194] This energy demand strained power grids, caused associated CO_2 emissions to increase by 73% to almost one gigatonne in 2021, and led to about 23,000 deaths from exposure to associated $PM_{2.5}$ emissions in 2020 (Figure 5). In many hot, low-income regions, AC remains largely inaccessible.[198] To deliver sustainable cooling for all, over 30 countries have completed or are developing National Cooling Action Plans.[199] The Cool Coalition recommends an integrated approach, including passive cooling; highly-efficient active cooling; climate-friendly refrigerants; and expanded access to cooling for all, but only where and when it is needed.[200]

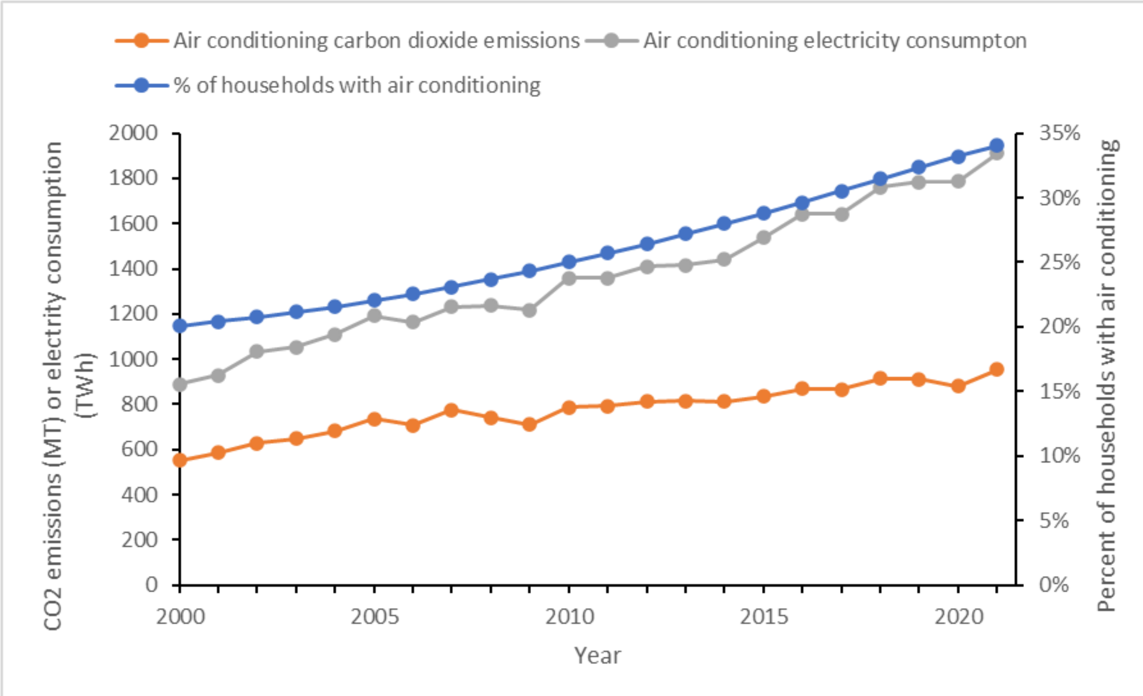


Figure 5 Air conditioning: global household prevalence, electricity consumption, and carbon dioxide emissions

Indicator 2.2.3: Urban Green Space

Headline finding: the proportion of urban centres with moderate or higher levels of greenness decreased from 18% in 2015 to 13% in 2022 in low HDI countries, with little variation across other HDI groups.

Green spaces can reduce the intensity of heat at the neighbourhood scale in urban centres, while positively affecting physical and mental health, providing local improvements in air quality, and helping reduce the risk of urban floods by reducing water runoff.[201–205] This indicator uses satellite measurements of vegetation (measured by Normalized Difference Vegetation Index (NDVI)) overlayed with population data to estimate greenspace exposure for 1,041 urban centres of over 500,000 inhabitants across 174 countries. Global urban greenness has remained low (mean NDVI = 0.34) since 2015. In very high HDI countries, 36% of urban centres had at least moderate levels of greenness, against 18% in high, 36% in medium, and 13% in low HDI countries. Concerningly, low HDI countries are the only HDI group to experience a reduction in exposure to moderate or higher levels of urban green space, with a drop from 18% in 2020 to 13% in 2022.

Indicator 2.2.4: Global Multilateral Funding for Health Adaptation Programs

Headline finding: US$ 1.61 billion of Green Climate Fund (GCF) financing was dedicated to adaptation projects in 2022, with 17.66% (US$ 199 million) going towards health-specific projects.

Financing is a key mechanism of country-level health adaptation; multilateral funding organizations can provide meaningful financing contributions to countries' health-related adaptation efforts.[2] This indicator reports on multilateral funding assigned by the Green Climate Fund (GCF), one of seven multilateral funding mechanisms under the UNFCCC,[206,207] for health-related adaptation projects. In 2022, 20 projects on adaptation, or on both adaptation and mitigation, were approved, for a total of US$1.61 billion. Of this, 17.66% (US$199 million) went to health-specific projects, with 12 of the 15 health-specific projects focusing on improved water and food security. Considering only GCF, this indicator does not capture all climate funding, but does provide a representative sample of funding priorities.

Indicator 2.2.5: Detection, Preparedness, and Response to Health Emergencies

Headline finding: 126 of 180 countries reported high to very-high implementation status for health emergency management in 2022.

With the climate suitability for the transmission of multiple infectious diseases increasing in many locations (indicator 1.3), reducing the risk of outbreaks and epidemics requires robust health emergency preparedness and response systems. This indicator reports on the implementation of the legally-binding International Health Regulation (IHR)'s core capacities on health emergency management.

In 2022, 126 of 180 (70%) countries reported high to very-high implementation (capacity score of 61–100) of health emergency management. However, while 85% of very high HDI countries reported high to very-high implementation, only 44% of low HDI and 54% of medium HDI did.

The Strategic Partnership for Health Security and Emergency Preparedness Portal tracks progress and gaps in IHR implementation through independent external evaluations, simulations, after-review exercises, and the development of national action plans for health security and resource mapping.[208] Since 2020, 25 country-level After-Action Reviews have been conducted, of which 8 covered epidemics and pandemics, 8 covered human-induced events, and 9 covered extreme natural events.

Following the COVID-19 pandemic, a review of the IHRs identified over 300 possible amendments to strengthen country capacity and compliance. A final proposal on IHR amendments will be presented at the 2024 World Health Assembly.[208,209]

2.3: Vulnerabilities, Health Risk, and Resilience to Climate Change

While mitigation can reduce climate change hazards, adaptation measures seek to equitably manage climate risks. The following three indicators monitor the changing vulnerabilities to climate hazards and health adaptation progress and gaps.

Indicator 2.3.1: Vulnerability to Mosquito-borne Disease

Headline finding: low HDI countries experienced a 37% decrease in vulnerability to Aedes-borne disease between 1990 and 2021, partly due to improvements in access to healthcare.

The spread of *Aedes*-borne diseases is rapidly increasing, fuelled by climatic changes (indicator 1.3), people movement and urbanisation.[210] Reducing the vulnerabilities to their most adverse health outcomes is essential to minimise health risks. This indicator captures the relative vulnerability to severe *Aedes*-borne disease outcomes, by combining increased susceptibility from urbanisation,[210,211] and coping capacity from improved healthcare access and quality.

The vulnerability to severe disease outcomes increased by 6.6% in very high HDI countries from 1990 to 2021, primarily driven by a 9% increase in urbanisation. In low HDI countries, healthcare access and quality improved by 48% over this time period, driving a 37% reduction in *Aedes*-borne disease vulnerability. City-level dengue transmission risk assessments, improving waste and territorial management, and operationalizing early warning systems are increasingly necessary to reduce the disease burden of *Aedes*-borne diseases.

Indicator 2.3.2: Lethality of Extreme Weather Events

Headline finding: the lethality of floods and storms decreased significantly in high and very high HDI countries between 1990-1999 and 2013-2022.

The frequency, intensity and duration of extreme weather events is increasing worldwide as a result of anthropogenic climate change.[39,59] Well-implemented adaptive measures can however avoid a proportional increase in deaths.[212] Using the Centre for Research on the Epidemiology of Disasters' database (EM-DAT),[213] this indicator tracks the changing risk of death from climate-related extreme events (defined as the proportion of people affected that died in the event), and the proportion of events that were deadly.

The risk of death from floods or storms did not change significantly since 1990 across any world region or HDI group. However, their lethality declined on average from 86 to 16 deaths per event in high HDI countries ($p=0.007$) and from 11 to 8 deaths in very high HDI countries ($p=0.02$) between 1990-1999 and 2013-2022, while remaining statistically unchanged in other groups.

Indicator 2.3.3: Migration, Displacement, and Rising Sea Levels

Headline finding: in 2022, 153.8 million people were living less than 1 metre above current sea levels

Global mean sea level increased 4.68 mm per year between 2013 and 2022, and is projected to reach 0.29–1.10m by 2100 (relative to 1986–2005), depending on emission scenarios and environmental responses.[214–216] Sea level rise can affect human health through episodic flooding, permanent inundation, erosion, soil and drinking water contamination, vector- and water-borne disease, and mental health impacts.[217–220] Using land elevation and population data, this indicator estimates that 153.8 million people were living less than 1m above sea level in 2022, up by 7.9% from 2010.

In many cases, populations are able to adapt in situ to climate hazards such as those of sea level rise. However, diverse (including environmental) factors can push people to relocate (forced or otherwise) or render them immobile. Different forms of human (im)mobility (which includes planned relocation, circular labour mobility or seasonal migration, temporary and permanent migration, short-term evacuation or trapped and immobile people) are influenced by a complex interplay of sociocultural, political, psychological, economic, demographic, and environmental factors.[221] Migration can bring varied benefits and difficulties for migrants and other populations in sites of origin, migration routes, and destinations. As of December 2022, 52 policies connecting climate change and migration were identified across 40 countries. No policy mentioned immobility,[222] and they tended to refer to health issues, even if peripherally, without explicitly connecting health to climate change and migration—or else explaining why links might not exist. Little engagement with or basis on science is evident across the policies.

Conclusion

Indicators in this section show that health adaptation, essential to minimise the impacts of climate change, continues to be insufficient. Low and middle HDI countries are often lagging, with scarce funding continuing to be a barrier (indicators 2.1.1-2.1.3, 2.2.4, and 2.2.5).

Scarce planned action has also resulted in maladaptation. The use of electricity for air conditioning increased 70% from 2000 to 2021, pushing associated emissions up by 73% and contributing 23,000 deaths from $PM_{2.5}$ in 2020 alone (indicator 2.2.2). Meanwhile, urban greenness remains low globally, exposing the unleveraged potential for sustainable cooling with multiple health co-benefits (indicator 2.2.3). As climate change impacts increase, the cost and challenges of adaptation will continue to rise steeply, leaving reduced scope for averting rapidly accelerating health harms.

However, there are some signs of progress. Countries are increasingly committing to deliver resilient, sustainable health systems (indicators 2.1.1 – 2.1.2), more cities identify and assess health risks yearly (indicator 2.1.3), and health system strengthening reduced the vulnerability to mosquito-borne diseases, particularly in the most exposed countries (indicators 2.3.1 and 2.3.3).

With further climate change now unavoidable, adaptation needs will keep increasing, and adaptation efforts must urgently ramp up to protect the health of all populations. Key to success will be fostering global knowledge exchange between different actors, particularly focusing on learnings from lower HDI countries, and especially harnessing the wealth of knowledge of Indigenous Peoples.[223] As the challenges to adaptation increase, monitoring progress will become increasingly important. Despite refinement of indicators over the past seven years, the challenge of capturing effective adaptation still remains, and many indicators rely on self-reported data which is inherently biased. In addition, adaptation efforts led by grassroots organisations, communities or civil society are still not being recorded in a standardised manner, limiting the capacity to monitor progress at a global level. Future efforts will focus on assessing the effectiveness of adaptation, and capturing their impact on different communities – although a lack of reported data is likely to limit the capacity to effectively monitor this.

Section 3: Mitigation Actions and Health Co-benefits

In recognition of the urgent need to accelerate action in this critical decade, the Mitigation Work Programme was established at COP27 to urgently scale up mitigation ambition and implementation. These actions hold the potential to avoid the most catastrophic human impacts of climate change, as well as improving the environmental and socioeconomic conditions that good health requires.

This section documents progress on climate change mitigation and its health implications. It explores the health impacts of the existing energy system and its current level of transition. It then explores the impacts of changes in outdoor and indoor air pollution exposures, with an improved indicator this year monitoring the health impacts of dirty household fuels. It highlights the health burden and emissions associated with existing diets and with the healthcare sector.

3.1: Energy Use, Energy Generation and Health

The energy system is the world's biggest single contributor to greenhouse gas emissions. The global energy crisis and an increase in people without access to electricity highlights the urgent need to transition away from fossil fuels and towards more equitable and decentralised renewable energy.[79] This section monitors progress in energy sector mitigation, and its potential health co-benefits.

Indicator 3.1.1: Energy Systems and Health

Headline finding: CO_2 emissions from the global energy system increased by 0.9% in 2022 due to reopening economies following the lift of COVID-19-related restrictions.

Despite renewable energies becoming increasingly cost-competitive,[224] fossil fuels still contributed 80% of global total energy supply (TES) in 2022, with little change in this proportion since 1990.[225]

The CO_2 emissions intensity of the global energy system has fallen by only 0.87% between 2015 and 2020, though experienced a 1.9% reduction to 54.2 tCO_2/TJ in 2020, driven by transport restrictions during the COVID-19 pandemic (Figure 6). However, this was reversed following a lifting of restrictions worldwide, with global energy-related carbon emissions rising by 0.9% in 2022.[226]

HDI groupings reflect global inequities in the transition to healthy, clean fuels. The very high HDI country group, with better access to renewable energy technologies, has been making steady progress, with a decadal reduction in the carbon intensity of their energy systems of 2.9 tCO_2/TJ. Meanwhile, with rapid industrialisation, the carbon intensity in medium HDI countries has increased at a rate of 4.7 tCO_2/TJ per decade. Low HDI countries, with little industrial development and overreliance on biomass burning, have the lowest carbon intensity of all (21 tCO_2/TJ in 2020), rising by 2.5 tCO_2/TJ per decade.

Global use of coal in the energy system, a major contributor to air pollution and GHG emissions, has remained above 150 EJ since 2010, accounting for 26.7% of TES in 2020. Despite commitments at COP27 to "[accelerate] efforts towards the phasedown of unabated coal power",[189] coal-fired power stations grew in 2022, comprising 59% of newly commissioned capacity in China.[227,228] With coal burning responsible for 560,000 deaths related to $PM_{2.5}$ exposure in 2020 (indicator 3.2.1), the resulting long-term health impacts will be claiming lives for decades, unless urgently reversed.

The share of modern renewables in electricity generation (mainly wind and solar energy) reached 9.5% in 2020, an increase of 360% over the last decade. Modern renewables accounted for 90% of the new electricity capacity in 2022.[226] However, according limiting temperature increase to 1.5°C would require an annual growth rate for renewables 13 times what it is now, and renewables must make up 77% of the world's primary energy supply by 2050.[42] Crucially, while modern renewables make up 11% of all electricity generated in very high HDI countries, they only account for 2.3% in low HDI ones. The shock in global fossil fuel prices in early 2022 and the lower price of renewable energy may bolster the shift to healthy, more secure, and sustainable sources.[229] Nonetheless, the economic crisis and high costs of capital are making renewable technologies increasingly unaffordable in lower-income countries, threatening to increase inequities in the adoption of these clean technologies.[230]

Accelerating efforts to phase out fossil fuels in favour of energy efficiency and decentralised modern renewable energy can help to expand electricity access in remote and low-resourced areas, reducing energy poverty and enabling universal access to quality healthcare (Panel 6). In pursuing these efforts, particular care is needed to avoid perpetuating harmful extractive industrial practices that disproportionately affect the health of minoritized communities, and act to amplify – rather than reduce – global health inequities.

Panel 6: Powering healthcare delivery through renewable energy

Reliable electricity in healthcare facilities is essential for quality healthcare provision: It is needed ensure basic amenities, such as lighting and clean water; it powers critical devices in healthcare settings, including vaccine and medication refrigeration, oxygen concentrators, and certain diagnostic and surgical equipment; it can also allow for use of key tools for maternal and child health, including ultrasounds, foetal heart monitors, and baby warmers.[231] Health centres without electricity perform fewer deliveries and have fewer patients.[232] Yet, close to one billion people are still served by healthcare facilities without reliable electricity. At least 25,000 healthcare facilities in Sub-Saharan Africa have no electricity access, and at least 68,000 healthcare facilities have unreliable electricity.[233]

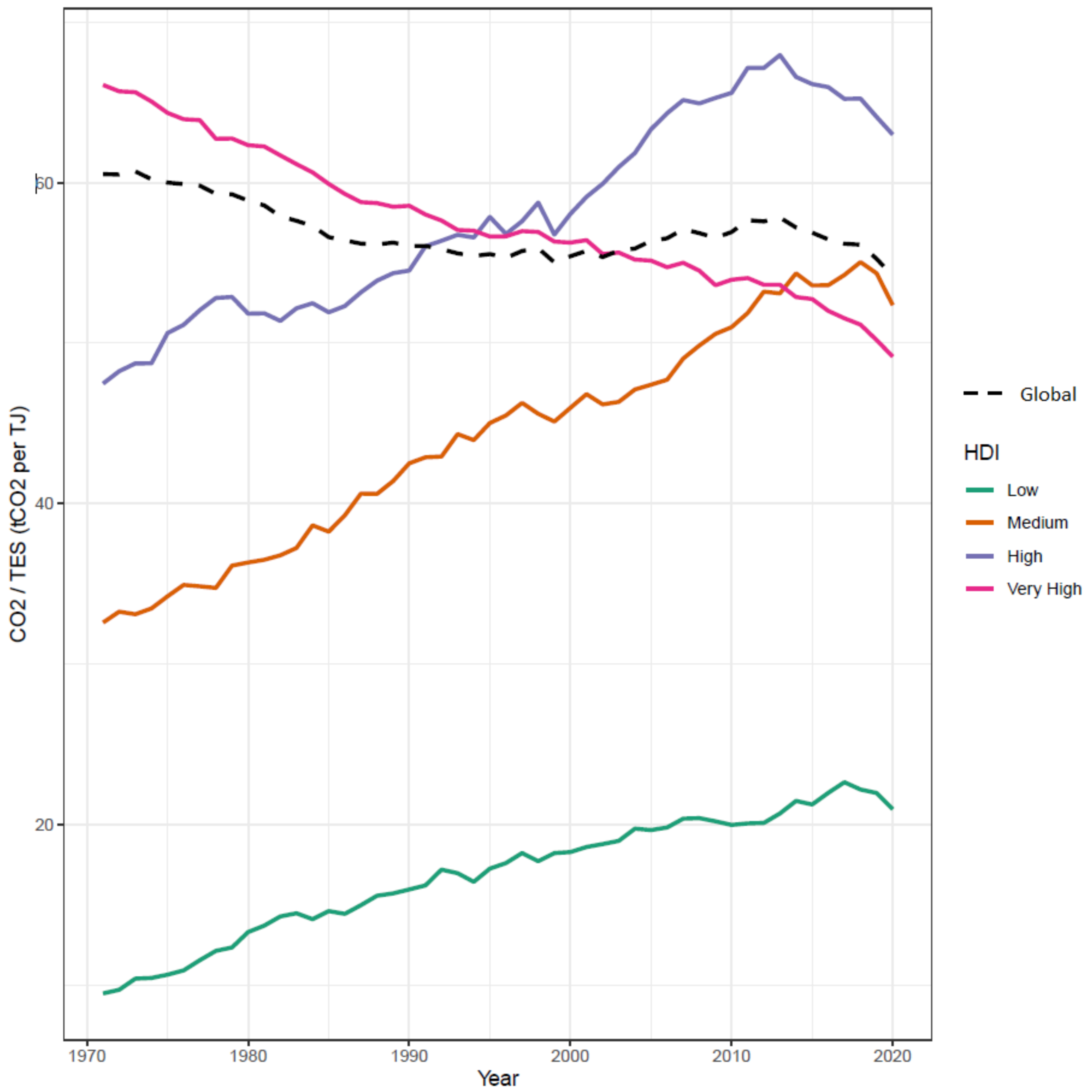
Clean renewable energy presents an opportunity to provide electricity to remote or energy-poor settings, with the potential of saving lives and improving health of the most vulnerable populations. While extending national grids can be expensive and slow, options like solar photovoltaics (PV) are cost-effective, and offer non-polluting energy without the need for grid connection or fuel input.

Because it is shown to improve vaccination rates, emergency capabilities, and quality of maternity care, electrification could be a key tool in limiting gender and health disparities.[234] With widely unequal access to electricity across rural and urban settings, it can also help reduce within-country health inequities. Moreover, access to decentralised renewable energy dramatically increases climate resilience of healthcare facilities, making them independent from volatile energy markets.[231]

Some laudable case studies exemplify the power of renewable energy in improving access to life-saving energy. An onsite solar array provides energy for Kalungi Hospital (over 100 kilometres from Kampala, Uganda),[235] allowing it to stay open later, to refrigerate vaccines and supplies, to increase the surgery patient load, and to power diagnostic tools and the sterilisation of medical instruments, all while lowering annual fuel costs and increasing clean water access and security through using electricity to also pump water at a well site.[235]

The SELCO Foundation has worked with hundreds of healthcare facilities in India on establishing decentralised energy systems. The installation and use of solar systems in facilities in the state of Manipur has led to 80-95% of facilities reporting less waste of vaccine dosages, extension of their clinic hours, and overall ease of operations.[231] After a rural electrification program in Gujarat, there were increases in the presence of functional operating and delivery tables and higher immunisation rates.[236]

In a joint report, the World Health Organization, World Bank, International Renewable Energy Agency, and Sustainable Energy for All provide a comprehensive update on the status of healthcare facility electrification, identify technical and economic solutions, estimate the amount of investment needed, and analyse the enabling policy frameworks to accelerate electrification of healthcare facilities.[231] It stresses that there is urgent need for US$4.9 billion to bring facilities up to a minimal or intermediate standard of electrification, ensuring the long-term functionality of decentralized energy systems, supporting local skills and renewable energy markets, providing access to medical devices and training, and increasing cooperation between energy and health sectors and various institutions. Efforts must be focused on leveraging synergies, maximizing impact, and unlocking resources to improve healthcare access in these countries.



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1498 *Figure 6: Carbon intensity of the energy system by HDI country group (tCO_2/TJ)*

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1500 ## Indicator 3.1.2 Household Energy Use

1501 *Headline finding: globally, only 32% of the domestic energy used per person is non-polluting at*
1502 *point of use, while 92% of the energy used in low HDI houses comes from polluting biofuels.*

Access to stable, non-polluting energy is crucial for advancing health and wellbeing.[237–239] The number of people without access to electricity worldwide is set to increase in 2022 to 775 million,[230] most of whom are in sub-Saharan Africa and South Asia. This indicator draws on data from the IEA to monitor the sources of energy used in people's homes. Globally, only 32% of the domestic energy used per person is non-polluting at point of usage (electricity, district or geothermal heat, or solar thermal), while 31% is solid biomass (wood and dung), and 35% fossil fuels. However, big global inequities exist. Biomass burning is highly polluting, and accounts for 92% of the household energy in low HDI countries against 7.5% in very high HDI countries. Meanwhile, non-polluting energy use has been growing rapidly in high (353% higher in 2020 than in 1990) and very high (49% higher) HDI countries. The overall use of energy also reflects global inequities, with people in very high HDI countries using, on average, 152%, 322%, and 106% more energy in their homes than people in high, medium, and low HDI countries, respectively.

Indicator 3.1.3: Sustainable and Healthy Road Transport

Headline finding: despite record growth in electric vehicle sales, fossil fuels still account for 95% of all road transport energy.

Global transport emissions grew by 8% in 2021, following easing of COVID-19 restrictions, and transport-derived $PM_{2.5}$ is responsible for up to 460,000 deaths annually (indicator 3.2.1).[240] The IEA has estimated electric vehicle sales exceeding 10 million in 2022 (14% of all new cars sold, an increase of 9% from 2021).[241] Yet maximal health benefits will be attained by encouraging urban morphologies which support increased walking and cycling, and by reducing particulate air pollution emitted by vehicle brakes and tyre wear.[240] Meanwhile, interventions to expand safe public transport could reduce the estimated 1.3 million annual deaths occurring annually worldwide from passenger vehicle accidents, while increasing active travel could contribute towards avoiding some of the 3.2 million annual deaths attributable to insufficient physical activity.[242,243]

Drawing on data from the IEA data[244] this indicator reports that, , despite a temporary reduction in road transport energy use as a result of COVID-19 lockdowns in 2020, the global use of electricity for road transport per capita grew by 97% between 2015 and 2020, but its proportion of total per capita road transport energy grew at a rate of only 0.04 percentage points each year. Fossil fuels still account for around 95% of all road transport energy, and total energy use in the transport sector increased since 1990.

3.2: Air Pollution and Health Co-benefits

Exposure to air pollution increases the risk of respiratory and cardiovascular disease, cancer, diabetes, neurological disorders, and adverse pregnancy outcomes.[245] Many of the major sources of GHG emissions also contribute substantially to air pollution. These indicators track the burden of energy sector air pollution and the potential health co-benefits of mitigation efforts that prioritise improved air quality.

Indicator 3.2.1: Mortality from Ambient Air Pollution by Sector

Headline finding: global deaths attributable to fossil fuel-derived $PM_{2.5}$ decreased from 1.4 million in 2005 to 1.2 million in 2020. Reduced coal pollution contributed to about 80% of the decrease.

With extended temporal coverage this year, this indicator estimates the mortality attributable to ambient $PM_{2.5}$, using the GAINS atmospheric model.[246]

In 2020, anthropogenic $PM_{2.5}$ was responsible for 3.3 million deaths globally. Deaths attributable to fossil fuel-derived $PM_{2.5}$ decreased from 1.4 million in 2005 to 1.2 million in 2020 (16.7%). Of this reduction, 80% was due to reduced coal-derived air pollution (

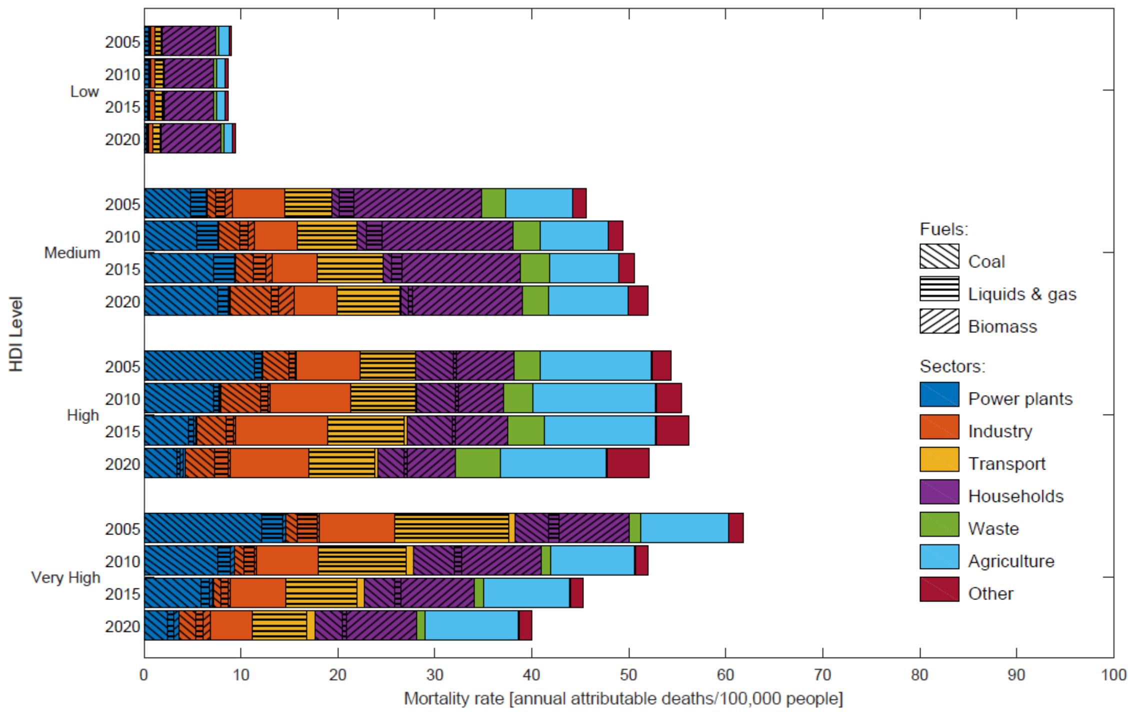

Figure 7). However, coal still contributed to 53% (560,000) of all deaths attributable to fossil fuel-derived $PM_{2.5}$ in 2020. Meanwhile, biomass burning contributed to 653,000 deaths. In the high and very high HDI groups, exposure to $PM_{2.5}$ decreased from 2005, thanks to emission controls and fuel switching. However, deaths have increased in medium HDI countries, where access to non-polluting energy and air quality control measures are lagging.

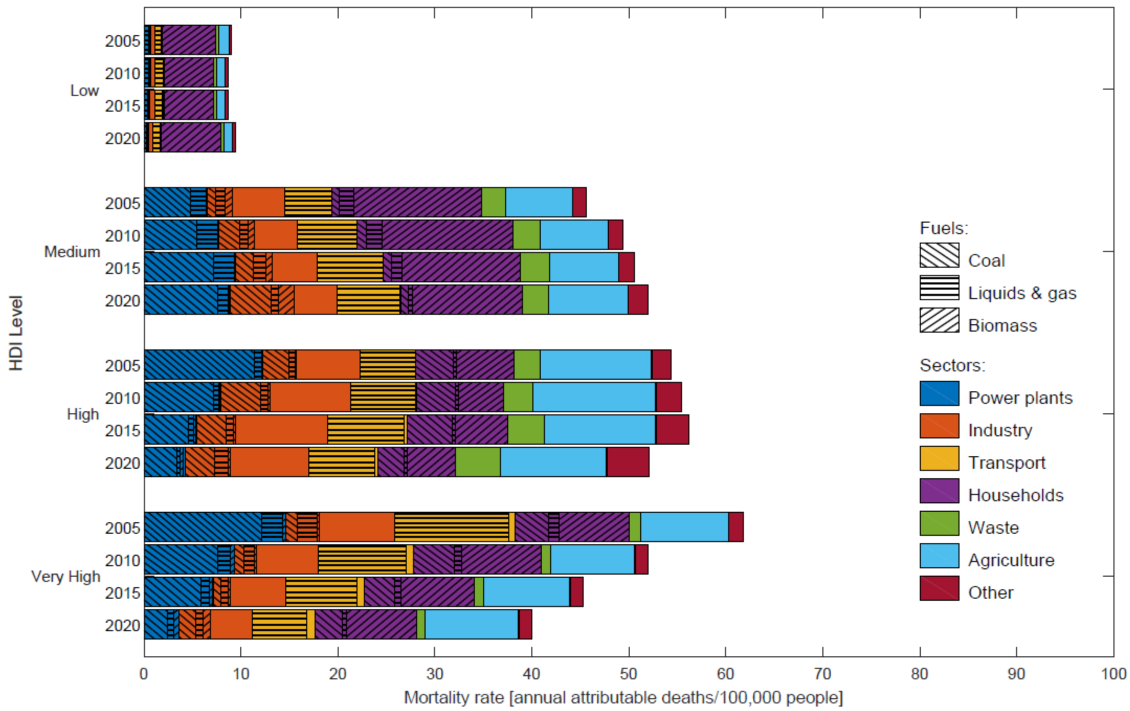

Figure 7 Mortality rate attributable to PM2.5 concentration by fuel, sector, year, and HDI country level

Indicator 3.2.2 Household Air Pollution

Headline finding: the use of polluting fuels resulted in 140 deaths per 100,000 associated with household air pollution in 2020 in 62 countries reviewed, 56% of which was due to the use of solid fuels.

Globally, 2.4 billion people still use polluting and inefficient fuels and technologies for cooking, and 733 million live without electricity.[80] The use of dirty fuels in the household sector results in exposure to toxic concentrations of air pollution inside people's homes, and is responsible for 55% of anthropogenic ambient $PM_{2.5}$ air pollution in low HDI countries, virtually all of which (97%)

comes from biomass burning (indicator 3.2.1). The surge in energy prices and economic pressures from the energy and economic crises may mean that 100 million more people revert to burning biomass. With women and girls often tasked with household energy-related activities, the burden of disease associated with the air pollution from dirty fuels in the domestic sector falls disproportionately on them.[247,248] In addition, women and girls are often those tasked with searching for biomass, which exposes them to violence and injuries, and due to the time allocated to these activities limits their capacity to access education, economic independence, and personal growth activities.[247,248] Paucity in the adoption of clean fuels in the domestic sector is therefore underpinned by, and exacerbates, gender health inequities and injustices.

This indicator estimates exposure to household air pollution (HAP)-derived $PM_{2.5}$ in 62 countries. It uses a Bayesian hierarchical model developed with sample data on indoor air quality from 282 peer-reviewed studies and accounts for socio-demographic and epidemiological characteristics,[249–251] and estimates attributable mortality through a comparative risk assessment.

In the 62 countries analysed, HAP led to 140 deaths per 100,000 in 2020. About half of their population used dirty fuels (biomass, charcoal, coal) as the primary source of energy for cooking and heating in 2020, representing most of the world population reliant on dirty fuels. This resulted in 151 µg/m^3 of $PM_{2.5}$[95% CI 133-169] on average inside their homes. Within this population, rural households had 171 µg/m^3 of $PM_{2.5}$ [95% CI 153-189] on average, and urban households 92 µg/m^3 [95% CI 77-106]. This HAP is estimated to have contributed to an average of 78 deaths per 100,000 [95% CI 69-87], with a rural average of 82 [95% CI 73-90] and an urban average of 66 [95% CI 57-75] deaths per 100,000.

Shifting to less-polluting fuels like biogas, natural gas, liquefied petroleum gas (LPG), and alcohol fuel (as well as solar and electric energy), can help reduce this health burden. However, combustion of these fuels still resulted in the population primarily reliant on them (about 50.1%

of the total population the 62 countries analysed) being exposed on average to 69 µg/m^3 [95% CI 62-76] of $PM_{2.5}$, with a rural average of 76 µg/m^3 [95% CI 69-83] and an urban average of 49 µg/m^3 [95% CI 46-53]. The associated mortality is estimated at 62 deaths per 100,000 [95% CI 54-70], with a rural average of 66 [95% CI 58-74] and an urban average of 52 [95% CI 47-57] deaths per 100,000. These data reflect the health impacts of so-called 'transition' fuels (natural gas, LPG) and biogas, and underline the untapped potential offered by expanding access to non-polluting, renewable energy to improve health, reduce health inequities, and minimise energy poverty.

3.3: Food, Agriculture, and Health Co-benefits

Food systems contribute around 30% of global GHG emissions, remaining incompatible with mitigation targets.[252,253] This section monitors the potential for mitigation and health co-benefits in the agriculture and food sector.[254]

Indicator 3.3.1: Emissions from Agricultural Production and Consumption

Headline finding: global agricultural emissions increased by 22% from 2000 to 2020, with red meat and dairy responsible for 57% of them in 2020.

This indicator shows that, while agricultural emissions per person remained stable at approximately 0.9 tCO_2e, the growing population pushed emissions up by 22% from 2000 to 2020. In 2020, around 57% of agricultural emissions came from red meat and dairy.

Per-person consumption-based emissions in 2020 were 43% higher in the very high HDI country group than in the low HDI group, revealing inequities in the global food system. However, agricultural practices and environmental pressures in low-HDI countries, notably Africa, lead to low productivity in animal rearing and result in relatively high emissions per unit of consumption (Figure 8).[256,257] As food systems become increasingly strained by environmental changes, supporting healthy, low-carbon diets will require shifts towards less polluting, more inclusive and resource-efficient foods and food production systems, with sustainable management practices and reduced reliance on fossil fuels.[258,259] This will require robust regulation of the agricultural and food industries, protecting smallholder farmers and Indigenous food systems, and promoting equitable and inclusive access to agricultural technology that aligns with local cultures and beliefs.[259] Harnessing and integrating the knowledge and technologies of traditional farmers and Indigenous Peoples in the sustainable management of natural agricultural resources can offer particular benefits in the transition to low-carbon, sustainable, efficient food systems.[260]

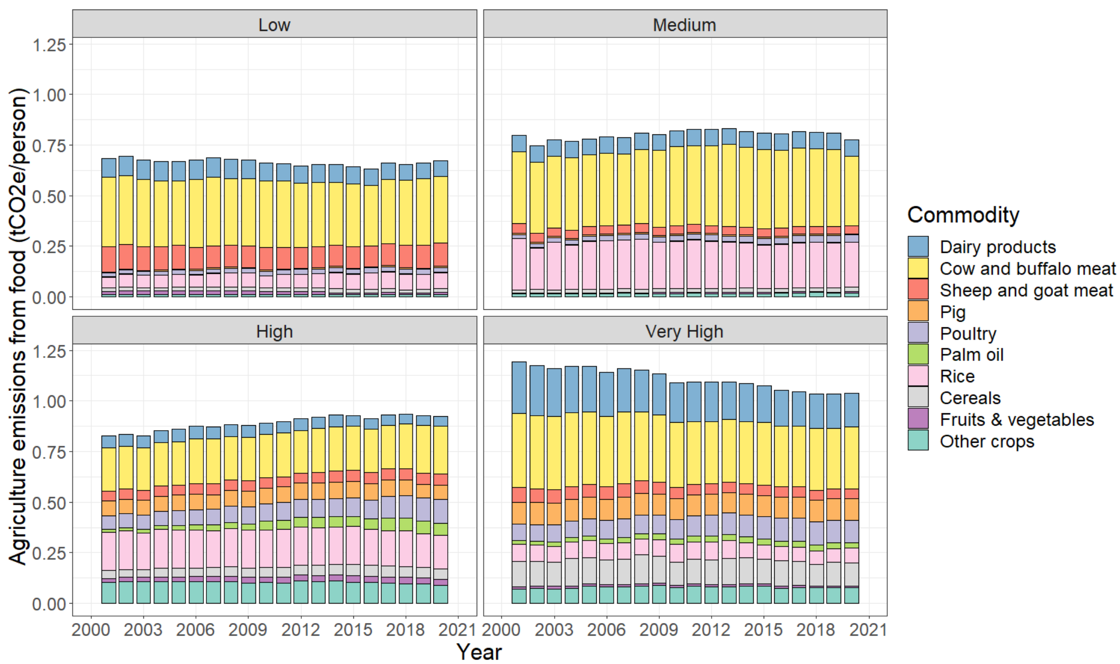

Figure 8: Emissions of greenhouse gases on farms associated with the consumption of agricultural products (production and net imports) per person by HDI level.

Indicator 3.3.2: Diet and Health Co-benefits

Headline finding: in 2020, 7.8 million deaths were associated with insufficient consumption of nutritious plant-based foods, and 1.9 million to excessive consumption of dairy, red and processed meat.

Suboptimal diets are a leading risk factor for NCDs globally.[254] Promoting shifts to healthier, more plant-based diets, can substantially reduce GHG emissions, whilst also delivering major benefits for public health.[261]

This indicator combines relative risk factors from a regularly updated meta-analysis, with population and mortality data to estimate the annual deaths attributable to dietary risk factors (appendix pp 160). It estimates that 12.2 million deaths in 2020 were attributable to dietary risks that could be reduced through balanced, low-emission diets, up by 282,000 deaths from 2019. Of the total, 7.8 million were associated with insufficient consumption of fruits, vegetables, legumes, wholegrains, nuts and seeds while excess consumption of diary, red and processed meat, which contributed to 57% of agricultural emissions (indicator 3.3.1), was responsible for 16% of all diet-related deaths (1.9 million). Very high HDI countries experienced the highest diet-related death rate (deaths per 100,000), 2.4 times higher than that in low HDI countries. The very high HDI group also had the highest death rate related to excess dairy, red and processed meat consumption, 6.7 times higher than the average mortality for countries in other HDI groups (Figure 9).

Figure 9: Deaths per 100,000 inhabitants attributable to dietary risk factors by HDI country group. A) deaths attributable to all dietary risk factors. B) deaths attributable to excess consumption of red and processed meat

Indicator 3.4: Healthcare Sector Emissions and Harms

Headline finding: increases in COVID-related healthcare spending in 2020 counterbalanced decreases in the carbon intensity of electricity, with global healthcare emissions remaining at 4.6% of total GHG emissions. Healthcare-associated $PM_{2.5}$ and ozone were responsible for approximately 4 million Disability-Adjusted Life Years (DALYs) annually.

The COVID-19 pandemic response pushed global health expenditures in 2020 to US$9 trillion, 11% of gross world product.[262] Quality healthcare requires the use of energy, goods, services, and infrastructure, which currently contribute to global GHG emissions. This indicator models emissions from the global healthcare sector using environmentally-extended multi-region input-output (EE-MRIO) models combined with national healthcare expenditure data. New this year, it also estimates healthcare-related emissions of $PM_{2.5}$ and ozone precursors, and their health damages.

The global healthcare sector still contributed around 4.6% of global GHG emissions in 2020, even while absolute emissions decreased by 3.7% from 2019. Globally, air pollution associated with healthcare delivery and supply chains contributed to an estimated 4 million DALYs in 2020. More than half of these estimated health harms were due to healthcare sector activities in China, while 12% are attributed to the United States.

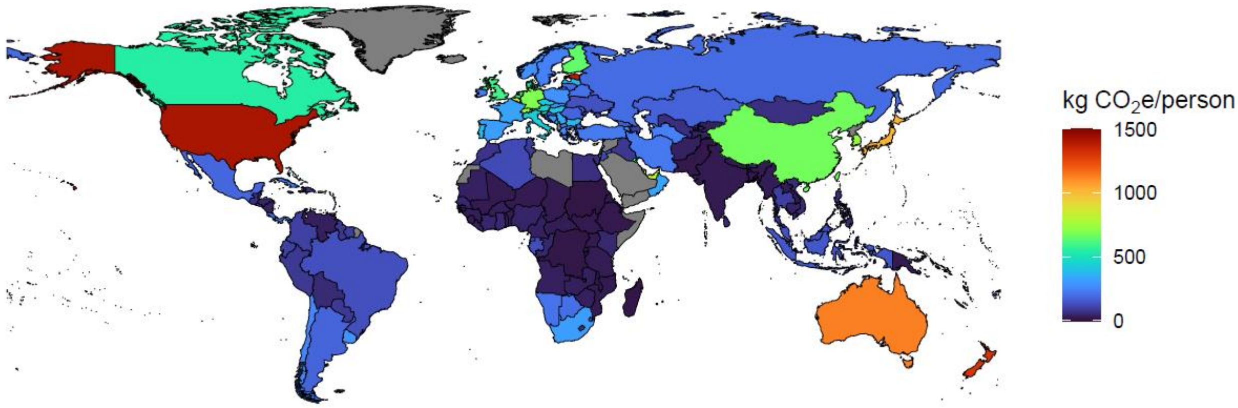

Figure 10: National per-capita GHG emissions from the healthcare sector in 2020. Data are not available for the countries in grey.

Conclusion

To reach net-zero by 2050, anthropogenic CO2 emissions must decrease by about 45 percent from 2010 levels by 2030.[123] Fossil fuels must be urgently phased-out to reach this goal, tackle climate change, and reduce its risk to human health and survival. Yet, they still provide 80% of global energy, 26% of which comes from coal, while 68% of household energy still comes from polluting fuels (indicator 3.1.2). Due to the global energy and economic crises, 100 million people risk returning to biomass, and many countries turn to coal.[229] Agricultural sector emissions add to the problem and increased by 22% from 2000 to 2020 (indicator 3.3.1). While the use of renewable energies is increasing, the pace has so far not been sufficient to curb increasing emissions from growing fossil fuel use (indicator 3.1.1). In addition, the global patterns of access and deployment of renewable energy technologies, with low HDI countries left behind in the transition, contrasts sharply with the availability of natural renewable energy resources.

Urgent mitigation can still keep temperatures within adaptability thresholds, simultaneously delivering health co-benefits in the immediate-term. Increasing access to zero-carbon energy can, if delivered with health as a key priority, not only reduce energy poverty, but also improve air quality, saving millions of deaths each year (Indicators 3.2.1 and 3.2.2). Transitioning to healthier, low-carbon diets could prevent up to 12.2 million deaths annually (indicator 3.3.2), while shifting to accessible active, public, and electric travel could avoid 460,000 deaths annually from travel-related $PM_{2.5}$ emissions and encourage increased physical activity (indicator 3.1.3). Additionally, these gains can reduce healthcare demand, helping minimise related emissions and their associated health impacts (indicator 3.4).

Realising this ambition requires concerted efforts. Those concerned with protecting health need to actively engage with energy, finance, civil society actors, Indigenous Peoples and minoritised communities to capture interdisciplinary and traditional knowledge and ensure the health and equity benefits of the zero-carbon transformation are maximised. To ensure a just transition, this must include preventing harmful extractive and exploitative industrial practices which disproportionately affect minoritized communities and further amplify global health inequities, focusing efforts in ensuring universal access to clean, healthy, zero-emission energy for all, and harnessing indigenous knowledge and technologies.[260,263]

Monitoring progress towards delivering mitigation ambitions is critical, particularly in this narrow window of opportunity left available to keep the goals of the Paris Agreement within reach. The Lancet Countdown will continue strengthening its indicators to support countries being held accountable on their mitigation progress, and to identify opportunities for increased health co-benefits of climate change actions. This will include quantifying progress towards delivering further co-benefits, including that of enhancing active travel, energy efficiency, or the health gains from nature-based solutions, as well as that of reducing adverse health impacts of CO2 emission-related extractive industries. Importantly, future efforts will also be focused on identifying potential unintended harms stemming from the transition to net zero emissions, and in capturing the knowledge of minoritised peoples. These challenges will require contributions from the broader scientific community, which the Lancet Countdown will continue to welcome and foster.

Section 4: Economics and Finance

The delays in climate change action have meant its health impacts continue to increase (Section 1), as do the associated economic health-related losses and damages. Limiting global mean temperature rise to 1.5°C requires rapid decarbonisation in all economic sectors. While the required up-front investment is substantial, the immediate economic and health co-benefits, alongside the loss and damage avoided, would vastly outweigh these costs.[43,264,265] With the right incentives, market conditions and governance, the necessary funds are available. However, the transition will only deliver these health gains if it is just, breaks entrenched harmful global power dynamics, and builds global health equity.

In 2022, COP27 saw a breakthrough agreement on the need for Loss and Damage funding for most affected countries, and calls for a transformation of financial systems to support the zero-carbon transition.[266] The details of the agreement are still to be determined,[267] and negotiations will take place amidst a global energy crisis which is increasing inflation and interest rates globally, saddling governments with debt, and restricting capital available for new investment while simultaneously stimulating the search for new sources of energy. On an individual level, the energy crisis is further increasing vulnerabilities and climate change impacts by driving a cost-of-living crisis, deepening energy poverty, and exposing the human costs of a fossil fuel-dependent global energy system.

Indicators in this section explore the economic costs of climate change, and monitor progress – or lack thereof – in the transition to a low-carbon, healthy, and just global economy, understanding that the transition to a net zero economic system is an essential component of the transition to a healthy, thriving future.

4.1 The Economic Impact of Climate Change and its Mitigation

The health impacts of climate change are causing additional economic losses and damages, including through increased healthcare demands and loss of labour capacity. This, in turn, undermines lives and livelihoods, increases the cost of adapting to climate change, and further restricts the resources available to finance accelerated climate change action. Indicators in this section track the economic costs associated with the health impacts of climate change.

Indicator 4.1.1: Economic Losses due to Weather-related Extreme Events

*Headline finding**:** global economic losses due to weather-related extreme events were US$264 billion in 2022. While 57.1% of losses in very high HDI countries were insured, 92.8% of losses in other countries were uninsured.*

The loss of infrastructure and resulting economic losses due to extreme events can exacerbate health impacts through disruption of essential services and impacts on the socioeconomic determinants of health. This indicator tracks the economic losses from weather-related extreme events, using data provided by Swiss Re.[268]

From 2010-2014 to 2018-2022, total measurable annual mean economic losses induced by climate-related extreme events increased by 23% in real terms. The percentage of global losses that were uninsured, however, fell from 67% to 55%. In 2022 alone, weather-related extreme events induced losses of US$264 billion, 78% of these in very high HDI countries. These losses were equivalent to 0.32% of GDP in the very high HDI country group compared to 0.16% for other countries, though lower losses in other countries may reflect the lower monetary value of the property damaged rather than the disruption and hardship caused. While 42.9% of losses in very high HDI countries were insured, 99.6%, 96.2% and 88.8% of losses in low, medium, and high HDI countries, respectively, were uninsured. These high levels of uninsured losses exacerbate the economic burden of climate change in lower HDI countries, with losses either unreplaced, or replacement costs falling directly on individuals and institutions.

Indicator 4.1.2: Value of Losses due to Heat-related Mortality

Headline finding: at US$164 billion, the average annual monetised global losses due to heat-related mortality for 2018-2022 were 146% higher than the 2000-2004 average.

This indicator estimates the economic value of heat-related mortality losses by combining the years of life lost (YLL) from indicator 1.1.5 and the value of a statistical life-year (VSLY). In 2018-2022, the average annual monetised heat-related mortality losses were US$164 billion, about 0.17% of the average gross world product (GWP). This was the highest loss in the past two decades, 146% higher than the 2000-2004 average, and equivalent to the loss of 12.8 million average incomes (expressed as per-capita GDP). The growth in the value of average heat-related mortality losses from 2000-2004 to 2018-2022, in terms of average incomes, was the highest in low HDI countries (131%), with growth of 84% in medium, 110% in high, and 61% in very high HDI countries.

Indicator 4.1.3: Loss of Earnings from Heat-related Labour Capacity Reduction

Headline finding: the global potential income loss from labour capacity reduction due to extreme heat was US$863 billion in 2022. The agricultural sector was the most severely affected, incurring 82% and 68% of the average losses in low and medium HDI countries, respectively.

Heat exposure endangers the health of workers, reduces labour productivity, and generates income and economic losses which cascade through the economies of the nations they live in.

This indicator quantifies the loss of earnings that could result from heat-related labour capacity loss, combining data from indicator 1.1.4 with hourly wage data from the International Labour Organization (ILO).

The global potential loss of earnings was US$863 billion in 2022, equivalent to 0.87% of GWP. Low and medium HDI countries experienced the highest average income losses, equivalent to 6.1% and 3.8% of their GDP, respectively. Of all global losses, 40% occurred in the agricultural sector, with 31% in construction. Agricultural labourers of low and medium HDI countries, often amongst the world's poorest,[269–271] endured on average 82% and 68% of the losses in those countries, respectively.

Indicator 4.1.4: Costs of the Health Impacts of Air Pollution

Headline finding: in 2020, the monetised costs of premature mortality due to air pollution amounted to US$2.2 trillion, the equivalent of 2.4% of gross world product.

Much of the 3.3 million annual deaths from exposure to anthropogenic $PM_{2.5}$ air pollution, could be avoided through ambitious mitigation (indicator 3.2.1). This indicator places an economic value on the years of lost life (YLLs) from exposure to anthropogenic ambient $PM_{2.5}$. While global costs relative to GDP and to average incomes (expressed as per-capita GDP) decreased slightly between 2005 and 2020, in 2020 the total costs amounted to US$2.2 trillion, or the equivalent of 2.4% of GWP. The high HDI country group had the greatest costs relative to per capita income, equivalent to the annual average income of 99.6 million people in 2020 (Figure 11). This group also had the greatest costs relative to the size of its countries' collective economies in 2020, equivalent to 3.69% of its GDP, closely followed by the medium HDI group (3.63% of GDP). Although the total cost is the highest in very high HDI countries, this fell significantly between 2005 and 2020. Moreover, their cost relative to GDP and in terms of average income is lower because of their high GDP and average incomes.

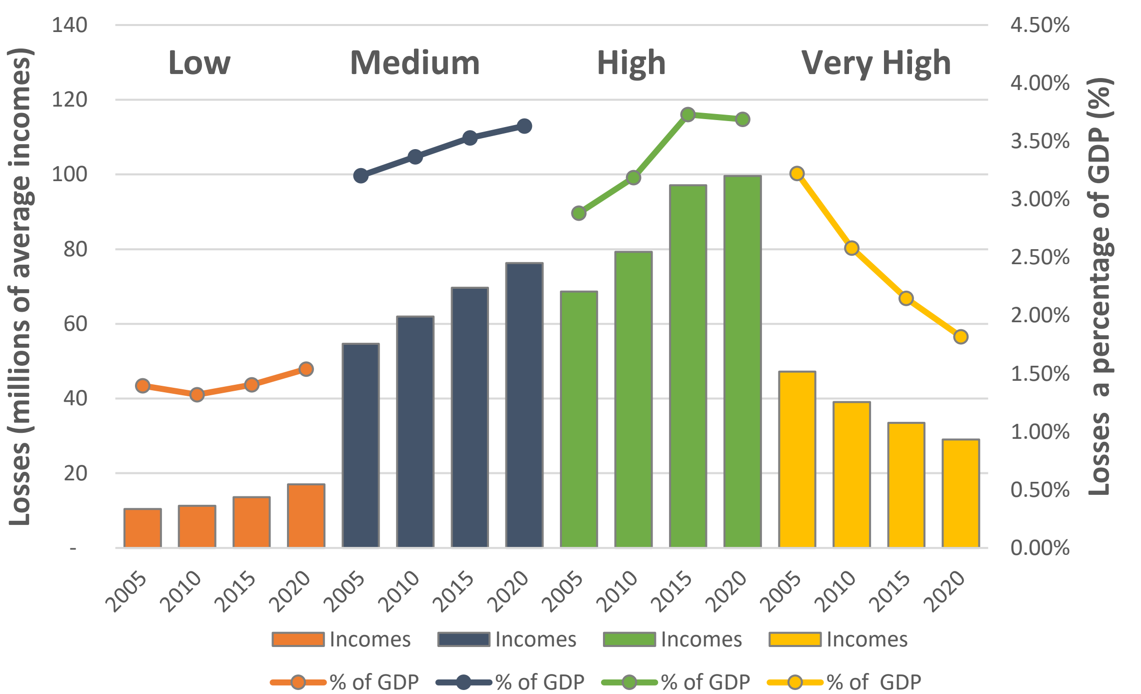

Figure 11: Monetised losses from premature mortality due to air pollution according to HDI group. Columns represent losses as numbers of average incomes, lines as losses expressed as a percentage of GDP.

4.2 The Economics of the Transition to Net Zero-carbon Economies

Protecting health from a changing climate, and realising the health co-benefits of climate action, requires a zero-carbon and just transition of the whole global economy, involving a rapid decline in the production and use of health-harming fossil fuels. If delivered while keeping people and their health as a core priority, this transition can also result in major health benefits from reduced inequities and improved socioeconomic determinants of health. The following indicators monitor this shift, tracking jobs and investment in zero-carbon energy, fossil fuel divestment, net carbon pricing and subsidising instruments, the effect of global trade on emissions, and the compliance of oil and gas firms with the 1.5°C climate target. Estimates suggest that 70% of the required green energy investment is likely to come from private sources, and an increasing amount will be mobilized as debt.[272] A new indicator on bank financing compares the amount of fossil fuel and green lending, and changes to lending to the fossil fuel sector since the Paris Agreement. Panel 7 explores the impacts of the current geopolitical turmoil on the financing and energy transition to a zero-carbon future.

Indicator 4.2.1: Clean Energy Investment

Headline finding: Global clean energy investment grew 15% in 2022, to US$1.6 trillion, and exceeded fossil fuel investment by 61%.

Investing in zero-carbon energy and energy efficiency is essential for both mitigating climate change and for reducing air pollution. Reaching net-zero emissions can lead to economic growth, which can, in turn, lead to further investment in clean energy.[265] Drawing on data from the IEA, this indicator monitors trends in global investment in energy supply and energy efficiency.[273]

Clean energy investment exceeded fossil fuel investment by 61% in 2022. Global clean energy investment in 2022 was 15% higher than in 2021 and 51% higher than in 2015, reaching US$1.6 trillion. Meanwhile, fossil fuel investment in 2022 was 10% higher than in 2021, but 24% lower than in 2015, at US$1.0 trillion. Energy efficiency accounted for 15% of all energy investment in 2022 – the same as in 2021. To be on track for net-zero emissions by 2050, clean energy investment must nearly triple by 2030, while fossil fuel investment must reduce to less than half its current value.[273,274]

Indicator 4.2.2: Employment in the Renewable Energy and Fossil Fuel Industries

Headline finding: direct and indirect employment in renewable energy grew 5.6% in 2021 to a record-high of nearly 12.7 million employees, while direct employment in fossil fuel extraction increased by nearly 20%.

The transition away from fossil fuels and to renewable energy can lead to net employment generation.[43] Employees in fossil fuel extraction industries, particularly coal mining, have greater risk of non-communicable disease than the general population.[275] Conversely, increasing employment in the renewable energy industry can improve both public health outcomes and livelihoods. This indicator uses data from IRENA and IBISWorld to compare employment in renewable energy and fossil fuel extraction.[276–278]

In 2021, nearly 12.7 million people were employed directly or indirectly by the renewable energy industry (Figure 12). This marks the largest ever workforce in renewables, and represents an increase of 5.6% from 2020, and 74.3% from 2012. Employment in renewables also exceeded direct employment in fossil fuel extraction for the first time in 2020. However, as the global economy recovered from COVID-19, direct employment in fossil fuel extraction rebounded by 19.6% in 2021, to a record 13.4 million. Nonetheless, over the medium-term, employment is growing faster in the renewable energy sector.

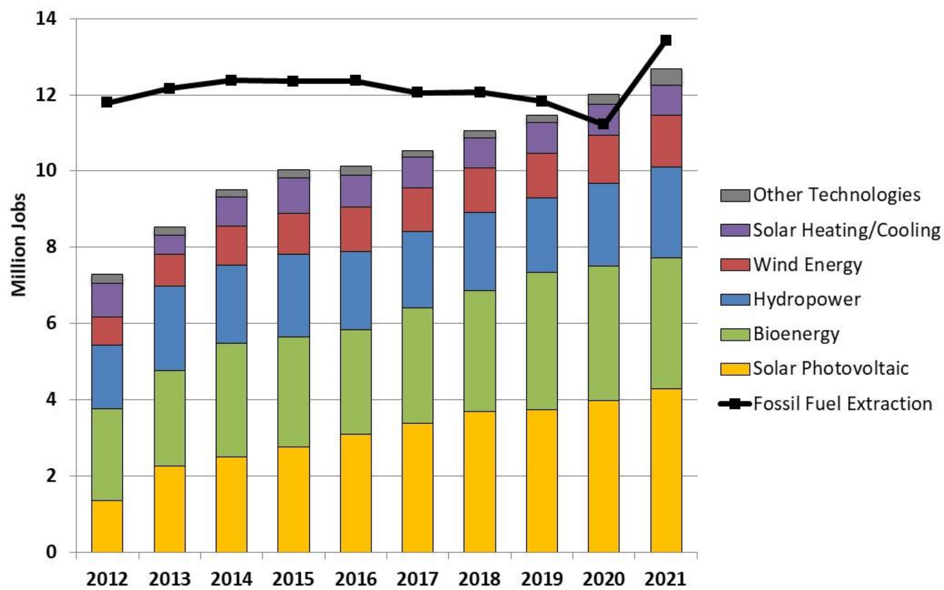

Figure 12: Direct and indirect employment in the renewable energy sector and direct employment in fossil fuel extraction

Indicator 4.2.3: Funds Divested from Fossil Fuels

Headline finding: between 2008 and the end of 2022, the global value of funds committed to fossil fuel divestment was US$40.51 trillion, with healthcare institutions accounting for US$54 billion.

By divesting holdings in fossil fuel companies, organisations can remove their financial support and reduce their social licence to operate. They also reduce their risk of losses due to stranded assets in a decarbonising world.[279,280] Healthcare institutions can take a lead in divesting from holdings in fossil fuel companies, thereby advancing their mission to protect health. This indicator tracks the value of funds divested from fossil fuels using data provided by stand.earth.[281]

From 1 January 2008 to 31 December 2022, 1,558 organisations committed to divestment, with assets worth at least US$40.51 trillion. Only 27 of these were healthcare institutions, with assets totalling US$54 billion. In 2022, 49 additional organisations with a value of US$58.7 billion committed to divestment. Of these, none were healthcare institutions.

Indicator 4.2.4: Net Value of Fossil Fuel Subsidies and Carbon Prices

Headline finding: 78% of the 87 countries reviewed had a net-negative carbon price in 2020, generating a net subsidy to fossil fuels of US$305 billion. The value of the resulting net subsidies exceeded 10% of national health budgets in nearly 30% of these countries.

Carbon prices can help economies transition away from high-carbon fuels, while fossil fuels subsidies provide incentives for health-harming emissions and slow the low-carbon transition.[81,82] This indicator compares carbon prices and monetary fossil fuel subsidies to calculate net economy-wide average carbon prices and revenues, covering 87 countries that emit 93% of global CO_2 emissions.

In 2020, despite 45 countries having a carbon pricing mechanism in place, simultaneous subsidies meant only 18 produced a net-positive carbon price – all but one of which were very high HDI countries. Out of 87 countries reviewed, 68 (78%) had net-negative carbon prices (i.e., provided a net subsidy to fossil fuels), for a net total of US$305 billion in 2020 alone. The median subsidy value in these 68 countries was US$1.3 billion, with eight countries each exceeding US$10 billion. Net subsidies exceeded 10% of national health spending in 30% (26) of countries, and 50% in ten countries. COVID-19 restrictions in the highly-subsidised transport sector meant total net subsidy spend was 47% lower in 2020 than in 2019. However, the spike in energy costs that followed is expected to have substantially increased net subsidies in 2021-2022.

Redirecting government support from subsidising fossil fuels to incentivising the expansion and affordability of low-carbon power, health protection, public health promotion and healthcare, and for providing other means of support to those who might be worst affected by potential increases in energy prices, would deliver net benefits to health and wellbeing and support a just transition.[282,283] International financing mechanisms are needed to support low-income countries vulnerable to energy costs in their transition to sustainable energy sources, particularly in the light of the ongoing energy crisis, and to safeguard all dimensions of human health.[283]

Panel 7: Strengthening climate finance in a time of geopolitical turmoil

Last year, the *Lancet* Countdown reported that the world faced multiple compounding crises. As countries devised responses to the converging energy, cost-of-living and climate crises, it identified the opportunity for an aligned response to enable a thriving, healthy future. Finance plays a key role in enabling such action, and is a primary focus in climate negotiations (Panel 2). The 2022 UN Production Gap Report outlined six approaches for financial sector reform, comprising: making financial markets more efficient; introducing carbon pricing; nudging financial behaviour through government interventions; creating markets for low-carbon technology; mobilising central banks; and creating local climate clubs of cooperating countries.[284]

Against this backdrop, economic sanctions and oil and gas (O&G) supply disruptions linked to the 2022-23 war in Ukraine, alongside the demands of post-COVID-19 economic rebound, and extreme weather events affecting energy production has led to a sharp increase in energy prices and a rapid pursuit of new energy sources.[285] In some places, this caused a reversion to dirty fossil fuels including coal, and renewed O&G exploration.[76] High energy prices and associated inflation pushed governments to borrow heavily to subsidise energy bills. High energy prices led to soaring profits for global O&G firms of US$4 trillion in 2022, around 270% higher than an average of US$1.5 trillion of recent years, with the bulk of these profits going to major O&G exporting states.[286,287] Profits of six oil majors reached a record of over US$200 billion in 2022.[288–293] Only limited taxes, if any, were applied to these windfall profits. Over half of O&G company outflows went to shareholder returns and debt repayments in 2022, the highest level in over 15 years; the US$1.5 trillion returned to shareholders in 2020-2022 could have fully covered the clean fuel investments required between 2023 and 2030 in the IEA's NZE Scenario. Although clean energy spending by O&G companies quadrupled between 2020 and 2022 to around US$20 billion, this only represented around 4% of their overall capital investment.[273] In fact, given this current situation of hyper-profitability, a number of O&G companies have backtracked on clean renewable energy activities and increased O&G production plans.[294–298]

However, expensive fossil fuel imports and an increased desire for energy security are also driving uptake in renewables, and the uptick in coal appears to be temporary.[299,300] The 2022 US Inflation Reduction Act (IRA) included US$369 billion for improving energy security and accelerating the zero-carbon energy transition, and is expected to increase the reduction in US GHG emissions from 26% to 40% of 2005 levels by 2030.[75] The subsidising of renewable energy under the IRA has sparked a subsidy race,[301] causing the EU, in response, to launch the Green Deal Industrial Plan in 2023 to seek to keep green projects in Europe.[302,303]
The urgent need to accelerate the net zero transition means fossil fuel firms must be pressed to abandon a near-term focus on returns and redirect profits to fund the green transition.[304]

Indicator 4.2.5: Production-based and Consumption-based Attribution of CO_2 and $PM_{2.5}$ Emissions

Headline finding: in 2021, 4.2% and 5.2% of global CO_2 and $PM_{2.5}$ emissions occurred in low, medium or high HDI countries due to the net import of goods and services consumed in very high HDI countries.

Consumption-based emission accounting allocates emissions to countries according to their consumption of goods and services, even when the physical emissions occurred abroad. This indicator uses an environmentally-extended multi-region input-output model[246,305,306] to quantify countries' consumption-based and production-based contribution to CO_2 and $PM_{2.5}$ emissions.

In 2021, 18.9% and 18.8% of global CO_2 and $PM_{2.5}$ emissions, respectively, were emitted to produce goods and services traded between different HDI country groups. The very high HDI group is the largest CO_2 emitter in both production-based (44.7% of total global CO_2 emissions) and consumption-based accounting (48.9%), followed by the high HDI group (43.7% and 39.5%, respectively). Furthermore, the net imports of goods and services into very high HDI countries resulted in CO_2 and $PM_{2.5}$ emissions in countries with lower HDI, accounting for 4.2% and 5.2% of global emissions, respectively. Very high HDI countries were the only ones with higher consumption-based than production-based emissions for both pollutants, resulting in pollution in countries with lower HDI levels.

Compared to 2020, in 2021, the global share of CO_2 from both production-based and consumption-based emissions increased in all HDI groups except the high HDI country group.

Indicator 4.2.6: Compatibility of Fossil Fuel Company Strategies with the Paris Agreement

Headline finding: the strategies of the 20 largest oil and gas companies as of February 2023 would lead to production exceeding levels consistent with 1.5°C of heating by 173% in 2040, an increase from 112% expected as from February 2022.

Emissions from oil and gas need to be reduced dramatically to keep global mean temperature rise below 1.5°C, and enable a healthy future.[85,308] This indicator assesses the alignment of current oil and gas company (O&G) production strategies with Paris Agreement goals, using data on actual commercial activities from the Rystad Energy database, based on actual commercial activities for the 20 largest O&G companies by projected 2040 production.[309] These include 11 state-owned national O&G companies (NOCs) and 9 publicly-listed international O&G companies (IOCs) responsible for 37% and 15.5% of total global production, respectively, in 2022 (52.5% overall). Projected emissions under current strategies are compared to the IEA's Net Zero Emissions (NZE) pathway compliant with 1.5°C,[310] assuming constant market shares at the 2015-2020 average.

Data indicate that, regardless of their claims and commitments, the compatibility of the plans of these O&G companies with international climate commitments has decreased further from 2021 to 2022. Their production strategies as of February 2023 would generate GHG emissions in 2030 which exceed their annual share compatible with 1.5°C of heating by an average of 48% (47% for NOCs and 50% for IOCs), rising to 173% in 2040 (181% for NOCs and 153% for IOCs) (Figure 13). These represent sizeable increases from their February 2022 strategies, which would have resulted in combined emissions excesses of 43% in 2030 and 112% in 2040. Although some of this is due to a slight tightening of the post-2030 NZE pathway, this still represents a substantial increase in the extent to which O&G production ambitions in company strategies are inconsistent with the goals of the Paris Agreement.

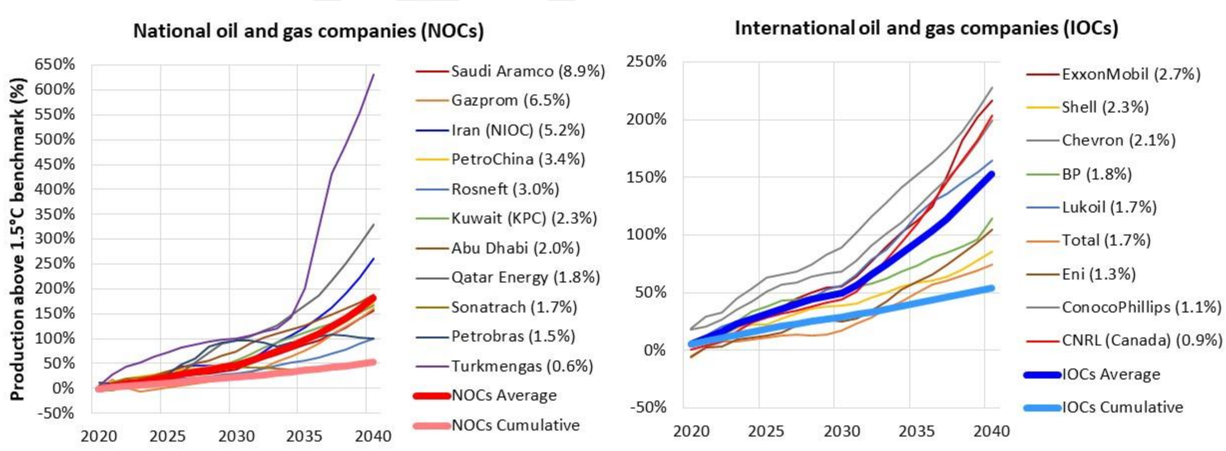

Figure 13: Compatibility of twenty large oil and gas company production strategies with Paris 1.5°C climate target. Percentages in brackets in the legend represent average 2015-2020 global market share.

Indicator 4.2.7: Fossil Fuel and Green Bank Lending

Headline finding: green sector lending has risen sharply since 2016, to US$498 billion in 2021, and is approaching fossil fuel lending. However, 22 of the top 40 private banks have increased their fossil fuel lending.

Redirecting finance away from fossil fuels and towards clean renewables, energy efficiency, and carbon sinks is essential for a healthy, just transition to net-zero emissions. The Net-Zero Banking Alliance (NZBA), currently representing 40% of global banking assets, was convened by United Nations Environment Programme (UNEP) in 2021 to promote this goal.[311] Estimates suggest that 70% of the required green energy investment will come from private sources (i.e. non-government), and an increasing amount will be mobilised as debt.[272] New to this year's report, this indicator draws on data from Bloomberg to monitor private banks lending to the fossil fuel and to the green sector (comprising renewable energy and energy efficiency, carbon sinks, and other energy sustainability, Appendix pp 204). Average annual lending to the fossil fuel sector in the six years before the Paris Agreement entered into force (2010-2016), was US$549 billion, and increased slightly in the following six years (2017-2021), to US$572 billion (Figure 14). The top seven lending banks, dominated by US institutions, account for 40% of total fossil fuel lending over the last decade.

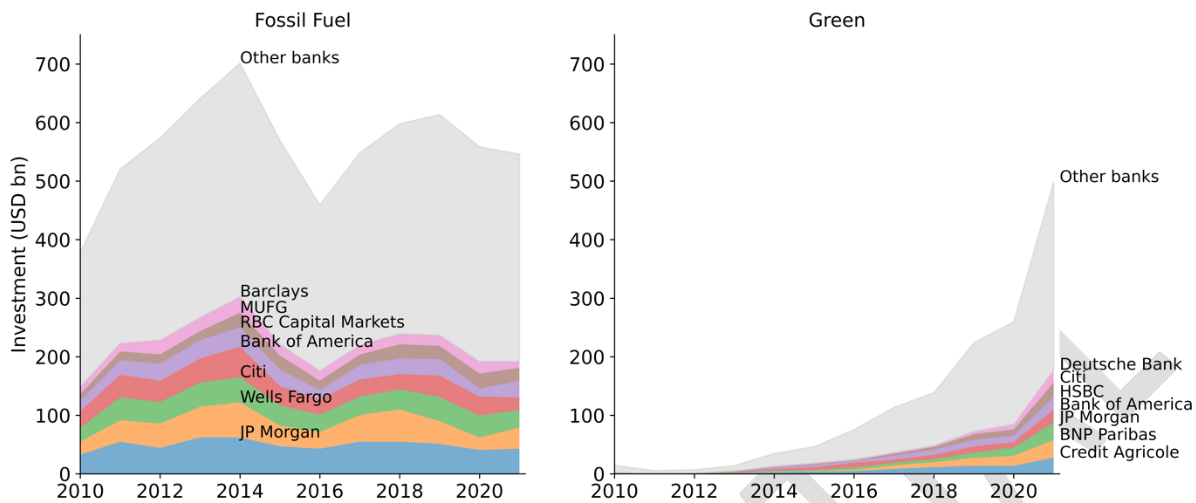

Figure 14: Total lending to the fossil fuel (left) and green sectors (right) between 2010 and 2021. The contributions of the 7 top banks (ranked by cumulative investment) are also shown.

In 2017-2021, the 40 banks that lent the most to the fossil fuel sector in the last decade invested on average US$489 billion yearly in O&G – 87% of total global bank lending to the fossil fuel sector. Of these banks, 22 (55%) had increased their average annual fossil fuel lending from 2010-2016. Despite being NZBA members, three Japanese banks (Sumitomo Mitsui, MUFG and Mizuho Financial) dominated this cohort in terms of absolute spend and relative increase. On the contrary, five European banks led fossil fuel finance reductions (Nordea, UBS, DNB ASA, Deutsche Bank and Credit Suisse), having reduced by over 25% their fossil fuel lending in 2017-2021 compared to 2010-2016.

The biggest fossil fuel lenders, Citi, Wells Fargo, and JP Morgan, who together provide 25% (US$616 billion) of the total fossil fuel lending provided by the top 40 banks in 2017-2021, have made negligible progress on reducing fossil fuel lending, even though they are NZBA members.

Green lending by the banking sector globally, on the other hand, has increased substantially, from US$75 billion in 2016 to US$498 billion in 2021, when it approached lending to the fossil fuel sector. Of the top seven institutions who together provided 34% of total finance in the last decade, four were European banks. Year-on-year growth rose from 16% in 2020 to 92% in 2021, reflecting the increased cost-competitiveness of renewables following the COVID-19 pandemic.

Conclusion

International loss and damage negotiations have put economics and finance at the centre of climate change discussions. This section exposes some of the extensive economic losses and damages from the health impacts of climate change currently affecting people around the world (indicators 4.1.1-4.1.4), which in turn further undermine the socioeconomic determinants of health, and further limit the scarce resources available to foster the transition to a healthy future.

Despite these impacts, substantial and sustained investment today can still deliver needed economic transformation to avert the most catastrophic health impacts, and to forge a fairer, prosperous future. However, governments continue to incentivise a carbon-intensive health-harming economy, allocating amounts often equivalent to substantial proportions of their health budgets to subsidising fossil fuels (indicator 4.2.4). Meanwhile, O&G companies are increasing their non-compliance with the Paris 1.5°C target as high energy prices have incentivised oil and gas investments (indicator 4.2.6); and leading banks have maintained high levels of lending to fossil fuel companies despite their commitments to the Net-Zero Banking Alliance (indicator 4.2.7).

Yet, some indicators show promising trends. Investments and employment in renewable energy continue to increase (indicators 4.2.1-4.2.2). Green lending has accelerated in recent years and is approaching fossil fuel lending (indicator 4.2.7). Increased investment in clean renewable sources of energy can help countries respond to the energy crisis, improve energy security, and reduce air pollution, thereby helping to achieve a net-zero-emission, healthy, and equitable future.

A financial transformation will be essential to achieve these goals. This will require comprehensive cost-benefit analyses which consider the economic costs of the health impacts of climate change, including those on the health system and the broader economy, as well as the potential savings from avoiding them. The current capacity to capture such effective costs is limited by the scarcity of data on health spend and economic performance, and is a gap that the *Lancet* Countdown will continue to seek to address. A further gap relates to a limited capacity to monitor the potential local economic benefits and harms of the transition away from fossil fuels and towards renewable energies, particularly for communities at sites of extraction – a gap that will be critical to address in the future to monitor and support a just transition.

Section 5: Public and Political Engagement in Health and Climate Change

Previous sections made clear that climate change is an increasing threat to health, driven by high-emitting countries but impacting most on communities least protected from its adverse effects.[312–314] Action to date has failed to reverse the upward trends in energy-related carbon emissions,[315] global temperatures,[316] and associated health-damaging exposures and impacts. Putting people at the centre of the climate conversation can help to expose the human impacts of inaction, and the benefits of an accelerated response to meet the ambitions of the Paris Agreement.

This section focuses on societal actors with a key role to play in accelerating action. It tracks engagement by the media, individuals, scientists, governments, international organisations (IOs) and the corporate sector. Where possible, indicators examine engagement with the health benefits of climate change action. For all indicators, methods, data sources and further analyses are provided in the Appendix.

Indicator 5.1: Media Engagement in Health and Climate Change

Headline finding: in 2022, global newspaper coverage of health and climate change continued its upward trend, reaching a record 28% of all climate change articles mentioning health.

Traditional media outlets (newspaper, radio, or television) are major platforms for public engagement, and continue to play an important agenda-setting role within today's multi-media landscape.[317–322] This indicator tracks coverage of health and climate change in 66 newspapers (print and online formats) from 36 countries, including the *People's Daily* (*Renmin Ribao*), the media outlet that best represents mainstream politics in China.[323–325] There is limited sample coverage in low-income countries, particularly sub-Saharan Africa, thus under-representing reporting in these highly vulnerable countries.

Media engagement continued its upward trend in the global set of newspapers. In 2022, 28% of climate change articles referred to health, the highest proportion to date. The number of articles engaging with health and climate change also increased, by 12% between 2021 and 2022, and by over 200% since 2017. However, there is little mention of health co-benefits: in English-language newspapers, less than 1% of articles in 2022 relating to health and climate change refer to health co-benefits. In the *People's Daily*, coverage of climate change in 2022 reached its highest recorded level. The increase was related to China's carbon neutrality goal, pledged at the end of 2020. However, only a small proportion (<1%) of climate change articles referred to health.

Indicator 5.2: Individual Engagement in Health and Climate Change

Headline finding: individual engagement with health and climate change remained low in 2022. Of all clickviews that led to health-related articles, only 0.03% came from climate change-related articles; and only 0.36% of clickviews that led to climate change-related articles came from health-related articles.

This indicator tracks individual engagement with health and climate change by monitoring searches on Wikipedia, the online information source with a wider population reach than traditional encyclopaedias.[326–330] With its content created and edited by users, it also influences the agenda of other media sources.[322] The analysis is based on the English-language Wikipedia that represents around 50% of global traffic to all Wikipedia language editions.[331,332]

The indicator measures 'clickstream' activity, where an individual clicks between an article on health and one on climate change (or vice versa). As in previous years, individuals seldom move between health and climate change; instead, co-click activity is predominantly within the set of articles on health or climate change. Among all clickviews that led to a health-related article, only 0.03% came from a climate change-related article; among all clickviews that led to a climate change-related article, only 0.36% came from a health-related article. Across the 2018-2022 period, there was no consistent trend in engagement between health and climate change as reflected in clickstream activity; the increase noted in 2021, which was driven by COVID-19 related searches, did not continue in 2022.

5.3: Scientific Engagement in Health and Climate Change

Peer-reviewed journals are the primary source of scientific evidence for the media, national governments and the public.[333] The following indicators track engagement on health and climate change in the scientific literature.

Indicator 5.3.1: Scientific Articles on Health and Climate Change

Headline finding: after rapid growth in 2020 and 2021, the number of scientific papers investigating the links between health and climate change in 2022 fell by 2% compared to 2021, but remained three times higher than in 2012.

This indicator uses a machine-learning methodology to monitor the number of peer-reviewed scientific articles on health and climate and reports a growing body of scientific literature on climate and health, 80% of which has been published since 2012. In 2022, a total of 3,149 papers were published, 3.7 times more than in 2012. This represents a reduction of 2% between 2021 and 2022; it remains to be seen whether this heralds a slowdown, or a return to previous trends after exceptionally high years in 2020 and 2021. Climate and health research continues to be dominated by studies on weather-related impacts, with little research on the links between health and mitigation and adaptation policies.

Indicator 5.3.2: Scientific Engagement on the Health Impacts of Climate Change

Headline finding: there are global inequalities in the location of studies referring to the health impacts of human-influenced climate drivers: 6.89 studies per million people in very high HDI *countries, and 1.61 and 1.51, respectively, for medium and low HDI countries. Of 37 extreme events analysed for detection and attribution between 2022 and 2023, 31 (84%) were more likely and/or more severe because of climate change.*

New to this year's report is a set of sub-indicators capturing health impacts that can be tentatively attributed to climate change, using different methods to estimate these climate-related health impacts.

Building on indicator 5.3.1, the first sub-indicator maps the volume of studies published between January 1985 and December 2022 referring to health impacts related to climate variables, where changes in the climate driver can be attributed to human influence. Across this period, 16,000 studies refer to health impacts from events that can be attributed to anthropogenic climate change, the majority of which (78%) related to infectious diseases.

However, there is a marked geographical inequality in the location of these studies (Figure 15). In very high HDI countries, there is a ratio of 6.89 studies per million people exposed to human-influenced climate drivers; in high HDI countries, the ratio stands at 2.53 studies per million. In contrast, for countries with medium and low HDI, the ratios stand at 1.61 and 1.51 respectively.

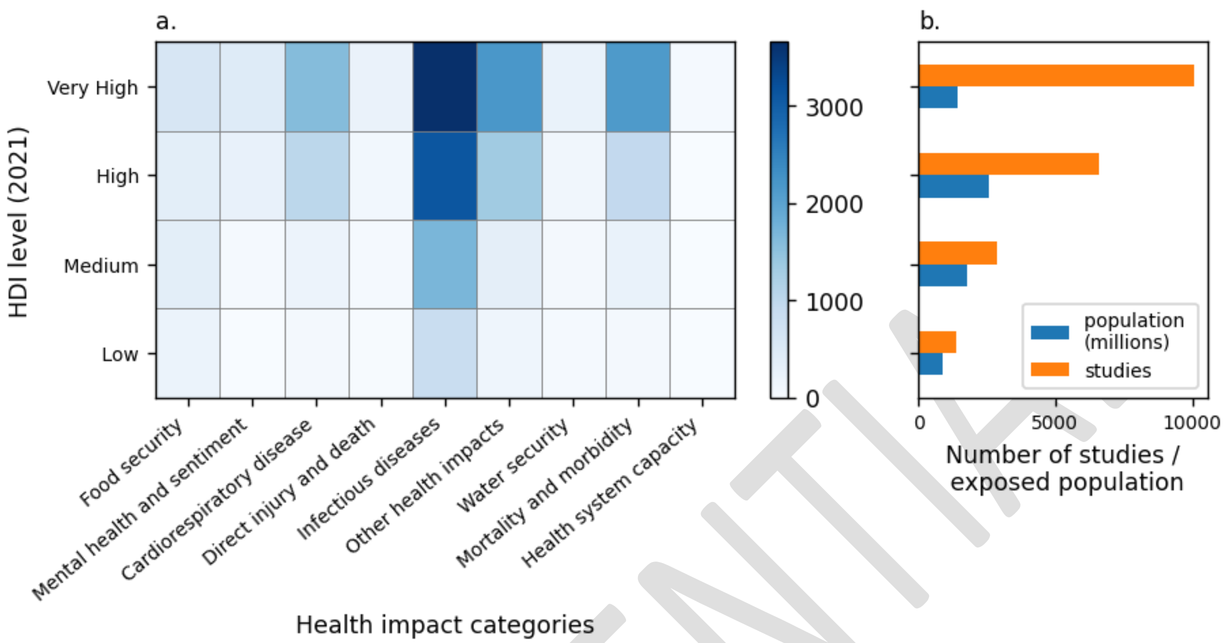

Figure 15: (a) Studies linking health impacts to attributable climate changes by topic area, grouped by level of HDI (b) Number of studies linking health impacts to attributable climate changes and millions of people exposed to attributable climate changes, in countries grouped by level of HDI.

Detection and attribution studies evaluate the causal role of climate change in weather-related events.[334] In this indicator, a literature review monitors published detection and attribution studies, combining them with associated morbidity and mortality reported by the Centre for Research on the Epidemiology of Disasters' database (EM-DAT).[213].

From January 2022 to March 2023, 40 attribution studies analysed 37 events across six regions. Of these events, 31 (84%) were found to have been made more likely and/or severe because of climate change. Extreme heat and flooding were the deadliest of the events analysed, causing 7,991 and 3,460 fatalities, respectively.[213] However, these figures are likely underestimates, as they do not include delayed or indirect deaths that can be substantial in prolonged events.[335]

Seven studies (18%) pertained to events that occurred in countries with low and medium HDI, an increase from four studies (6%) in 2021, and three (12%) in 2020.[38] Additionally, 17 (43%) made direct reference to health impacts, consistent with an overall increase in "impact attribution" research linking attribution science directly with environmental and socioeconomic outcomes, including health.

5.4: Political Engagement in Health and Climate Change

Engagement by political leaders is central to climate interventions that protect human health. The following indicators monitor political engagement through national leaders' statements at the UN General Debate (UNGD), the cornerstone of the annual UNGA,[336,337] and Nationally Determined Contributions (NDCs), the key policy instrument to protect people and the planet from climate change.[338] In addition, a new indicator tracks engagement by International Organisations (IOs) with the intersection of health and climate change.

Indicator 5.4.1: Government Engagement

Headline finding: 50% of countries mentioned the intersection of health and climate change at the UN General Debate in 2022, a 10% decrease from 2021. 95% of updated NDC documents make reference to health, up from 73% in the first submission.

The UNGA is the policy-making body of the UN,[336,339] and through the annual UN General Debate (UNGD) provides the major global platform for national governments to highlight challenges requiring action by the international community. In 2022, engagement in heath and climate change declined compared to 2021, when 60% of government leaders discussed health and climate change, many in the context of COVID-19. Nonetheless, 50% of national leaders discussed the health-climate change nexus; SIDS represented 64% of those, continuing to lead engagement.

The speeches made by countries least responsible but most affected by climate change continued to highlight the human and environmental devastation of climate change. For example, the Pakistan address focused on the floods the country experienced in 2022, stating "In that ground-zero of climate change, 33 million people, including women and children, are now at high risk from health hazards, with 650,000 women giving birth underneath makeshift tarpaulins…in peril from disease and malnutrition." While most of the references focused on the impacts of climate change on health, there were also references to the health co-benefits of mitigation. For example, Fiji's address stated "We legislated a net-zero commitment by 2050…which will make us more energy secure, protect us from energy price shocks beyond our control and provide us with cleaner air, better health and better jobs."

The second part of this indicator measures engagement with health and climate change in NDCs. In compliance with the Paris Agreement, countries must periodically report increasingly ambitious contributions towards international climate commitments.[45] UN member states' second NDCs (as of February 2023) point to increasing engagement in health compared to their first NDCs. Engagement in the first NDCs was led by countries most affected by climate change and all countries in the low HDI group referred to health. In subsequent NDCs, engagement increased sharply in the high (from 86% to 100% of countries) and very high (from 33% to 87%) HDI country groups. Of all updated NDCs, 95% now make reference to health – up from 73% in the first round. However, across all three rounds of NDCs, the very high HDI group was least likely to refer to health.

As a further indicator of government engagement, Panel 8 presents evidence on how national laws can serve as instruments of climate change action, by mandating mitigation and adaptation actions with health co-benefits.

Panel 8: Protecting health through climate legislation and litigation

The law is an important arena for action on health and climate change.[340,341] Across different countries, climate-related legislation has been passed at national and subnational levels, and citizens have turned to litigation to force governments to strengthen mitigation and adaptation actions. These legal instruments have incorporated health in various ways.

Health Impact and Adaptation: A growing number of countries have enacted laws establishing national emissions reduction targets and strengthening climate governance.[342,343] Many of these laws include direct references to the health impacts of climate change – both in terms of justifying the legislation and including adaptation provisions focusing on citizens' health. For example, Portugal's 2021 Framework Climate Law includes an article on public health that stipulates that the government must support the "assessment of global and national risks and the preparation of action, prevention and contingency plans in the face of extreme climatic phenomena, the emergence of new diseases or the worsening of the incidence of diseases as a result of climate change".[344] Climate laws that include health adaptation provisions have been introduced in places such as Ecuador,[345] Nauru,[346] and the EU.[347]

Mitigation and Health Co-Benefits: Other countries have introduced laws targeting emissions reductions and environmental protections that explicitly refer to health co-benefits. For example, North Macedonia's Law on Ambient Air Quality.[348] The emphasis on health can also be seen in laws that may not primarily target climate change. For example, the US's 2022 Inflation Reduction Act (IRA) aims to curb inflation by, among others, investing in domestic energy production, and promoting healthy, zero-emission energy.[349] Through various health and climate-related provisions, the IRA could play a crucial role in protecting health from the adverse impacts of climate change.[350]

Litigation: Evidence relating to the health impacts of climate change has also been used in litigation cases, such as civil legal proceedings against governments to accelerate climate change action.[351] In a landmark court case in Germany in 2020, a group of young people filed a legal challenge to Germany's Federal Climate Protection Act (KSG) on the basis that the target of reducing greenhouse gas emissions by 55% between 1990 and 2030 was insufficient for the country to meet its Paris Agreement targets, which therefore violated their human rights as protected in Germany's constitution.[352] A key component of the claimants' case was evidence of the health impacts of climate change, which they argued violated their right to life and physical integrity.[353] The court ruled in their favour, leading to the German Government revising their mitigation targets.[352] An emphasis on the health impacts of climate change can also be observed in other recent and ongoing litigation cases at the international level. For example, the UN Human Rights Committee ruling in favour of Indigenous Torres Straight Islanders – who had lodged a complaint against the Australian Government for failing to adequately cut emissions or implement necessary adaptation measures – referred to the health impacts of climate change for Indigenous people on the low-lying islands.[354] A focus on the health dimensions of climate change is also likely to be central to climate-related litigation pursued by Small Island Development States (SIDS). In December 2022, The Commission of Small Island States on Climate Change and International Law (COSIS) made an unprecedented formal request for an Advisory Opinion to the International Tribunal for the Law of the Sea.[355] The case documents include a strong focus on the health impacts of climate change, particularly in relation to undermining the right to health, and the right to a clean, healthy and sustainable environment for citizens of SIDS.[356]

As well as being effective instruments of action on health and climate change, legislation and litigation can increase engagement in other key societal domains, including by the media, the public and the corporate sector.[340,357]

Indicator 5.4.2: Engagement by International Organisations

Headline finding: tweets mentioning the health co-benefits of climate change action reached a record of 22% of all monthly tweets from International Organisations in November 2022, in a continuously upward trend.

IOs – for example, international and regional development agencies, supra-national bodies like the EU, African Union and UN agencies – are playing an increasingly important role in climate change action.[358–360] This new indicator tracks engagement in the health co-benefits of climate mitigation in IOs' official Twitter accounts, a key mode of communication with journalists and the public.[361]

The indicator focuses on 41 IOs within an operational focus on climate mitigation and/or adaptation across a broad range of sectors (e.g. development and disaster risk management, trade and finance, energy policy, food and agriculture). The dataset consisted of 1,392,892 tweets between 2010 and 2022, of which 1,354,924 were English language tweets, analysed to identify those engaging with health co-benefits of mitigation. Engagement in these co-benefits (as a proportion of the total number of tweets by that IO) increased across this period: by November 2022, a record of 22% of tweets mentioned co-benefits, up from an average of 7% in 2010 (Figure 16). There were clear sectoral differences, with the greatest co-benefits engagement by IOs from the Energy, Environment, Food and Agriculture, and Global Development Banking sectors.

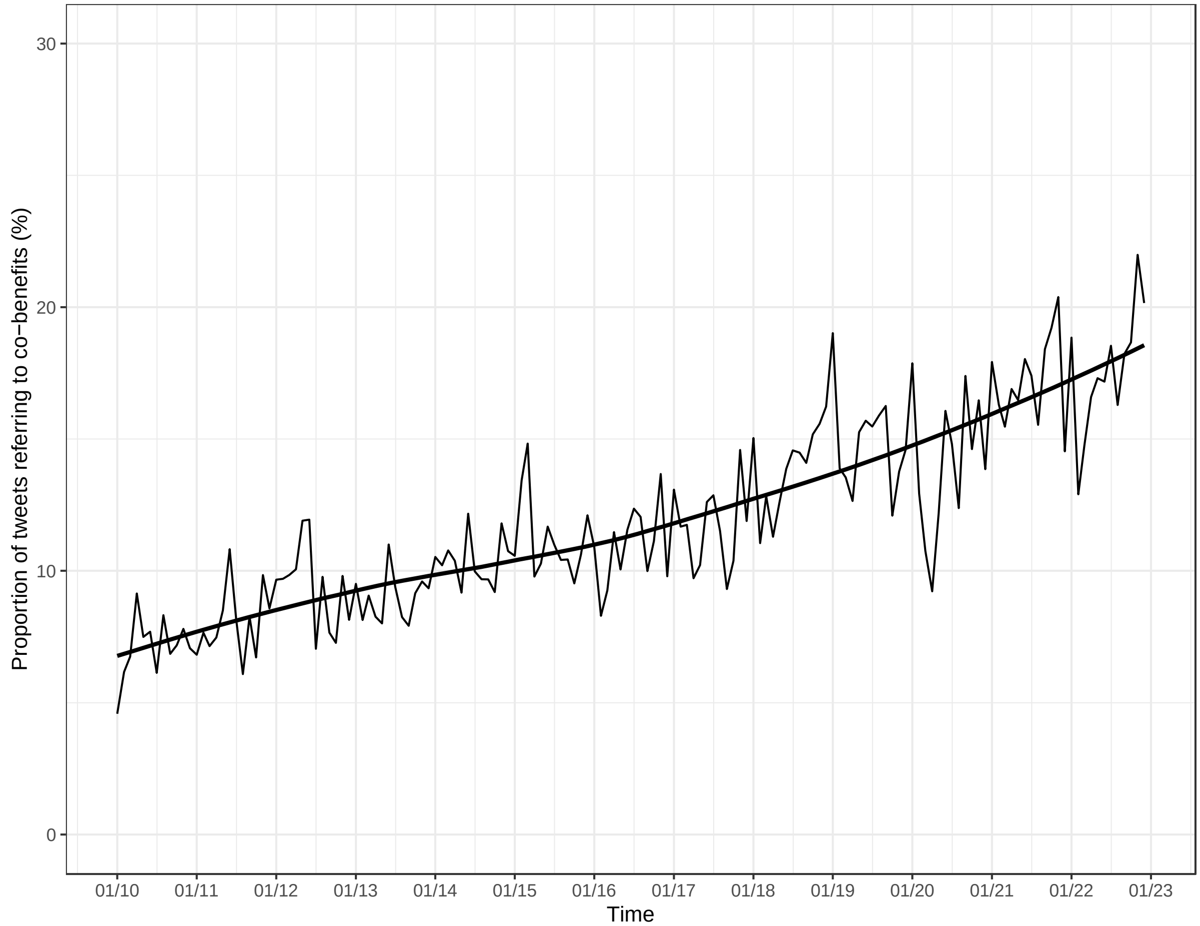

Figure 16: Engagement with health co-benefits of mitigation in Twitter posts of 41 International Organisations, 2010-2022. The smooth line represents a local regression using locally estimated scatterplot smoothing; the thinner line represents the actual number of tweets over time. The 95% confidence interval is indicated by the shaded area around the trend line.

Indicator 5.5: Corporate Sector Engagement in Health and Climate Change

Headline finding: corporate sector engagement with health and climate change reached its highest recorded level in 2022, with 38% of companies referring to the health dimensions of climate change.

The UN Global Compact (UNGC) is the largest global corporate sustainability framework,[362] and one associated with improved environmental and social responsibility among participating companies.[363,364] This indicator monitors engagement on health and climate change from the over 20,000 companies from 162 countries who signed up to the UNGC by tracking mentions of health and climate change in their annual Global Compact Communication of Progress (GCCOP) reports.

Engagement in 2022 reached its highest recorded level, with 38% (2337/6089) of companies referring to the health dimensions of climate change. However, a higher proportion of companies continue to engage with either health (88% in 2022) or climate change (75%) alone.

Conclusion

Public and political engagement in health and climate change continued its upward trend across 2022, reaching the highest recorded level in global newspapers and among government leaders and companies signed up to the UN sustainability charter. There is also evidence of increasing engagement in the health co-benefits of climate mitigation, for example among IOs. The Lancet Countdown will continue to track key sites of engagement. It will address gaps in coverage, by extending the global reach of existing indicators and by introducing new indicators that directly capture people's perceptions of health and climate change within and between countries.

Engagement in the climate change-health nexus is growing. But as this section demonstrates, there is greater engagement with health and climate change as separate issues, as evidenced in the digital footprint of Wikipedia users and by government leaders at the UNGD and companies in the UNGC. In addition, profound inequities in engagement persist. Scientific research is concentrated in countries and regions more protected from the adverse consequences of climate change, with much less focus on climate-vulnerable communities in Africa, Asia and South and Central America. At the same time, government engagement has been led by countries bearing the brunt of a climate crisis to which they contributed little. These stark contrasts point to the negative inequality impacts of climate change and the importance of tracking the distributional effects of climate change action across and within countries.[314,365,366]

Conclusion: the 2023 report of the *Lancet* Countdown

The 2022 report of the *Lancet* Countdown warned that global health is at the mercy of fossil fuels, and noted a unique opportunity, as countries responded to the energy crisis, to deliver transformative climate change action for a thriving future.[251] This year's report finds few, if any, signs of the urgently needed progress, in a world still bound to fossil fuel ambitions.

With extreme weather records breached in all continents through 2022, risks to human health and survival are increasing across all dimensions monitored. Around the world people face increased heat-related illness and extreme weather-related risks, infectious disease spread, and worsened food insecurity (Section 1). The associated economic losses add to the health burden, eroding the socioeconomic building blocks of health (indicators 1.1.4, 4.1.1, and 4.1.3). Despite the rising risks, adaptation efforts fall short of the necessary action to protect people's health, particularly in lower Human Development Index (HDI) countries where structural inequities limit access to funding and technical capacity (Section 2). This scarcity is aggravated by the rising economic losses from climate change impacts, and the persistent failure of wealthier countries reach the promised sum of U$S 100 billion annually to support countries most affected by climate change.[367] As a result, the most vulnerable and minoritised communities are left the least protected, and the deep within and between-country health inequities ae further exacerbated.

The impacts observed at the current average global 1.14°C of heating offer an early glimpse into a future that increasingly threatens people's health. New to this year's report, projections reveal the potential human cost of further delayed action, with every health hazard assessed projected to increase even under a scenario compatible with a 2°C mean temperature rise (section 1). Accelerating adaptation remains essential to minimise the associated health impacts. However, with various limits to adaptation being rapidly reached,[2] these data underline the critical health imperative to strengthen mitigation efforts urgently to restrict global mean temperature rise to 1.5°C.

However, the pace and scale of mitigation efforts continue to fall very far short of those required to safeguard people's safety. Current policies put the world on track for a potentially catastrophic 2.7°C of heating by 2100, and energy-related emissions reached a new record high in 2022 (indicator 3.1.1). Meanwhile, high energy prices yielded US$4 trillion in profits for oil and gas (O&G) companies (panel 7), incentivising fossil fuel expansion. Indeed, O&G companies allocated only around 4% of their capital investment to renewables, and further reduced the compliance of their strategies with international climate change goals (panel 7 and indicator 4.2.6).[273] The finance sector is also contributing to growing health threats, as 55% of the private banks that provide the most finance to fossil fuels are increasing their lending (indicator 4.2.7).[76,294–298] Rather than discouraging health-harming fossil fuel burning, most governments keep incentivising it through subsidies, often for sums equivalent to substantial proportions of their health budgets (indicator 4.2.4). Meanwhile, agricultural emissions continue to increase as well, alongside a global food system that supports unhealthy, carbon-intensive diets (indicators 3.3.1 and 3.3.2).

Despite a rapidly growing use of clean renewable energy, they still account for only 9.5% of the world's electricity (indicator 3.1.1). The share is even less in low HDI countries where, often in spite of vast availability of natural renewable energy resources, clean renewables account for just 2.3% of electricity generation, and 92% of domestic energy still comes from polluting fuels (indicators 3.1.1 and 3.1.2). This resulted in 1.8 million deaths from ambient fossil fuel-derived air pollution globally in 2020, and the use of dirty fuels inside homes caused, on average, 140 deaths per 100,000 inhabitants across 62 countries assessed (indicators 3.1.2, 3.2.1 and 3.2.2). Populations in low HDI countries are exposed not only to dirty fuels, but also to persistent energy poverty (indicator 3.1.2 and 3.2.2). In addition, those communities living in the proximity of extraction sites of fossil fuels and renewable industries often also see their health affected by the harms of poorly-regulated local industrial activity.[34,78] This inequitable energy transition is leaving the most underserved populations behind, exacerbating heath inequities, and perpetuating harmful extractive practices that undermine human health, wellbeing, and the social, economic, and environmental conditions on which they depend (Part A).

Notwithstanding the insufficient progress identified, this report reveals the path to a healthy future. Redirecting subsidies, lending, investment, and other financial flows away from fossil fuels is critical to support a healthy future. Funds are available to support a just clean energy transition, health-promoting activities and reduced inequities (indicators 4.2 and panel 7). Empowering countries and local communities in the safe development, deployment and adoption of clean energies, can reduce energy poverty by supporting access to de-centralised energy. In turn, this can promote access to quality health-supporting services and promote local skills, generate jobs and support local economies, strengthening the socioeconomic determinants of health (indicator 4.2.2 and panel 6).[78,80,368,369] Health-centred urban redesign can promote safe active travel, reduce building and transport-based air pollution and GHG emissions, and increase resilience to climate hazards (indicators 3.1.3 and 3.2.1). Increasing urban green spaces can additionally offer local cooling, increase carbon sequestration, and provide direct benefits to physical and mental health (indicators 2.2.2 and 2.2.3). Providing further support for climate and health risk assessments and adaptation planning can support increased resilience to unavoidable climate change, delivering stronger health systems for all (indicators 2.1.1-2.1.3, 2.3.1 and 2.3.2). The health benefits of climate action could be transformative, protecting lives and livelihoods and paving the way to a thriving future.

Achieving these ambitions requires guidance and leadership on health-promoting climate policies, and steadfast, sustained commitments to deliver a just transition. Driven by the mandate to protect people's health, wellbeing, an survival above all else, health professionals are uniquely positioned to guide actions to safeguard the human right to heath and a healthy environment.

Encouragingly, following decades of the health sector raising the alarm,[370] engagement with health and climate change is increasing among key actors and decision makers (indicators 5.1, 5.4, and 5.5). The renewed focus on health within forthcoming UNFCCC negotiations offers an unprecedented opportunity to foster climate action (panel 2).[371] Harnessing this opportunity will require coordinated efforts grounded in science to keep decision makers accountable, and counteract the growing lobbying and influence of the fossil fuel sector and other health-harming industries. To truly protect health, climate negotiations must drive a rapid and sustained shift away from fossil fuels, accelerate mitigation, and increase support for health adaptation. Anything less would amount to healthwashing – increasing the acceptability of initiatives that minimally advance climate change action, to the detriment of billions alive today.

With climate change claiming millions of lives annually and its threats rapidly growing, seizing the opportunity to secure a healthier future has never been more vital. It will take the coordinated action of health professionals, policy makers, corporations and financial institutions to ensure a thriving future remains within reach.

Contributors

The *Lancet* Countdown and the work for this report were conducted by five working groups, which were responsible for the design, drafting, and review of their individual indicators and sections, alongside contributions from *Lancet* Countdown Regional Centres for the section on regional analysis. All authors contributed to the overall paper structure and concepts and provided input and expertise to the relevant sections. AC, HM, PG, MRo, MWa provided coordination, strategic direction, and editorial support. EJZR, CdN, JC, TJC, SD, CF, SHG, YH, RH, JH, OJ, RK, JKWL, BL, YL, ZL, MLB, RL, MOS, JMU, KMi, NCM, MML, KAM, NO, MO, FO, FP, AP, MRa, JRo, JCS, MSo, MTa, MTr, JAT, and QZ contributed to Working Group 1. KLE, CG, SAK, DCL, RD, SD, JJH, IK, PK, DK, CMcM, KMo, TN, MN, JCS, JRo, JSG, JS, RT, and MYG contributed to Working Group 2. IH, TO, HK, KBe, CD, MD, PDS, ME, SH, SCH, GK, ML, JM, NM, JDS, MSp, JT, LW, and MWi contributed to Working Group 3. PE, DS, NA, WC, KH, FL, ZM, JRi, FW, and SZ contributed to Working Group 4. HG, PL, LBF, KBo, MC, WC, ND, OG, SL, LMcA, JCM, SM, GS, OP, and CT contributed to Working Group 5. ZA, PJB, WC, KvD, GGS, SH, RL, KAM, RNS, and YZ contributed to the regional analysis.

Declaration of interests

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