

The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels

Article

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Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., Scamman, D., Arnell, N. ORCID: <https://orcid.org/0000-0003-2691-4436>, Ayeb-Karlsson, S., Ford, L. B., Belesova, K., Bowen, K., Cai, W., Callaghan, M., Campbell-Lendrum, D., Chambers, J., van Daalen, K. R., Dalin, C., Dasandi, N., Dasgupta, S., Davies, M., Dominguez-Salas, P., Dubrow, R., Ebi, K. L., Eckelman, M., Ekins, P., Escobar, L. E., Georgeson, L., Graham, H., Gunther, S. H., Hamilton, I., Hang, Y., Hänninen, R., Hartinger, S., He, K., Hess, J. J., Hsu, S.-C., Jankin, S., Jamart, L., Jay, O., Kelman, I., Kiesewetter, G., Kinney, P., Kjellstrom, T., Kniveton, D., Lee, J. K. W., Lemke, B., Liu, Y., Liu, Z., Lott, M., Batista, M. L., Lowe, R., MacGuire, F., Sewe, M. O., Martinez-Urtaza, J., Maslin, M., McAllister, L., McGushin, A., McMichael, C., Mi, Z., Milner, J., Minor, K., Minx, J. C., Mohajeri, N., Moradi-Lakeh, M., Morrissey, K., Munzert, S., Murray, K. A., Neville, T., Nilsson, M., Obradovich, N., O'Hare, M. B., Oreszczyn, T., Otto, M., Owfi, F., Pearman, O., Rabbaniha, M., Robinson, E. J. Z., Rocklöv, J., Salas, R. N., Semenza, J. C., Sherman, J. D., Shi, L., Shumake-Guillemot, J., Silbert, G., Sofiev, M., Springmann, M., Stowell, J., Tabatabaei, M., Taylor, J.,

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The 2022 Report of The *Lancet* Countdown on Health and Climate Change: compounding health crises

Marina Romanello, Claudia Di Napoli, Paul Drummond, Carole Green, Harry Kennard, Pete Lampard, Daniel Scamman, Nigel Arnell, Sonja Ayeb-Karlsson, Lea Berrang Ford, Kristine Belesova, Kathryn Bowen, Wenjia Cai, Max Callaghan, Diarmid Campbell-Lendrum, Jonathan Chambers, Kim R. van Daalen, Carole Dalin, Niheer Dasandi, Shouro Dasgupta, Michael Davies, Paula Dominguez-Salas, Robert Dubrow, Kristie L. Ebi, Matthew Eckelman, Paul Ekins, Luis E. Escobar, Lucien Georgeson, Hilary Graham, Samuel H. Gunther, Ian Hamilton, Yun Hang, Risto Hänninen, Stella Hartinger, Kehan He, Jeremy Hess, Shih-Che Hsu, Slava Jankin, Louis Jamart, Ollie Jay, Ilan Kelman, Gregor Kiesewetter, Patrick Kinney, Tord Kjellstrom, Dominic Kniveton, Jason K.W. Lee, Bruno Lemke, Yang Liu, Zhao Liu, Melissa Lott, Martin Lotto Batista, Rachel Lowe, Frances MacGuire, Sewe Maquins Odhiambo, Jaime Martinez-Urtaza, Mark Maslin, Lucy McAllister, Alice McGushin, Celia McMichael, Zhifu Mi, James Milner, Kelton Minor, Jan C. Minx, Nahid Mohajeri, Maziar Moradi-Lakeh, Karyn Morrissey, Simon Munzert, Kris A. Murray, Tara Neville, Maria Nilsson, Nick Obradovich, Megan B. O'Hare, Tadj Oreszczyn, Matthias Otto, Fereidoon Owfi, Olivia Pearman, Mahnaz Rabbaniha, Elizabeth J. Z. Robinson, Joacim Rocklöv, Renee N. Salas, Jan C. Semenza, Jodi D. Sherman, Lihua Shi, Joy Shumake-Guillemot, Grant Silbert, Mikhail Sofiev, Marco Springmann, Jennifer Stowell, Meisam Tabatabaei, Jonathon Taylor, Joaquin Trinanes, Fabian Wagner, Paul Wilkinson, Matthew Winning, Marisol Yglesias-González, Shihui Zhang

Peng Gong^a, Hugh Montgomery^a, Anthony Costello^a

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List of Abbreviations

A&RCC – Adaptation & Resilience to Climate Change
AC – Air Conditioning
CO₂ – Carbon Dioxide
CO₂e – Carbon Dioxide Equivalent
COP – Conference of the Parties
D&A – Detection and Attribution
EE MRIO – Environmentally-Extended Multi-Region Input-Output
EJ – Exajoule
EM-DAT – Emergency Events Database
ERA – European Research Area
ETS – Emissions Trading System
EU – European Union
EU28 – 28 European Union Member States
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
GtCO₂ – Gigatons of Carbon Dioxide
GW – Gigawatt
GWP – Gross World Product
HIC – High Income Countries
IEA – International Energy Agency
IHR – International Health Regulations
IPC – Infection Prevention and Control
IPCC – Intergovernmental Panel on Climate Change
IRENA – International Renewable Energy Agency
LMICs – Low- and Middle-Income Countries
LPG – Liquefied Petroleum Gas
Mt – Metric Megaton
MtCO₂e – Metric Megatons of Carbon Dioxide Equivalent
MODIS – Moderate Resolution Imaging Spectroradiometer
NAP – National Adaptation Plan
NASA – National Aeronautics and Space Administration
NDCs – Nationally Determined Contributions
NHS – National Health Service
NO_x – Nitrogen Oxide
NDVI – Normalised Difference Vegetation Index
OECD – Organization for Economic Cooperation and Development
PM_{2.5} – Fine Particulate Matter

PV – Photovoltaic
SDG – Sustainable Development Goal
SDU – Sustainable Development Unit
SSS – Sea Surface Salinity
SST – Sea Surface Temperature
tCO₂ – Tons of Carbon Dioxide
tCO₂/TJ – Total Carbon Dioxide per Terajoule
TJ – Terajoule
TPES – Total Primary Energy Supply
TWh – Terawatt Hours
UN – United Nations
UNFCCC – United Nations Framework Convention on Climate Change
UNGA – United Nations General Assembly
UNGD – United Nations General Debate
US\$ – 2021 United States Dollars (unless clarified in the text)
WHO – World Health Organization
WMO – World Meteorological Organization

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138 Executive Summary

139

140 Compounding Health Crises in a Heating World

141 Publication of the 2022 report of the Lancet Countdown lands in a world confronting profound
142 and concurrent systemic shocks. Countries and health systems continue to grapple with the
143 health, social and economic devastation of the COVID-19 pandemic, while Russia’s war on
144 Ukraine and a persistent fossil fuel overdependence has plunged the world into a global energy
145 and cost of living crisis. As these crises unfold, climate change rises unabated. Its worsening
146 impacts are increasingly opening fissures in the foundations of human health and wellbeing,
147 exacerbating the vulnerability of the world’s populations.

148 In 2021-2022, as the COVID-19 pandemic continued to overwhelm health systems around the
149 world, extreme weather events caused devastation across every continent and added extra
150 pressure to health services, with the influence of climate change on many of them increasingly
151 understood and quantified through detection and attribution studies. Floods in Australia, Brazil,
152 China, Western Europe, Malaysia, South Africa, and South Sudan caused hundreds of deaths,
153 displaced hundreds of thousands of people, and caused billions of dollars in economic losses.
154 Wildfires ravaged Canada, the United States, Greece, Algeria, Italy, Spain, and Turkey; and record
155 temperatures were recorded in many countries, including Australia, Canada, India, Italy, Oman,
156 Turkey, Pakistan, and the United Kingdom.

157 Exposed to rapidly rising temperatures, vulnerable populations faced 3.7 billion more heatwave
158 days in 2021 than annually in 1986-2005 (indicator 1.1.2), while heat-related deaths increased by
159 some 68% between 2000-2004 and 2017-2021 (indicator 1.1.5) – a death toll that was
160 significantly amplified by the confluence of the COVID-19 pandemic.

161 Simultaneously, the changing climate is affecting the spread of infectious diseases, putting
162 populations at increased risk of emerging diseases and co-epidemics. Coastal waters are
163 becoming increasingly suitable for the transmission of *Vibrio* pathogens; the number of months
164 suitable for malaria transmission rose by 31.3% and 13.8% in the highland areas of the Americas
165 and Africa, respectively, from 1951–1960 to 2012–2021; and the likelihood of dengue
166 transmission rose by 12% in this same period (indicator 1.3.1). Indeed, the coexistence of dengue
167 outbreaks with the COVID-19 pandemic led to aggravated pressure to health systems,
168 misdiagnosis, and difficulties in management of both diseases in many regions of South America,
169 Asia and Africa.

170 The impacts of climate change also translate to economic losses, increasing pressure on families
171 and economies already facing the synergistic challenges of the COVID-19 pandemic and of the
172 international energy and cost of living crises, and further undermining the socioeconomic
173 determinants that good health depends on. Heat exposure led to 470 billion potential labour
174 hours lost globally in 2021 (indicator 1.1.4), with income losses equivalent to 0.72% of the global
175 economic output, and rising to 5.6% of the gross domestic product in low Human Development
176 Index (HDI) countries, where workers are most vulnerable to financial shocks (indicator 4.1.3). In
177 addition, extreme weather events caused damage worth US\$253 billion in 2021, particularly
178 overburdening people in low HDI countries where essentially none of the losses were insured
179 (indicator 4.1.1).

180 Climate change is also affecting every pillar of food security, compounding the impacts of other
181 coexisting crises. Rising temperatures threaten crop yields directly, with the growth seasons of
182 maize 9 days shorter, and that of winter and spring 6 days shorter, in 2020 as compared to 1981–
183 2010 (indicator 1.4). These effects add onto the rising impact of extreme weather on crops and
184 supply chains, socioeconomic pressures, and the heightened risk of infectious diseases, to
185 undermine food availability, access, stability, and utilisation. Indeed, new analysis suggests that
186 extreme heat was associated with 98 million more people reporting moderate to severe food

187 insecurity in 103 countries in 2020, than annually in 1981-2010 (indicator 1.4). These impacts
188 exacerbate the fragility of global food systems, acting in synergy with other concurrent crisis to
189 reverse progress towards hunger eradication. Indeed, after remaining stable since 2015, 150
190 million more people were affected by hunger since the outbreak of the COVID-19 pandemic and
191 the associated economic impacts, while Russia’s invasion of Ukraine and the energy crisis has
192 affected international agricultural production and supply chains, increased the cost of living, and
193 could lead to 13 million more people facing undernutrition in 2022 alone.

194 [A Debilitated First Line of Defence](#)

195 With the compounding health risks of climate change on the rise, world populations increasingly
196 turn to health systems as their first line of defence. But precisely when they are most needed,
197 the world finds global health systems grappling with the effects of the COVID-19 pandemic and
198 supply chain disruptions, and extreme weather events increasingly affect fail health system
199 infrastructure.

200 Strengthening health system resilience is therefore critical to prevent a rapidly increasing loss of
201 lives and suffering in a changing climate. However, only 48 out of 95 countries reported having
202 assessed their climate change adaptation needs (indicator 2.1.1) and, even with COVID-19
203 experience, only 63% of countries reported high to very high implementation status for health
204 emergency management in 2021 (indicator 2.2.4).

205 The lack of proactive adaptation is exposed in the response to extreme heat. Despite the local
206 cooling and overall health benefits of urban greenspaces, only 27% of global urban centres were
207 at least moderately green in 2021 (indicator 2.2.3), while the fraction of households with air
208 conditioning increased by 66% from 2000 to 2020 – a maladaptive response that deepens the
209 energy crisis and further increases urban heat, air pollution, and greenhouse gas emissions.

210 As converging crises further threaten the world’s life-supporting systems, rapid, decisive, and
211 coherent intersectoral action is primordial to protect human health.

212

213 [Health at the Mercy of Fossil Fuel Ambitions](#)

214 2022 marks the 30th anniversary of the signing of the UN Framework Convention on Climate
215 Change, in which countries agreed to prevent dangerous anthropogenic climate change, and its
216 deleterious effects on human health and welfare. However, little meaningful action has since
217 followed. The carbon intensity of the global energy system has decreased by less than 1% since
218 the UNFCCC was established, and global electricity generation is still dominated by fossil fuels,
219 with renewable energy contributing to only 8.2% (indicator 3.1). Meanwhile, the total energy
220 demand has risen by 59%, pushing energy-related emissions to a historical high in 2021. Current
221 policies put the world on track to a catastrophic 2.7°C by the end of the century, and even under
222 the commitments countries set in their recently-updated Nationally Determined Contributions
223 (NDCs), global emissions could be 17.5% above 1990 levels by 2030 – far from the 43% decrease
224 from current levels required to meet Paris Agreement goals and keep temperatures within the
225 limits of adaptation.

226 The current fossil fuel dependence is not only undermining global health through increased
227 climate change impacts, but also affected human health and wellbeing directly, by subjecting
228 households to volatile fossil fuel markets, frail supply chains, and geopolitical conflicts. As a
229 result, millions lack access to the energy needed to keep their homes at healthy temperatures,
230 preserve food and medication, and achieve the 7th sustainable development goal (SDG7). With
231 governments not providing sufficient support, access to clean energies has been particularly slow
232 in low HDI countries, and only 1.4% of their electricity came from modern renewables (mostly
233 wind and solar power) in 2020 (indicator 3.1). Around 60% of healthcare facilities in low and

234 middle-income countries still lack access to the reliable electricity needed to provide basic care.
235 Meanwhile, biomass accounts for as much as 31% of the energy consumed in the domestic sector
236 globally, mostly from traditional sources – a proportion that rises to 96% in low HDI countries
237 (indicator 3.2). The associated burden of disease is substantial, with the air in people’s homes
238 exceeding the World Health Organization’s guidelines for safe concentrations of small particulate
239 air pollution (PM_{2.5}) in 2020, by a staggering 30-fold on average in in 62 countries assessed
240 (indicator 3.2). After six years of improvement, the number of people without access to
241 electricity increased in 2020 as a result of the socioeconomic pressures of the COVID-19
242 pandemic. The current energy and cost of living crisis now threatens to further reverse progress
243 towards affordable, reliable, sustainable and modern energy, further undermining the
244 socioeconomic determinants of health.

245 In parallel, at a time when fossil fuel burning threatens global health and overburdens health
246 systems, and high energy prices deepen the cost of living crisis, oil and gas companies have
247 registered record profits, hampering efforts to shift to cleaner energies. Indeed, the current
248 production strategies of 15 of the world’s largest oil and gas companies would generate
249 emissions that would exceed, by 37% in 2030 and 103% in 2040, their share of emissions
250 consistent with 1.5°C of global heating (indicator 4.2.6), continuing to undermine efforts to
251 protect the health of the world’s population from climate change, and overburdening health
252 systems. Meanwhile, governments continue to favour fossil fuel production and consumption in
253 detriment of global health: 69 of 86 countries reviewed had net-negative carbon prices (i.e.
254 provided a net subsidy to fossil fuels), for a net total of US\$400 billion in 2019 alone , allocating
255 amounts often comparable or even exceeding their total health budgets (indicator 4.2.4).
256 Simultaneously, wealthier countries failed to mobilise the considerably lower sum of US\$100
257 billion annually by 2020 which was committed at the 2009 Copenhagen Accord to support climate
258 action in “developing countries”, and climate efforts are being undercut by a profound lack of
259 funding (indicator 2.1.1), exposing the low prioritisation of a healthy, low-carbon future in the

260 global political agenda. Now, the impacts of climate change on global economies, together with
261 the recession triggered by COVID-19 and worsened by geopolitical instability, may paradoxically
262 further reduce the willingness of countries to allocate the funds needed to enable a just climate
263 transition.

264 [A Health-centred Response for a Thriving Future](#)

265 The world is yet again at a pivotal moment. However, with countries facing concurrent crises, the
266 implementation of long-term emissions-reduction policies risks been deflected or defeated by
267 challenges wrongly perceived as more immediate. Addressing each of the concurrent crises in
268 isolation risks alleviating one, while worsening another. For example, the response to COVID-19
269 has so far failed to deliver the green recovery the health community proposed, and is aggravating
270 climate change-related health risks: less than one third of US\$3.11 trillion allocated to COVID-19
271 economic recovery is likely to reduce greenhouse gas emissions or air pollution, with the net
272 effect likely to increase emissions. Further, the COVID-19 pandemic affected climate action at the
273 city level, and 30% of 798 cities reported that it COVID-19 reduced financing available for climate
274 action (indicator 2.1.3).

275 Now, as countries search for alternatives to Russian fossil fuels, many continue to favour fossil
276 fuel burning with some even turning back to coal, and shifts in global energy supplies threaten to
277 increase fossil fuel production. Even if implemented as a temporary transition, these fossil fuel-
278 centred response could reverse progress on air quality improvement, push the world irreversibly
279 off-track from meeting the commitments laid out in the Paris Agreement, and lock in a future of
280 accelerated climate change, threatening human survival.

281 On the contrary, a health-centred response to the current crises would still provide the
282 opportunity to deliver a low-carbon, resilient, healthy future, where world populations can not
283 only survive, but also thrive. Such response will see countries promptly shifting away from fossil

284 fuels, reducing their dependence on frail international fossil fuel markets, and accelerating a just
285 transition to clean energy sources. Such response will reduce the likelihood of the most
286 catastrophic climate change impacts, while improving energy security, delivering a path for
287 economic recovery, and offering immediate health benefits. Improvements in air quality will help
288 prevent the 1.2 million deaths resulting from exposure to fossil fuel-derived ambient PM_{2.5} in
289 2020 alone (indicator 3.3), and a health-centred energy transition will enhance low-carbon travel
290 and increase urban green spaces, promoting physical activity, and improving physical and mental
291 health. Turning to the food sector, an accelerated transition to balanced and more plant-based
292 diets will not only help reduce the 55% of agricultural sector emissions coming from red meat
293 and milk production (indicator 3.5.1), but also prevent up to 11.5 million diet-related deaths
294 annually (indicator 3.5.2), and substantially reduce the risk of zoonotic diseases. These health-
295 focused shifts will reduce the burden of communicable and non-communicable diseases, in turn
296 reducing the strain on overwhelmed healthcare providers. Importantly, accelerating climate
297 change adaptation will deliver more robust health systems, minimizing the negative impacts of
298 future infectious disease outbreaks and geopolitical conflicts, and restoring the first line of
299 defence of global populations.

300

301 [Glimmers of Hope](#)

302 Despite decades of insufficient action, emerging, albeit few, signs of change provide some
303 glimmers of hope that a health-centred response might be starting to emerge. Individual
304 engagement with the health dimensions of climate change, essential to drive and enable an
305 accelerated response, continues to increase (indicator 5.2), and coverage of health and climate
306 change in the media reached a new record high in 2021, with a 4.7% increase from 2020
307 (indicator 5.1). This increased engagement is also reflected by country leaders, with a record 60%
308 of countries drawing the attention to between climate change and health in the 2021 UN General
309 Debate, and with 86% of national updated or new NDCs making references to health (indicator

310 5.4). At the city level, local authorities are progressively identifying risks of climate change on the
311 health of their populations (indicator 2.1.3), a first step to delivering a tailored response that
312 strengthens local health systems. The health sector itself, while still responsible for 5.2% of all
313 global emissions (indicator 3.6), has shown impressive climate leadership, and 60 countries had
314 committed to transitioning to climate-resilient and/or low- or net zero-carbon health systems as
315 part of the COP26 Health Programme at the time of writing.

316
317 Signs of change are also emerging in the energy sector. While total clean energy generation
318 remains grossly insufficient, it reached record high levels in 2020 (indicator 3.1). Zero-carbon
319 sources accounted for 80% of investment in electricity generation in 2021 (indicator 4.2.1), and
320 renewable energies have reached cost parity with fossil fuel energies. Now, as some of the
321 highest-emitting countries attempt to cut their dependence on oil and gas in response to the war
322 in Ukraine and soaring energy prices, many are focusing on increasing renewable energy
323 generation, raising hopes for a health-centred response . However, increased awareness and
324 commitments must be urgently translated into action for hope to turn into reality.

325
326 [A Call to Action](#)

327 After 30 years of UNFCCC negotiations, Lancet Countdown indicators show that countries and
328 companies continue to make choices that increasingly threaten the health and survival of people
329 alive today. As countries strive to recover from the coexisting crises the evidence is unequivocal:
330 an immediate, aligned and health-centred response is essential to secure a liveable future, and
331 today presents a new opportunity to deliver a healthier world, in which present and future
332 generations can not only survive, but also thrive.

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Introduction

Due to human activity, average global temperatures are 1.1°C above the pre-industrial average, and the past seven years were the warmest on record.¹ Climate change is increasing the frequency and intensity of many extreme events, resulting in severe damage to the natural and social systems on which health depends. These changes are also shifting the geographic range of climate-sensitive infectious diseases, affecting food and water security, worsening air quality, and damaging socioeconomic systems. While the world grappled with the ongoing COVID-19 pandemic, 2021 and 2022 was marked by weather events of unprecedented intensity: record temperatures of nearly 50°C in British Columbia claimed 570 lives,² floods in Australia, Canada, China, Malaysia South Sudan and Western Europe led to hundreds of deaths hundreds of thousands of people displaced from their homes, and billions of dollars in losses,^{3,4} and wildfires caused devastation in the US, Greece, Algeria, and Turkey. And yet, energy-related greenhouse gas (GHG) emissions rebounded to a historical record in 2021,⁵ and atmospheric CO₂ reached its highest concentration in over 2 million years.⁶

Current policies put the world on track to 2.4–3.5°C of heating above pre-industrial times by 2100, and there is a 48% chance the 1.5°C threshold enshrined in the Paris Agreement will be exceeded within 5 years.⁷⁻⁹ COVID-19 recovery efforts have thus far failed to deliver the transformation the health community and others called for,¹⁰ and ongoing geopolitical conflicts put the 1.5°C threshold further out of reach. The findings in this report, summarised in Panel 1, underscore the urgency of delivering climate action, and can inform an aligned response to compounding crises, to protect the health of present and future generations.

357

358 Panel 1: Key findings of the 2022 report of the Lancet Countdown

- 359 1. Climate change is undermining every dimension of global health tracked, increasing the fragility
360 of the global systems that health depends on, increasing the vulnerability of population health
361 and functioning of healthcare facilities, and compounding the impacts of coexisting global crises.
362
- 363 2. Climate change is increasingly undermining global food security, exacerbating the effects of the
364 COVID-19, geopolitical, energy and cost of living crises. New analysis shows that extreme heat
365 due to climate change accounted for an estimated 98 million more people reporting moderate
366 to severe food insecurity in 103 countries in 2020, than the 1981-2010 average (indicator 1.4).
367
- 368 3. Global health systems have been drastically weakened by the effects of the COVID-19 pandemic.
369 For example, 30% of 798 cities reported that COVID-19 reduced financing available for climate
370 change and 42% reported no change; only 22% reported an increase in financing (indicator
371 2.1.3).
372
- 373 4. Insufficient climate change adaptation efforts mean health systems they remain vulnerable and
374 ill-prepared to cope with the increasing climate change-related health hazards. Only 48 out of 95
375 countries have assessed their climate change adaptation needs (indicator 2.1.1) and in 2021
376 only 63% of countries reported high to very high implementation status for health emergency
377 management (indicator 2.2.4). Increasing adaptation for health is essential to prevent the worst
378 health impacts from climate change, and will additionally increase resilience of health systems
379 to better manage future infectious disease outbreaks and other health emergencies (indicator
380 2.3.1).
381
- 382 5. As the single biggest source of greenhouse gas emissions, mitigation of the energy sector must
383 accelerate to keep global temperatures within the 1.5°C target set in the Paris Agreement, and
384 prevent the most dangerous levels of global heating. However, the energy sector is still heavily
385 reliant on fossil fuels, its carbon intensity decreased by less than 1% since the year the UNFCCC
386 was signed, and a simultaneous increase in energy demand of 59% has pushed total energy
387 sector emissions to record high levels in 2021 (indicator 3.1). Now, even this limited progress is
388 at risk of being reversed: as countries search for alternatives to Russian fossil fuels, many are
389 turning back to coal, and shifts in global energy supplies risk a net increase in fossil fuel
390 production, further increasing emissions from the energy sector.
391
- 392 6. The slow adoption of renewable energies, which contribute to only 2.2% of total global energy
393 supply (indicator 3.1), means households remain vulnerable to highly volatile international fossil
394 fuel markets, and millions lack access to reliable, clean sources of fuel. Traditional biomass still

accounts for 31% of the energy consumed in the domestic sector globally, and for 96% of that in low HDI countries (indicator 3.2). New analysis shows that the air in people's homes in the 62 countries analysed exceeded the World Health Organization's guidelines for safe concentrations of small particulate air pollution (PM_{2.5}) in 2020, by 30-fold on average (indicator 3.2). The current energy and cost-of-living crises, together with the limited access to clean energies, now threatens to make matters worse.

7. A new indicator this year tracks the current production strategies of 15 of the largest oil and gas companies (both publicly-listed international companies (IOCs), and state-owned national companies (NOCs)) and reveals that, on the basis of their current strategies and market shares, they will exceed their share of greenhouse gas emissions compatible with the 1.5°C climate target by an average of 87% (for IOCs) and 111% (for NOCs) in 2040. the realisation of these strategies would make meeting the goals of the Paris Agreement virtually unattainable (indicator 4.2.6).
8. In 2019, 69 countries out of 86 reviewed (80%) had net-negative carbon prices (i.e. provided a net subsidy to fossil fuels), for a net total of US\$400 billion. These subsidies exceeded 10% of national health spending in 31 countries, and exceeded 100% in 5 countries (indicator 4.2.4). At the same time, climate efforts are being undercut by a profound lack of funding (indicator 2.1.1), and fossil fuel companies register record profits as a result of the high energy prices.
9. Despite the critically insufficient progress to date, a health-centred response to the coexisting crises still offers an opportunity to deliver a healthy, low-carbon future. Accelerating the transition to clean energy and improved energy efficiency can avoid the most catastrophic climate change impacts, as well as improve energy security, support economic recovery, prevent the 1.2 million annual deaths resulting from exposure to fossil fuel-derived ambient PM_{2.5} (indicator 3.3), improve health outcomes by promoting active forms of travel, and deliver greener, healthier, and more livable cities. The associated reduction in the burden of communicable and non-communicable diseases, will in turn also reduce the strain on overwhelmed healthcare providers.
10. The media, the scientific community, corporations and country leaders are increasingly engaging in health and climate change (indicators 5.1-5.5), and new analysis shows that 86% of updated or new Nationally Determined Contributions now reference health (indicator 5.4).
11. As countries attempt to cut their dependence on international oil and gas supplies in response to the war in Ukraine and energy crisis, some are focusing efforts on increasing renewable energy generation, raising hopes that a health-centred response could be emerging. However, the increased engagement and commitments must be urgently translated into action for hope to turn into reality and secure a world in which populations can not only survive, but also thrive.

432 **Taking stock of progress on health and climate change**

433 The *Lancet* Countdown: Tracking Progress on Health and Climate Change is an international,
434 transdisciplinary collaboration of 51 academic institutions and UN agencies, monitoring the
435 changing health profile of climate change.¹¹

436 Its 43 indicators (Table 1) are the result of seven years of refinement, and reflect the consensus
437 of 99 multidisciplinary researchers, the guidance of the *Lancet* Countdown’s Scientific Advisory
438 Group and High-Level Advisory Board, and the continuous support of *The Lancet* and the
439 Wellcome Trust. Most indicators have been improved this year to better monitor links between
440 climate change and health. New and re-introduced metrics monitor the impact of extreme
441 temperature on food insecurity; exposure to wildfire smoke; household air pollution; the
442 alignment of fossil fuel industry with a healthy future; and health considerations in countries’
443 Nationally Determined Contributions (NDCs). All new or substantially modified indicators were
444 assessed by an independent expert panel, to ensure their appropriateness and robustness,^{12,13}
445 and some existing indicators were also independently assessed, to ensure their continued
446 relevance and rigour.

447 This report, more concise than previous iterations, is complemented by an online [data](#)
448 [visualisation platform](#), where indicators can be explored in greater detail and geographical
449 resolution. Reports from the *Lancet* Countdown regional centres in Asia (Tsinghua University,
450 China), Europe (Barcelona Supercomputing Center, Spain), South America (Universidad Peruana
451 Cayetano Heredia, Peru), and Australia (Macquarie University and The University of Sydney) offer
452 more detailed regional assessments. Meanwhile, newly established centres are working to
453 explore in further depth the links between health and climate change in Small Island Developing
454 States (SIDS) (University of the West Indies, Jamaica) and Africa (Medical Research Council Unit,
455 The Gambia). Through these expanding local networks, the *Lancet* Countdown now brings
456 together over 250 researchers from almost 100 institutions around the globe.

457 As the world strives to meet Paris Agreement commitments, *Lancet* Countdown indicators are
458 contributing to national and international climate and health monitoring systems, and they have
459 been incorporated into the European Climate and Health Observatory and into the climate and
460 health assessment of the Italian National Institute of Health (Istituto Superiore di Sanità).¹⁴ In
461 2023 the UNFCCC will run the first Global Stocktake (GST), an assessment of collective progress
462 towards meeting Paris Agreement goals, designed to help countries adjust efforts to meet
463 climate targets. Taking stock of the health impacts of climate action, this report can help
464 countries realise the ambition of making the Paris Agreement the “most important public health
465 agreement of the century”.¹⁵

466 *Table 1: The indicators of the 2022 report of The Lancet Countdown*

Working Group	Indicator	
Health Hazards, Exposures, and Impacts	1.1: Health and Heat	1.1.1: Exposure to Warming
		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 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	
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: Health Adaptation-Related Funding
		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
Mitigation Actions and Health Co-Benefits	3.1: Energy System and Health	
	3.2: Clean Household Energy	
	3.3: Premature Mortality from Ambient Air Pollution by Sector	
	3.4: Sustainable and Healthy Transport	
	3.5: Food, Agriculture, and Health	3.5.1: Emissions from Agricultural Production and Consumption
		3.5.2: Diet and Health Co-Benefits
	3.6: Healthcare Sector Emissions	
Economics and Finance	4.1: The Economic Impact of Climate Change and its Mitigation	4.1.1: Economic Losses due to Climate-Related Extreme Events
		4.1.2: Costs of Heat-Related Mortality
		4.1.3: Loss of Earnings from Heat-Related Labour Capacity Loss
		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 Low-Carbon and High-Carbon 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- 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
Public and Political Engagement	5.1: Media Coverage of Health and Climate Change	
	5.2: Individual Engagement in Health and Climate Change	
	5.3: Scientific Engagement in Health and Climate Change	
	5.4: Government Engagement in Health and Climate Change	
	5.5: Corporate Sector Engagement in Health and Climate Change	

467 Section 1: Health Hazards, Exposures, and Impacts

468 Climate change is already affecting the health of people across the globe. Detrimental impacts
469 occur directly through increased exposure to extreme weather, and indirectly through cascading
470 impacts on the physical, natural, and social systems on which health depends. Additionally,
471 climatic changes are amplifying the existing threats to food and water security, built
472 infrastructure, essential services, and livelihoods.

473 Section 1 tracks the health hazards, exposures, and impacts of climate change, with indicators
474 that monitor vulnerabilities now explored within Section 2. Indicators have been improved and
475 expanded to provide a more comprehensive picture of the health impacts of climate change,¹³
476 and help disentangle the effects of climatic and demographic changes on health-related
477 outcomes. Three new sub-indicators track the influence of wildfires on exposure to PM_{2.5} air
478 pollution (indicator 1.2.1), the links between both heat and extreme precipitation and online
479 sentiment expressions (indicator 1.2.3), and the increasing impact of extreme heat on global food
480 security (indicator 1.4.1).

481

482 1.1 Health and Heat

483 Climate change is leading to an increase in average global temperatures and in the frequency,
484 intensity, and duration of heatwaves.¹⁶ Exposure to extreme heat is associated with exacerbation
485 of underlying cardiovascular and respiratory disease, acute kidney injury and heat stroke,¹⁷
486 adverse pregnancy outcomes,^{18,19} worsened sleep patterns,²⁰ impacts on mental health, and
487 increases in non-accidental and injury-related deaths.²¹ It also affects health indirectly by limiting
488 people's capacity to work and exercise.²²⁻²⁶ The elderly, pregnant women and newborns, the
489 socially deprived, and those working outdoors are particularly at risk.^{27,28}

490 Indicator 1.1.1: Exposure to Warming

491 *Headline finding: From 2000 to 2021, populations were exposed to an average increase in summer*
492 *temperature two times higher than the global mean.*

493 Inhabited land areas experience faster warming than oceans. By overlapping gridded
494 temperature and population data, this indicator shows that the temperatures humans were
495 exposed to during summer seasons in 2021 were 0.6°C higher than the 1986–2005 average,
496 representing twice the global mean temperature increase over the same period (0.3°C).

497 Indicator 1.1.2: Exposure of Vulnerable Populations to Heatwaves

498 *Headline finding: Children under 1 year old experienced 600 million more person-days of*
499 *heatwaves, and adults over 65 years 3.1 billion more person-days, in 2012–2021, compared to*
500 *1986–2005.*

501 Between 2021 and 2022, the world saw record temperatures in Oman, the Middle East,²⁹
502 Australia,³⁰ numerous Mediterranean countries, and Canada.³¹ This indicator overlays daily
503 temperature and demographic data to track the exposure of vulnerable age-groups to heatwaves
504 (defined as a period of 2 or more days where both the minimum and maximum temperatures are
505 above the 95th percentile of 1986–2005, as defined previously).^{32,33} Over 2012–2021, children
506 younger than 1 year experienced 600 million more person-days of heatwaves (4.4 more days per
507 child) annually relative to the 1986–2005 average, while adults older than 65 years experienced
508 3.1 billion more days (3.2 more days per person) (Figure 1). In 2021, people over 65 in Canada
509 experienced a record of 47 million more person-days of heatwaves (2.4 million in children under
510 1 year) than annually in 1986–2005, mainly due to an unprecedented heatwave which was over
511 150 times more likely to occur due to climate change (Panel 2).

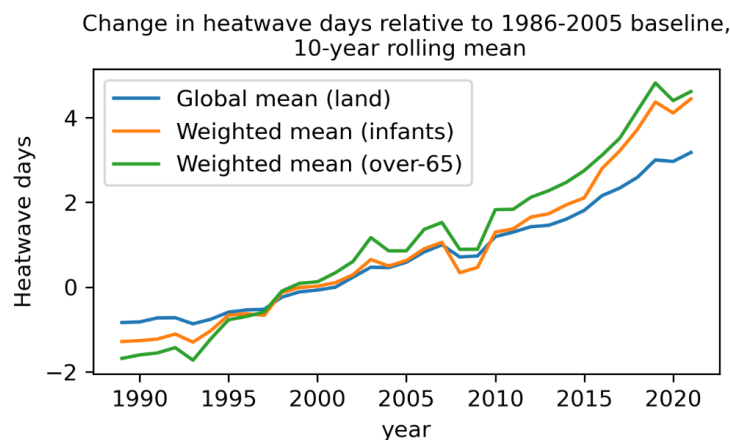


Figure 1: Comparison of change in heatwave days relative to 1986–2005 baseline (10-year rolling mean) between global mean for land, mean weighted by infant population, and mean weighted by over-65 population.

Indicator 1.1.3: Heat and Physical Activity

Headline finding: Over the last 10 years, people experienced on average an extra 281 hours annually during which the high heat posed at least a moderate heat stress risk during light outdoor physical activity, compared to 1991-2000.

Regular physical activity contributes to a healthy body weight, improves physical and mental health,³⁴⁻³⁶ and helps prevent many non-communicable diseases.³⁷ However, hot weather reduces the likelihood of engaging in exercise, and increase heat illness risk when it is undertaken.²²⁻²⁴ This indicator has been improved to track the daily hours during which physical activity would entail heat stress risk.³⁸ Compared to a 1991-2000 baseline average, the number

of annual hours of moderate-risk and high-risk of heat stress during light outdoor physical activity increased globally in 2012-2021 by an average of 281 (33% increase) and 238 (42%) hours per person, respectively. The greatest rise occurred in medium HDI countries, with a 310 (20%) and 296 (26%) increase in the number of moderate-risk and high-risk hours per person annually, respectively.

Indicator 1.1.4: Change in Labour Capacity

Headline finding: In 2021, heat exposure led to the loss of 470 billion potential labour hours, a 37% increase from 1990–1999. 87% of the losses in low HDI countries occurred in the agricultural sector.

Heat exposure affects labour productivity and puts the health of exposed workers at risk.³⁹ The resulting labour loss undermines livelihoods and the socioeconomic determinants of health.⁴⁰ This indicator monitors the potential work hours lost as a result of heat exposure and, in an improvement from previous years' reports, of solar radiation, by associating wet bulb globe temperature with the typical metabolic rate of workers in specific economic sectors. Since 1999, the potential hours lost increased by 5.6 billion hours per year (Figure 2). In 2021, 470 billion hours were lost – a rise of 37% from the annual average in 1990–1999, and an average of 139 hours lost per person. Two thirds of all labour hours lost globally in 2021 occurred in the agricultural sector. This proportion was highest in low HDI countries, at 87%

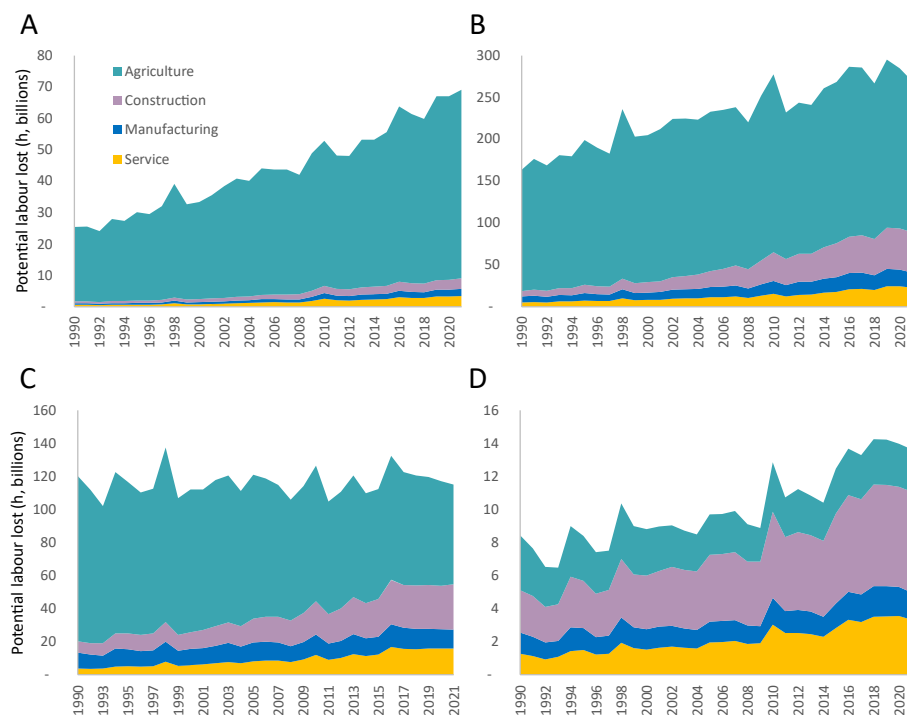


Figure 2: Potential labour lost due to heat-related factors in each sector, assuming all work is undertaken in the sun. Low HDI (A), medium HDI (B), high HDI (C), and very high HDI (D) groups (2019 HDI country group). HDI=human development index.

Indicator 1.1.5: Heat-Related Mortality

Headline finding: Heat-related mortality for people over 65 increased by approximately 68% between 2000-2004 and 2017-2021.

554 A recent study covering 43 countries estimated that 37% of heat-related deaths are attributable
555 to human-induced climate change.⁴¹ However, limited data sharing and reporting restricts the
556 capacity to produce accurate estimates globally, to assess adaptation measures, and to identify
557 vulnerable populations.^{11,13} Using a generalised exposure-response function to provide an
558 estimate of heat-related deaths globally, this indicator finds that annual heat-related mortality
559 of people over 65 increased by an estimated 68% between 2000-2004 and 2017-2021.

560

561 1.2 Health and Extreme Weather Events

562 Detection and attribution studies unequivocally demonstrate the increasing influence of
563 anthropogenic climate change on weather extremes (Panel 2).⁴² Resulting direct injuries and
564 death are often compounded with impacts on sanitation and service provision, forced
565 displacement, loss of assets and infrastructure, economic losses, and adverse mental health
566 outcomes, with oftentimes cascading, long-lasting effects.⁴³⁻⁴⁶ This suite of indicators,
567 complemented by indicators 2.3.2 and 4.1.1, explores the links between climate change, extreme
568 weather events, and health.

569

570 **Panel 2: Detection and attribution studies: Ascertaining the influence of climate change in**
571 **health-harming extreme events**

572 Detection and attribution (D&A) studies are increasingly exposing the influence of climate change
573 on weather-related morbidity and mortality, and being applied in public health to inform decision
574 making.⁴⁷ However, only a small proportion of all extreme events that occur are being assessed,
575 and seldom those affecting the highly vulnerable low or middle HDI countries. Expanding the
576 coverage and funding available for D&A studies, and strengthening their health assessment, can

577 help better elucidate the health costs of climate change and provide compelling evidence to
578 support climate action.^{48,49}

579 D&A studies were published for 31 discrete weather-related events occurring between 2019 and
580 2021. All except two of the analysed events occurred in high or very high HDI countries. The
581 events for which D&A studies were published included extreme heat, heavy precipitation and
582 floods, wildfires, storms, tornadoes, cyclones, or drought events. Climate change was shown to
583 have increased the likelihood or severity of 84% of these events (24 studies), in which over
584 113,300 deaths were registered. All but one of the nine extreme heat events studied, which
585 caused 13,480 deaths, were found to have been made more likely or intense due to climate
586 change. Climate change decreased the likelihood or severity of just three events, all of which
587 related to extreme rainfall, reflecting the climate-induced alteration of hydrological cycles. Most
588 of the events studied had cascading effects on health systems, and most were compounded by
589 concurrent crises. A full list of the events assessed is presented in the appendix (pp 24), while
590 some key examples are explored in further detail below.

591 ***Australia's 'black summer'***

592 Australia's 2019–2020 'black summer' fires were unprecedented in scale, intensity, and extent of
593 damage. Anthropogenic climate change increased their probability by more than 30%,⁵⁰ both
594 directly and through compounding mechanisms.⁵¹ The fires directly caused some 450 deaths,
595 1300 emergency asthma presentations, and 1120 cardiovascular and 2030 respiratory
596 admissions,⁵² in addition to worsening mental health outcomes and displacing of 47 000
597 people.^{53–55} In addition, these events contributed to 715 Mt of CO₂ emissions, equivalent to some
598 0.2% of global greenhouse gas emissions that year.⁵⁶

599 ***South African drought***

600 Between 2015–2019, South Africa's Western Cape record drought was two to nine times more

likely due to climate change.^{57,58} In a neighbouring rural region, the drought limited provision of, and access to, HIV care, thereby contributing to treatment failure.⁵⁹ Although health data were limited, it is likely that vulnerable populations were disproportionately exposed to the drought, resulting in adverse health,⁶⁰ including mental health,⁶¹ outcomes.

Floods in Western Europe

In July 2021 north-western Europe was exposed to devastating floods, primarily driven by heavy rainfall that was 1.2 to 9 times more likely due to climate change.⁶² The floods directly killed over 200 people across Europe.^{63,64} Health was also impacted as a result of damage to pharmacies, hospitals and clinics; scarce potable water; destruction of sewerage infrastructure; and disruption of healthcare services, including the administration of COVID-19 vaccines.^{63,65}

North American heat dome

In June-July 2021, Northwest North America experienced a 6-day heat wave that was at least 150 times more likely to occur due to climate change, and “virtually impossible” without it,⁶⁶ directly causing at least 569 excess deaths in British Columbia, and over 100 in Washington state.^{67,68} Material deprivation and reduced access to urban green spaces were found to have increased mortality risk.^{69,70} Alaska, Idaho, Oregon, and Washington registered over 1,000 heat-related emergency service presentations, a 69-fold increase over the same period the year prior.⁷¹

South Asian heat wave

During March-April 2022, India and Pakistan experienced a prolonged heat wave that was 30 times more likely due to climate change². Despite widespread underreporting, 90 deaths were attributed³, alongside reduced wheat yields which have further compounded global shortages caused by the war in Ukraine. The full health impacts of lost income, increased hospitalisations,

623 and food and energy insecurity, in addition to a glacial lake outburst flood and forest fires, are
624 not yet quantified².

625

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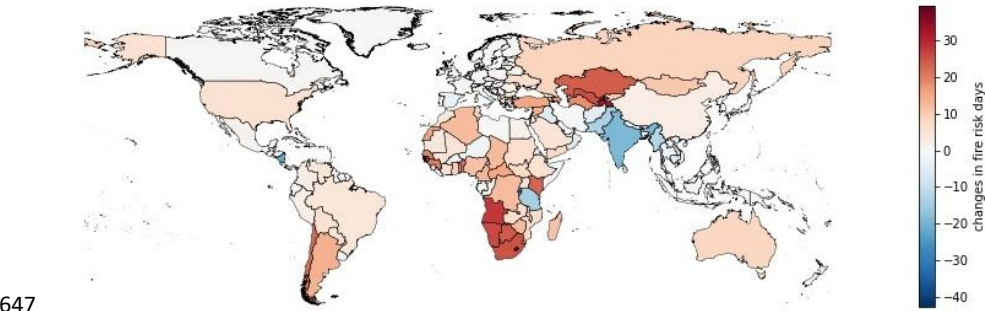
627 Indicator 1.2.1: Wildfires

628 *Headline finding: Human exposure to days of very-high or extremely-high fire danger increased*
629 *in 61% of countries from 2001–2004 to 2018–2021.*

630 Wildfires affect health through thermal injuries, exposure to wildfire smoke, loss of physical
631 infrastructure, and impacts on mental health and wellbeing.⁷²⁻⁷⁴ Drier and hotter conditions
632 increasingly favour their occurrence, intensity, and spread, and undermine control efforts.⁷⁵ This
633 indicator uses remote sensing to track exposure to days of high meteorological wildfire danger
634 and wildfire exposure, this year better accounting for cloud cover in the detection of wildfire
635 spots. New to this report, the indicator incorporates atmospheric modelling (IS4FIRES-SILAM
636 model) to track exposure to wildfire smoke (PM_{2.5}).^{76,77}

637 Globally, people each experienced an average of nine extra days of very- or extremely-high
638 meteorological wildfire danger in 2018–2021 compared to 2001–2004, with 61% (110/181) of
639 countries seeing an increase (Figure 3) – a trend driven by climate variation rather than
640 demographic shifts. The yearly average wildfire exposure increased by 9.17 million person-days
641 between 2003–2006 and 2018–2021. Increases were observed in 64% (21 of 33) of low HDI,
642 compared to 42% (27 of 65) of very high HDI countries, which could reflect differences in wildfire
643 prevention and management.

644 Population exposure to wildfire-derived PM_{2.5} was modelled using the SILAM chemistry transport
645 model.⁷⁸ Data shows a statistically significant increase in 16.5% of the global land surface from
646 2003 to 2021, and a statistically significant decrease in 8.8% of the surface land area.



648 *Figure 3: Population-weighted mean changes in extremely high and very high fire danger days in 2018-*
649 *2021 compared with 2001-2004. Large urban areas with population density ≥ 400 persons/km² are*
650 *excluded.*

652 Indicator 1.2.2: Drought

653 *Headline finding: On average, 29% more of the global land area was affected by extreme drought*
654 *annually in 2012–21, than in 1951–1960.*

655 Droughts undermine food and water security, threaten sanitation, affect livelihoods, and
656 increase the risk of wildfires and infectious disease transmission.^{42,79} This indicator uses the 6-
657 monthly Standard Precipitation and Evapotranspiration Index (SPEI6) to capture changes in
658 extreme drought (SPEI ≤ -1.6) due to precipitation and temperature-driven evapotranspiration.⁸⁰
659 On average in 2012–21, almost 47% of the global land area was affected by at least 1 month of
660 extreme drought each year, up by 29% from 1951–60. The Middle East and Northern Africa,

661 where 41 million people lack access to safe water and 66 million lack basic sanitation,⁸¹ were
662 particularly affected, with some areas experiencing over 10 extra months of extreme drought.

663 Indicator 1.2.3: Extreme Weather and Sentiment

664 *Headline finding: Heatwaves during 2021 were associated with a statistically significant decrease*
665 *of 0.20 percentage points in the number of tweets expressing positive sentiment, while extreme*
666 *precipitation days were associated with a statistically significant decrease of 0.26 percentage*
667 *points.*

668 Heatwaves and extreme weather increase the risk of mental health disorders (Panel 3).^{21,82,83} This
669 indicator uses a multivariate ordinary least squares fixed effects model to monitor the influence
670 of heatwaves and, new to this year’s report, extreme precipitation, on online sentiment
671 expression.⁸⁴ It analyses 7.7 billion tweets from 190 countries and adjusts by month, calendar
672 date, and location. Days of extreme precipitation during 2021 reduced the percentage of tweets
673 that had positive expression by a statistically significant 0.26 percentage points, a record
674 reduction in positive expression during extreme precipitation days since 2015. Since 2015
675 heatwave days and days of extreme precipitation have consistently worsened sentiment
676 expression. In 2021, heatwave days increased the proportion of tweets that expressed negative
677 sentiment by a statistically significant 0.20 percentage points, producing the largest effect in the
678 historical series. The 2021 Pacific Northwest heatwave increased negative sentiment 9.8 times
679 and decreased positive sentiment 3.7 times the 2015–2020 average effects of heatwaves on
680 sentiment. Further, the 2021 Western European extreme rainfall events increased negative
681 sentiment 4.9 times, and decreased positive sentiment 6.6 times the 2015–2020 average effects
682 of extreme precipitation on sentiment.

683

684 **Panel 3: Mental health and climate change**

685 Climate change is affecting mental health, psychological wellbeing and their social and
686 environmental determinants.^{82,83,85-87} Acute temperature increase, heatwaves, and humidity
687 have been associated with worse mental health outcomes and increased suicidality.^{88,89} Through
688 more indirect pathways, hazards like droughts can disrupt agricultural production, affect
689 livelihoods, and cause food and water scarcity and other hardships that affect family
690 relationships, increase stress, and negatively impact mental health - with differences between
691 genders.⁹⁰⁻⁹² Climate change may also exacerbate conflict and violence (including gender-based
692 violence),⁹³⁻⁹⁵ and can influence people's decision to migrate, which can in turn affect mental
693 health and well-being.⁹⁶ Additionally, climate change may impact the mental health of
694 populations who either choose to stay or are unable to migrate, with studies showing that mental
695 health can be compromised by the feeling of being trapped.⁹⁷⁻⁹⁹

696 Marginalised and vulnerable populations are often disproportionately affected by climate-
697 change related mental health impacts – which can compound pre-existing mental health
698 inequalities, especially where health systems are inadequate. Indigenous peoples may be more
699 strongly affected by climate change-induced ecological breakdown.^{100,101} The elderly, women
700 and religious or ethnic minorities are particularly at risk of adverse mental health outcomes, and
701 youth have been shown to be more prone to anxiety, phobias, depression, stress-related
702 conditions, substance abuse and sleep disorders, as well as reduced capacity to regulate
703 emotions, and increased cognitive deficits.¹⁰² The increasingly visible effects of the climate crisis
704 have given rise to emerging concepts such as climate change anxiety, solastalgia, eco-anxiety and
705 ecological grief.

706 Integrating mental health considerations within adaptation, mitigation and disaster risk
707 reduction (DRR) efforts, could both reduce climate change-related mental health risks, and
708 deliver mental health co-benefits. Actions to reduce heat and ambient air pollution through
709 urban redesign - such as improved shade and green space, walkable neighbourhoods, and
710 improved active and public transport infrastructure - may deliver mental health co-benefits

711 through increased physical activity, improved sleep quality, social connectivity, cooling spaces
712 and exposure to greenness.^{103,104} Furthermore, climate activism may be associated with
713 increased mental wellbeing,¹⁰⁵ although it might increase distress for others.¹⁰⁶ This emphasises
714 the importance of including mental health considerations when designing climate policies. Yet,
715 despite multidimensional connections between climate change and mental health, few National
716 Adaptation Plans (7/18 documents assessed by the WHO) and Nationally Determined
717 Contributions (10/197 documents representing 9/197 parties assessed by Climate Watch)
718 consider mental health and psychosocial implications.^{107,108} Additionally, only 28% of countries
719 report having a functional programme that integrates mental health and psychosocial support
720 within preparedness and DRR, including for climate-related hazards.¹⁰⁹

721 The persistent lack of standardised definitions, stigmatisation and lack of recognition of mental
722 health in many places, together with lack of available data, undermines the capacity to identify
723 populations at risk, to develop targeted resilience strategies, to monitor and assess the mental
724 health implications of climate change and climate action - and ultimately to develop mental
725 health indicators.¹¹⁰⁻¹¹³

726 Nonetheless, the world has sufficient experience and evidence to guide immediate action.
727 Dramatically accelerating efforts to address the impacts of climate change on mental health and
728 psychosocial well-being is essential to protect all dimensions of human health.¹¹¹

729

730 Indicator 1.3 Climate Suitability for Infectious Disease Transmission

731 *Headline finding: The climatic suitability for the transmission of dengue increased by 11.5% for A.*
732 *aegypti and 12.0% for A. albopictus from 1951–1960 to 2012–2021; the length of the transmission*
733 *season for malaria increased by 31.3% and 13.8% in the highlands of the Americas and Africa,*
734 *respectively, from 1951–1960 to 2012–2021.*

735 Climate change is affecting the distribution and transmission of many infectious diseases,
736 including vector-, food-, and water-borne diseases.¹¹⁴⁻¹¹⁶ This indicator monitors the influence of
737 the changing climate on the potential for transmission for key infectious diseases that are a public
738 health concern.

739 With the increased movement of people and goods, urbanisation, and climate change, *Aedes*-
740 transmitted arboviruses spread rapidly over the last two decades, and half the world population
741 now lives in countries where dengue is present.¹¹⁷⁻¹¹⁹ Combining data on temperature, rainfall,
742 and population, this indicator tracks the basic reproduction number (R0) for dengue, Zika and
743 chikungunya as a proxy for their transmissibility and, new to this report, the number of months
744 suitable for their transmission. On average, during 2012–2021, the R0 was 11.5% higher for the
745 transmission of dengue by *A. aegypti*, 12.0% by *A. albopictus*, 12.0% for Chikungunya, and 12.4%
746 for Zika, with respect to 1951–1960, globally (Figure 4). During this same period, the length of
747 the transmission season increased for all arboviruses by approximately 6%.

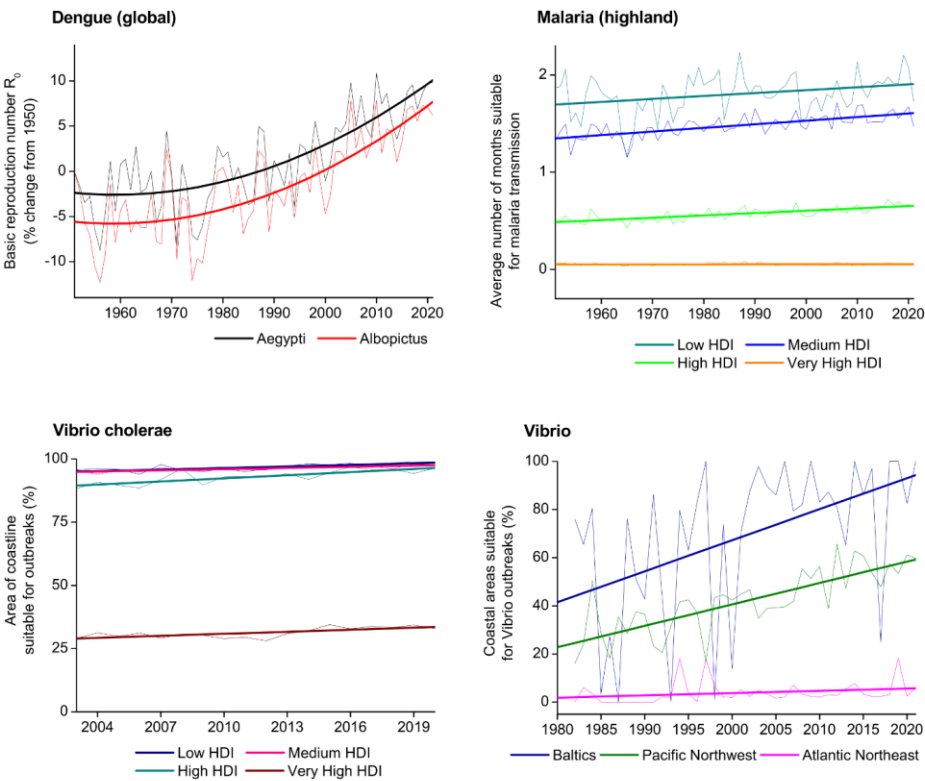
748
749 The number of months suitable for the transmission of *Plasmodium falciparum* by *Anopheles*
750 mosquitoes was computed using temperature, precipitation and humidity thresholds and, new
751 to this year, land classes suitable for the vector. The number of suitable months in highlands ($\geq$
752 1500m above sea level), increased by 31.3% in the WHO region of the Americas , and 13.8% in
753 Africa between 1951–1960 and 2012–2021.

754 Non-cholera *Vibrio* bacteria survive in brackish waters, and can cause gastroenteritis if ingested
755 in contaminated food, and potentially lethal wound infections through direct contact with
756 contaminated water.¹²⁰ Between 2014–2021 and 1982–1989, due to changes in sea salt
757 concentrations and temperature, the area of coastline suitable for *Vibrio* pathogens increased
758 from 47.5% to 86.3% in the Baltic, 30.0% to 57.1% in the US Northeast and from 1.2% to 5.7% in
759 the Pacific Northwest, three regions where *Vibriosis* is regularly reported. An extra 4.3% of the
760 coastal waters in Northern latitudes (40–70° N) had temperatures suitable for *Vibrio* in 2014–

761 2021 compared to 1982–1989, with 2021 the second most suitable year on record (11.3% of the
762 coastal area suitable) – making brackish waters in these latitudes increasingly suitable for *Vibrio*
763 transmission.

764 The ongoing 7th cholera pandemic, which started in the 1960s, is responsible for over 2.8 million
765 cases and 95,000 deaths annually.^{121,122} While inadequate sanitation is the main enabler, climate
766 conditions are increasingly favouring the survival of *Vibrio cholerae* in natural waters, keeping an
767 environmental reservoir and favouring its spread.¹¹⁶ Using an ecological niche model, this
768 indicator estimates that since 2003–2005 alone, an extra 3.5% of the global coastal waters have
769 become suitable for its transmission.

770



771

772 *Figure 4: Change in climate suitability for infectious diseases. Thin lines represent the annual change. Thick*
773 *lines represent the trend since 1951 (for malaria), 1951 (for dengue), 1982 (for Vibrio bacteria), and 2003*
774 *(for Vibrio cholerae). HDI=human development index.*

775

776 Indicator 1.4 Food Security and Undernutrition

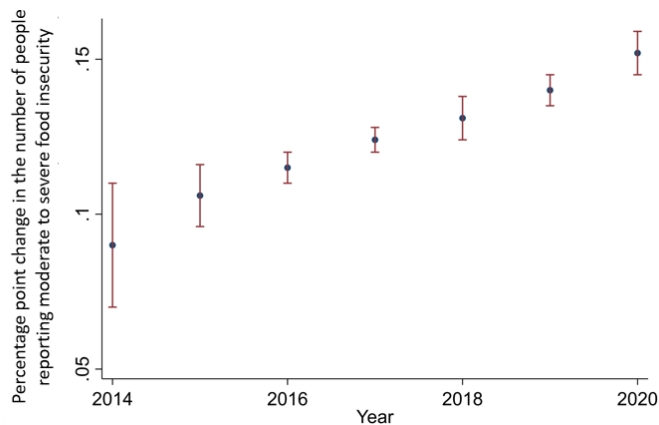
777 *Headline finding: Relative to 1981–2010, higher temperatures in 2021 shortened crop growth*
778 *seasons globally by 9.3 days for maize, 1.7 days for rice and 6 days for winter and spring wheat,*
779 *and heatwave days in 2020 were associated with 98 million more people reporting moderate to*
780 *severe food insecurity.*

781 Food insecurity is increasing globally, with 720–811 million people hungry in 2020. Climate change
782 is exacerbating risks of malnutrition through multiple, interconnected pathways (Panel 4). Less-
783 educated and lower-income households have a higher chance of being food insecure,¹²³ and due
784 to social roles and reduced land ownership, women, and the households they lead, may be more
785 prone to malnutrition.^{124–126}

786 Higher temperatures during growing seasons lead to faster crop maturation, which reduces the
787 maximum potential yield that could be achieved with no limitations of water or nutrients.
788 Combining temperature and crop growth data, the first part of this indicator shows that, relative
789 to the 1981–2010 average, crop growth seasons in 2021 continue to shorten globally for all staple
790 crops tracked: by 9.3 days for maize, 1.7 days for rice, and more than six days for winter and
791 spring wheat.

792 The increasing atmospheric CO₂ concentrations are also increasing sea surface temperature,
793 temperatures of inland water bodies, acidifying oceans and reducing their oxygenation, which
794 exacerbate coral reef bleaching and undermine marine and inland fishery productivity.^{127–131}
795 Together with a shift to farm-based fish products of lower nutritional quality, climate change is
796 thus putting marine food security at risk.^{132–134} The average sea surface temperature in coastal
797 waters of 142 countries increased globally by nearly 0.7°C in 2019–2021 compared with 1980–
798 1982.

799 New to this year, the third part of this indicator examines the impact of heatwave days during
800 crop growth season of maize, rice, sorghum, and wheat, on self-reported experience of food
801 insecurity. It combines data from the FAO Food Insecurity Experience Scale from 103 countries
802 with temperature, using a time-varying regression.^{135,136} Compared to 1981–2010, increases in
803 the number of heatwave days resulted in an increase of 3.7 percentage-points in self-reported
804 moderate to severe food insecurity in 2020, approximately equivalent to an additional 98 million
805 people reporting moderate or severe food insecurity.



806 *Figure 5: Change in the percentage of people reporting moderate to severe food insecurity due to*
807 *heatwave days (percentage point change) occurring during four major crop (maize, rice, sorghum, and*
808 *wheat) growing seasons.*

811 **Panel 4: Climate Change and Food Insecurity**

812 Food security requires all people, at all times, to have physical and economic access to sufficient,
813 safe and nutritious food that meets their dietary needs and food preferences for an active and
814 healthy life.^{137 138}

815 In 2015, the world committed to ending malnutrition and achieving global food security by 2030
816 (SDG2).¹³⁹ However, the prevalence of undernourishment has increased since 2017.¹⁴⁰
817 Government-imposed restrictions during the COVID-19 pandemic, worsened this situation¹⁴¹,
818 and the number of undernourished people increased by 161 million to 720-811 million between
819 2019 and 2020.¹⁴⁰ Russia's war on Ukraine is further exacerbating food insecurity: Russia and
820 Ukraine typically supply around 30% of global wheat exports, and 20% of maize, and the expected
821 shortfall in supply, coupled with the energy crisis, is likely to drive further increases in food prices.
822 This could result in an additional 7.6 to 13.1 million people undernourished globally in 2022.
823 Meanwhile, conflict in places like Afghanistan, Burkina Faso, Chad, Democratic Republic of
824 Congo, Ethiopia, Nigeria, Mozambique, Myanmar, Syria, Mali, Niger, and South Sudan, further
825 worsens the food crises in those regions.¹⁴²

826 This panel explores how climate change undermines each dimension of global food security and
827 nutrition, and highlights priorities for climate action, providing a cross-cutting assessment of the
828 evidence presented in this report.

829
830 *Food availability, access, and stability*
831 Climate change is putting food production, supply chains and access at risk. Rising temperatures
832 are reducing crop growth duration (indicator 1.4) in many countries, posing a threat to crop
833 yields. The increasing intensity and frequency of extreme weather events, including heatwaves
834 (indicator 1.1.2), droughts (indicator 1.2.2), and wildfires (indicator 1.2.1), can damage crops and
835 agricultural lands, affect livestock, disrupt supply chains, and affect food availability and stability
836 of supplies.^{143,144} Changing environmental conditions affect the spread of crop and livestock pests
837 and diseases, driving production losses.^{145,146} Increasing water temperatures and ocean
838 acidification threaten fish stocks thereby undermining marine food supplies (indicator 1.4), while
839 rising sea levels and sea water intrusion can lead to soil salinisation and crop losses.¹⁴⁷⁻¹⁵⁰ Exposure
840 to high temperatures and extreme weather events reduces labour capacity, and 65% of all

841 potential hours of labour lost globally occurred in the agricultural sector, with agricultural
842 workers, in low and medium HDI countries disproportionately affected. (indicator 1.1.4).

843
844 More broadly, reduced labour capacity can result in lower incomes (indicator 4.1.3), while
845 extreme events can lead to direct economic damages, particularly in LMICs where most losses
846 are not insured (indicator 4.1.1). The resulting economic losses can contribute to reduced
847 purchasing power, undermining food access.

848
849 *Food utilisation and malnutrition*
850 Diarrhoeal diseases are the leading cause of malnutrition in children under 5,¹⁵¹ while other
851 infections can severely affect nutrient absorption and utilisation.¹⁵²⁻¹⁵⁴ Climate change therefore
852 increases the risk of malnutrition, by increasing the transmission risk of many infectious diseases,
853 such as malaria, dengue and vibriosis (indicator 1.3), while the increasing incidence of floods,
854 droughts, and other extreme events affect sanitation and disease outbreaks (indicator 1.1.2).
855 Further, although increasing atmospheric CO₂ concentration may increase crop yields through
856 the fertilisation effect, it may also reduce the nutritional quality of some grains,¹⁵⁵ and rising sea
857 levels can increase the salinity of the soils and water supplies (indicator 2.3.3), leading to
858 unhealthy levels of sodium in diets.¹⁵⁶

859
860 *Mitigation, adaptation planning, and resilience for health*
861 Addressing threats to food insecurity requires coordinated and robust action across multiple
862 sectors of governments and societies. There are some signs of progress in this respect: while 10%
863 of the first NDCs made reference to this issue, the proportion increased to 17% in the second
864 NDCs, updated from January 2020 onward (indicator 5.4). Further, 49% of cities identified
865 climate-related risks to food and agriculture assets and services in 2020 (indicator 2.1.2).
866 Shifting to low-carbon, plant-forward diets would have the multiple benefits of reducing
867 agricultural GHG emissions (indicator 3.5.1), improving health outcomes (indicator 3.5.2),

868 reducing the diversion of grains to livestock and the demand of land for crop production, water
869 demand, and the risk of agriculture-related zoonotic disease outbreaks.^{157 158} Nonetheless, the
870 possibility of increased exposure to agricultural chemicals in plant-based foods needs to be
871 addressed and minimized through sustainable agricultural practices to avoid related health
872 harms in this transition.¹⁵⁹ Interventions to increase the resilience of food systems, and improve
873 sanitation and healthcare can minimise climate-related nutritional risks. These include proactive
874 safety nets, nudge programmes that encourage savings, and mother and child feeding
875 programmes.¹⁶⁰ Investment in sustainable irrigation methods,¹⁶¹⁻¹⁶³ drought-resistant crops,¹⁶⁴
876 financial support for smallholder agriculture,^{165,166} regional crop storage¹⁶⁷,
877 insurance/reinsurance, and early warning systems for extreme weather events that might
878 damage crops, or increase infectious disease transmission., are each likely important in specific
879 contexts.

880

881 Conclusion

882 With 1.1°C of global average surface heating, climate change is increasingly affecting the pillars
883 of mental and physical health. Changing climatic conditions are increasing the risk of heat-related
884 illness (indicators 1.1.1–1.1.5), changing the pattern of infectious disease transmission (indicator
885 1.3), increasing health risks from extreme events (indicators 1.2.1–1.2.3), undermining
886 sanitation, and having multidimensional impacts on food and water security (indicator 1.3 and
887 panel 4). Importantly, these impacts often occur simultaneously, exacerbating the pressure on
888 health and health-supporting systems, and potentially triggering cascading impacts on the social
889 and natural systems that good health depends upon.

890 With the world on track to 2.4–3.5°C of heating by 2100, this section exposes the urgency of
891 accelerating mitigation and adaptation to prevent the most devastating health outcomes of a
892 heating world.

893

894 Section 2: Adaptation, Planning, and Resilience for Health

895 With rapidly increasing climate change-related health hazards, transformative, proactive, and
896 effective adaptation measures are immediately required to manage the health threats of
897 unavoidable global heating, reducing exposure and vulnerabilities, and increasing resilience.⁴²
898 Given the interconnected and multifactorial nature of health determinants and climate impacts,
899 adaptation must be integrated across sectors, and into policies and programs in health systems,
900 governments, and private corporations.⁴²

901 Three clusters of indicators are presented here. Adaptation plans and risk and vulnerability
902 assessments—key first steps in health adaptation—are covered in indicators 2.1.1–2.1.2. The
903 implementation of health adaptation measures and their financing are presented in indicators
904 2.2.1–2.2.5. The final set of indicators, presented within Section 1 in previous *Lancet* Countdown
905 reports, have been refined and better explored to assess population vulnerabilities, resilience
906 and adaptation interventions, and the risks associated with changing climate hazards (indicators
907 2.3.1–2.3.3).

908

909 2.1: Assessment and Planning of Health Adaptation

910 Evidence-based policy making requires comprehensive evaluation of the health threats of climate
911 change. Climate change and health risk, vulnerability and adaptation assessments identify
912 vulnerable populations, assess the influence of existing policies, programmes and health system
913 capacities in building resilience, and determine future adaptation needs. The following indicators
914 monitor the extent to which such assessments are being undertaken, and their contribution to
915 shaping adaptation plans that can protect populations from climate-related health impacts.

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

918 *Headline finding: In 2021, 48 out of 95 countries reported having completed a climate change and*
919 *health vulnerability and adaptation assessment, but these only strongly influenced resource*
920 *allocation in nine countries.*

921 Using data from the 2021 WHO Health and Climate Change Global Survey,¹⁶⁸ this indicator
922 monitors whether countries have completed a health vulnerability and adaptation assessment.
923 Although 48 out of 95 countries reported completing such assessment, only nine reported that
924 its findings ‘strongly’ influenced the allocation of human and financial resources to address health
925 risks of climate change, and just 18 reported that assessments ‘strongly’ informed the
926 development of health policies and programmes.

927

928 Indicator 2.1.2: National Adaptation Plans for Health

929 *Headline finding: Approximately half of countries (49 out of 95) reported having a national health*
930 *and climate change plan in place in 2021.*

931 This indicator monitors whether countries have a national health and climate change plan in
932 place, drawing on data from the 2021 WHO Health and Climate Change Global Survey.¹⁶⁸ Only
933 about half of countries (49/95) reported having a national health and climate change plan in
934 place. 65% of these countries indicated a ‘moderate’ or lower level of implementation, with 70%
935 of countries citing insufficient finance as a main barrier. As part of the new COP26 Health
936 Programme Initiative on Climate Resilient Health Systems,¹⁶⁹ 59 countries committed to
937 conducting a vulnerability and adaptation assessment, and using the findings to inform the
938 development of a Health National Adaptation Plan, which contributes to the UNFCCC’s National

939 Adaptation Plan process. Implementing commitments to the COP26 Health Programme will
940 strengthen access to climate finance, inform national roadmaps for investments in climate
941 resilient and sustainable health systems, and support the implementation of critical health
942 adaptation interventions.

943

944 Indicator 2.1.3: City-level Climate Change Risk Assessments

945 *Headline finding: 78% of cities reporting to the CDP's global survey had completed or were in the*
946 *process of conducting city-level climate change risk assessments.*

947 Cities are home to over half of the world's population¹⁷⁰ and, through local interventions, are
948 critical to delivering adaptation to climate change. Using data reported to the CDP,¹⁷¹ this
949 indicator reveals that, over the past 5 years, the number of cities that declared having conducted
950 climate assessments grew from 205 of 449 respondents (2016) to 725 out of 930 (2021),
951 reflecting an increased recognition of the city-level impacts of climate change. While 91% (849 of
952 930) of responding cities belonged to very high or high HDI countries, responding cities from low
953 and medium HDI countries increased by 70%, from 24 out of 471 in 2020, to 41 out of 522 in
954 2021. 64% (530 of 822) of cities reported that climate change threatened public health and/or
955 health services. In a shift from last year's reporting, infectious diseases were identified as the
956 most prominent climate-related health hazard (identified by 382 cities), followed by heatwaves
957 and poor air quality (339 and 267 cities, respectively). The COVID-19 pandemic affected climate
958 action at the city level, with 39% of cities (310 of 805) reporting it increased emphasis on climate
959 action, and only 14% (116 of 805) reporting it decreased this emphasis. However, 30% of (242 of
960 798) cities reported that COVID-19 reduced financing available for climate change while only 22%
961 (178 of 798) reported an increase in financing.

962

963 2.2: Enabling Conditions, Adaptation Delivery and Implementation

964 Interventions in health-related sectors can reduce climate-related exposure, vulnerability and
965 hazards, minimising risks to health and well-being.⁴² Interventions must be integrated across
966 sectors, and include health system strengthening, capacity building, behaviour change, early
967 warning systems, physical infrastructure, and climate-smart agriculture, with adequate financing
968 essential to their implementation. Indicators in this section track progress on delivering such
969 interventions.

970

971 Indicator 2.2.1: Climate Information for Health

972 *Headline finding: In 2021, less than 40% of countries had climate-informed health surveillance*
973 *systems in place for vector-borne, waterborne and/or airborne diseases.*

974 Delivering a robust preparedness and response to climate hazards requires that health system
975 have access to, and utilise, climate information. This indicator uses data from the 2021 WHO
976 Health and Climate Change Global Survey, to monitor the use of climate information for health
977 surveillance and early warning systems.¹⁶⁸

978 In 2021, 39% of countries (30 out of 78) reported having climate-informed health surveillance
979 systems for vector-borne diseases, 32% (25 out of 78) for waterborne diseases, 35% (23 out of
980 65) for airborne diseases, and 21% (14 out of 66) for zoonoses. However, only 13% (6 out of 47)
981 had such surveillance for mental health risks and 11% (8 out of 70) for foodborne diseases.

982 As extreme weather intensifies, climate-informed health early warning systems (HEWS) can help
983 limit and respond to its health impacts. About one third of countries reported having climate-
984 informed HEWS in place for heat-related events (28 of 84) and other extreme weather events (26
985 of 86). Half of the very high HDI countries (13 of 26) had HEWS for extreme weather events

986 compared to only 19% (6 out of 31) of low or medium HDI countries. While 64% (16 of 25) of the
987 very high HDI countries had climate-informed HEWS for heat-related events this dropped to just
988 13% of low or medium HDI countries (4 of 30).

989

990 Indicator 2.2.2: Air Conditioning: Benefits and Harms

991 *Headline finding: While helping prevent heat-related illness, AC in 2020 was also responsible for*
992 *0.9 gigaton of CO₂ emissions and 24,000 deaths attributable to PM_{2.5} exposure.*

993 While air conditioning (AC) is effective at protecting against heat-related illness,¹⁷² 1.8–4.1 billion
994 people in LMICs exposed to heat stress lack indoor cooling, and AC is often unaffordable in these
995 countries.^{173,174} Where used, it also contributes to greenhouse gas emissions, air pollution, urban
996 heat island effects, power outages, and energy poverty.¹⁷⁵⁻¹⁷⁹ Using data from the International
997 Energy Agency,¹⁸⁰ this indicator reports that about one-third of households globally had AC in
998 2020, up by 66% from 2000. AC use in 2020 was responsible for 0.9 gigaton of CO₂ emissions and
999 for 24,000 deaths from PM_{2.5} exposure. Sustainable cooling alternatives need to be rolled out
1000 rapidly to avoid the worst health impacts from rising temperatures (panel 5).

1001

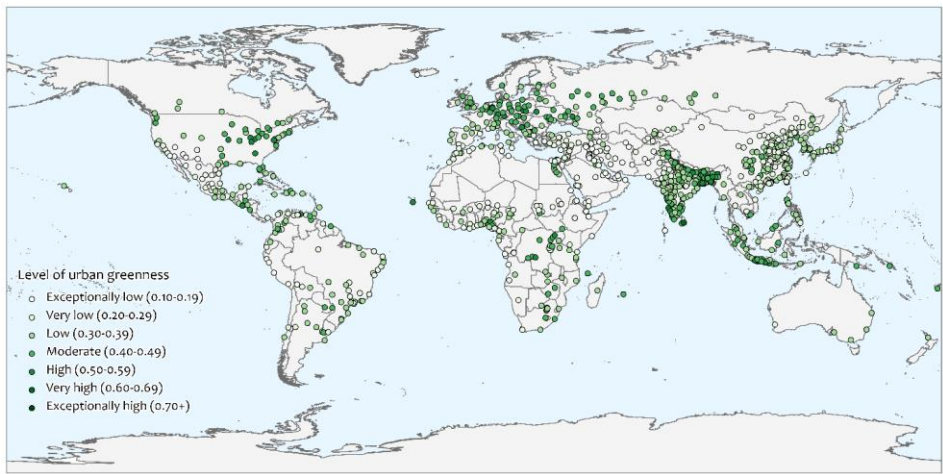
1002 Indicator 2.2.3: Urban Green Space

1003 *Headline finding: In 2021, just 27% of urban centres were classified as moderately-green or above.*

1004 Nature-based solutions can contribute to climate change adaptation and have ecosystem
1005 benefits.⁴² Green spaces reduce urban heat islands, positively affect physical and mental health,
1006 and provide adaptation to extreme heat.¹⁸¹⁻¹⁸³ This indicator reports population-weighted
1007 Normalized Difference Vegetation Index (NDVI) as a proxy for green space exposure in 1038

1008 urban centres. Despite increasingly extreme heat, average global exposure to urban greenspace
1009 remained consistently low since 2015 (mean NDVI 0.34), and just 27% of urban centres were
1010 moderately-green or above in 2021 (Figure 6). Only 33% of cities in very high HDI countries, and
1011 39% of those in medium HDI countries, had at least moderate levels of greenness; a proportion
1012 that is even lower in high and low HDI countries (16% for both).

1013



1014

1015 *Figure 6: Level of urban greenness in urban centres with more than 500,000 inhabitants in 2021. The*
1016 *numbers in brackets represent the population-weighted NDVI level.*

1017

1018 **Panel 5: Heat adaptation strategies through sustainable low-energy cooling**

1019 Of all natural disasters, heatwaves cause the most deaths,¹⁸⁴ with older adults and those with
1020 cardiovascular disease, living with poverty and isolated in low-cost housing, most at risk.¹⁸⁵ Air-
1021 conditioning (AC) can offer effective protection,¹⁷² but is expensive and thus inaccessible to

1022 many.¹⁸⁶ Peak energy demands from widespread AC use can overwhelm energy systems and
1023 result in electricity blackouts and brownouts, particularly in places where energy infrastructure
1024 is frail or sources are restricted, worsening health impacts.¹⁸⁷ As more people adopt AC
1025 worldwide, the soaring electricity demand also hinders low-energy transition, and contributes to
1026 increased GHG emissions (indicator 3.1).¹⁸⁸ Through waste heat generation, AC use also
1027 intensifies urban heat, and contributes to increased exposure to air pollution (indicator 2.2.2).
1028 Sustainable and affordable cooling alternatives are therefore urgently needed.

1029 Modifications in the landscape and built environment can provide local cooling benefits. Water
1030 bodies act as heat sinks, and vegetation provides shading and cooling by evapo-transpiration.¹⁸⁹
1031 Reflective roofs and better building insulation can attenuate heat transfer to the individual.¹⁸⁶
1032 However, such interventions can require long-term changes to urban or regional infrastructure.
1033 Alternatively, heat resilience in the immediate-term can be built through low-resource and
1034 sustainable cooling behaviours at the personal scale. The use of window blinds can help reduce
1035 indoor temperatures by blocking solar radiation. Where AC is available, moving indoor air with
1036 fans elevates the upper temperature of warm discomfort by 3-4°C, allowing for AC to be set at a
1037 higher temperature,¹⁹⁰ reducing AC-energy demand.¹⁹¹ Electric fans provide effective cooling up
1038 to at least 40°C for resting and active young adults,^{192,193} and to around 38°C for resting older
1039 adults, while using 30-times less energy than AC.¹⁹⁴ However, in very hot-dry conditions (>45°C
1040 with <15% relative humidity (RH)), fans must be used with extreme caution because they can
1041 worsen physiological heat strain and dehydration;¹⁹³ an effect likely aggravated in older adults.
1042 Evaporative coolers, depending on their size, use 2 to 5-times less energy than AC, and can reduce
1043 indoor temperatures by 5-10°C in dry weather (<20-30% RH). However, they are inefficient
1044 cooling devices in high humidity (>50-60% RH) unless used with a dehumidifier¹⁹⁵ and are
1045 dependent on reliable water supply. In cases where electricity is unavailable, including during
1046 power blackouts, studies suggest that cooling could be achieved by frequently wetting large skin
1047 areas, which may reduce physiological heat strain and improve thermal comfort up to at least

1048 47°C.¹⁹⁶ Donning lightweight water-soaked clothing, provides similar benefits up to at least
1049 ~43°C.¹⁹⁷ Immersing both feet in cool water (<20°C) for 10 minutes every 20 minutes might
1050 reduce dehydration and improve thermal comfort up to at least 47°C.¹⁹⁶ Immersing both
1051 hands/arms to the elbow in 10°C water can blunt core temperature rises at air temperatures up
1052 to 40°C.¹⁹⁸

1053 Public health campaigns promoting these evidence-based sustainable cooling strategies in
1054 advance of, and during, bouts of extreme heat will not only help reduce energy demand and
1055 energy poverty, but also reduce the risk of heat-related morbidity and mortality, and help build
1056 resilience in the face of rising global temperatures.

1057

1058 Indicator 2.2.4: Health Adaptation-Related Funding

1059 *Headline finding: In 2021, only 15% of US\$1.14 billion under the Green Climate Fund went towards*
1060 *adaptation activities with health benefits.*

1061 Financial resources are essential to implementation health adaptation interventions.⁴² This
1062 indicator uses transactional data from kMatrix's Adaptation and Resilience to Climate Change
1063 dataset, to monitor global spending with the potential to support adaptation in healthcare
1064 sectors, and in sectors of health relevance (e.g. agriculture, water and built environment). In the
1065 fiscal year 2020/21, US\$21.78 billion was spent in transactions that could support health and
1066 healthcare adaptation (5.6% of total adaptation-related spending), and US\$111.2 billion (28.5%)
1067 was spent in transactions with the potential to deliver adaptation in health-relevant sectors. In a
1068 reversal of previous years' trend, the share of spending in these two sectors with respect to total
1069 adaptation-related spending fell slightly (by less than 0.1%).

1070 The second part of this indicator monitors global multilateral funding for health-related
1071 adaptation projects by the Green Climate Fund (GCF). In 2021, the GCF approved US\$726 million
1072 for 15 adaptation projects and US\$414 million for eight ‘cross-cutting’ mitigation and adaptation
1073 projects. Of this, only 15% (US\$166 million) went to projects whose benefits included ‘increased
1074 resilience of health and wellbeing’. Furthermore, of the 54 concept notes submitted for
1075 adaptation and cross-cutting projects (US\$1.6 billion), only four focused on health systems
1076 (US\$218 million), none of which were approved. These findings highlight a deficit in the
1077 prioritisation of health within adaptation funding.

1078

1079 Indicator 2.2.5: Detection, Preparedness and Response to Health Emergencies

1080 *Headline finding: 63% of 177 countries reported high to very high implementation status for*
1081 *health emergency management in 2021.*

1082 This indicator monitors implementation of core capacity 7 (C7), health emergency management,
1083 of the International Health Regulations (IHR). With slight changes from previous years,
1084 emergency management under core capacity 7 is now comprised of three capacity requirements:
1085 planning for health emergencies, management of health emergency response, and emergency
1086 logistic and supply chain management. In 2021, 63% of countries (112 out of 177) reported high
1087 to very high implementation (capacity score of 61-100) of health emergency management.
1088 Considering HDI, large disparities existed, with only 35% of low or medium HDI countries
1089 reporting high to very high implementation status of health emergency management compared
1090 to 88% of very high HDI countries.

1091 The COVID-19 pandemic triggered a review of the IHR by the World Health Assembly in
1092 2020.^{199,200} Proposed reforms include regular country reviews and monitoring mechanisms,
1093 increased support for their implementation, and better information sharing, all of which can help

strengthen health systems from climate change- related health hazards. Climate change emergency preparedness and response requires a multisectoral approach with strengthened leadership and coordination of international financial and health institutions, and increased ability to address public health misinformation. Such measures would deliver cascading benefits through the whole health system.^{199,201}

1099

2.3: Vulnerabilities, Health Risk and Resilience to Climate Change

Climate change adaptation aims to reduce human exposure and vulnerability to climate hazards; minimising health risks, and ultimately minimising climate change-related health impacts. The following indicators provide a glance at the effectiveness of adaptation and health system strengthening in modifying climate-related health risks.

1105

Indicator 2.3.1: Vulnerability to Mosquito-Borne Diseases

*Headline finding: Improvements in healthcare contributed to a **43%** decrease in vulnerability to severe dengue outcomes in low HDI countries from 1990 to 2019, while urbanisation drove a **5%** increase in very high HDI countries.*

Dengue incidence increased eightfold in the past two decades, driven by population movement, international trade, urbanisation, and increasing climatic suitability (indicator 1.3).^{117-119,202,203}

While controlling its spread is challenging,²⁰⁴ timely and adequate treatment is essential to prevent severe health outcomes.^{42,205,206} This indicator tracks the relative vulnerability to severe adverse dengue outcomes in countries where the climatic conditions are suitable for dengue outbreaks ($RO>1$, as per indicator 1.3), combining two main determinants of dengue vulnerability: healthcare access and quality (using mortality from key preventable diseases as a proxy), and the

1117 proportion of population in urban environments.^{202,207} Between 1990 and 2019, improvements
1118 in healthcare contributed to a ~~45~~43% reduction in vulnerability to severe dengue outcomes in
1119 low HDI countries, and a ~~28~~23% reduction in medium HDI countries. However, urbanisation drove
1120 an increase of ~~17~~5% in vulnerability to dengue in very high HDI countries.

1121 Indicator 2.3.2: Lethality of Extreme Weather Events

1122 *Headline finding: The average lethality per climate-related disaster has decreased from 837*
1123 *deaths in 1980–1989 to 46 in 2012–2021, and is negatively associated with healthcare spending.*

1124 The number of reported climate and weather-related disasters increased five-fold over the last
1125 50 years.²⁰⁸ Using data from the Centre for Research on the Epidemiology of Disasters,²⁰⁹ data in
1126 this indicator shows that the proportion of all climate-related events that were deadly has
1127 increased steadily since at least 1980. However their lethality decreased globally from an average
1128 of 837 deaths per event in 1980–1989 to 46 in 2012–2021 ($P < 0.031$). The average number of
1129 people affected per disaster is negatively correlated with GDP, HDI, and the percentage of GDP
1130 spent on healthcare, with the latter showing the strongest correlation. With many extreme
1131 events becoming increasingly frequent and severe, these results underscore the importance of
1132 health system strengthening, including through the implementation of the priorities outlined in
1133 the Sendai Framework for Disaster Risk Reduction.²¹⁰ Given the socially-defined gender
1134 differences in the impacts and response of extreme events, a gender-sensitive approach is
1135 particularly needed.²¹¹

1136

1137 Indicator 2.3.3: Migration, Displacement, and Rising Sea Levels

1138 *Headline finding: In 2020, 149.6 million people were settled less than 1 metre above current sea*
1139 *level, in regions increasingly at risk from the hazards of the rising seas.*

1140 Global mean sea level (GMSL) has risen by 3.7mm per year between 2006 and 2018, and will
1141 reach 0.28–1.01 m or more by 2100, depending on climate change mitigation efforts, ice sheet
1142 collapse, and local factors.^{74,212-215} Using land elevation and population data, this indicator
1143 reports that there were 149.6 million people living less than 1m above sea level in 2020, a slight
1144 increase from the 145.2 million people settled there in 2010. These populations face risks from
1145 flooding, coastal and riverbank erosion, severe storms, soil and water salinisation, spread of
1146 infectious diseases, and permanent inundation.²¹⁵⁻²¹⁷ With insufficient in situ adaptation, human
1147 relocation (forced, or as a proactive adaptation measure) could be a response, and its health
1148 impacts will largely depend on the support given to migrant populations.⁴² The development of
1149 policies to protect the health of migrant and immobile populations is critical. As of December
1150 2021, 45 policies connecting climate change and migration were identified in 37 countries.

1151

1152 Conclusion

1153 The indicators in this section expose how, while national and city-level assessment of the climate-
1154 related health risks is gradually increasing and health system strengthening might have reduced
1155 the impact of extreme events, the pace and scale of climate change adaptation, planning, and
1156 resilience is far from what is necessary to reduce the health impacts of climate change. Despite
1157 rising heat, only 27% of urban centres have at least a moderate level of greenness, and just 28 of
1158 84 countries report having heat-related early warning systems for health. Funding to support
1159 health adaptation remains grossly insufficient, and is seldom influenced by vulnerability and
1160 adaptation assessments. The past year saw global health, economic, and conflict shocks that
1161 lacerated public health, with climate change playing a role in exacerbating many of them.
1162 Without global coordination, transparency, and cooperation between governments,
1163 communities, civil society, businesses, and public health leaders, the world will remain vulnerable

1164 to international emergencies. The gap between the health impacts of climate change, and
1165 adaptation investment and implementation continues to increase, to the detriment of all.

1166

1167 Section 3: Mitigation Actions and Health Co-Benefits

1168 Due to COVID-19-related responses, anthropogenic CO₂ emissions fell by 5.4% on 2020 - the
1169 largest drop over the past 25 years.²¹⁸ However, with little structural change to limit fossil fuels
1170 use, emissions rebounded by 6% in 2021, reaching an all-time high.²¹⁹ The current 1.1°C of
1171 warming proved to be already dangerous to health (Section 1). To limit temperature rise to 1.5°C
1172 above pre-industrial levels, emissions should decrease 45% from 2010 levels by 2030. However,
1173 even if commitments in countries' NDCs were enacted, emissions in 2030 would be 13.7% above
1174 2010 levels.²²⁰ The grossly insufficient decarbonisation, compounded by geopolitical conflict, has
1175 made it vastly more challenging to limit temperature rise to 1.5°C, and the window of opportunity
1176 to achieve this is rapidly closing.⁸

1177 Accelerated decarbonisation would not only prevent the most catastrophic health impacts of
1178 accelerated heating but, if designed to maximise health benefits, could also save millions of lives
1179 through healthier diets, more active lifestyles, and improved air quality.²²¹ Indicators in this
1180 section monitor the world's efforts to reduce GHG emissions across energy (indicators 3.1 and
1181 3.2), transport (indicator 3.4), food and agriculture (indicator 3.5) and healthcare (indicator 3.6),
1182 and monitor the health benefits that could arise from prioritising health in mitigation policies.

1183

1184 Indicator 3.1: Energy System and Health

1185 *Headline finding: CO₂ emissions from fossil fuel combustion alone rebounded in 2021 by 4.8%*
1186 *after a 5.8% drop in 2020 due to COVID-19-related impacts.*

1187 Energy systems are the largest single source of greenhouse gas emissions and are major
1188 contributors to air pollution. Global energy system transition to renewables is not only critical for
1189 climate change mitigation,⁸ but could also contribute towards universal, affordable, and clean
1190 energy;²²² reduce air pollution; and decrease dependence on international markets and foreign
1191 policies. Using data from the IEA, this indicator shows that the carbon intensity of the global
1192 energy system continued to fall in 2019 for the seventh consecutive year, to 55.4 tCO₂/TJ.
1193 However, this is still far from the requirements of keeping global warming at 1.5°C, with a
1194 reduction of less than 1% from 1992 levels, the year the UNFCCC was adopted. At the pace
1195 recorded from 2014, fully decarbonising the energy system would take 150 years. In addition,
1196 the increasing demand for energy means fossil fuel use is still rising, and fossil fuel-derived CO₂
1197 emissions rebounded in 2021 by 4.8%, after a 5.8% drop in 2020 during the COVID-19 pandemic
1198 (Figure 7), driving CO₂ emissions to a record high.²¹⁹

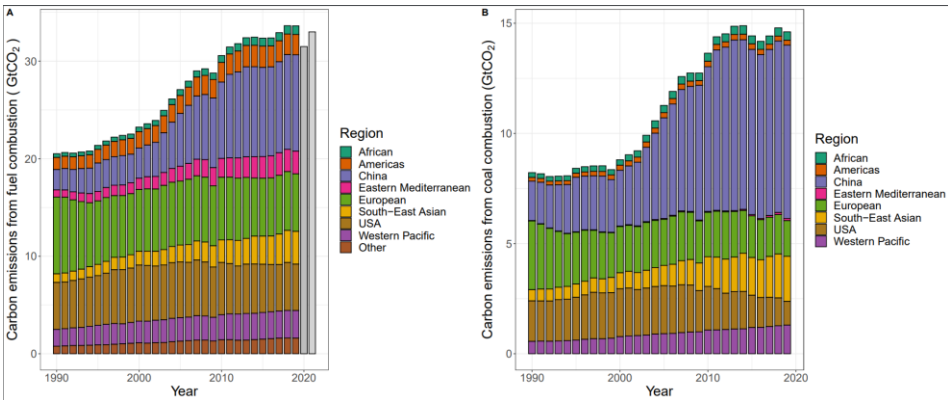
1199 Phasing-out coal is particularly urgent, given its high GHG and air pollution intensity. However,
1200 coal still provides 26.7% of global energy supply, 2.8 percentage points more than in 1992.
1201 Responsible for 54% of global coal energy use in 2019, China's coal expansion was a major
1202 contributor to the rise in global GHG emissions since the early 2000s, with its per capita emissions
1203 at 7tCO₂/person in 2019 now equivalent to the OECD average.²²³

1204 Growth in renewable electricity reached record levels in 2020, with the installation of 139 GW of
1205 solar PV and 93 GW of wind power. This corresponded to 90% of new electricity installation in
1206 2020,²²⁴ and to renewables providing 8.2% of global electricity, twice 2013 levels. However, big
1207 differences exist between countries globally, and only 1.4% of the electricity of low HDI countries

1208 is produced from modern renewables (mostly solar, wind and geothermal), against 9.5% in very
1209 high HDI countries. Concerningly, 60% of healthcare facilities in low and middle-income countries
1210 still lack access to the reliable electricity needed to provide basic care,²²⁵ only 2.2% of total world
1211 energy comes from renewable sources, and fossil fuel use, in absolute terms, has grown faster.
1212 A low-carbon transition can help countries increase local energy production, gain independence
1213 from volatile fossil fuel markets, and reduce energy poverty.

1214

1215



1216
1217 *Figure 7: Greenhouse gas emissions from the global energy system. Panel A: Global CO₂ emissions from*
1218 *fossil fuel usage. Preliminary and modelled values shown for years 2020 and 2021 respectively. Panel B:*
1219 *Global CO₂ emissions from the use of coal*

1220

1221 Indicator 3.2: Clean Household Energy

1222 *Headline finding: Despite improved access to clean fuels, biomass and fossil fuels accounted for*
1223 *31% and 26% of global household energy, respectively, in 2020.*

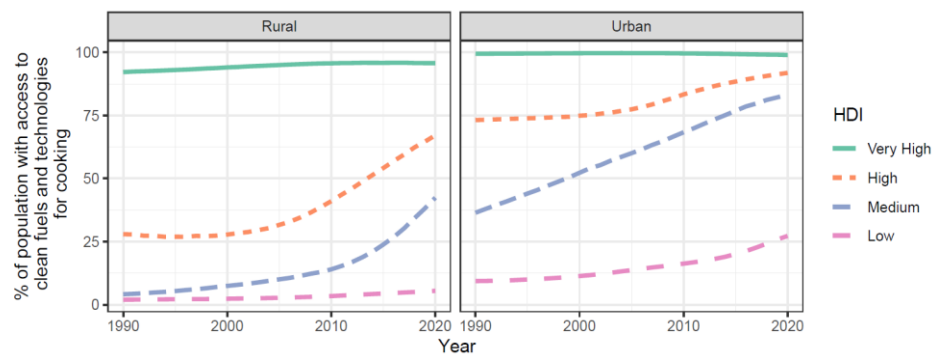
1224 Around 770 million people lack access to electricity in their homes,²²⁶ and their use of dirty fuels
1225 is leading to high exposure to air pollution.²²⁷ In parallel, with residential energy contributing to
1226 17% of global GHG emissions, transitioning to clean fuels in the domestic sector is essential to
1227 meet mitigation goals.²²⁸ Drawing on IEA data, this indicator reveals that biomass still
1228 represented the largest source of residential energy in 2020 (31%), while electricity contributed
1229 to 25%, and fossil fuels to 26%. Africa and Southeast Asia improved access to clean energy from
1230 13% and 19% respectively in 2000, to 20% and 64% in 2020. However, they remain heavily reliant
1231 on solid biofuels. Data from the WHO indicates that globally, while 86% of the urban population
1232 had access to clean fuels and technologies for cooking in 2020, only 48% of rural populations did.
1233 Inequities were also marked between countries, with 98% of the population in very high HDI
1234 countries having access to clean fuels and technologies for cooking, against just 13% in low HDI
1235 countries (Figure 8).

1236 The WHO estimates that the use of solid fuels for cooking resulted in 3.8 million deaths
1237 attributable to household air pollution (HAP) in 2016.²²⁹ Providing the capacity to monitor
1238 changes in HAP exposure year on year, this new indicator builds on a previously published
1239 model,²³⁰ to estimate HAP using a Bayesian hierarchical model that accounts for fuel usage, stove
1240 types, socioeconomic variables, and ambient air pollution in 62 countries. It estimates the use of
1241 solid fuels for cooking and heating resulted in a global average PM_{2.5} concentration in people's
1242 homes of 150 µg/m³ in 2020 (168 µg/m³ in rural households and 91 µg/m³ in urban dwellings).
1243 With values broadly exceeding the 5 µg/m³ threshold recommended by the WHO,²³¹ the delayed
1244 transition to clean household energies is profoundly affecting people's health.

1245

1246 Economic hardship during the COVID-19 pandemic has deepened energy insecurity in households
1247 in countries of all HDI levels. The number of people without access to electricity increased in 2020
1248 for the first time in six years,²³² with shifts and dirty fuels, and increasing exposure to household
1249 air pollution.^{233,234} Indeed, the share of the population without access to electricity in Sub-
1250 Saharan Africa increased by three percentage points, to 77% in 2020.²²⁶ Russia’s invasion of
1251 Ukraine threatens to exacerbate this situation, through rising energy prices and supply chain
1252 disruption.^{235,236}

1253



1254

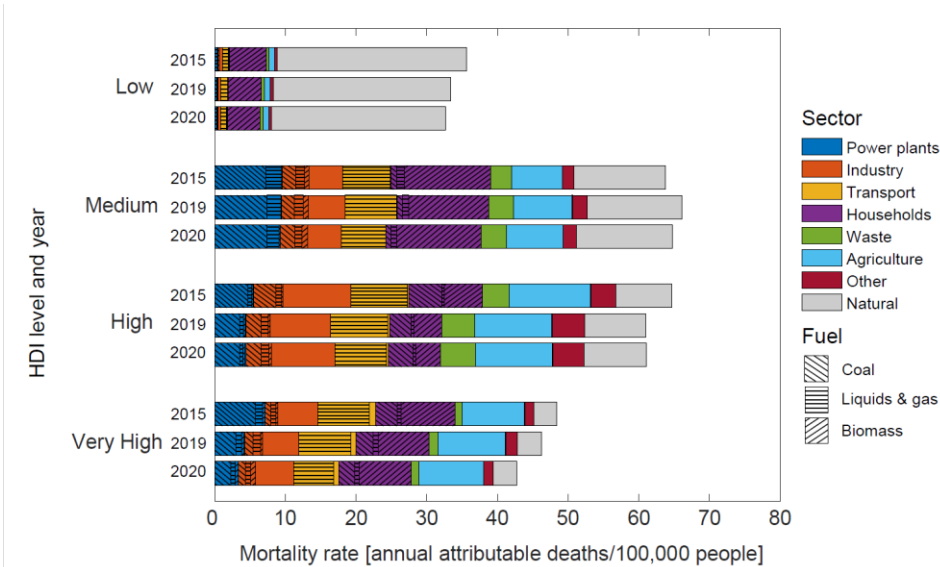
1255 *Figure 8: Percentage of the rural and urban population with primary reliance on clean fuels for cooking,*
1256 *by HDI country group.*

1257

1258 Indicator 3.3: Mortality from Ambient Air Pollution by Sector

1259 *Headline finding: In 2020, exposure to ambient anthropogenic PM_{2.5} contributed to 3.3 million*
1260 *deaths. Of these, 1.2 million were directly related to fossil fuel combustion.*

1261 Exposure to air pollution increases the risk of respiratory and cardiovascular disease, lung cancer,
1262 diabetes, neurological disorders, and adverse pregnancy outcomes.²³⁷ This indicator estimates
1263 the mortality attributable to ambient PM_{2.5}, combining atmospheric modelling with information
1264 of activity in emitting sectors. This year, baseline mortality data was updated, and attributable
1265 deaths from type 2 diabetes also included.²³⁸ In 2020, exposure to ambient PM_{2.5} contributed to
1266 4.2 million deaths, unchanged from 2015, while mortality per 100,000 decreased by 5% (Figure
1267 9). Of these, 80% (3.3 million) were attributable to anthropogenic emissions; of which 1.2 million
1268 (35%) were directly related to fossil fuel combustion. Deaths due to coal combustion have
1269 decreased by 18% from 687,000 in 2015 to 561,000 in 2020, largely due to strict air pollution
1270 control measures in China and coal phase down in Europe.



1271

1272 *Figure 9: Mortality attributable to ambient PM_{2.5} exposure by region, sector, and source fuel.*

1273

1274 Indicator 3.4: Sustainable and Healthy Road Transport

1275 *Headline finding: Fossil fuel use in road transport fell by 0.8% in 2019, while electricity use grew*
1276 *by 15.7%.*

1277 The transport sector contributed to 25% of global CO₂ emissions in 2019.^{5,219,239} If combined with
1278 energy grid decarbonisation, electric vehicles can be an important mitigation tool. The use of
1279 electricity for road transport grew by 237% in the last decade, but still represents just 0.3% of
1280 total fuel use for road travel. Sales of electric vehicles more than doubled in 2021,²⁴⁰ a growth
1281 led by China, with nearly 3.4 million sales (12% of the total). However, only 1% of the global car
1282 stock is electric.²⁴¹

1283 Road transport decarbonisation through modal shift to active travel can deliver health benefits
1284 from reduced air pollution, which accounted for 497,000 deaths in 2020 (indicator 3.3), and
1285 increased physical activity.^{242,243} Smartphone data suggests that public transit use has returned
1286 to pre-pandemic levels in 85% of countries for which data are available,²⁴⁴ and highlights the
1287 need to deliver robust policies that encourage shifts towards active travel and public transit
1288 modes.

1289

1290 3.5: Food, Agriculture, and Health

1291 The global food system contributes one third of all GHG emissions.²⁴⁵ Emissions from the
1292 agricultural sector are dominated by ruminant rearing, mostly mediated by methane emissions
1293 and land use change.^{246,247} Shifting to low-carbon plant-forward diets can not only help mitigate
1294 agricultural-sector emissions, but also have important health co-benefits from improvements in
1295 dietary risk factors and mortality from non-communicable diseases.^{238,248,249} The following two
1296 indicators track agricultural emissions (indicator 3.5.1) and the health impacts of carbon-

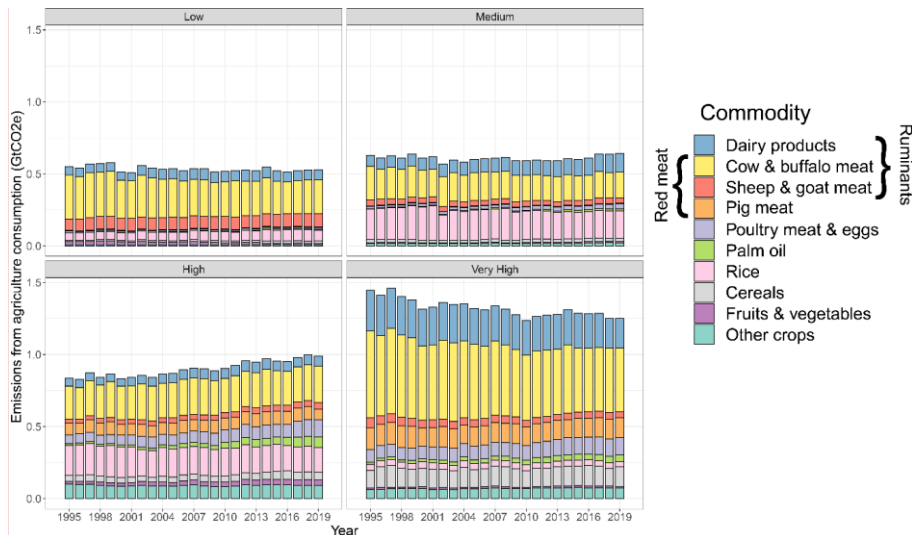
1297 intensive diets (indicator 3.5.2), identifying the potential health opportunity of agricultural
1298 decarbonisation.

1299

1300 Indicator 3.5.1: Emissions From Agricultural Production and Consumption

1301 *Headline finding: Red meat and milk contribute to 55% of global agriculture emissions.*

1302 This indicator, improved from previous reports to include data on 140 food types, estimates that
1303 emissions from agricultural product consumption have remained stable at around
1304 0.9tCO₂e/capita, while total emissions have increased 31% since 2000 (Figure 10). In 2019, 55%
1305 of global agricultural emissions came from red meat and dairy products. Per capita emissions
1306 from red meat and dairy consumption in very high HDI countries were twice those in the rest of
1307 the world (0.8 tCO₂e/capita vs 0.4tCO₂e/capita). Increases in palm oil production account for
1308 some of the greatest changes since 2000, for which emissions in South-East Asia (mainly
1309 Indonesia) increased over 600%.



Commented [MR1]: Clarify that this is emissions per person!

Figure 10: Emissions of greenhouse gases on farms associated with food consumption (production and net imports) per person by HDI level.

Indicator 3.5.2: Diet and Health Co-Benefits

Headline finding: In 2019, 11.5 million deaths were attributable to imbalanced diets, 17% related to high intake of red and processed meat and dairy products.

This indicator tracks the health burden from unhealthy diets and, new to this year, of imbalanced energy intake.

In 2019, 11.5 million deaths were attributable to imbalanced diets. 17% (2 million) of them were related to red and processed meat and dairy consumption, of which 93% occurred in high and very high HDI countries. In low and medium HDI countries, the low consumption of fresh fruit

1322 and vegetables was the major contributor to diet-related mortality; at 44% of all diet-related
1323 deaths in low HDI countries, and 37% in medium HDI countries.

1324

1325 Indicator 3.6: Healthcare Sector Emissions

1326 *Headline finding: From 2018 to 2019, emissions from the healthcare sector grew more than 5%,*
1327 *reaching 5.2% of global GHG emissions.*

1328 Given the health impacts of climate change, health systems must be at the forefront of
1329 decarbonisation to fulfil their mandate of doing no harm. This indicator monitors healthcare
1330 sector emissions combining healthcare expenditure data with a global environmentally-extended
1331 multi-region input-output model. It estimates that in 2019, the healthcare sector contributed
1332 approximately 5.2% (2.7 Gt CO₂e) of global GHG emissions, a rise of over 5% from the previous
1333 year. Of the 37 health systems analysed individually, the USA's had the most per-capita
1334 emissions, 50 times those of India's (Figure 11). Despite this, the USA has the 6th-lowest healthy
1335 life expectancy at birth (66.2 years). Per capita emissions in the 10 countries with the highest life
1336 expectancy ranged from 1065 kgCO₂e/person in the Republic of Korea, to 321 kgCO₂e/person in
1337 France, highlighting that high quality healthcare can be achieved with lower emissions. Recent
1338 decarbonisation commitments from over 50 national health services provide hope for emerging
1339 progress (Panel 6).²⁵⁰

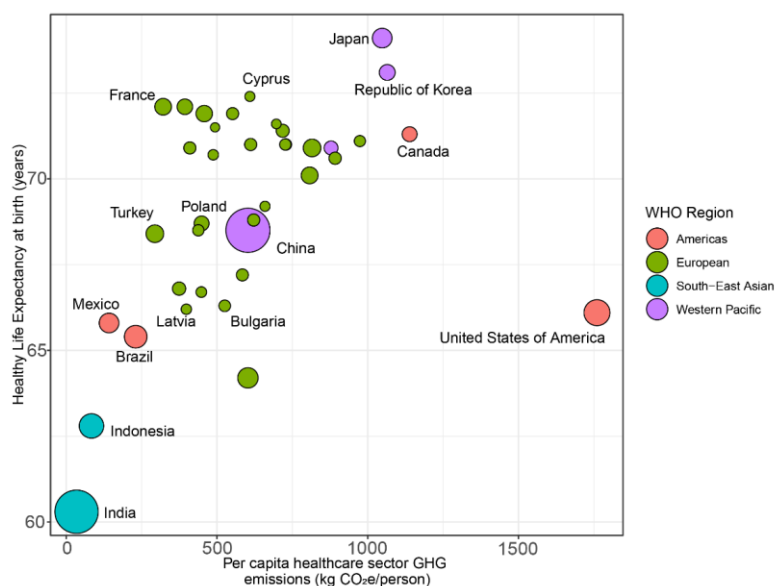


Figure 11: National per-capita greenhouse gas emissions from the healthcare sector against the healthy life expectancy at birth in 2019, by WHO region. The point circle size is proportional to country population kgCO₂e=kilograms of carbon dioxide equivalent.

Panel 6: Healthcare, COVID and Climate Change

The COVID-19 pandemic has greatly altered patterns of healthcare usage in countries around the world, and in turn, their healthcare-associated emissions. Many health systems experienced massive increases in expenditures on personal protective equipment (PPE), diagnostic testing, and provision of critical care, but also saw decreases in non-COVID-19 essential and elective care. As a result, healthcare GHG emissions are expected to have shifted substantially in 2020–2021, perhaps even decreasing in some countries. But while reducing usage and associated emissions

1352 is a goal of healthcare climate change mitigation efforts, this must not come at the expense of
1353 deferring or avoiding necessary care. Measures of progress toward decarbonising the health
1354 sector need to be simultaneously oriented toward achieving both optimal health and reduced
1355 GHG emissions.

1356 The pandemic has highlighted risks associated with healthcare’s sprawling supply chains,
1357 including widespread shortages of basic medicines, equipment, and PPE, among others. Leading
1358 health systems must simultaneously focus on reducing these supply chain risks and mitigating
1359 GHG emissions. COP26 resulted in historic commitments by 60 countries thus far, to develop
1360 climate-resilient and/or low- or net zero-carbon health systems,²⁵⁰ and many are beginning to
1361 implement and share best practices that both improve resilience and reduce life cycle GHG
1362 emissions²⁵¹.

1363

1364 Conclusion

1365 Following the easing of COVID-19 pandemic lockdowns, CO₂ emissions rebounded to record
1366 levels in 2021. With each year that global GHG emissions fail to fall, reaching net-zero by 2050
1367 becomes more challenging, putting lives at increased risk from climate change.

1368 Whilst impacts of COVID-19 on the indicators in this section are still emerging, many of the
1369 challenges to delivering mitigation and health co-benefits have been entrenched since the start
1370 of the pandemic, including the domestic overreliance on biomass, record levels of coal extraction
1371 in China, and rebounding emissions from road transport. The ongoing energy crisis, deepened by
1372 Russia’s war on Ukraine, threatens to worsen this situation, further undermining progress and
1373 exacerbating energy poverty. Increasing energy efficiency, conservation, and adoption of
1374 renewables, on the other hand, could deliver healthier, more resilient, and self-sufficient energy

1375 systems. Millions of lives could be saved each year through an accelerated transition to cleaner
1376 fuels, healthier diets, and active modes of travel.
1377

1378 Section 4: Economics and Finance

1379 Limiting global temperature rise to 1.5°C requires rapid decarbonisation in all economic sectors.
1380 While the up-front investment required to deliver a low-carbon transformation is substantial,
1381 this would deliver immediate economic benefits and health co-benefits, in addition to avoiding
1382 long-term climate change impacts.^{252,253} With the right incentives, and market and governance
1383 conditions, the necessary private sector investment is available. Separately, it is disappointing
1384 that parties to the UNFCCC have so far failed to deliver on the goal of mobilising the much smaller
1385 sum of US\$100 billion annually to support climate action in “developing” countries to which they
1386 committed 13 years ago; a commitment essential not only to deliver global climate goals, but
1387 also to ensure a just transition.⁸ In addition, the ongoing energy crisis, stimulated by the COVID-
1388 19 pandemic and exacerbated by the war in Ukraine, is deepening energy poverty, and exposing
1389 further dimensions of the human costs of a fossil fuel-dependent global energy system. Indicators
1390 in this section explore the economic costs of climate change, and monitor the transition to a low-
1391 carbon, healthy, and just global economy.

1392

1393 4.1 The Economic Impact of Climate Change and its Mitigation

1394 Climate change is causing additional healthcare costs and loss of labour productivity. This, in turn,
1395 affects household incomes and national economies, and the damage caused by climate-related
1396 extreme events results in further economic losses. Indicators in this section track the economic
1397 costs associated with the health impacts of climate change, revealing the potential benefits from
1398 accelerated climate action.

1399

1400 Indicator 4.1.1: Economic Losses due to Climate-Related Extreme Events

1401 *Headline finding: Very high HDI countries suffered around half the global economic losses due to*
1402 *climate-related extreme events in 2021, and double the rate of the global average as proportion*
1403 *of GDP. While around half of their losses were insured, the vast majority of the losses in other*
1404 *countries were uninsured.*

1405 The loss of infrastructure and resulting economic losses due to extreme events can exacerbate
1406 the health impacts through disruption of essential services and impacts on the social
1407 determinants of health. This indicator tracks the economic losses from climate-related extreme
1408 events, using data provided by Swiss Re.²⁵⁴

1409 In 2021, climate-related extreme events induced measurable economic losses of US\$ 253 billion,
1410 with 84% of these losses in very high HDI countries. As a proportion of GDP, losses in the very
1411 high HDI group are double the global average. However, nearly half of these losses were insured,
1412 while insured losses represented only 8% and 5% of all losses in high and medium HDI countries
1413 and were effectively zero in the low HDI country group. These high levels of uninsured losses
1414 exacerbate the economic burden of climate change in lower HDI countries, with losses going
1415 either unreplaced, or the cost of replacement falling directly on individuals and institutions.

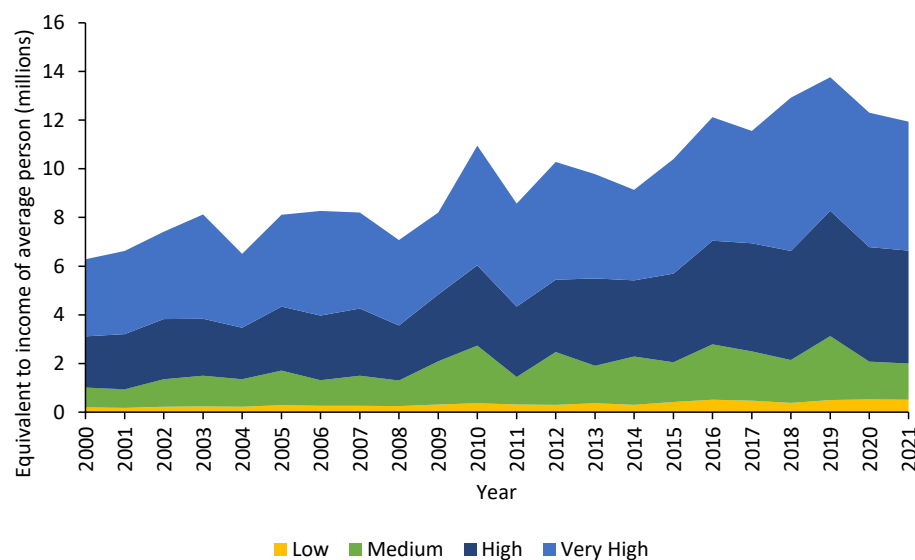
1416

1417 Indicator 4.1.2: Costs of Heat-Related Mortality

1418 *Headline finding: The monetised value of global heat-related mortality was estimated to be*
1419 *US\$144 billion in 2021, equivalent to the average income of 12.4 million people.*
1420

1421 This indicator combines estimates of years of life lost (YLL) data from indicator 1.1.6 with value
1422 of statistical life-year (VSLY), to estimate the monetised loss caused by heat-related mortality.
1423 The valuation of life across varying HDI levels presents a methodological and ethical challenge,

1424 which this indicator addresses by presenting the cost of deaths attributable to heat as the
1425 proportion of GDP and the equivalent annual average income. From 2000 to 2021, monetised
1426 losses increased at an average rate of US\$4.9 billion each year, equivalent to 0.16% of gross world
1427 product (GWP) in 2021 (Figure 12). The last six years register the highest losses, at an average
1428 equivalent to the income of 12.4 million people, 73% higher than in 2000–2005. In 2021, very
1429 high HDI countries incurred the highest losses, equivalent to 5.3 million of their residents’
1430 average income, with losses equivalent to 4.7 million, 1.48 million and 0.51 million average
1431 incomes in high, medium and low HDI countries, respectively.



1432
1433 *Figure 12: Monetized value of heat-related mortality (in terms of equivalence to the average income) by*
1434 *HDI country groups from 2000 to 2021*

1436 Indicator 4.1.3: Loss of Earnings from Heat-Related Labour Capacity Reduction

1437 *Headline finding: The global potential income loss from labour capacity reduction due to extreme*
1438 *heat was US\$669 billion in 2021. The agricultural sector was the most severely affected, incurring*
1439 *82% and 71% of the average losses in low and medium HDI countries, respectively.*

1440 This indicator quantifies the loss of earnings that could result from heat-related labour capacity
1441 loss, combining data from indicator 1.1.4 with hourly wage data from the International Labour
1442 Organization (ILO).

1443 The global potential loss of earnings was US\$669 billion in 2021, equivalent to for 0.72% of GWP
1444 in 2021. In 2021, low and medium HDI countries experienced the highest average relative income
1445 losses, equivalent to 5.6% and 3.9% of their GDP respectively (Figure 13). Of all global losses, 40%
1446 occurred in the agricultural sector. Agricultural labourers of low and medium HDI countries, often
1447 amongst the world's poorest,²⁵⁵⁻²⁵⁷ endured on average 82% and 71% of the losses in those
1448 countries, respectively. Affecting individual finances, these losses impact on people's wellbeing,
1449 food security, and the social determinants of health,² and cascade through the economies of the
1450 nations they live in.

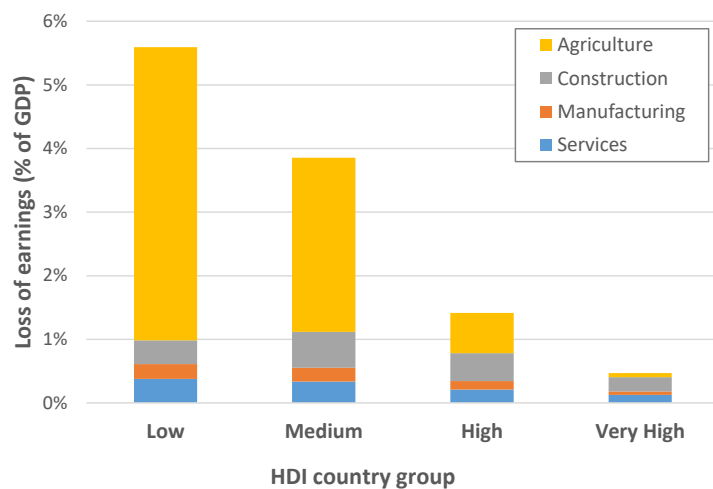


Figure 13: Average potential loss of earnings per Human Development Index country group as a result of potential labour loss due to heat exposure. Losses are presented as share of GDP and sector of employment.

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\$2.3 trillion, the equivalent of 2.7% of gross world product.

This indicator places an economic value on the YLLs from exposure to anthropogenic ambient PM_{2.5} as per indicator 3.3. While costs relative to average income and GDP decreased between 2019 and 2020 in all HDI groups, in 2020 the total cost amounted to US\$2.3 trillion, or the equivalent of 2.7% of GWP. The high HDI country group has the greatest costs relative to per capita income, equivalent to the annual average income of 92.3 million of its people. The medium

1464 HDI group has the greatest costs relative to the size of their collective economies, equivalent to
1465 nearly 4% of GDP.

1466

1467 4.2 The Economics of the Transition to Net Zero-Carbon Economies

1468 Meeting the Paris Agreement goals requires a low-carbon transition of the whole economy.
1469 Indicators in this section monitor jobs and investment in low-carbon energy, net carbon pricing,
1470 and the effect of global trade on emissions. A new indicator quantifies the extent to which the
1471 activities of oil and gas firms are in line with the pathways needed to achieve 1.5°C of heating.

1472

1473 Indicator 4.2.1: Clean Energy Investment

1474 *Headline finding: Between 2020 and 2021, investment in global energy supply investment*
1475 *increased by 14%; zero-carbon sources accounted for 80% of investment in electricity generation*
1476 *in 2021.*

1477 As described in the previous section, phasing out fossil fuels , and particularly coal, and investing
1478 in low-carbon energy supply is essential for both mitigating climate change and for reducing
1479 premature mortality due to air pollution. Taking data from the IEA, this indicator monitors trends
1480 in global investment in energy supply and energy efficiency.

1481 Between 2020 and 2021 total investment increased by 14%, with investment increasing in all
1482 forms of energy supply and end-use efficiency except coal for electricity generation. In 2021,
1483 electricity generation accounted for 28% of investment. Of this, 80% was invested in zero-carbon
1484 sources. However, fossil fuels continue to account for more than 90% of non-electricity sector
1485 investment. Energy efficiency accounted for 15% of all investment – an increase from 13% in

1486 2020. To be on track for net-zero global emissions by 2050, investment in low-carbon energy,
1487 efficiency and electricity networks must nearly quadruple by 2030, and account for at least 90%
1488 of all energy investment.²⁵⁸

1489 Indicator 4.2.2: Employment in Low-Carbon and High-Carbon Industries

1490 *Headline finding: With over 12 million employees, direct and indirect employment in renewable*
1491 *energy exceeded direct employment in fossil fuel extraction for the first time in 2020.*

1492 Employees in fossil fuel extraction industries, particularly coal mining, can have a greater
1493 incidence of non-communicable disease than the general population.²⁵⁹ Increasing employment
1494 in the renewable industry could improve health and livelihoods. It could also deliver
1495 improvements in gender balance, with a greater proportion of women employed in the
1496 renewable sector than in the fossil fuel industry.²⁶⁰

1497 This indicator shows that over 12 million people were employed directly or indirectly by the
1498 renewable energy industry in 2020, up by 5% from 2019. For the first time, direct and indirect
1499 employment in renewables exceeded direct employment in fossil fuel extraction industry, which
1500 recorded 10.5 million employees (down by 10% from 2019), reaffirming that renewable energy
1501 could support job security, now and in the future.

1502

1503 Indicator 4.2.3: Funds Divested from Fossil Fuels

1504 *Headline finding: The global value of funds committing to fossil fuel divestment between 2008*
1505 *and 2021 was US\$40.23 trillion, with health institutions accounting for US\$54 billion.*

1506 By divesting holdings in fossil fuel companies, organisations can both reduce the social licence of
1507 fossil fuel companies to operate, and hedge against risk of losses due to so-called stranded assets

1508 in an increasingly decarbonised world.^{261,262} This indicator tracks the value of funds divested from
1509 fossil fuels using data provided by stand.earth and 350.org.²⁶³

1510 From 2008 until the end of 2021, 1,506 organisations, with assets worth at least US\$40.23 trillion,
1511 have committed to divestment. Of these organisations, only 27 are health institutions, with
1512 assets totalling US\$54 billion. The value of new funds committed to divesting in 2021 was
1513 US\$9.42 trillion, with no new health institutions divesting.

1514

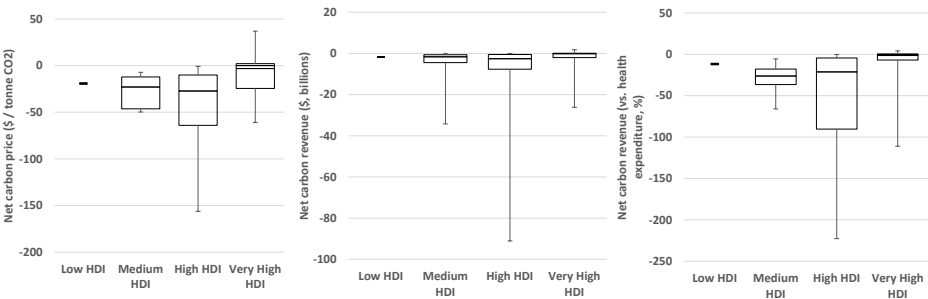
1515 Indicator 4.2.4: Net Value of Fossil Fuel Subsidies and Carbon Prices

1516 *Headline finding: 80% of the 86 countries reviewed had a net-negative carbon price in 2019,*
1517 *hindering the transition away from fossil fuels. The resulting net loss of government revenue was*
1518 *in many cases equivalent to large proportions of the national health budget.*

1519 Carbon prices help economies transition from high-carbon fuels, but many governments
1520 subsidise fossil fuels, encouraging health-harming emissions and slowing the low-carbon
1521 transition. This indicator compares carbon prices and monetary fossil fuel subsidies to calculate
1522 net economy-wide average carbon prices and revenues, covering 86 countries responsible for
1523 92% of global CO₂ emissions.

1524 In 2019, 42 countries had a carbon pricing mechanism in place, but only 17 produced a net-
1525 positive carbon price – all of which were very high HDI countries (Figure 14). 69 countries out of
1526 86 reviewed (80%) had net-negative carbon prices (i.e., provided a net subsidy to fossil fuels), for
1527 a net total of US\$400 billion that year alone. The median subsidy value in these countries was
1528 US\$1.6 billion, with ten countries each exceeding US\$10 billion of net subsidies. In 31 countries,
1529 net subsidies exceeded 10% of national health spending, and exceeded 100% in 5 countries.

1530 Redirecting government support from subsidising fossil fuels to low-carbon power generation,
 1531 health protection, public health promotion and healthcare is likely to deliver net benefits to
 1532 health and wellbeing.^{264,265} International financing mechanisms are needed to support low-
 1533 income countries vulnerable to energy costs in their transition to sustainable energy sources,
 1534 particularly in the light of the ongoing energy crisis, and to safeguard all dimensions of human
 1535 health.²⁶⁵



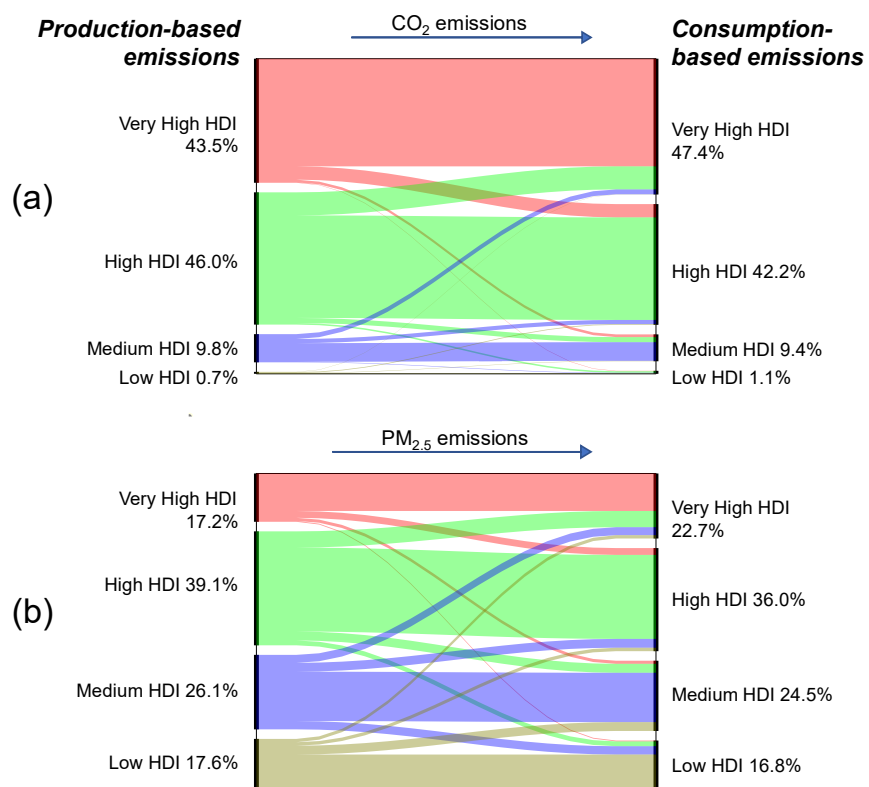
1536
 1537 *Figure 14: Net carbon prices (left), net carbon revenues (centre), and net carbon revenue as a share of*
 1538 *current national health expenditure (right), across 86 countries in 2019, arranged by Human Development*
 1539 *Index country group: low (n=1), medium (n=7), high (n=24) and very high (n=54). Boxes show the*
 1540 *interquartile range (IQR), horizontal lines inside the boxes show the medians, and the brackets represent*
 1541 *the full range from minimum to maximum.*

1542
 1543 Indicator 4.2.5: Production- and Consumption-Based of CO₂ and PM_{2.5} Emissions
 1544 *Headline finding: In 2020, 18% of CO₂ and 17% of PM_{2.5} global emissions were emitted in the*
 1545 *production of goods and services traded between countries of different HDI levels. The very high*
 1546 *HDI country group remained as the only group with net outsourcing of both CO₂ and PM_{2.5}*
 1547 *emissions from its consumption.*

1548 The production of goods and services result in local greenhouse gas and PM_{2.5} emissions, which
1549 can be monitored through production-based emission accounting. However, these goods and
1550 services are often consumed in different locations. Consumption-based emission accounting
1551 allocates emissions to countries according to their consumption of goods and services. This
1552 indicator uses an environmentally-extended multi-region input-output (EE-MRIO) model and the
1553 same air pollution modelling described in indicator 3.3,²⁶⁶⁻²⁶⁸ to assess countries' consumption-
1554 and production-based contribution to CO₂ and PM_{2.5} emissions.

1555 In 2020, 18% of CO₂ and 17% of PM_{2.5} global emissions were emitted in the production of goods
1556 and services traded between countries of different HDI levels. Emissions were 3% and 7% lower,
1557 respectively, than the year before—likely as a result of restrictions during the COVID-19
1558 pandemic. In 2020, the very high HDI country group contributed the most consumption-based
1559 (47%) CO₂ emissions, whereas the high HDI country group contributed the most production-
1560 based (46%) CO₂ emissions. However, on a per-capita basis, consumption-based emissions were
1561 highest in very high HDI countries, 1.3 times higher than the global average, and 26.3 times higher
1562 than per-capita emissions in low-HDI countries

1563 Meanwhile, high HDI countries were the biggest contributors to both production-based (39%)
1564 and consumption-based (36%) PM_{2.5} emissions, even if their contribution share fell from 2019
1565 (Figure 15). Per-capita PM_{2.5} emissions were largest in low HDI countries, a reflection of poorer
1566 air quality control measures and the use of dirtier fuels. The very high HDI country group
1567 remained the only group with higher consumption-based than production-based emissions of
1568 both CO₂ and PM_{2.5} emissions.



1569

1570 *Figure 15: CO₂ and PM_{2.5} emissions emitted in the production of goods and services traded among*

1571 *countries in 2020, grouped by Human Development Index*

1572

1573 Indicator 4.2.6: Compatibility of Fossil Fuel Company Strategies with the Paris Agreement

1574 *Headline finding: The current strategies of 15 of the largest oil and gas companies would lead to*
1575 *production exceeding their share of levels consistent with limiting global average surface*
1576 *temperature rise to 1.5°C by 37% in 2030, and 103% in 2040.*

1577 Emissions from oil and gas need to be reduced dramatically to enable a healthy future.^{8,269} This
1578 indicator assesses the extent to which current oil and gas company production strategies are
1579 compatible with Paris Agreement goals, regardless of their claims and commitments. It uses data
1580 from the Rystad Energy database on commercial activities for the eight largest publicly-listed
1581 international oil and gas companies (IOCs) by production volume, and the seven largest state-
1582 owned national oil and gas companies (NOCs). These IOCs and NOCs accounted for 14% and 28%
1583 of total global production, respectively, in 2021 (42% overall). Projected emissions under current
1584 strategies are compared to a pathway compliant with 1.5°C, assuming constant market shares at
1585 the 2015-2019 average.

1586 Data in this indicator suggests that the current production strategies of these companies would
1587 generate greenhouse gas emissions that exceed their share compatible with 1.5°C by an average
1588 of 39% for these IOCs, and 37% for the NOCs, in 2030. These excess emissions would rise to 87%
1589 and 111%, respectively, in 2040 (Figure 16). Cumulative production from 2020 to 2040 is
1590 projected to exceed their share of the 1.5°C benchmark by 36% for IOCs and 38% for NOCs.

1591 According to these results, the activities of some of the largest oil and gas companies are far from
1592 compliant with the goals of the Paris Agreement. Strong government action and pressure from
1593 civil society could be essential to bring about such compliance, through a far faster transition
1594 from fossil fuels to low-carbon energy sources.

1595

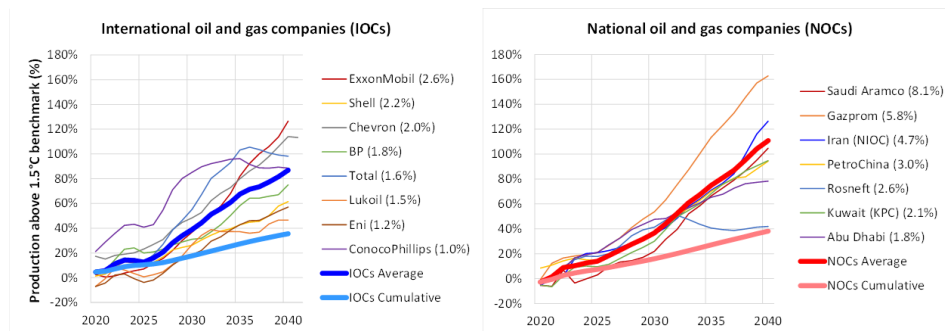


Figure 16: Compatibility of large oil and gas company production strategies with Paris 1.5°C climate target. Percentages in brackets in the legend represent the average 2015-19 global market share for each company.

Panel 7: Financing the response to compounding crises

The economic benefits of keeping temperatures below 1.5°C of heating and minimising climate change impacts through accelerated adaptation, are expected to outweigh the costs of climate action.⁸ While delivering the needed transition to net-zero emissions will require substantial capital investment,²⁵² the money is available. However, it is concentrated in relatively few economies that bear much of the historic responsibility for human-caused climate change, have only moderate direct and immediate geographic vulnerability to climate change, and can most afford to decarbonise and adapt.²⁷⁰ Conversely, the lower-income countries that have contributed the least to cumulative CO₂ emissions generally are more vulnerable, and have more limited resources to decarbonise and protect populations from climate hazards, and to recover from climate impacts. In acknowledgement of this, in the 2009 Copenhagen Accord “developed countries commit[ted] to a goal of mobilizing jointly US\$100 billion dollars a year by 2020 to address the needs of developing countries”.²⁷¹ To date, only US\$79 billion has been

1614 committed²⁵², two-thirds of this being in the form of loans, with most of the remainder evenly
1615 split between public grants and private finance.²⁵² At COP26, it was acknowledged that the
1616 US\$100 billion target would not be met until 2023,²⁷² a delay that not only jeopardises mitigation
1617 goals, but also leaves poorer countries more vulnerable to exacerbated climate change-related
1618 loss and damage. The economic impacts of COVID-19 and of geopolitical conflicts threaten to
1619 further put this target out of reach

1620 This is in stark contrast with countries' response to the COVID-19 pandemic, in which over US\$15
1621 trillion for 'rescue' spending by governments were announced globally during 2020 and 2021,
1622 with a further US\$3.11 trillion pledged for 'recovery' spending (concentrated heavily in OECD
1623 countries, plus China). Although US\$92 billion were pledged to improve future pandemic
1624 preparedness, and could therefore increase the capacity to manage future climate health
1625 hazards,²⁷³ the net effect of recovery spending is likely to worsen climate change-related health
1626 outcomes: less than US\$1 trillion was allocated to purposes that are likely to reduce GHG
1627 emissions or air pollution, and the net effect of recovery spending is likely to result in increased
1628 emissions through direct or indirect investment in carbon-intensive activities.²⁷³

1629 The COVID-19 response demonstrated the extent to which decision-makers in developed
1630 economies are willing and able to rapidly raise and allocate vast sums of public money to tackle
1631 what they perceive as a clear and present danger to the health of their population and economy.
1632 Under this light, the paucity of international climate finance reveals a concerning finding: despite
1633 the extensive evidence on the unprecedented short- and long-term dangers of climate change,
1634 and the cost effectiveness of climate action, climate change is not yet viewed as a crisis by those
1635 decision makers who may most effectively address it. The capacity to mobilise the necessary
1636 resources is however clear. With the window of opportunity for keeping temperatures below
1637 1.5°C rapidly closing, averting the catastrophic health impacts of climate change depends now
1638 on political will.

1639

1640 Conclusion

1641 Indicators in this section expose some of the extensive costs attached to the health impacts of
1642 climate change. Through economic impacts, climate change is undermining livelihoods, and the
1643 socioeconomic conditions on which good physical and mental health depend. Substantial and
1644 sustained investment in the low-carbon transition is essential to limit these impacts and deliver
1645 a healthy future. Both governments and the private sector have crucial roles to play in making
1646 this happen. Indicators show that investments and employment continue to slowly transition
1647 from fossil fuels to clean energy, along with divestments from fossil fuel assets. However, the
1648 pace must be accelerated to prevent devastating economic and health impacts of climate change.
1649 And still, governments continue to incentivise a carbon-intensive and health-harming economy
1650 by subsidising fossil fuels; to a level of value often equivalent to substantial proportions of
1651 national health budgets. Meanwhile, oil and gas companies are on track towards exceeding their
1652 share of maximum emissions compatible with 1.5°C of heating by over 100% in 2040, and need
1653 to be subjected to greater regulations and scrutiny to align their activities with agreed climate
1654 targets. Governments around the world are in a unique position to accelerate the transition and
1655 must set policy, and where possible directly invest, as we emerge from the depths of the
1656 pandemic to a world of economic and geopolitical uncertainty.

1657

Section 5: Public and Political Engagement

The integration of health and climate policies is essential to delivering a rapid climate transition that protects human health,^{274,275} particularly in countries and communities that have contributed least to rising global temperatures, and are yet the most affected by them.²⁷⁶⁻²⁷⁹

Public and political engagement with the health dimensions of climate change is essential to deliver equity-focused climate policies at speed and scale, and to bridge implementation gaps.^{280,281}

This section focuses on key domains of public and political engagement in health and climate change: engagement by the mainstream media (indicator 5.1), individuals (indicator 5.2), the scientific community (indicator 5.3), governments (indicator 5.4) and the corporate sector (indicator 5.5). Where appropriate, analyses begin in 2007, the year before the UN World Health Assembly made a multilateral commitment to protect people's health from climate change.²⁸²

Wherever appropriate, the analysis includes engagement with climate change adaptation and pandemic preparedness, to capture engagement with key dimensions of a coordinated response to climate change and the COVID-19 pandemic. For all indicators, detailed methodological description and further analysis are presented in the appendix.

Indicator 5.1 Media Engagement in Health and Climate Change

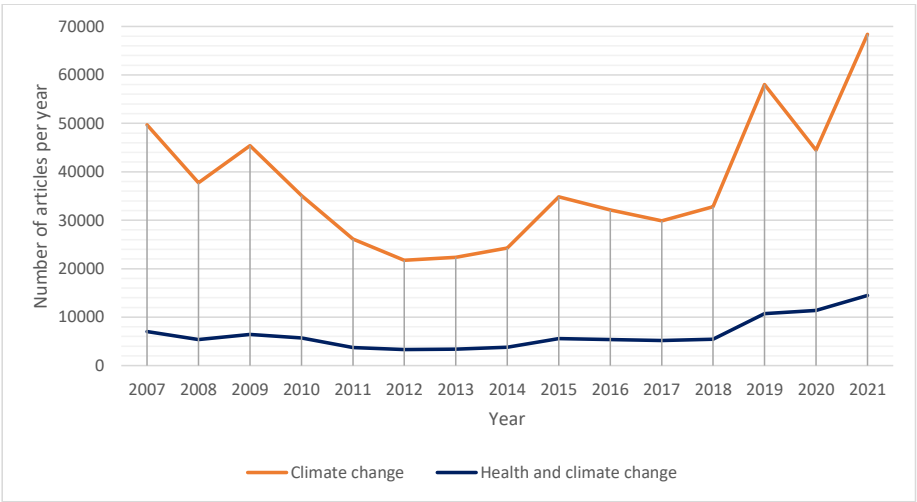
Headline finding: Coverage of health and climate change reached a record of 14 474 articles in 2021; however, this coverage only constitutes a small proportion of climate change coverage.

Newspapers, in their print and online versions, are a widely-used source of public information that influence public perceptions of climate change,^{283,284} governments,²⁸⁵ and the social media agenda.²⁸⁶ This indicator covers newspapers across 37 countries, including China's *People's Daily*,

1681 based on keyword searches (in English, German, Portuguese, Spanish and Chinese) of relevant
1682 newspaper databases.

1683 In 2021, global coverage of both climate change, and health and climate change, reached a new
1684 record high, with 14 474 articles that year, 4.7% more than in 2020 (Figure 17). In China’s People’s
1685 Daily, climate change coverage also reached its highest recorded level. Coverage of health and
1686 climate change remained limited, with only 1% of People’s Daily articles relating to both issues;
1687 none of these articles related to pandemic preparedness and only one to adaptation.

1688 In English language newspapers (n=51) across 24 countries, 20% of articles referring to both
1689 health and climate change also referred to adaptation and 48% to the pandemic. Very few (5%)
1690 referred to health, climate change, adaptation, and the pandemic.



1691

1692 *Figure 17: Newspaper coverage of health and climate change in 36 countries, 2007-2021*

1693 Indicator 5.2 Individual Engagement in Health and Climate Change

1694 *Headline finding: Individual engagement in health and climate change increased by 19% between*
1695 *2020 and 2021 - but health and climate change are seldom topics that people engaged with at*
1696 *the same time.*

1697 The indicator is based on global usage of the online encyclopaedia Wikipedia, an information
1698 source with increasing coverage and comprehensiveness and wide public reach,²⁸⁷⁻²⁹² that
1699 amplifies the diffusion of science.^{293,294}

1700 The indicator tracks people's movements between articles on health and on climate change
1701 ("clickstream statistics"), based on the English Wikipedia, the most popular language edition in
1702 multiple countries worldwide.^{295,296}

1703 Users click between articles on health or on climate change, with these domains heavily co-visited
1704 internally. There are fewer connections between domains: health and climate change are seldom
1705 topics that people engage with at the same time. Of all clickviews leading to a climate change-
1706 related article, 0.3% came from a health-related article; of clickviews leading to a health-related
1707 article, 0.02% came from a climate change-related article. These movements increased by 19%
1708 from 2020 to 2021, reversing the decline between 2019 and 2020. The COVID-19 pandemic
1709 continued to be a catalyst with, for example, COP26 triggering a higher engagement on health
1710 and climate change, mainly driven by interest in the pandemic situation in its host country.

1711

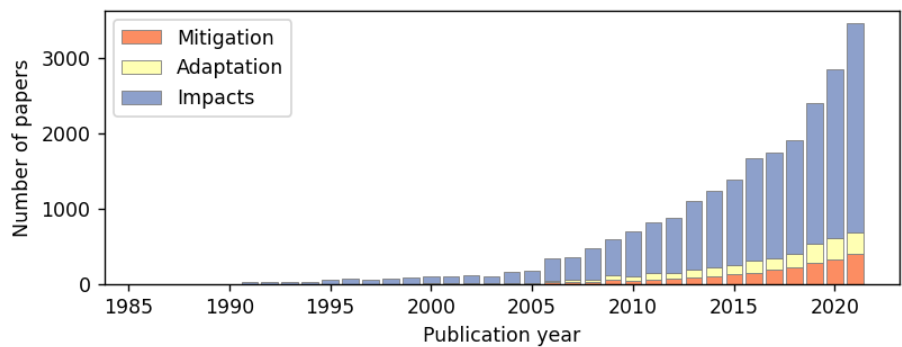
1712 Indicator 5.3: Scientific Engagement in Health and Climate Change

1713 *Headline finding: The number of scientific papers investigating health and climate change*
1714 *increased by 22% from 2020 to 2021.*

1715 Scientific engagement is tracked in peer-reviewed journals, the primary source of scientific
1716 evidence for the media and governments.^{292,297} The indicator employs an enhanced methodology

1717 in this year’s report, using supervised machine learning and associated methods (topic modelling
1718 and geoparsing) to map scientific articles on health and climate change over time,²⁹⁸ and extends
1719 the time period to 1985–2021.

1720 In 2021, over 3,200 articles engaged with health and climate change, an increase of 22%
1721 compared to 2020 (Figure 18). However, this represents a very small proportion of scientific
1722 articles on climate change and on climate impacts.²⁹⁹ The majority of health and -climate change
1723 articles were located in, and led by, authors in the WHO regions of Western Pacific and the
1724 Americas. While research on the health implications of climate change continues to dominate
1725 (86% of articles), climate solutions (mitigation and adaptation) are being given increasing
1726 attention. 20% of health and climate change articles engaged with pandemic preparedness.



1727
1728 *Figure 18: Number of scientific papers on health and climate change, with focus (impacts, mitigation,*
1729 *adaptation) indicated, 1985-2021*

1730

1731 Indicator 5.4: Government Engagement in Health and Climate Change

1732 *Headline finding: The proportion of countries referring to the health-climate change nexus*
1733 *increased in both the 2021 UN General Assembly (to 60%) and in updated NDC submissions (to*
1734 *86%).*

1735 Government engagement, essential for climate action,³⁰⁰ is tracked by two indicators: statements
1736 made by national leaders at UN General Debate (UNGD) at the UN General Assembly, the policy-
1737 making body of the UN,³⁰¹ and NDCs, the major policy instrument to protect health from
1738 “dangerous anthropogenic interference with the climate system”.^{302,303} Analysis is based,
1739 respectively, on the UNGD text corpus,³⁰⁴ and on content analysis of the first and the updated
1740 NDCs accessed from the UNFCCC interim registry.³⁰⁵⁻³⁰⁸

1741 In 2021, the proportion of countries referring to the health-climate change nexus at the UNGD
1742 increased to 60%, its highest recorded level, up from 47% in 2020 (Figure 19). As in 2020, the
1743 COVID-19 pandemic drove this engagement. As St Lucia’s UNGD address noted, “The COVID-19
1744 pandemic and the climate change challenge...provide us with a harsh and timely reminder that
1745 human health and planetary health are linked.”³⁰⁹

1746 Countries with low HDI, particularly Small Independent Developing States (SIDS), continue to lead
1747 engagement: 76% of SIDS discussed the health-climate change nexus in the 2021 UN General
1748 Debate. However, growing engagement with health and climate change is evident across all
1749 countries, including those with high and very high HDI.

1750

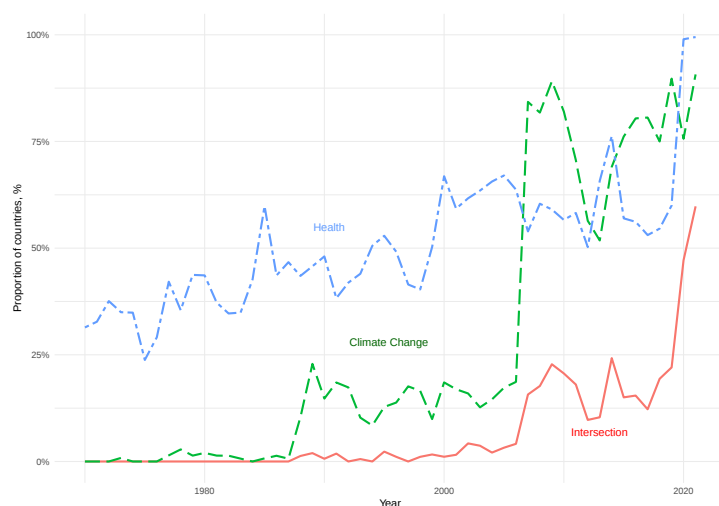


Figure 19: Proportion of countries referring to health, climate change and the intersection between the two in UN General Debates, 1970-2021.

Greater engagement with health is also evident in updated or new NDCs submitted by 126 UN member states (including the one representing 27 EU nations). Of these, 86% refer to health, an increase from 82% in the first NDCs. The increase is greatest for member states in the high HDI category, where all now refer to health, followed by the very high HDI group (where 71% made references in the updated NDCs, up from 65% in the first round). The proportions have slightly declined for the medium (87% to 86%) and low (94% to 86%) HDI groups. Most health references relate to adaptation needs or efforts (83% of the NDCs mentioning health, compared to 87% in the first round); 40% also relate to mitigation (up from 18%).

References to the health sector also increased, from 74% in the first round to 81% in the second round. Healthcare infrastructure was a particular focus: up from 39% to 73%. For example, Albania's second NDC³¹⁰ outlines how "health facilities could be damaged by climate-related changes, such as SLR [sea level rise], heavy rains or extreme temperatures".

1766 Indicator 5.5: Corporate Sector Engagement in Health and Climate change

1767 *Headline finding: Engagement in health and climate change increased in 2021 to its highest level*
1768 *among companies in the UN Global Compact, with 38% of corporations referring to the health-*
1769 *climate change nexus.*

1770 The indicator tracks engagement in health and climate change in the annual Communication of
1771 Progress (COP) among companies signed up to the UN Global Compact,³¹¹ the world's largest
1772 corporate sustainability framework operating across 165 countries without restriction by sector
1773 or company size.^{312,313} In an improvement from previous iterations in which only English-
1774 language COPs were analysed, COPs in all languages are now included.

1775 Engagement in health and climate change reached its highest level in 2021, with 38% of
1776 corporations referring to the health-climate change nexus in their COP report. However, as in
1777 previous years, there was much greater corporate engagement in climate change (87%) and
1778 health (72%) as separate issues. Engagement in the health-climate change nexus was greatest in
1779 companies based in the Western Pacific (53% COPs) and South-East Asia (43%) regions.

1780

1781 Conclusion

1782 Engagement in health and climate change reached its highest recorded level in 2021, with climate
1783 change solutions becoming an increasing focus of health-climate change engagement (for
1784 example in scientific research and the enhanced NDCs). As in previous years, government
1785 engagement is led by countries most vulnerable to a climate crisis not of their making.^{274,314,315}

1786 As in 2020, the COVID-19 pandemic continues to be a major driver of health-climate change
1787 engagement. In the media, a large proportion of English-language newspapers engaging with
1788 health and climate change referred to the pandemic. The pandemic also triggered engagement

1789 by individuals and by government leaders in health and climate change. This raises the question
1790 of whether greater engagement is contingent on the pandemic context.

1791 While health-climate change engagement increased in 2021, there is greater engagement with
1792 health and climate change as separate issues, a pattern evident for individual Wikipedia users,
1793 government leaders at the UNGD and companies in the UNGC. Similarly, media and scientific
1794 engagement in climate change continues to outstrip engagement in health and climate change.
1795 Despite mounting evidence of the health toll of climate change, health and climate change have
1796 yet to be securely linked in the public, political and corporate domains that hold the key to
1797 climate action.

1798

1799 Conclusion: The 2022 Report of the *Lancet* Countdown

1800 In its seventh iteration, the 2022 report of the *Lancet* Countdown paints the direst picture yet.
1801 At 1.1°C of heating,⁷⁴ climate change is increasingly undermining every pillar of good health, and
1802 compounding the health impacts of the ongoing COVID-19 pandemic and geopolitical conflicts.

1803 The health harms from extreme heat exposure are rising, affecting mental health, undermining
1804 the capacity to work and exercise, and resulting in annual heat-related deaths in people over 65
1805 increasing by 68% from 2000-2004 to 2017-2021 (indicators 1.1.1-1.1.5). Increasingly extreme
1806 weather is affecting physical and mental health directly and indirectly, with economic losses
1807 particularly overburdening low HDI countries, where they are mostly uninsured (indicators 1.2.1–
1808 1.2.3 and 4.1.1). The changing climate is exacerbating the risk of infectious disease outbreaks
1809 (indicator 1.3), and threatening global food security (Panel 4), with heatwave days associated
1810 with 98 million more food insecure people in 2020 than in 1981–2010 (indicator 1.4).

1811 These health impacts add further pressure on overwhelmed health systems (panel 6). With a
1812 further 0.4°C temperature rise probably unavoidable, accelerated adaptation is more urgent than

1813 ever. Yet, national and city authorities are not acting fast enough, while adaptation funding
1814 remains grossly insufficient (indicators 2.1.1, 2.1.2 and 2.2.4). The increased use of air
1815 conditioning and scant adoption of nature-based solutions (indicators 2.2.2-2.2.3) reflect a drift
1816 towards unplanned, maladaptive responses. Concerningly, and at least partly fuelled by
1817 wealthier countries' failure to meet climate finance goals (panel 7), the adaptation response
1818 often lags behind in low HDI countries, exacerbating their vulnerability to a climate crisis largely
1819 not of their making.

1820 Despite these profound health impacts, mitigation efforts remain inadequate to avert
1821 catastrophic temperature rise.⁸ CO₂ emissions from fuel combustion grew 4.8% in 2021 (indicator
1822 3.1), while agricultural GHG emissions have increased by 31% since 2000 (indicator 3.5.1). The
1823 inaction came with major health costs: fossil fuels contributed to 1.3 million deaths from ambient
1824 PM_{2.5} exposure in 2020; the overdependence on solid fuels, deepened by the energy crisis,
1825 exacerbated exposure to indoor air pollution (indicators 3.3 and 3.2);^{233,234,316} and consumption
1826 of carbon-intensive meat and dairy resulted in 2 million deaths in 2019 alone. Meanwhile,
1827 governments keep providing billions of dollars annually for fossil fuel subsidies (indicator 4.2.4).

1828 However, some indicators provide a sliver of hope. Governmental engagement with health and
1829 climate change reached record levels in 2021, and the updated NDCs reflect increased awareness
1830 of the need to protect health from climate change hazards (indicator 5.4). Renewable electricity
1831 generation and electric vehicle use reached record growth, and investments and employment in
1832 the clean energy industry are slowly increasing (indicators 3.1, 3.4, 4.2.1 and 4.2.2). If sustained,
1833 these shifts could deliver energy security, better jobs, cleaner air, and a path for a green COVID-
1834 19 recovery. Meanwhile, the health sector is increasingly preparing to face climate hazards
1835 (indicator 2.2.1), 60 countries committed to developing climate-resilient and/or low- or net zero-
1836 carbon health systems during COP26.²⁵⁰ Importantly, an expanding number of countries are
1837 starting to develop their own observatories, to monitor and identify progress on health and
1838 climate change. However, this could come too little too late.

1839 With countries facing multiple crises simultaneously, their policies on COVID-19 recovery and
1840 energy sovereignty will have profound, and potentially irreversible consequences for health and
1841 climate change. However, accelerated climate action would deliver cascading benefits, with more
1842 resilient health, food, and energy systems, and improved security and diplomatic autonomy,
1843 minimising the health impact of health shocks. With the world in turmoil, putting human health
1844 at the centre of an aligned response to these concurrent crises could represent the last hope of
1845 securing a healthier, safer future for all.

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