

The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises

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The 2020 Report of The Lancet Countdown on Health and Climate Change

Nick Watts, Markus Amann, Nigel Arnell, Sonja Ayeb-Karlsson, Jessica Beagley, Kristine Belesova, Maxwell Boykoff, Peter Byass, Wenjia Cai, Diarmid Campbell-Lendrum, Stuart Capstick, Jonathan Chambers, Samantha Coleman, Carole Dalin, Meaghan Daly, Niheer Dasandi, Shouro Dasgupta, Michael Davies, Claudia Di Napoli, Paula Dominguez-Salas, Paul Drummond, Robert Dubrow, Kristie L. Ebi, Matthew Eckelman, Paul Ekins, Luis E. Escobar, Lucien Georgeson, Su Golder, Delia Grace, Hilary Graham, Paul Haggar, Ian Hamilton, Stella Hartinger, Jeremy Hess, Shih-Che Hsu, Nick Hughes, Slava Jankin Mikhaylov, Marcia P. Jimenez, Ilan Kelman, Harry Kennard, Gregor Kiesewetter, Patrick Kinney, Tord Kjellstrom, Dominic Kniveton, Pete Lampard, Bruno Lemke, Yang Liu, Zhao Liu, Melissa Lott, Rachel Lowe, Jaime Martinez-Urtaza, Mark Maslin, Lucy McAllister, Alice McGushin, Celia McMichael, James Milner, Maziar Moradi-Lakeh, Karyn Morrissey, Simon Munzert, Kris A. Murray, Tara Neville, Maria Nilsson, Maquins Odhiambo Sewe, Tadj Oreszczyn, Matthias Otto, Fereidoon Owfi, Olivia Pearman, David Pencheon, Ruth Quinn, Mahnaz Rabbaniha, Elizabeth Robinson, Joacim Rocklöv, Marina Romanello, Jan C. Semenza, Jodi Sherman, Lihua Shi, Marco Springmann, Meisam Tabatabaei, Jonathon Taylor, Joaquin Trinanes, Joy Shumake-Guillemot, Bryan Vu, Paul Wilkinson, Matthew Winning, Peng Gong*, Hugh Montgomery*, Anthony Costello*

* Denotes Co-Chair

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171	List of Abbreviations
172	A&RCC – Adaptation & Resilience to Climate Change
173	CDP – Carbon Disclosure Project
174	CFU – Climate Funds Update
175	CO ₂ – Carbon Dioxide
176	CO ₂ e – Carbon Dioxide Equivalent
177	COP – Conference of the Parties
178	ECMWF – European Centre for Medium-Range Weather Forecasts
179	EE MRIO – Environmentally-Extended Multi-Region Input-Output
180	EJ – Exajoule
181	EM-DAT – Emergency Events Database
182	ERA – European Research Area
183	ETS – Emissions Trading System
184	EU – European Union
185	EU28 – 28 European Union Member States
186	FAO – Food and Agriculture Organization of the United Nations
187	GBD – Global Burden of Disease
188	GDP – Gross Domestic Product
189	GHG – Greenhouse Gas
190	GNI – Gross National Income
191	GtCO ₂ – Gigatons of Carbon Dioxide
192	GW – Gigawatt
193	GWP – Gross World Product
194	HIC – High Income Countries
195	IEA – International Energy Agency
196	IHR – International Health Regulations
197	IPC – Infection Prevention and Control
198	IPCC - Intergovernmental Panel on Climate Change
199	IRENA - International Renewable Energy Agency
200	LMICs – Low- and Middle-Income Countries
201	LPG – Liquefied Petroleum Gas
202	Mt – Metric Megaton
203	MtCO ₂ e – Metric Megatons of Carbon Dioxide Equivalent
204	MODIS – Moderate Resolution Imaging Spectroradiometer
205	MRIO – Multi-Region Input-Output
206	NAP – National Adaptation Plan
207	NASA – National Aeronautics and Space Administration
208	NDCs - Nationally Determined Contributions
209	NHS – National Health Service
210	NO _x – Nitrogen Oxide
211	NDVI – Normalised Difference Vegetation Index
212	OECD – Organization for Economic Cooperation and Development
213	PM _{2.5} – Fine Particulate Matter
214	PV – Photovoltaic

- 215 SDG – Sustainable Development Goal
- 216 SIDS – Small Island Developing State
- 217 SDU – Sustainable Development Unit
- 218 SSS – Sea Surface Salinity
- 219 SST – Sea Surface Temperature
- 220 tCO₂ – Tons of Carbon Dioxide
- 221 tCO₂/TJ – Total Carbon Dioxide per Terajoule
- 222 TJ – Terajoule
- 223 TPES – Total Primary Energy Supply
- 224 TWh – Terawatt Hours
- 225 UN – United Nations
- 226 UNFCCC – United Nations Framework Convention on Climate Change
- 227 UNGA – United Nations General Assembly
- 228 UNGD – United Nations General Debate
- 229 VC – Vectorial Capacity
- 230 WHO – World Health Organization
- 231 WMO – World Meteorological Organization

232 Executive Summary

233 The Lancet Countdown is an international collaboration, established to provide an
234 independent, global monitoring system dedicated to tracking the emerging health profile of
235 the changing climate.

236 The 2020 report presents 43 indicators across five sections: climate change impacts,
237 exposures, and vulnerability; adaptation, planning, and resilience for health; mitigation
238 actions and health co-benefits; economics and finance; and public and political engagement.
239 This report represents the findings and consensus of the 35 leading academic institutions
240 and UN agencies that make up the Lancet Countdown, and draws on the expertise of
241 climate scientists, geographers, and engineers; of energy, food, and transport experts; and
242 of economists, social and political scientists, data scientists, public health professionals, and
243 doctors.

244

245 The Emerging Health Profile of the Changing Climate

246 Five years ago, countries committed to limit warming to “well below 2°C”, as part of the
247 landmark Paris Agreement. Five years on, global CO₂ emissions continue to rise steadily,
248 with no convincing or sustained abatement, and a resultant 1.2°C of global average
249 temperature rise. Indeed, the five hottest years on record have occurred since 2015.

250 The changing climate has already produced significant shifts in the underlying social and
251 environmental determinants of health, at the global level. Indicators in all of the domains of
252 *impacts, exposures and vulnerabilities* that the collaboration tracks are worsening. Here,
253 concerning, and often accelerating trends are seen for each of the human symptoms of
254 climate change monitored, with the 2020 indicators presenting the most worrying outlook
255 reported since the Lancet Countdown was first established.

256 These effects are often unequal, disproportionately impacting populations who have
257 contributed the least to the problem. This reveals a deeper question of justice, whereby
258 climate change interacts with existing social and economic inequalities and exacerbates
259 long-standing trends within and between countries. An examination of the causes of climate
260 change reveals similar issues, and many carbon-intensive practices and policies lead to poor
261 air quality, poor food quality, and poor housing quality, which disproportionately harms the
262 health of disadvantaged populations.

263 Vulnerable populations experienced an additional 475 million heatwave exposure events
264 globally, which is in turn reflected in excess morbidity and mortality, with a 53.7% increase
265 in heat-related deaths over the last 20 years, up to a total of 296,000 deaths in 2018
266 (Indicators 1.1.2 and 1.1.3). The high cost in terms of human lives and suffering is associated

267 with impacts on economic output, with more than 80 billion hours of potential labour
268 capacity lost in 2019 (Indicators 1.1.3 and 1.1.4). China, India, and Indonesia are among the
269 worst affected countries, experiencing potential labour capacity losses equivalent to 4-6% of
270 their annual gross domestic product (Indicator 4.1.3). In Europe, the monetised cost of heat-
271 related mortality was equivalent to 1.2% of its gross national income, or the average income
272 of 11 million European citizens (Indicator 4.1.2).

273 Turning to extremes of weather, advancements in climate science increasingly allow for
274 greater accuracy and certainty in attribution, with studies from 2015 to present day
275 demonstrating the fingerprints of climate change in 76 floods, droughts, storms, and
276 temperature anomalies (Indicator 1.2.3). Further, 114 countries experienced an increased
277 number of days where people were exposed to very high or extremely high wildfire risk up
278 to present day (Indicators 1.2.1). Correspondingly, 67% of global cities surveyed expect
279 climate change to seriously compromise their public health assets and infrastructure
280 (Indicator 2.1.3).

281 The changing climate has down-stream effects, impacting broader environmental systems,
282 which in turn harms human health. Global food security is threatened by rising
283 temperatures and increases in the frequency of extreme events, with a 1.8-5.6% decline in
284 global yield potential for major crops observed from 1981 to present day (Indicator 1.4.1).
285 The climate suitability for infectious disease transmission has been growing rapidly since the
286 1950s, with a 15% increase for dengue from *Aedes albopictus* globally, and similar regional
287 increases for malaria and *Vibrio* (Indicator 1.3.1). Projecting forward based on current
288 populations, between 145 million and 565 million people face potential inundation from sea
289 level rise (Indicator 1.5).

290 Despite these clear and escalating signs, the global response to climate change has been
291 muted and national efforts continue to fall far short of the commitments made in the Paris
292 Agreement. The carbon intensity of the global energy system has remained almost flat for
293 30 years, with global coal use increasing by 74% over this time (Indicators 3.1.1 and 3.1.2).
294 The reduction in global coal use that had been observed since 2013 has now reversed for
295 the last two consecutive years as coal use rose by 1.7% from 2016 to 2018. The health
296 burden here is substantial – over one million deaths occur every year as a result of air
297 pollution from coal-fired power, and some 390,000 of these as a result of particulate
298 pollution in 2018 (Indicator 3.3). The response in the food and agricultural sector has been
299 similarly concerning. Emissions from livestock grew by 16% from 2000 to 2017, 82% of
300 which came from cattle (Indicator 3.5.1). This mirrors increasingly unhealthy diets seen
301 around the world, with excess red meat consumption contributing to some 990,000 deaths
302 in 2017 (Indicator 3.5.2). Five years on from when countries reached agreement in Paris, a
303 concerning number of indicators are showing an early, but sustained reversal of previously
304 positive trends identified in past reports (Indicators 1.3.2, 3.1.2 and 4.2.3).

305

306 A Growing Response from Health Professionals

307 Despite limited economy-wide improvement, relative gains have been made in a number of
308 key sectors, with a 21% annual increase in renewable energy capacity from 2010 to 2017,
309 and low-carbon electricity now responsible for 28% of capacity in China (Indicator 3.1.3).
310 However, the indicators presented in the 2020 report of the Lancet Countdown suggest that
311 some of the most significant progress can be seen in the growing momentum of the health
312 profession's engagement with climate change, globally. Doctors, nurses, and the broader
313 profession have a central role to play in health system adaptation and mitigation, in seeking
314 to understand and maximise the health benefits of any intervention, and in communicating
315 the need for an accelerated response.

316 In the case of national health system adaptation, this change is underway. Impressively,
317 health services in 86 countries are now connected with their equivalent meteorological
318 services to assist in health adaptation planning (Indicator 2.2). At least 51 countries have
319 developed national health adaptation plans, which is coupled with a sustained 5.3% rise in
320 health adaptation spending globally, reaching US\$18.4 billion in 2019 (Indicators 2.1.1 and
321 2.4).

322 The healthcare sector – responsible for 4.6% of global greenhouse gas emissions – is taking
323 early but significant steps to reduce its own emissions (Indicator 3.6). In the United
324 Kingdom, the National Health Service has declared an ambition to deliver a 'net-zero health
325 service' as soon as possible, building on a decade of impressive progress that achieved a
326 57% reduction in 'delivery of care' emissions from 1990, and a 22% reduction when
327 considering its supply chain and broader responsibilities. Elsewhere, the Western Australian
328 Department of Health used its 2016 *Public Health Act* to conduct Australia's first Climate
329 and Health Inquiry, and the German Ministry of Health has restructured to include a new
330 department on Climate, Sustainability and Health Protection. This progress is becoming
331 more evenly distributed around the world, with 73% of countries making explicit reference
332 to health and wellbeing in their national commitments under the Paris Agreement, and
333 100% of countries in South East Asia and the East Mediterranean doing so (Indicator 5.4).
334 Similarly, Least Developed Countries and Small Island Developing States are providing
335 increasing global leadership within the UN General Debate on the connections between
336 health and climate change (Indicator 5.4).

337 Individual health professionals and their associations are responding as well, with health
338 institutions committing to divest over US\$42 billion worth of assets from fossil fuels
339 (Indicator 4.2.4). In academia, there has been a nine-fold increase in publication of original
340 scientific articles on health and climate change from 2007 to 2019 (Indicator 5.3).

341 These shifts are being translated into the broader public discourse. From 2018 to 2019, the
342 coverage of health and climate change in the media has risen by 96% around the world,
343 outpacing the increased attention in climate change overall, and reaching the highest

344 observed point to-date (Indicator 5.1). Just as it did with advancements in sanitation and
345 hygiene and with tobacco control, growing and sustained engagement from the health
346 profession over the last five years is now beginning to fill a crucial gap in the global response
347 to climate change.

348

349 [The Next Five Years: A Joint Response to Two Public Health Crises](#)

350 December 12, 2020, marks the anniversary of the 2015 Paris Agreement, with countries set
351 to update their national commitments and review them every five years. These next five
352 years will be pivotal. In order to reach the 1.5°C target and maintain temperature rise “well
353 below 2°C”, the 56 gigatons of CO₂e currently emitted annually will need to drop to 25 Gt
354 CO₂e within only 10 years (by 2030). In effect, this requires a 7.6% reduction every year,
355 representing a five-fold increase in current levels of national government ambition. Without
356 further intervention over the next five years, the reductions required increase to 15.4%
357 every year, moving the 1.5°C target out of reach.

358 The need for accelerated efforts to tackle climate change over the next five years will be
359 contextualised by the impacts of, and the global response to, COVID-19. With the loss of life
360 from the pandemic and from climate change measured in the hundreds of thousands, the
361 potential economic costs measured in the trillions, and the broader consequences expected
362 to continue for years to come, the measures taken to address both of these public health
363 crises must be carefully examined, and closely linked. In May 2020, over 40 million health
364 professionals wrote to global leaders, emphasising this point. These health professionals are
365 well placed to act as a bridge between the two issues, and considering the clinical approach
366 to managing a patient with COVID-19 may be useful in understanding the ways in which
367 these challenges should be jointly addressed.

368 In an acute setting, a high priority is placed on rapidly diagnosing and comprehensively
369 assessing the situation. Likewise, further work is required to understand the problem,
370 including: which populations are vulnerable to both the pandemic and to climate change;
371 how global and national economies have reacted and adapted, and the health and
372 environmental consequences of this; and which aspects of these shifts should be retained to
373 support longer term sustainable development. Secondly, appropriate resuscitation and
374 treatment options are reviewed and administered, with careful consideration of any
375 potential side-effects, the goals of care, and the life-long health of the patient. Economic
376 recovery packages that prioritise out-dated fossil fuel-intensive forms of energy and
377 transport will have unintended side-effects, unnecessarily adding to the seven million
378 people that die every year from air pollution. Instead, investments in health imperatives
379 such as renewable energy and clean air, active travel infrastructure and physical activity,
380 and resilient and climate-smart healthcare, will ultimately be more effective.

381 Thirdly, attention turns to secondary prevention and long-term recovery, seeking to
382 minimise the permanent effects of the disease and prevent its recurrence. Many of the
383 steps taken to prepare for unexpected shocks such as a pandemic are similar to those
384 required to adapt to the extremes of weather and new threats expected from climate
385 change. This includes the need to identify vulnerable populations, assess the capacity of
386 public health systems, develop and invest in preparedness measures, and emphasise
387 community resilience and equity. Indeed, without considering the current and future
388 impacts of climate change, efforts to prepare for future pandemics will likely be
389 undermined.

390 At every step and in both cases, acting with a level of urgency proportionate to the scale of
391 the threat, adhering to the best-available science, and practising clear and consistent
392 communications is paramount. The consequences of the pandemic will contextualise
393 governments' economic, social, and environmental policies over the next five years, a
394 period that is crucial in determining whether temperatures will remain "well below 2°C".
395 Unless the global response to COVID-19 is aligned with the response to climate change, the
396 world will fail to meet the target laid out in the Paris Agreement, damaging public health
397 both in the short-term and in the long-term.
398

400 The world has already warmed by over 1.2°C compared to pre-industrial levels, resulting in
401 profound, immediate, and rapidly worsening health impacts, and moving dangerously close
402 to the agreed limit of maintaining temperatures “well below 2°C”.¹⁻⁴ These are seen on
403 every continent, with the ongoing spread of dengue fever across South America; the
404 cardiovascular and respiratory effects of record heatwaves and wildfires in Australia,
405 California, and Western Europe; and the undernutrition and mental health impacts of flood
406 and drought in China, Bangladesh, Ethiopia, and South Africa.⁵⁻⁸ In the long-term, climate
407 change threatens the very foundations of human health and wellbeing, with the Global Risks
408 Report registering it as one of the five most damaging or likely global risks, every year, for
409 the last decade.⁹

410 It is clear that human and environmental systems are inextricably linked, and that any
411 response to climate change must harness, rather than damage these connections.¹⁰ Indeed,
412 a response commensurate to the size of the challenge – which prioritises health system
413 strengthening, invests in local communities, and ensures clean air, safe drinking water, and
414 nourishing food – will provide the foundations for future generations to not only survive,
415 but to thrive.¹¹ Recent evidence suggests that increasing ambition from current climate
416 policies to those which would limit warming to 1.5°C by 2100 would generate a net global
417 benefit of US\$264 to \$610 trillion.¹² The economic case is further strengthened when the
418 benefits of a healthier workforce and of reduced healthcare costs are considered.¹³⁻¹⁵

419 The present-day impacts of climate change will continue to worsen without meaningful
420 intervention. These tangible, if less-visible, public health impacts have so far resulted in a
421 delayed and inadequate policy response. By contrast and on a significantly shorter time-
422 scale, COVID-19, the disease caused by severe acute respiratory syndrome coronavirus 2
423 (SARS-CoV-2), has rapidly developed in to a global public health emergency. Since it was first
424 detected in December 2019, the loss of life and livelihoods has occurred with staggering
425 speed. However, as for climate change, much of the impact is expected to unfold over the
426 coming months and years, and is likely to disproportionately affect vulnerable populations
427 as both the direct impacts of the virus, and the indirect effects of the response to the virus
428 are felt throughout the world. Panel 1 takes stock of this, and draws a number of lessons
429 and parallels between climate change and COVID-19, focusing on the response to, and
430 recovery from the two health crises.

431 The Lancet Countdown exists as an independent, multi-disciplinary collaboration dedicated
432 to tracking the links between public health and climate change. It brings together 35
433 academic institutions and UN agencies from every continent, and structures its work across
434 five key domains: climate change impacts, exposures, and vulnerability; adaptation planning
435 and resilience for health; mitigation actions and their health co-benefits; economics and
436 finance; and public and political engagement (Panel 2). The 43 indicators and conclusions
437 presented in this report are the cumulative result of the last eight years of collaboration,

438 and represent the consensus of its 86 climate scientists; geographers; engineers; energy,
439 food, and transport experts; economists; social and political scientists; public health
440 professionals; and doctors.

441 Where the pandemic has direct implications for an indicator being reported (and where
442 accurate data exists to allow meaningful comment), these will be discussed in-text. Beyond
443 this, the 2020 report of the Lancet Countdown will maintain its focus on the connections
444 between public health and climate change, and the collaboration has worked hard to ensure
445 the continued high quality of its indicators, with only minor amendments and omissions
446 resulting from the ongoing disruptions.

447

448

449 [Expanding and strengthening a global monitoring system for health and climate](#)
450 [change](#)

451 The Lancet Countdown's work draws on decades of underlying scientific progress and data,
452 with the initial indicator set selected as part of an open, global consultation that sought to
453 identify which of the connections between health and climate change could be meaningfully
454 tracked.¹⁶ Proposals for indicators were considered and adopted based on a number of
455 criteria, including: the existence of a credible underlying link between climate change and
456 health that was well described in the scientific literature; the availability of reliable and
457 regularly updated data across expanded geographical and temporal scales; the presence of
458 acceptable methods for monitoring; and the policy relevance and availability of actionable
459 interventions.

460 An iterative and adaptive approach has seen substantive improvements to the vast majority
461 of this initial set of indicators, as well as the development of a number of additional
462 indicators. Given this approach, and the rapidly evolving nature of the scientific and data
463 landscape, each annual update replaces the analysis from previous years. The Appendix
464 describes the methods, data sources, and improvements for each indicator in full, and is an
465 essential companion to the main report.

466 The 2020 report of the Lancet Countdown reflects an enormous amount of work refining
467 and improving these indicators, conducted over the last 12 months, including an annual
468 update of the data.

469 A number of key developments have occurred, including:

- 470 - The strengthening and standardisation of methods and datasets for indicators that
471 capture heat and heatwave; flood and drought; wildfires; the climate suitability of
472 infectious disease; food security and undernutrition; health adaptation spending;

- 473 food and agriculture; low-carbon healthcare; the economics of air pollution; and
474 engagement in health and climate change from the media, the scientific community,
475 and individuals.
- 476 - Improved or expanded geographical or temporal coverage of indicators that track:
477 heat and heatwave; labour capacity loss; flood and drought; the climate suitability of
478 infectious disease; climate change risk assessments in cities; use of healthy
479 household energy; and household air pollution.
 - 480 - The development of new indicators, exploring: heat-related mortality; migration and
481 population displacement; access to urban green space; the health benefits of low-
482 carbon diets; the economics of extremes of heat and of labour capacity loss; net
483 carbon pricing; and the extent to which the UNFCCC's Nationally Determined
484 Contributions (NDCs) engage with public health.

485 This continued progress has been supported by the Lancet Countdown's Scientific Advisory
486 Group and the creation of a new, independent Quality Improvement Process, which
487 provides independent expert input on the indicators prior to the formal peer review
488 process, adding rigour and transparency to the collaboration's research. In every case, the
489 most up-to-date data available is presented, with the precise nature and timing of these
490 updates varying depending on the data source. This has occurred despite the impact of
491 COVID-19, which has only impacted on the production of a small sub-set of indicators for
492 this report.

493 The Lancet Countdown has also taken a number of steps to ensure that it has the expertise,
494 data, and representation required to build a global monitoring system. Partnering with
495 Tsinghua University and Universidad Peruana Cayetano Heredia, the collaboration launched
496 two new regional offices for South America (in Lima), and for Asia (in Beijing), as well as the
497 development of a new partnership to build capacity in West Africa. This expansion is
498 coupled with ongoing work to develop national and regional Lancet Countdown reports: in
499 Australia, in partnership with the Medical Journal of Australia; in the European Union, in
500 partnership with the European Environment Agency; in China; and in the United States. At
501 the same time, a new data visualisation platform has been launched, allowing health
502 professionals and policymakers to investigate the indicators in this report.
503 (lancetcountdown.org/data-platform).

504 Future work will be concentrated on supporting these regional and national efforts, on
505 building communications and engagement capacity, on developing new indicators (with a
506 particular interest in developing indicators related to mental health and to gender), and on
507 further improving existing indicators. To this end, the continued growth of the Lancet
508 Countdown depends on the dedication of each of its composite experts and partners,
509 continued support from the Wellcome Trust, and ongoing input and offers of support from
510 new academic institutions willing to build on the analysis published in this report.

Panel 1: Health, Climate Change, and COVID-19

As of the 31st of July 2020, the COVID-19 pandemic has spread to 188 countries, with over 17,320,000 cases confirmed, and over 673,800 deaths recorded.¹⁷ The scale and extent of the suffering, and the social and economic toll will continue to evolve over the coming months, with its effects likely felt for years to come.¹⁸ The relationship between the spread of existing and novel infectious diseases, and worsening environmental degradation, deforestation and land-use change, and animal ill-health have long been analysed and described. Equally, both climate change and COVID-19 act to exacerbate existing inequalities within and between countries.¹⁹⁻²¹

As a direct consequence of the pandemic, an 8% reduction in greenhouse gas (GHG) emissions is projected for 2020, which would be the most rapid one-year decline on record.²² Crucially, these reductions do not represent the decarbonisation of the economy required to respond to climate change, but simply the freezing of economic activity. Equally, the 1.4% reduction which followed the 2008 global financial crisis was followed by a rebound, with emissions rising by 5.9% in 2010. Likewise, it is unlikely that the current fall in emissions will be sustained, with any reductions potentially outweighed by a shift away from otherwise ambitious climate change mitigation policies. However, this need not be the case.²² Over the next five years, considerable financial, social, and political investment will be required to continue to protect populations and health systems from the worst effects of COVID-19, to safely restart and restructure national and local economies, and to rebuild in a way that prepares for future economic and public health shocks. Harnessing the health co-benefits of climate change mitigation and adaptation will ensure the economic, social, and environmental sustainability of these efforts, while providing a framework that encourages investment in local communities and health systems, as well as synergies with existing health challenges.²³

Multiple, 'ready-to-go' examples of such alignment are available, such as commonalities seen in future pandemic preparedness and effective health adaptation climate-related impacts.²⁴ In the latter, decision-making under deep uncertainty necessitates the use of the principles of flexibility, robustness, economic low-regrets, and equity to guide decisions.^{25,26} At the broader level, poverty reduction and health system strengthening will both stimulate and restructure economies, and are among the most effective measures to enhance community resilience to climate change.²⁷

Turning to mitigation, at a time when more and more countries are closing down the last of their coal-fired power plants and oil prices are reaching record lows, the fossil fuel sector is expected to be worse affected than renewable energy.²² If done with care and adequate protection for workers, government stimulus packages are well placed to prioritise investment in healthier, cleaner forms of energy. Finally, the response to COVID-19 has encouraged a re-thinking of the scale and pace of ambition. Health systems have restructured services practically overnight to conduct millions of general practitioner and specialist appointments online, and a sudden shift to online work and virtual conferencing has shifted investment towards communications infrastructure instead of aviation and road transport.^{28,29} A number of these changes should be reviewed, improved on, and retained over the coming years.

It is clear that a growing body of literature and rhetoric will be inadequate, and this work must take advantage of the moment, to combine public health and climate change policies in a way that addresses inequality directly. The UNFCCC's COP26 – postponed to 2021, in Glasgow – presents an immediate opportunity for this, to ensure the long-term effectiveness of the response to COVID-19 by linking the recovery to countries' revised commitments (Nationally Determined Contributions) under the Paris Agreement. It is essential that the solution to one economic and public health crisis does not exacerbate another, and in the long-term, the response to COVID-19 and climate change will be most successful when they are closely aligned.

Working Group	Indicator	
Climate Change Impacts, Exposure, and Vulnerability	1.1: Health and Heat	1.1.1: Vulnerability to Extremes of Heat
		1.1.2: Exposure of Vulnerable Populations to Heatwaves
		1.1.3: Heat-Related Mortality
		1.1.4: Change in Labour Capacity
	1.2: Health and Extreme Weather Events	1.2.1: Wildfires
		1.2.2: Flood and Drought
		1.2.3: Lethality of Weather-Related Disasters
	1.3: Climate-Sensitive Infectious Diseases	1.3.1: Climate Suitability for Infectious Disease Transmission
		1.3.2: Vulnerability to Mosquito-Borne Diseases
	1.4: Food Security and Undernutrition	1.4.1: Terrestrial Food Security and Undernutrition
1.4.2: Marine Food Security and Undernutrition		
	1.5: Migration, Displacement and Sea-Level Rise	
Adaptation, Planning, and Resilience for Health	2.1: Adaptation Planning and Assessment	2.1.1: National Adaptation Plans for Health
		2.1.2: National Assessments of Climate Change Impacts, Vulnerability, and Adaptation for Health
		2.1.3: City-Level Climate Change Risk Assessments
	2.2: Climate Information Services for Health	
	2.3: Adaptation Delivery and Implementation	2.3.1: Detection, Preparedness and Response to Health Emergencies
		2.3.2: Air Conditioning Benefits and Harms
		2.3.3: Urban Green Space
2.4: Spending on Adaptation for Health and Health-Related Activities		
Mitigation Actions and Health Co-Benefits	3.1: Energy System and Health	3.1.1: Carbon Intensity of the Energy System
		3.1.2: Coal Phase-Out
		3.1.3: Zero-Carbon Emission Electricity
	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: Mitigation in the Healthcare Sector		
Economics and Finance	4.1: The Health and Economic Costs of Climate Change and Benefits from 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: Investment in New Coal Capacity
		4.2.2: Investments in Zero-Carbon Energy and Energy Efficiency
		4.2.3: Employment in Low-Carbon and High-Carbon Industries
		4.2.4: Funds Divested from Fossil Fuels
		4.2.5: Net Value of Fossil Fuel Subsidies and Carbon Prices
Public and Political Engagement	5.1: Media Coverage of Health and Climate Change	
	5.2: Individual Engagement in Health and Climate Change	
	5.3: Coverage of Health and Climate Change in Scientific Journals	
	5.4: Government Engagement in Health and Climate Change	
	5.5: Corporate Sector Engagement in Health and Climate Change	

512 Panel 2: The Indicators of the 2020 report of the Lancet Countdown

513 Section 1: Climate Change Impacts, Exposures, and Vulnerability

514 A changing climate threatens to undermine the last 50 years of gains in public health,
515 disrupting the wellbeing of communities, and the foundations on which health systems are
516 built.³⁰ Its effects are pervasive, and impact the food, air, water, and shelter that society
517 depends on, extending across every region of the world and every income group. These
518 effects act to exacerbate existing inequities, with vulnerable populations within and
519 between countries affected more frequently, and with more lasting impact.³

520 Section 1 of the 2020 report tracks the links between climate change and human health
521 along several exposure pathways, from the climate signal through to the resulting health
522 outcome. This section begins by examining a number of dimensions of the effects of heat
523 and heatwave, ranging from exposure and vulnerability, through to the effects on labour
524 capacity, and on mortality (Indicators 1.1.1-1.1.4). The indicator on heat mortality has been
525 developed for 2020, and while ongoing work will strengthen these findings in subsequent
526 years, it complements existing indicators on exposure and vulnerability, and represents an
527 important step forward.

528 The second cluster of indicators navigate the effects of extreme weather events, tracking
529 wildfire risk and exposure, flood and drought, and the lethality of extreme weather events
530 (Indicators 1.2.1-1.2.3). The wildfire indicator now tracks wildfire risk as well as exposure,
531 the classification of drought has been updated to better align with climate change trends,
532 and an overview of the attribution of climate change to the health impacts of certain
533 extreme weather events is presented for the first time presented. The climate suitability
534 and associated population-vulnerability of several infectious diseases are monitored, and so
535 too are the evolving impacts of climate change on terrestrial and marine food security
536 (Indicators 1.3.1-1.4.2), with the consideration of regional variation providing more robust
537 estimates of the effects of temperature rise on crop yield potential. Another new indicator
538 closes this section, tracking population exposure to sea level rise in the context of migration
539 and displacement, alongside the resulting health impacts and the policy responses
540 (Indicator 1.5).

541

542

543 1.1 Health and Heat

544 Exposure to high temperature and heatwave results in a range of negative health
545 impacts, from morbidity and mortality due to heat stress and heat stroke, to exacerbations
546 of cardiovascular and respiratory disease.^{31,32} The worst affected are the elderly, those with
547 disability or pre-existing medical conditions, those working outdoors or in non-cooled
548 environments and those living in regions already at the limits for human habitation.³³ The

549 following indicators track the vulnerability, exposure, and impacts of heat and heatwave in
550 every region of the world.

551

552 [Indicator 1.1.1: Vulnerability to Extremes of Heat](#)

553 *Headline finding: Vulnerability to extremes of heat continue to rise in every region of the*
554 *world, led by populations in Europe, and with those in the Western Pacific, South East Asia*
555 *and Africa all seeing an increase of more than 10% since 1990.*

556 This indicator re-examines the index results presented in the 2019 report, and introduces a
557 more comprehensive index of heat vulnerability, which combines heatwave exposure data
558 with data on the population susceptibility and the health system's ability to cope.³⁰

559 As a result of aging populations, high prevalence of chronic disease and rising levels of
560 urbanisation, since 1990, European and the Eastern Mediterranean populations have been
561 the most vulnerable to extremes of heat, with vulnerabilities of 40.6% and 38.7%
562 respectively in 2017. However, no region of the world is immune, with vulnerability
563 worsening everywhere, and has risen since 1990 in Africa (28.4% to 31.3%), South-East Asia
564 (28.3% to 31.3%) and the Western Pacific (33.2% to 36.6%). By taking into account health
565 system strengthening and heat wave exposure across these regions, this vulnerability
566 indicator can be more usefully built in to one which captures population risk. This has been
567 done for the 2020 report (see Appendix), demonstrating trends similar to those seen above,
568 with risk rising in every region. This index will be further developed over the course of 2020,
569 and presented in-full alongside a broader suite of risk indicators, in future reports.

570

571 [Indicator 1.1.2: Exposure of Vulnerable Populations to Heatwaves](#)

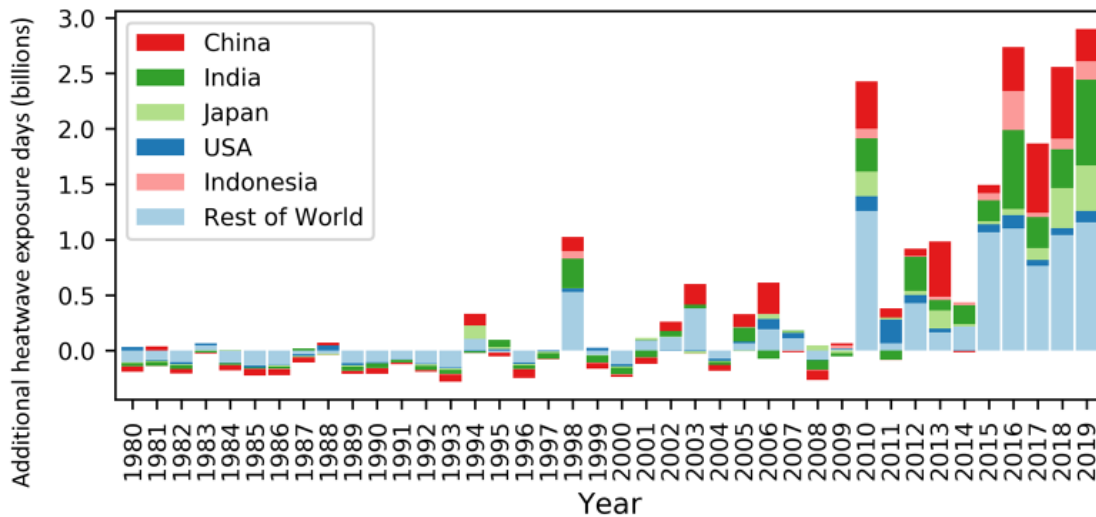
572 *Headline finding: A record 475 million additional heatwave exposures affecting vulnerable*
573 *populations were observed in 2019, representing some 2.9 billion additional days of*
574 *heatwave experienced.*

575 Figure 1 presents the change in days of heatwave exposure since 1980, relative to a historic
576 1986-2005 baseline. It highlights a dramatic rise since 2010, driven by the combination of
577 increasing heatwave occurrences and aging populations. In 2019 there were 475 million
578 additional exposure events. Expressed as the number of days a heatwave was experienced,
579 this breaks the previous 2016 record by an additional 160 million person-days.

580 Indicator 1.1.2 tracks heatwave exposure of vulnerable populations, now updated to make
581 use of the latest climate data and a hybrid population dataset.³⁴⁻³⁶ This indicator has

582 undergone several additional improvements (detailed in full, in the Appendix) in order to
 583 best capture heatwave exposure in every region of the world, including an improved
 584 definition of heatwave; the quantification of exposure-days to capture changing frequency
 585 and duration; and improved estimates of demographic breakdown.

586



587
 588 *Figure 1: Change in days of heatwave exposure relative to the 1986-2005 baseline in the over 65*
 589 *population.*

590

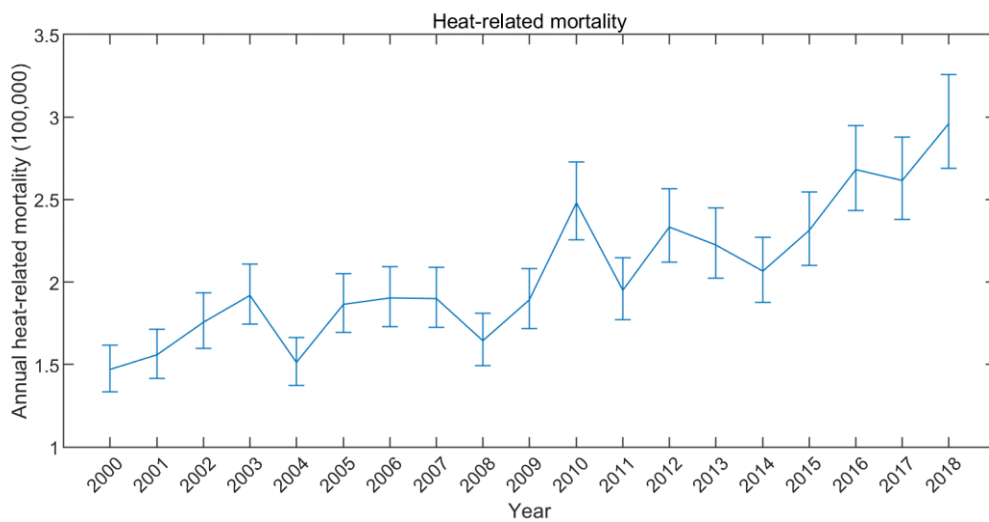
591 **Indicator 1.1.3: Heat-Related Mortality**

592 *Headline finding: In the past two decades, heat-related mortality in the over-65 population*
 593 *has increased by 53.7%, reaching 296,000 deaths in 2018, with the majority occurring in*
 594 *Japan, eastern China, northern India, and central Europe.*

595 This metric, newly created for the 2020 report, tracks global heat-related mortality in
 596 populations over 65. Using methods originally described by the World Health Organization
 597 (WHO), it applies the exposure-response function and optimum temperature described by
 598 Honda et al (2014) to the daily maximum temperature exposure of the over 65 population
 599 to estimate the attributable fraction and thus the heat-related excess mortality.^{37,38} Daily
 600 maximum temperature data is taken from ERA5 and gridded population data was taken
 601 from a hybrid of NASA GPWv4 and ISIMIP population data, with a full methodology
 602 described in the Appendix.³⁴⁻³⁶

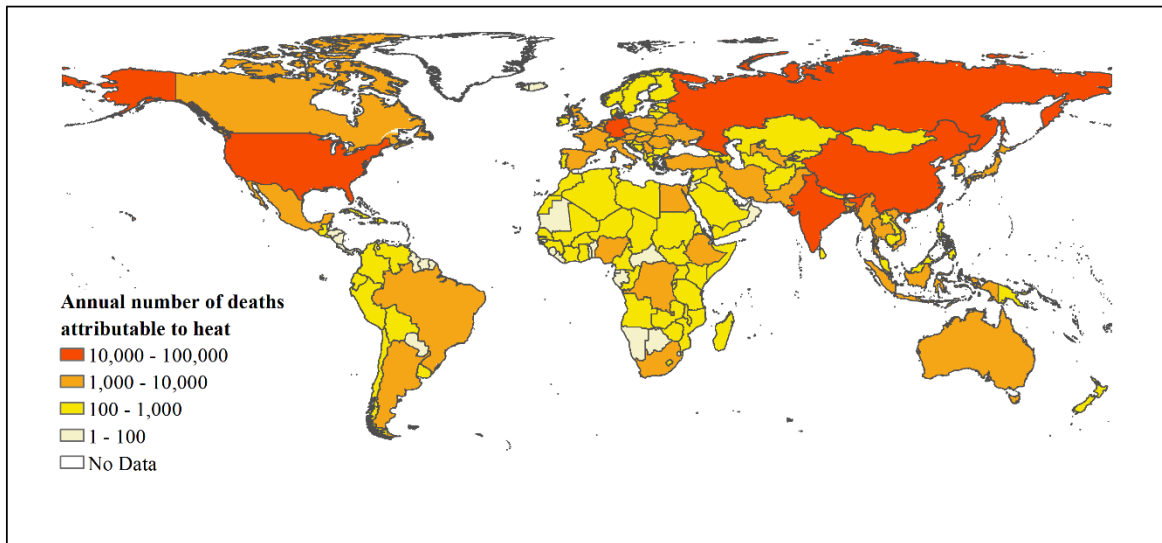
603 This indicator estimates that global average annual heat-related mortality in the over 65
 604 population has increased by 53.7% from 2000-2004 to 2014-2018, with a total of 296,000
 605 deaths in 2018 (Figure 2 and Figure 3). With the largest populations, China and India were
 606 greatest affected, with over 62,000 and 31,000 heat-related deaths respectively, followed
 607 by Germany (over 20,000), the USA (almost 19,000), Russia (18,600), and Japan (over
 608 14,000). At over 104,000 deaths, Europe was the most affected of the WHO regions.
 609 Importantly, the effects of temperature on mortality vary by region, and are modified by
 610 local factors including population urban green space, and inequality both within and
 611 between countries.^{39,40} Work has begun to develop a future form of this indicator, which
 612 builds in more localised exposure-response functions, as they become available.

613



614

615 *Figure 2: Global heat-related mortality for populations over the age of 65, from 2000-2018.*



616
617 *Figure 3: Annual heat-related mortality in the over 65 population, averaged from 2014 to 2018.*

618

619 **Indicator 1.1.4: Change in Labour Capacity**

620 *Headline finding: Rising temperatures were responsible for an excess of 100 billion potential*
621 *work-hours hours lost globally in 2019 compared to 2000, with India’s agricultural sector*
622 *among the worst affected.*

623 This indicator tracks the effects of heat exposure on working people, with impact expressed
624 as potential work hours lost.⁴¹ It has been updated to capture construction, alongside
625 service, manufacturing, and agriculture sectors, drawing climate data from the ERA5
626 models, with methods and data described in full in the Appendix and previously.^{35,42-45}

627 Across the globe a potential 302 billion work hours were lost in 2019 – 103 billion hours
628 greater than in 2000. Thirteen countries represent approximately 80% of the global hours
629 lost in 2019 (Table 1), with India experiencing by far the greatest loss (39% of total global
630 work hours lost in 2019) and Cambodia the highest impact per capita loss. Agricultural
631 workers experience the worst of these effects in many countries in the world, whereas the
632 burden is often on those in construction in high-income countries such as the USA.

633 *Table 1: Work hours lost (WHL) due to heat. These estimates are assuming all agricultural and*
634 *construction work was in the shade or indoors – the lower bounds of potential work hours lost. Work*
635 *hours lost per person are estimated for the population over 15.*

636

Country	WHL 2000 (billions)	WHL 2019 (billions)	% of Global WHL, 2019	WHL per person, 2019
<i>Global</i>	199.0	302.4	100%	52.7
<i>India</i>	75.0	118.3	39.1%	111.2
<i>China</i>	33.4	28.3	9.4%	24.5
<i>Bangladesh</i>	13.3	18.2	6.0%	148.0
<i>Pakistan</i>	9.5	17.0	5.6%	116.2
<i>Indonesia</i>	10.7	15.0	5.0%	71.8
<i>Vietnam</i>	7.7	12.5	4.1%	160.3
<i>Thailand</i>	6.3	9.7	3.2%	164.4
<i>Nigeria</i>	4.3	9.4	3.1%	66.7
<i>Philippines</i>	3.5	5.8	1.9%	71.4
<i>Brazil</i>	2.8	4.0	1.3%	23.3
<i>Cambodia</i>	1.7	2.2	0.7%	202.2
<i>USA</i>	1.2	2.0	0.7%	7.1
<i>Mexico</i>	0.9	1.7	0.6%	17.4
<i>Rest of world</i>	28.7	58.3	19.3%	27.5

637

638 1.2 Health and Extreme Weather Events

639 Extreme weather events, including wildfires, floods, storms, and droughts, affect human
640 health in a variety of ways, with the frequency and intensity of such events shifting as a
641 result of climate change. Death and injury as a direct result of an extreme event is often
642 compounded by effects that are mediated through the environment – for example, the
643 exacerbation of respiratory symptoms from wildfire smoke, or the spread of vector- and
644 water-borne diseases following a flood or drought. Finally, impacts are mediated through
645 social systems – for example, the disruption to health services, and the mental ill-health that
646 can result from storms and fires.^{3,46} The following indicators track population risk and
647 exposure to wildfires, changes in meteorological flood and drought, and the lethality of
648 extreme weather events.

649

650 Indicator 1.2.1: Wildfires

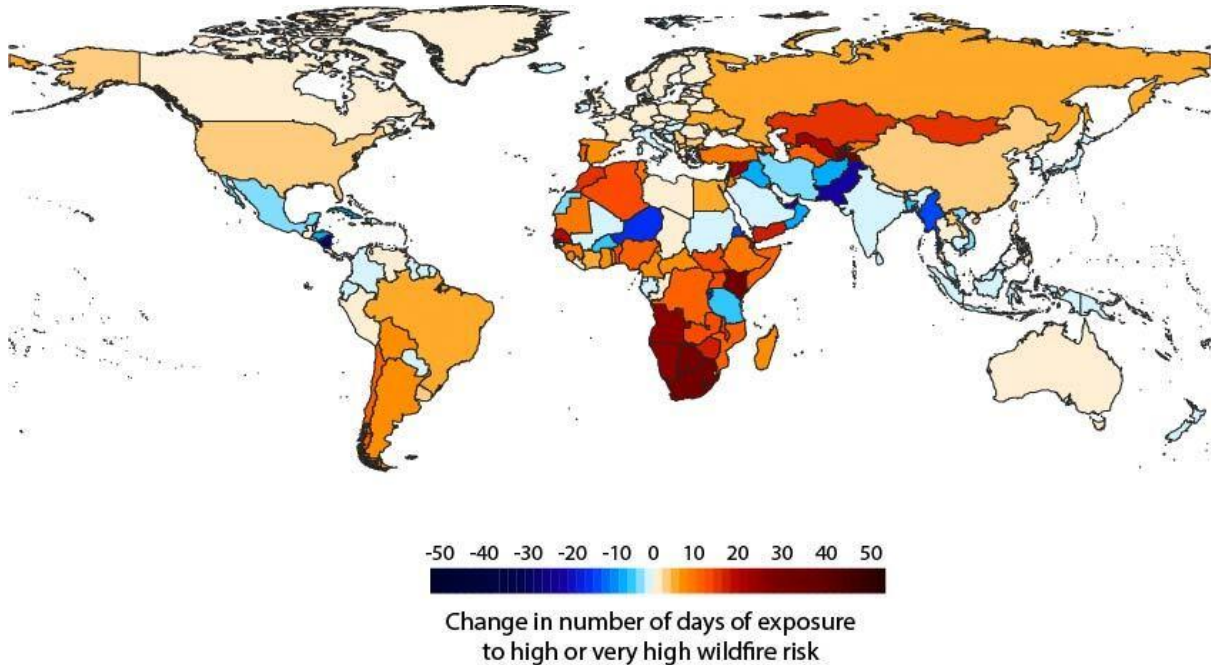
651 *Headline finding: 114 countries experienced an increase in the number of days people were*
652 *exposed to ‘very high’ or ‘extremely high’ fire danger risk for the four-year period ending*
653 *2019. At the same time, 128 countries experienced an increase in population exposure to*
654 *wildfires.*

655 For the 2020 report, analysis on the effects of wildfires has been developed to track the
656 average number of days people are exposed to very high and extremely high wildfire risk
657 annually, as well as the change in actual population wildfire exposure across the globe,
658 using both model-based risk to wildfires and satellite-observed exposure. Climatological
659 wildfire risk is estimated by combining fire danger indices (FDI ≥ 5) with climate and
660 population data for every 0.25° x 0.25° grid cell.^{34,47} For wildfire exposure, satellite-observed
661 active fire spots were detected using the Moderate Resolution Imaging Spectroradiometer
662 (MODIS), and then aggregated and spatially joined with gridded global population data on a
663 global 10 km resolution grid, with urban areas excluded.^{34,48} A full description of the
664 methodology can be found in the Appendix.

665 Increased wildfire risk was observed in 114 out of 196 countries for the period 2016-2019
666 compared to 2001-2004, with the most prominent increases occurring in Lebanon, Kenya
667 and South Africa (Figure 4). Considering area-weighted rather than population-weighted
668 change, Australia, devastated by the 2019-2020 fire season, had one of the largest increases
669 in wildfire risk. Over the same time period, this risk translated into an additional 194,000
670 daily exposures to wildfires happening annually, around the world, and 128 countries
671 experiencing an increase in this metric. Driven by the record-breaking 2017 and 2018 fires,

672 the USA experienced one of the largest increases globally, with over 470,000 additional
673 annual daily exposures to wildfires occurring from 2001-2004 to 2016-2019.

674



675
676 *Figure 4: Population-weighted mean changes in extremely high and very high fire danger days in*
677 *2016-2019 compared with 2001-2004. Large urban areas with population density ≥ 400 persons/km²*
678 *are excluded.*

679

680 Indicator 1.2.2: Flood and Drought

681 *Headline finding: 2019 saw over twice the global land surface area affected by excess*
682 *drought compared with the historical baseline.*

683 Climate change alters hydrological cycles, tending to make dry areas drier and wet areas
684 wetter.²⁷ By altering rainfall patterns and increasing temperatures, climate change affects
685 the intensity, duration and frequency of drought events.^{3,49} Drought poses multiple risks for
686 health, threatening drinking water supplies and sanitation, crop and livestock productivity,
687 enhancing the risk of wildfires and potentially leading to forced migration.⁵⁰ At the same
688 time, altered precipitation patterns increase the risk of localised flood events, resulting in
689 direct injury, the spread of infectious diseases and impacts on mental health.⁵¹

690 In the 2020 report, meteorological drought is tracked through using the Standardised
691 Precipitation-Evapotranspiration Index (SPEI), which takes into account both precipitation

692 and temperature, as well as its impact on the loss of soil moisture. This measures significant
693 increases in the number of months of drought compared with an extended historical
694 baseline, from 1950-2005, in order to account for periodic variations such as those
695 generated by the El Niño Southern Oscillation.⁵² A full explanation of the methodology and
696 additional analysis are in the Appendix.

697 Since the turn of the century, the area affected by excess number of months in drought has
698 increased globally, with more exceptional drought events affecting all populated continents
699 in 2018. Areas that experienced unusually high number of months under excess drought in
700 2018 include Europe, the Eastern Mediterranean region, and specifically, Mongolia.

701

702 [Indicator 1.2.3: Lethality of Extreme Weather Events](#)

703 *Headline finding: Long term increasing trends in the number of weather-related disasters*
704 *from 1990 to 2019 were accompanied by increasing trends in the number of people affected*
705 *by these disasters, in the countries where health expenditure has reduced or minimally*
706 *increased over the last two decades.*

707 The links between climate change and the health impacts of extreme weather events are
708 presented in two ways for this indicator. The first studies long-term trends in the occurrence
709 of such events along with the change in the number of people affected, and the resultant
710 mortality. The methods and data for this are similar to that used in previous reports, and
711 described in full in the Appendix.^{53,54} Recognising that an increase in the variability and
712 intensity of these events is also expected, the second part considers the attribution of
713 climate change to individual extreme events in recent years, and the effects that a selection
714 of events have had on the health of populations (Table 2 and Panel 3).

715 There are clear, statistically significant trends in the number of occurrences of weather-
716 related disasters, however insufficient evidence in either direction with respect to the
717 number of deaths or number of people affected per event. Within the sub-set of countries
718 demonstrating a reduction, or minimal increase in healthcare expenditure from 2000-2017,
719 a significant increase in the number of people affected is identified. By contrast, in countries
720 with the greatest increase in healthcare expenditure, the number of people affected by
721 extreme weather events has declined despite an increasing frequency of events. One
722 possible explanation for this could be the adaptive effects of health system strengthening.
723 This relationship will be further explored, considering variables such as expenditure for
724 specific healthcare functions and excess deaths in addition to the immediate event-related
725 deaths.

726 *Table 2: Detection and attribution studies linking recent extreme weather events to climate change*
 727 *from 2015 to 2020.*

Event type	Anthropogenic influence increased event likelihood or strength	Anthropogenic influence decreased event likelihood or strength	Anthropogenic influence not identified or uncertain, or had varied effects (*)
Heat 36 studies 32 events	2015: India; Pakistan; China; Indonesia; Europe; ^{8,55} Egypt; Japan; Southern India and Sri Lanka; Australia; Global. ^{8,56} 2016: Southern Africa; Thailand; Asia; Global. 2017: Australia; ⁵⁷ USA; South Korea; Western Europe; ⁵⁸ China; Euro-Mediterranean. 2018: Northeast Asia; Iberia; Europe. 2019: France; ⁵⁹ Western Europe. ⁶⁰ 2020: Australia. ⁶¹		2015-2016: India. ⁶²
Cold and frost 9 studies 8 events	2016: Australia.	2015: USA. 2016: China. 2018: North America, ⁶³ UK.	
Drought and reduced precipitation 26 studies 24 events	2015: USA; Canada; Ethiopia; Indonesia; Australia. 2016: Southern Africa; Thailand. 2017: East Africa; USA; China. 2018: South Africa; ⁶⁴ China; USA		2015: Brazil; ⁶⁵ Nigeria; Ethiopia. ⁶⁶ 2016: Brazil; USA; Somalia; ⁶⁷ Western Europe. 2017: Kenya. ⁶⁸ USA. 2019: Australia. ⁶¹
Wildfire 5 studies 6 events	2015: USA. 2016: Australia; Western North America. 2018: Australia. 2020: Australia. ⁶¹		2017: Australia.
Heavy precipitation and flood 23 studies 19 events	2015: China; USA. 2016: France; ⁶⁹ China; Louisiana, USA. ⁷⁰ 2017: Bangladesh; Peru; Uruguay; China. 2018: USA; Japan. ^{6,71}	2018: China.	2015: India. 2016: Germany; ⁶⁹ Australia; 2017: Bangladesh. ⁷² 2018: Mozambique, Zimbabwe and Zambia; Australia; India; ⁷³ China.*
Storms 8 events 8 studies	2015: UK; ⁷⁴ Western North Pacific ⁷⁵ 2017: USA. ⁷⁶ 2018: USA. ⁷⁷ 2019: USA. ⁷⁸		2016: USA. 2018: Western Europe. ⁷⁹
Marine heat and melting sea ice 10 events 13 studies	2015: Northern Hemisphere. 2016: USA; Australia; Coral Sea; ^{7,80} North Pole; ^{7,81} Gulf of Alaska and Bering Sea; Central Equatorial Pacific. 2018: Tasman Sea; Bering Sea.		2015: Central Equatorial Pacific. 2016: Eastern Equatorial Pacific.
Total events and studies	76 events, 81 studies	5 events, 6 studies	28 events, 27 studies

728
 729
 730
 731
 732
 Events have been listed according to the year in which they ended. In some countries and regions multiple events in the same year were studied. References are in Herring et al, 2016,⁸ Herring et al, 2018,⁷ Herring et al, 2019,⁵ Herring et al 2020,⁶ or listed separately. Adapted from the Bulletin of the American Meteorological Society.

Panel 3: Quantifying the Links between Climate Change, Human Health, and Extreme Events

Formal statistical methods, grouped as detection and attribution studies (D&A) are already used widely in other sectors, and are increasingly deployed to quantify the extent to which climate change has had observed impacts on population health and health systems.⁸²⁻⁸⁴ However, recent D&A studies focusing on the changing likelihood and intensity of extreme events are generally limited to meteorological events in high- and upper-middle income countries. Further development of this body of literature offers an essential and unique way of improving understanding of current impacts and future risks of climate change on lives and livelihoods, guiding evidence-based management and adaptation.

The following three case studies illustrate the linkage of D&A studies of meteorological events to the resulting health impacts.

1. Reduced sea ice in the Arctic Region

The Arctic Region is warming two to three times faster than the global annual average, with observable impacts for Arctic communities, but limited data on the health consequences.⁸⁵ Extreme weather events, shifting migration patterns, and warmer and shorter winters now threaten food security and vital infrastructure.

The winter of 2017-18 heralded warm temperatures and an extreme 'low ice year' in the Bering Sea.⁸⁶ Sea ice extent was the lowest in recorded and reconstructed history: an estimated two in 1800-year event compared with pre-industrial levels. One study suggested that climate change was responsible for 90% of the attributable risk, and that this level may become the mean within 20 years.⁸⁷

This had multiple detrimental effects on communities in Western Alaska, although the health impacts have rarely been measured. These communities generally depend on sea ice for transportation, hunting and fishing, coastal buffering from storms, and a host of other ecosystem services. During this period of record-low sea ice, a range of events occurred, from the loss of power, and damage to the water treatment plant in Little Diomedea to a fatal accident that resulted from open water-holes along a previously frozen travel corridor on the Kuskokwim River.⁸⁸⁻⁹⁰

2. Northern European Heatwaves in 2018 and 2019

During the summer of 2018, parts of northern Scandinavia experienced record-breaking daily temperatures more than 5°C warmer than in 1981-2010, an occurrence that evidence suggests was made five times more likely as a result of climate change.⁹¹ In Sweden, the Public Health Agency estimated an excess mortality of 750 deaths between July and August, with more than 600 of these attributed to higher temperatures when compared with the same weeks in 2017.⁹²

Countries across Western Europe and Scandinavia again experienced record-breaking temperatures in 2019, with several countries exceeding 40°C for 3-4 days during June and July. Attribution studies suggest climate change was responsible for a 10-fold increase in the likelihood of the event occurring, and a 1.2-3°C increase in temperature of these events, with almost 1,500 deaths in France and 400 deaths in the Netherlands.^{60,93,94}

3. Japan Heatwave 2018

The summer of 2018 in Japan saw a combination of a national emergency resulting from extreme precipitation, followed closely by record-breaking temperatures. The event had roughly a 20% probability of occurring in today's world compared with a zero probability in a world without climate change.^{95,96} Another attribution study compared modest and extreme heatwave days with a 1941-79 baseline, concluding that the probability of the defined heatwave event was 1.5 times higher for 1980-2018 and 7-8 times higher for 2019-2050. This hot summer had large health implications. In 2018, there were an estimated 14,200 heat-related deaths in Japan's over 65 population – over 3,000 more deaths than the previous record set in 2010, and 8,100 greater than the 2000-2004 average (Indicator 1.1.3).

734 1.3 Climate-Sensitive Infectious Diseases

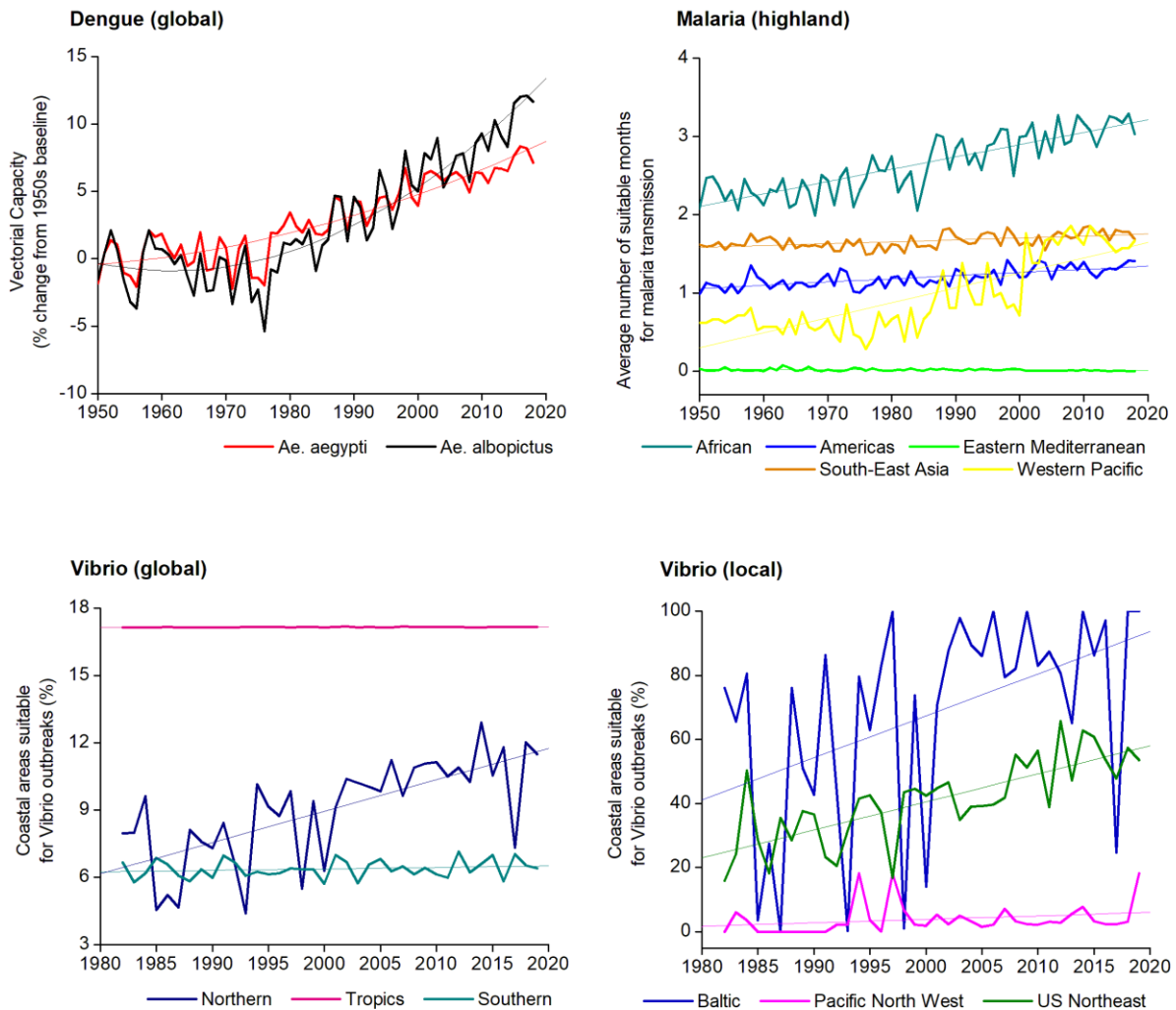
735 Indicator 1.3.1: Climate Suitability for Infectious Disease Transmission

736 *Headline finding: Changing climatic conditions are increasingly suitable for the transmission*
737 *of numerous infectious diseases. From 1950 to 2018, the global climate suitability for the*
738 *transmission of dengue fever increased by 8.9% for *A. aegypti*, and 15.0% for *A. albopictus*. In*
739 *the last 5 years, suitability for malaria transmission in highland areas was 38.7% higher in the*
740 *WHO African region and 149.7% higher in the WHO Western Pacific Region compared to a*
741 *1950s baseline.*

742 Climate change is affecting the distribution and risk of many infectious diseases to humans,
743 including vector-, food- and water-borne diseases.³ Using three different models, this
744 indicator tracks the change in climate suitability for the transmission of infectious diseases
745 of particular global significance: dengue; malaria; and pathogenic *Vibrio* bacteria (*V.*
746 *parahaemolyticus*, *V. vulnificus*, and non-toxigenic *V. cholerae*). In the case of *Aedes aegypti*
747 and *A. albopictus*, temperature-driven process-based mathematical models were used to
748 capture the vectorial capacity (VC) for the transmission of dengue.⁹⁷ Change in the climate
749 suitability for *Plasmodium falciparum* malaria is modelled based on empirically derived
750 thresholds of precipitation, temperature and relative humidity.^{97,98} Highland areas ($\geq 1500\text{m}$
751 above sea-level) are highlighted in the model, as increasing temperatures are eroding the
752 effect altitude once had as a barrier to malaria transmission, resulting in more favourable
753 conditions in densely populated highland areas, as seen in Ethiopia.⁹⁹ In the case of
754 pathogenic *Vibrio* species, which cause a range of human infections including
755 gastroenteritis, wound infections, septicemia, and cholera, recent changes in climate
756 suitability were compared with a 1980s baseline globally, as well as for one region each in
757 Europe (Baltic), the Northeast Atlantic coast of the USA and the Pacific North West coast of
758 North America.¹⁰⁰⁻¹⁰² Full descriptions of the context of these diseases, the methodology of
759 the models, and additional analysis can be found in the Appendix.

760 Climate suitability for disease transmission is rising globally, for all diseases being tracked.
761 2018 was particularly favourable for the transmission of dengue, with a global rise of 8.7%
762 and 14.5% above the 1950s baseline for *A. aegypti* and *A. albopictus*, respectively (Figure 5).
763 Although average suitability for dengue remains low in Europe, 2018 was the most suitable
764 year yet recorded for both vector species in this region (25.8% and 40.7% for *A. aegypti* and
765 *A. albopictus*, respectively). There have been significant increases in the environmental
766 suitability for the transmission of falciparum malaria in highland areas of four of the five
767 malaria-endemic regions, with an increase of 38.7% in the African Region and 149.7% in the
768 Western Pacific Region in 2015-2019 compared to a 1950s baseline (**Error! Reference**
769 **source not found.**). The coastal area suitable for *Vibrio* infections in the past five years has
770 increased at northern latitudes (40-70° N) by 50.6% compared to a 1980s baseline.
771 Regionally, the area of coastline suitable for *Vibrio* has increased by 61.2% and 98.9% for the

772 Baltic and USA Northeast respectively. In 2019, for the second consecutive year, the entirety
 773 of the Baltic coastline was suitable for disease transmission.



774

775

776 *Figure 5: Change in climate suitability for infectious diseases: dengue (A. aegypti); malaria (highland*
 777 *regions ≥1500m); and Vibrio species.*

778

779 **Indicator 1.3.2: Vulnerability to Mosquito-Borne Diseases**

780 *Headline finding: Following a sharp decline over the last decade, 2016 to 2018 saw small up-*
 781 *ticks in national vulnerability to dengue outbreaks in four out of six WHO regions, with*
 782 *further data required to establish a trend.*

783 As discussed above, climate change is expected to facilitate the expansion of *Aedes*
784 mosquito vectors that transmit dengue. Improvements in public health services may
785 counteract these threats in the short- to medium-term, however climate change will
786 continue to make such efforts increasingly difficult and costly.¹⁰³ This indicator tracks
787 vulnerability to mosquito-borne disease by combining the above indicator on climate
788 suitability for the transmission of dengue, with countries' health system core capacities as
789 outlined by the International Health Regulations (IHR), which have been shown to be an
790 effective predictor of protection against disease outbreak.¹⁰⁴ The methods used here remain
791 unchanged from previous reports, and are described in the Appendix in full.^{97,105}

792 From 2010, a substantial decline in vulnerability for the four most vulnerable WHO regions,
793 is seen around the world, reflecting significant improvements in their core health capacities.
794 However, from 2016 to 2018, this trend begins to halt, and then reverse, with further data
795 required to confirm any long-term shift.

796

797 1.4 Food Security and Undernutrition

798 Whilst the global food system still produces enough to feed a growing world population,
799 poor management and distribution has resulted in a lack of progress on the second
800 Sustainable Development Goal (SDG) on hunger, as the global number of under-nourished
801 people projected to rise to over 840 million in 2030.¹⁰⁶

802 Climate change threatens to exacerbate this further, with increasing temperatures, climatic
803 shocks and ground-level ozone impacting crop yields, and with sea surface temperature
804 (SST) and coral bleaching impacting marine food security.¹⁰⁷ These effects will be
805 experienced unequally, disproportionately affecting countries and populations already
806 facing poverty and malnutrition, and exacerbating existing inequalities. The following two
807 indicators monitor these changes, tracking the change in crop yield potential and SST.

808

809 Indicator 1.4.1: Terrestrial Food Security and Undernutrition

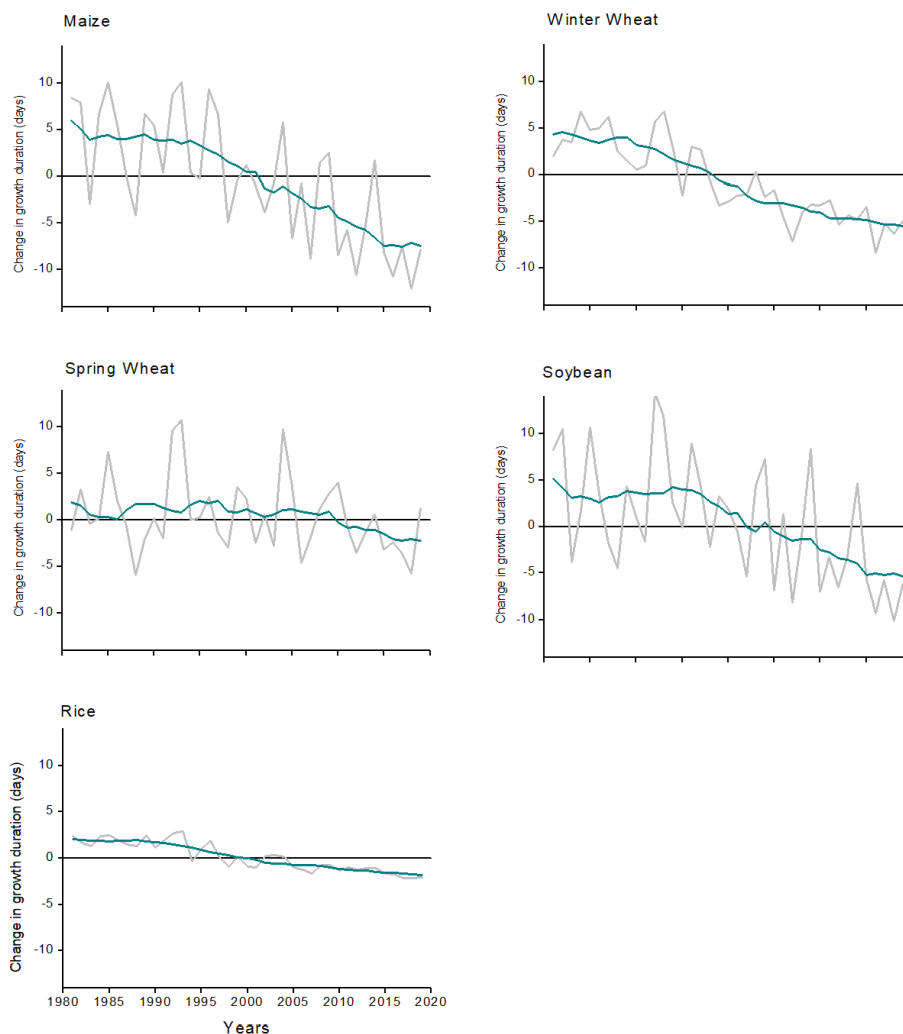
810 *Headline finding: Crop yield potential for maize, winter wheat, soybean, and rice has*
811 *followed a consistently downward trend from 1980 to 2019, with reductions of 5.6%, 2.1%,*
812 *4.8% and 1.8% seen respectively.*

813 Here, crop yield potential is characterised by “crop growth duration” (the time taken to
814 reach a target sum of accumulated temperatures), over its growing season. If this sum is
815 reached early then the crop matures too quickly and yields are lower than average, with a
816 reduction in crop growth duration therefore representing a reduction in yield potential.¹⁰⁸

817 This indicator tracks the change in the crop growth duration for four key staple crops:
818 maize, wheat, soybean, and rice at the individual country level and globally, using a similar
819 approach to previous reports, which has been improved to provide more accurate local
820 estimates, and now uses ERA5 data.³⁶

821 The yield potential of maize, winter wheat, soybean, and rice continue to decline globally
822 and for most individual countries, with this indicator demonstrating that it is increasingly
823 difficult to continue to increase or even maintain global production due to the changing
824 climate. In 2019, the reduction in crop growth duration relative to baseline, was 7.9 days
825 (5.6%), 4.9 days (2.1%), 6.1 days (4.8%), and 2 days (1.8%) for maize, winter wheat, soybean,
826 and rice respectively (Figure 6). For maize, most countries in the world experienced a
827 decline, with large areas of South Africa, the USA, and Europe experiencing reductions in
828 their crop growing seasons of over 20 days – a reduction of over 14% of the global average
829 crop duration. This compounds the current negative impacts of weather and climate shocks,
830 made more frequent and more extreme by climate change, that are hampering localised
831 efforts to reduce undernutrition.

832



833
 834 *Figure 6: Change in crop growth duration for maize, soybean, spring wheat, winter wheat, and rice,*
 835 *relative to the 1981-2010 global average.*

836

837 [Indicator 1.4.2: Marine Food Security and Undernutrition](#)

838 *Headline finding: Average sea surface temperature rose in 46 of 64 investigated territorial*
 839 *waters between 2003-2007 and 2015-2019, presenting a risk to marine food security.*

840 A large proportion of the global population, especially in low- and middle-income countries
 841 is highly dependent on fish sources of protein.¹⁰⁹ Additionally, omega-3 is important in the
 842 prevention of ischaemic heart disease and diets low in seafood omega-3 fatty acids, a risk
 843 factor to which over 1.4 million deaths globally were attributed in 2017.¹¹⁰ Sea surface
 844 temperatures, rising as a consequence of climate change, impair marine fish capacity and
 845 capture through a number of mechanisms, including the bleaching of coral reefs and

846 reduced oxygen content, putting populations at risk.¹¹¹ This indicator tracks SST in territorial
847 waters of 64 countries located in 16 Food and Agriculture Organization (FAO) fishing
848 areas.¹¹²⁻¹¹⁴

849 Comparing 2003-07 and 2015-19 time periods, average SST rose in 46 of the 64 investigated
850 areas, with a maximum increase of 0.87°C observed in the territorial waters of Ecuador.
851 Farm-based fish consumption has increased consistently over the last four decades, with a
852 corresponding decline in capture-based fish consumption, exacerbated in part by these
853 evolving temperature trends.¹¹¹ Between 1990 and 2017, diets low in seafood ω3 increased
854 by 4.7% at global level with more than 70% of the countries experiencing an increase in
855 exposure to this risk factor, increasing the mortality risk from ischemic heart disease.

856

857

858 Indicator 1.5: Migration, Displacement and Sea Level Rise

859

860 *Headline finding: Without intervention, between 145 million and 565 million people living in*
861 *coastal areas today will be exposed to and affected by future sea level rise.*

862

863 Through its impacts on extreme weather events, land degradation, food and water security,
864 and sea level rise (SLR), climate change is influencing human migration, displacement, and
865 relocation with human health consequences.^{115,116} Left unabated, average estimates for
866 global mean sea level rise (GMSLR) range from 1-2.5 metres (m) by the end of the century,
867 with projections rising as high as 5m when taking into account regional and local coastal
868 variation.^{117,118} This indicator, newly introduced for the 2020 report, tracks current
869 population exposure to future SLR and provides a measure of the extent to which health or
870 well-being are considered in national policies which connect climate change and human
871 mobility.

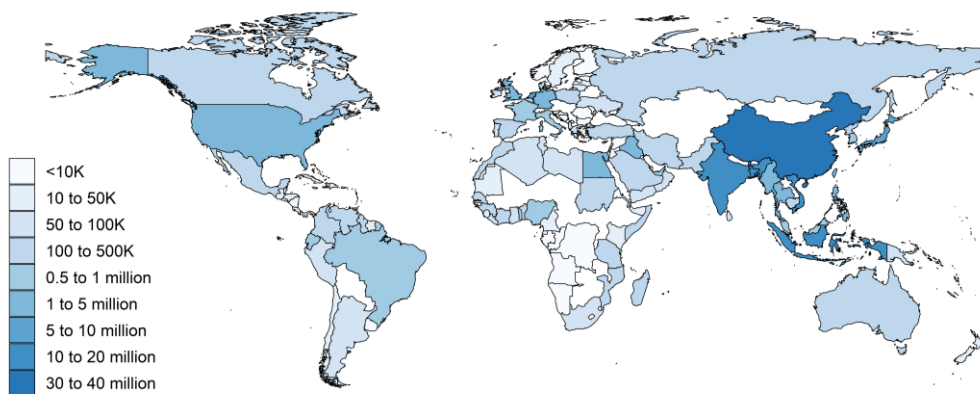
872

873 Population exposure to GMSLR of 1m and 5m was determined using a Coastal Digital
874 Elevation Model (CoastalDEM) and current population distribution data, with a full
875 description of this new indicator outlined in the Appendix.^{119,120} Based on today's
876 population distributions, 1m of GMSLR could expose 145.5 million of the world's current
877 population to potential inundation, rising to 565 million people with 5m of SLR (Figure 7). A
878 range of SLR-related health impacts are likely to be experienced, with changes in water and
879 soil quality and supply, livelihood security, disease vector ecology, flooding, and saltwater
880 intrusion.^{121,122} The health consequences of these effects will depend on a variety of factors,
881 including both *in situ* and migration adaptation options.¹²³⁻¹²⁵ These effects could be
882 moderated if countries begin to prepare. A review in 2019 identified 43 national policies,
883 across 37 countries, connecting climate change and migration, and 40 of these policies
884 across 35 countries explicitly referencing health or wellbeing. The policies commonly accept

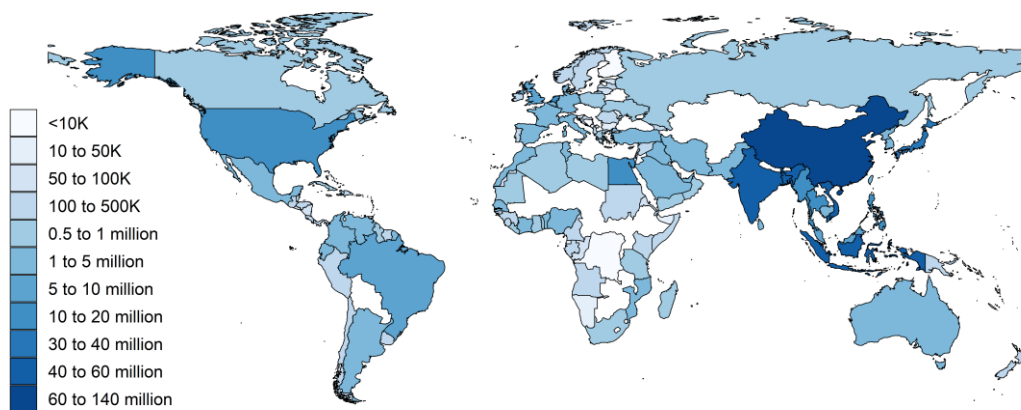
885 that mobility could be domestic and international, although mention of immobility was
886 lacking.

887

Exposure to 1m Global Mean Sea Level Rise



Exposure to 5m Global Mean Sea Level Rise



888 *Figure 7: Number of people exposed to 1m and 5m of global mean sea level rise by country.*

889 Conclusion

890 The indicators that comprise Section 1 of the 2020 report describe a warming world that is
891 affecting human health both directly and indirectly, and putting already vulnerable
892 populations at higher risk. Metrics of exposure and vulnerability to extreme weather are
893 complemented by trends of worsening global yield potential and climatic suitability for the
894 transmission of infectious disease. Subsequent reports will continue to develop the
895 methods and data underlying these indicators, with a particular focus on the creation of a
896 new indicator on mental health, and the exploration of the gender dimensions of existing
897 indicators.

898 Correlating climate change and mental health is challenging for a number of reasons,
899 including local and global stigma and underreporting, differences in health systems, and
900 variation in cultural understandings of wellbeing. In part because of this, the literature has
901 focused on extremes of heat, with investigations reporting correlations between higher
902 temperatures and heatwaves, and the risk of violence or suicide. Proposed reasons for this
903 association vary from the effects of disrupted sleep through to short-term agitation.^{126,127}
904 Stronger evidence exists outlining the links between extreme weather events and mental ill-
905 health, with emerging research describing the impact of a loss of access to the environment
906 and ecosystem services.¹²⁸

907 Taken as a whole, the data described in Section 1 provides a compelling justification for an
908 accelerated response. There are clear limits to adaptation, necessitating increasingly urgent
909 interventions to reduce GHG emissions. How communities, governments, and health
910 systems will be able to moderate the impacts of a changing climate is discussed in Section 2
911 and Section 3.

912

913

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

915 With a growing understanding of the human costs of a warming climate, the need for
916 adaptation measures to protect health is now more important than ever. The current
917 COVID-19 pandemic makes clear the challenges experienced by health systems around the
918 world, when faced with large unexpected shifts in demand, without sufficient adaptation or
919 integration of health services across other sectors.¹²⁹ As this public health crisis continues,
920 and is compounded by climate-attributable risks, rapid and proactive interventions are
921 crucial in order to prepare for and build resilience to both the health threats of climate
922 change and of pandemics.¹³⁰

923 Heavily determined by regional hazards and underlying population health needs, the
924 implementation of adaptation and resiliency measures require localised planning and
925 intervention. National adaptation priorities must take into account subnational capacities,
926 as well as the distribution of vulnerable populations and inequality, locally. As health
927 adaptation interventions are being increasingly introduced, evidence of their success often
928 remains mixed.¹³¹ Measuring the impact of these long-term interventions at the global scale
929 presents particular challenges, and the indicators in this section aim to monitor adaptation
930 progress through the lens of the WHO Operational Framework for Building Climate Resilient
931 Health Systems.²⁴ The adaptation indicators expand beyond the health system to focus on
932 the following domains: planning and assessment (Indicators 2.1.1-2.1.3), information
933 systems (Indicator 2.2), delivery and implementation (Indicators 2.3.1-2.3.3), and spend
934 (Indicator 2.4). As is often the case in adaptation, several of these indicators rely on self-
935 reported data on adaptation plans, assessments, and services, which also presents
936 challenges. Where possible, efforts have been made to validate this data.

937 Numerous indicators in this section have been further developed for the 2020 report and
938 one new indicator is presented. The data on national health adaptation planning and
939 assessments (Indicators 2.1.1 and 2.1.2) has been presented in greater detail, whilst
940 calculations of the effectiveness of air conditioning as an intervention (Indicator 2.3.2) have
941 been improved using more recent evidence. The definition of health-related adaptation
942 spending (Indicator 2.4) has been expanded to capture activities that are closely health-
943 related, in a variety of non-health sectors. Importantly, a new indicator, focusing on the use
944 of urban green spaces as an adaptive measure with numerous health benefits, has been
945 introduced in this year's report (Indicator 2.3.3).

946
947

948 2.1 Adaptation Planning and Assessment

949 Adaptation planning and risk management is essential across all levels of government, with
950 national strategy and coordination linked to sub-national and local implementation and
951 delivery.¹³² In every case, risk assessments are an important first step of this process.

952 The following three indicators track national- and city-level adaptation plans and
953 assessments, using data from the WHO Health and Climate Change Survey and the CDP
954 Annual Cities Survey.^{133,134} Information on the data and methods for each are presented in
955 the Appendix. Data from the WHO survey has not been updated for this year, and hence
956 further qualitative analysis has been conducted to investigate the barriers to adaptation.

957

958 Indicator 2.1.1: National Adaptation Plans for Health

959 *Headline finding: 51 out of 101 of countries surveyed have developed national health and*
960 *climate change strategies or plans. However, funding remains a key barrier to*
961 *implementation, with less than 10% of countries reporting to have the funds to fully*
962 *implement their plans.*

963 National governments identified financing as one of the main barriers to the
964 implementation of national health and climate change plans.^{30,134} Of the countries with
965 these plans, only four report having adequate national funding available to fully implement
966 them. This highlights the importance of access to international climate finance for
967 governments from low-resource settings. Despite this, less than half of national health
968 authorities from low and lower-middle income countries (17 out of 35 LLMICs) report having
969 current access to climate funds from mechanisms such as the Global Environment Facility,
970 the Adaptation Fund, the Green Climate Fund (GCF) or other donors. The GCF, which so far
971 has not funded a single health sector project for the 10th year running, is now looking to
972 align its programming to incorporate health and wellbeing co-benefits in light of, and in
973 response to COVID-19. While not yet accredited to submit and implement projects, WHO
974 became a GCF Readiness Partner in 2020, giving WHO the ability to support countries in
975 their efforts to develop health components of National Adaptation Plans and to strengthen
976 health considerations related to climate change.

977 A second key barrier to the implementation of national health and climate strategies is a
978 lack of multisectoral collaboration within government. Progress on cooperation across
979 sectors remains uneven, with 45 out of 101 countries reporting the existence of a
980 memorandum of understanding between the health sector and the water and sanitation
981 sector, on climate change policy. However, less than a third of countries have a similar
982 agreement with the agricultural, or social service sectors. Furthermore, only about a quarter
983 of countries reported agreements in places between health and the transport, household

984 energy or electricity generation sectors. This represents a significant missed opportunity to
985 recognise the health implications of national climate policies and to promote activities that
986 maximise health benefits, avoid negative health effects and evaluate the associated health
987 savings that may result.

988

989 [Indicator 2.1.2: National Assessments of Climate Change Impacts, Vulnerabilities, and](#)
990 [Adaptation for Health](#)

991 *Headline finding: Just under half of 101 countries surveyed have conducted a national*
992 *vulnerability and adaptation assessment for health, with further investment required to*
993 *adequately fund these vital components of health system resilience.*

994 Strengthening all aspects of a health system allows it to protect and promote the health of a
995 population in the face of known and unexpected stressors and pressures. In the case of
996 climate change, this requires a comprehensive assessment of current and projected risks,
997 and population vulnerability. This indicator focuses on national-level vulnerability
998 assessments and the barriers faced by national health systems.¹³⁴

999 Similar to the lack of funding highlighted above, it is clear that vulnerability assessments for
1000 health are also under-resourced. Indeed, conducting vulnerability assessments were among
1001 the top three adaptation priorities identified as being underfunded by national health
1002 authorities, alongside the strengthening of surveillance and early warning systems, and
1003 broader research on health and climate change. This was thought to be particularly true for
1004 sub-national assessments and for those designed to be particularly sensitive to the needs of
1005 vulnerable population groups.

1006

1007 [Indicator 2.1.3: City Level Climate Change Risk Assessments](#)

1008 *Headline finding: Of the 789 global cities surveyed, 76% have either already completed or*
1009 *are currently undertaking climate-change risk assessments, with 67% expecting climate*
1010 *change to seriously compromise their public health assets and services, a substantial*
1011 *increase from 2018.*

1012 Cities are home to more than half of the world's population, produce 80% of global gross
1013 domestic product (GDP), consume two thirds of the world's energy, and represent a crucial
1014 component of the local adaptation response to climate change.¹³⁵ As such, this indicator
1015 captures cities that have undertaken a climate change risk or vulnerability assessment, as
1016 well as their expectations on the vulnerability of their public health assets. First presented in

1017 the 2017 report of the Lancet Countdown and since improved to include further public
1018 health-specific questions, data for this indicator is sourced from the CDP's 2019 survey of
1019 789 global cities: a 33% increase in survey respondents from 2018.^{133,136}

1020 In 2019, 62% of cities had completed a climate-change risk or vulnerability assessment, and
1021 a further 28% of city assessments were either in the process of doing so, or will have
1022 completed one within the next two years. While some selection bias likely exists, it is
1023 important to note that a growing number of risk assessments are being completed by cities
1024 in low-income countries (63% of cities in LICs in 2019), highlighting the beginning of
1025 adaptation where it is arguably most needed. The survey also reveals a core driving factor in
1026 these assessments - some 67% of cities report that their vital public health infrastructure
1027 would be seriously compromised by climate change.

1028

1029 [Indicator 2.2: Climate Information Services for Health](#)

1030 *Headline finding: The number of countries with meteorological services providing climate*
1031 *information to the health sector has continued to grow, increasing from 70 to 86 countries*
1032 *over the past 12 months.*

1033 The use of meteorological services in the health sector is an essential component of
1034 adaptation. This indicator tracks the collaboration between these two parts of government,
1035 using data reported by national meteorological and hydrological services to the World
1036 Meteorological Organization (WMO).¹³⁷ Further detail is provided in the Appendix.

1037 A total of 86 national meteorological and hydrological services of WMO member states
1038 reported providing climate services to the health sector, an increase of 16 from the 2019
1039 report of the Lancet Countdown.³⁰ By WHO region, 19 of the countries reporting were from
1040 Africa, 16 from the Americas, seven from the Eastern Mediterranean Region, 23 from
1041 Europe, eight from South East Asia, and 13 from the Western Pacific Region. Of the 86
1042 positive respondents, 66 reported being 'highly engaged' with their corresponding health
1043 service, alongside other sectors such as agriculture, water, and electricity generation. As
1044 detailed in Indicator 2.1.1, multi-sector collaborations present governments with the
1045 opportunity to support a fully integrated adaptation approach to the risks of climate
1046 change.

1047

1048

1049 2.3 Adaptation Delivery and Implementation

1050 Indicator 2.3.1: Detection, Preparedness and Response to Health Emergencies

1051 *Headline finding: In preparation for a multi-hazard public health emergency, 109 countries*
1052 *have reported medium to high implementation of a national health emergency framework.*

1053 The International Health Regulations (IHR) are an instrument of international law designed
1054 to aid the global community in preventing and responding to potential public health
1055 emergencies.¹⁰⁵ This indicator focuses on core capacity eight (C8), which evaluates the
1056 degree to which countries have implemented a national health emergency framework by
1057 assessing levels of planning, management and resource allocation.¹⁰⁵ The national health
1058 emergency framework applies to all public health events and emergencies, air pollution,
1059 extreme temperatures, droughts, floods, and storms. The IHR core capacities are also
1060 important components of the response to infectious disease threats, with similar capacities
1061 and functions considered when assessing preparedness to a pandemic such as COVID-19.¹³⁸
1062 The results of this survey are provided in full, in the Appendix.

1063 In 2019, 166 out of 194 WHO member states completed the assessment portion related to
1064 C8, 16 fewer than in 2018. Of these, 109 countries have reported having medium to high
1065 degrees of implementation of multi-hazard preparedness and capacity, a 10% increase
1066 compared to 2018 data. The level of implementation varies by region, with medium-to-high
1067 levels reported in over 85% of countries in the Americas, Western Pacific, and Europe, 60%
1068 of Eastern Mediterranean and South East Asian countries, but only 26% of African countries.
1069 Despite disparities here, capacities have increased across all regions, and the global average
1070 increased from 59% in 2018 to 62% in 2019.

1071

1072 Indicator 2.3.2: Air Conditioning Benefits and Harms

1073 *Headline finding: Between 2016 and 2018, the world's air conditioning stock continued to*
1074 *rise, further contributing to climate change, air pollution, peak electricity demand and urban*
1075 *heat islands, whilst also conferring protection against heat-related illness.*

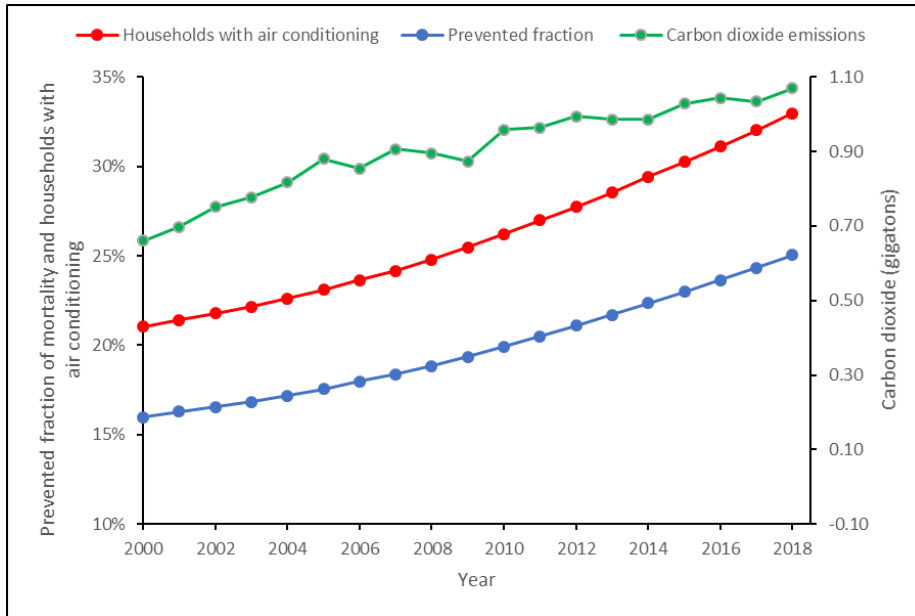
1076 Air conditioning represents one of a number of effective indoor cooling mechanisms for
1077 preventing heat-related illness and mortality.¹³⁹ However, in 2018, air conditioning
1078 accounted for an enormous 8.5% of total global electricity consumption, contributing to, if
1079 sourced from fossil fuels, CO₂ emissions, fine particulate matter (PM_{2.5}) emissions, and
1080 ground-level ozone formation, with the potential to leak hydrofluorocarbons which act as
1081 powerful GHGs. On hot days, air conditioning can be responsible for more than half of peak
1082 electricity demand locally, and emits waste heat that contributes to the urban heat island

1083 effect.^{140,141} Further research is needed to determine if the overall harms of air conditioning
1084 outweigh its benefits. However, increased air conditioning use in response to the warming
1085 climate could result in around 1,000 additional air-pollution-related deaths every summer in
1086 the eastern USA by 2050.¹⁴²

1087 International programs and organisations, including Sustainable Energy for All, the Kigali
1088 Cooling Efficiency Program, and the International Energy Agency (IEA), are working to
1089 develop solutions to provide efficient indoor cooling that protects vulnerable populations
1090 against heat-related illness whilst minimising the health-associated harms. Such measures
1091 include building designs with improved insulation, energy efficiency measures, and
1092 improved ventilation, as well as increasing urban green space, detailed in Indicator 2.3.3.
1093 Recent evidence suggests that simple electric fans could also be an effective stay-at-home
1094 measure against most heatwaves during the COVID-19 pandemic.¹⁴³

1095 This indicator draws on data provided by the IEA, and includes an improved calculation of
1096 the prevented fraction of deaths from air conditioning, making use of an updated meta-
1097 analysis which builds on the previously available 2007 assessment, with full detail described
1098 in the Appendix.^{139,144}

1099 Between 2016 and 2018, the world's air conditioning stock (residential and commercial)
1100 increased from 1.74 to 1.90 billion units and the proportion of households with air
1101 conditioning increased from 31.1% to 33.0%: a 56.7% rise since 2000 (Figure 8).
1102 Correspondingly, the global prevented fraction of heatwave related mortality increased
1103 from 23.6% in 2016 to 25.0% in 2018, but global emissions from air conditioning electricity
1104 consumption increased from 1.04 to 1.07 GtCO₂ (2% of total global emissions), highlighting
1105 the need for sustainable cooling methods in the face of a warming climate.



1106

1107 *Figure 8: Global proportion of households with air conditioning (red line), prevented fraction of*
 1108 *heatwave-related mortality due to air conditioning (blue line), and carbon dioxide emissions from air*
 1109 *conditioning (green line), 2000-2018.*

1110

1111 [Indicator 2.3.3: Urban Green Space](#)

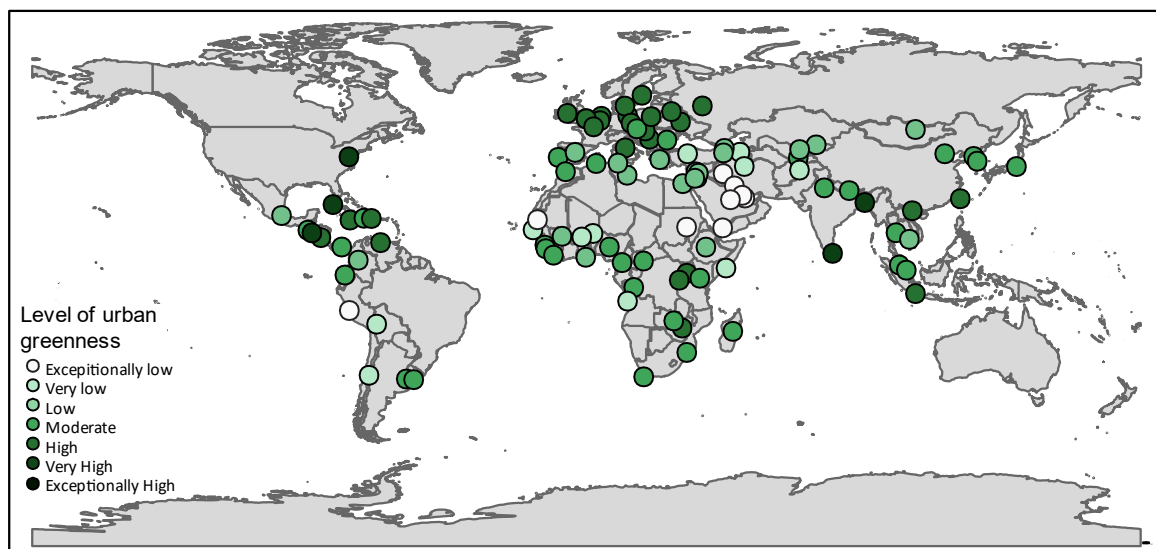
1112 *Headline finding: Urban green space is an important measure to reduce population heat*
 1113 *exposure, with 8.5% of global urban centres having a very high or exceptionally high degree*
 1114 *of greenness in 2019, and over 156 million people living in urban centres with concerningly*
 1115 *low levels.*

1116 Access to urban green space provides benefits to human health by reducing exposure to air
 1117 and noise pollution, relieving stress, providing a setting for social interaction and physical
 1118 activity, and reducing all-cause mortality.^{145,146} In addition, green space sequesters carbon
 1119 and provides local cooling benefits which disrupt urban heat islands, providing both climate
 1120 change mitigation and heat adaptation benefits. As access can often disproportionately
 1121 benefit the most privileged in society, it is important that careful consideration is given to
 1122 how green spaces are designed and distributed, ensuring safety and equitable access.^{147,148}

1123 This indicator, new in the 2020 report, quantifies urban green space exposure for 2019 in
 1124 the 467 urban centres of over one million inhabitants, as defined by the Global Human
 1125 Settlement (GHS).^{149,150} It is based on remote sensing of green vegetation through the
 1126 satellite-based normalised difference vegetation index (NDVI), which measures the
 1127 reflectance signature of visible red and near-infrared parts of spectrum of green plants,
 1128 providing an indication of the level of green coverage of the earth surface. The maximum

1129 NDVI for all seasons was used to define the average level of greenness of each urban area. A
1130 full description of the methodology can be found in the Appendix.

1131 In 2019, only 8.5 % of global urban centres had very high to exceptionally high levels of
1132 greenness, with five capital cities – Colombo, Washington DC, Dhaka, San Salvador, and
1133 Havana – highlighted (Figure 9). Concerningly, 9.9% of urban centers, home to over 156
1134 million people and including 21 capital cities, lie at the opposite end of the spectrum, with
1135 very low levels of urban green space.⁴⁰



1136
1137 *Figure 9: Urban greenness in capital cities >1 million inhabitants in 2019.*

1138
1139 **Indicator 2.4: Spending on Adaptation for Health and Health-Related Activities**

1140 *Headline finding: At US\$18.43 billion in 2019, global spending on health adaptation rose to*
1141 *5.3% of total adaptation spending, while health-related spending remained flat at*
1142 *approximately 28.4% from 2015 to 2019.*

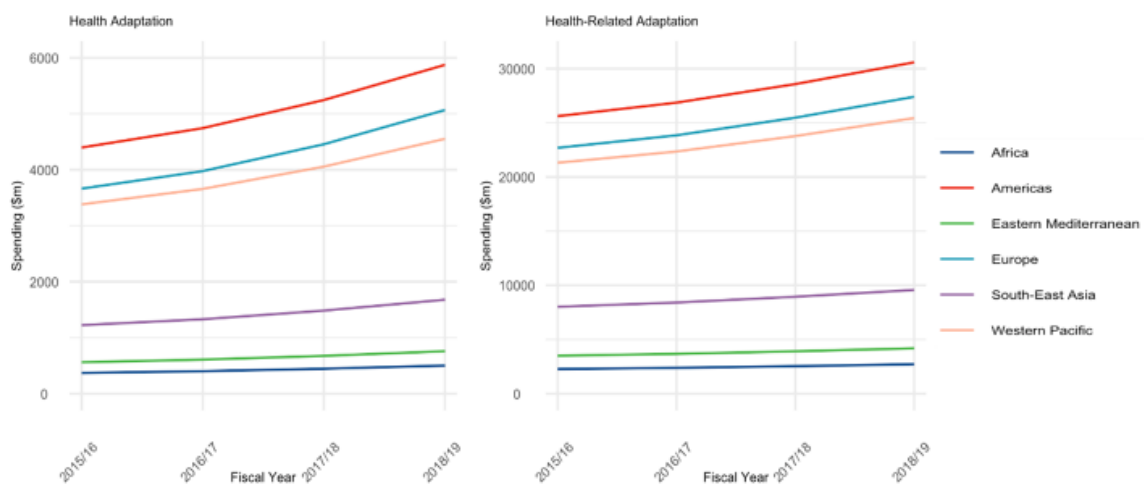
1143 As noted in the evaluation of national adaptation plans (Indicator 2.1.1), inadequate
1144 financial resource poses the largest barrier to the implementation of adaptation measures.
1145 This indicator tracks health and health-related adaptation spending within the Adaptation
1146 and Resilience to Climate Change dataset from the data research firm, kMatrix, which
1147 includes spend data from 191 countries.¹⁵¹ Health-specific spend is that which occurs within
1148 the formal healthcare sector. For the 2020 report, an enhanced definition of health-related
1149 spending was developed through an expert review workshop to more accurately categorise
1150 spend. It captures adaptation spending within other sectors (agriculture & forestry, the built
1151 environment, disaster preparedness, energy, transportation, waste, or water) that have a
1152 direct impact on one or more of the basic determinants of health (food, water, air, or

1153 shelter), with a demonstrated link to health outcomes in the literature. A full description of
1154 the methodology can be found in the Appendix.

1155 Climate change adaptation spending within the healthcare sector increased by 12.7% to
1156 US\$18.43 billion in 2018/19, compared to 2017/18 data (Figure 10). As a share of all
1157 adaptation spending globally, health adaptation spending is now at 5.3% in 2018/19, above
1158 5% for the first time. The wider measure of health-related adaptation spending increased by
1159 7.2% to US\$99.9 billion in 2018/19, although as a share of global adaptation spending, it has
1160 remained more or less constant: 28.4% in 2015/16 and 28.5% in 2018/19.

1161 Grouped by WHO region, spending for health adaptation varies from US\$0.48 per capita in
1162 Africa to US\$5.92 in the Americas, remaining below US\$1 per capita in South East Asia.
1163 Again, taking the broader health-related adaptation spend, a wider variation, ranging from
1164 US\$2.63 (Africa) to US\$30.82 (Americas), is evident.

1165



1166
1167 *Figure 10: Adaptation and Resilience to Climate Change (A&RCC) spending for financial years*
1168 *2015/16 to 2018/19 by WHO Region. A) Health A&RCC spending (\$m), B) Health-related A&RCC*
1169 *adaptation spending (\$m).*

1170

1171

1172 Conclusion

1173 The indicators presented in this section continue to move in a positive direction, with
1174 growing recognition of the impacts of climate change within the health community.
1175 However, there is much more work to do, with a need to move from planning to
1176 implementation, and to better engage with other sectors of society in adaptation
1177 interventions (Indicators 2.1.2, 2.1.2, and 2.2). The IHR core capacity scores show a need for
1178 support across many African and Eastern Mediterranean countries (Indicator 2.3.1),
1179 requiring additional engagement and resource.

1180 Global spending trends have shown promise over recent years for health and health-related
1181 adaptation (Indicator 2.4), however governments remain unable to fully implement their
1182 national health adaptation plans (Indicator 2.1.1). The findings here reiterate the need to
1183 strengthen underlying health systems and create multi-sectoral alignment to protect human
1184 health, particularly for the most vulnerable populations. COVID-19 has dramatically altered
1185 the pattern of healthcare demand, with health systems restructuring services overnight.¹⁵²
1186 While the full impact of these changes are unclear, the rapid introduction of new online and
1187 telemedicine services brings many synergies with efforts to reduce the emissions of the
1188 healthcare sector, and with those to increase service delivery resilience. As governments
1189 continue to respond to the public health and economic effects of COVID-19, it will be
1190 important to align these priorities and ensure that enhanced preparedness for future
1191 pandemics also confers increased capacity to respond to climate change.
1192

1193 Section 3: Mitigation Actions and Health Co-Benefits

1194 In 2018, GHG emissions rose to an unprecedented 51.8 GtCO₂e (55.3 GtCO₂e including land
1195 use change), with fossil fuel emissions from transport, power generation, and industry
1196 accounting for 72%.¹⁵³ The vast majority of the growth in emissions, the economy, and the
1197 demand for energy occurred in low- and middle-income countries, despite global economic
1198 headwinds.¹⁵⁴

1199 COVID-19 has had a profound effect on the global economy and on emissions. Ongoing
1200 volatility makes the projections of any long-term effects challenging, although daily CO₂
1201 emissions were 17% lower in April 2020 compared with April 2019, with some countries
1202 experiencing emissions reductions of up to 26%.¹⁵⁵ Current estimates suggest that global
1203 emissions will fall by 8% in 2020 as a result of both the economic downturn, and restrictions
1204 to local and international travel.^{22,155} As efforts to revitalise the economy take effect,
1205 aligning such interventions with those necessary to mitigate climate change will allow
1206 governments to generate a synergistic response, improving public health in the short-term
1207 and in the long-term.

1208 If carefully planned and implemented, these interventions will yield major health benefits,
1209 underlining the importance of a “health in all policies” approach.^{156,157} Highlighting this
1210 practice, the following section tracks climate change mitigation efforts in the sectors most
1211 relevant to public health: power generation and air pollution (Indicators 3.1.1-3.1.3 and
1212 3.3); household energy and buildings (Indicator 3.2); transport (Indicator 3.4); diets and
1213 agriculture (Indicators 3.5.1 and 3.5.2); as well as mitigation within the healthcare sector
1214 (Indicator 3.6). New in the 2020 report are indicators of the national emissions from
1215 agricultural consumption (Indicator 3.5.1) as well as the associated premature mortality
1216 from unhealthy and emissions-intensive diets (Indicator 3.5.2). The methodologies of each
1217 of the existing indicators have also improved, particularly Indicator 3.6, which, based on
1218 feedback, has been revised to better estimate emissions from the healthcare sector.

1219 Importantly, this section must be interpreted with the understanding that enhanced
1220 ambition is urgently required, and that countries will need to increase the strength of their
1221 mitigation commitments within the Paris Agreement’s NDCs by a factor of three to achieve
1222 a 2°C target, and by a factor of five for 1.5°C.¹⁵³
1223

1224 3.1 Energy System and Health

1225 Indicator 3.1.1: Carbon Intensity of the Energy System

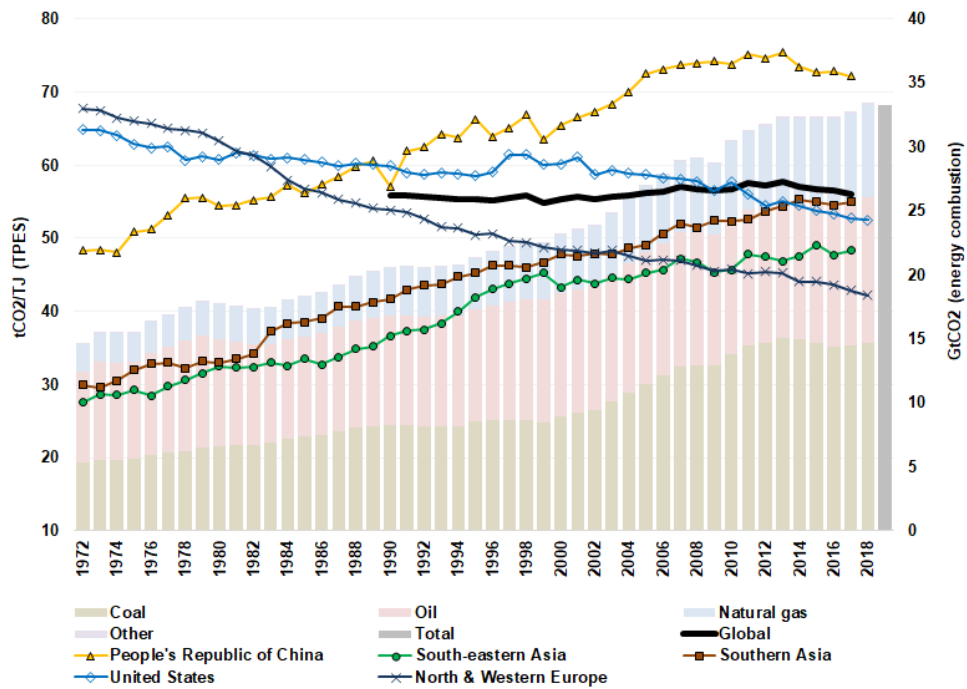
1226 *Headline finding: The carbon intensity of the global primary energy supply has remained flat*
1227 *for the last three decades. Whilst in 2017 it was at its lowest since 2006, it still remained*
1228 *0.4% higher than 1990 levels.*

1229 As fossil fuel combustion in the energy system continues to be the biggest source of GHG
1230 emissions, mitigation in this area is key to meeting the commitments of the Paris
1231 Agreement. This indicator tracks the carbon intensity of the global energy system, expressed
1232 as the CO₂ emitted per terajoule of total primary energy supply (TPES), with methods and
1233 data described in the Appendix.^{158,159}

1234 The carbon intensity of the global energy system has barely altered in almost 30 years: in
1235 2017 it was 0.4% higher than in 1990 (Figure 11). Regional values have changed
1236 substantially, however, with reductions in the carbon intensity of the USA and north and
1237 western Europe now 12% and 20% lower than 1990 levels. China's carbon intensity of TPES
1238 remains high at 72 tCO₂/TJ, however it is decreasing, and in 2017 was 4% lower than its
1239 peak in 2013. Early statistics for 2020 suggest that global demand for all fossil fuels has
1240 reduced in the first quarter due to COVID-19, and will continue to decline across the year,
1241 with resulting reductions in emissions.²² However, without targeted intervention, emissions
1242 could rebound, as they did following the 2008-2009 global financial crisis, where a 1.4%
1243 decrease in CO₂ emissions in 2009 was offset by a 5.9% rise in 2010.¹⁶⁰

1244

1245



1246

1247

Figure 11: Carbon intensity of Total Primary Energy Supply (TPES) for selected regions and countries, and global CO₂ emissions by fuel type, 1971-2019. Carbon intensity trends are shown by trend line (primary axis) and global emissions by stacked bars (secondary axis). This carbon intensity metric estimates the tonnes of CO₂ for each unit of total primary energy supplied (tCO₂/TJ). For reference, carbon intensity of fuels (tCO₂/TJ) are as follows: coal 95-100, oil 70-75, and natural gas 56.

1248

1249

1250

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1252

1253 **Indicator 3.1.2: Coal Phase-Out**

1254 **Headline finding:** Global energy supply from coal in 2018 increased by 1.2% from 2017 and
 1255 was 74% higher than in 1990.

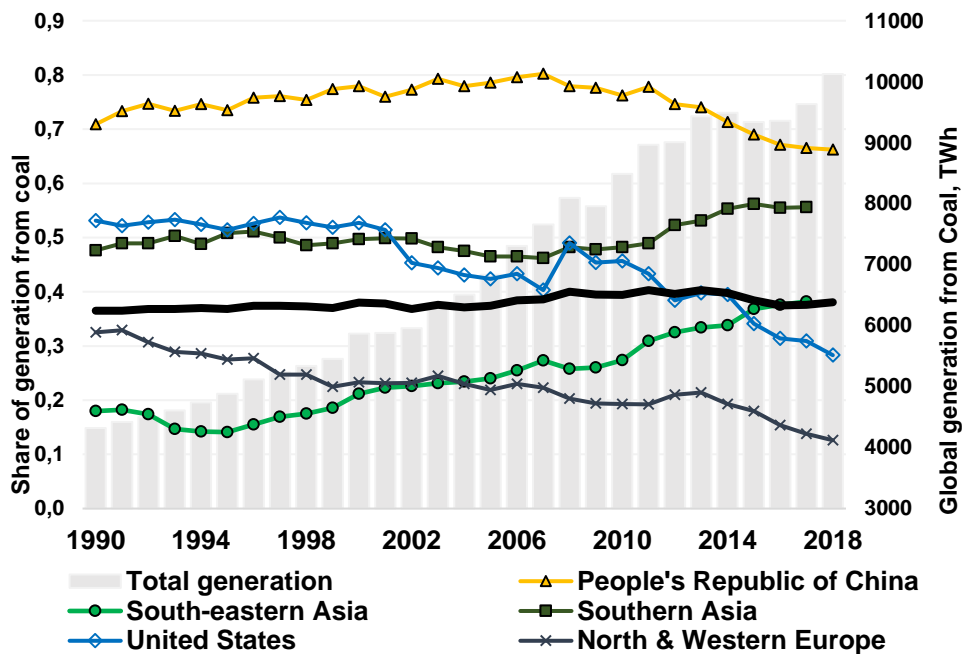
1256 Coal combustion continues to be the largest contributor to emissions from the energy
 1257 sector, and is a major contributor to premature mortality due to air pollution (Indicator 3.3).
 1258 The phase-out of coal-fired power is therefore an important first step in the mitigation of
 1259 climate change. This indicator reports on progress towards a global phase-out, tracking the
 1260 TPES from coal, as well as coal's share of total electricity generation, with methods provided
 1261 in full in the Appendix.¹⁶¹

1262 Global coal use for energy increased by 1.2% from 2017 to 2018, and while it remains below
 1263 its 2014 peak, it has increased by 74% overall since 1990. China, responsible for 52% of
 1264 global coal consumption, has driven the rise in recent years, counteracting a 2017-2018

1265 reduction in coal use from other major economies such as Germany (-6%), the USA (-4.2%),
 1266 Australia (-3.3%), and Japan (-1.2%). Importantly, Figure 12 makes clear that this is not the
 1267 full picture: China's share of coal in its power generation is falling rapidly, from 80% in 2007,
 1268 to 66% in 2018, as it moves to other sources to meet rising demand for electricity. Likewise,
 1269 northern and western Europe have seen falls in their share of coal power, from 21% in 2013
 1270 to 13% in 2018.

1271 As a result of the COVID-19 pandemic, as well as cheap oil and continued growth in
 1272 renewables, global demand for coal fell by almost 8% in the first quarter of 2020, where it is
 1273 expected to remain throughout the year.²² Additionally, Austria and Sweden closed their
 1274 last coal-fired power plants in April 2020, with other countries soon to follow.¹⁶²

1275



1276
 1277 *Figure 12: Share of electricity generation coal in selected countries and regions, and global coal*
 1278 *generation. Regional shares of coal generation are shown by the trend lines (primary axis) and total*
 1279 *coal generation by the bars (secondary axis). Global share of generation from coal is shown with the*
 1280 *thick black line. Data series are shown to at least 2017 and extended to 2018 where data allows.*

1281

1282

1283 [Indicator 3.1.3: Zero-Carbon Emission Electricity](#)

1284 *Headline finding: The average annual growth rate in power generation from wind and solar*
1285 *was 21% globally and 38% in China, from 2010 to 2017, with all forms of low-carbon energy*
1286 *responsible for 33% of total generation, globally.*

1287 Continued growth in renewable energy, particularly wind and solar, is key to displacing fossil
1288 fuels. This indicator tracks electricity generation (in TWh) and the share of total electricity
1289 generation from all low-carbon sources (nuclear and all renewables, including hydro) as well
1290 as renewables (wind and solar, excluding hydro and biomass). A full description of the
1291 methods and data can be found in the Appendix.¹⁶¹

1292 Low-carbon electricity generation continues to rise, growing by 10% from 2015 to 2017, to
1293 then account for 33% of total generation. China experienced a 21% increase over the same
1294 period, reaching 1800 TWh and 28% of all electricity produced.

1295 Focussing on wind and solar energy reveals a similar picture, with a global annual rate of
1296 21% between 2010 and 2017. China saw an even higher growth rate of approximately 38%
1297 per year, due to a rapid increase in solar, reaching 425 TWh in 2017. Despite this, its share
1298 of renewable energy generation remains relatively small at 6.5%; comparable to India's at
1299 5%. Contrary to the decline in demand for fossil fuels, the IEA expect renewable energy
1300 demand to increase in 2020, due to low operational costs compared to fossil fuel sources,
1301 but further policy support is necessary in order to continue this growth.^{22,163}

1302

1303 [Indicator 3.2: Clean Household Energy](#)

1304 *Headline finding: Primary reliance on healthy fuels and technology for household cooking*
1305 *continued to rise, reaching 63% in 2018. However total consumption of zero emission energy*
1306 *for all household needs remains low, at 26%.*

1307 The use of unhealthy and unsustainable fuels and technologies for cooking, heating and
1308 lighting in the home contributes both to GHG emissions and to dangerous concentrations of
1309 household air pollution.¹⁶⁴ Primary reliance on such fuels and technologies for cooking is
1310 particularly problematic, resulting in recurrent direct exposure to high concentrations of
1311 poor quality air, causing over 3.8 million premature deaths every year.¹⁶⁵ This
1312 disproportionately affects women and children, who in many cultural contexts spend more
1313 time in the home, may be in charge of food preparation, and face threats to their safety
1314 associated with the gathering of cooking fuels.¹⁶⁴

1315 This indicator draws on national surveys collected by the WHO across 194 countries, to track
1316 the proportion of the population using clean fuels and technologies for cooking, defined

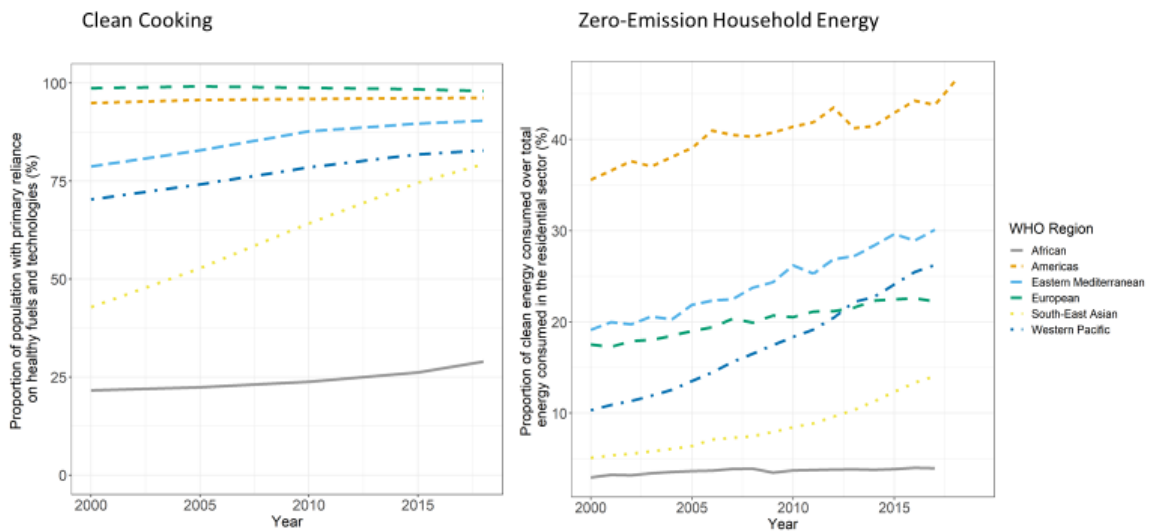
1317 those whose emission rate targets meeting WHO air quality guidelines. It also tracks zero-
1318 emission energy usage in the residential sector, measured as fuels with both zero GHG and
1319 zero particulate emissions at the point of use (mainly electricity and renewable heating)
1320 using data from the IEA.¹⁶¹

1321 In 2018, 63% of the global population relied primarily on clean fuels and technologies for
1322 cooking, an increase of 26% since 2000. In China, this proportion increased from 43% in
1323 2000 to 64% in 2018, while in Viet Nam it increased from 13% to 64% over the same period
1324 (Figure 19). However, little progress has been made in Sub-Saharan Africa, where only 15%
1325 of households rely on clean fuels and technology for cooking. Importantly, overall use of
1326 zero emission energy in the home (for all sources, including heating and lighting) remains
1327 low, at 26% globally, increasing by only 2% per year since 2010 (Figure 13).

1328 This section of the report is continuously evolving to understand the health co-benefits of
1329 mitigation efforts, and is now able to present findings from a new indicator under
1330 development, that tracks mortality from household air pollution. Taking data on fuel and
1331 stove types used for cooking as well as typical housing ventilation characteristics, this
1332 indicator calculates household fine particulate matter (PM_{2.5}) exposure, both from cooking
1333 and from air pollution infiltrating from outside. A full explanation of the methods is
1334 described in the Appendix. Here, the estimated effect of household factors on deaths
1335 attributable to PM_{2.5} pollution in 2018 are presented for selected countries (Figure 14). In
1336 the middle-income countries assessed, the use of solid fuels for cooking is combined with
1337 poor housing ventilation to increase mortality from PM_{2.5} exposure. For other mostly high-
1338 income countries, housing design and extract ventilation are preventing ambient air
1339 pollution from entering the home. Combined with the use healthy cooking fuels, this results
1340 in a net negative effect on total (both household and ambient) PM_{2.5} attributable mortality,
1341 demonstrating a clear co-benefit of mitigation.

1342

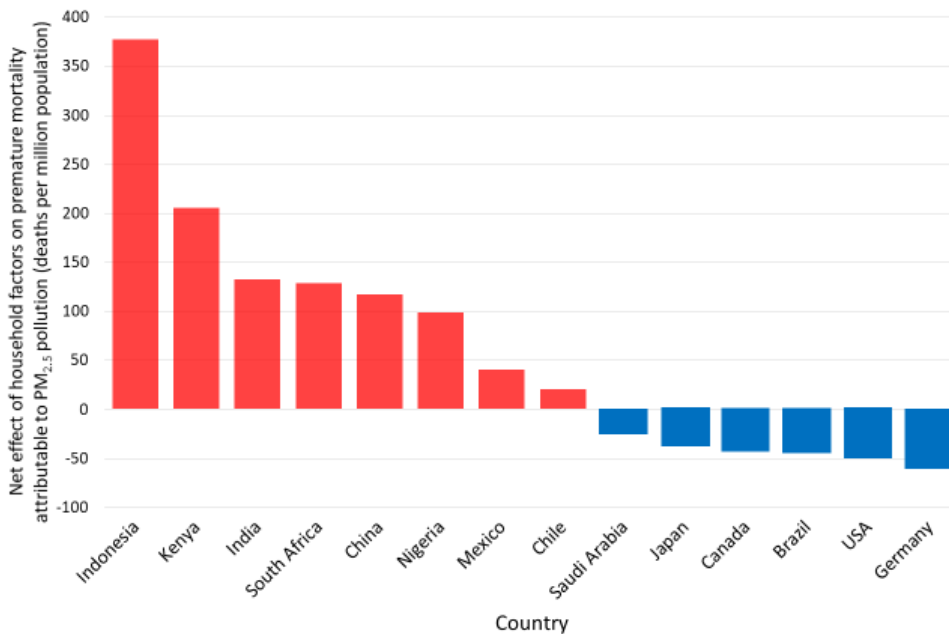
1343



1344

1345 *Figure 13: Household energy usage: proportion of population with primary reliance on healthy fuels*
 1346 *and technology for cooking by WHO region 2000-2018 (left); and proportion of clean energy*
 1347 *consumption in the global residential sector, 2000-2016 (right). Proportion is measured as fuels with*
 1348 *no emissions at point of use (not generation) over total residential sector consumption. Electricity*
 1349 *comprises 75% of total clean energy use in 2016.*

1350



1351 *Figure 14: Estimated net effect of housing design and indoor fuel burning on premature mortality due*
 1352 *to air pollution in 2018.*
 1353

1354 Indicator 3.3: Premature mortality from ambient air pollution by sector

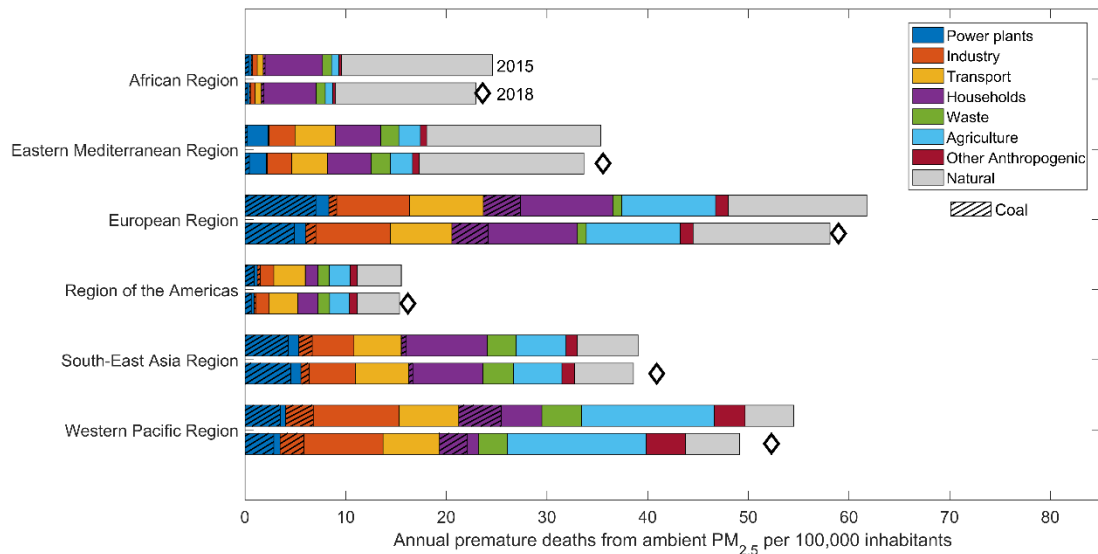
1355 *Headline finding: Premature deaths from ambient particulate pollution attributed to coal use*
1356 *are rapidly declining, from 440,000 in 2015 to 390,000 in 2018. However, total deaths from*
1357 *ambient particulate pollution have increased slightly over this time period, from 2.95 million*
1358 *to 3.01 million, highlighting the need for accelerated intervention.*

1359 Many of the leading contributors to global GHG emissions also contribute to ambient air
1360 pollution, disproportionately impacting on the health of low-socioeconomic communities.¹⁶⁶
1361 Indeed, some 91% of deaths from ambient air pollution come from LMICs.¹⁶⁷ This indicator
1362 tracks the source-attributable premature mortality from outdoor ambient air pollution. The
1363 methods remain unchanged and are described in the Appendix.^{168,169}

1364 Trends in air pollution mortality vary by world region, with decreases in Europe and China
1365 as a result of the implementation of emission control technologies and reductions in the use
1366 of raw coal in the power and residential sectors.¹⁷⁰ The overall number of deaths
1367 attributable to ambient PM_{2.5} in 2018 is estimated at 3.01 million, a slight increase from 2.95
1368 million deaths in 2015. Nonetheless, the total and per-capita deaths attributable to coal
1369 combustion have decreased from roughly 440,000 in 2015 to fewer than 390,000 in 2018
1370 (Figure 15). Decreases are also seen in the contribution from biomass burning to ambient
1371 PM_{2.5} deaths (about 410,000 deaths in 2015 decreasing to 360,000 in 2018), mostly due to
1372 increasing access to cleaner household fuels, although 2.6 billion people still rely on
1373 fuelwood combustion in the home.¹⁷¹

1374 If measures to respond to the economic fall-out from COVID-19 are aligned with the
1375 priorities of the Paris Agreement, transient reductions in air pollution following the sudden
1376 halt in economic activities and road transport, could become more permanent, resulting in
1377 further improvements in health and air quality in 2020 and into the future.

1378



1379
 1380 *Figure 15: Premature deaths attributable to exposure to ambient fine particulate matter (PM_{2.5}) in*
 1381 *2015 and 2018, by key sources of pollution in WHO-specified regions. Coloured bars: attributable*
 1382 *deaths with constant 2015 population structure, diamonds: totals for 2018 when considering*
 1383 *demographic changes.*

1384
 1385 **Indicator 3.4: Sustainable and Healthy Transport**

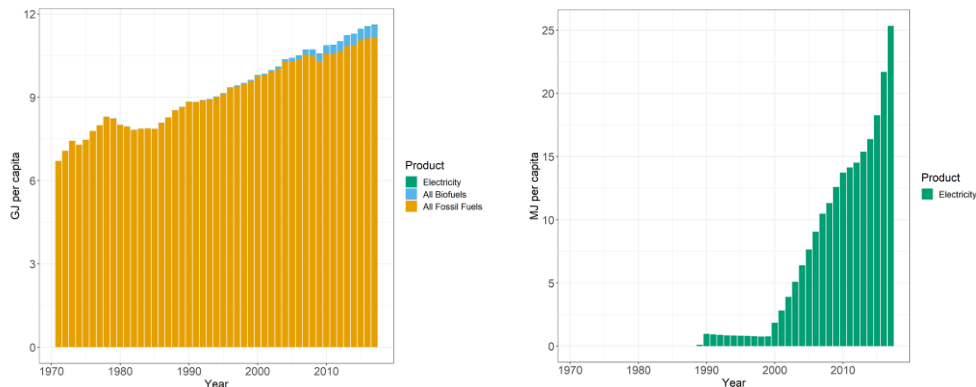
1386 *Headline finding: While fossil fuels continue to dominate the transport sector, the use of*
 1387 *electricity rose by 18.1% from 2016 to 2017, and the global electric vehicle fleet increased to*
 1388 *more than 5.1 million in 2018 (rising by 2 million in only 12 months).*

1389 The transition to ultra-low emissions vehicles is another essential component of climate
 1390 change mitigation. In addition, policies that reduce overall vehicle use and increase walking
 1391 and cycling will yield the greatest benefits in terms of reductions in GHG emissions and air
 1392 pollution, as well as the health benefits of increased physical activity.¹⁷² Well-designed
 1393 public transport and active travel infrastructure can also help reduce inequality and improve
 1394 mobility for those who otherwise have limited travel options.¹⁷³ For the 2020 report, global
 1395 trends in fuel use for road transport are monitored, with methods and data available in the
 1396 Appendix.¹⁷⁴

1397 Global per-capita road transport fuel use increased by 0.5% from 2016 to 2017, with the
 1398 rate of growth slowing slightly from previous years (Figure 16). Although fossil fuels
 1399 continue to contribute the vast majority of total fuel use, the use of clean fuels is growing at
 1400 a much faster pace. Total fossil fuel use for transport increased by 1.7% between 2016 and
 1401 2017, compared with 18.1% growth in electricity. From 2017 to 2018, the global electric
 1402 vehicle fleet grew by an enormous 64.5%, rising above 5.1 million in 2018. In line with this

1403 rapid growth, there are now more than 5.2 million charging stations available for passenger
1404 vehicles and another 157,000 fast-chargers available for buses worldwide.

1405



1406

1407 *Figure 16: Per capita fuel use for road transport: A) All fossil fuels, biofuels, electricity; B) Electricity*
1408 *only. NB. The varying scales in y-axes.*

1409

1410

1411 3.5 Food, Agriculture, and Health

1412 Indicator 3.5.1: Emissions from Agricultural Production and Consumption

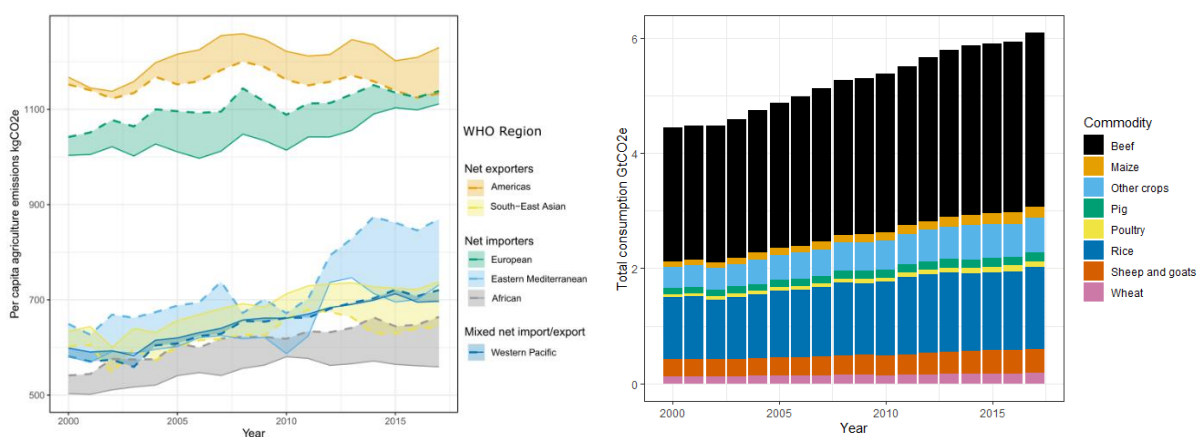
1413 *Headline finding: Ruminant livestock continue to dominate agriculture's contribution to*
1414 *climate change, responsible for 56% of its total emissions, and 93% of all livestock emissions*
1415 *globally. This represents a 5.5% increase in the per capita emissions from beef consumption*
1416 *since 2000, which is particularly concerning, given the sharp rise in population over this time*
1417 *period, and the health impacts of excess red meat consumption.*

1418 The food system is responsible for 20-30% of global GHG emissions, with the majority
1419 originating from meat and dairy livestock.¹⁷⁵ Improved for the 2020 report, agricultural
1420 emissions from countries' production and consumption (adjusting for international trade)
1421 are tracked using data from the FAO, with a full description of methods and data provided in
1422 the Appendix.¹⁷⁶⁻¹⁷⁸ While countries' emissions are typically measured on a production
1423 basis, it is their consumption that generates the demand, and results in diet-related health
1424 outcomes.

1425 Overall emissions from livestock production have increased by 16% since 2000 to over 3.2
1426 billion tonnes of CO₂e in 2017. Ruminants contribute 93% of total livestock emissions, with
1427 non-dairy cattle contributing 67% of this. Moving to consumption emissions, beef industry

1428 products dominate, both in absolute and per-capita terms (Figure 17). Average beef
 1429 consumption emissions were 402 kg CO₂e per person in 2017, compared to 380 kg CO₂e per
 1430 person in 2000.

1431 Ultimately, effective mitigation will maximise human health while reducing food and
 1432 agricultural emissions, however no one diet is applicable everywhere, and there are
 1433 important nuances and variations to be considered across regions and countries. Excessive
 1434 consumption of red meat brings significant health consequences, as outlined below, and
 1435 less emissions-intensive plant-based sources are important alternatives, particularly in
 1436 Europe and the Americas, where per capita emissions are high. In other parts of the world,
 1437 sustainable farming and agricultural practices are being implemented to meet the
 1438 nutritional requirements of rapidly growing populations while also keeping emissions low.¹⁷⁹



1439
 1440 *Figure 17: Agricultural production and consumption emissions 2000-2017 calculated using FAO trade*
 1441 *data: per capita production (solid line) and consumption (dotted line) emissions by WHO region (left);*
 1442 *Global agricultural consumption emissions by commodity (right).*

1443

1444 [Indicator 3.5.2: Diet and Health Co-Benefits](#)

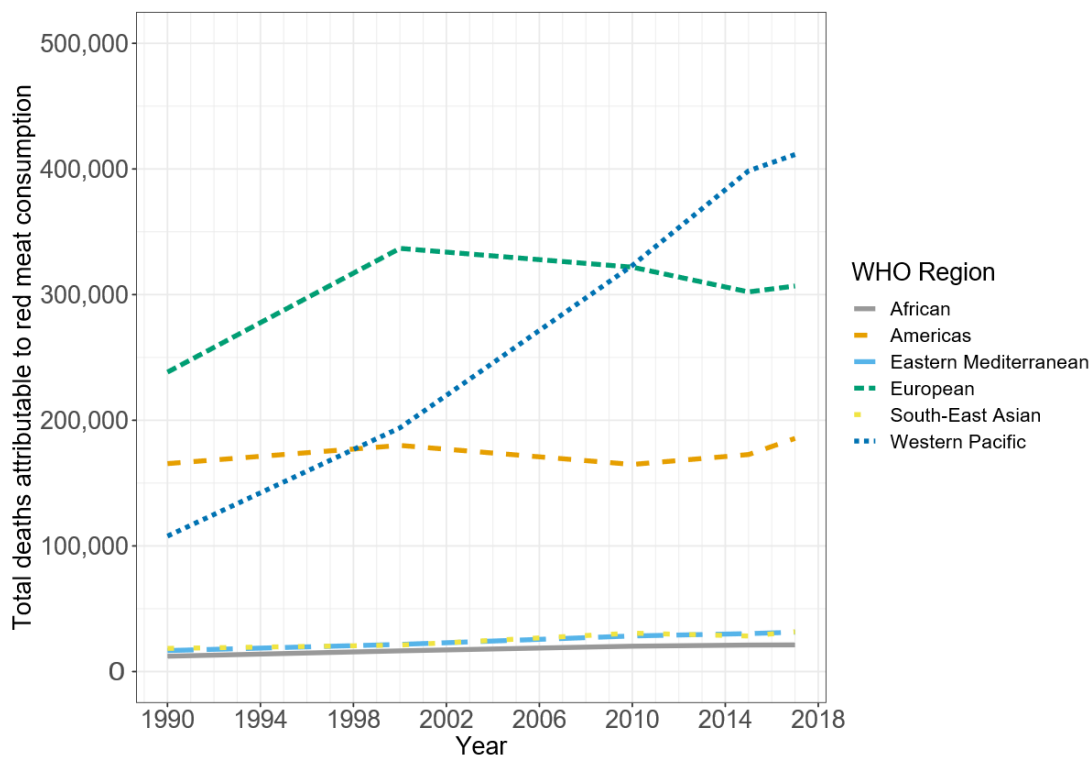
1445 *Headline finding: The global number of deaths due to excess red meat consumption has risen*
 1446 *to 990,000 in 2017, a 72% increase since 1990.*

1447 Unhealthy diet is one of the leading risk factors for premature death, both globally and in
 1448 most regions.¹¹⁰ Combined with a range of food-system-wide interventions, it is possible to
 1449 achieve dietary change consistent with the Paris Agreement and the SDGs, by reducing
 1450 reliance on red meat consumption and prioritising healthier alternatives, with a variety of
 1451 diets and choices available depending on the region, individual, and cultural context.^{180,181}
 1452 New to the 2020 report, this indicator presents the change in deaths attributable to dietary
 1453 risks, by focusing in on one particular area – the consumption of excess red meat. Here, it

1454 links food consumption from the FAO's food balance sheets with dietary and weight-related
1455 risk factors, with a full description of methods and data presented in the Appendix.^{112,182}

1456 Globally, diet and weight-related risk factors accounted for 8.8 million deaths in 2017, which
1457 represented 19% of total mortality, with little overall change since 1990. The regions with
1458 the largest ratio of diet-related deaths include the Eastern Mediterranean (28%), Europe
1459 (25%), and the Americas (22%). High red meat consumption was responsible for 990,000
1460 deaths globally in 2017 (Figure 18). The greatest contribution to this total came from the
1461 Western Pacific, where red meat consumption was responsible for an estimated 411,500
1462 deaths (3.3% of all deaths) and, while there has been an overall improvement in dietary risk
1463 factors in Europe, the share of all deaths attributable to red meat consumption still accounts
1464 for 3.4% (306,800 deaths) .

1465



1466
1467 *Figure 18: Deaths attributable to high red meat consumption 1990-2017 by WHO region.*

1468

1469

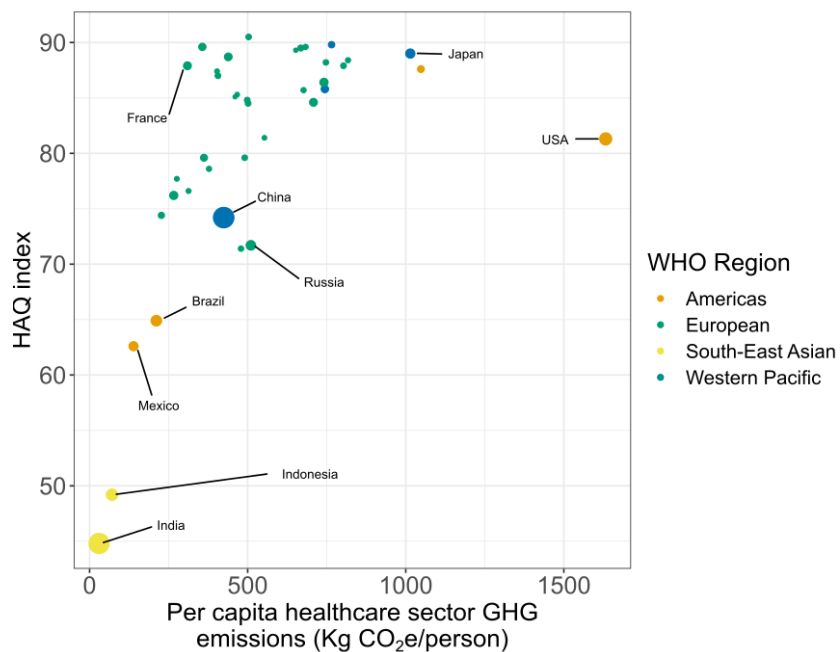
1470 Indicator 3.6: Mitigation in the Healthcare Sector

1471 *Headline finding: The healthcare sector was responsible for approximately 4.6% of global*
1472 *GHG emissions in 2017, with substantial variations in per capita emissions and healthcare*
1473 *access and quality.*

1474 Healthcare is among the most important sectors in managing the effects of climate change
1475 and, simultaneously, it has an important role to play in reducing its own carbon emissions
1476 (Panel 4). Emissions from the global healthcare sector are modelled using environmentally
1477 extended multi-region input-output (EE MRIO) models combined with WHO healthcare
1478 expenditure data.¹⁸³⁻¹⁸⁷ Based on external review and feedback, the methodology
1479 improvements include adjustments in the EE MRIO satellite accounts that reflect recent
1480 shifts in emissions intensities, particularly in the energy sector, with a full description of
1481 methods and additional analysis in the Appendix.

1482 In updated results to 2017, the healthcare sector contributed approximately 4.6% of global
1483 GHG emissions, a rise of 6.1% from 2016. On a per capita level, comparing emissions alone
1484 fails to capture vital differences in health outcomes among countries, including access to
1485 care. Similarly, increases in emissions in a single country over time may reflect additional
1486 healthcare spending that improves population health. Figure 19 plots per capita healthcare
1487 GHG emissions against the Healthcare Access and Quality (HAQ) Index.¹⁸⁴ There is a clear
1488 positive relationship between the two, up to 400 kgCO₂e per person. Above this point,
1489 countries achieve very similar HAQ levels with vastly different emissions profiles. For
1490 example, France, Japan, and the USA have very high HAQ attainment, with per capita
1491 emissions ranging from 350 kgCO₂e, through to 1,220 kgCO₂e, and 1,720 kgCO₂e
1492 respectively, suggesting that much of healthcare can achieve high-quality patient outcomes,
1493 with significantly reduced emissions.

1494



1495
1496
1497

Figure 19: National per capita healthcare GHG emissions against the Healthcare Access and Quality Index for 2015.

1498

Panel 4: For a Greener NHS

With over 1.5 million employees, England’s National Health Service (NHS England) is the largest single employer in Europe and is the largest single-payer healthcare system in the world, with an annual budget of £134 billion. While providing high-quality healthcare to a population of almost 56 million, NHS England contributes 4-5% of the country’s total GHG emissions. Accountable to both NHS England and Public Health England, the Sustainable Development Unit was founded in 2008 to ensure the health service met its commitments under the UK Climate Change Act. Since then, the NHS has achieved impressive reductions in GHG emissions whilst maintaining high standards of care and reducing costs.¹⁸⁸ In January 2020, NHS England announced its commitment to become the world’s first ‘net zero health system’, alongside its new campaign “For a greener NHS”.¹⁸⁹ A new baseline of NHS England’s current carbon footprint was quantified, identifying the different sources of emissions using a hybrid model of bottom-up measurements of direct emissions (on-site fossil fuel use, fleet and transport, and anaesthetic gases) and energy use and top-down MRIO-based measurements to estimate other indirect emissions (including upstream energy system emissions, pharmaceutical procurement, and patient use of metered dose inhalers). NHS England is now working to develop a strategy for how and when Net Zero emissions can be achieved.

1499 Conclusion

1500 The trends over the past year show a concerning lack of progress in a number of sectors,
1501 including a continued failure to reduce the carbon intensity of the global energy system, a
1502 rise in the use of coal-fired power, and rising agricultural emissions and premature deaths
1503 from excess red meat consumption. This is in-part counteracted by the growth of renewable
1504 energy and improvements in low-carbon transport. While these continue to rise at a pace, it
1505 is important to consider that they are starting from a low baseline.

1506 In many cases, it is likely that 2020 will be an inflection point for a number of indicators
1507 presented over the coming decade, with the direction of future trends yet to be seen..
1508 Ensuring that the recovery from the pandemic is synergistic with the long-term public health
1509 imperative of responding to climate change will be vital in the coming months, years, and
1510 decades.

1511

1512

1513 Section 4: Economics and Finance

1514 Section 1 described the emerging human symptoms of climate change, while Sections 2 and
1515 3 detailed efforts to adapt and mitigate against the worst of these effects. In turn, Section 4
1516 examines the financial and economic dimensions of both the impacts of climate change, and
1517 efforts to respond.

1518 The Intergovernmental Panel on Climate Change (IPCC) estimate limiting warming to 1.5°C
1519 would require annual investment in the energy system equivalent to around 2.5% of global
1520 GDP, through to 2035.⁸⁵ Such investment would both limit the cost of the damage from
1521 climate change (up to US\$4 trillion per year by 2100 from a 3°C world as compared to a 2°C
1522 world) and generate a range of other economic benefits (including the creation of new
1523 technologies and industries) and health benefits from avoiding the effects of climate change
1524 current carbon-intensive activities. Once such factors are considered, the overall economic
1525 implications of limiting warming to 1.5°C are likely to be positive – particularly if policy
1526 responses are accelerated as soon as possible to a level commensurate with the scale of the
1527 challenge. Recent estimates suggest that investment to “bend the curve” from the world’s
1528 current path, to a limited temperature rise of 1.5°C by 2100, would generate global net
1529 benefit of US\$264-610 trillion (3.1-7.2 times of the size of the global economy in 2018).¹²

1530 The global economy will look substantially different following the recovery from the COVID-
1531 19 pandemic. As governments around the world grapple with the challenge of restarting
1532 their economies, it will be important to ensure these efforts are aligned with the response
1533 to climate change. If the enormous fiscal stimulus that will be required is directed away
1534 from high-carbon, and towards low-carbon infrastructure and activities, an opportunity to
1535 permanently bend the curve presents itself. Metrics examining these core concepts are
1536 currently tracked in this report, allowing future data to reveal the long-term effect of
1537 COVID-19 on the low-carbon economy.

1538 The nine indicators in this section fall into two broad domains. The first is the health and
1539 economic costs of climate change and its mitigation (Indicators 4.1.1 to 4.1.4). This includes
1540 two new indicators for the 2020 report, on the economics of heat-related mortality and the
1541 potential reduction in earnings from heat-related labour capacity loss (Indicators 4.1.2 and
1542 4.1.3). The second domain examines the economics of the transition to zero-carbon
1543 economies (Indicators 4.2.1 to 4.2.5), which is fundamental to the improvement of human
1544 health and wellbeing. This theme also includes a new indicator, (Indicator 4.2.5), which
1545 merges three indicators presented in previous reports (on fossil fuel subsidies, the strength
1546 and coverage of carbon prices, and carbon pricing revenues) to examine the “net” carbon
1547 prices in place around the world.

1548

1549 4.1 Health and Economic Costs of Climate Change and Benefits from Mitigation

1550 Indicator 4.1.1: Economic Losses due to Climate-Related Extreme Events

1551 *Headline finding: Economic losses from climate-related extreme events in 2019 were nearly*
1552 *five times greater in low-income economies than high-income economies, and with just 4%*
1553 *of these losses insured, compared to 60% in high-income economies.*

1554 Section 1 presented the evidence linking the impacts of climate change to human health
1555 and wellbeing. The loss of physical infrastructure (agricultural land, homes, health
1556 infrastructure) due to such events will further exacerbate these health impacts. This
1557 indicator tracks the total annual economic losses (insured and uninsured) that result from
1558 climate-related extreme events. The methodology is described in full in the Appendix, which
1559 has changed compared to previous years.^{190,191}

1560 In 2019 there were 236 recorded climate-related extreme events, with absolute economic
1561 losses totalling US\$132 billion. Although most of these losses occurred in high-income
1562 economies, when normalised by GDP, the value of total economic losses in low-income
1563 countries is nearly five times greater. In addition, while 60% of losses in high-income
1564 economies were insured, this reduces to 3-5% for other income groups. It is important to
1565 note that, when normalised by GDP, relative economic losses have been decreasing, while
1566 the number of total extreme events is increasing, suggesting that adaptation and prevention
1567 are reducing their impacts.¹⁹²

1568

1569 Indicator 4.1.2: Costs of Heat-Related Mortality

1570

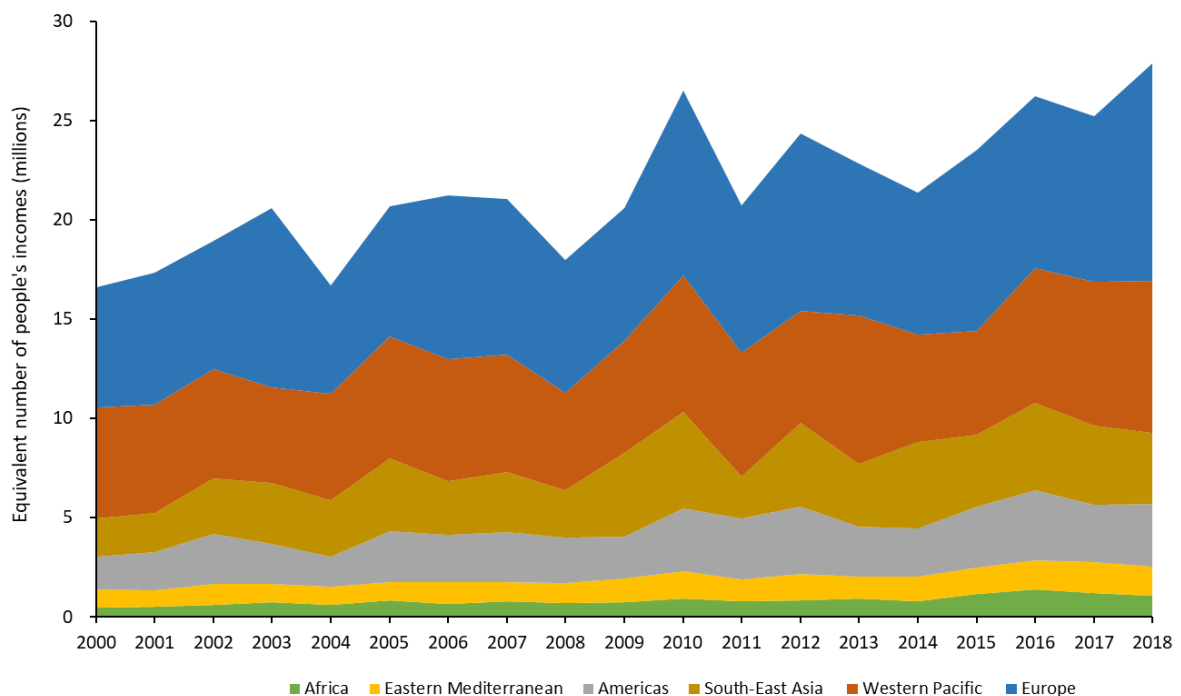
1571 *Headline finding: In 2018, the monetised value of global heat-related mortality reached*
1572 *0.37% of Gross World Product, compared to 0.23% in 2000. Europe suffered the most in*
1573 *2018, with costs equal to the average income of 11 million of its citizens, and 1.2% Gross*
1574 *National Income.*

1575 As Indicator 1.1.3 highlights, rising temperatures and extremes of heat are resulting in
1576 worsening morbidity and mortality for populations around the world. The 2020 report
1577 introduces a new indicator, which considers the economic impact of this, by tracking the
1578 monetised value of global heat-related mortality. To do so, it makes use of the value of a
1579 statistical life (VSL), drawing on estimates produced for the Organisation for Economic Co-
1580 operation and Development (OECD) for those countries, making use of a fixed ratio of VSL to
1581 gross national income (GNI) for non-OECD countries, and applying this to the heat-related
1582 mortality data from Indicator 1.1.3.^{193,194} To address any distributional effects, and more
1583 accurately capture the economic harm that climate change presents to low- and middle-
1584 income countries, two indices have been calculated. The value of mortality is presented as a

1585 proportion of total GNI, and as the average income per person this loss would be equivalent
 1586 to, in a given country and region. A full description of the methods, data, caveats and
 1587 further analysis are described in the Appendix.

1588 As global heat-related mortality increased from 2000, so too did the monetised cost of
 1589 these deaths. At a global level and represented as a proportion of Gross World Product
 1590 (GWP), the cost increased from 0.23% in 2000 to 0.37% in 2018. Due the high number of
 1591 heat-related deaths, Europe was the worst affected, reaching a cost equivalent to the
 1592 income of 11 million of its citizens in 2018 (led by Germany at 1.9 million, Figure 20), and
 1593 1.2% of regional GNI. While the value in terms of proportion of GNI for the Western Pacific
 1594 and South East Asia were comparatively low at 0.43% and 0.19% respectively, these impacts
 1595 are more substantial when considered against the average income in those regions.

1596
 1597



1598
 1599 *Figure 20: Monetised value of heat-related mortality represented as the number of people to whose*
 1600 *income this value is equivalent, on average, for each WHO region.*

1601

1602 **Indicator 4.1.3: Loss of Earnings from Heat-Related Labour Capacity Reduction**

1603 *Headline finding: Rising temperatures make outdoor labour increasingly difficult, often*
 1604 *resulting in public health and economic consequences for a wide range of occupations. If*

1605 *borne out, the heat related reduction in labour capacity experienced would result in earnings*
1606 *losses equivalent to an estimated 4-6% of GDP in lower-middle income countries tracked.*

1607 Higher temperatures, driven by climate change, are affecting people's ability to work
1608 (Indicator 1.1.4). This new indicator considers the loss of earnings that could result from
1609 such reduced capacity, compounding the initial cause of ill health and impacting on
1610 wellbeing. It adopts the outputs of Indicator 1.1.4 for 25 countries, selected by the impact
1611 their workers experience and for geographical coverage, and combines these with data on
1612 average earnings by country and sector held in the International Labor Organization (ILO)
1613 databases.⁴² These estimates will be modified by a variety of factors, ranging from whether
1614 or not sick leave was taken, the presence of workers sick pay rights, and the availability of
1615 shade. A full description of the methods and additional analysis is provided in the Appendix.

1616 When taken as a share of GDP, low- and lower middle-income countries are the hardest hit,
1617 with losses predominantly seen in agriculture, despite this being on average the lowest paid
1618 of the sectors considered. By 2015, averaged estimated earnings losses reached the
1619 equivalent of 4-6% of GDP for lower-middle income countries tracked including Indonesia,
1620 India, and Cambodia, and between 0.6-1% for upper-middle income countries, including
1621 China, Brazil, and Mexico.

1622

1623 [Indicator 4.1.4: Economics of the Health Impacts of Air Pollution](#)

1624

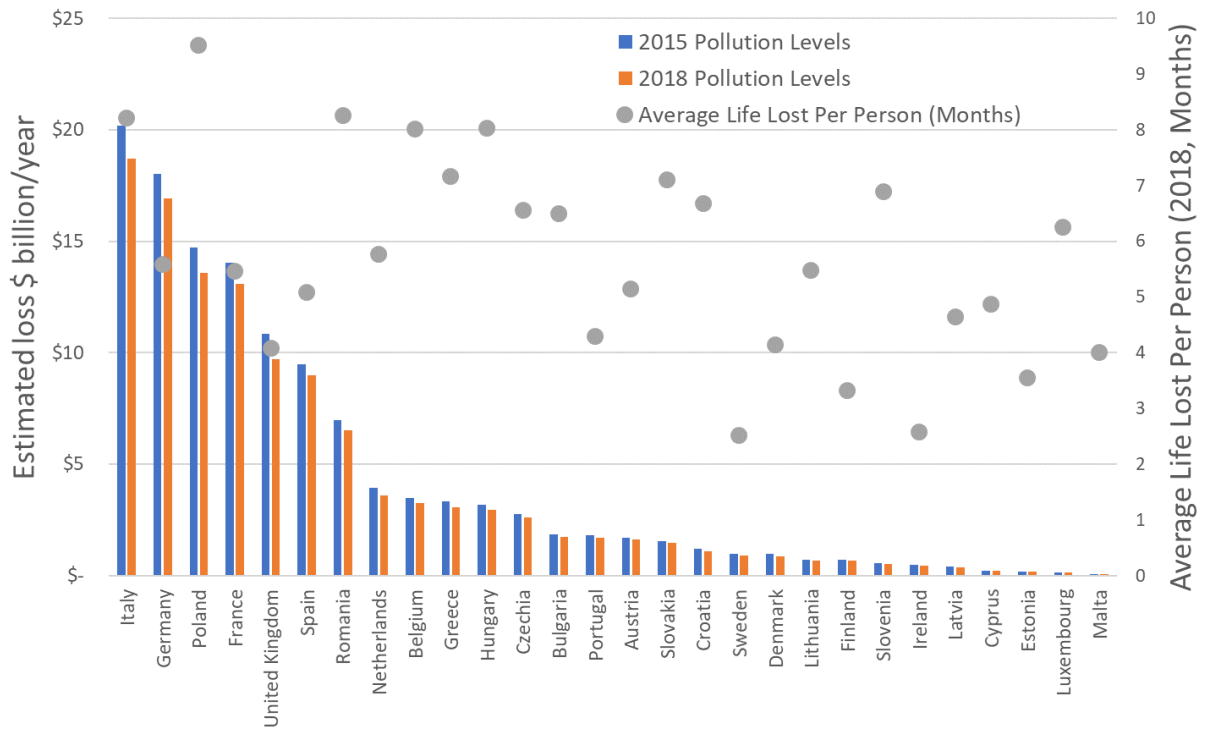
1625 *Headline finding: Across Europe, ongoing reductions in particulate air pollution from human*
1626 *activity were seen from 2015 to 2018. If held constant, this improvement alone would lead*
1627 *to an annual average reduction in years of life lost to the current population worth \$8.8*
1628 *billion.*

1629 As described in Indicator 3.3, global mortality due to ambient PM_{2.5} pollution has risen from
1630 around 2.95 million in 2015 to 3.01 million in 2018. However, due to improvements in air
1631 quality, including the closure of coal power stations, premature mortality due to air
1632 pollution in Europe has decreased over the same period. This indicator captures the cost of
1633 that change in the European Union (EU) by placing an economic value on the Years of Life
1634 Lost (YLL) that result from exposure to PM_{2.5} from anthropogenic sources, with the methods
1635 and data described in full in the Appendix.¹⁹⁵

1636 If the population of the EU in 2015 were to experience anthropogenic PM_{2.5} emissions at
1637 2018 levels instead of levels experienced in 2015, consistently over the course of their lives,
1638 the total average economic value of the reduction in YLLs would be around \$8.8 billion
1639 (€9.85 billion), every year. Despite this, 2018 PM_{2.5} levels are still damaging to
1640 cardiovascular and respiratory systems, and the total annual average cost to the current
1641 population would still be \$116 billion (€129 billion). Based on 2018 levels of air pollution,

1642 the average life lost per person in the EU is 5.7 months, but this loss of life is estimated at
 1643 over 8 months per person for Poland, Romania, Hungary, Italy and Belgium (Figure 21).

1644



1645

1646

1647 *Figure 21: Annual monetised value of YLLs due to anthropogenic PM2.5 exposure, and average*
 1648 *months of life lost per person (2018 pollution levels).*

1649

1650 4.2 The Economics of the Transition to Zero-Carbon Economies

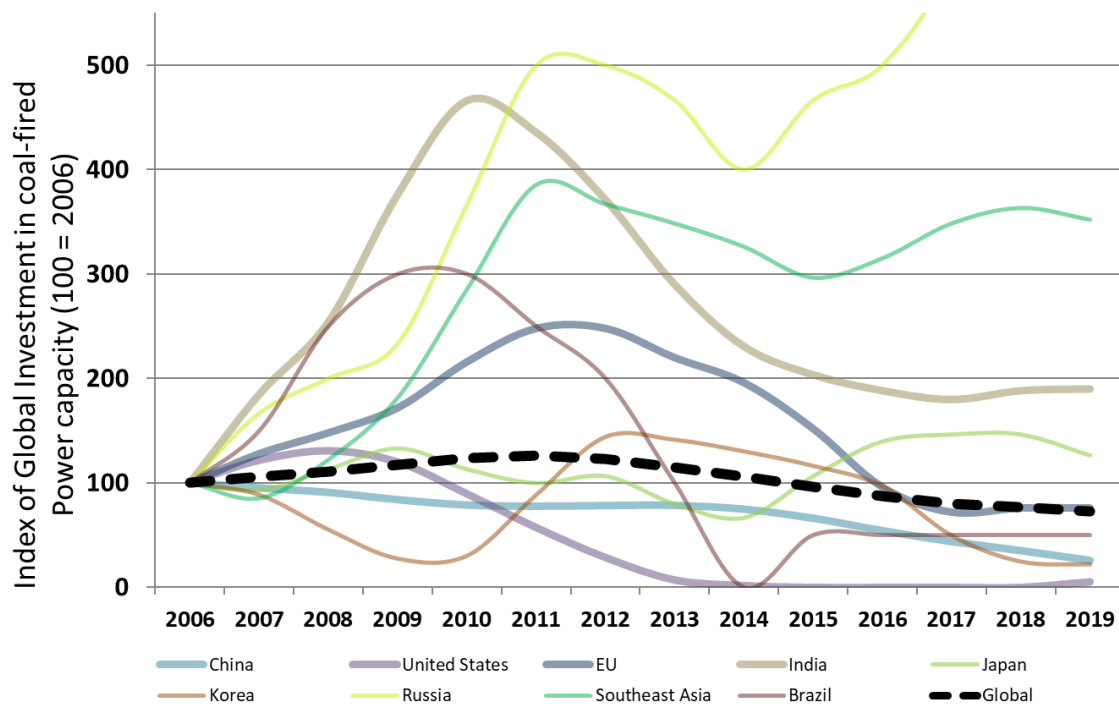
1651 Indicator 4.2.1: Investment in New Coal Capacity

1652 *Headline finding: Largely driven by China, investment in new coal capacity has been*
1653 *declining since 2011 and reduced by 6% from 2018 to 2019. Despite this, global coal capacity*
1654 *continues to increase, with fewer coal plant retirements than additions for every year*
1655 *tracked.*

1656 As identified in Section 3, coal phase-out is essential, not only for the mitigation of climate
1657 change, but also for the reduction of premature mortality due to air pollution. Taking data
1658 from the IEA, this indicator points to future coal use, tracking investment in new coal-fired
1659 power generation. The data represents ‘ongoing’ capital spending, with investment in a new
1660 plant spread evenly from the year new construction begins, to the year it becomes
1661 operational.¹⁹⁶ For the 2020 report, data is presented for key countries and regions,
1662 alongside the global trend. Further details on the methods and data are found in the
1663 Appendix.

1664 Following the trend since 2011, global investment reduced a further 6% between 2018 and
1665 2019. With a 27% reduction in investments over these two years, China has been driving
1666 this decline. Final Investment Decisions (FIDs, the point at which the project’s future
1667 development is approved) have reached their lowest point in 40 years, with a further 11%
1668 reduction in investment forecast for 2020 – driven by declining investment in Asia, in part as
1669 a result of COVID-19. However, despite a substantial decline in actual investment, FIDs in
1670 China increased in 2019 compared to 2018, and, with the approval of 8 GW of new capacity,
1671 reached 2019 levels by March 2020. Additionally, with fewer coal plant retirements than
1672 additions in 2019 (and in every year presented), there was an overall increase in global
1673 capacity.

1674



1675 Figure 22: Annual investment in coal-fired capacity 2006-2019 (an index score of 100 corresponds to
 1676 2006 levels).
 1677

1678

1679 [Indicator 4.2.2: Investments in Zero-Carbon Energy and Energy Efficiency](#)

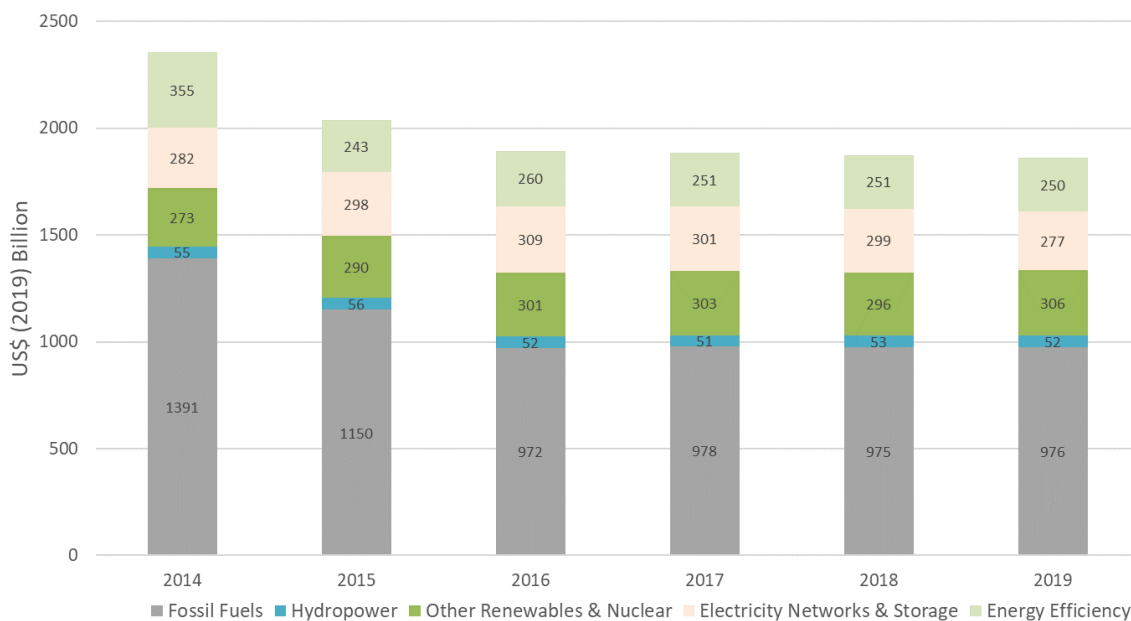
1680 *Headline finding: Progress towards zero-carbon energy has stalled in recent years, and*
 1681 *investments in zero-carbon energy and energy efficiency have not risen since 2016, and are a*
 1682 *long way from the doubling by 2030 required to be consistent with the Paris Agreement.*

1683 This indicator monitors annual global investment in these areas, as well as investment in all
 1684 fossil fuels, complementing and providing a wider context to Indicator 4.2.1, above. Data is
 1685 sourced from the IEA, and the methodology remains the same as the 2019 report of Lancet
 1686 Countdown, with hydropower now considered separately and all values presented in
 1687 US\$2019.¹⁹⁶

1688 Since 2016, investment in global energy supply and energy efficiency has remained relatively
 1689 stable at just under US\$1.9 trillion, with fossil fuel supply consistently accounting for around
 1690 half this value, and all renewables and energy efficiency combined maintaining a share of
 1691 32%. For a pathway consistent with 1.5°C of warming this century, annual investments must
 1692 increase to US\$4.3 trillion by 2030, with investment in renewable electricity, electricity
 1693 networks and storage, and energy efficiency accounting for at least 50%.¹⁹⁷

1694 As a result of the COVID-19 pandemic, short-term disruption and long-term reassessments
 1695 of likely returns mean that total energy investment is estimated to reduce by 20% in 2020 –
 1696 the largest fall ever recorded – with oil and gas supply investment to be reduced by a third.
 1697 Renewable investment is likely to fare better than fossil fuel capacity, with investment in
 1698 zero-carbon energy (nuclear, hydropower and other renewables) and energy efficiency
 1699 projected to jump from 32% to 37% of investment in 2020, due to falling investments in
 1700 fossil fuels.¹⁹⁶ Stimulus plans focussed on boosting energy efficiency and renewable energy
 1701 will be essential to ensure that the power generation system is on track to meet the SDGs
 1702 and the goals of the Paris Agreement.¹⁶³

1703



1704

1705 *Figure 23: Annual Investment in energy supply and efficiency.*

1706

1707 **Indicator 4.2.3: Employment in Renewable and Fossil Fuel Energy Industries**

1708 *Headline finding: Renewable energy provided 11 million jobs in 2018, a 4.2% rise from 2017.*
 1709 *Whilst still employing more people overall, employment in fossil fuel extraction declined by*
 1710 *3% from 2018 to 2019.*

1711 There is mounting evidence that employees in some fossil-fuel extractive industries,
 1712 particularly coal mining, and populations living in close proximity, suffer a greater incidence
 1713 of certain illnesses, such as chronic respiratory diseases, cancers and congenital

1714 anomalies.^{198,199} Combined with increased job certainty, a managed transition of
1715 employment opportunities away from fossil fuel-related industries, and towards low-carbon
1716 industries will result in improved occupational health of employees within the energy
1717 sector. This indicator tracks global direct employment in fossil fuel extraction industries
1718 (coal mining and oil and gas exploration and production) and direct and indirect (supply
1719 chain) employment in renewable energy for the most recent year available, with a full
1720 description of the methods and data available in the Appendix.²⁰⁰⁻²⁰²

1721 Around 11 million people globally were employed directly or indirectly by the renewable
1722 energy industry in 2018, representing an increase of 4.2% from 2017. Solar photovoltaic
1723 (PV) continues to provide the largest share of jobs, at over 3.6 million, with employment
1724 also rising in wind, bioenergy, and other technologies. Fossil fuel extraction industries
1725 continue to employ more people globally than all renewable energy industries, although the
1726 number of jobs in 2019 are slightly lower than in 2018, at 12.7 million compared with 13.1
1727 million.

1728 As the demand for fossil fuels declines, planned efforts, including retraining and job
1729 placement is important to ensure the ongoing employment of those currently working in
1730 fossil fuel extraction industries. The same will be true as part of the response to COVID-19,
1731 with structured re-training and deployment programmes for renewable energy potentially
1732 forming an important component of a recovery plan. Indeed, the IEA estimates that such a
1733 strategy, which accelerates the deployment of low-carbon electricity sources, expands
1734 electricity grid access and energy efficiency, and delivers cleaner transport, would create an
1735 additional nine million jobs a year, globally over the next three years.¹⁶³

1736

1737 [Indicator 4.2.4: Funds Divested from Fossil Fuels](#)

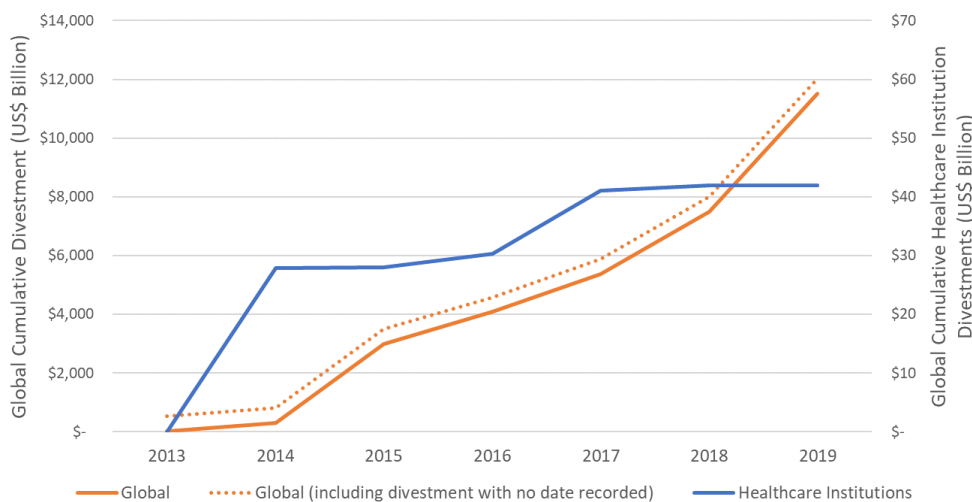
1738 *Headline finding: The global value of new funds committed to fossil fuel divestment in 2019*
1739 *was US\$4.01 trillion, of which health institutions accounted for around US\$19 million. This*
1740 *represents a cumulative sum of US\$11.51 trillion since 2008, with health institutions*
1741 *accounting for US\$42 billion.*

1742 By encouraging investors to reduce their financial interests in the fossil fuel industry,
1743 divestment efforts both remove the 'social license to operate' and guard against the risk of
1744 losses due to 'stranded assets' in a world in which demand for fossil fuels rapidly
1745 reduces.^{203,204} This indicator tracks the total global value of funds divested from fossil fuels,
1746 and the value of divested funds coming from health institutions, using data provided by
1747 350.org, with annual data and full methodology described in the Appendix.²⁰⁵

1748 From 2008 to the end of 2019, 1,157 organisations, with cumulative assets worth at least
1749 US\$11.51 trillion have committed to fossil fuel divestment. Of these, only 23 are health

1750 institutions, including the World Medical Association, the British Medical Association, the
 1751 Canadian Medical Association, the UK Faculty of Public Health, the Royal College of General
 1752 Practitioners, the Royal Australasian College of Physicians, Gundersen Health System, the
 1753 Berlin Doctors Pension Fund, and the Royal College of Emergency Medicine, with total
 1754 assets of approximately US\$42 billion. The annual value of new funds committed to
 1755 divesting increased from US\$2.14 trillion in 2018 to US\$4.01 trillion in 2019. However,
 1756 divestment from health institutions has slowed, with US\$19 million divested in 2019,
 1757 compared to US\$867 million in 2018, owing primarily to divestment from particularly large
 1758 institutions in previous years.

1759



1760
 1761

Figure 24: Cumulative divestment – Global total and in healthcare institutions.

1762

1763 Indicator 4.2.5: Net Value of Fossil Fuel Subsidies and Carbon Prices

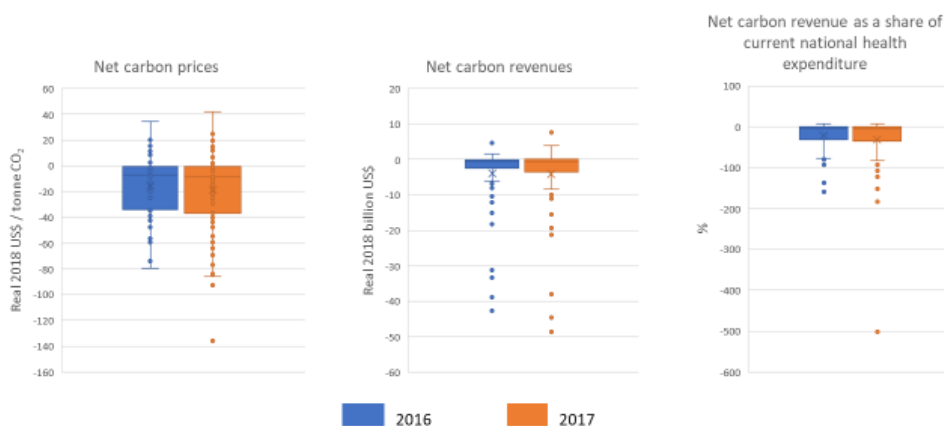
1764 *Headline finding: 58 out of 75 countries reviewed were operating with a net-negative carbon*
 1765 *price in 2017. The resulting net loss of revenue was in many cases equivalent to substantial*
 1766 *portions of the national health budget.*

1767 Placing a price on GHG emissions provides an incentive to drive the transition towards a
 1768 low-carbon economy.^{206,207} It also allows for a closer reflection of the true cost of emissions-
 1769 intensive practices, particularly fossil fuel use, capturing some of the negative externalities
 1770 resulting from their impact on health. However, not all countries explicitly set carbon prices,
 1771 and in some cases the strength of any carbon price may be undermined by the opposing
 1772 influence of subsidies on fossil fuel production and consumption.^{208,209}

1773 Indicator 4.2.5 has been created for the 2020 report by combining previous indicators on
 1774 fossil fuel subsidies and carbon pricing. It calculates “net” economy-wide average carbon
 1775 prices and associated net carbon revenue to government. The calculations are based on the
 1776 value of overall fossil fuel subsidies, the revenue from carbon pricing mechanisms, and the
 1777 total CO₂ emissions of the economy. Data on fossil fuel subsidies are calculated based on
 1778 analysis from the IEA and OECD.^{210,211} Together these sources cover 75 countries and
 1779 account for around 92% of global CO₂ emissions. Carbon prices and revenues are derived
 1780 from data in the World Bank Carbon Pricing Dashboard and include international, national
 1781 and subnational mechanisms within countries, 38 of which overlap with those covered by
 1782 subsidy data and thus form part of this analysis.²¹² A full description of the methodology,
 1783 other data sources, and the methods for integrating them, can be found in the Appendix.

1784 Most of the 75 countries in 2016 and 2017 had net-negative carbon prices (61 and 58
 1785 respectively), and only 25% with a price above zero in both years, resulting from substantial
 1786 subsidies for fossil fuel production and consumption (Figure 25). The median net carbon
 1787 revenue was negative – a pay-out of US\$0.7 billion, with some countries providing net fossil
 1788 fuel subsidies in the tens of billions of dollars each year. In many cases these subsidies are
 1789 equivalent to substantial proportions of the national health budget – greater than 100% in
 1790 eight of the 75 countries in 2017. Of the 38 countries that had formal carbon pricing
 1791 mechanisms in place in 2017, 21 nonetheless had net-negative carbon prices.

1792



1793 *Figure 25: Net carbon prices; net carbon revenues; and net carbon revenue as a share of current*
 1794 *national health expenditure, across 75 countries, 2016 and 2017. Boxes show the interquartile range*
 1795 *(IQR), horizontal lines inside the boxes showing the medians. The means are shown by crosses. The*
 1796 *brackets represent the range from minimum to maximum, however points are represented as*
 1797 *outliers beyond this range if they are 1.5 times the IQR below the 1st quartile, or above the 3rd*
 1798 *quartile.*

1800

1801 Conclusion

1802 The economic and financial dimensions of public health and climate change are central to
1803 any comprehensive mitigation and adaptation effort. This section has covered both the
1804 health and economic costs of climate change, as well as indicators of progress underlying a
1805 transition to a low-carbon economy. It has developed a number of new metrics to inform
1806 this and will continue to expand the geographical coverage and reach of these in
1807 subsequent reports.

1808 The outlook presented here is mixed. On the one hand, investment in new coal capacity
1809 continues to decline, and employment in renewable energy continues to rise. On the other
1810 hand, composite indicators of net carbon pricing reveal that government policies are often
1811 mis-coordinated, resulting in inefficiencies and disrupted price signals. The full economic
1812 impacts of COVID-19 will continue to play out over the course of a number of years, leaving
1813 a lasting impact on the world. Indeed, the nature and extent of the economic impact and
1814 response to this pandemic will play a defining role in determining whether or not the world
1815 meets its commitments under the Paris Agreement. It is for this reason that strong
1816 investment in mitigation and adaptation technologies and interventions is more important
1817 now than ever before, leading to healthier and more prepared hospitals, economies, and
1818 populations.

1819 Section 5: Public and Political Engagement

1820 As previous sections make clear, the health impacts of climate change are multiplying,
1821 hitting hardest those who have contributed least to rising global temperatures. The public
1822 are voicing concern as individuals, and as members of Indigenous communities, and new
1823 social movements, urging greater ambition from those with the power to curb carbon
1824 emissions.²¹³⁻²²⁰

1825 This section tracks engagement in health and climate change across multiple parts of
1826 society, including the media, by individuals, scientists, governments, and the corporate
1827 sector. For each of these, methods used in previous Lancet Countdown reports have been
1828 enhanced, increasing the sensitivity and specificity of health and climate change
1829 engagement in each.

1830 The media, and national newspapers in particular, are central to shaping public perceptions
1831 of climate change.²²¹⁻²²⁴ The media indicator (Indicator 5.1) tracks newspaper coverage of
1832 health and climate change in 36 countries, with additional analysis provided for China's
1833 *People's Daily*, the official voice of the government and China's most influential newspaper,
1834 and content analysis of newspaper coverage in India and the USA.^{225,226}

1835 Individual engagement (Indicator 5.2) is tracked through the use of Wikipedia, an online
1836 information source that has outpaced traditional encyclopaedias in terms of reach, coverage
1837 and comprehensiveness.²²⁷⁻²³¹

1838 Reintroduced in 2020 with a revised methodology, the scientific indicator (Indicator 5.3)
1839 tracks academic engagement with health and climate change in peer-reviewed journals, the
1840 premier source of high-quality research that provides evidence used by the media,
1841 government, and the public.^{228,232,233}

1842 The fourth indicator (Indicator 5.4) focuses on the governmental domain, a key arena for
1843 driving the global response to climate change. It tracks government engagement in health
1844 and climate change at the UN General Assembly, where the UN General Debate provides a
1845 platform for national leaders to address the global community.^{234,235} New to the 2020
1846 report, it also examines engagement with health in the NDCs which underpin the UN
1847 Framework Convention on Climate Change (UNFCCC) 2015 Paris Agreement.^{4,236,237}

1848 The final indicator (Indicator 5.5) focuses on the corporate sector, which, through its
1849 behaviour and wider political influence is central to the transition to a low-carbon
1850 economy.²³⁸⁻²⁴⁰ This indicator tracks engagement with health and climate change in
1851 healthcare companies within the UN Global Compact, the world's biggest corporate
1852 sustainability framework.²⁴¹

1853 [Indicator 5.1 Media Coverage of Health and Climate Change](#)

1854 *Headline finding: While total climate change coverage increased substantially from 2018 to*
1855 *2019, the rise was even greater for health and climate change coverage, which increased by*
1856 *96% over this period, and has increased substantially from 2007 to 2019.*

1857 This indicator tracks coverage of health and climate change from 2007 to 2019 in 36
1858 countries, together with separate analyses of China’s People’s Daily and the content of
1859 coverage in leading newspapers in India and the USA. Full descriptions of the methods, data
1860 sources and further analyses are presented in the Appendix.

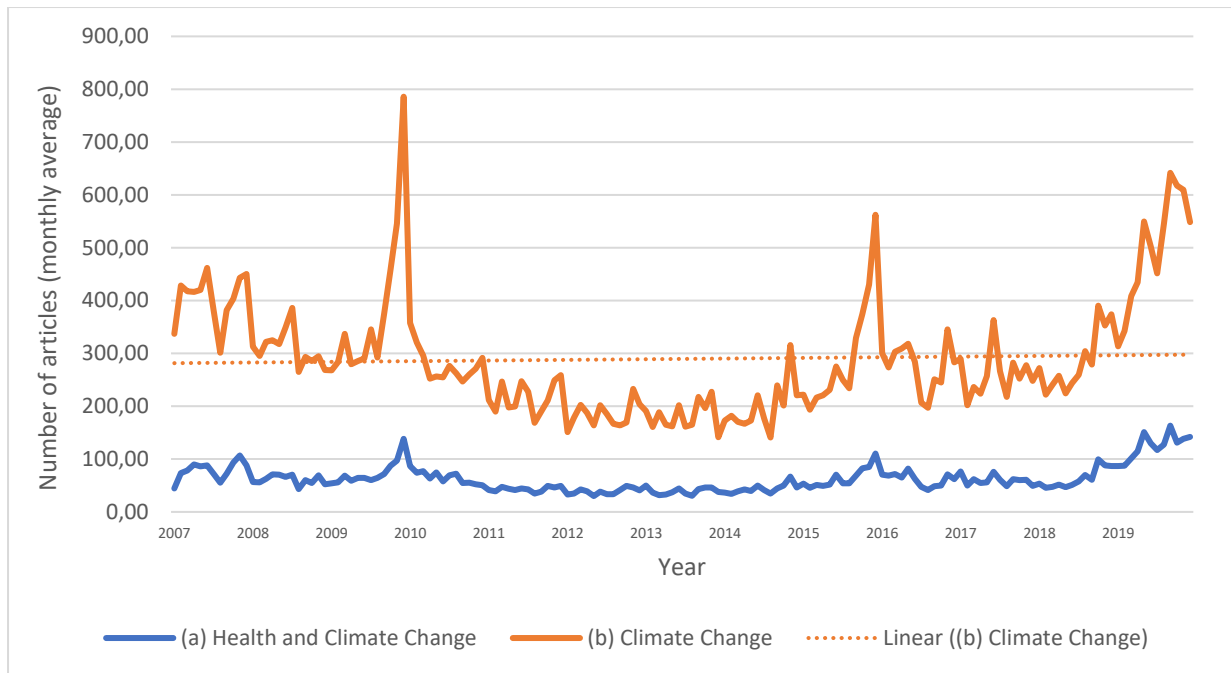
1861 Across the 36 countries, an increasing proportion of newspaper articles on climate change
1862 refer to human health. From 2018 to 2019, health and climate change coverage increased
1863 by 96%, outpacing the increase in overall climate change coverage (74%). From 2007 to
1864 2019, the average monthly number of newspaper articles on health and climate change
1865 increased by 57% compared to a 23% increase in articles on climate change. Overall, the
1866 coverage for health and climate change only makes up 16% of all climate change coverage in
1867 the 2007-19 period (Figure 26).

1868 Coverage of health and climate change peaked in months that coincided with COP15 in 2009
1869 (Copenhagen) and COP21 in 2015 (Paris). It rose again in late 2018 and remained high across
1870 2019, corresponding with the time of the rise of the School Climate Strikes and a series of
1871 extreme weather events, including the Californian and southern Australian wildfires.

1872 The analysis was based on key word searches for health and climate change in 61
1873 newspapers (English, German, Portuguese, Spanish) selected to provide a global spread of
1874 higher-circulation papers. The search strategy was revised for the 2020 report in order to
1875 exclude false positives whilst retaining true positive articles.

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Figure 26: Average monthly coverage of (a) health and climate change and (b) climate change in 61 newspapers (36 countries), 2007-2019.

1881

1882 Additionally, coverage of health and climate change in *Renmin Ribao*, the Chinese language
1883 edition of *People's Daily*, was tracked using keyword searches, algorithm-based natural
1884 language processing and manual screening. Between 2008 and 2019, 2% of articles on
1885 climate change were related to health. Health-related coverage spiked in 2013 with
1886 coverage of the health threats of air pollution and heatwaves.²⁴²

1887 The content of coverage of health and climate change was analysed in India (the *Times of*
1888 *India* and the *Hindustan Times*) and the USA (the *New York Times* and the *Washington Post*)
1889 from July-September and November-December 2019, chosen to include periods of extreme
1890 weather (monsoons, drought) and COP25.³⁰ The newspapers form part of the 'elite press'
1891 which, via their influence on the country's political and economic elites, have an influence
1892 on the policy agenda.²⁴³⁻²⁴⁸

1893 Three broad themes were identified in articles linking health and climate change. The
1894 dominant theme was the health impacts of climate change, discussed in 68% of articles.
1895 References were often to broad health impacts (e.g. "few countries are likely to suffer from
1896 the health effects of climate change as much as India", *Hindustan Times*, 14 November).
1897 More specific connections were also made to climate-related stressors (e.g. extreme
1898 weather events, wildfires, population displacement) and health sequelae (e.g. vector-borne
1899 disease, mental ill-health).

1900 The second theme relates to the common causes and co-benefits of addressing climate
1901 change and health, discussed in 39% of articles. Air pollution was the most frequently
1902 highlighted. Co-benefits of lifestyle changes to protect health and reduce emissions were
1903 also noted. The third theme focused on adaptation, discussed in 12% of articles. For
1904 example, the *Times of India*, 10 December, noted that “all levels of government need to
1905 prioritize building health system resilience to climate change”. In addition, a small group of
1906 articles (six across the corpus) made a link between health and climate change with respect
1907 to activism and protest.

1908 The relative prominence of the three main themes in the 2019 analysis matches that for
1909 2018 and the *Times of India* again gave greater emphasis to common causes and co-benefits
1910 than the other newspapers.³⁰

1911 For this indicator, articles were searched by health and climate change keywords and
1912 manually screened; the final sample of 209 articles was independently coded using the
1913 template developed for the 2018 analysis.^{30,249}

1914

1915

1916 [Indicator 5.2: Individual Engagement in Health and Climate Change](#)

1917 *Headline finding: Individual information-seeking about health and climate change increased*
1918 *by 24% from 2018 to 2019, driven primarily by initial interest in health.*

1919 Wikipedia usage provides a digital footprint of individual information-seeking.^{250,251} This
1920 indicator tracks individuals’ engagement in health and climate change, by capturing visits to
1921 pairs of articles, for example, an individual clicking from a page on human health to one on
1922 climate change. Using data from the Wikimedia Foundation on the English version of
1923 Wikipedia (representing around 50% of global traffic to all Wikipedia language editions), this
1924 indicator is based on 6,902 articles related to health and 1,837 articles related to climate
1925 change.^{252,253} Methods, data sources and further analyses are described in the Appendix.

1926 In both 2018 and 2019, individuals typically visited articles on either health or climate
1927 change, with little co-click activity between them, and when they were linked, the majority
1928 (75%) of co-visits started from a health-related page. While the overall number of health
1929 and climate change co-views is low, it increased by 24% across from 2018 to 2019, pointing
1930 to a rising individual engagement in the links between these two topics. In both years, co-
1931 clicks increased in months coinciding with key events in climate politics. As well as the 2019
1932 COP, co-clicks from articles on climate change to health in 2019 spiked in September at the
1933 time of Greta Thunberg’s speech at the UN’s Climate Action Summit.²⁵⁴

1934

1935 **Indicator 5.3: Coverage of Health and Climate Change in Scientific Journals**

1936 *Headline finding: There was a nine-fold increase in original research on health and climate*
1937 *change between 2007 and 2019, a trend driven by research led by scientists in high-income*
1938 *countries.*

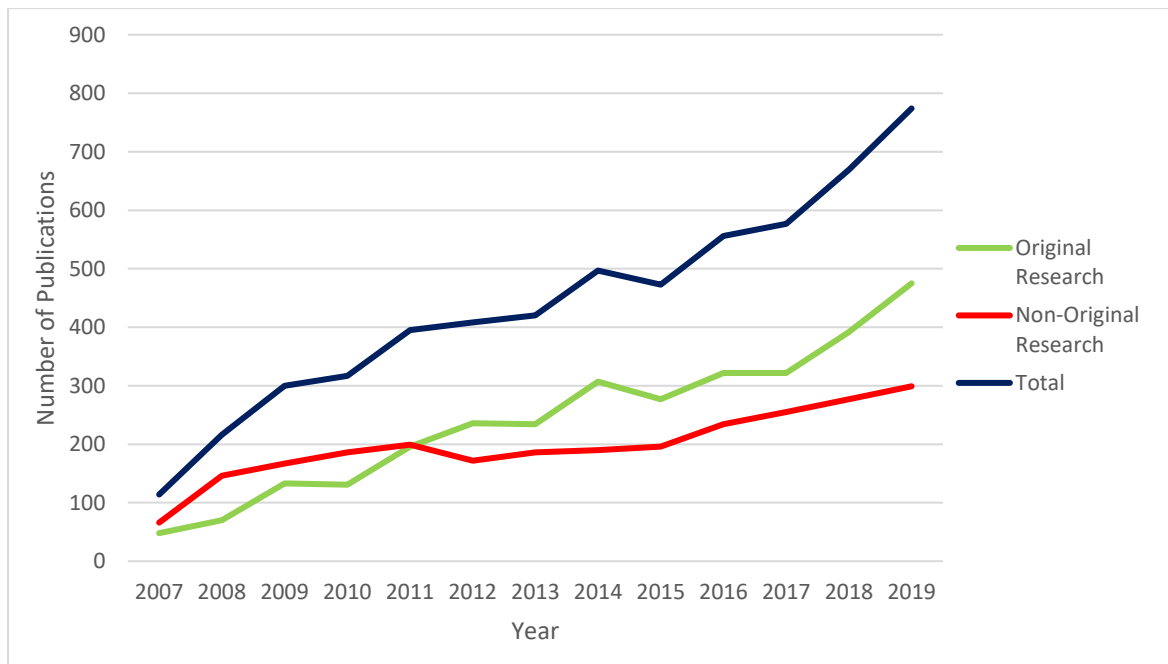
1939 Between 2007 and 2019, 5,579 published academic articles referred to links between
1940 climate change and health. The period saw a nine-fold increase in original research (primary
1941 studies and evidence reviews) and a three-fold increase in research-related articles
1942 (editorials, reviews, comments, letters). Since 2011, original research has now surpassed
1943 research-related articles, with new research representing 61% of total scientific output in
1944 2019 (Figure 27).

1945 Consistent with observations in Section 1 (see Panel 3), the overall increase in research on
1946 health and climate change was primarily led by scientists based in high-income countries.
1947 USA-led and UK-led research made up 27% and 15% of the total output for 2007 to 2019,
1948 and respectively, 26% and 15% in 2019. Major contributions to 2019 output also come from
1949 the Netherlands (8%) and Switzerland (7%). Increases were also evident for China, South
1950 Africa, and India.

1951 Across the period, articles on health and climate change represented only a small
1952 proportion (9%) of total articles on climate change. However, the increase in articles relating
1953 to health and climate change was greater than for overall climate change output.

1954 This indicator is based on key word searches for health and climate change in OVID Medline
1955 and OVID Embase using the comprehensive indexing systems and thesaurus of Medical
1956 Subject Headings (MeSH) for Medline and Emtree for Embase. Methods, data sources and
1957 further analyses are described in the Appendix.

1958



1959

1960 *Figure 27: Scientific journal articles relating to health and climate change, 2007-2019.*

1961

1962

1963 **Indicator 5.4: Government Engagement in Health and Climate Change**

1964 *Headline finding: National governments are increasingly paying attention to health and*
1965 *climate change. Small island developing states are leading this trend at the UN General*
1966 *Debate, and poorer and more climate-vulnerable countries are more likely to reference*
1967 *health in their NDCs, with 95% of the least developed countries making these references.*

1968 This indicator examines engagement with health and climate change in the UN General
1969 Debate (UNGD) and with health in the NDCs committed to as part of the 2015 Paris
1970 Agreement.^{4,234} The indicator is based on a key word search of the United Nations General
1971 Debate corpus, with algorithm-based natural language processing applied to the official
1972 English versions of the statements.^{255,256} References to health-related terms (e.g. 'health',
1973 'illness', 'disease' and 'malnutrition') and climate-related health exposures were examined
1974 in the 185 countries registering their NDCs in the UNFCCC repository by March 2020, with a
1975 total of 2,159 pages of text analysed. Building on previous analyses, this indicator analyses
1976 not only references, but the prominence they are given in the text.^{237,257} Methods, data
1977 sources and further analyses are described in the Appendix.

1978 As part of the annual UN General Assembly, the UNGD provides a global forum for national
1979 leaders to discuss issues they consider important. Health has been a long-standing issue,
1980 whilst engagement with climate change was limited until the late 1980s (**Error! Reference**
1981 **source not found.**). From the mid-2000s, national leaders began to focus on the
1982 connections between health and climate change, with the proportion rising rapidly from
1983 2007 and peaking in 2014 at 24%.

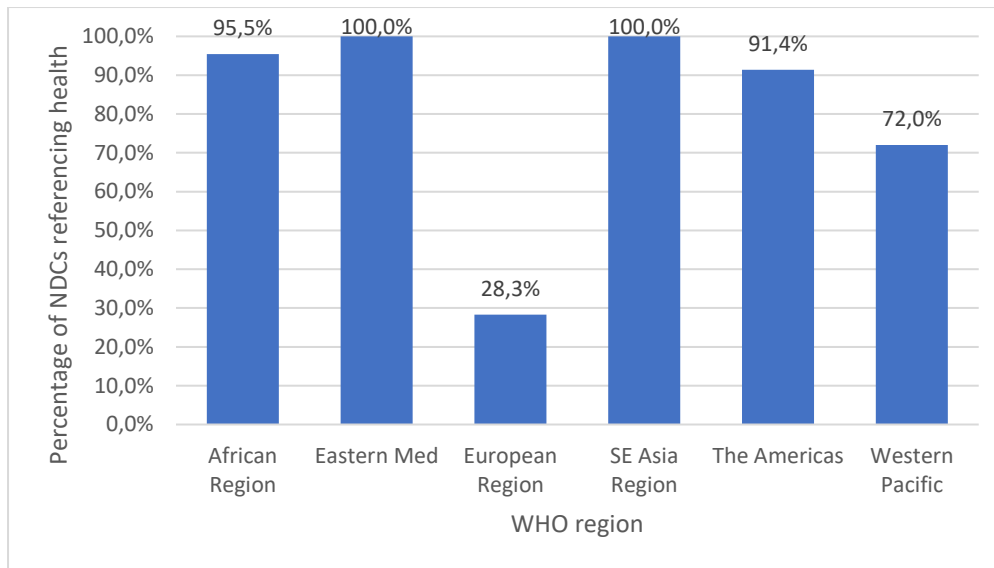
1984 Engagement in health and climate change continues to be led by the small island developing
1985 states (SIDS), particularly in the Western Pacific Region. In contrast, engagement remained
1986 low among the more powerful global actors, particularly those with the highest CO₂
1987 emissions (USA, China, and the EU). For the third consecutive year, President Donald
1988 Trump's statement on behalf of the USA failed to make a single reference to climate change,
1989 let alone to climate change and health linkages. However, 2019 did see growing
1990 engagement with climate change and health by other high-income nations (including
1991 Australia, Canada, Germany, and Spain) and by low-income countries, particularly in the
1992 African Region (for example Burkina Faso, Botswana, Côte d'Ivoire, Niger, and Togo).

1993 At the 2019 UNGD, the majority of health and climate change references focused on the
1994 health impacts of climate change. For example, Dominica highlighted the impacts of climate
1995 change on SIDS', including "rising sea levels, violent tropical storms and hurricanes, periods
1996 of severe drought alternating with floods and forest fires, new plant diseases, and vector-
1997 borne disease such as chikungunya and Zika present an existential threat." Similarly, Tonga's
1998 UNGD statement discussed how extreme weather events linked to climate change "are
1999 increasingly more intense, inflicting damage and destruction on our communities and
2000 ecosystems and putting the health of our peoples at risk."

2001 The 2019 UNGD also saw discussion of adaptation and resilience to "upgrade and climate-
2002 proof our health-care facilities" (Nauru), improve "the quality of health care and the
2003 durability of health-care systems in the face of the climate crisis" (Palau) and build "climate
2004 change resilience in our sectoral policies and strategies for health, transport, agriculture and
2005 pastoral production" (Niger).

2006 The second part of this indicator focuses on health within the NDCs, assessing both the
2007 references and their prominence within the text. Here, some 73% of NDCs included
2008 considerations of public health. At the WHO regional level, all countries in the South East
2009 Asian and Eastern Mediterranean Regions discuss these links (Figure 28). At the country
2010 level, references to health are particularly common among Least Developed Countries
2011 (95%). In contrast, the European Union (representing the contributions of 28 countries) and
2012 the USA NDCs have none.

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Figure 28: Reference to health in the NDCs by WHO region. The European region (which consists of 53 countries) is adjusted for the single NDC representing 28 EU countries; treating the EU as one country would increase the regional proportion to 60%.

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A range of health dimensions were highlighted in the NDCs, including the direct impacts of climate change on health and health-related infrastructure. For example, in their respective NDCs, Morocco notes that climate change would increase deaths “by 250,000 annually between 2030 and 2050 due to malnutrition, malaria, diarrhea and heat-related stress” and Cambodia discusses the effects of climate change on “death, injury, psychological disorders and damage to public health infrastructure”. There are also references to the co-benefits of interventions; for example, Saint Lucia refers to “human health benefits” among “co-benefits associated with its mitigation efforts”.

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Among the NDCs considering health and climate change, extreme weather events (e.g. floods, drought) and food security were most commonly cited, with 52% discussing these links. The proportion was highest in the NDCs from countries in South East Asia, and lowest in Europe. Examples include Sri Lanka’s NDC, which warns of its “water borne diseases” which “can increase due to extreme heat and drought” and Nepal’s NDC which describes “an increased frequency of extreme weather events such as landslides, floods and droughts resulting to the loss of human lives”.

2034

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2036 Indicator 5.5: Corporate Sector Engagement in Health and Climate change

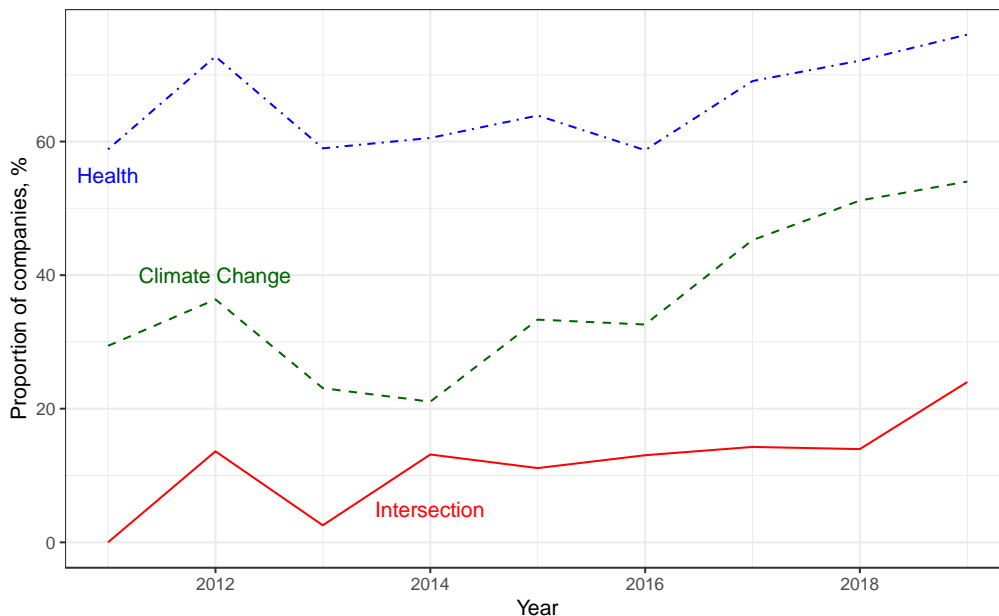
2037 *Headline finding: engagement in health and climate change increased to 24% in 2019*
2038 *among healthcare companies in the UN Global Compact, although this engagement*
2039 *continues to lag behind other sectors.*

2040 The UN Global Compact (UNGC) is a UN-supported platform, created to promote
2041 environmental and social responsibility in the business sector.²⁵⁸ It represents over 10,000
2042 companies from more than 160 countries.²⁴¹ Focusing on the healthcare sector, Figure 29
2043 tracks engagement in health and climate change in the UNGC Communication on Progress
2044 reports that companies submit each year.

2045 Analysis was based on key word searches of health-related and of climate change-related
2046 terms in 20,775 annual reports in the UNGC database, and engagement in health and
2047 climate change was identified using natural language processing.²⁴¹ Methods, data sources
2048 and further analyses are described in the Appendix.

2049 This indicator points to an increase in healthcare sector engagement in 2019, with 24% of
2050 companies referring to the links between climate change and health (Figure 29). However,
2051 other sectors have higher levels of engagement, including the energy sector and real estate
2052 investment sector.

2053



2054

2055 *Figure 29: Proportion of healthcare sector companies referring to climate change, health, and the*
2056 *intersection of health and climate change in Communication on Progress reports, 2011-2019.*

2057 Conclusion

2058 Public and political engagement is essential to curb fossil fuel consumption and hold global
2059 temperature rise to below 1.5°C.²⁵⁹ Section Five has examined indicators of engagement
2060 relating to the media, the public, the scientific community, national government and the
2061 corporate sector. Taken together, the analyses point to two broad trends.

2062 Firstly, engagement with health and climate change continues to increase. Between 2007
2063 and 2019, newspaper coverage increased by over 50% and scientific journal output by over
2064 500%. Across 2018 and 2019, the proportion of Wikipedia users searching for articles that
2065 linked health and climate change also increased. There is evidence of dynamic and
2066 reinforcing relationships between these domains. Media coverage increased at times of
2067 heightened political engagement and public engagement. September 2019, and Greta
2068 Thunberg's speech at the UN Climate Action Summit in particular, also saw a spike in
2069 individual engagement in health and climate change, as captured by Wikipedia use.

2070 However, beneath these trends are persisting inequalities in wealth and political influence.
2071 In both the UNGD and the NDCs, engagement in health and climate change is led by
2072 countries and regions that are suffering most from a changing climate to which they have
2073 contributed least. At the same time, the science of health and climate change continues to
2074 be led by higher-income, high-emitting countries, which are the most responsible for
2075 climate change.^{218,260}

2076 Secondly, in absolute terms, climate change continues to be framed in ways that pay little
2077 attention to its health dimensions. One in six newspaper articles on climate change discuss
2078 its health dimensions; less than one in ten scientific articles do so; as do less than one in
2079 four healthcare companies signed up to sustainable business practices. In the political
2080 domain, health and climate change are rarely connected by government leaders in their
2081 speeches at the UN's major global forum and, while most NDCs refer to health, countries
2082 with high per capita carbon emissions – including EU countries and the USA – do not.
2083 Nonetheless, in key domains of engagement, the health dimensions of climate change are
2084 increasingly recognised, with media and scientific coverage increasing more rapidly than for
2085 climate change as a whole.

2086 In conclusion, despite the fact that underlying inequalities in the drivers and impacts of
2087 climate change remain, there is evidence that health is becoming increasingly central to
2088 public and political engagement.

2089 Conclusion: The 2020 Report of the Lancet Countdown

2090 With global average temperature rise having reached 1.2°C above pre-industrial times, the
2091 indicators contained in the 2020 report provide insights into the health impacts of climate
2092 change today, and in the future. Extremes of heat hit vulnerable populations the hardest,
2093 with some 296,000 deaths occurring as a result of high temperatures in 2018 (Indicator
2094 1.1.3)

2095 The climate suitability for the transmission of a range of infectious diseases – dengue fever,
2096 malaria, and *Vibrio* bacteria– have demonstrated sustained rises across the world (Indicator
2097 1.3.1). This is occurring at the same time as crop yield potential is falling for each of the
2098 major crops tracked, with dire consequences anticipated for food-insecure populations
2099 (Indicator 1.4.1).

2100 And yet, the global response has remained muted. The carbon intensity of the global energy
2101 system has remained flat over the past three decades, and global coal use for energy has
2102 increased by 74% over the same period (Indicators 3.1.1 and 3.1.2). This has resulted in an
2103 estimated 390,000 deaths from particulate air pollution generated by coal fired power, with
2104 total global deaths for all ambient sources exceeding 3.01 million in 2018 (Indicator 3.3). In
2105 the agricultural sector, emissions from livestock grew by 16% from 2000 to 2017, with some
2106 990,000 deaths occurring globally from excess red meat consumption in 2017 (Indicators
2107 3.5.1 and 3.5.2).

2108 In the face of this, the response from the health profession continues to gain momentum.
2109 Spending on health system adaptation continued its previous upward trend, rising by 5.3%
2110 in 2019, to \$18.4 billion (Indicator 2.4). A nine-fold increase in original research on health
2111 and climate change has occurred in just over 10 years, and, in half that time, health
2112 institutions with total assets of \$42 billion have divested their holdings from fossil fuel
2113 industries (Indicators 5.3 and 4.2.3). Led by low-income countries, more governments are
2114 linking health and climate change in their annual UN General Debate speeches and their
2115 NDCs under the Paris Agreement.

2116 The public health and financial effects of COVID-19 will be felt for years to come, and efforts
2117 to protect and rebuild local communities and national economies will need to be robust and
2118 sustained. Despite concerning indicators across each section of this report, the 2021 UN
2119 climate change conference presents an opportunity for course correction, and revitalised
2120 Nationally Determined Contributions. The window of opportunity is narrow, and if the
2121 response to COVID-19 is not fully and directly aligned with countries' national climate
2122 change strategies, the world will be unable to meet its commitments under the Paris
2123 Agreement, damaging health and health systems today, and in the future.

2124

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