



Framework Convention on Climate Change



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Individual Climate and Health Country Profiles and the Climate and Health Global Overview form a complementary package of documents.

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EXECUTIVE SUMMARY

To protect health from risks derived from climate change, decision-makers (going from national leaders to individual citizens) need access to the best information possible on the risks and the opportunities for action. This report accompanies a set of country profiles on climate change and health. It provides an overview of the global consequences of collectively acting, or failing to act, to address climate change and its associated health risks.

Emissions of the pollutants that are driving climate change are growing rapidly. If current trends continue, the world could see a 4°C rise in global mean surface temperatures over the course of the current century. This will entail severe disruptions to precipitation patterns and to the frequency and intensity of some extreme weather events.

Such a degree of climate change would trigger a range of health impacts, concentrated on the poorest and most vulnerable populations, both within and between countries. Even considering only a subset of the health risks, and making optimistic assumptions about economic growth, climate change can be expected to cause an additional 250,000 deaths yearly by 2030, by hampering the progress that is being made against important killers such as undernutrition, malaria and diarrhoea. Reducing global carbon emissions may not bring clear reductions in these diseases for several decades, due to the long time lags involved, and changes in other health determinants. However, such reductions remain essential to maintain the conditions for combatting these diseases in the long term, as well as to avoid other uncertain, but potentially severe risks, including extreme weather events overwhelming health systems; breakdown in food systems; large-scale population displacement, and exacerbation of poverty, thereby reversing progress in health and overall development.

There is an additional important health motivation to mitigate climate change. Many of the drivers of carbon emissions to the atmosphere, such as inefficient and polluting energy and transport systems, also directly harm health. The largest and most directly connected of these risks is air pollution, which causes over 7 million deaths each year, or one in eight of all deaths. The close connection between actions that drive climate change, and those that cause local air pollution, call for an integrated approach to address both sets of risks.

Making the changes necessary to avoid the worst of the risks is a very large challenge. To limit global warming, with a 50% probability or more, to the widely agreed target of less than a 2°C increase from preindustrial times, global emissions of greenhouse

gases would need to fall by between 25% to 55% over the 2010-2050 period. Instead, emissions have grown by approximately 2.2% per year during 2000-2010. In addition, although it is estimated that \$70 billion to \$100 billion per year will be needed globally to adapt to climate change by 2050, only a fraction of these funds have been made available to date, and a much smaller proportion directed to health protection.

There is an important opportunity, however, for coordinated action to address climate change and improve health. Strengthening the resilience of health systems would both save lives now, and protect populations from much of the potential health impacts of climate change at least until the middle of the coming century. Promoting more sustainable public policy and individual choices could bring substantial reductions in climate pollution, and bring large, immediate and local health gains. For example, implementing a targeted set of measures specifically to address Short Lived Climate Pollutants (SLCPs) would be expected to save approximately 2.4 million lives a year, and reduce global warming by about 0.5°C by 2050. Placing a price on polluting fuels that reflected their health impacts could be expected to cut outdoor air pollution deaths by approximately half, and reduce greenhouse gas emissions by over 20%. This can also be expected to raise approximately 3% of GDP, or \$3 trillion per year in revenue – over half the total value of health spending by all of the world's governments.

The international community has made important progress in recent years. Global climate and health agreements now provide clear mandates for stronger action to protect health from climate risks, and to promote the health benefits of cleaner development choices. A range of policy and technical support is now being made available to support countries in their efforts to include health in adaptation and mitigation policies. What is needed now is a more systematic, evidence-based and scaled-up implementation. The country profiles both provide a summary of information to support national actions, and lay the basis for sustained tracking of progress in this critical endeavour.

INTRODUCTION

There is now a very large body of evidence that human actions, mainly the burning of fossil fuels, have caused significant changes in the climate system. The effects will persist for centuries or longer, with profound implications for human health and well-being.

The implications of climate change for health - and the opportunities to reduce greenhouse gas emissions - vary greatly between and even within countries. The World Health Organization, in partnership with the United Nations Framework Convention on Climate Change and working with a range of experts and researchers, is therefore producing country profiles to provide evidence on the links between climate change and health as well as the effects on health of policies to reduce greenhouse gas emissions within individual nations.

In addition, as a global society, we have a choice. The actions taken by countries, and their citizens, add up. If we take strong actions to address climate change, while also choosing paths that protect and promote health, we have the opportunity to collectively bring about a planet that is not only more environmentally intact, but also has cleaner air, more abundant and safer freshwater and food, more effective and fairer

health and social protection systems - and as a consequence, healthier people. In contrast, if we continue on our current path of high levels of greenhouse gas emissions, we are choosing a planet that is more environmentally degraded, inequitable, and hostile to human life. If we fail to adapt to climate change, the most vulnerable populations will be exposed to increasing health risks.

This document is to accompany the country profiles. It follows the same structure to provide an overview of the global trends in climate change and health that we can expect to experience, depending on our collective level of ambition and effectiveness.

The health community has a unique contribution to make in supporting reductions in greenhouse gas emissions, and in implementing the preventive public health measures that will protect populations from the worst consequences of global warming.

The level and rate of future climate change will depend on amounts of emitted greenhouse gases and other climate pollutants, such as black carbon. The Intergovernmental Panel on Climate Change (IPCC) has defined four alternative pathways of future emissions. The country profiles, and this report, use the highest (RCP 8.5) and lowest (RCP 2.6) of the emissions pathways to illustrate the choice between inhabiting a planet with unabated climate change, and that in which the extent of climate disruption is limited.

Current emissions of greenhouse gases are tracking along the higher end of the range of IPCC pathways (i.e. closer to RCP 8.5). By the end of the century, such high emissions are projected to lead to concentrations of greenhouse gases in the atmosphere that are almost four times preindustrial levels. This would be expected to bring a 3.7°C rise in global mean surface temperatures (with a likely range of 2.6°C to 4.8°C)

by the 2090s compared to 1986–2005 temperatures, in addition to the warming of 0.6°C which has already occurred since preindustrial times. Such warming would cause severe disruptions to precipitation patterns, as well as to the frequency and intensity of some extreme weather events such as heat waves, extreme precipitation, and storm surge in coastal areas [1].

Phenomenon and direction of trend	Assessment that changes occurred [typically since 1950 unless otherwise indicated]	Assessment of a human contribution to observed changes	Likelihood of further changes [Early 21 st Century]	Likelihood of further changes [Late 21 st Century]
Warmer and/or fewer cold days and nights over most land areas	Very likely	Very likely	Likely	Virtually certain
Warmer and/or more frequent hot days and nights over most land areas	Very likely	Very likely	Likely	Virtually certain
Warm spells/heat waves. Frequency and/or duration increases over most land areas	Medium confidence on a global scale - Likely in large parts of Europe, Asia and Australia	Likely	Not formally assessed	Very likely
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation	Likely more land areas with increases than decreases	Medium confidence	Likely over many land areas	Very likely over most of the mid-latitude land masses and over wet tropical regions
Increases in intensity and/or duration of drought	Low confidence on a global scale - Likely changes in some regions	Low confidence	Low confidence	Likely (medium confidence) on a regional to global scale
Increases in intense tropical cyclone activity	Low confidence in long term (centennial) changes - Virtually certain in North Atlantic since 1970	Low confidence	Low confidence	More likely than not in the Western North Pacific and North Atlantic
Increased incidence and/or magnitude of extreme high sea level	Likely [since 1970]	Likely	Likely	Very likely

Table 1.1. **Extreme weather and climate events:** Global-scale assessment of recent observed changes, human contribution to the changes, and projected further changes for the early [2016–2035] and late [2081–2100] 21st century: Adapted from [1].

In contrast, effective national action, supported by international cooperation, could limit carbon emissions to a lower pathway such as RCP2.6. This would be expected to lead to considerably lower increases in global temperature, in the order of 1.0°C [likely range 0.3-1.7°C] by the end of the century compared to 1986-2005 temperatures [i.e. 1.6°C since the preindustrial era] [1].

While climate projections are often presented for the course of the 21st century, the trends will continue beyond that time, in some cases for many centuries to come. For example, it is virtually certain that global mean sea level rise will continue for many centuries beyond 2100. It is expected that if we continue to follow the RCP 8.5 emissions pathway, global mean sea level rise will be 1 to more than 3 meters by 2300 [2].

Our current greenhouse gas emission trajectory is committing the planet to significant climate change, including warming, and increase in the frequency and intensity of some extreme weather events. It is still possible for concerted action by individuals, communities and nations to make the transition to a lower-carbon pathway, that would slow and eventually halt further human disruption of the climate.

GLOBAL AVERAGE SURFACE TEMPERATURE CHANGE

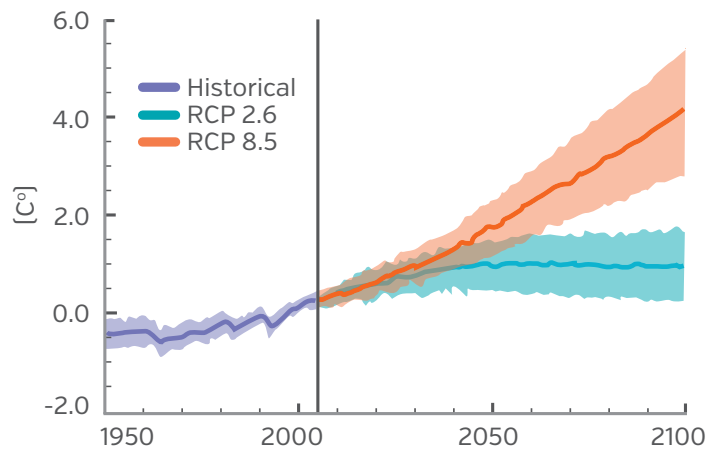


Figure 1.1. Projected global average surface temperature change during 1950-2100 under two emissions pathways described by IPCC, ranging from the results of weak action to reduce greenhouse gas emissions [RCP 8.5], to the expected effects of more ambitious and effective interventions [RCP 2.6] [1].

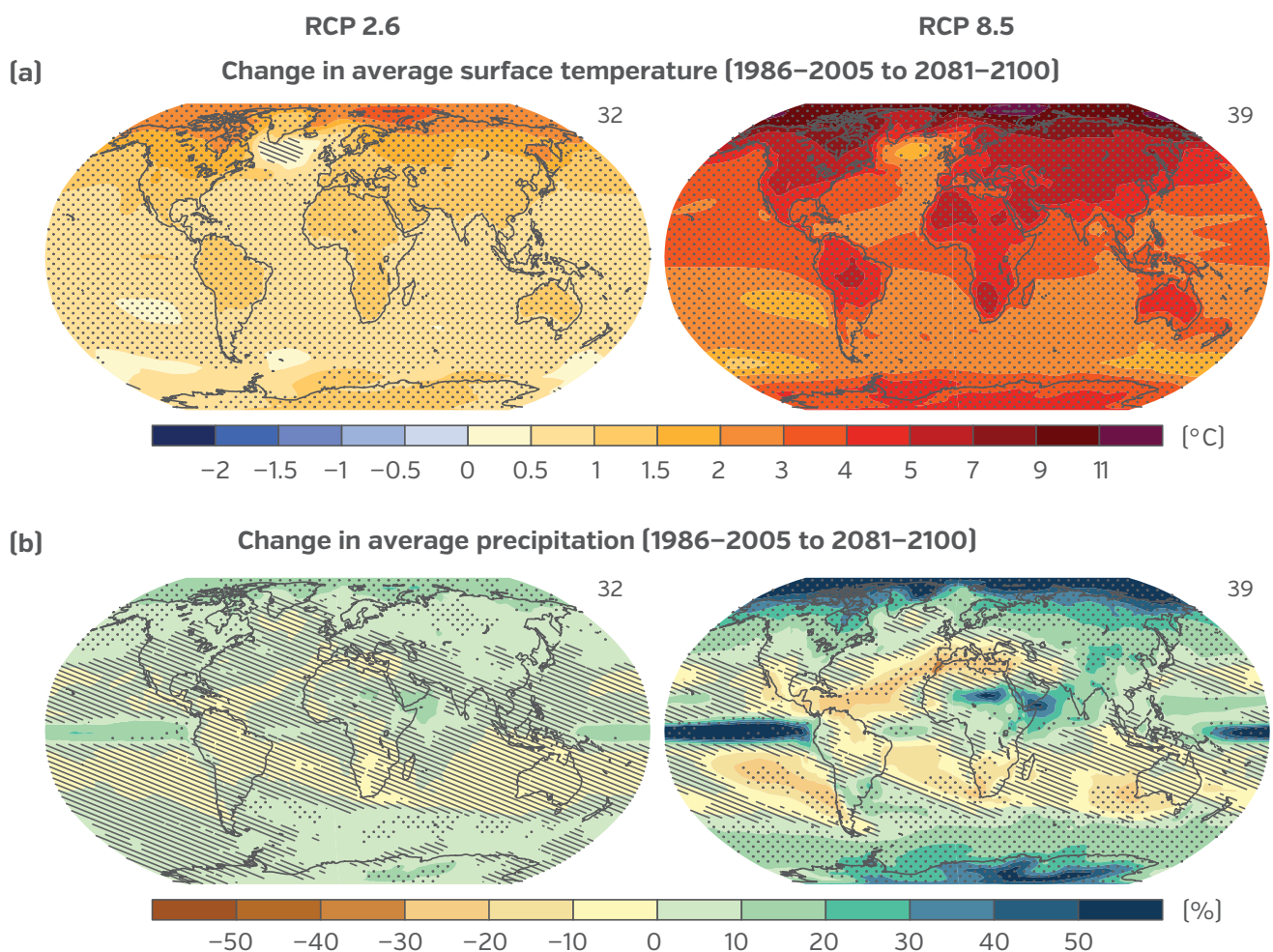


Figure 1.2. Maps of projected changes in average temperature and precipitation by the end of the current century, under the lower [RCP 2.6] and higher [RCP 8.5] of the pathways of greenhouse gas emissions assessed by IPCC [1].

CURRENT AND FUTURE HEALTH RISKS DUE TO CLIMATE CHANGE

There is strong evidence that climate and human health are tightly connected. Assessments by the IPCC, WHO and others have concluded that health is already affected both by climate variability and by climate change, and that the overall impact for most populations, and for the world as a whole, is negative. The impacts are expected to grow as climate change continues, exacerbating existing threats and undermining progress in development and global health.

In recent years, evidence has built up that increasing temperatures, changing precipitation patterns, more extreme weather, and sea level rise, will bring a range

of health effects [3-5]. Table 2 summarizes some of the most important expected impacts of climate change by the middle of the current century.

	Exposures affected by climate change	Health risks	Health impacts	Confidence rating
Direct effects	Increased numbers of warm days and nights; increase in frequency and intensity of heat waves; increased fire risk in low rainfall conditions	Excess heat-related mortality; increased incidence of heat exhaustion and heat stroke, particularly for outdoor labourers, athletes, elderly; exacerbated circulatory, cardio-vascular, respiratory, and kidney diseases; increased premature mortality related to ozone, and air pollution produced by fires, particularly during heat waves	Greater risk of injury, disease, and death due to more intense heat waves and fires	Very high
	Decreased numbers of cold days and nights	Lower cold-related mortality, reduced cardiovascular, and respiratory disease, particularly for the elderly in cold and temperate climates	Modest improvements in cold-related mortality and morbidity	Low
Effects mediated through natural systems	Higher temperatures and humidity, changing and increasingly variable precipitation, higher sea surface and freshwater temperatures	Accelerated microbial growth, survival, persistence, transmission, virulence of pathogens; shifting geographic and seasonal distributions of e.g. cholera, schistosomiasis, and harmful algal blooms; lack of water for hygiene; flood damage to water and sanitation infrastructure, and contamination of water sources through overflow	Increased risks of food- and water-borne diseases	Very high
	Higher temperatures and humidity, changing and increasingly variable precipitation	Accelerated parasite replication and increased biting rates; prolonged transmission seasons; re-emergence of formerly prevalent diseases; changing distribution and abundance of disease vectors; reduced effectiveness of vector control interventions	Increased risks of vector-borne diseases	Medium
Effects heavily mediated by human systems	Higher temperatures and changes in precipitation	Lower food production in tropics; lower access to food due to reduced supply and higher prices; combined effects of undernutrition and infectious diseases; chronic effects of stunting and wasting in children	Increased risk of under-nutrition resulting from diminished food production in poor regions	High
	Higher temperatures and humidity	Outdoor and unprotected workers obliged to work in physiologically unsafe conditions, or to lose income or livelihood opportunities	Consequences for health of lost work capacity and reduced labour productivity in vulnerable populations	High
Combined effect	Overall climate change	Combination and interactions of risks above	Negative health effects will outweigh positive effects worldwide	High

Table 2.1. **Summary of the main expected health impacts of climate variability and climate change globally by the middle of this century.** The final column refers to the level of confidence in the evidence for expected health impacts, as assessed in IPCC's Fifth Assessment Report [6]. Other health impacts are possible (see text), but were not assigned an evidence grading by the IPCC.

Negative impacts will also be greater where climate change combines with factors that increase vulnerability. For example, diseases such as malaria, diarrhoea, and the health impacts of malnutrition, are highly sensitive to climate conditions, but they are also strongly affected by poverty, and the effectiveness of

health and other social protection systems. The effects will be felt hardest in low- and middle-income countries and populations, including in sub-Saharan Africa, South Asia and Small Island Developing States (see Figure 2.1).

QUANTIFYING FUTURE HEALTH RISKS FROM CLIMATE CHANGE

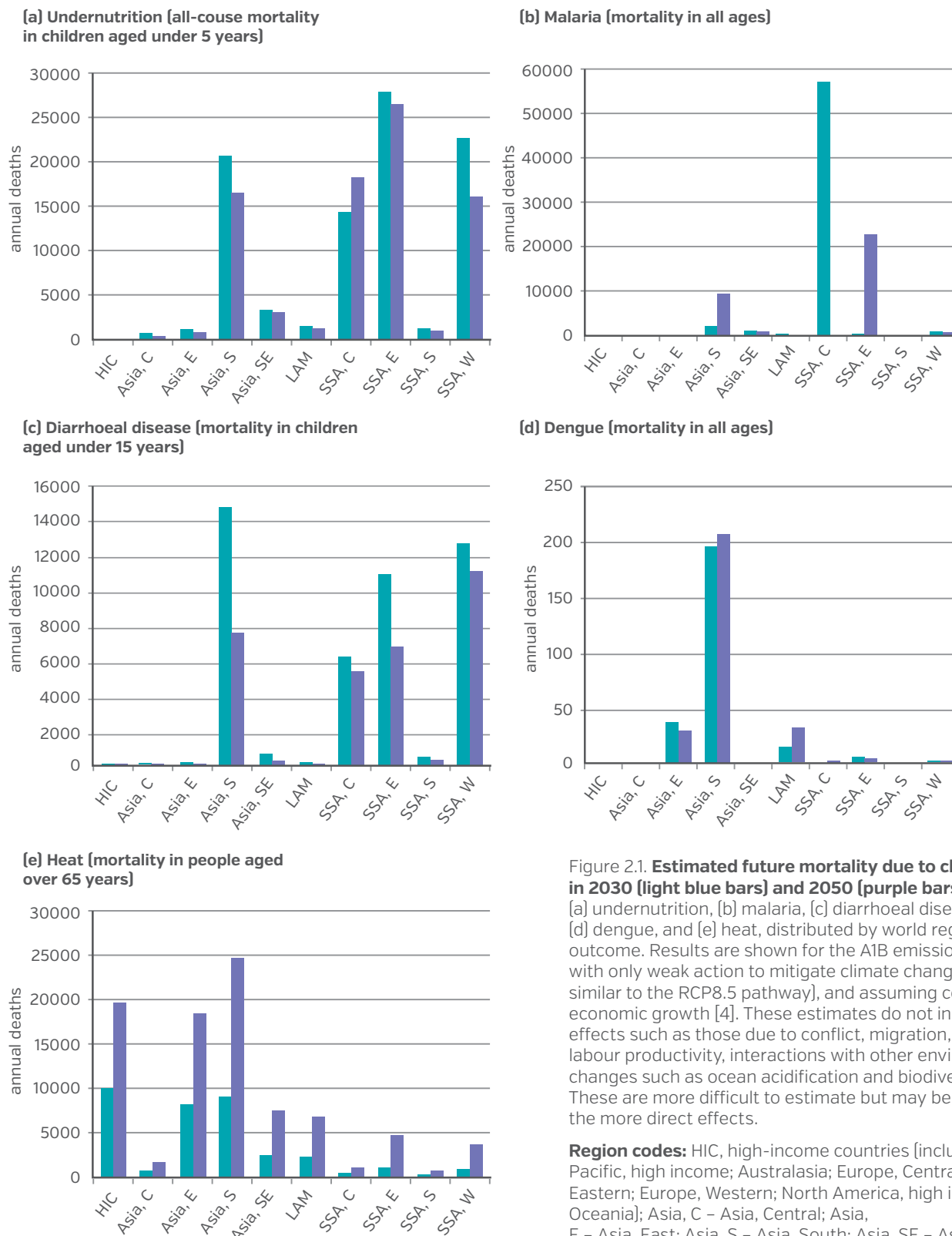


Figure 2.1. **Estimated future mortality due to climate change in 2030 (light blue bars) and 2050 (purple bars)** from (a) undernutrition, (b) malaria, (c) diarrhoeal disease, (d) dengue, and (e) heat, distributed by world region and health outcome. Results are shown for the A1B emissions scenario, with only weak action to mitigate climate change (i.e. most similar to the RCP8.5 pathway), and assuming continued economic growth [4]. These estimates do not include indirect effects such as those due to conflict, migration, reduced labour productivity, interactions with other environmental changes such as ocean acidification and biodiversity loss. These are more difficult to estimate but may be larger than the more direct effects.

Region codes: HIC, high-income countries (includes Asia Pacific, high income; Australasia; Europe, Central; Europe, Eastern; Europe, Western; North America, high income; and Oceania); Asia, C – Asia, Central; Asia, E – Asia, East; Asia, S – Asia, South; Asia, SE – Asia, South-East; LAM – Latin America (includes Latin America, Andean; Latin America, Central; Latin America, southern; Latin America, tropical; and Caribbean); SSA, C – sub-Saharan Africa, central; SSA, E – sub-Saharan Africa, eastern; SSA, S – sub-Saharan Africa, southern; SSA, W – sub-Saharan Africa, western. Estimates for North Africa/Middle East are not included.

They will also disproportionately affect vulnerable groups within each country. These include the poor; children, due to their developmental susceptibility and their anticipated long-term exposure to environmental changes; women, who make up over 70% of the 1.3 billion people living in extreme poverty; and the elderly. Climate change therefore strains existing health systems and social structures and amplifies already existing social inequities [7].

In addition to health impacts for which there is strong evidence, and for which it is possible to make quantitative assessments, there is an emerging body of evidence of other reasons for concern – effects of climate change which are either particularly severe or irreversible [8]. The IPCC highlights:

- The potential for increasing severity and frequency of extreme weather events including storms and floods, inland flooding, in particular vulnerable urban centres, causing severe ill-health and adverse social outcomes, and threatening the viability of the health system by damaging critical services and infrastructure networks;

- Mass displacement and disruption of livelihoods in low-lying coastal zones and small island states due to storm surges and sea-level rise; breakdown in food systems from drought, flooding, and extremes in precipitation, resulting in food shortages and volatile prices, disproportionately affecting those in low- and middle- income countries; potentially increased risk of violent conflict associated with resource scarcity and population movements;
- Slow-down in economic growth and exacerbation of poverty, with associated reversal of global health progress

Reducing emissions of greenhouse gases together with short-lived climate pollutants such as black carbon will slow down climate change, minimize damage to the environmental and social determinants of health and (providing other health determinants are maintained or improved) also avoid unacceptable health risks over the long term [Box 1].

BOX 1. UNACCEPTABLE RISKS AND LIMITS TO ADAPTATION

Risk assessments for climate change often aim to provide the best conservative, quantitative estimates of health impacts, such as numbers of people who are likely to be exposed to, or die from, infectious diseases sensitive to meteorological conditions. As a complementary approach, specific outcomes considered as unacceptably hazardous are identified, and their probability is assessed, depending on preventive measures undertaken. This approach is widely used to evaluate, inter alia, the risk of natural disasters, or intentional or accidental incidents at nuclear facilities.

This approach is particularly relevant where there are clear thresholds that should be avoided. For example, human physiology dictates that it is unsafe, and very rapidly fatal, to carry out physical activity above specific levels of temperature and humidity. The limits vary with the level of exertion, and can be modified by acclimatization and behaviour change, but only to a limited extent.

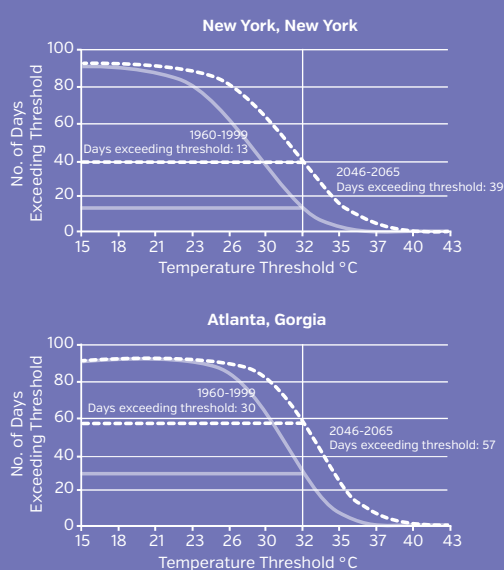


Figure 2.2. **Probability of exceeding temperature thresholds of 32°C in US cities**, under the IPCC A1B emissions scenario, by the middle of the century, compared to a 1961-1990 reference period. Adapted from [9].

Using these well-studied limits, it is possible to evaluate the probability of climate change raising temperatures and humidity to levels where it would be impossible to carry out different levels of physical activity during daylight hours, for at least one month during the year, in different locations around the world. As shown in Figure 2.2., projected temperature change by the middle of the century is for example expected to increase the probability of passing a threshold associated with higher mortality in US cities, almost doubling in Atlanta, USA, and tripling in New York City.

To take another example, Figure 2.3., a global mean temperature increase of about 4.5°C [within the likely range for the end of the century under current emissions paths] would have a 50% chance of completely precluding medium or heavy physical work outside in northern India in the hottest month of the year. Other kinds of physical activity would be impossible at even lower levels. For example, even a 1°C increase has a 40% chance of making sporting activity dangerous in northern India throughout the summer, and with a 4°C warming this probability will have risen to approximately 80-90% in Northern India and Southeastern USA, and 50% in South-Eastern China.

Our degree of ambition and success in addressing global warming will therefore determine, among many other things, whether it will continue to be possible for people to live, work and play outside for significant parts of the year, in many regions of the world, calling their habitability into question.

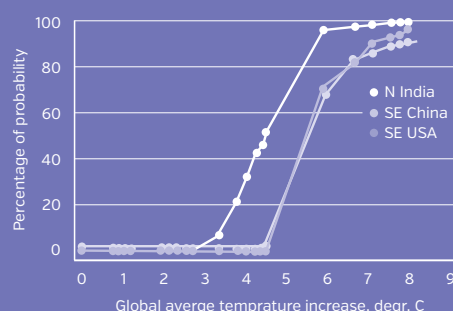


Figure 2.3. **Probability that heat stress will preclude medium to heavy physical work outside during at least one month of the year**, for different levels of global temperature increase, in different locations. More intense activity, such as active sport, would be made impossible at lower levels of warming [10].

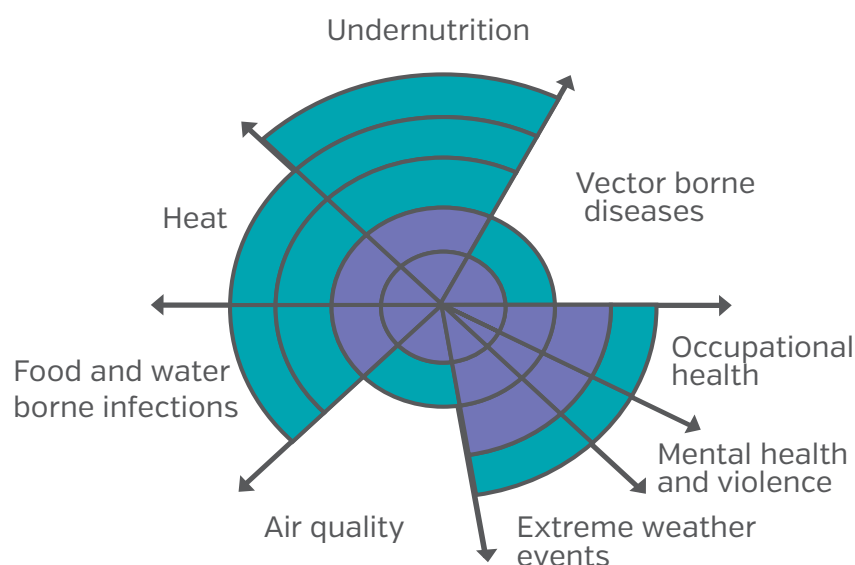
Future climate risks to health can be evaluated in different ways. This can include using quantitative models to make the best conservative estimates of health impacts, while acknowledging that many indirect risks, such as those due to conflict, migration, reduced labour productivity and interactions with other environmental changes such as biodiversity loss and ocean acidification, are difficult to estimate. An alternative approach is to identify “thresholds” for particular health risks, and then assess the possibility of their occurring under different scenarios [Box 1].

In the coming few decades there is also much that countries can do to protect and improve health, through acting on the environmental and social determinants of climate-sensitive diseases, strengthening the climate resilience of both preventive and curative aspects of health systems, and adapting to changing climate conditions.

Figure 2.4. shows a qualitative assessment from the health chapter of the latest IPCC report [3] of the comparative burden of the different health outcomes affected by climate change, and illustrates the degree to which they could be reduced by health adaptation measures.

Climate change is already harming, and will continue to harm, human health. The health community has a unique contribution to make in supporting reductions in greenhouse gas emissions, and in implementing the preventive public health measures that will protect populations from the worst consequences of global warming.

2080-2100 “Era of Climate Options”



Risk and potential for adaption

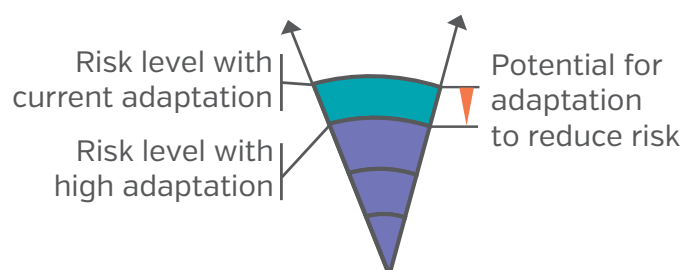


Figure 2.4. **Qualitative assessment of the health impacts from climate change, with and without adaptation measures.** The width of the slices gives an indication of the attributable burden for each health impact, and the light blue area indicates the proportion that could be avoided through strong adaptation measures. Assessment is shown for the period 2080–2100, in which vigorous mitigation efforts could potentially avoid part of the 4°C or higher global temperature increase that would otherwise be expected from current emissions trends [6].

CURRENT EXPOSURES AND HEALTH RISKS DUE TO AIR POLLUTION

Many of the drivers of climate change, such as inefficient and polluting energy and transport systems, also directly harm health. The largest and most directly connected of these risks is air pollution, particularly from fine particulate matter (PM_{2.5}), which causes cancer, cardiovascular and respiratory disease. This is now one of the largest global health risks, with a disease burden comparable to that from tobacco smoking [11, 12].

Approximately 4.3 million deaths each year are attributable to household air pollution, produced mainly by combustion of solid fuels on inefficient cook stoves in poorly ventilated houses in the poorest countries and communities [13]. Furthermore, populations around the world, and particularly in cities, are exposed to high levels of outdoor air pollution,

mainly from transport, industry and power plants. Almost 90% of the global urban population is exposed to air which does not meet WHO air quality standards. As a result, outdoor air pollution is estimated to cause some 3.7 million premature deaths annually [14].

Taken together, and accounting for overlap between household and outdoor exposures, air pollution is estimated to cause seven million deaths every year, or one in eight of all deaths around the world [13, 14].

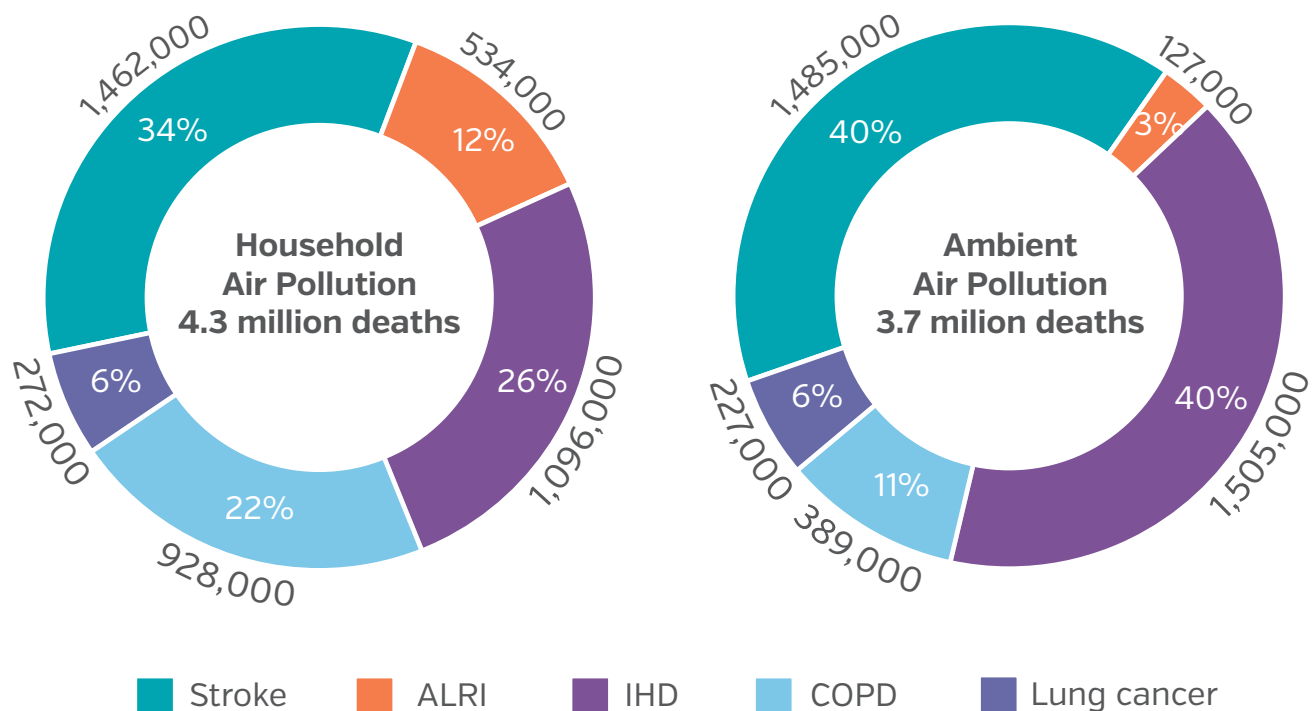


Figure 3.1. **Household and ambient air pollution are among the most important risks to health globally.** Deaths attributable to household and ambient air pollution, 2012 [13,14]. ALRI = acute lower respiratory infections, IHD = ischemic heart disease, COPD = chronic obstructive pulmonary disease.

In many parts of the world, a large proportion of particulate pollution is made up of black carbon, a short-lived climate pollutant (SLCP) that contributes significantly to regional and local warming. Other SLCPs which both have a strong warming effect and damage health include ozone, which is estimated to cause 150,000 deaths each year from respiratory disease [15], and methane, which is an ozone precursor. In addition, there is a large overlap between the sources of health damaging pollution, and those of carbon dioxide, which is the main driver of long-term climate change. For example, in many regions, coal-fired power stations, and diesel and petrol for road transport, are among the main contributors to both CO₂ emissions and outdoor particulate air pollution.

The close connections between activities that drive climate change, and that cause local air pollution call for an integrated approach to address both sets of risks. There is an important opportunity to promote policies that protect the climate, and bring large, immediate and local improvements in air quality and human health.

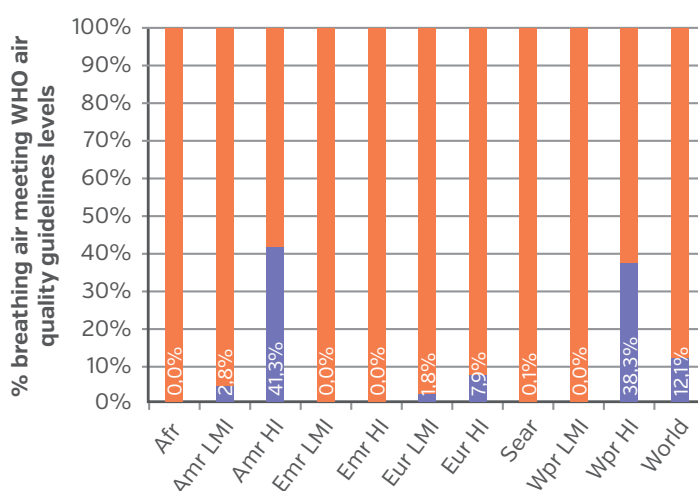


Figure 3.2. **Most people living in cities around the world are exposed to hazardous levels of air pollution.** Percentage of assessed urban population exposed to air quality which meets the WHO air quality standard (purple), compared to those that do not (orange), for countries in different regional and income groupings. Afr = WHO African Region. Amr = WHO Region of the Americas. Emr = WHO Eastern Mediterranean Region. Sear = WHO South-East Asian Region. Wpr = WHO Western Pacific region. Eur = WHO European region. LMI = Low and Middle income; HI = High income. Only approximately 12% of the urban global population breathes air that meets the WHO standard [11].

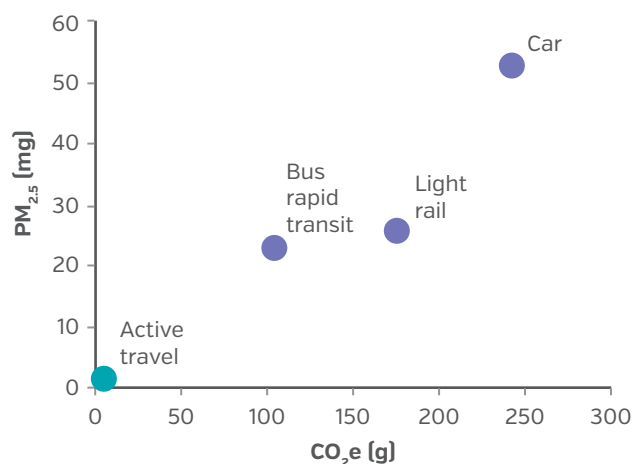


Figure 3.3w. **Emissions of particulate air pollution that harm health, and of greenhouse gases that cause climate change, are often closely correlated.** Life-cycle emissions of PM_{2.5} and CO₂-eq per passenger mile for different modes of urban transport. Results for car, bus, and light rail adapted from Chester et al. [2013] [16,17] for average-occupancy vehicles in Los Angeles, USA. Results for active travel estimated. Adapted from [18].

CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION

Energy and development choices that drive climate change occur throughout the economy. Globally, the main sectors contributing to greenhouse gas emissions are electricity and heat production; agriculture and land use (including deforestation); industry; transport; and buildings. While these are all integral parts of the social and economic system that supports human health, each is also associated with significant health risks. The need for each of these sectors to address climate change therefore presents an important opportunity to promote a “Health in All Policies” approach.

There is an opportunity to take advantage of the very large yet insufficiently recognized potential to implement policies that would both promote health and reduce climate change.

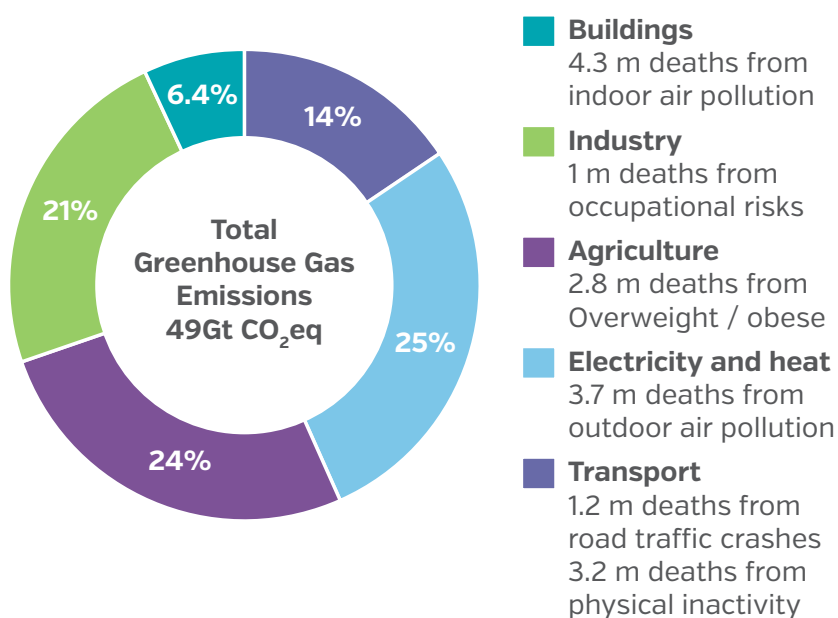


Figure 4.1. **Opportunities to reduce greenhouse gas emissions and reduce health burdens.** Sizes of segments are proportional to greenhouse gas emissions in 2010 (metric tons of CO₂-equivalent), by different sectors (outer circle), and in total (inner circle) [19]. Also shown are WHO estimates of disease burdens from risk factors that are strongly affected by policies in each of these sectors [20].

The most direct health gains - and likely the largest - will probably arise if air pollution and climate change are simultaneously addressed. For example, it is estimated that if the world is able to change track from current emissions pathways to a more modest one (the RCP4.5 scenario which is between the two examined here), this would save approximately 500,000 lives a year by 2030. Economic valuation of these benefits would exceed the costs of mitigation at the global level, and by 10-70 times in East Asia [21].

Implementing a more targeted set of measures specifically to address Short Lived Climate Pollutants (SLCPs) would be expected to save approximately 2.4 million lives a year by 2050, and reduce global warming by about 0.5°C [22]. Some of the largest gains would come through promoting cleaner household energy for cooking, heating and lighting in the poorest communities, who carry the greatest share of the burden of indoor air pollution, largely from black carbon.

Benefits for Public Health

Rapid SLCP mitigation can provide important benefits for public health, saving millions of lives every year.

HEALTH BENEFITS FROM GLOBAL IMPLEMENTATION OF SLCP MEASURES

2,400,000

[0.7-4.6 MILLION]



DEATHS AVOIDED ANNUALLY FROM
REDUCED PM_{2.5} OUTDOOR
AIR POLLUTION BY 2030

+ ADDITIONAL HEALTH BENEFITS
FROM REDUCED PM_{2.5} INDOOR
AND O₃ AIR POLLUTION

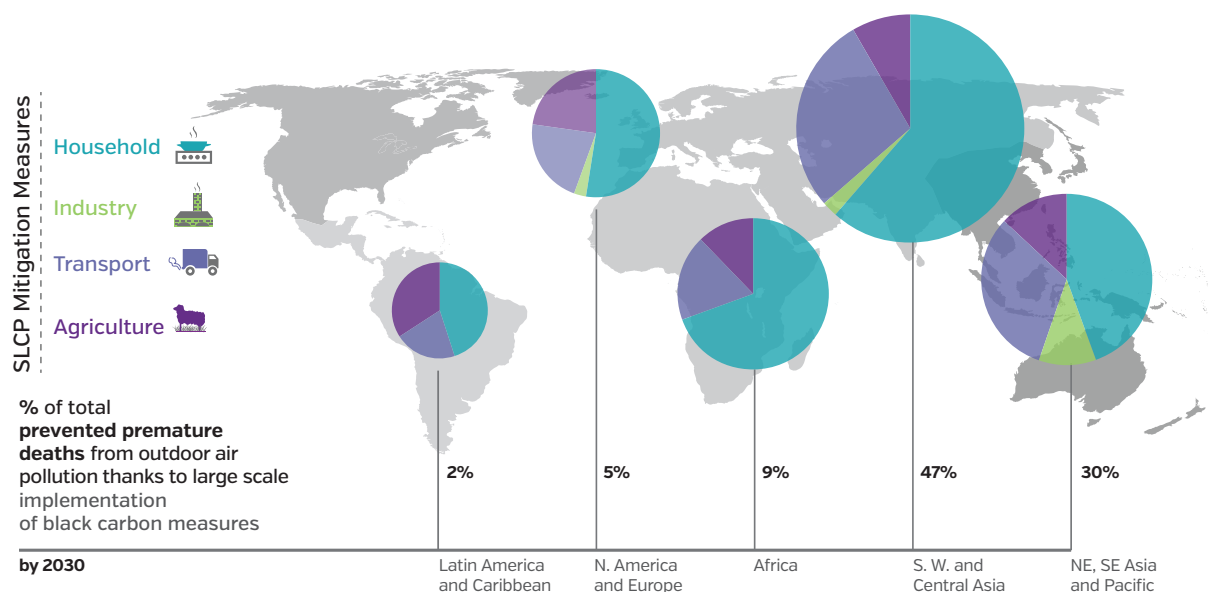


Figure 4.2. **Health benefits of actions to reduce short-lived climate pollutants.** Estimates of the proportion of current deaths from air pollution in different regions of the world that could be avoided by a set of 14 defined interventions to reduce short-lived climate pollutants [22].

There are also important opportunities for health gains in other sectors. For example, transport and urban planning policies that promote walking, cycling and public transport rather than the use of private cars will see reductions in disease not only from lower levels of outdoor air pollution, but also in illnesses related to physical inactivity and noise exposure, alongside positive effects on mental health [23, 24]. Some of these health gains may be very large. Applying existing models of the relationship between physical activity and health [25], researchers have estimated that transitioning from current patterns of urban transport to the same high rates of walking and cycling currently practised in the Netherlands, would lead to an reductions in national disease burden ranging from 0.4% in Bangladesh, to approximately 5% in Canada to over 7% in Jordan [26]. Similarly, policies and individual choices that moderate consumption

of red and processed meat and increase fruit and vegetable consumption in high-consuming populations are expected not only to reduce the significant greenhouse gas emissions associated with the livestock sector, but also reduce the growing burden of associated non-communicable diseases, including cancer and heart disease [27, 28].

In addition to mitigation policies in individual sectors, a complementary approach is for Governments to set a price on carbon emissions, which would be reflected in the costs of goods and services, with revenues either returned to consumers or reinvested in less polluting and more socially beneficial investments. Placing a value on the health impacts of pollution, and including them in the price of carbon, would provide a strong market incentive in favour of cleaner and healthier energy sources [29,30].

There is now strong evidence that the health benefits of many climate change mitigation policies are so large that they would outweigh the investment costs. The goals of health promotion, and addressing climate change, can be advanced through a “Health in All Policies” approach, in which the health sector plays its role in identifying and promoting sectoral choices that are both greener and healthier.

BOX 2. PUTTING THE RIGHT PRICE ON CARBON: OPPORTUNITIES TO IMPROVE THE ECONOMY, ADDRESS CLIMATE CHANGE, AND IMPROVE PUBLIC HEALTH

Failure to include health in energy and climate policies leads to economically inefficient and socially harmful decisions. Subsidies and externalities (impacts on people not directly involved in the transaction) are well known to distort markets, reducing overall benefits to populations. Globally, the energy sector is estimated to receive \$5.3 trillion support a year in the form of subsidies, and in avoiding paying for the negative consequences of energy use. Approximately half of this value is the health impact of local air pollution, which is not included in the price of the fuels being used [29].

Countries can remove this unfair competitive advantage to polluting energy sources by placing a price on carbon. This move is in their own national interest, even without considering the benefits for the global climate. It would increase the relative price of highly polluting fuels as compared to cleaner ones, so as to maximize the overall net benefit to local populations: the gains for health and other environmental benefits, plus higher revenues, minus the losses due to consumers facing higher energy prices. Countries do not have to wait for international agreements to take such action whereby gains and costs (and overall gain) will relate to their own population.

Research from the International Monetary Fund estimates that the implementation of nationally appropriate energy prices that take into account health impacts would cut outdoor air pollution deaths by approximately one third, and reduce greenhouse gas emissions by over 20%. The same analysis shows this would raise approximately 3% of GDP, or \$3 trillion per year [29]. In comparison, IPCC estimates that the marginal cost of mitigating greenhouse gas emissions globally is approximately \$1 trillion per year [19]. Already, countries such as Norway, Iran, and Indonesia have experience in removing energy subsidies and/or placing a price on carbon, and reinvesting the resulting revenues in socially beneficial and growth-enhancing public spending, such as in infrastructure, health and education.

The engagement of the health community is important to support the case for placing an appropriate price on polluting energy; analysing health impacts to set the right value in the national context, and ensuring well-designed policy measures so that particularly the poorest populations are protected from the transitional impacts of any removal of subsidies and increases in prices for energy (i.e. ensuring that subsidy removal and carbon pricing is at least revenue neutral, particularly for the poorest households).

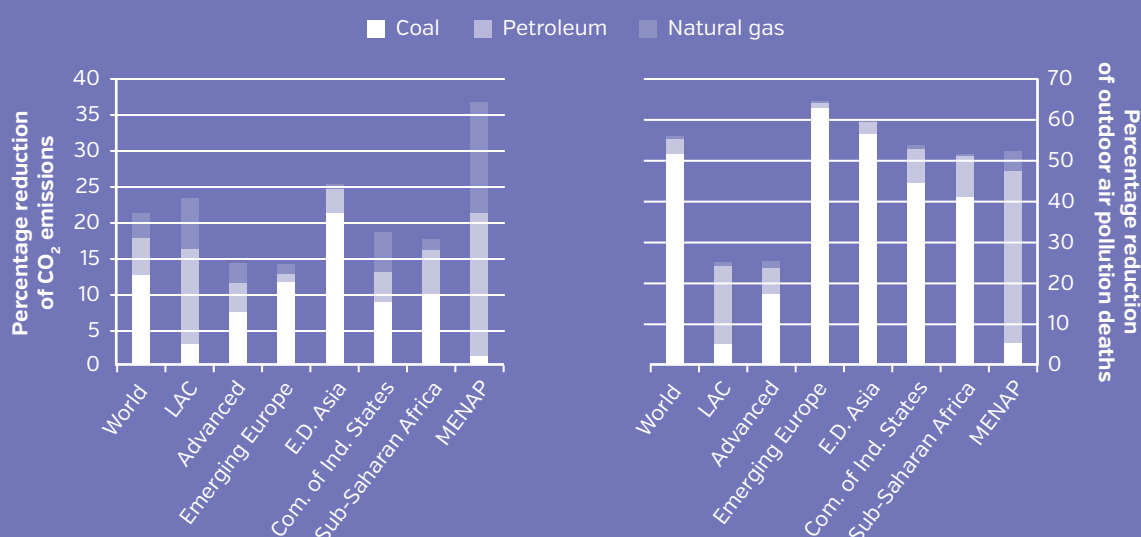


Figure 4.3. **Health and environmental benefits of placing nationally appropriate prices on carbon.** Estimates of the expected reductions in carbon dioxide emissions, and outdoor air pollution deaths, that would be expected through setting a price on carbon that is in countries’ own best interests. LAC = Latin America and the Caribbean; E.D. Asia = Eastern and developing Asia; Commonwealth of Independent States; MENAP = Middle East, North Africa. Figure reproduced from [29].

By signing the United Nations Framework Convention on Climate Change in 1992, countries have committed to taking action to “anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects” including those on human health and welfare. For more than 20 years countries have been working to reduce global greenhouse gas emissions, and increase protection for populations that are most vulnerable to impacts of climate change - including impacts on their health.

Addressing climate change is a very large challenge. In order to have at least a 50% probability of limiting global warming to a 2°C increase from preindustrial times (a widely agreed international target to limit the worst of the damages from climate change), approximately 80% of coal reserves, half of gas reserves, and one-third of oil reserves, will need to remain in the ground [31]. Global emissions of greenhouse gases would need to fall by between 25 to 55% below 2010 levels by 2050 and continue to decrease afterwards.

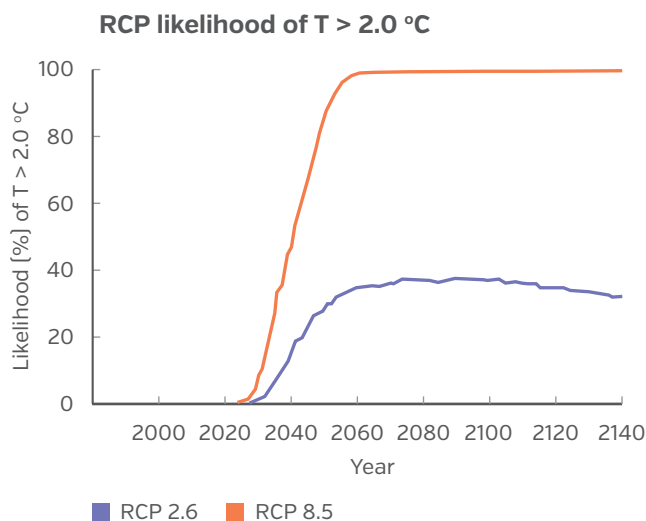


Figure 5.1. **Likelihood of exceeding the 2°C target of global mean temperature increase since the preindustrial era**, depending on which of the different IPCC emissions pathways are followed [1].

However, emissions continued to rise by approximately 1.3% per year between 1970 and 2000, with a faster rate of 2.2% per year from 2000-2010 [19]. Emissions will therefore need to be stabilized, and then reduced, across all sectors of the global economy [32].

The current agreement on the reductions to be made by individual countries, known as the Kyoto Protocol [1997], included commitments to reduce emissions taken by developed countries only. However, countries at all levels of development have now submitted Intended Nationally Determined Contributions (INDCs) that encompass targets for stabilization and reduction of greenhouse gas emissions. The degree of ambition and successful implementation of these targets will determine whether it will be possible to avoid the most severe, and health-threatening, climate change scenarios. In addition, the actual design and implementation of aimed reductions across sectors will determine to what extent countries will be able to get local and immediate health benefits from cleaner and more sustainable energy and development choices.

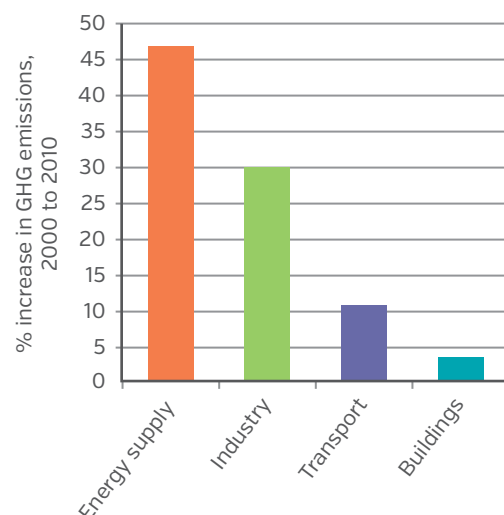


Figure 5.2. **Fastest growing sectors in terms of greenhouse gas emissions, from 2000-2010.** Global yearly greenhouse gas emissions rose by approximately 22%, or from 40 to 49 gigatons per year [19].

The more we are able to limit climate change, the less costly the adaptation to changing conditions will be. However, due to past emissions and the long persistence of greenhouse gases in the atmosphere, significant investment in adaptation will be necessary under any scenario. The most recent IPCC Assessment Report suggests that \$70 billion to \$100 billion per year will be needed globally to adapt to climate change by 2050, with a high degree of uncertainty [33]. As part of the UNFCCC negotiation process, Member States agreed to mobilize \$100 billion per year in international climate financing by 2020, with approximately 50% to be invested in adaptation. By mid-2015, the newly established Green Climate Fund, intended as the main multilateral financing instrument, had received approximately \$10 billion in pledges.

Only a very small proportion of global climate financing has been allocated to health projects. A survey of the main multilateral climate funds that have been in operation for several years (Special Climate Change Fund, Least Developed Countries Fund, Strategic Priority on Adaptation run by the Global Environmental Facility, Adaptation Fund, Pilot Programme for Climate and Resilience and MDG Achievement Fund), revealed that out of over \$2.5 billion of approved funding, only approximately \$36 million (or less than 1.5%) have been allocated to projects specifically addressing health [34] – mainly because very few health projects are submitted.

Countries are making important efforts to reduce greenhouse gas emissions, and to provide financing for adaptation, but much greater efforts will be needed to fully address the challenge. Health can contribute to, and benefit from, stronger mitigation action, and a scale-up of support for climate resilience and adaptation.



Since the entry into force of the United Nations Framework Convention on Climate Change in 1994, the international community has made important steps in mitigation and adaptation, acting nationally, bilaterally, and multilaterally. The UNFCCC has established a wide-ranging support programme for these initiatives. At the policy level, countries are invited to report on their greenhouse gas emissions and on their main vulnerabilities to climate change, as well as their plans for mitigation. Technical and financial support is provided for developing National Adaptation Plans and supporting adaptation projects, with a particular focus on the Least Developed Countries and Small Island Developing States.

Health is part of the core rationale for the UNFCCC, and signatories are also committed to assess the health implications of mitigation and adaptation policies [32]. In 2008, the 194 Member States of the World Health Assembly passed a resolution highlighting the importance of climate change as a critical public health issue [35]. Since that time, frameworks for action have been established in all regions, which has in turn supported the development of the health components of national adaptation plans, health vulnerability and adaptation assessments and implementation projects in a range of countries, along with a rapid expansion of applied research [36]. There has been a particular increase in attention to the opportunities to promote health while also reducing greenhouse gas emissions. At its 20th Session, the UNFCCC Conference of the Parties called for, "...technical examination of opportunities with high mitigation potential, including

those with adaptation, health and sustainable development co-benefits" [37], and countries have requested WHO to place greater emphasis on actions that can improve health while also mitigating the extent of climate change within their work.

The challenge is now to continue to scale up the health contribution to the shared goal of addressing climate change. This requires the health community to play a proactive role in awareness-raising and advocacy, strengthening the evidence base, and climate and health programming. WHO, in partnership with the UNFCCC and partner agencies in the UN system, is now providing policy and technical support to countries to achieve this goal. This includes defining a systematic approach to mainstreaming climate resilience into core health programming, as well as evidence and technical tools on assessing the health implications of mitigation policies.

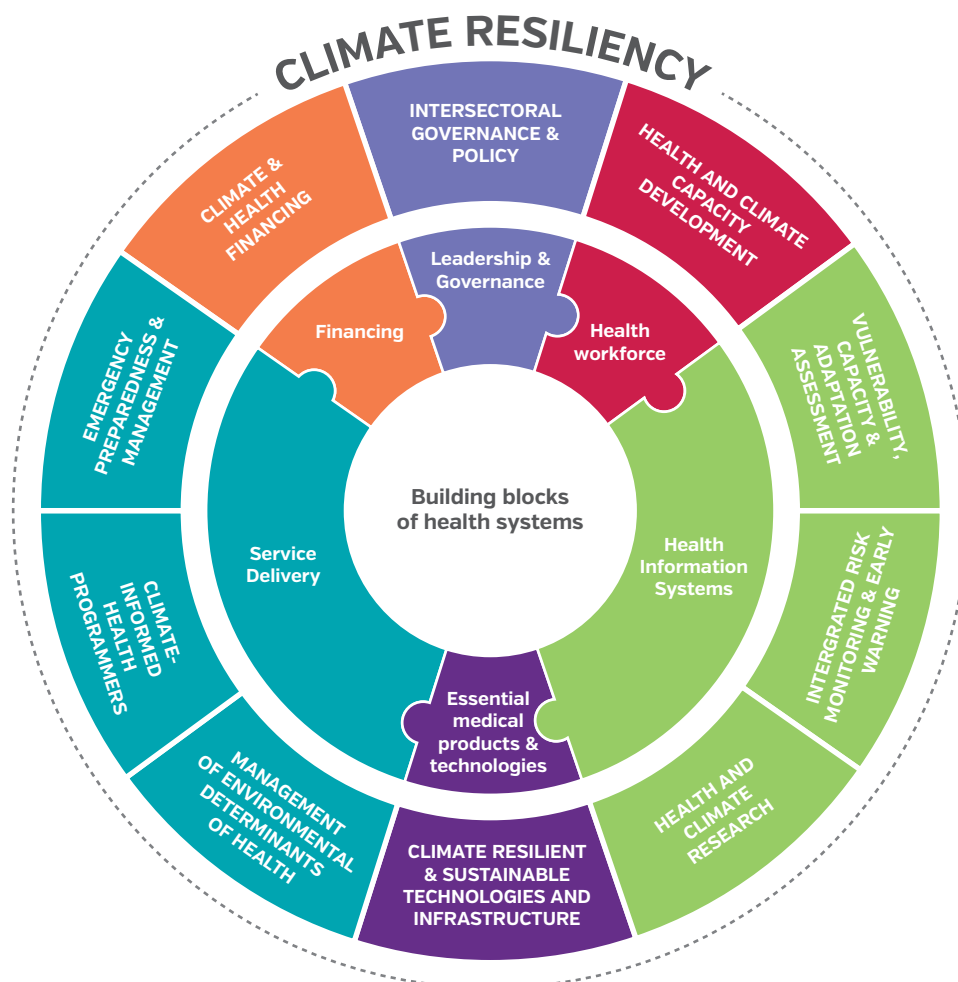


Figure 6.1. **WHO Operational Framework for building climate-resilient health systems.** The inner ring shows the core “building blocks” that support the functioning of all health systems. The outer ring shows the additional components that can integrate climate resilience into core health system programming [38].

To maintain progress, it must be measured. Countries collect and report on a range of relevant data, going from greenhouse gas emissions to climate change vulnerabilities. Those are however not necessarily easily accessible and usable, which prevents the health community from playing its full role in both adaptation and mitigation. The country profiles that accompany this document contribute to bridging that gap. Data collection systems established to compile the profiles also lay the basis for a comprehensive and sustained system for measuring international progress in scaling up health resilience to climate change, and in placing health considerations where they belong - at the heart of mitigation policies.

International mandates, policy and technical support mechanisms are in place to support a stronger engagement by the health sector. The country profiles on climate change and health are an important contribution to measuring and maintaining progress in protecting health from climate change.

Governance and Policy
Country has identified a national focal point for climate change in the Ministry of Health
Country has a National Health Adaptation Strategy approved by the relevant Government entity
The National Communication submitted to UNFCCC includes health implications of climate change mitigation policies
Health Adaptation Implementation
Country currently implementing projects or programmes on health adaptation to climate change
Country has implemented actions to build institutional and technical capacities to work on climate change and health
Country has conducted a national assessment of climate change impacts, vulnerability and adaptation for health
Country with climate information included in Integrated Disease Surveillance and Response (IDSR) system, including development of early warning and response systems for climate-sensitive health risks
Country has implemented activities to increase climate resilience of health infrastructure
Financing and costing mechanisms
Estimated costs to implement Health Resilience to climate change included in planned allocations from domestic funds in the last financial biennium
Estimated costs to implement Health Resilience to climate change included in planned allocations from international funds in the last financial biennium
Health Benefits from Climate Change Mitigation
The national strategy for climate change mitigation includes consideration of the health implications (health risks or cobenefits) of climate change mitigation actions
Country has conducted valuation of co-benefits of health implications of climate mitigation policies

Table 6.1. **Indicators to measure national progress in protecting health from climate change [39].**

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ANNEX A: CONTRIBUTIONS

The Climate and Health Country Profile project is led by the climate change team at WHO-Headquarters: Tara Neville [project manager - consultant]; Diarmid Campbell-Lendrum; Marina Maiero; Mariam Otmani Del Barrio; Elena Villalobos Prats; Sabina Moya Huerta and Judy Sanchez Santana, under the guidance of Maria Neira, Director of The Department of Public Health, Environmental and Social Determinants of Health [WHO] and Flavia Bustreo, Assistant Director-General, Family, Women's and Children Health [WHO]. The Climate and Health Global Overview document was prepared by Diarmid Campbell-Lendrum [WHO], as a complementary product within the Climate and Health Country Profile project.

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