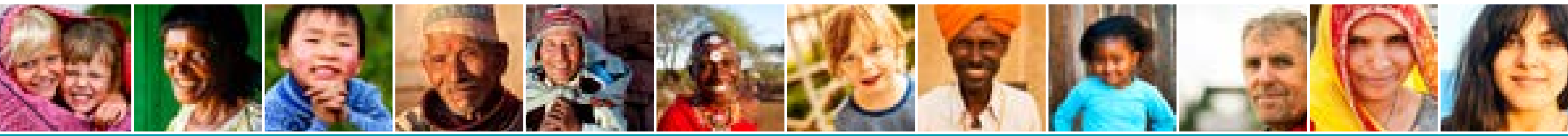
CLIMATE AND HEALTH COUNTRY PROFILE – 2015
MADAGASCAR

World Health Organization

United Nations Framework Convention on Climate Change



OVERVIEW

The island nation of the Republic of Madagascar, situated in the Indian Ocean, has a unique ecosystem. The hot rainy season (November to April) can often bring destructive tropical cyclones. Drought conditions are persistent in Madagascar, in particular in southern areas of the country. Madagascar is also affected by flooding and increased rainfall variability across different areas of the island [Madagascar INDC, 2015]. These climate hazards are expected to worsen as the effects of climate change increase. Without action, climate change in Madagascar is likely to lead to increased mortality and morbidity associated with extreme weather events, heat stress and increased risk of vector-borne diseases. Decreased agricultural yields and poor fishery performance may lead to increased food insecurity, aggravating poverty. Health infrastructure may continue to be destroyed in extreme weather events.

Madagascar has approximately three-quarters of its population living below the national poverty line [World Bank Development Indicators, 2016] and is experiencing slow economic growth, in part due to its high vulnerability to natural disasters [World Bank Country Overview, 2016]. An estimated quarter of the population live in an area at high risk of experiencing a natural disaster [World Bank Development Indicators, 2016].

SUMMARY OF KEY FINDINGS

- In Madagascar, under a high emissions scenario, mean annual temperature is projected to rise by about 4.1°C on average from 1990 to 2100. If global emissions decrease rapidly, the temperature rise is limited to about 1.1°C (page 2).
- In Madagascar, the risk of vector-borne diseases such as malaria and dengue are expected to increase towards 2070 (page 3).
- In Madagascar, under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 50 deaths per 100,000 by 2080 compared to the estimated baseline of just over 1 death per 100,000 annually between 1961 and 1990. A rapid reduction in global emissions could limit heat-related deaths in the elderly to about 10 deaths per 100,000 in 2080 (page 4).

OPPORTUNITIES FOR ACTION

Madagascar has an approved national health adaptation plan and is currently implementing projects on health adaptation to climate change. Additionally, Madagascar has conducted a national assessment of climate change impacts, vulnerability and adaptation for health and is building technical and institutional capacities to work on climate change and health. Country reported data (see section 6) indicate that there are opportunities for further action in the following areas:

1) Adaptation

- Scale up the activities of the Project Climate-Health, which is implemented by the working group on Climate-Health, in partnership with WMO.
- Strengthen the Strategic Alliance of the working group on Health and Climate change, and mobilize resources for the implementation of the National Adaptation Plan on Health and Climate Change.
- Implement activities to increase the climate resilience of health infrastructure.

2) Mitigation

- Develop a national strategy for climate change mitigation which considers the health implications of climate change mitigation actions.
- Conduct a valuation of the health co-benefits of climate change mitigation policies.

3) National Policy Implementation

- Mobilize authorities and development partners for the implementation of policies and strategies integrating adaptation and mitigation measures for climate change.
- Develop a normative, legal and technical frame for the implementation of interventions related to health sector adaptation to climate change and mitigation.

DEMOGRAPHIC ESTIMATES	
Population (2013)[a]	22.92 million
Population growth rate (2013)[a]	2.8%
Population living in urban areas (2013)[b]	33.8%
Population under five (2013)[a]	15.7%
Population aged 65 or over (2013)[a]	2.8%
ECONOMIC AND DEVELOPMENT INDICATORS	
GDP per capita (current US$, 2013)[c]	463 USD
Total expenditure on health as % of GDP (2013)[d]	4.2%
Percentage share of income for lowest 20% of population (2010)[c]	6.5
HDI (2013, +/- 0.01 change from 2005 is indicated with arrow)[e]	0.498 ▲
HEALTH ESTIMATES	
Life expectancy at birth (2013)[f]	64 years
Under-5 mortality per 1000 live births (2013)[g]	53

a World Population Prospects: The 2015 Revision, UNDESA (2015)
b World Urbanization Prospects: The 2014 Revision, UNDESA (2014)
c World Development Indicators, World Bank (2015)
d Global Health Expenditure Database, WHO (2014)
e United Nations Development Programme, Human Development Reports (2014)
f Global Health Observatory, WHO (2014)
g Levels & Trends in Child Mortality Report 2015, UN Inter-agency Group for Child Mortality Estimation (2015)

1 CURRENT AND FUTURE CLIMATE HAZARDS

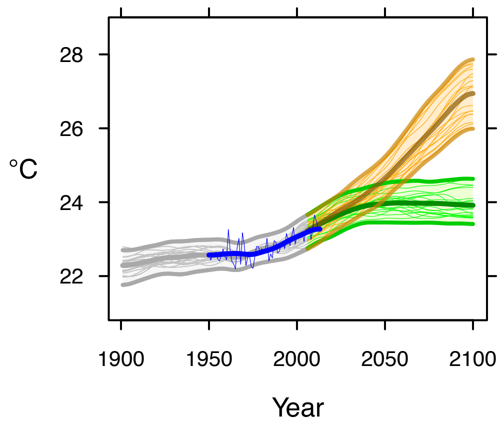
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

Outlined here are country–specific projections up to the year 2100 for climate hazards under a 'business as usual' high emissions scenario compared to projections under a 'two-degree' scenario with rapidly decreasing global emissions. Most hazards caused by climate change will persist for many centuries.

COUNTRY-SPECIFIC CLIMATE HAZARD PROJECTIONS

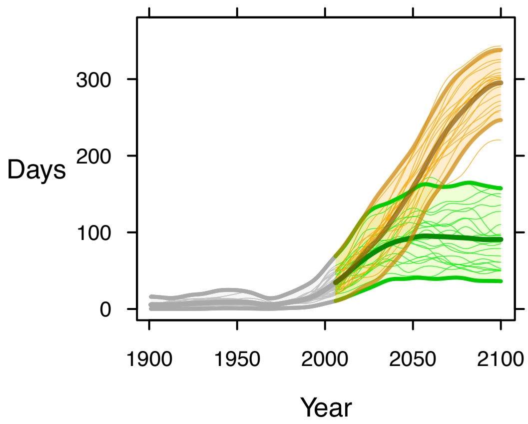
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).[a] The text boxes describe the projected changes averaged across about 20 models (thick line). The figures also show each model individually as well as the 90% model range (shaded) as a measure of uncertainty and, where available, the annual and smoothed observed record (in blue).[b,c]

MEAN ANNUAL TEMPERATURE



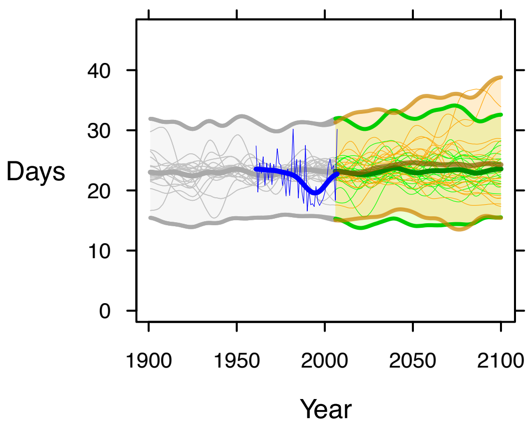
Under a high emissions scenario, mean annual temperature is projected to rise by about 4.1°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.1°C.

DAYS OF WARM SPELL ('HEAT WAVES')



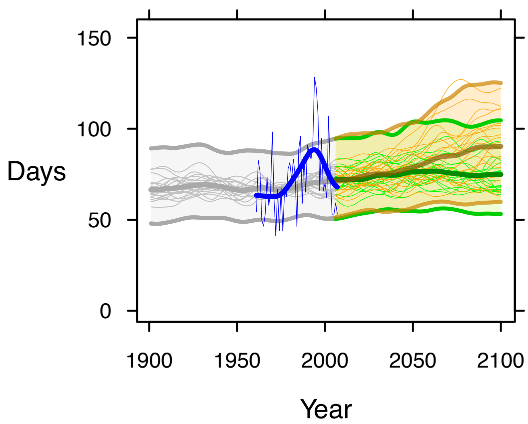
Under a high emissions scenario, the number of days of warm spell[d] is projected to increase from less than 15 days in 1990 to about 295 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 90 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under a high emissions scenario, the number of days with very heavy precipitation (20 mm or more) is not indicated to increase by more than 1 day on average from 1990 to 2100. A few models indicate increases just outside the range of historical variability, implying a slight increase in flood risk. If emissions decrease rapidly, no change in risk is indicated.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell is indicated to increase by about 20 days on average, to about 90 days on average in 2100, with continuing large year-to-year variability. If emissions decrease rapidly, the increase is limited to about 5 days on average.

a Model projections are from CMIP5 for RCP8.5 (high emissions) and RCP2.6 (low emissions). Model anomalies are added to the historical mean and smoothed.
b Observed historical record of mean temperature is from CRU-TSv.3.22; observed historical records of extremes are from HadEX2.
c Analysis by the Climatic Research Unit and Tyndall Centre for Climate Change Research, University of East Anglia, 2015.
d A 'warm spell' day is a day when maximum temperature, together with that of at least the 6 consecutive previous days, exceeds the 90th percentile threshold for that time of the year.

2 CURRENT AND FUTURE HEALTH RISKS DUE TO CLIMATE CHANGE

Human health is profoundly affected by weather and climate. Climate change threatens to exacerbate today's health problems – deaths from extreme weather events, cardiovascular and respiratory diseases, infectious diseases and malnutrition – whilst undermining water and food supplies, infrastructure, health systems and social protection systems.

ANNUAL EXPOSURE TO FLOODING DUE TO SEA LEVEL RISE (2070–2100)

Severity of climate change scenario

	Without Adaptation	With Adaptation
RCP2.6	380,600	1,200
RCP8.5	573,200	2,200

* Medium ice melting scenario ** Values rounded to nearest '00

In Madagascar, under a high emissions scenario, and without large investments in adaptation, an annual average of about 573,200 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If global emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/raising of dikes) the annual affected population could be limited to about 1,200 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Source: Human dynamics of climate change, technical report, Met Office, HM Government, UK, 2014.

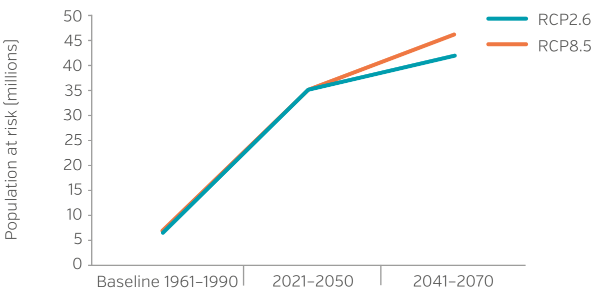
KEY IMPLICATIONS FOR HEALTH

Madagascar also faces inland river flood risk. It is projected, that by 2030, an additional 50,800 people may be at risk of river floods annually as a result of climate change and 62,100 due to socio-economic change above the estimated 95,500 annually affected population in 2010.[a]

In addition to deaths from drowning, flooding causes extensive indirect health effects, including impacts on food production, water provision, ecosystem disruption, infectious disease outbreak and vector distribution. Longer term effects of flooding may include post-traumatic stress and population displacement.

INFECTIOUS AND VECTOR-BORNE DISEASES

Population at risk of malaria in Madagascar (in millions)



By 2070, under a high emissions scenario about 46 million people are projected to be at risk of malaria. A low emissions scenario could slightly reduce the population at risk towards 2070. Population growth can also cause increases in the population at-risk in areas where malaria presence is static in the future.

Source: Rocklöv, J., Quam, M. et al. 2015.[d]

KEY IMPLICATIONS FOR HEALTH

Some of the worlds most virulent infections are also highly sensitive to climate: temperature , precipitation and humidity have a strong influence on the life-cycles of the vectors and the infectious agents they carry and influence the transmission of water and food-borne diseases.[b]

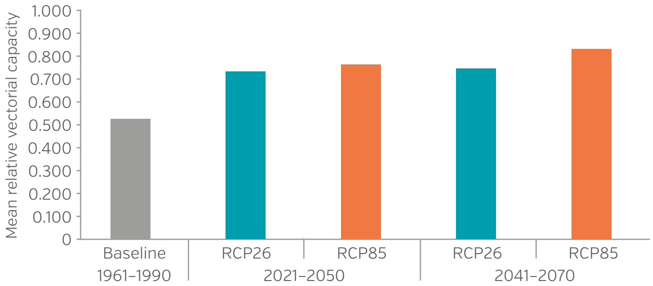
Socioeconomic development and health interventions are driving down burdens of several infectious diseases, and these projections assume that this will continue. However, climate conditions are projected to become significantly more favourable for transmission, slowing progress in reducing burdens, and increasing the populations at risk if control measures are not maintained or strengthened.[c]

For example, in the baseline year of 2008 there were about 9,200 estimated diarrhoeal deaths in children under 15 years old. Under a high emissions scenario, diarrhoeal deaths attributable to climate change in children under 15 years old is projected to be about 8.5% of an estimated 6,100 diarrhoeal deaths projected in 2030. Although diarrhoeal deaths are projected to decline to about 3,100 by 2050 the proportion of deaths attributable to climate change will rise to approximately 12.3% (Source: Lloyd, S., 2015).[d]

a World Resources Institute, http://www.wri.org. Aqueduct Global Flood Analyzer. Assumes continued current socio-economic trends (SSP2) and a 10-year flood protection.
b Atlas of Health and Climate, World Health Organization and World Meteorological Organization, 2012.
c Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.
d Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. The mean of impact estimates for three global climate models are presented. Models assume continued socioeconomic trends (SSP2 or comparable).

INFECTIOUS AND VECTOR-BORNE DISEASES

Mean relative vectorial capacity for dengue fever transmission in Madagascar

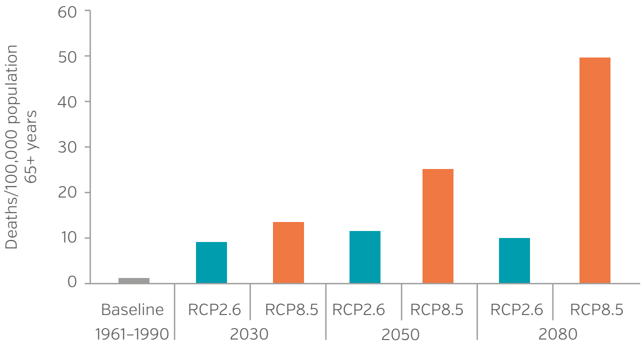


Under a high emissions scenario the mean relative vectorial capacity for dengue fever is expected to rise to about 0.83 from about 0.53 during the baseline period. If global emissions decline rapidly, the increased estimate in mean relative vectorial capacity could be limited to about 0.75.

Source: Rocklöv, J., Quam, M. et al., 2015.[a]

HEAT-RELATED MORTALITY

Heat-related mortality in population 65 years or over, Madagascar (deaths / 100,000 population 65+ yrs)



Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 50 deaths per 100,000 by 2080 compared to the estimated baseline of just over 1 death per 100,000 annually between 1961 and 1990. A rapid reduction in global emissions could limit heat-related deaths in the elderly to about 10 deaths per 100,000 in 2080.

Source: Honda et al., 2015.[a]

KEY IMPLICATIONS FOR HEALTH

Climate change is expected to increase mean annual temperature and the intensity and frequency of heat waves resulting in a greater number of people at risk of heat-related medical conditions.

The elderly, children, the chronically ill, the socially isolated and at-risk occupational groups are particularly vulnerable to heat-related conditions.

UNDERNUTRITION

Climate change, through higher temperatures, land and water scarcity, flooding, drought and displacement, negatively impacts agricultural production and causes breakdown in food systems. These disproportionally affect those most vulnerable people at risk to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme climate events.[b]

Without considerable efforts made to improve climate resilience, it has been estimated that the global risk of hunger and malnutrition could increase by up to 20 percent by 2050.[b]

In Madagascar, the prevalence of stunting in children under age 5 was 49.2% in 2009, the prevalence of underweight children and wasting in children under 5 was not available for this time period.[c,d]

a Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. The mean of impact estimates for three global climate models are presented. Models assume continued socioeconomic trends (SSP2 or comparable).
b World Food Project 2015 https://www.wfp.org/content/two-minutes-climate-change-and-hunger
c World Health Organization, Global Database on Child Growth and Malnutrition (2015 edition). Please see source for definition of child malnutrition measures.
d The WHO child malnutrition estimates provided may not represent the most recent national estimates available for Madagascar. Please see 'National MDG Monitoring Survey, 2013 for further information.

3 CURRENT EXPOSURES AND HEALTH RISKS DUE TO AIR POLLUTION

Many of the drivers of climate change, such as inefficient and polluting forms of energy and transport systems, also contribute to air pollution. Air pollution is now one of the largest global health risks, causing approximately seven million deaths every year. There is an important opportunity to promote policies that both protect the climate at a global level, and also have large and immediate health benefits at a local level.

OUTDOOR AIR POLLUTION EXPOSURE

KEY IMPLICATIONS FOR HEALTH

Outdoor air pollution can have direct and sometimes severe consequences for health.

Fine particles which penetrate deep into the respiratory tract subsequently increase mortality from respiratory infections, lung cancer and cardiovascular disease.

Data for outdoor air pollution in Madagascar was not available in the WHO ambient air pollution database (WHO, May 2014).

HOUSEHOLD AIR POLLUTION

MADAGASCAR

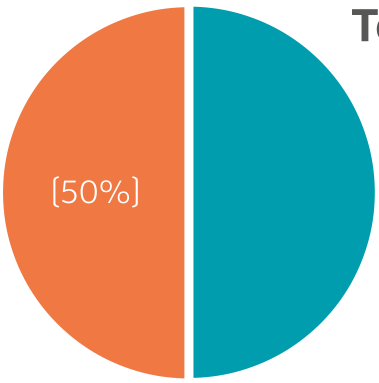
Percentage of population primarily using solid fuels for cooking (%), 2013

RURAL AREAS	URBAN AREAS	NATIONAL TOTAL
>95	>95	>95

Source: Global Health Observatory, data repository, World Health Organization, 2013.

Percent of total deaths from ischaemic heart disease, stroke, lung cancer, chronic obstructive pulmonary disease (18 years +) and acute lower respiratory infections (under 5 years) attributable to household air pollution, 2012.

Total Deaths: 33,400



Attributable to household air pollution

KEY IMPLICATIONS FOR HEALTH

Air pollution in and around the home is largely a result of the burning of solid fuels (biomass or coal) for cooking.

Women and children are at a greater risk for disease from household air pollution. Consequently, household air pollution is responsible for a larger proportion of the of total number of deaths from ischaemic heart disease, stroke, lung cancer and COPD in women compared to men.[a]

In Madagascar, about 63% percent of an estimated 8,000 child deaths due to acute lower respiratory infections is attributable to household air pollution (WHO, 2012).

Source: Global Health Observatory, data repository, World Health Organization, 2012.

a Annu. Rev. Public. Health. 2014.35:185-206. http://www.who.int/phe/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf?ua=1

4 CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION: A GLOBAL PERSPECTIVE

Health co-benefits are local, national and international measures with the potential to simultaneously yield large, immediate public health benefits and reduce the upward trajectory of greenhouse gas emissions. Lower carbon strategies can also be cost-effective investments for individuals and societies.

Presented here are examples of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.[a]

The examples provided are from a global perspective and are not based on country-specific data.

Transport

Transport injuries lead to 1.2 million deaths every year, and land use and transport planning contribute to the 2–3 million deaths from physical inactivity. The transport sector is also responsible for some 14% (7.0 $GtCO_2e$) of global carbon emissions. The IPCC has noted significant opportunities to reduce energy demand in the sector, potentially resulting in a 15%–40% reduction in CO_2 emissions, and bringing substantial opportunities for health: A modal shift towards walking and cycling could see reductions in illnesses related to physical inactivity and reduced outdoor air pollution and noise exposure; increased use of public transport is likely to result in reduced GHG emissions; compact urban planning fosters walkable residential neighborhoods, improves accessibility to jobs, schools and services and can encourage physical activity and improve health equity by making urban services more accessible to the elderly and poor.

Electricity Generation

Reliable electricity generation is essential for economic growth, with 1.4 billion people living without access to electricity. However, current patterns of electricity generation in many parts of the world, particularly the reliance on coal combustion in highly polluting power plants contributes heavily to poor local air quality, causing cancer, cardiovascular and respiratory disease. Outdoor air pollution is responsible for 3.7 million premature deaths annually, 88% of these deaths occur in low and middle income countries. The health benefits of transitioning from fuels such as coal to lower carbon sources, including ultimately to renewable energy, are clear: Reduced rates of cardiovascular and respiratory disease such as stroke, lung cancer, coronary artery disease, and COPD; cost-savings for health systems; improved economic productivity from a healthier and more productive workforce.

Household Heating, Cooking and Lighting

Household air pollution causes over 4.3 million premature deaths annually, predominantly due to stroke, ischaemic heart disease, chronic respiratory disease, and childhood pneumonia. A range of interventions can both improve public health and reduce household emissions: a transition from the inefficient use of solid fuels like wood and charcoal, towards cleaner energy sources like liquefied petroleum gas (LPG), biogas, and electricity could save lives by reducing indoor levels of black carbon and other fine particulate matter; where intermediate steps are necessary, lower emission transition fuels and technologies should be prioritized to obtain respiratory and heart health benefits; women and children are disproportionately affected by household air pollution, meaning that actions to address household air pollution will yield important gains in health equity; replacing kerosene lamps with cleaner energy sources (e.g. electricity, solar) will reduce black carbon emissions and the risk of burns and poisoning.

Healthcare Systems

Health care activities are an important source of greenhouse gas emissions. In the US and in EU countries, for example, health care activities account for between 3–8% of greenhouse gas (CO_2-eq) emissions. Major sources include procurement and inefficient energy consumption. Modern, on-site, low-carbon energy solutions (e.g. solar, wind, or hybrid solutions) and the development of combined heat and power generation capacity in larger facilities offer significant potential to lower the health sector's carbon footprint, particularly when coupled with building and equipment energy efficiency measures. Where electricity access is limited and heavily reliant upon diesel generators, or in the case of emergencies when local energy grids are damaged or not operational, such solutions can also improve the quality and reliability of energy services. In this way, low carbon energy for health care could not only mitigate climate change, it could enhance access to essential health services and ensure resilience.

In Madagascar, by 2030, an estimated 1,500 annual premature deaths due to outdoor air pollution may be avoided each year and near-term climate change mitigated by implementing 14 short lived climate pollutant reduction measures.

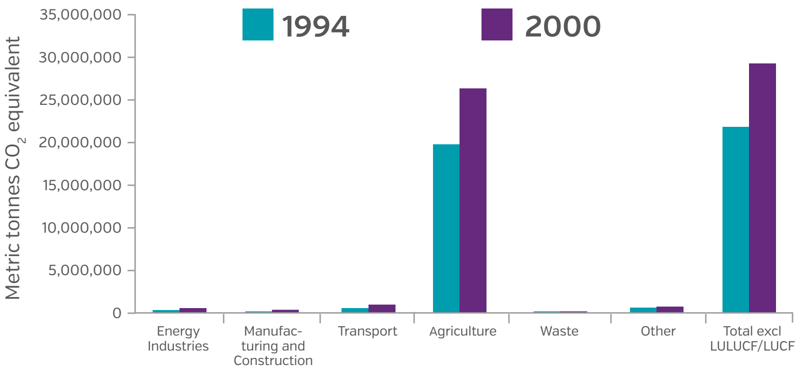
Source: Shindell, D., et al, Science, 2012.

a For a complete list of references used in the health co-benefits text please see the Climate and Health Country Profile Reference Document, http://www.who.int/globalchange/en/

5 EMISSIONS AND COMMITMENTS

Global carbon emissions increased by 80% from 1970 to 2010, and continue to rise.[a,b] Collective action is necessary, but the need and opportunity to reduce greenhouse gas emissions varies between countries. Information on the contribution of different sectors, such as energy, manufacturing, transport and agriculture, can help decision-makers to identify the largest opportunities to work across sectors to protect health, and address climate change.

MADAGASCAR ANNUAL GREENHOUSE GAS EMISSIONS
(metric tonnes CO_2 equivalent)



Source: UNFCCC Greenhouse Gas Data Inventory, UNFCCC [2015].

The most recent greenhouse gas emissions data for Madagascar is from the year 2000. At that time the largest contributions were from the agriculture sector. Through intersectoral collaboration, the health community can help to identify the best policy options not only to eventually stabilize greenhouse gas emissions, but also to provide the largest direct benefits to health.

A 2°C upper limit of temperature increase relative to pre-industrial levels has been internationally agreed in order to prevent severe and potentially catastrophic impacts from climate change. Reductions are necessary across countries and sectors. In order to stay below the 2°C upper limit it is estimated that global annual CO_2-energy emissions, currently at 5.2 tons per capita, need to be reduced to 1.6 tons per capita.[c]

NATIONAL RESPONSE[d]

1997	ADOPTION OF MALAGASY FOREST POLICY
1998	MADAGASCAR RATIFIES THE UNFCCC
2003	MADAGASCAR RATIFIES THE KYOTO PROTOCOL
2006	NATIONAL ADAPTATION PROGRAMME OF ACTION
2010	NATIONALLY APPROPRIATE MITIGATION ACTIONS

a Boden, T.A., G. Marland, and R.J. Andres (2010). Global, Regional, and National Fossil-Fuel CO_2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2010.
b IPCC [2014] Blanco G., R. Gerlagh, S. Suh, J. Barrett, H.C. de Coninck, C.F. Diaz Morejon, R. Mathur, N. Nakicenovic, A. Ofosu Ahenkora, J. Pan, H. Pathak, J. Rice, R. Richels, S.J. Smith, D.I. Stern, F.L. Toth, and P. Zhou, 2014: Drivers, Trends and Mitigation. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom
c Pathways to deep decarbonization, Sustainable development Solutions Network, 2014 report.
d Columbia Law School, 'Climate Change Laws Of The World'. N.p., 2015.

6 NATIONAL POLICY RESPONSE

The following table outlines the status of development or implementation of climate resilient measures, plans or strategies for health adaptation and mitigation of climate change (reported by countries).[a]

GOVERNANCE AND POLICY	
Country has identified a national focal point for climate change in the Ministry of Health	✓
Country has a national health adaptation plan approved by relevant government body	✓
The National Communication submitted to UNFCCC includes health implications of climate change mitigation policies	✓
HEALTH ADAPTATION IMPLEMENTATION	
Country is 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 has 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 co-benefits) of climate change mitigation actions	✗
Country has conducted valuation of co-benefits of health implications of climate mitigation policies	✗

a Supporting monitoring efforts on health adaptation and mitigation of climate change: a systematic approach for tracking progress at the global level. WHO survey, 2015.

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World Health Organization

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