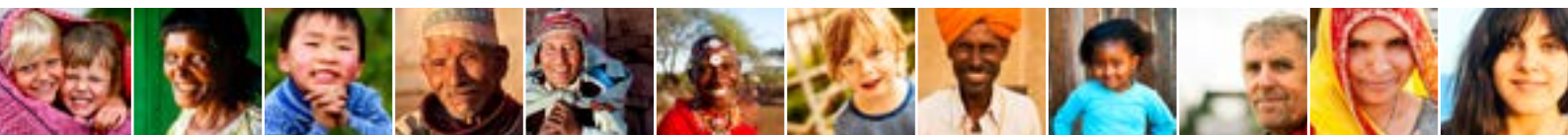


CLIMATE AND HEALTH COUNTRY PROFILE – 2015

OMAN



United Nations
Framework Convention on
Climate Change



OVERVIEW

The Sultanate of Oman is located in the southeast of the Arabian Peninsula, with a population of 4 million^a and an economy predominantly dependent on oil. The country is one of the most water scarce in the world and climate change is likely to worsen drought and desertification, threaten water security and disrupt agricultural production. Rising temperatures increase the risk of heat-related morbidity and mortality. Furthermore, the incidence and severity of natural disasters, such as the cyclones experienced in recent years, are expected to rise.

SUMMARY OF KEY FINDINGS

- Under a high emissions scenario, mean annual temperature is projected to rise by about 5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.5°C.
- Under a high emissions scenario, and without large investments in adaptation, an annual average of about 81,300 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If 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 100 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.
- Under a high emissions scenario heat-related deaths in the elderly [65+ years] are projected to increase to about 34 deaths per 100,000 by 2080 compared to the estimated baseline of just over 3 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to about 7 deaths per 100,000 in 2080.

OPPORTUNITIES FOR ACTION

Oman has an approved national health adaptation strategy and has conducted a national assessment of climate change impacts, vulnerability and adaptation for health. Country reported data [see section 6] indicate there remain opportunities for action in the following areas:

1) Adaptation

- Implement projects or programmes on health adaptation to climate change.
- Implement actions to build institutional and technical capacities to work on climate change and health.
- Strengthen adaptive capacity by building climate resilient health infrastructure.
- Strengthen the health surveillance system to be able to detect potential effects of climate change on health [e.g. pattern of malaria, asthma, and COPD incidence and prevalence in the country and its relation to heat waves, dust storms etc.].

2) Mitigation

- Include the health implications of climate change mitigations actions in the national strategy on climate change.
- Enhance awareness of climate change and health among public health and medical practitioners at the private and public sector level; thereby strengthening the first line of defence in protecting human health from climate change.
- Conduct valuation of co-benefits to health of climate change mitigation policies.

DEMOGRAPHIC ESTIMATES

Population [2013] ^a	4 million
Population growth rate [2013] ^a	8.9%
Population living in urban areas [2013] ^b	76.7%
Population under five [2013] ^a	9.2%
Population aged 65 or older [2013] ^a	2.5%

ECONOMIC AND DEVELOPMENT INDICATORS

GDP per capita [current US\$, 2013] ^c	20,011 USD
Total expenditure on health as % of GDP [2013] ^d	2.6%
Percentage share of income for lowest 20% of population [2012] ^c	NA
HDI [2013, +/- 0.01 change from 2005 is indicated with arrow] ^e	0.783 ▲

HEALTH ESTIMATES

Life expectancy at birth [2013] ^f	76 years
Under-5 mortality per 1000 live births [2013] ^g	11.7

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]

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CURRENT AND FUTURE CLIMATE HAZARDS

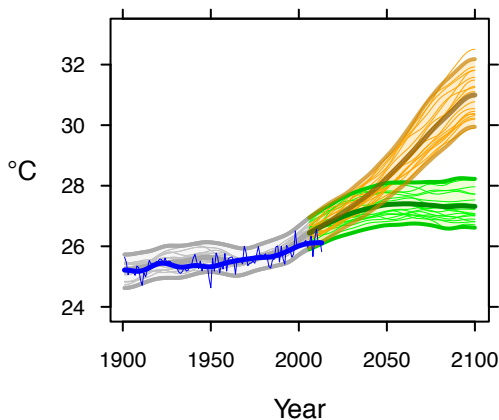
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

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

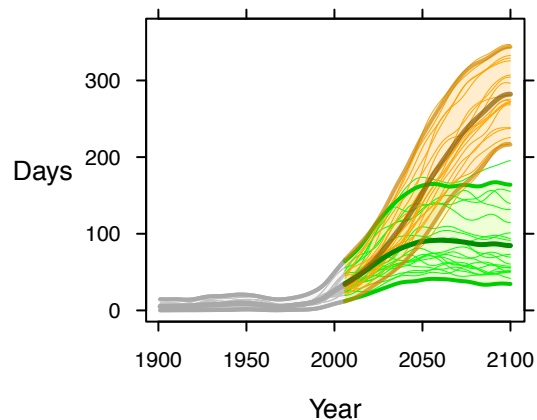
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).^a The text boxes describe the projected changes averaged across about 20 models (thick line). The figures 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



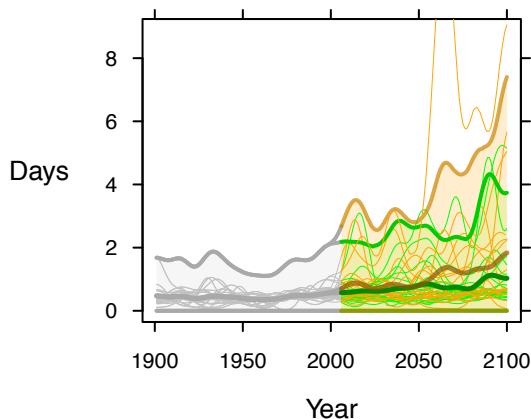
Under a high emissions scenario, mean annual temperature is projected to rise by about 5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.5°C.

DAYS OF WARM SPELL ('HEAT WAVES')



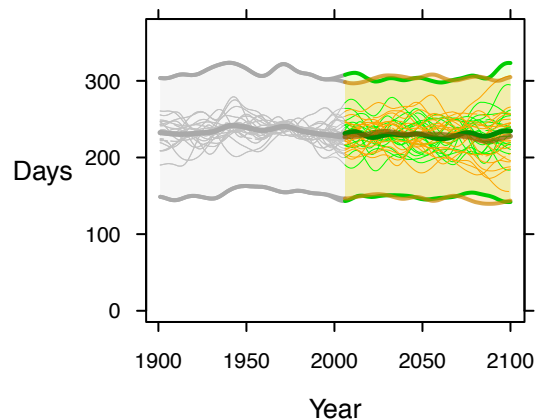
Under a high emissions scenario, the number of days of warm spell^d is projected to increase from less than 15 days in 1990 to about 280 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 85 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under a high emissions scenario, the number of days with very heavy precipitation [20 mm or more] could increase by almost 2 days on average from 1990 to 2100. Some models indicate larger increases but the total number of such days remains low. If emissions decrease rapidly, there is almost no increase in risk.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under both high and low emissions scenarios, the longest dry spell is not indicated to change much from an average of about 230 days, with continuing large year-to-year variability.

^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-TSv3.22.

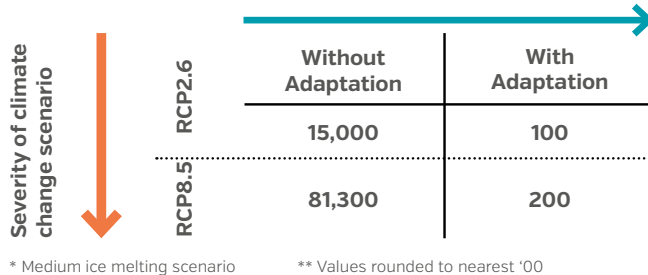
^c Analysis by the Climatic Research Unit and Tyndall Centre for Climate Change Research, University of East Anglia, 2015.

^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.

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.

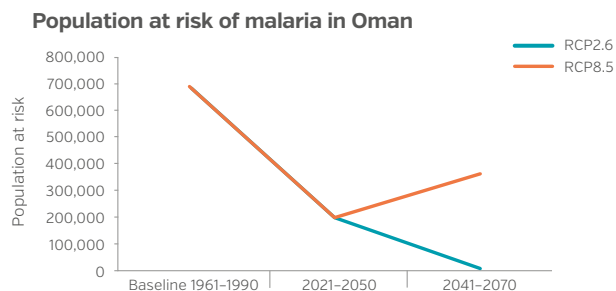
EXPOSURE TO FLOODING DUE TO SEA LEVEL RISE



Under a high emissions scenario, and without large investments in adaptation, an annual average of about 81,300 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If 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 100 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.

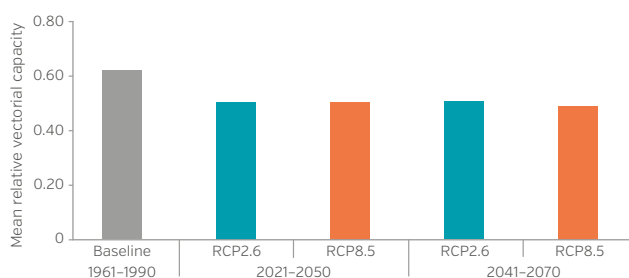
INFECTIOUS AND VECTOR-BORNE DISEASES



By 2050, under both emissions scenarios, approximately 200,000 people are projected to be at risk of malaria, a decline from the baseline value of just over 681,000. A high emissions scenario is projected to see the population at risk increase towards 2070 whereas a rapid decrease in emissions could support the continued decline of malaria risk towards 2070, with the population at risk projected to be just over 6,100.

Source: Rocklöv, J., Quam, M. et al. 2015.^c

Mean relative vectorial capacity for dengue fever transmission in Oman



a Atlas of Health and Climate, WHO & WMO 2012.

b Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

c 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.



KEY IMPLICATIONS FOR HEALTH

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.



KEY IMPLICATIONS FOR HEALTH

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

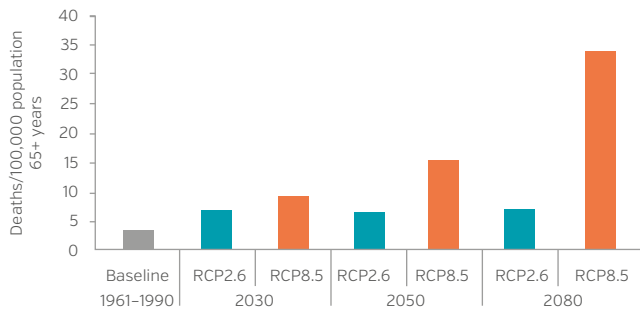
Socioeconomic development and health interventions are driving down the burden of several infectious diseases, and current projections assume that this will continue. However, climate conditions are projected to become significantly more favourable for transmission, slowing progress in reducing disease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

Although the mean relative vectorial capacity for dengue fever transmission is projected to decline from the baseline period, it remains at a relatively high transmission level towards 2070. Co-factors such as urbanization, development and population movements may modify the disease burdens associated with dengue, and make the disease cross new sub-national borders.

Source: Rocklöv, J., Quam, M. et al., 2015.^c

HEAT-RELATED MORTALITY

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



Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 34 deaths per 100,000 by 2080 compared to the estimated baseline of just over 3 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to about 7 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 disproportionately affect those most vulnerable to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme weather events.^b

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

In Oman, the prevalence of child malnutrition in children under age 5 is 8.6% (2009).^c

^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.

^b World Food Project 2015 <https://www.wfp.org/content/two-minutes-climate-change-and-hunger>

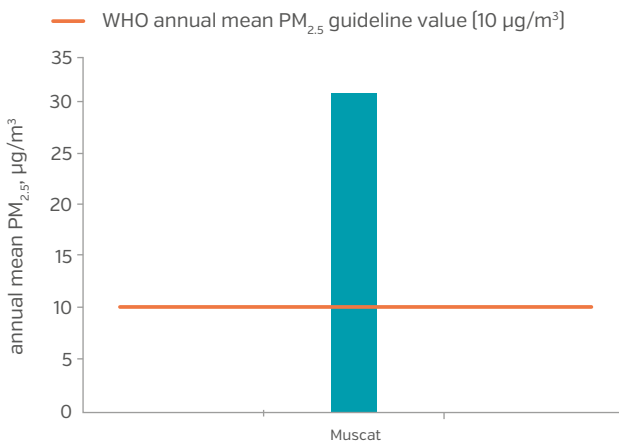
^c World Health Organization, Global Database on Child Growth and Malnutrition [2015 edition]. Child malnutrition estimates are for % underweight, defined as: Percentage of children aged 0-59 months who are below minus two standard deviations from median weight-for-age of the World Health Organization (WHO) Child Growth Standards.

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

Outdoor air pollution in Muscat, Oman annual mean PM_{2.5} (µg/m³) 2008–2010*



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 infection, lung cancer, and cardiovascular disease.

Air quality, measured between 2008 and 2010 in Muscat, indicate the annual mean PM_{2.5} levels were above the WHO guideline value of 10 µg/m³.

Source: Ambient Air Pollution Database, WHO, May 2014.

* A standard conversion has been used, please see source for further details.

AIR POLLUTION IN OMAN^a

In the Sultanate of Oman, rapid economic development, improved living standards, and increased urban population density have led to increased air pollution from both stationary and mobile sources.

The major sources of air pollution are from energy production, transportation and industry (i.e. cement plants, chemical and petrochemical plants). This is particularly evident in coastal areas where the combination of high population, industrial concentration and unfavorable natural conditions for pollution dispersal aggravate air pollution problems.^b

Intense industrial activity in Sohar City make this area one of the most problematic in terms of air pollution, particularly sulfur dioxide from oil refineries.^c

Other prominent areas with air pollution concerns include the capital Muscat where dense vehicular traffic contributes to high ambient air concentrations of nitrogen oxide (NO_x).

a Text is adapted from the Initial National Communication under The United Nations Framework Convention on Climate Change, Ministry of Environment & Climate affairs, The Sultanate of Oman, October 2013.

b Charabi and Al-Yahyai, 2010 as cited in the Initial National Communication under The United Nations Framework Convention on Climate Change, Ministry of Environment & Climate Affairs, The Sultanate of Oman, October 2013.

c Charabi et al, 2012 as cited in the Initial National Communication under The United Nations Framework Convention on Climate Change, Ministry of Environment & Climate Affairs, The Sultanate of Oman, October 2013.

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, from a global perspective, of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.^a

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 GtCO₂e] 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 CO₂ 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

Current patterns of electricity generation in many parts of the world, particularly the reliance on coal combustion in highly polluting power plants, contribute heavily to poor local air quality, causing cancer, cardiovascular and respiratory disease. Outdoor air pollution is responsible for 3.7 million premature deaths annually. High-income countries still have work to do in transitioning to cleaner and healthier energy sources.

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.



Food and Agriculture

Agricultural emissions account for some 5.0–5.8 GtCO₂e annually, with food and nutrition constituting an important determinant of health. Many high-income countries are feeling the burden of poor diet and obesity-related diseases, with some 1.9 billion adults overweight globally.

A wide range of interventions designed to reduce emissions from agriculture and land-use will also yield positive benefits for public health. For example, policy and behavioural interventions to encourage a reduction in red meat consumption and a shift towards local and seasonal fruit and vegetables, which tend to have lower carbon emissions associated with their production, will improve diets and result in reductions in cardiovascular disease and colorectal cancer.



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 [CO₂-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.



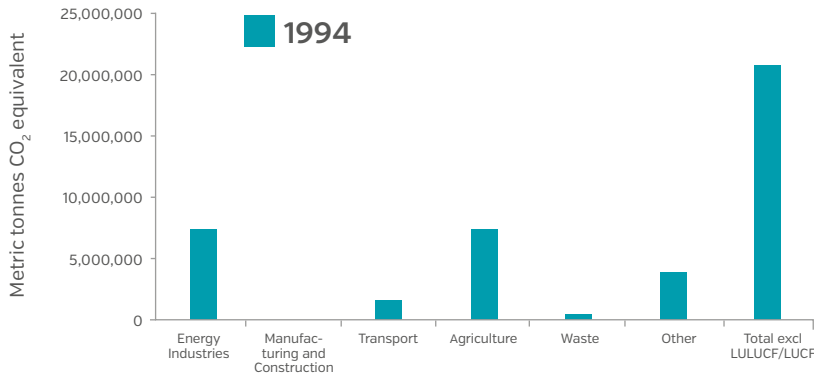
^a For a complete list of references used in the health co-benefits text please see the Climate and Health Country Profile Reference Document, <http://www.who.int/globalchange/en/>

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.

OMAN ANNUAL GREENHOUSE GAS EMISSIONS (metric tonnes CO₂ equivalent)



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 CO₂-energy emissions, currently at 5.2 tons per capita, need to be reduced to 1.6 tons per capita.^c

The most recent emissions data available for Oman is from 1994. At that time, the largest contributions of carbon emissions came from the agriculture sector and energy industries. 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.

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

NATIONAL RESPONSE^d

2001	LAW ON THE CONSERVATION OF THE ENVIRONMENT AND COMBATING OF POLLUTION (ROYAL DECREE NO. 114/01)
2005	OMAN RATIFIED THE KYOTO PROTOCOL
2007	LAW ESTABLISHING THE MINISTRY OF ENVIRONMENT AND CLIMATE AFFAIRS (ROYAL DECREE NO. 90/2007)
2008	FORMATION OF A STEERING COMMITTEE FOR COORDINATION AND SUPERVISION OF THE IMPLEMENTATION OF THE SKILL-BUILDING PROJECT IN THE FIELD OF CLIMATE CHANGE

a Boden, T.A., G. Marland, and R.J. Andres [2010]. Global, Regional, and National Fossil-Fuel CO₂ 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 Oman Government: Portal 2015. <https://omanportal.gov.om>.

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 strategy 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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The estimates and projections provided in this document have been derived using standard categories and methods to enhance their cross-national comparability. As a result, they should not be regarded as the nationally endorsed statistics of Member States which may have been derived using alternative methodologies.

To ensure readability, health estimates and projections have been presented without the margins of uncertainty which are available upon request.