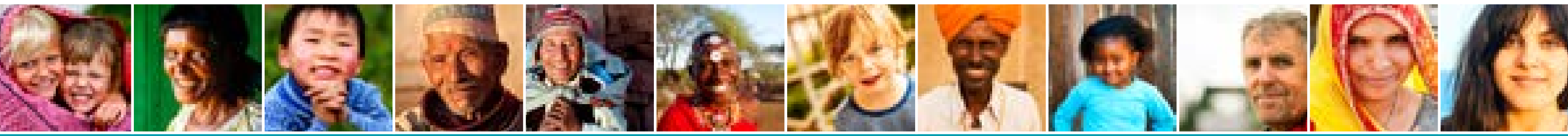
CLIMATE AND HEALTH COUNTRY PROFILE – 2015
UNITED KINGDOM

World Health Organization

United Nations Framework Convention on Climate Change



OVERVIEW

The United Kingdom of Great Britain and Northern Ireland has a temperate climate with prevailing southwest winds over the North Atlantic Current. It is overcast on more than 50% of days and has rainfall throughout the year.[a] The UK floods of 2007 and in winter 2013/2014, and the heatwaves in 2003, 2006 and 2013, resulting in excess morbidity and mortality, are a stark illustration of the devastating effects that extreme weather events can have. In addition to increased frequency and severity of such events, climate change will likely have further health impacts in the UK: excess mortality and morbidity from heat; respiratory diseases related to ground-level ozone; vector-, water- and food-borne diseases and increases in the prevalence of skin cancer related to UV exposure.

The health sector in the UK has been taking action to strengthen mitigation and adaptation measures. The carbon footprint in the health sector has been monitored since 2008 at national, regional and local level and Sustainable Development Management Plans (SDMPs) include a public health outcomes framework indicator. Additionally, the development of national health sector strategies (Carbon reduction 2009 and Sustainable Development 2014) and other tools support continued progress. In the UK, considerable work on the Climate Change Risk Assessment process has been conducted and research efforts have explored the mental health effects of flooding, and the effectiveness of the National Heatwave Plan (HWP). Other notable initiatives include the development of the Living With Environmental Change (LWEC) document and the Economics of Climate Resilience (ECR) project.[a]

SUMMARY OF KEY FINDINGS

- In the UK, under a high emissions scenario, mean annual temperature is projected to rise by about 3.7°C on average from 1990 to 2100. If global emissions decrease rapidly, the temperature rise is limited to about 1°C (see page 2).
- In the UK, under a high emissions scenario, an average of 585,400 people are projected to be affected by flooding due to sea level rise every year between 2070–2100. If global emissions decrease rapidly and adaptation interventions are taken, the population affected by flooding could be limited to an average of 900 people (see page 3).
- It is likely that vectors (ticks and mosquitoes) will spread within the United Kingdom due to warmer summers, wetter springs and milder winters by the 2080s.

OPPORTUNITIES FOR ACTION

1) Adaptation

- Strengthening of climate-resilient public health and social care systems and emergency services, through the National Adaptation Programme and UK country-specific adaptation plans, such as syndromic surveillance (e.g. for asthma, allergic rhinitis, and pollen).
- Further development, implementation and evaluation of extreme weather plans such as the Heatwave Plan and the Cold Weather Plan for England in line with the all-hazards approach.
- Strengthening of UV monitoring and dissemination of public health advice by the UK Met Office and Public Health England; Ground-level measurements of ozone and other air pollutants are carried out by Defra and local authorities.
- Further awareness raising in the public and training of medical professionals through the Public Health England blog on climate change.[b]
- Collaboration with other sectors, and promotion of measures with health co-benefits.[c]
- Continued efforts to reflect regional assessments and priorities for action within country-specific adaptation plans.

2) Mitigation

- Policies to reduce greenhouse gas emissions have collateral effects on public health. The so-called 'health co-benefits' of a low-carbon society, will result in cleaner air and more active, healthier lifestyles to help combat obesity, cancer and heart disease.

3) National policy implementation

- Climate change mitigation policies are suggested to be subject to health impact assessment. For example – plans to reduce GHG emissions in the health sector by sealing buildings to increase their energy efficiency, could lead to increased exposure to indoor air pollution unless ventilation control is simultaneously improved.

DEMOGRAPHIC ESTIMATES	
Population (2013)[d]	64 million
Population growth rate (2013)[d]	0.6%
Population living in urban areas (2013)[e]	82.1%
Population under five (2013)[d]	6.4%
Population aged 65 or older (2013)[d]	17.2%
ECONOMIC AND DEVELOPMENT INDICATORS	
GDP per capita (current US$, 2013)[f]	42,295 USD
Total expenditure on health as % of GDP (2013)[g]	9.1%
Percentage share of income for lowest 20% of population (2010)[f]	5.8%
HDI (2013, +/- 0.01 change from 2005 is indicated with arrow)[h]	0.892 ▬
HEALTH ESTIMATES	
Life expectancy at birth (2013)[i]	81 years
Under-5 mortality per 1000 live births (2013)[j]	4.6

a Central Intelligence Agency. (n.d.). CIA World Fact Book: United Kingdom. Retrieved October 07, 2014, from https://www.cia.gov/library/publications/the-world-factbook/geos/uk.html
b Public Health England. (2015). Health in a changing climate. Retrieved October 21, 2015, from https://publichealthmatters.blog.gov.uk/category/health-in-a-changing-climate/
c IPCC, 2015. Climate Change 2014 Synthesis Report Summary Chapter for Policy-makers, Geneva. Retrieved October 21 2015, from https://ipcc.ch/report/ar5/syr/
d World Population Prospects: The 2015 Revision, UNDESA (2015)
e World Urbanization Prospects: The 2014 Revision, UNDESA (2014)
f World Development Indicators, World Bank (2015)
g Global Health Expenditure Database, WHO (2014)
h United Nations Development Programme, Human Development Reports (2014)
i Global Health Observatory, WHO (2014)
j Levels & Trends in Child Mortality Report 2015, The UN Inter-agency Group for Child Mortality Estimation (2015)

1 CURRENT AND FUTURE CLIMATE HAZARDS

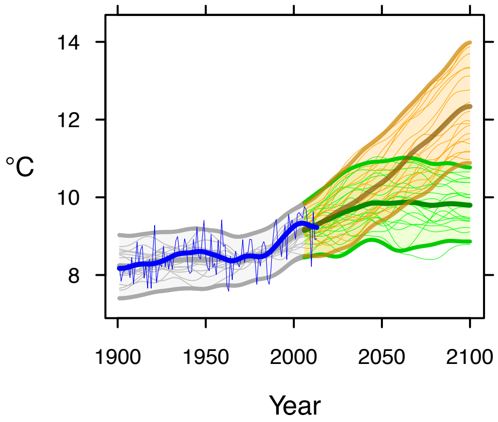
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

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

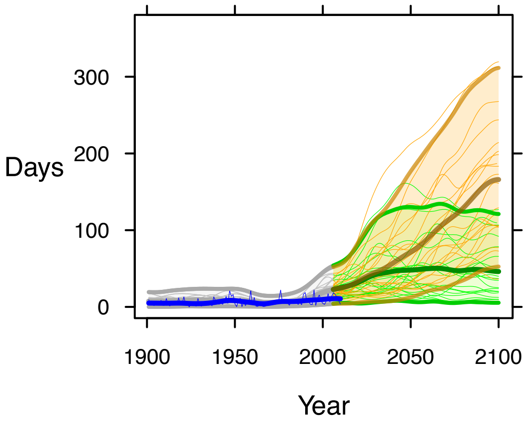
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).[a] The text boxes describe the projected changes averaged across about 20 models (thick line). The figures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



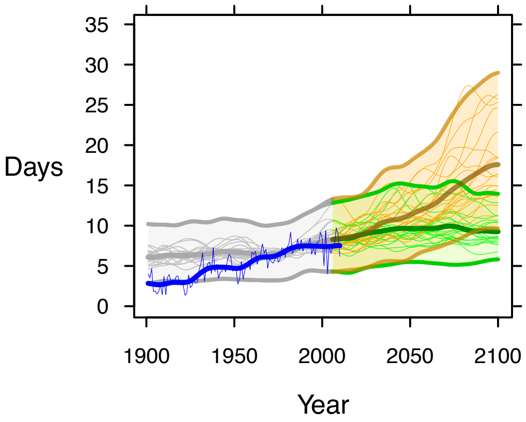
Under a high emissions scenario, mean annual temperature is projected to rise by about 3.7°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1°C.

DAYS OF WARM SPELL ('HEAT WAVES')



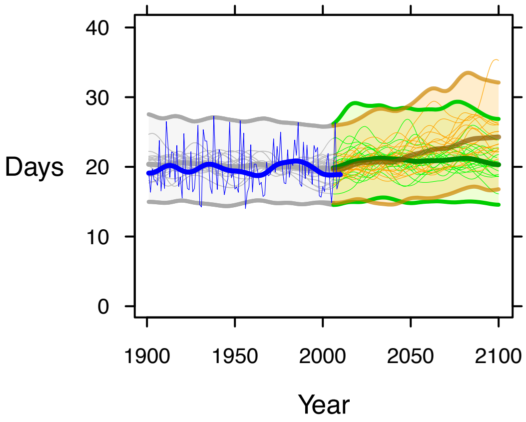
Under a high emissions scenario, the number of days of warm spell[d] is projected to increase from about 10 days in 1990 to just over 165 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 45 on average.

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 just over 10 days on average from 1990 to 2100, increasing the risk of floods. Some models indicate increases outside the range of historical variability, implying even greater risk. If emissions decrease rapidly, the risk is much reduced.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell could increase from about 19 days in 1990 to about 24 days on average in 2100, suggesting slightly greater persistence of droughts, with continuing large year-to-year variability. If emissions decrease rapidly, there are limited changes anticipated in the length of dry spells.

a Model projections are from Coupled Model Intercomparison Project (Phase 5) (CMIP5). 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.

For additional resources on climate hazards and health in the UK please see: Stanke, C., Kerac, M., Prudhomme, C., Medlock, J., & Murray, V. (2013). Health effects of drought: a systematic review of the evidence. PLoS currents, 5. The Natural Hazards Partnership (NHP)

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, UK (2070–2100)

Severity of climate change scenario	Without Adaptation	With Adaptation
RCP2.6	95,400	900
RCP8.5	585,400	1,300

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

In the UK, under a high emissions scenario, and without large investments in adaptation, an annual average of 585,400 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 an average of 900 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

In addition to flooding due to sea level rise, the UK faces inland river flood risk due to climate change. Under a high emissions scenario, it is projected that by 2030, 36,300 additional people may be at risk of river floods annually due to climate change and 14,900 due to socio-economic change above the estimated annual affected population of 24,700 in 2010.[a]

Flooding causes deaths from drowning and 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

Tick-borne disease in the UK

In Britain there are 20 native species of tick. Of most concern to human health, the *Ixodes ricinus* (sheep/deer tick), is a vector of Lyme borreliosis to humans, and Tick-borne encephalitis virus in continental Europe.

Ixodes ricinus continues to be reported in new locations and increased abundance in Europe. Warmer springs associated with climate change and land use change can lead to increased tick numbers.[d]

Mosquito-borne disease in the UK

The Asian Tiger mosquito, *Aedes albopictus*, is a vector of dengue virus, and has also been the primary vector of chikungunya virus in recent outbreaks. *Aedes albopictus* has not been reported in the UK, but recent climate modelling by ECDC predicts further establishment of this species across Europe, including the UK.[d]

For additional information on vector-borne diseases and climate change in the UK please see Medlock JM & Leach S (2015) Effect of climate change on vector-borne disease in the UK. Lancet Infectious Diseases March 23, 2015 http://dx.doi.org/10.1016/S1473-3099(15)70091-5.

KEY IMPLICATIONS FOR HEALTH

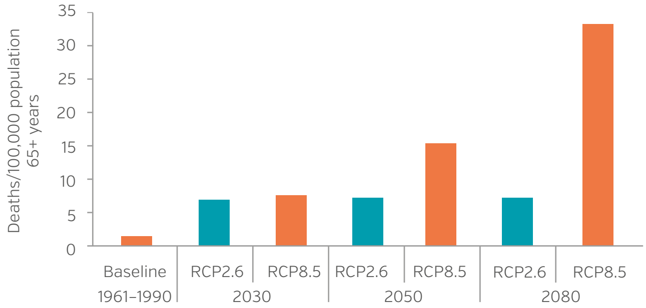
Some of the worlds most virulent infections are also highly sensitive to climate: temperature, precipitation and humidity have a strong influence on the life-cycles of the vectors and the infectious agents they carry and influence the transmission of water and food-borne diseases.[b]

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]

a World Resources Institute, Aqueduct Global Flood Analyzer, http://www.wri.org//resources/maps/aqueduct-global-flood-analyzer. Assumes continued current socio-economic development trends (SSP2) and a 100-year flood protection.
b Atlas of Health and Climate, WHO & WMO 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 Health Effects of Climate Change in the UK 2012 Current evidence, recommendations and research gaps. Health Protection Agency, 2012. from https://www.gov.uk/government/publications/climate-change-health-effects-in-the-uk

HEAT-RELATED MORTALITY

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



In the UK, under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 33 deaths per 100,000 by 2080 compared to the estimated baseline of less than 2 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in global 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.

"SIGNIFICANT SEVEN" CLIMATE CHANGE RISKS TO HEALTH

1) Increased heat-related illness and death and increased mortality from respiratory and cardiovascular disease – the exceptional 2003 heatwave that resulted in 2,000 excess deaths across England and Wales and over 70,000 deaths across Europe is thought to become a 'normal heatwave' by 2040. In the UK, the number of heat-related deaths is expected to increase in the future due to warmer summers, and the number of cold-related deaths will likely decrease due to milder winters.

2) Flood-related illness and displacement – as well as injury and infection, the effect of flooding on mental health is a considerable part of the overall health burden (2–5 times higher in flood victims), persisting for months or years after the event. One in six properties in England are currently at risk of flooding from increased rainfall and rising sea-levels which cause coastal erosion and floods.

3) Increase in food-borne, water-borne and vector-borne diseases – Higher temperatures, drought, flooding, changes in habitat and rainfall patterns will likely lead to an increase in food-borne, water-borne and vector-borne diseases. The changing patterns of disease could also lead to an emergence of tropical diseases, with diseases such as malaria and dengue already appearing in southern Europe.

4) Health impacts relating to air quality and aeroallergens – Increased air pollution from ozone (formed by sunlight), fine particles (PM_{10} and $PM_{2.5}$) and extended pollen seasons will likely lead to higher rates of respiratory and cardiovascular disease.

5) Skin cancer and sunburn – Malignant melanoma, a type of skin cancer, has increased by 78% among males and 48% among females from 2003 to 2012. This is now the fifth most common cancer in England and is set to continue rising as people will spend more time outdoors due to warmer weather.

6) Pressure on healthcare providers to keep services running in extreme weather – Flooding, storms and wildfires are set to become more common thereby affecting critical infrastructure (e.g. water supply, electricity, hospital services).

7) Increase in health inequalities – Increased fuel and food prices, reduced access to heating, cooling, insurance, insurance and green spaces are just examples of how health inequalities can be exacerbated.

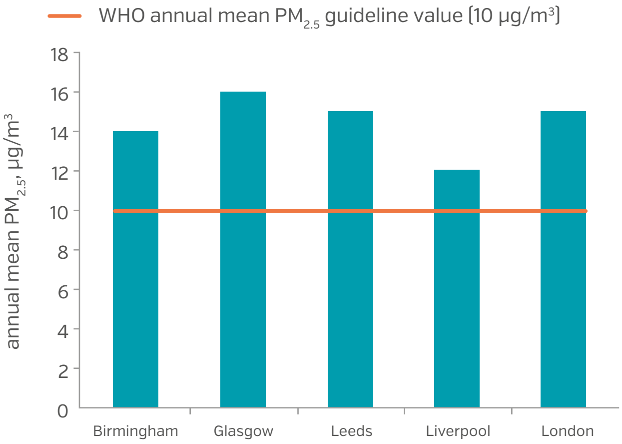
a Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. The mean of impact estimates for three global climate models are presented. Models assume continued socioeconomic trends (SSP2 or comparable).

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

Outdoor air pollution in cities in the UK annual mean $PM_{2.5}$ (μg/m³) 2013



The five most populated cities for which there was air pollution data available had annual mean $PM_{2.5}$ levels that were above the WHO guideline value of 10 μg/m³.

Source: Ambient Air Pollution Database, WHO, May 2016.

KEY IMPLICATIONS FOR HEALTH

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

Long-term exposure to fine particles has been associated with an increase in mortality from cardiovascular and respiratory causes, and lung cancer.

SHORT LIVED CLIMATE POLLUTANTS

Short-lived climate pollutants such as black carbon, methane and ground-level ozone – released through inefficient use and burning of biomass and fossil fuels for transport, housing, power production, waste disposal and industry – are responsible for a substantial fraction of global warming as well as air-pollution related deaths and diseases.

Since short-lived climate pollutants (SLCPs) persist in the atmosphere for weeks or months while CO_2 emissions persist for years, significant reductions of SLCP emissions could reap immediate health benefits and health cost savings,[a] and generate very rapid climate benefits – helping to reduce annual global mean temperature by as much as 0.5°C before 2050.[a]

In the UK, it is estimated that a reduction in SLCPs* could prevent 1,800 premature deaths attributed to outdoor air pollution per year, from 2030 onwards (Shindell, D., Science, 2012).

* Through implementation of 14 reduction measures: 7 targeting methane emissions and the rest, emissions from incomplete combustion. See source for further detail.

a United Nations Environment Programme. Reducing Climate-related Air Pollution and Improving Health: Countries can act now and reap immediate benefits. http://www.unep.org/ccac/Media/PressReleases/ReducingClimate-relatedAirPollution/tabid/131802/language/en-US/Default.aspx

4 CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION

Many policies to mitigate climate change through reducing greenhouse gas emissions and short-lived climate pollutants such as black carbon, can also lead to improvements in health, through a range of mechanisms. For example, reduced coal combustion or shift from diesel vehicles to petrol-hybrid or electric vehicles, bring co-benefits due to reductions in fine particulate air pollution. However, policies that directly encourage active travel (walking and cycling) and the use of public transport (with increased walking), rather than private cars, can have the added benefit of reducing the risks of conditions related to physical inactivity. A number of studies have been done to illustrate the approximate magnitude of health co-benefits that could be achieved by such policies in the UK.[a,1]

Transportation

The health effects of alternative urban land transport scenarios have been assessed for London[2], comparing a business-as-usual 2030 projection (without policies for reduction of greenhouse gases) with alternative scenarios – lower-carbon-emission motor vehicles, increased active travel, and a combination of the two.[2] A combination of increasing walking and cycling to levels observed in cities such as Copenhagen, Denmark, along with lower-emission motor vehicles, provides the largest health benefits per million population (7439 DALYs). The largest gains are through diseases associated with physical inactivity – type 2 diabetes, dementia, cerebrovascular disease, breast cancer, colorectal cancer, depression, and most notably from ischaemic heart disease (10–19% reduction). Greater reductions in air pollution and related mortality could be achieved by a transition to petrol-hybrid or electric vehicles.

Such measures should bring significant cost savings to the National Health Service (NHS).[3] Increasing walking and cycling in urban England and Wales to the levels of Copenhagen, can be expected to reduce the prevalence of the seven diseases listed above, although slightly increasing the risk of road traffic injuries. This is estimated to lead to roughly UK£17 billion (in 2010 prices) of costs averted to the NHS within 20 years, with savings continuing further in the future.

Energy and Industry

The power and industry sectors are together responsible for 42% of UK domestic GHG emissions. Electricity generation from coal, the most carbon-intensive fuel source, decreased by 23% in 2014.[6] Half of this is permanent, as 1.2 GW of coal fired generating capacity closed due to EU air quality directives, and some (0.65 GW) converted to biomass generation, with the rest from reduced use of the 20 GW of remaining coal plant capacity. Coal combustion can affect health through fine particulate air pollution and emissions of mercury and other toxins. More work is needed to quantify the health and economic co-benefits of policies to promote low carbon electricity generation and industrial energy sources, but these are likely to be significant.[7]

It has been estimated that air pollution overall is responsible for around £15 bn annual health costs in the UK, even greater than the costs of obesity. Under two scenarios designed to meet the Climate Change Act reduction targets for 2020 and 2050; mitigating climate change leads to reductions in air pollutant emissions. In Scenario A, this reduction delivers a value of £15 billion by 2050. However, when the technology is optimised to take into account air quality (B), additional benefits worth £24 billion can be achieved (net present value).[7] These results illustrate the potential magnitude of benefits that can arise from well designed policies to reduce GHG emissions.

Food and Agriculture

A recent study estimated that if the average UK diet were optimised to comply with the WHO dietary recommendations, there would be an incidental reduction of 17% in GHG emissions.[4,5] Such a dietary pattern could save almost 7 million years of life lost prematurely in the UK over the next 30 years and increase average life expectancy by over 8 months. Diets that result in additional GHG emission reductions could achieve further net health benefits, however for emission reductions greater than 40%, improvements in some health outcomes may decrease and acceptability will diminish.

Housing Electricity

Research has examined the effect of hypothetical strategies to improve energy efficiency in UK housing stock.[a] For UK housing, the interventions were generally beneficial for health, although the magnitude and even direction of the changes depended on details of the intervention. For a strategy of combined fabric, ventilation, fuel switching, and behavioural changes, the study estimated 850 fewer disability-adjusted life-years (DALYs), and a saving of 0.6 megatonnes of carbon dioxide (CO_2), per million population in 1 year.[8]

a The studies followed the approach of the WHO Comparative Risk Assessment Exercise, using estimates of the relative risk of different diseases under different levels of environmental exposure or behaviour, in order to compare the health of the 2010 population with and without the specified measures.

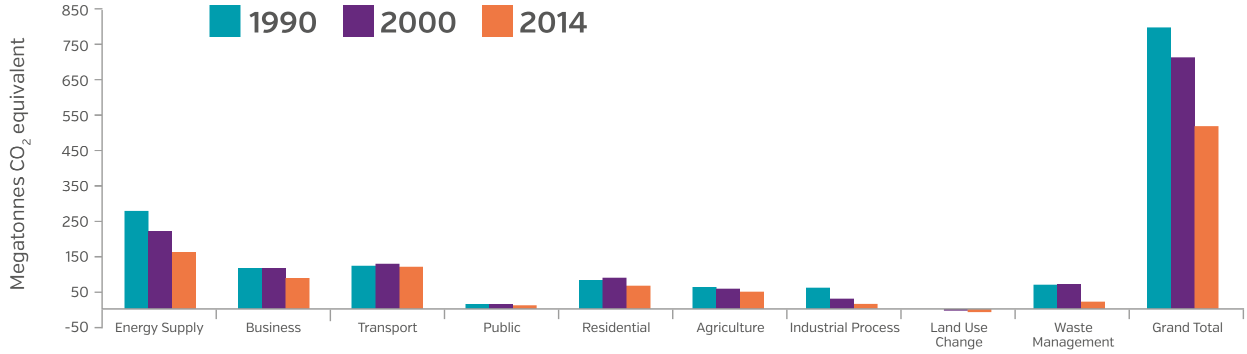
For a complete list of references used in the health co-benefits text please see last page.

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.

UNITED KINGDOM ANNUAL GREENHOUSE GAS EMISSIONS

(megatonnes CO_2 equivalent)



Through intersectoral collaboration, the health community can help to identify the best policy options not only to achieve continued reduction in greenhouse gas emissions, but also to provide the largest direct benefits to health.

Source: Department of Energy & Climate Change, 2016. https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics

NATIONAL RESPONSE[d]

1993	THE UK SIGNED THE UNFCCC
2006	CLIMATE CHANGE AND SUSTAINABLE ENERGY ACT
2012	CLIMATE CHANGE RISK ASSESSMENT (CCRA)[E]
2012	HEALTH EFFECTS OF CLIMATE CHANGE IN THE UK (HECC)[E]
2013	NATIONAL ADAPTATION PROGRAMME (NAP)[E]