This briefing considers some of the anticipated impacts of climate change on health in Scotland, and associated policy. Climate change is considered to be a “threat multiplier,” amplifying pre-existing health problems and inequities.

Included in this briefing are a description of projected impacts on health in Scotland of 1) changes to Scotland’s climate, 2) the transition to a low carbon economy, and 3) the global effects of climate change.
EXECUTIVE SUMMARY

Climate change will have major impacts for health on a global scale, acting as an amplifying factor for many causes of ill health. It will affect the poorest populations in the world disproportionately, primarily because of their lack of capacity to adapt.

The impacts of climate change on health will be much smaller in the developed world, including Scotland. This is partially the result of the affluence achieved through industrialisation and economic growth driven by burning fossil fuels. Globally, climate change is expected to increase the divide between rich and poor.

Several factors make some parts Scotland’s population particularly vulnerable to the health impacts of climate change, including poorer health and an ageing population. Within Scotland, health impacts will be distributed unevenly, having the greatest effect in areas of high deprivation.

It is probable that direct impacts of climate change on health in Scotland can be almost entirely countered by public health policies. The most significant impacts are changing patterns of temperature-related mortality, increased incidence of respiratory, water-borne and food-borne diseases and the effects of more frequent flooding.

It has been suggested that there are alignments between policies to reduce greenhouse gas emissions and to improve public health. Such measures are expected to be particularly powerful in tackling obesity, cardiovascular and respiratory disease. However, whether the transition to a lower carbon economy will have significant effects on the health of Scotland’s population depends on policy decisions.

Over the longer term, the global impacts of climate change will begin to be felt in Scotland, affecting many parts of life, including health. Falling crop yields, driven largely by water scarcity, will reduce the security of Scotland’s food supplies, potentially causing price increases that would affect the diet of the poorest people in Scotland. Patterns of migration are expected to change, although there is no evidence to suggest that this will result in a substantially larger flow of people into Scotland. Increased conflict due to scarcity of water and other resources is expected to increase volatility of international markets, with consequences which are difficult to predict.
CLIMATE CHANGE AND HEALTH

It is well established that the Earth’s climate is changing. The United Nations Intergovernmental Panel on Climate Change (IPCC) describes the warming of the Earth’s climate as “unequivocal” and predicts an increase in global average temperature of two to three degrees above pre-industrial levels after 2090 for medium risk scenarios. Higher emission scenarios predict temperature increases of up to 6 degrees.

There is a broad consensus among climate scientists that climate change is caused by an increase in greenhouse gas concentrations due to human activity. The most recent IPCC Assessment Report (2007) states that the majority of the increase in the earth’s surface temperature over the last century was “very likely” to have been the result of greenhouse gas emissions associated with industrialisation. Carbon dioxide (CO₂), the most prevalent of the greenhouse gases, is released in large quantities during the burning of fossil fuels.

Climate change is expected to cause global sea level rise due to ice melting, and an increase in the incidence of extreme weather events, such as hurricanes, floods and droughts. Additionally, a 1.5-2.5°C global temperature rise would lead to an estimated 20-30% loss of biodiversity. A greater rise in temperature has the potential to drive changes that would have a major lasting impact on the climate system such as the devastation of the Amazon rainforest, disruption of the monsoon cycle and widespread ecosystem degradation (IPCC, 2007; HM Treasury Review, 2006).

The impacts of climate change have been recognised as being critical to current and future global health by the IPCC (IPCC, 2007) and the World Health Organisation (WHO, 2009). Increases in temperature, changes to weather patterns and an increased frequency of extreme weather events will contribute to changes in patterns of mortality and disease. Increased scarcity of water in parts of the world and the associated reduction in crop yields will also affect health. The Climate Change Human Impact Report (Global Humanitarian Forum 2009), states that climate change already “aggravates already enormous health problems, especially in the poorest parts of the world.” This report suggests that malnutrition due to both reduced food supply and decreased income from farming or fishing may be the largest global health impact of climate change.

Policy responses to climate change fall into two categories:

1) **Mitigation** is action to reduce the global output of greenhouse gases so as to minimise the magnitude of the eventual temperature rise.

2) **Adaptation** is action taken in preparation for, or response to, the impacts of climate change.

The timing, intensity and location of any specific impacts of climate change are uncertain, so adaptation policy is commonly developed from general rather than specific predictions of climate change impacts.

Furthermore, climate and environmental change is just one among many equally, and sometimes more, important drivers of poor health. Climate change policy relating to health is therefore inextricably linked with other policy areas, such as inequity, sustainable development and overall economic growth. Climate change is “not a stand alone risk factor but, rather, an amplifier of existing health risks” (Costello et al., 2009).
GLOBAL CONTEXT

The Stern Review (2006) states that “the impacts of climate change are not evenly distributed – the poorest countries and people will suffer earliest and most.” A country’s vulnerability to the effects of climate change depends on its geographical situation, wealth, infrastructure and strength of governance. Climate change is expected to increase global health inequity – its human consequences will be most severe in the poorest parts of the world, which have contributed the least to the world’s greenhouse gas emissions. A report by the Charted Institute of Environmental Health (2008) states that climate change is “already contributing towards widening the gap in health inequalities between people living in the developing and developed world.”

The use of fossil fuels, and accompanying industrialisation, have contributed to “doubled longevity, dramatically reduced poverty, and increased education and security” in the developed world (Costello, 2009). Wealthier countries are therefore able to adapt to changing weather patterns and environments and to minimise the impacts of global change for their own populations (the relationship between carbon emissions and Gross Domestic Product is explored in Appendixes 1 and 2). In northern Europe and North America, climate change may actually decrease mortality rates as the number of winter deaths fall. Figure 1 shows estimates of the relative effects of climate change on health for different World Health Organisation regions, expressed in Disability Adjusted Life Years (DALYs).

Figure 1: The effect of climate change on global health by WHO region in 2000 (Costello et al., 2009; WHO 2003). These estimations relate only to the effects of floods, landslides, malnutrition, cardiovascular disease, diarrhoea and malaria.

<table>
<thead>
<tr>
<th>Region</th>
<th>Total DALYs (1000s)</th>
<th>DALYs per million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa region</td>
<td>1894</td>
<td>3071.5</td>
</tr>
<tr>
<td>Eastern Mediterranean region</td>
<td>768</td>
<td>1586.5</td>
</tr>
<tr>
<td>South America and Caribbean region</td>
<td>93</td>
<td>188.5</td>
</tr>
<tr>
<td>Southeast Asia region</td>
<td>257</td>
<td>1703.5</td>
</tr>
<tr>
<td>Western Pacific region*</td>
<td>169</td>
<td>111.4</td>
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<tr>
<td>Developing countries†</td>
<td>8</td>
<td>8.9</td>
</tr>
<tr>
<td>World</td>
<td>5547</td>
<td>920.3</td>
</tr>
</tbody>
</table>

*Without developed countries. †And Cuba.

1 Disability Adjusted Life Years (DALYs) are a measure of time lost due to ill health or death used by the WHO to measure the effectiveness of health interventions. One DALY represents the equivalent of the loss of one year of healthy life.
High per capita emissions, both today and over the 20th century, place the responsibility for current climate change on developed countries. In 2008, Scotland had about 0.08% of the world’s population, but contributed about 0.14% of global CO₂ emissions (Scottish Government, 2010b; World Bank, 2012). Scotland’s per capita CO₂ emissions are just over the average for developed countries and significantly higher than the per capita emissions of developing countries of similar population. (Figure 2, Appendix 1, Table 1, data from 2008). Along with most of Northern Europe, Scotland is one of the least vulnerable countries to climate change in the world (Figure 1), both because of its position at high latitude, and because it has the wealth to adapt to it; however there are specific climate change impacts which could have particular implications in Scotland – these are discussed later.

![Figure 2: Carbon dioxide emissions per capita for countries of population between 4 and 6 million (data presented in Table 1, Appendix 1). There is a clear difference in emissions per head population from developed (average 8.6 tonnes CO₂ per capita) and developing countries (average 0.1 tonnes CO₂ per capita).](image)

In the developing world, climate change will increase the vulnerability of poor populations already at risk of ill health due to other factors, such as malnutrition or poor housing (Costello et al., 2009). These populations will be more exposed to climate change, and be more sensitive to those changes than people living in wealthier nations. The regions considered to be at greatest immediate risk from more frequent droughts and flooding are in Sub-Saharan Africa and South Asia (WHO, 2003; Figure 1). The number of healthy life years² lost due to environmental change has been estimated to be 500 times greater in some low income African countries than in Europe (McMichael, 2008). Decreased agricultural yields will cause malnutrition and hunger, and will also restrict economic growth, increasing poverty and having a negative feedback effect on health (WHO, 2003; Costello et al., 2009). Obstacles to dealing with the health effects of climate change in the developing world include limited local health data and a lack of research and technological capacity. Increasing the resilience of developing countries by acting to reduce poverty and improve health (e.g. malaria control) will have large benefits for climate change adaptation. Costello et al., (2009) advocate a strategy of “contraction and convergence, whereby rich countries rapidly reduce emissions and poor countries can increase emissions to achieve health and development gain, both having the same sustainable emissions per person.”

² The concept of ‘healthy life years’ takes account of both mortality and morbidity (poor health or disability). It measures the years that a person of a certain age can expect to live without disability.
SCOTTISH CONTEXT

The impacts of climate change in Scotland can be divided into three groups:

1) Direct impacts caused by changes to temperature, weather patterns and the environment in Scotland

2) Indirect impacts caused by the changes in society that are made to meet carbon reductions targets

3) The effects that global climate change impacts will have on Scotland.

POLICY CONTEXT

In the long term, the impacts of worldwide change are likely to have a greater effect on life in Britain than the direct effects of local temperature change (Foresight, 2011a). It is not yet clear how significant indirect effects due to the transition to a low carbon economy will be. Most Scottish policy has so far focussed on direct effects of climate change on health. These are, to a certain extent, easier to predict. Additionally, many of the direct impacts of climate change on health in Scotland may be mitigated by preparation and adaptation policies.

The Climate Change (Scotland) Act 2009 drives mitigation policy in Scotland and requires an 80% reduction in greenhouse gas emissions by 2020. The Scottish Government’s policies on mitigation are developed by a suite of Low Carbon Society publications (e.g. Scottish Government, 2011b).

Adaptation policy is also formalised by the 2009 Act, which includes the requirement that that the government present a statutory adaptation programme to the Scottish Parliament including objectives, and specific policies and proposals for meeting them.

Precursory work on adaptation was set out in Scotland’s Climate Change Adaptation Framework (Scottish Government, 2009b), which included a ‘Sector Action Plan’ for Health and Wellbeing (Scottish Government, 2009c). Further work has recently been published in the first Climate Change Risk Assessment for Scotland (Defra, 2012b), where Health and Wellbeing is one of five themes. The statutory adaptation programme required by the Climate Change (Scotland) Act 2009 is currently in development, with a public consultation later in 2012 and a finalised programme expected in 2013.

Organisations involved in health related climate change adaptation in Scotland, including Adaptation Scotland and various NHS Boards, are set out in Table 3, Appendix 3.

THE CHANGING CLIMATE

Research into changes in Scotland’s climate over the past century (Barnett et al., 2006) show that mean temperatures over the whole country have risen, summers become drier, winters wetter and heavy rain events more frequent. Mainland Scotland warmed by 0.5°C between 1914 and 2003, with faster warming after 1960. Northern Scotland has warmed at a slower rate than the rest of the country, with little change to winter temperatures. Changes to average mean temperatures between 1961 and 2004 are shown in Figures 3 (summer) and 4 (winter).

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3 Personal Communication, Scottish Government
Between 1961 and 2003 there was an increase of almost 60% in winter precipitation in northern Scotland, but a decrease in summer precipitation limited to some parts of northwest Scotland. Historical trends in wind, number of hours of sunshine and amount of cloud cover are difficult to identify.

The 2009 UK Climate Projections (UKCP09, Defra, 2009) estimate the probability of specific future climate change scenarios. More confidence can be placed in predictions on large rather than local scales. The primary changes expected in the UK by 2080 are an increase in temperature (mostly in summer), increased winter precipitation and increase in sea level. The greatest increase in mean summer temperatures is expected to be in southern England (central estimate 4.2 °C, very unlikely to exceed 6.8 °C) and the lowest on the Scottish islands (central estimate 2.5 °C, very unlikely to exceed 4.1 °C)\(^4\). The projections show no major change to annual precipitation, but an increase in winter precipitation by up to 33% in the western British Isles (Defra, 2009). Increased cloud cover of about 5% is also anticipated in Northern Scotland by 2080. The UKCP09 include no projections of changes to storms as these are very different between different climate models.

\(^4\) The UKCP09 ‘central estimates’ are at 50% probability level and ‘very unlikely to be exceeded’ indicates 10% probability level for temperature reaching a particular temperature or lower (Defra, 2009).
PARTICULAR VULNERABILITIES

As in the rest of the world, the effects of climate change on health in Scotland are expected to be most severe in populations which are already vulnerable. Several factors make Scotland’s population more vulnerable to the health impacts of climate change than other parts of the UK and Europe (UKCCC ASC, 2011). The elderly and people suffering from poor health are particularly vulnerable to extreme weather events and to extremes of heat and cold. Scotland’s population is ageing; the proportion of the population of pensionable age is expected to increase from about 20% to 25% by 2033. Scotland also has areas of greater deprivation than the rest of the UK.

Health is poorest in the most deprived areas of Scotland, with life expectancy for men just 58 years in the most deprived 15% of areas, compared to 68 years for the whole of Scotland. Glasgow has been found to be the most vulnerable place in Scotland to the effects of high temperatures and flooding, due largely to high levels of deprivation (Lindley et al., 2011).

An investigation into the social impacts of climate change in the UK (Chalmers et al., 2009) expects the most vulnerable people to be:

1) Ill, poorly housed or not mobile
2) Living in places at risk (e.g. flood zones, coast)
3) Socially isolated or otherwise unable to adapt to change.

The remoteness of some communities in the north and central Highlands and Islands is also expected to increase their vulnerability to extreme weather (UKCC ASC, 2011).

DIRECT HEALTH IMPACTS

The UK Climate Change Risk Assessment (Defra, 2012a) identifies lower winter mortality rates as a benefit as well as four potential threats to public health. These are increases in:

1) Heat-related death and illness in summer
2) Marine and freshwater pathogens
3) Health problems due to air pollution
4) The many health impacts of flooding.

The CCRA for Scotland (Defra, 2012b) additionally discusses respiratory conditions associated with algal and fungal growth in housing and potential for increased rates of food poisoning. As many of the direct impacts of climate change on health in Scotland will primarily affect the most vulnerable, policies to address health inequities may mitigate its worst effects.

Temperature-related mortality

Milder winters and hotter summers are expected to change seasonal patterns of mortality in Scotland. Milder winters are expected to lead to a decrease in the number of premature cold related deaths by between 550 and 890 by the 2050s, a drop of 20-32% from excess winter mortality in 2009/10 (2760, General Register Office for Scotland, 2011). Heat related summer deaths are expected to increase by approximately 100 (Defra, 2012b). These figures constitute a small change in the total number of deaths per year in Scotland. For example, taking the total number of deaths in Scotland in 2009 (52,000), this would be around a 1% decrease due to cold related deaths and <0.2% increase due to summer heat related deaths. The threshold temperatures at which deaths increase vary across the UK, and are higher for hotter and lower
in colder regions. These mortality estimations do not take population growth or future adaptation to changing temperatures into account.

Heat waves (when high temperatures are sustained continuously over several days) have been shown to increase respiratory and cardiovascular illnesses (Patz et al., 2005). The elderly are particularly vulnerable to both heat and cold related stress, most particularly those in long term care or hospital. People taking diuretic drugs, suffering from dementia, heart disease, some neurological conditions and types of diabetes are also particularly sensitive to temperature extremes (Defra, 2012a). The number of cold temperature related hospital admissions in Scotland is expected to decrease by many hundreds of thousands, while hospital admissions due to heat related illness increase by tens to a few hundreds of thousands by the 2050s (Defra, 2012b).

**Respiratory conditions**

In winter, high levels of air pollution are associated with temperature inversions, where atmospheric temperature increases with height, trapping polluted air at the earth’s surface. In summer, additional air pollution is caused by pollutants reacting in the presence of sunlight to produce ozone. Although it is thought that winter inversions will become less frequent with climate change, the number of ozone pollution episodes in summer is expected to increase. Ozone irritates the respiratory system and damages the lungs when inhaled. It is particularly dangerous for people suffering from respiratory conditions such as asthma. The UKCCRA estimates that 2900 additional premature deaths and 10,000 additional respiratory hospital admissions may occur in the UK due to increases in the number of ground level ozone events by 2080 (no intermediate estimations are made). An increase in the number of days with high pollen counts will also cause problems for those who have respiratory diseases, or suffer from hay fever. The number of ozone events could be minimised by more stringent controls on the emission of the pollutant gases from which ozone forms.

Wetter winters are expected to lead to increased algal and fungal growth in poor quality or inadequately heated housing, causing problems for those suffering from asthma and other respiratory diseases (Defra, 2012b; Williamson et al., 1997). Damp housing is associated with fuel poverty (Olsen, 2001) (the inability to heat a home to an adequate level due to costs), which affects a third of homes in Scotland (National Statistics, 2010). In addition to health impacts, damp has been associated with overcrowding and other social and economic impacts. An increase in winter temperatures may contribute to alleviating fuel poverty, although the effects of fuel prices and income levels are likely to be more important. The Scottish Government’s aims of eradicating fuel poverty by 2016 (Scottish Government, 2011c), and removing substandard housing by 2015 (Scottish Government, 2011a) would eliminate any significant impact of climate change on domestic conditions that contribute to respiratory disease.

**Extreme weather events**

The most significant health risks posed by extreme weather events in Scotland are expected to be due to flooding (Defra, 2012a &b). Spring floods due to snow melt are expected to become less frequent, while autumn and winter flooding due to intense precipitation becomes more frequent. Projected increases in flooding and coastal wave activity are expected to put more people at risk of injury or death (up to 100 more flood related injuries per year in Scotland expected by 2080s for high emissions scenarios (Defra, 2012b)). Floods are associated with increased incidence of skin and ear infections, gastrointestinal infections and traumatic injuries.

The CCRA for Scotland (2012) estimates that an additional 800 people will suffer “an (unspecified) mental health effect” due to flooding by the 2080s. This is based on two studies (Reacher et al., 2004; Tunstall et al., 2006) which administered General Health Questionnaires
to flooded and non-flooded households. This measure is not diagnostic of mental illness, but of “measurable distress”.

The Scottish Environment Protection Agency (SEPA) runs an automatic electronic flood warning service and was also responsible for the preparation of a National Flood Risk Assessment, an analysis of data on the sources and impacts of flooding in Scotland (SEPA’s national flood risk map is shown in Figure 5). Flooding is expected to increase pressure on healthcare infrastructure, particularly emergency services, with isolated communities being the most vulnerable to infrastructure damage. Health Facilities Scotland (HFS) is currently working with Adaptation Scotland to develop operational guidance on adaptation to climate change for healthcare facilities in Scotland.

**Figure 5:** Map of Scotland showing catchment unit of increased flood risk. Dark brown areas have more than 50 houses at risk from a once in 200 year flood (SEPA, 2011), as reproduced in UK Committee on Climate Change Adaptation Subcommittee report (2011). The Scottish Environment Protection Agency reserves all copyright and database rights.

The threat that more frequent flooding and extreme weather poses to infrastructure has been widely recognised. For example, the Highland Climate Change Adaptation Plan (2012) describes a pilot project from Gairloch and Loch Ewe that identified the transport sector as that perceived to be most vulnerable to the effects of climate change, particularly transport for the elderly and emergency services. This plan aims to use records of past emergency responses to
identify gaps in provision, test emergency planning procedures under different scenarios and review the locations of emergency response centres. Recommendations from the Scottish Road Network Climate Change Study (Scottish Government, 2005) are focussed on improvements to drainage systems to cope with more intense rainfall.

**Increases in food and water borne diseases**

Higher summer temperatures may allow the growth of pathogens (dominantly bacteria), both in coastal waters and in drinking water supplies. The treatment of drinking water in Scotland is expected to be adequate to remove dangerous pathogens, such as cryptosporidium or E. coli, across most of the country (Defra, 2012b). Scottish Water is responsible for the production of Drinking Water Safety Plans for all their supplies by the end of 2012. However, rural populations dependent on sometimes inadequately treated local water supplies (about 3% of the population) are most at risk from increased pathogen levels due to rising temperatures (Pollack et al., 2010).

Pathogens in coastal waters can potentially cause ear infections, gastrointestinal and respiratory disease after swimming. However, Scottish coastal waters are not expected to have sustained periods of high enough temperatures to introduce significant risk this century (Defra, 2012b). There may also be an increased risk of contamination of coastal and drinking water, if extreme rainfall events become more frequent.

A recent Food Standards Agency (FSA) report into the effects of climate change (Lake et al., 2010), highlighted increased unpredictability in food-borne disease as a predicted impact of climate change. Pathogens that cause food-borne disease multiply faster at higher temperatures (e.g. Salmonella growth is fastest above 37°C and Campylobacter above 30°C). It has been estimated that an increase in temperature of 1°C would result in an increase in food poisoning reported by about 4.5% (at least an additional 4000 cases per year) (Bentham, 2008). On the IPCC medium emissions scenario this would result in an increase of 5-14% by the 2050s. However, it is expected that this could be mitigated by improved food hygiene (e.g. Lake et al., 2009). As rates of food poisoning correlate with the temperature before the outbreak (Kovats et al., 2004), there may be potential for a public warning system during hot weather periods. Health Protection Scotland (HPS) is responsible for monitoring gastro-intestinal diseases in Scotland and operate an alert system to pick up on any increased incidence of food poisoning.

**Changes to ultraviolet (UV) radiation exposure**

Both positive and negative health effects have been proposed for increased UV exposure in Scotland due to climate change. Exposure to sunlight is important for the body’s uptake of vitamin D, which is essential for health, although only a little exposure is needed. Epidemiological studies have confirmed the role of UV radiation in skin cancers and potentially some types of cataract (Bentham, 2008). However, projections of changes to the UK climate (Defra, 2009, see section above) do not necessarily suggest that Scotland’s population will have an increased UV exposure, as this will largely depend on cloud cover. Social factors and individual behaviour, rather than climate, are more important in determining UV exposure (Defra, 2012a).
Vector-borne diseases

This risk of new vector species being introduced to the UK is thought to be low (Rogers et al., 2008). It has been suggested that there may an increased incidence of Lyme disease and tick-borne encephalitis associated with climate change, although land management and human behaviour are likely to be more important (Randolph, 2010). Whether or not environmental change has an impact on patterns of disease is largely a function of other factors such as water and food safety measures, the monitoring and treatment of communicable diseases and the susceptibility of the local population. There may, however, be an increased incidence of vector-borne diseases such as malaria or dengue fever in travellers entering or returning to Scotland as the global distribution of these diseases changes (Costello et al., 2009). Monitoring the incidence of vector-borne diseases and the emergence of new diseases in Scotland falls under the remit of Health Protection Scotland (HPS).

POTENTIAL IMPACTS OF MITIGATION POLICIES ON HUMAN HEALTH

Recent work on the potential impacts on public health of policies aimed at tackling climate change has reached the general conclusion that “actions to reduce greenhouse gas emissions often, although not always, entail net benefits for health” (Haines et al., 2009). They also suggest that policies designed to address the combined goals of greenhouse gas emissions reduction and public health improvement will be “cost effective and socially attractive”, partially because the costs of implementing such mitigation strategies can then be considered against savings made in healthcare. One of the key recommendations in Audit Scotland’s report on Reducing Scottish Greenhouse Gas Emissions (2011) is that the Scottish Government should “develop and communicate a better understanding of policies’ wider non-financial and financial benefits”. This aspect of climate change mitigation policy has also been advocated by several NGOs in Scotland, including Friends of the Earth Scotland and Transform Scotland (Friends of the Earth Scotland, 2010; Transform Scotland, 2008).

Transport

Transport accounts for almost a quarter of global carbon dioxide emissions. A shift away from using cars in favour of walking or cycling, especially in urban areas, would have a range of impacts on health. Increases in physical activity will reduce incidence of heart disease, cerebrovascular disease, some types of cancer and diabetes. There may however be a trade-off between the increase in people’s exposure to air pollution and road traffic danger and the reduction in urban air pollution due to increased active transport (Haines et al., 2009). Air pollution levels would also be reduced by increased use of public transport, especially if new, lower emission vehicles such as hybrid electric buses are adopted (discussed in Friends of the Earth Scotland, 2010). The health benefits of increased physical activity are expected to far exceed those from a reduction in urban air pollution (Woodcock et al., 2009).

In 2003 the estimated cost of obesity to NHS Scotland was £171 million, just behind smoking in terms of economic burden (Walker, 2003). In the UK as a whole, the percentage of obese people is expected to increase to 40% by 2025 (Foresight, 2007), and UK NHS costs attributed to treating disease contributed to by excess weight and obesity are expected to double by 2050 (Haines et al., 2009). Any policy that reduces obesity is therefore expected to save lives and money. Pucher et al., (2010) found that high levels of walking and cycling can explain up to half the difference between obesity rates between different countries. Transform Scotland recently used the WHO Health Economic Assessment Tool for Cycling to estimate the economic savings

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5 Vector-borne diseases are infections transmitted from person to person via an infected animal (e.g. a mosquito, black fly or snail).

6 Cerebrovascular diseases develop due to problems with blood vessels inside the brain.
for Scotland of an increase in cycling from current levels up to 20% and 40% of all journeys under 5 miles. This indicated savings of £1,215,000 and £2 billion respectively, considering just money saved from reduced mortality (Transform Scotland, 2008).

One of the objectives stated in the Scottish Government’s Low Carbon Economic Strategy for Scotland (2011b) is to encourage low carbon transport options. This includes the aim to provide “safe and convenient opportunities for walking and cycling and invest in the necessary infrastructure to do so.” The Scottish Government’s Cycling Action Plan for Scotland, aims to increase the percentage of journeys made on a bicycle to 10% by 2020. In addition to its role in lowering the carbon footprint of Scotland’s transport sector, this is also motivated by the fact that “more cycling and walking brings major health as well as environmental benefits” (Scottish Government, 2010a). However, the Sustainable and Active Travel Budget for 2012/13 is expected “to remain significantly down” on 2011/12 levels (Transform Scotland, 2012). The Healthy Environment Network (NHS Health Scotland, 2008) also consider “claiming the health benefits of action on climate change” through “active commuting” to be a priority.

**Food**

The agriculture sector accounts for 10-12% of total greenhouse gas emissions worldwide, and 17% of emissions from Scotland (Audit Scotland, 2011). Additionally, the food sector is the “category contributing most to … [Scotland’s] land footprint”, that is the area of the earth’s surface required to produce all the food consumed in Scotland (Scottish Government, 2009d). Meat and meat products have the greatest environmental impact in the food sector (Tukker et al., 2006). The relationship between meat and dairy production, greenhouse gas emissions and human health is illustrated schematically in Figure 6. The Sustainable Development Commission has identified a reduction in meat and dairy consumption as being one of the changes that would have the “most significant and immediate impact on making our diets more sustainable” (Sustainable Development Commission, 2009).

Recent UK Government commissioned reports (Audsley et al, 2009; Foresight, 2011c) have suggested that reducing demand for resource-intensive food in high income countries could make an important contribution both to stabilising the global food system and to reducing greenhouse gas emissions. It has been suggested that this could be achieved by a shift away from meat and dairy consumption in favour of fruit and vegetables. A 50% reduction in livestock product consumption in the UK is expected to reduce greenhouse gas emissions from primary production by 19%, as well as significantly decreasing the land required to produce the UK’s food (Audsley, 2009). This report acknowledges that “these consumption changes may seem remote,” but suggests that motivation for the shift to a lower meat and dairy intake may come from predicted health benefits and increased food prices (discussed later).
A reduction in the consumption of meat and dairy would have benefits for health for most people in wealthy countries [Friel et al, 2009; Millward and Garnet, 2010]. For example, a lower saturated fat intake is expected to reduce rates of heart disease [Goodland, 1997; Garnet, 2009; Stehfest, 2009]. Friel et al. (2009) estimate that a decrease in livestock production of 30% would result in a decrease in particular types of heart disease of 15%.

Although a significant reduction in meat and dairy and increase in fruit and vegetable consumption currently seems very unlikely, this would be in line with Scottish Government goals for healthy eating. Poor diet is a major cause of ill health in Scotland, contributing to coronary heart disease, some types of cancer, diabetes, strokes and osteoporosis. Illness associated with excess weight cost NHS Scotland around £312 million a year (Scottish Government, 2010c).

The Scottish Government has set dietary goals that recommend that fruit and vegetable intake should double and carbohydrate intake increase by 25% (Scottish Government, 1996). The Review of the Scottish Diet Action Plan (2006) proposed that a “strategic theme” for the Scottish Government’s policy on diet should be “closer integration between the policy goals of improving Scotland’s diet-related ill health and those of social justice [and] sustainable development”. A report by the Stockholm Environment Institute (Frey and Barret, 2006) compares the environmental footprint of the average Scottish diet with one that follows nutritional guidelines and finds that a switch to healthier eating could decrease Scotland’s food footprint (in terms of land required for production) by 15-25%.
Energy

The adoption of low carbon fuels and technologies will decrease particulate air pollution, with positive effects on cardiopulmonary mortality and lung cancer. This effect would be much greater in, for example, China and India than in the EU, where levels of pollution from electricity production are already much lower. The costs of switching electricity production to lower carbon methods is predicted to be offset to some extent by savings due to reduced pollution related mortality, although again this is likely to be a smaller effect in Europe than parts of the developing world (Markandya et al., 2009).

There may be detrimental effects on health due to higher electricity prices, and a resultant increase in fuel poverty (Haines et al., 2009). However, accompanying insulation schemes and improved energy efficiency, have the potential to have “positive effects [on fuel poverty] … over the long term” (Scottish Government, 2009e (SEA)) and alleviate any impact of higher electricity prices. Insulation programmes that reduce ventilation may also increase domestic pollution concentrations (e.g. second hand tobacco smoke, carbon monoxide). These negative effects could be avoided by effective air filtering or exchange. Wilkinson et al. (2009) conclude that “Improvements in the efficiency of UK household energy use could, if implemented correctly, have appreciable benefits for population health.” These are however, likely to be small relative to co-benefits associated with increased exercise and improved diet.

THE IMPACT OF GLOBAL CLIMATE CHANGE IN SCOTLAND

Climate change in other parts of the world, and especially the developing world, will have significant impacts on global wealth and stability. The consequences for any particular country of changes to international markets and to societies in other parts of the world are very difficult to predict. Some of the issues anticipated to be important to Scotland’s future will depend on global trends, likely to be affected by changes to the Earth’s climate (Newsham et al., 2007).

Food security

Both climate change and mitigation policies are expected to put pressure on food security between now and 2050 (Foresight, 2011c). Climate change has also been described as a “threat multiplier, making the challenges of sustainable food security much more difficult” (Nelson et al., 2010). Other important factors are the projected population increase from just under seven billion today to nine billion in 2050, and an increase in demand for varied, high quality diet as the number of wealthier people increases. There will also be higher competition for increasingly scarce resources. The UK Government Foresight Food and Farming Report (2011) advocates an integrated policy response, with simultaneous action to increase sustainable food production, contain demand for the most resource intensive foods, and minimise waste. The report does not consider national self-sufficiency a viable option for achieving a global sustainable food system, as trade barriers “distort agricultural markets” and increase international prices.

For a moderate temperature rise (2-3°C) crop yields may increase at mid-high latitudes, including the UK and northern Europe, but then decline with any further increase in temperature. At lower latitudes, crop yields are expected to decline, especially in Africa where hundreds of millions of people are expected to be left with limited ability to grow or buy food (HM Treasury, 2006). Climate change will also make some contribution to increased volatility in the global food system due to an increase in the frequency of floods, droughts and hurricanes causing sharp fluctuations in food production.

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7 Relating to both the heart and lungs.
Crop yield reduction, caused by climate change, will contribute to increased food prices. The price of wheat is expected to rise by over 50%, rice by almost 60% and maize by 100% in real terms by 2050 (Foresight, 2011c). Some limited price rise may have positive consequences, such as acting as an incentive to reduce waste or stimulating growth in agricultural economies. However, prices rises will have a disproportionate effect on the poorest people, both in low-income countries and the poorest of people in mid to high income countries.

On current trends, Scotland’s food security policy will “continue to look to the international market as the solution” (Newsham et al., 2007). Food supplies would then be dependent on the stabilities of suppliers. The long term effects of increasing food prices are likely to be an increase in the divide in quality of diet that already exists between the rich and the poor. Defra suggest that share of spending on food by low income households would be a headline indicator of food security (Defra, 2008). The Scottish Government cites the Food Standards Agency participation in a multi-agency research programme into food security and sustainability as a pillar of its Health and Wellbeing Sector Action Plan.

Environmental Change and Migration

The impact of environmental change on migration is expected to increase in the future, primarily through its amplifying effect on economic and political drivers. [Foresight (2011b)]. However, the relationship between environmental change and other ‘push’ and ‘pull’ factors is complex, and will likely result in people migrating to environmentally vulnerable areas as well as away from them. The effects of climate change are expected to lead to increased internal migration, as people move away from low lying coasts or growing deserts, and decreased international migration, which is expensive and requires capital. The capacity to migrate is an important part of adaptation, and populations who become trapped in environmentally degraded areas are among the most vulnerable.

Drivers for migration related to climate change include sudden weather-related disaster (e.g. flooding, hurricane), gradual environmental change (e.g. drought, degradation of farmland), the loss of land due to sea-level rise, and conflict over decreasing natural resources. Currently most people displaced due to environmental change have moved due to natural disasters, or drought and famine, but the effects of sea level rise are expected to become important over the next century. Approximately 146 million people live in areas below an elevation of one metre above sea level, and although sea level change is not currently a driver for migration on a global scale (examples do exist from Pacific Islands and Papua New Guinea), it is expected to become important through the 21st Century (Global Humanitarian Forum, 2009).

Estimating the numbers of people who are or will be displaced because of climate change is problematic because it is rarely possible to distinguish the role of climate change as a driver for migration from other factors like poverty, unsustainable population growth and limited employment options. Estimates of the number of people displaced by climate change in 2050 range from 150-300 million, but are subject to large uncertainties (Myers, 2001; HM Treasury, 2006; Christian Aid, 2007; Gemenne, 2011).

From a global perspective the effects of climate change driven migration in Scotland are likely to be minor. Although future food insecurity could drive irregular migration from Northern Africa into Southern Europe, it is considered “moderately unlikely that large flows of environmentally induced migration would enter Europe in general and the UK in particular over the next 20 years” (Findlay, 2011). However, the CCRA for Scotland (2012) speculates that there could be a northwards migration of people within the EU, the return of some British Citizens living abroad and net immigration into Scotland from other parts of the United Kingdom. Even a relatively small increase in migration will have significant impacts for the health sector in Scotland, as it will have impacts on the demographics of Scotland’s population and on demand for healthcare.
Amplifying Factors

Water scarcity

Water scarcity is the “primary medium through which climate change influences the Earth’s ecosystems and therefore people’s livelihoods and well-being” (UN World Water Assessment Programme, 2011). The loss of mountain glaciers will threaten the water supply of people living in the Himalayan and Andes drainage area, while more frequent droughts are expected to make farming impossible in parts of Sub-Saharan Africa (HM Treasury, 2006). Lack of water is expected to drive migration and both internal and international conflict. Dam building and water extraction from shared rivers already heightens political tensions today, for example, in the Middle East or along the Nile (HM Treasury, 2006). Water shortages commonly lead to an increase in illnesses spread by unsafe drinking water and a lack of sanitation (e.g. diarrhoea, cholera). The volume of water needed to produce food to feed one person for a day is about a thousand times the amount that they drink in a day (Global Humanitarian Forum, 2009), so water shortages also cause hunger and malnutrition. About 1.3 billion people already lived with extreme water scarcity in 2009 (Global Humanitarian Forum, 2009). Although climate change will have a large impact on water resources, it is “not the only, or the main, source of stress.” Population growth, increasing demands for drinking water and increased demand for products that require water as incomes increase are more important in many parts of the world.

Although domestic water shortages are not predicted in the near future, the majority of the population of the United Kingdom is expected to be living in regions with vulnerable water supplies by the 2080s (Defra, 2012a). Drought mitigation and the distribution of UK water supplies were discussed by UK Government representatives, water companies, environmental agencies and NGO’s at a ‘drought summit’ on 20th February 2012, following one of the driest two year periods on record (Defra, 2012c; WWF, 2012; BBC, 2012). Hosepipe bans affecting 20 million people in southern England were introduced in early April 2012. Future supply/demand deficits may lead to disruptions in water supply and increased water prices, which would be most damaging for the elderly and ill. Scotland is likely to be less susceptible to this than the rest of the UK.

The impacts of water insecurity in other parts of the world on health in Scotland are indirect, and difficult to predict. Water scarcity is, however, a fundamental driver of food insecurity, migration and economic instability, all of which are likely to affect life in Scotland. National and international water security has been a recent theme of work at the University of Dundee’s UNESCO Centre for Water Law, Policy and Science (e.g. Tarlock and Wouters, 2011).

Conflict

Climate change has the potential to be a driver for conflict, largely because it simultaneously contributes to multiple destabilising factors. For example, increased scarcity of natural resources (especially fresh water), increased frequency of weather-related disasters (e.g. hurricanes, flooding, drought) and loss of land due to rising seas levels all exacerbate existing tensions. Large scale migration may both drive conflict and be a consequence of it.

However, conflict is not a necessary outcome of climate change. A report commissioned by the World Bank notes that “the many processes associated with global warming … over the last fifteen years, have occurred during a time when we have witnessed a dramatic reduction in the frequency and severity of armed conflict” (Buhaug et al., 2008). Climate change is a threat to human security in societies unable to adapt to change, either due to existing vulnerabilities or because change is too rapid. Conflict is made more probable by bad governance, social
inequity, ethnic and religious tensions and a history of violence (Buhaug et al., 2008; IISD, 2010).

Potential origins of conflict driven in part by climate change include (Foresight, 2011a):

1) Tensions in the Arctic over resources, economic and trade interests
2) An increase in failed states acting as a source of insurgent and terrorist activity
3) An increase in calls for both international intervention and humanitarian assistance

International conflict also threatens transportation, communications and power infrastructure, so that its effects are felt around the globe. An increase in conflicts would have a destabilising effect on world trade and financial security.
APPENDIX 1: CO₂ EMISSIONS FOR COUNTRIES OF SIMILAR POPULATION TO SCOTLAND

**Figure 7**: CO₂ emissions per capita: ten countries close in population to Scotland. There is a clear divide between CO₂ emissions per head in the developed and the developing world. Scotland’s per capita emissions are around the average for developed countries of similar population. For comparison, equivalent plots for the 15 countries that emit most CO₂ including the UK, are shown in Appendix 2 (World Bank Database, 2012; Scottish Government, 2010b; General Register Office for Scotland, 2011).

**Figure 8**: CO₂ emissions per economic output: ten countries close in population to Scotland (Appendix 1). The ratio of CO₂ emissions to GDP is sometimes called “carbon efficiency.” For developed countries, after a spike in emissions associated with early industrialisation, CO₂ output per billion $ GDP decreases slightly. It should be noted that Turkmenistan’s CO₂ production is unusually high due to heavy industry (compare with figures in Appendix 2) (World Bank Database, 2012; Scottish Government, 2010b; Scottish Government, 2012).
Table 1. CO$_2$ emissions and GDP for Scotland in 2008 compared to equivalent values for countries of similar population. Data on total CO$_2$ emission, GDP and population for all countries but Scotland are from the World Bank Database (2012). CO$_2$ emission per resident and CO$_2$ emission per GDP were calculated from these numbers.

<table>
<thead>
<tr>
<th>Population (millions)</th>
<th>GDP (billions $)</th>
<th>Total CO$_2$ emission (Mt)</th>
<th>CO$_2$ emission per resident (t)</th>
<th>CO$_2$ emission over GDP (Mt/billion $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Togo</td>
<td>5.78</td>
<td>3.1</td>
<td>1.4</td>
<td>0.24</td>
</tr>
<tr>
<td>Denmark</td>
<td>5.50</td>
<td>341.5</td>
<td>46.0</td>
<td>8.36</td>
</tr>
<tr>
<td>Slovak Rep.</td>
<td>5.44</td>
<td>94.4</td>
<td>37.6</td>
<td>6.91</td>
</tr>
<tr>
<td>Finland</td>
<td>5.32</td>
<td>271.9</td>
<td>56.5</td>
<td>10.62</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>5.20</td>
<td>5.1</td>
<td>6.2</td>
<td>1.19</td>
</tr>
<tr>
<td><strong>Scotland</strong></td>
<td><strong>5.17</strong></td>
<td><strong>217</strong></td>
<td><strong>44.0</strong></td>
<td><strong>8.46</strong></td>
</tr>
<tr>
<td>Eritrea</td>
<td>4.95</td>
<td>1.4</td>
<td>0.4</td>
<td>0.08</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>4.92</td>
<td>19.1</td>
<td>47.8</td>
<td>9.72</td>
</tr>
<tr>
<td>Norway</td>
<td>4.78</td>
<td>445.2</td>
<td>50.0</td>
<td>10.46</td>
</tr>
<tr>
<td>Singapore</td>
<td>4.77</td>
<td>189.3</td>
<td>32.3</td>
<td>6.77</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>4.24</td>
<td>1.98</td>
<td>0.26</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 1 shows carbon dioxide emission data for countries similar in population to Scotland (5.2 million) for 2008. Populations ranged from 4.2 million (Central African Republic) to 5.8 million (Togo), and made up 0.06% to 0.09% of the world’s population, respectively. It should be noted that this table shows CO$_2$ emissions only, not total greenhouse gas emissions. In 2008, although CO$_2$ emissions in Scotland were estimated to be 44.4Mt, total greenhouse gas emissions were 56.1Mt of CO$_2$ equivalent.

By 2009 both Scotland’s GDP (£130,155 million with geographical share of Extra-Regio) and CO$_2$ emissions decreased (39.3Mt, Scottish Government, 2011d). The population in 2009 had risen to 5.19 million (General Register Office for Scotland, 2011), so CO$_2$ emissions per capita fell to 7.57 Mt. CO$_2$ emissions per billion $ GDP had fallen to 0.18 Mt/billion $ by 2009.

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8 Scotland GDP in 2008 was £144,728 million with a geographical share of Extra-Regio (£116,203 million onshore only), converted to dollars at rate of 1.5 $ (approximate average exchange rate 2008) (Scottish Government, 2012).

9 Scottish Government, 2010b.
APPENDIX 2: CO₂ EMISSIONS FOR THE TOP FIFTEEN GLOBAL EMITTERS

Figure 9: Carbon dioxide emission per capita: the 15 greatest emitters (source: Table 2)

Figure 10: Carbon dioxide emission per economic output: the 15 greatest emitters (source: Table 2)
Table 2. CO₂ emissions and GDP for the fifteen greatest emitters of CO₂ in 2008, ordered from largest to smallest. Data on total CO₂ emission, GDP and population for all countries are from the World Bank Database (World Bank, 2012). CO₂ emission per resident and CO₂ emission per GDP were calculated from these numbers.

<table>
<thead>
<tr>
<th>Country</th>
<th>Population (millions)</th>
<th>GDP (billions $)</th>
<th>Total CO₂ emission (Mt)</th>
<th>CO₂ emission per resident (t)</th>
<th>CO₂ emission over GDP (Mt/billion $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1315</td>
<td>4532</td>
<td>7032</td>
<td>5.3</td>
<td>1.55</td>
</tr>
<tr>
<td>US</td>
<td>305</td>
<td>14219</td>
<td>5461</td>
<td>17.9</td>
<td>0.38</td>
</tr>
<tr>
<td>India</td>
<td>1191</td>
<td>1283</td>
<td>1743</td>
<td>1.5</td>
<td>1.36</td>
</tr>
<tr>
<td>Russia</td>
<td>143</td>
<td>1661</td>
<td>1709</td>
<td>11.9</td>
<td>1.03</td>
</tr>
<tr>
<td>Japan</td>
<td>126</td>
<td>4880</td>
<td>1208</td>
<td>9.6</td>
<td>0.25</td>
</tr>
<tr>
<td>Germany</td>
<td>83</td>
<td>3624</td>
<td>787</td>
<td>9.5</td>
<td>0.22</td>
</tr>
<tr>
<td>Canada</td>
<td>33</td>
<td>1503</td>
<td>544</td>
<td>16.5</td>
<td>0.36</td>
</tr>
<tr>
<td>Iran</td>
<td>71</td>
<td>366</td>
<td>538</td>
<td>7.5</td>
<td>1.47</td>
</tr>
<tr>
<td><strong>UK</strong></td>
<td><strong>61</strong></td>
<td><strong>2636</strong></td>
<td><strong>523</strong></td>
<td><strong>8.5</strong></td>
<td><strong>0.20</strong></td>
</tr>
<tr>
<td>South Korea</td>
<td>48</td>
<td>931</td>
<td>509</td>
<td>10.7</td>
<td>0.55</td>
</tr>
<tr>
<td>Mexico</td>
<td>109</td>
<td>1092</td>
<td>476</td>
<td>4.4</td>
<td>0.44</td>
</tr>
<tr>
<td>Italy</td>
<td>60</td>
<td>2297</td>
<td>445</td>
<td>7.5</td>
<td>0.19</td>
</tr>
<tr>
<td>South Africa</td>
<td>49</td>
<td>275</td>
<td>436</td>
<td>8.9</td>
<td>1.58</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>26</td>
<td>476</td>
<td>434</td>
<td>17</td>
<td>0.91</td>
</tr>
<tr>
<td>Indonesia</td>
<td>233</td>
<td>510</td>
<td>406</td>
<td>1.7</td>
<td>0.80</td>
</tr>
</tbody>
</table>

This table shows data for the top 15 carbon dioxide emitters ranked in order of total CO₂ emissions for 2008. The UK, including Scotland, is 9th in this list. After Italy, the UK has the lowest CO₂ emissions per billion $ GDP of this group – that is, relatively high “carbon efficiency.” The UK also ranks 9th out of this group for CO₂ emissions per capita.
### APPENDIX 3: ORGANISATIONS INVOLVED IN CLIMATE CHANGE AND HEALTH POLICY IN SCOTLAND

Table 3: Organisations involved in Health and Climate change policy in Scotland

<table>
<thead>
<tr>
<th>Organisations involved in developing or implementing Scotland’s adaptation strategy</th>
<th>Description of role/responsibility with respect to climate change policy and health</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adaptation Scotland (formerly the Scottish Climate Change Impacts Partnership)</strong></td>
<td>Aim to “increase the resilience of organisations and infrastructure in Scotland to meet the challenges and opportunities presented by the impacts of climate change”. Run by SNIFTER</td>
</tr>
<tr>
<td><strong>Food Standards Agency Scotland (FSAS)</strong></td>
<td>Responsible for the safety of food in production, distribution, storage and preparation. Contributing to research on food security.</td>
</tr>
<tr>
<td><strong>Scottish Environment Protection Agency (SEPA)</strong></td>
<td>SEPA is Scotland’s flood warning authority and operates warning systems. It has also undertaken a flood risk assessment.</td>
</tr>
<tr>
<td><strong>Scottish Water</strong></td>
<td>Responsible for production of Drinking Water Safety Plans by 2012</td>
</tr>
<tr>
<td><strong>Sustainable Scotland Network (SSN)</strong></td>
<td>Exists to assist local government with implementing the government’s sustainable development and climate change programmes</td>
</tr>
<tr>
<td><strong>NHS Health Scotland</strong></td>
<td>NHS special health board with responsibility for improving public health in Scotland. Run Healthy Environment Network (HEN) and Scottish (Managed) Sustainable Health Network (SMaSH) which are forums for exchange of research and policy ideas. Contributes to the “Good Places, Better Health” programme.</td>
</tr>
<tr>
<td><strong>Health Facilities Scotland (HFS)</strong></td>
<td>Part of National Services Scotland, developing operational guidance for adapting to climate change.</td>
</tr>
<tr>
<td><strong>Health Protection Scotland (HPS)</strong></td>
<td>Currently conducting scoping reports on flooding and heatwaves. Responsible for monitoring infectious diseases and is “looking at whether the current system can be used to track diseases triggered by climate change” [UKCCASC report 2011]. Contributes to the “Good places, better health” programme. Involved in monitoring gastrointestinal disease and vector-borne disease.</td>
</tr>
<tr>
<td><strong>Local Authorities</strong></td>
<td>Responsible for many services relevant to climate change adaptation (e.g. building control, flood management etc.) and all signatories to Scotland’s ‘Climate Change Declaration’</td>
</tr>
<tr>
<td><strong>Stop Climate Chaos</strong></td>
<td>Coalition of mostly environmental and international development NGOs, campaigning for mitigation.</td>
</tr>
<tr>
<td><strong>2020 Climate Group</strong></td>
<td>Group set up to “set up to ensure that all sectors of Scotland’s economy and civic society contribute fully to achieving Scotland’s ambitious climate change targets.” Work on mitigation in the energy and food sectors in Scotland</td>
</tr>
</tbody>
</table>
SOURCES


Friends of the Earth Scotland (2010) 42% Better: The feasibility and added value of meeting Scotland’s climate change target for 2020 Available at: http://www.foe-scotland.org.uk/42percent-report


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