**Large Scale Action on Climate Change**

**Introduction**

National and international mitigation is mediated by a range of governmental and intergovernmental bodies and policies. The most famous of these is probably the Kyoto Protocol, but this is only a starting point, with a more effective global agreement required to sufficiently reduce carbon emissions and avoid dangerous climate change. Possible changes to the global economy are explored and national-scale adaptation in the UK is considered along with sources of technological innovation. The causes of behavioural change are also discussed along with the role of networks, leading to the ideas of societal and personal action on national and/or global scale issues. The connection between different scales of action is discussed, noting that truly individual actions are covered in another unit.

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**Learning outcomes**

By the end of this unit you should be able to:

* have an understanding of the broad political systems involved in tackling climate change;
* have an understanding of some large-scale changes required to tackle climate change effectively;
* have familiarity with active citizenship and some related system tools;
* have familiarity with collective intelligence and networks;
* have an understanding of the connections between activity at different scales.

**1 National and international mitigation**

**1.1 The Kyoto Protocol**

The Kyoto Protocol is well known, at least in name. Although not perfect, it can be considered as the first step towards a truly global agreement aimed at stabilising greenhouse gas (GHG) emissions. It is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). It sets binding targets for 37 industrialised countries and the European community for reducing emissions by an average of 5% against 1990 levels over the period 2008–2012. The major difference between the protocol and the convention is that while the convention encouraged industrialised countries to stabilise emissions, the protocol commits them to do so, with a heavier burden placed on industrialised nations.

Countries must meet their targets mainly through national measures, although there are also three market-based measures that may be used: emissions trading, the clean development mechanism (CDM) and joint implementation (JI). The idea of these mechanisms is to stimulate green investment and help emissions targets to be met in a cost-effective way. JI and CDM are the two mechanisms which feed the carbon market.

Emissions have to be monitored by country and precise trading records kept with registry systems tracking and recording transactions under the mechanisms. The UN Climate Change Secretariat is based in Bonn, Germany, and keeps an international transaction log to verify that transactions are within the rules of the protocol. Countries submit national reports and annual emissions inventories and there is a compliance system which aims to ensure that commitments are met or provide and help where required. The Kyoto Protocol is also designed to assist in adapting to the effects of climate change. An adaptation fund was established to support adaptation projects and programmes in developing countries within the Kyoto Protocol and is financed mainly by proceeds from CDM project activities.

**1.2 The Bali road map**

The 13th Conference of the Parties (COP13) took place in Bali in December 2007 and culminated in the ‘Bali road map’, a 2-year negotiating process aiming to secure a binding deal at the 2009 UN summit in Denmark.

**Some key elements of the Bali Road Map and other issues agreed in Bali can be summarised as follows:**

**Emissions cuts**

* Acknowledges that evidence for climatic warming is unequivocal and that delays in reducing emissions increase the risks of severe climate change impacts.
* Recognises that deep cuts in global emissions will be required to avoid dangerous climate change, the ultimate objective of the UN climate convention.
* Decides to look at a long-term global goal for emission reductions.
* Developed nations to take on commitments that are ‘measurable, reportable and verifiable’, and ‘nationally appropriate’ and which may include quantified, binding targets for all or some.
* For developing nations,‘measurable, reportable and verifiable’ actions with Western support in the context of sustainable development.

**Adaptation**

* Enhanced cooperation to ‘support urgent implementation’ of measures to protect poorer countries against climate change impacts.
* Acknowledges that economic diversification can ‘build resilience’.
* Resolves to consider ways of reducing the occurrence or damage from natural disasters.

**Technology transfer**

* Will consider how to remove obstacles to, and provide financial and other incentives for, ‘scaling up’ the transfer of clean energy technologies from industrialised nations to the developing world.
* Decides to reinstate an expert group on technology transfer to advise developing countries.

**Forests**

* Pledges to consider ‘policy approaches and positive incentives’ to reduce deforestation and conserve forest cover.
* Funds pledged to the World Bank to initiate projects under the banner of reducing emissions from deforestation and forest degradation (REDD) in developing countries.

**1.3 Reducing emissions from deforestation and forest degradation (REDD)**

REDD is one of the most controversial new climate-related issues. The idea itself is simple: governments, companies or forest owners in the global South should be rewarded for keeping forests instead of cutting them down. A similar idea was rejected during development of the Kyoto Protocol, but REDD developed from a 2005 proposal by a group of countries calling themselves the Coalition of Rainforest Nations. Online resources about REDD can be found on the UN-REDD Programme website.

**1.4 United Nations Climate Change Conference in Poznań, Poland**

The United Nations Climate Change Conference in Poznań, Poland (COP14), took place 1–12 December 2008 and saw the completion of the adaptation fund, with the Fund Board being given the legal capacity to grant direct access to developing countries. The conference included a ministerial round table on a shared vision on long-term cooperative action on climate change, including further work on an agreed outcome at COP15, 7–18 December 2009 in Copenhagen, which is seen as possibly the last chance to produce an effective agreement to reduce carbon emissions globally in time to prevent the worst effects of climate change.

**1.5 The European Commission's ‘Climate Action: Energy for a Changing World’**

Similar debates occur at different political scales. For example, the European Commission's ‘Climate Action: Energy for a Changing World’ is the EU's integrated energy and climate change policy adopted in December 2008. It includes three key targets for 2020:

* cutting greenhouse gases by 20% (30% if international agreement is reached)
* reducing energy consumption by 20% through increased energy efficiency
* meeting 20% of energy needs from renewable sources.

**1.6 ‘The Stern Review on the Economics of Climate Change’**

Published in October 2006, ‘The Stern Review on the Economics of Climate Change’ was the most comprehensive review ever carried out on the economics of climate change. It was led by Lord Stern, then Head of the Government Economic Service and former World Bank Chief Economist. The Climate Change Programme was also published in 2006 and set out policies and priorities for action in the UK and internationally. The Climate Change and Sustainable Energy Act 2006 placed an obligation on the Department for Environment, Food and Rural Affairs (Defra) to report to Parliament on UK GHG emissions and action taken by Government to reduce them.

**1.7 UK Climate Change Act**

The Climate Change Bill was published in March 2007 with the aim of creating a long-term legal framework for the UK's contribution to tackling climate change. The bill proposed a statutory goal of at least a 60% reduction in CO2 emissions by 2050. The bill became law as the Climate Change Act on 26 November 2008 and has two main aims, repeated here verbatim:

* to improve carbon management and help the transition towards a low carbon economy in the UK;
* to demonstrate strong UK leadership internationally, signalling that we are committed to taking our share of responsibility for reducing global emissions in the context of developing negotiations on a post-2012 global agreement at Copenhagen next year.

The 2050 emissions reduction goal was increased to 80%, following strong scientific evidence and lobbying from green groups and the act's Impact Assessment was updated in March 2009 to reflect the act's final contents. The act also created the Committee on Climate Change (CCC), a new independent, expert body (chaired by Lord Turner) to advise Government on the level of carbon budgets and where cost-effective savings can be made. The CCC submits annual reports to Parliament on UK progress towards targets and budgets to which the Government must respond; in December 2008 it published the report ‘Building a low-carbon economy – the UK's contribution to tackling climate change’. Carbon budgets place legally binding ceilings on UK GHG emissions over 5-year periods. In its first report, the CCC advised on the level of the budgets for 2008–2012, 2013–2017 and 2018–2022, following the EU framework to produce two sets of budgets: the intended budget, which should apply following a global deal on climate change, and the less stringent interim budget, to apply before a global deal is reached. The intended budgets require an emissions reduction of 42% in 2020 relative to 1990 (31% relative to 2005). This translates to required emissions reductions of 175 MtCO2e (where Mt means megatonnes) in 2020. The interim budgets require an emissions reduction of 34% in 2020 relative to 1990 (21% relative to 2005). This translates to required emissions reductions of 110 MtCO2e in 2020.

**1.8 The UK Department of Energy and Climate Change (DECC)**

In October 2008, the Department of Energy and Climate Change (DECC) was created (led by Secretary of State Ed Miliband), bringing together energy policy (previously with the Department for Business, Enterprise and Regulatory Reform) and climate change mitigation policy (previously with Defra). With business and climate change policies previously pulling in different directions, it is hoped that DECC will be able to produce effective climate change policies via its three overall objectives:

* ensuring our energy is secure, affordable and efficient
* bringing about the transition to a low-carbon Britain
* achieving an international agreement on climate change at Copenhagen in December 2009.

In January 2008, the EU had announced plans to make Europe ‘the first economy for the low-carbon age’ and gave the UK a new set of climate change targets – to cut energy consumption 16% and increase the use of renewable energy more than sevenfold by 2020 in order to meet its share of the EU's targets. In October 2008, when increasing the UK's commitment to cut GHG emissions to 80% by 2050 (from the previous 60%), Ed Miliband told MPs the Government accepted all the recommendations in the CCC's report. The target does not include aviation or shipping emissions, though Mr Miliband said they would ‘play a part’ in the overall strategy.

By April 2009 it appeared that CO2 emissions would fall by about 3% per year in 2009 and 2010 due to the economic downturn and more use of gas instead of coal to produce electricity. However, research by Cambridge Econometrics indicates that continued reliance on coal and gas-fired power stations will mean emissions fall more slowly over the long term. By 2020, CO2 emissions are predicted to be 19% below 1990 levels, meaning the Government would fail to meet the recommendation of its own CCC for a 29% cut.

The UK Energy and the Environment report also found that the Government will not meet its targets to increase electricity from renewables. Analysts stated that the ‘ambitious’ EU target for the UK to produce 15% of all energy from renewables by 2020 is likely to be missed by a ‘wide margin’. Despite short-term potential in improvements to bus, cycling and walking infrastructure, car sharing and school travel plans, a separate report from the UK Energy Research Centre shows Britain lagging behind other countries in the use of cleaner modes of travel, highlighting the need to move away from reliance on the car.

[**View document**](http://www.open.edu/openlearncreate/pluginfile.php/37007/mod_oucontent/oucontent/471/none/none/slcc_2section1.pdf?forcedownload=1)

**2 Analysing the effectiveness of large-scale mitigation**

**2.1 Negotiating Kyoto post-2012**

Kyoto does not expire in 2012 (it's just the end of the first commitment period), but a new international framework needs to have been negotiated and ratified by this date. At COP13, countries started to negotiate post-2012 commitments for industrialised countries who had ratified Kyoto. This process proceeds in parallel to looking at a post-2012 deal for all countries, although the two tracks may be combined when/if a new climate compact is agreed at COP15. Any new international framework must be able to deliver emission reductions at least as great as those indicated by the IPCC.

**Intergovernmental Panel on Climate Change (IPCC)**

The IPCC is a scientific body set up by the World Meteorological Organization (WMO) and the UN Environment Programme (UNEP), and its constituency is formed of governments (of member countries of WMO and UNEP), scientists and other interested parties.

As an objective source of information about climate change, the IPCC does not conduct any research nor does it monitor climate-related data or parameters. Its role is to assess the latest scientific, technical and socio-economic literature relevant to understanding the risk of human-induced climate change, its impacts and options for adaptation and mitigation.

The main activity of the IPCC is to provide regular assessment reports of the state of knowledge on climate change. The latest one is *Climate Change 2007*, the Fourth IPCC Assessment Report (AR4) with the outline of AR5 having been started (report due for completion in 2014). The IPCC also produces special reports, methodology reports, technical papers and supporting material, often following requests from the Conference of the Parties to the UNFCCC, or from other environmental conventions.

While politicians, including those from the UN, made very positive statements about the production of the Bali road map, especially given the difficult negotiations required, other observers were not so impressed. Hans Verolme of WWF stated that ‘The [US] administration was out on a wrecking mission’, while Friends of the Earth and Christian Aid bemoaned the lack of a clear ‘destination’ for the road map, with crucial target figures for cutting carbon emissions in wealthier countries being removed from the final agreement. Some, however, were optimistic about the deal having been made, citing the importance of including the USA in any agreement. Still under the Bush administration at the time, the USA said that the climate change negotiating process it agreed to in Bali must ensure developing states took their fair share of emission cuts. This was contrary to existing agreements, which acknowledged that the more industrialised nations should bear a greater burden of emissions cuts.

With President Obama in office, it was generally believed that the USA would take a more progressive and effective stance. In April 2009, with EU leaders urging him to follow their ambitious climate targets, Obama said the USA was ready to take the lead in tackling climate change. New US leadership on fighting climate change has been sought ahead of COP15 due to the need for a new, effective agreement reaching beyond 2012. EU targets are to cut GHG emissions by 20% by 2020 from 1990 levels, rising to 30% if the rest of the developed world (primarily the USA and Japan) also agree to do so. The US House of Representatives recently received a draft bill for clean energy development which aims to increase reliance on renewable sources of energy and cut emissions by 20% by 2020, but from their 2005 levels. With emissions targets absent during the Bush administration, this move was welcomed in Europe, though cautiously due to the later base year, meaning they represent only a 5–6% reduction from 1990 levels.

**2.2 National action**

Equivalent measures to those covered in [**Section 1**](http://www.open.edu/openlearncreate/mod/oucontent/view.php?id=22656&amp;printable=1&section=1.1.1) have been seen in other parts of the world. In May 2007, Australian National University economics professor Ross Garnaut was appointed to produce Australia's version of the Stern Report. This was widely seen as a rebuff to the Howard administration due to its unwillingness to take genuine action on climate change. The Garnaut Climate Change Review was presented in September 2008 and acknowledged that Australia's per capita emissions were among the highest in the world. It noted the increase in mitigation efforts around the world, but that this was too slow to avoid the worst effects of climate change and, therefore, that mitigation by major economies will need to be stronger and earlier than previously thought.

**2.3 Contradictory carbon reduction policies: the Forest Carbon Partnership Facility (FCPF)**

Another programme launched in Bali (by the World Bank) was the Forest Carbon Partnership Facility (FCPF), whose goal is ‘to jump-start a forest carbon market that tips the economic balance in favor of conserving forests’. The World Bank claims that it involves ‘a high degree of consultation with civil society and indigenous peoples' organizations’; however, the FCPF was launched without prior consultation with indigenous groups. Meanwhile, in the Bali Action Plan, REDD is covered by the statement ‘Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries’, often referred to as REDD-plus. In June 2008, a World Bank FCPF document stated that reforestation might be undertaken through the promotion of new commercial plantations and that companies establishing them could receive subsidies through the CDM of the Kyoto Protocol. Plantations would be on ‘degraded’ land even though this might have been degraded due to the destruction of primary rainforest with the companies responsible potentially in receipt of FCPF subsidies to ‘reforest’ them with commercial plantations. A *New Scientist* article (22 March 2008) sums up the problem as follows:

Meanwhile, some huge forest destroyers are drawing up plans to get compensation. On the Indonesian island of Sumatra, for instance, giant pulp mills are responsible for vast amounts of carbon being released into the air as they log rainforests and drain peat bogs to plant new trees. One of them, Asia Pacific Resources International (APRIL), wants to set up a REDD pilot project under which it will block the canals that now drain the Kampar swamp. APRIL could receive tens of millions of dollars a year in compensation for protecting the forest and not releasing the peat carbon. The project is genuine and is based on sound science, but the reductions are only possible because the company has been so destructive in the past.

Unsurprisingly, paying large sums of money to the very companies responsible for deforestation has led to controversy – more so as it is widely understood that plantations do not relieve pressure on native forests. An article by the World Bank even states that ‘plantations have had no discernible global impact on reducing deforestation’, while the Center for International Forestry Research (CIFOR) states that ‘there is little evidence to suggest that fast wood plantations have taken pressure off natural forests elsewhere’. Both Brazil and Indonesia have rapidly expanding industrial tree plantations *and* rapid deforestation.

**2.4 Contradictory carbon reduction policies: biofuel targets**

Also causing concern over deforestation was the mandatory biofuel target endorsed by the EU on agreeing the Renewable Energy Directive in 2007. The 10% mandatory ‘renewable energy for transport’ target was adopted for each member state by 2020 and, with ‘renewable sources’ being read as ‘biofuels’, was in effect a biofuel target. Owing to evidence that biofuel production led quickly to increased deforestation (a large contributor to CO2 levels) food shortages and poverty, the agreement was reworked in September 2008 to introduce an interim target of 5% biofuel use by 2015, with a review in 2014 to consider the sustainability of reinstating the original target.

**2.5 Contradictory carbon reduction policies: the case of aviation**

In the UK and wider EU, examples can also be seen where carbon reduction policies are not matched by policies in other sectors. For example, in 2007, the USA and EU signed an ‘open skies’ agreement deregulating aviation and having the potential to increase greatly the sector's emissions – despite the EU developing strict emissions reduction targets. Similarly, the DECC notes in its ‘Road to Copenhagen’ the importance of COP15 and the need to tackle climate change.

Meanwhile, the 2003 Aviation White Paper sets out the Government's aviation policy until 2030 and predicts a near trebling in the number of passengers using UK airports. If aviation expanded according to the paper, by 2050 its increased emissions could cancel out all the carbon savings made from other sources, rendering it impossible to meet even the old 60% reduction target, let alone the new stricter 80% requirement. Aviation is the fastest growing contributor to anthropogenic climate change, and the independent Tyndall Centre for Climate Change Research estimated that aviation emissions could account for up to half of all UK emissions by 2050. In January 2009, the UK Government decided to back a proposed third runway at Heathrow despite the large increases in carbon emissions that would result in Heathrow being the UK's largest source of GHG emissions. This has led to considerable opposition from environmental groups; example links are given below. Following the announcement, the CCC was asked to conduct a review of UK aviation emissions to 2050 by the Secretary of State for Transport, Geoff Hoon.

The aviation report is due by December 2009 and will look at:

* UK aviation demand and emissions – projection of UK aviation demand and emissions up to 2050, including the scope for switching from domestic and EU flights to rail
* improving the carbon efficiency of planes
* use of biofuels and hydrogen in aviation
* elements of a global deal on aviation – the CCC will consider what a global framework to reduce aviation emissions might look like, including a global cap-and-trade scheme in the context of a (post-Kyoto) agreement to reduce global emissions.

**2.6 Contradictory carbon reduction policies: coal**

A similar issue leading to considerable opposition from environmental groups is the UK Government's continuing support for new coal-fired power stations alongside a lack of large-scale support for alternative/renewable sources of energy.

Again asked to report, the CCC noted that coal is the most carbon-intensive method of UK power generation and, therefore, they made a key recommendation to close coal plants that don't capture and bury their emissions by the early 2020s at the latest. To do this, a carbon capture and storage (CCS) capability would need to be fitted to all coal-fired plants. However, even according to E.On (the company that wished to build the controversial Kingsnorth coal-fired station), CCS is a ‘developing technology’ with ‘technical risk’ while the IPCC does not expect CCS to be commercially viable for decades – too late to help avoid ‘dangerous’ climate change – and major issues of storage safety and energy efficiency would need to be overcome (currently CCS uses a large part of the energy output of its host power plant). However, the world's first CCS test plant has been opened in Germany.

In April 2009, Ed Miliband announced new regulations for coal plants and the launch of a consultation on coal policy, which environmental groups welcome as a starting point. A key part of the announcement was the requirement by power companies to capture and bury all the CO2 emissions from new coal plants by 2025 at the latest if the Environment Agency (EA) states that CCS works – a major departure from previous policies. However, the effectiveness of the new policy is dependent on some unanswered questions:

* Will new coal plants be allowed to operate for a decade with 75% of their emissions entering the atmosphere?
* How will the Government ensure that, if CCS doesn't work, the UK won't be left with a legacy of new coal plants emitting large amounts of CO2 at a time when we must be slashing emissions?
* Will existing coal plants be allowed to operate unabated despite their large CO2 emissions?

As a further example, a UN meeting using information from a UK-based survey found a low level of awareness, and trust, of CCS, with renewables strongly favoured over other energy sources, including CCS-enabled coal. Though based on less expert knowledge, this echoed the meeting's conclusion that CCS doesn't help with the urgent need to cut emissions and provide access to clean energy.

**Activity 8**

Though technically feasible, if CCS is to genuinely help reduce carbon emissions, it needs to be implemented widely and quickly. From the sources of evidence you can find, do you believe that this will be the case? If not, why do you feel that some politicians are promoting it?

**2.7 UK emissions targets**

More fundamentally, research by the Tyndall Centre indicates that that the emission reduction targets recommended by the UK's CCC are too weak to meet the Government's commitment not to exceed the 2°C threshold between ‘acceptable’ and ‘dangerous’ climate change. Although a positive move towards effective national action on climate change, many of the assumptions made are overoptimistic and the report as a whole supports the UK buying over 25% of its emissions reductions from poorer parts of the world and up to half from the EU.

With the use of offsets and buy-outs to meet targets rather than genuinely reducing overall emissions tending to lock countries into carbon-intensive development, such action is likely to make it more difficult to develop a genuinely low carbon economy. Instead, domestic emission reductions need to be achieved directly. The issue of effective targets was highlighted by the author of the 2006 Stern report, who stated that developed nations needed to ensure nothing less than an 80% reduction of emissions by 2050 in order to achieve an effective global climate agreement at COP15 in Copenhagen.

This echoes Yvo de Boer, Executive Secretary of the UNFCCC, who highlighted the need for European countries to meet climate targets in order to encourage other regions to enter into serious climate negotiations and so make COP15 a success. With emissions high and still rising, China is one of these key regions. With media attention focusing on the rate of building of new coal-fired plants, the country is portrayed as a block to reducing global emissions; but this is an oversimplification – China also has the most installed renewable capacity in the world, vehicle emissions restrictions stronger than those in Europe and the USA, and a renewables target more ambitious than President Obama's.

[**View document**](http://www.open.edu/openlearncreate/pluginfile.php/37007/mod_oucontent/oucontent/471/none/none/slcc_2section2.pdf?forcedownload=1)

**4 Climate change: national adaptation**

**4.1 Climate change adaptation in the UK**

Given the issues surrounding public perceptions of climate change and the effect this may have on policy, it is important to consider the current state of climate change adaptation in the UK. One key role of the DECC is to help the UK move to a low-carbon economy. With energy production responsible for a large proportion of CO2 emissions, a low-carbon energy supply is a central aim. As well as Government policy and individual action, action from business is required to meet climate change targets, with low-carbon technologies offering new markets and improved energy efficiency. Key policies and mechanisms include:

* market mechanisms, including the EU emissions trading scheme, the climate change levy and climate change agreements, and the carbon reduction commitment
* providing information, advice and support through the Carbon Trust, energy efficiency loans, smart meters and the enhanced capital allowances scheme
* supporting innovation through the UK Environmental Transformation Fund.

Meanwhile, low-carbon transport is the remit of the Department for Transport's low carbon transport innovation strategy.

**4.2 Floods**

Policies such as these facilitate adaptation to climate change but may not be strictly adaptive themselves. One organisation with a key role in England and Wales is the EA with its remit including flooding and coastal defence. Increased frequency and severity of storms and wetter winters increase the risk of flooding through higher peak river flows, sea levels and tidal surges. Flood risk management aims to reduce the probability of flooding from rivers and the sea through the management of land, river systems, and flood and coastal defences. Flood damage can also be reduced through effective land use planning, flood warning and emergency responses.

**The 2004 ‘Foresight future flooding report’**

This report evaluated a range of possible scenarios for climate change in the UK over the next century. It estimated that the risk of flooding from rivers and the sea will at least double by the 2080s, and could increase by up to 20 times. The number of people at a high risk of flooding could rise from 1.5 million to between 2.3 and 3.5 million over the same period, with the cost of flooding rising from the current £1 billion a year to between £1.5 billion and £21 billion. The cost of damage through coastal erosion will increase three to nine times by the 2080s, although the worst case (£126 million per year) is still well below current flood losses. Foresight was updated as part of the Pitt Review covering the 2007 floods, but the original report raises some key points that remain relevant:

* Should we accept increasing levels of flooding, maintain existing risk levels, or try to reduce the risks of flooding?
* Reducing the severity of climate change could make the task of managing flood risk substantially easier.
* Changes in risk and the costs of flood management are uncertain, particularly for urban flooding. Investment in better modelling and flood prediction is needed for us to plan ahead more effectively.
* How should we use land, balancing the wider economic, environmental and social needs against creating a legacy of flood risk?
* How should we manage the balance between state and market forces in decisions on land use?
* How should we use market mechanisms and incentives to manage future risks, while recognising the central role of government?

The EA sees Foresight as promoting its messages that we must take all reasonable steps to help reduce climate change along with a tougher line against actions such as floodplain development that can increase the problems associated with flood risk.

Some key EA strategies are:

* Catchment flood management plans, which seek to understand the factors that contribute to flood risk within a catchment and recommend the best ways of managing that risk over the next 50 to 100 years. Within the EU Water Framework Directive (which includes a requirement to restore water bodies to good ecological status by 2015), there are also related river basin management plans.
* The provision of standing advice on flooding to the planning sector, both developers and local authorities.
* The Water Resources Strategy launched in March 2009. This notes key pressures (including climate change) on water resources and covers the actions required to ensure there is enough water for people and wildlife. There is an associated report, ‘Water resources in England and Wales – current state and future pressures’, which includes how the availability of water varies from place to place and how water is abstracted for various uses.

Typical flood defences include embankments, walls, weirs, sluices and pumping stations, with some, such as the Thames Barrier, only used when there is a high tide or flood. Such ‘hard defences’ were generally put in place for long-term flood protection, although the increased flood risk associated with climate change means that reassessment of their effectiveness is required – including the Thames Barrier, which protects 125 km2 of central London from tidal surges. However, the EA increasingly uses more natural methods, known as ‘soft defences’ or ‘managed realignment’. These use mudflats and saltmarshes to provide space for floodwater and prevent flooding elsewhere, a method which also creates wildlife habitat. Managed realignment generally uses a larger area of land than a hard defence, but is cheaper and lower maintenance. In coastal and estuary areas, saltmarshes help break the power of incoming tides, reducing the impact of a wave by up to 95%. One example is the Cuckmere estuary in East Sussex which is being allowed to return to being a tidal estuary.

**4.3 Sustainable urban drainage systems (SUDS)**

As well as working directly on flood management, adaptation needs to include changes to developments. The UK has a legacy of building on floodplains, along rivers and the coast, which has placed developments at an increased risk of flooding. With the UK Government unwilling to rule out new development on floodplains, flood risk management seems likely to increase in importance.

Sustainable urban drainage systems (SUDS) seek to avoid some of the problems of flooding, pollution and damage to the environment associated with much existing urban drainage due to factors such as altered drainage patterns, excessive hard surfacing, polluted run-off entering groundwater and flow which exceeds capacity.

**4.4 Ecotowns**

One UK Government idea which could be seen as an adaptation, at least within the scope of proposed numbers of new-build houses, is the planning of ‘ecotowns’. These new settlements of 5000 to 15,000 low-carbon homes would be designed using strict environmental criteria with the whole town being carbon neutral; that is, a town's energy use must be less than or equal to the amount put back into the national grid through renewables. There has been considerable local opposition to suggested sites, including claims that the new settlements will put more pressure on existing infrastructure and that they will destroy areas of countryside. Although there are no ecotowns yet, there are a small number of low-carbon developments in the UK, such as London's BedZED.

Another route to aid adaptation is through the 2007 Sustainable Communities Act, which set up a new process of governance where councils are able to drive central government action to promote and protect local communities. Councils choosing to put forward proposals under the act can do so covering many areas relevant to climate change adaptation; for example, by planning for greater use of renewables or requesting the power and resources to refurbish existing housing to reduce emissions(e.g. by retrofitting insulation).

**4.5 The role of the UK government's budget**

One key mechanism through which UK adaptation measures can be announced is the Budget. The 2009 Budget included a number of green measures:

* the world's first binding near-term carbon budget, committing the UK to cut carbon emissions by 34% by 2020
* commitment to build two to four CCS demonstrations
* £4 billion for renewable energy projects via the European Investment Bank
* exemption of new combined heat-and-power (CHP) plants from the Climate Change Levy from 2013 (the equivalent of £2.5 billion in investment)
* £1.4 billion of funding to combat climate change by supporting low-carbon industries and green-collar jobs.

As Britain has some of the least energy-efficient homes in Europe, measures to improve efficiency are welcome and offer one relatively easy and quick way to reduce carbon emissions. Of the UK's 25 million residential buildings, 17 million have cavity walls, but less than half of these have wall insulation. Millions of houses have unlagged lofts and water tanks, and fewer than 10% of windows are double-glazed. Although positive about some of the Budget measures – such as the £375 million pledged to improve energy efficiency in buildings over two years, and funding for renewables – green and business groups highlighted the tiny reduction in carbon emissions, with Greenpeace dismissing the measures as ‘woeful', as the annual emissions savings represent just two weeks’ emissions from Radcliffe-on-Soar coal-powered station, Britain's third biggest power station.

**4.6 Agriculture and forestry**

Moving away from urban development, farmers and other land managers will be some of the first to feel the effects of climate change. One option may be for agriculture to grow biofuel crops or produce non-food materials to replace those currently made from fossil fuels. However, agriculture, which must reduce emissions like any other sector, currently emits about 7% of the UK total (mostly as methane from livestock and nitrous oxide from fertilisers, rather than as CO2).

Many opportunities exist for reducing emissions, including biogas production from anaerobic digestion. This captures methane from organic waste, but it is underutilised in the UK. Farmers can obtain practical advice about climate change adaptation from the Defra-funded ‘Farming Futures’ project. Defra also acts on emissions via its agriculture and climate change policies, including the Environmental Stewardship Scheme, Rural Development Regulation and reform of the Common Agricultural Policy (CAP). Similarly, the Forestry Commission provides information on adaptation relating to forests and woodlands, noting that those in Britain can be managed as a sustainable source of wood – an alternative and less polluting energy source to fossil fuels, and a low-energy construction material.

With climate change impacts likely to vary between regions, Scotland, northern England and much of Wales may see increased timber production due to rising CO2 levels, a longer growing season and a generally warmer climate. In other areas, more frequent summer droughts may reduce growth rates of many tree species. The character of our native woods is also likely to change. Tree pests and diseases may become more serious, with new pathogens arriving, especially with trees already under stress from climate change. Most insect pests are likely to benefit from climate change through increased summer activity and reduced winter mortality. Thus, adaptation is likely to focus on the types of tree grown as well as on the management of forests. Coming from a conservation rather than commercial viewpoint, the Woodland Trust focuses on climate change as being the greatest threat faced by the natural world, including our woodlands. The Woodland Trust takes a landscape-scale view of habitat creation to counter the impacts of climate change

Dialogue between Government and the agricultural sector occurs via the Rural Climate Change Forum. This aims to raise awareness of climate change among farmers and land managers, coordinates work on climate change in the rural sector, advises Defra on rural climate change policies, helps ensure that policies are sufficiently ambitious and will lead to real results, and advises on research priorities relating to reducing emissions and managing climate change impacts.

**Activity 14**

The impacts on agriculture and forestry, and the resulting adaptations, are complex and vary around the UK. However, having looked at the resources above, can you think of three ways these adaptations will affect you (including positive effects) and three actions you could take to aid adaptation?

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**5 Changing the global economy**

**5.1 Global-scale environmental impacts and externalities**

The global economy currently refers to the increasing integration of fragmented national markets for goods and services into a single global market. This process has been facilitated by advances in technology, primarily transport and communications, alongside removal of trade barriers. However, a globalised economy has led to global-scale environmental impacts. One key economic concept here is that of an ‘externality’, an impact on a party that is not directly involved in a transaction, and which means that the price does not reflect the full cost or benefit in the production or consumption of a product or service. A well-known externality might be a pollutant such as, in climate change terms, CO2.

CO2 is produced by many economic activities but has effects via climate change that are not included in the prices allocated to the goods and services that emit it. Thus, a carbon-intensive lifestyle in the developed world can lead to impacts in a less-developed nation without the emitter having to pay for it directly. If a pollutant is internalised, then the costs of its impacts (or mitigation to prevent them) are borne by the polluter and may be passed on to the price of the good or service. However, in practice this can be difficult if monetary values of impacts cannot be adequately determined. This links into the idea of the atmosphere and climate system being a global ‘commons’ which is owned by no-one but can be used by all – in this case as a dump for excess CO2 – a situation which, like many other commons, has led to its degradation.

There have been many alternatives proposed as models for changing the global economy, and many of these might be argued to help reduce carbon emissions and mitigate climate change (there are around 40 fully formulated frameworks). Given the importance of rapid and effective large-scale action, and that a 2008 survey in 12 countries indicated that consumers were able to put climate concerns ahead of the economy and wanted governments to stop haggling and start acting on climate change, it is worth exploring some of the changes that could be made to the global economy.

**5.2 Changing the fossil fuel industry**

One approach might be to radically change key sectors; for example, fossil fuel industries. Following the publication of two papers in the journal *Nature*, in May 2009 George Monbiot wrote about how much CO2 we can produce and still be able to avoid more than 2°C of global warming. This approach is radically different from that of the UN and national governments, which set targets for reductions by a certain date but do not act on the total amount of carbon released. This would mean imposing a limit on the use of reserves already discovered and a permanent moratorium on prospecting for new reserves – essentially choosing to leave it in the ground. There is arguably little benefit in seeking to reduce the consumption of fossil fuels unless their production is also reduced; however, no government is currently attempting to do this, as the global economy is so dependent on fossil fuels. As well as professional writers such as Monbiot, this issue has been taken up by a number of campaign groups, generally focusing on coal.

Looking beyond 2012, Kyoto2 is a framework for a new climate agreement under the UNFCCC, intended to replace the Kyoto Protocol. The agreement would be in the form of a climate treaty to limit emissions of greenhouse gases to a level that would prevent dangerous interference with the Earth's climate system, while generating other economic, social and environmental benefits. It is thus a delivery mechanism for the objective and principles of the UNFCCC. Based on the book *Kyoto2* by Oliver Tickell (Zed Books 2008), it moves away from the standard political idea of capping emissions towards the need to reduce the global supply of fossil fuels. It sees climate change as a global problem that needs a global solution and is in essence a new green economics of climate change.

Given the global economic reliance on fossil fuels, to remove this requires decoupling economies from these fuels. This has been done to some extent in Japan through energy conservation, with successive governments redesigning cities to encourage public transport. Car companies developed high-mileage engines even when oil prices fell and oil saving was promoted by a variety of public programmes and incentives. Policy was given a legal framework, such as the 1979 ‘Law Concerning Rational Use of Energy’, which accelerated energy conservation overall. However, this is essentially a financial programme, and though it promotes energy diversification it was not designed as a move towards a low-carbon economy.

**Peak oil**

The need to move beyond a petroleum-based economy is made clearer by considering the concept of peak oil. Peak oil is the point when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline. If political and economic systems react only to high prices and shortages rather than planning for the threat of a peak, then the degree of economic damage to importing countries depends on how rapidly oil imports decline post-peak. The Export Land Model shows oil exports dropping much more quickly than production due to increased domestic consumption in exporting countries. This would lead to lack of supply and enormous price inflation, unless demand was mitigated via planned conservation measures and increased use of alternatives. However, despite this clear threat to global and national economies, little if any awareness, let alone action, is shown by governments regarding peak oil. Estimated peak oil years vary, but it is strongly suggested that the global peak may have happened around 2006, possibly with a delay until around 2010 if less conventional oil resources are included. Even the more optimistic estimates (e.g. from the oil industry) suggest a global peak by around 2020. Nationally, most nations have already peaked – the USA in 1970, Russia in 1987 and the UK in 1999. Although measures might be planned primarily to prevent economic problems, moving away from fossil fuels would clearly be of great benefit to large-scale carbon reduction. However, oil production, even if in post-peak decline, would not decline quickly enough to reduce emissions sufficiently to tackle climate change – planned action is required to reduce emissions more quickly.

**5.3 Carbon markets**

Leaving peak oil aside and returning to carbon reduction programmes, one of the key problems with many (such as REDD) is arguably that they are tied into commercial considerations through carbon markets.

Carbon markets allow companies or countries to trade emissions reductions, thus allowing emissions targets to be met (in theory) at least cost. They comprise two main types of scheme: cap-and-trade schemes (such as the EU emissions trading scheme (ETS)) and schemes which generate offset credits (such as the clean development mechanism). Although widely supported politically, environmental groups are wary of carbon markets, arguing that they simply enable industrialised nations to avoid the steep emissions reductions needed to avoid dangerous climate change. If relatively inexpensive carbon credits flow into carbon trading systems that are supposed to encourage movement towards lower carbon economies in industrialised countries, then they are likely to find it cheaper to purchase credits than genuinely reduce emissions. Even in the UK Government, the CCC states that a low-carbon energy system for the UK cannot be produced via the EU ETS alone, supporting the need for genuine domestic emissions reductions.

**5.4 Contraction and convergence**

However it is achieved, avoiding dangerous climate change requires industrialised nations to cut emissions by at least 80% (some estimates cite a figure of 95%) while developing nations grow their economies. One proposed global framework is contraction and convergence (C&C), which was conceived by the Global Commons Institute in the early 1990s.

C&C consists of reducing overall emissions of GHGs to a safe level (contraction), with global emissions being reduced because every country brings emissions per capita to an equal level (convergence). The first stage of implementation is a contraction budget for global emissions consistent with stabilising atmospheric concentrations of greenhouse gases at a pre-agreed safe maximum concentration. C&C is favoured by the European Commission, European Parliament and many other government bodies; and with the contraction aspect reducing total carbon emissions, it is supported by many campaigners (including George Monbiot cited above). Supporters of C&C, such as the Climate Justice Project, believe that the safe maximum is much lower than other estimates. Specifically, they believe that the IPCC's safe estimate of 550 ppmv CO2 is wrong and risks entering a phase of runaway ‘climate feedback’, with one change causing another with unpredictable results. They advocate a more precautionary approach, with atmospheric CO2 being stabilized at 350–450 ppmv. In the UK, to reach these targets, individuals' emissions would need to be cut by between 60% and 90%.

**5.5 Transition initiatives**

There are many alternative suggestions for changes to the global economy – a range of ‘green manifestos’, ‘new green orders’ and similar. They do, however, share many common themes, some of which have been explored above. However, all involve some form of transition, often to a post-petroleum economy to reduce emissions while retaining viable economic systems and avoiding sudden catastrophic changes associated with large unmitigated climatic and economic instabilities.

At a community or town scale, a transition initiative is a group of people working together to tackle peak oil and climate change by addressing the question ‘How do we significantly increase resilience (to mitigate the effects of peak oil) and drastically reduce carbon emissions (to mitigate the effects of climate change)?’ To do so involves working through a process of:

* awareness raising
* networking with existing community groups, local government and other transition initiatives
* forming subgroups to look at key areas, such as food, energy, transport, health and economics
* starting projects aimed at building people's understanding of resilience, carbon issues and community engagement
* eventually launching an ‘Energy Descent Action Plan’ with a 15- to 20-year timescale.

The approach recognises two key points:

* much creativity, ingenuity and adaptability was used on the way up the energy slope, and there's no reason for us not to do the same on the way back down
* collective planning and action, if undertaken early enough, can create a lifestyle that's more connected to our environment and community than the petroleum-based globalised version we have now.

Thus, a key aspect of transition is that it integrates climate change and peak oil by acknowledging that climate change makes carbon reduction essential, peak oil makes it inevitable and transition initiatives make it feasible. Thus, changing the global economy links to local initiatives and vice versa.

On a national scale, ZeroCarbonBritain suggests linking energy production with economic transition and emissions reduction in such a way that allows Britain to eliminate emissions from fossil fuels within 20 years and breaking our dependence on imported energy. This would need to be part of international action, but broadly speaking would be approached within a C&C framework using ‘tradable energy quotas’, halving energy demand and greatly increasing the use of renewables.

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**6 Technological innovation**

**6.1 Geo-engineering**

Since climate change first became a mainstream issue, as well as carbon reduction programmes, there have been proposed technological fixes aiming to reverse climate change without the need to reduce emissions.

These large-scale ‘geo-engineering’ proposals have included seeding the oceans with iron, large-scale sequestration, ‘engineered weathering’ of marine chemistry, spraying liquefied SO2 into the stratosphere, launching orbital mirrors and building tens of millions of atmospheric CO2 filter systems. Though sometimes appealing as a way of circumventing or delaying the difficulty of reducing emissions, it has become increasingly clear that there is no quick fix.

There is no evidence that technological alterations of the climate system would be as quick or easy as claimed by their proponents, and many might not work – certainly, all remain speculative at an early experimental stage. With the uncertainties surrounding the precise impacts of climate change, the effects of technological change may not be predictable and risk creating even greater global problems (e.g. slowing the hydrological cycle). Geo-engineering has been used in Russia and China to seed clouds as drought relief and to disperse rain ahead of public holidays and events. Chinese claims that cloud seeding lowered daytime temperatures during the 2008 Summer Olympics and kept rain away from the opening ceremony are difficult to verify. However, even at this smaller scale, weather manipulation can amplify drought conditions in one area or increase the risk of floods in another, and – beyond political rhetoric – is highly unreliable. Under the Bush administration, geo-engineering was seen as a viable option. However, Obama has moved the USA quickly towards a targets-based approach; and in the UK, climate minister Joan Ruddock is wary of radical technologies being used as an excuse to avoid meeting emissions targets.

However, despite the problems associated with geo-engineering, there are some areas of genuine technological innovation that have the potential to help tackle climate change. These include renewables, improved efficiencies, fuels, infrastructure and energy carriers, environmental technologies, smart energy systems and technologies relating to adaptation.

**6.2 Other innovations: smart energy systems**

In some areas, such as renewables, the technologies are likely to be relatively familiar – solar, wind and wave power, for example. In others, this may not be the case. Smart energy systems require smart grids – intelligent electricity delivery systems, in which suppliers and consumers are all interconnected through a network. Smart meters in homes and businesses transmit information on consumption back to energy providers who can automatically bring down consumption if demand is too high. The UK Government has announced its intention to extend smart metering to all households by 2020 and sees this as an important part of the transition to a low-carbon economy, giving consumers and providers more control over their energy use and carbon emissions. Beyond metering, smart buildings may form an important part of future energy systems, with integrated functions including lighting (presence detection and intelligent shading), heating/ventilation (individual room control and sun shading), climate control and energy management. Grid connection and microgeneration can reduce energy costs and CO2 emissions by increasing the use of renewable energy sources.

**6.3 Other innovations: decentralised energy**

Moving beyond the single-building scale, another major area of innovation is decentralised energy (DE). This means moving away from a centralised model of a few large power stations which send electricity to relatively distant consumers via the National Grid to a system of interconnected local networks. Currently, a typical power plant in the UK is only around 38% efficient; and by the time we use electricity in our homes and workplaces, nearly 80% of the usable energy from burning fossil fuels has been lost. The main reason for this is that we have two separate energy systems: one for electricity and another to heat water and buildings, with heat contributing more to climate change. For electricity about two-thirds of available energy is lost within the power plant as waste heat, and during transmission, with another 13% lost through inefficient use in buildings. For heat, we burn more fossil fuels (mostly natural gas) in boilers in our homes and workplaces.

However, a DE system based on CHP avoids this problem and is the most efficient way to burn fuel because so little energy is lost as waste heat – CHP plants in Denmark reach up to 95% efficiency. As the heat needs to be captured and piped around the local district, CHP plants are usually sited in the towns and cities where electricity and heat will be used. This makes it efficient for electricity generation as well as heat, as little is lost in transmission. CHP has considerable potential in the transition from fossil fuels, as they can switch to low-carbon fuels such as biogas and biomass. Most organic matter can be used to produce biogas, with farm waste the most famous example, but the biodegradable waste making up about half our landfill could be used. Combining CHP with improved efficiencies (e.g. effective insulation and minimum efficiency standards for appliances), much of the wastage of our current system would be prevented. However, DE has components other than CHP, including the full range of renewables – the UK Government has stated that just using wind, wave and tidal resources could meet 40% of our energy needs by 2020, and more in the longer term.

DE is also scalable and flexible – a supermarket could have a tiny CHP plant while a large industrial facility can have an large plant. This tailoring to local needs is one reason why DE systems can be installed much more quickly than large centralised power plants. Using many small energy generators instead of a few major ones greatly reduces the risk of system failure; and if a local DE network does fail, then it only affects a small area, which could in any case use the inbuilt connectivity to import from nearby areas. Linking to a wider scale still, DE allows decoupling from fossil fuel markets, which not only aids energy security and reduces costs (by removing the subsidies required for the current inefficient infrastructure), but is one of the requirements for moving towards a post-petroleum global economy.

Although some pioneering UK councils have adopted DE schemes (e.g. Manchester, Eastleigh, Southampton, Woking and Birmingham), the Labour Government (unlike the other UK parties) remains unwilling to move towards DE, focusing on new centralised power plants, including coal-fired (CCS-enabled or otherwise) and nuclear. Although recent developments have indicated some governmental support for renewables and microgeneration, policy such as the 2003 Energy White Paper has not moved away from the current centralised model, despite the existing need to replace the National Grid infrastructure, which was built in the 1950s and 1960s and is nearing the end of its design life. Other areas of Government are looking at low-carbon technologies; for example, via the Environmental Transformation Fund.

**6.4 Technology transfer**

It is clear that there are a number of areas of technological innovation. Assuming these achieve their potential to help tackle climate change, it is essential that they can be implemented widely – something that requires technology transfer. This is the process of sharing skills, knowledge, technologies themselves, methods and samples of manufacturing, and facilities between governments and other institutions to ensure that developments are accessible where they are needed, not only where funds and facilities exist to develop them.

Technology transfer is commonly undertaken, but there are some aspects that relate specifically to climate change. First, the scale of the transfer would need to be much greater than usual, with all countries and thousands of technologies potentially involved. Second, with the payback period for research and development expenses often being too long to be of interest to the private sector, special incentives may be required through government policies or undertaking research and development in the public sector. Of course, unlike most other technologies, it can be argued that, as everybody in the world requires a functioning climate, everybody would be a beneficiary. Article 4.5 of the UNFCCC requires that countries facilitate technology transfer, and there are measures such as the clean development mechanism of the Kyoto Protocol which can help to achieve this.

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[◀︎ Large Scale Action on Climate Change](http://www.open.edu/openlearncreate/mod/oucontent/view.php?id=22656" \o "Large Scale Action on Climate Change)

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