

Exploring Climate Change

The response

Introduction

At the end of 2015, over 150 nations took part in crucial climate talks at the so-called COP21 Summit in Paris. The conference presented an historic opportunity to reduce global greenhouse gas emissions and tackle dangerous climate change. By the end of the conference, 195 nations agreed to attempt to cut greenhouse gas emissions to below 2°C.

Most of the developed countries around the world had previously agreed to address climate change, signing and ratifying The Kyoto Protocol in 2005 and the Cancun agreement in 2010. The Kyoto Protocol's major feature is mandatory targets on greenhouse gas emissions for the world's leading economies, while the Cancun agreement requires they submit annual greenhouse gas inventories and reports on progress. A Green Climate Fund has been established to help developing countries adapt.

Scotland's Climate Change Act is to date the most ambitious climate change law in the world. It will introduce a statutory target to reduce Scotland's greenhouse gas emissions by at least 80% by 2050.

Every year the countries of the developed world continue to emit millions of tonnes of global warming pollution, burning fossil fuels to heat homes, power industries, fly airplanes, drive cars and generate electricity. The challenge is that major economies around the world, each with a range of different economic and social factors, are able to find ways to cap these emissions.

Although changing attitudes and behaviours will play a significant part in reducing carbon emissions, responding to climate change long term will also mean using new clean technologies alongside careful consideration of sustainable food production methods and innovative building, planning and design.

COP 21 Paris summit on climate change

Negotiators from 195 nations gathered in Paris for crucial climate talks. The so-called COP21 Summit ran from 30th November to 11th December 2015 and was attended by more than 150 heads of state and government, including US President Barack Obama, Chinese President Xi Jinping, and Russian President Vladimir Putin. Forty thousand delegates attended, including government ministers, climate activists, non-governmental organisations and journalists from across the globe.

The conference presented an historic opportunity to reduce global greenhouse gas emissions and tackle dangerous climate change. The ambition of the negotiations was to limit the rise in global temperature to below 2°C. Recent research¹ shows that mean global temperature is approaching a 1°C rise over the pre-industrial average for the first time.

In the days before the conference opened, it was estimated that over 500,000 people around the world took part in marches and protests to urge world leaders to take tough action to make the most of the opportunity that the conference presented.

For information on the conference – see these webcasts:
<http://unfccc6.meta-fusion.com/cop21/events/>

¹ <http://www.metoffice.gov.uk/research/news/2015/global-average-temperature-2015>

The route to Paris

Global climate change negotiations began at the United Nations Earth Summit in Rio de Janeiro in **1992** and led to the United Nations Framework Convention on Climate Change² (UNFCCC), which is still in force.

In **1995**, the first Conference of Parties (COP) meeting took place in Berlin, Germany. This was the first annual meeting of all 195 nations that had signed up to the UNFCCC.

World leaders met again in Japan in **2007**, at the COP3 meeting, to agree further targets. This led to the development of the Kyoto Protocol, which required participating countries to cut greenhouse gas emissions by 5% over 1990 levels by 2012.

Expectations were high when world leaders met again in **2009** for the COP15 Summit³ in Copenhagen, Denmark, but many were disappointed that a tough, legally-binding agreement was not secured. However, the conference did provide a landmark in that it was the first time that all developed nations, and the biggest developing nations, agreed to limits on their greenhouse gas emissions.

The climate negotiations in Paris were the 21st annual meeting⁴ of the Conference of Parties.

Reaching agreement

There is much hope that climate negotiators attending the COP 21 Summit in Paris will reach a legally-binding agreement with ambitious targets that will help avoid dangerous climate change. The Kyoto Protocol agreement will run out in 2020, so a new deal is crucial.

The aim of the conference is to secure an ambitious and legally-binding agreement from nations to reduce their greenhouse gas emissions. Many experts say an agreement of this nature is urgently needed to avoid catastrophic and irreversible climate change. Developed nations are also being asked to give over US \$100 billion dollars to help the poorest nations develop clean technologies and help their citizens adapt to the changing climate.

Many countries have been submitting their pledges to the United Nations in advance of the conference in Paris. These pledges are referred to as 'intended nationally determined contributions' or INDCs. The success of the COP21 conference rests on the deal that is struck over these pledges.

Pledges

- China pledge to cut their emissions by 60-65% by expanding their renewable energy industry
- USA promise a 26-28% cut in their carbon pollution by 2025 from 2005 levels
- The European Union pledge a 40% cut by 2030.

The Carbon Brief⁵ and Climate Action Tracker⁶ websites provide updates on the climate pledges from countries around the world:

Scotland set some of the most ambitious targets for tackling climate change when it introduced the Climate Change (Scotland) Act 2009⁷. The Act commits Scotland to reducing

² <http://unfccc.int/2860.php>

³ http://unfccc.int/meetings/copenhagen_dec_2009/meeting/6295.php

⁴ <http://www.cop21.gouv.fr/en/>

⁵

<http://www.carbonbrief.org/paris-2015-tracking-country-climate-pledges>

⁶ <http://climateactiontracker.org/>

greenhouse gas emissions by 42% (over 1990 levels) by 2020 and by 80% by 2050. Scottish Government figures show our country is on track to meet these targets⁸.

International support

Pope Francis published an encyclical in June 2015⁹. In this, he states that human activity in developed industrialised countries is doing the most damage to the climate. He is urging people to take action.

Islamic leaders have appealed to the 1.6 billion Muslims in the world to play an active role in tackling climate change¹⁰. They want all nations and their leaders to commit to a zero emissions strategy.

Barack Obama is the first US President to regulate carbon pollution from power plants¹¹, and in May 2015 he called climate change a threat to national security¹².

The Kyoto Protocol



Photo credit: Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC

The Kyoto Protocol was the world's first international agreement on how to tackle climate change, and an important tool that governments around the world have used since it was made law in 2005. By 2009 183 countries had signed up to the Protocol and had made a commitment to reduce their carbon dioxide emissions and five other greenhouse gases by an average of 5.2%.

Many countries set their own targets. In the EU this was originally 8% but later increased to 20% by 2020, as governments began to realise that much more had to be done. In the UK and Scotland, Climate bills more recently committed to reductions of 80%.

⁷ <http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact>

⁸ <http://news.scotland.gov.uk/News/Scotland-on-track-for-2020-climate-targets-19c0.aspx>

⁹ <https://blogs.glowscotland.org.uk/glowblogs/eslb/2015/08/07/global-interest-in-climate-change/>

¹⁰ <http://islamicclimatedeclaration.org/islamic-declaration-on-global-climate-change/>

¹¹ <https://www.theguardian.com/environment/2014/jun/02/obama-rules-coal-climate-change>

¹² <https://www.theguardian.com/environment/2015/may/20/barack-obama-climate-change-poses-risk-to-us-military-bases>

Stopping dangerous climate change

The main aim of the Kyoto Treaty was to hold greenhouse gases at a level that will stop dangerous changes to the planet's climate system. All of the industrialised nations that signed and ratified the Treaty would collectively reduce their emissions.

Common problem but different responsibilities

The Kyoto Treaty recognised that we have a common problem but that not all countries have contributed to this problem in the same way. Some countries, including China and India, were exempted from targets because they were not main contributors during the period of industrialisation that is believed to be the cause of climate change.

Criticism

The United States and Australia originally opted out of Kyoto because of the exemptions granted to China, India and developing countries. They also claimed, along with some economists, that it would cost jobs and damage their countries' economies. However, Australia later signed Kyoto after a change of leadership in 2007, and the US has recently begun working towards its own climate bill.

Many people criticised Kyoto because its mechanisms created a carbon marketplace, where carbon credits could be traded. This allowed richer nations to avoid cutting their emissions and, in some cases, disguise an increase.

Other major criticisms included that the original targets of 5.2% would make little impact on the main cause of climate change - human induced emissions.

Has the Kyoto Protocol stopped dangerous climate change?

The first phase of Kyoto is due to expire in 2012. It has had its successes and difficulties, and many countries' emissions have actually increased since ratifying the Kyoto Protocol. Many other countries (such as most European countries, the UK and Scotland) have however succeeded in reducing their emissions. Most people agree that the Kyoto Protocol has been an important step towards recognising and tackling the problem of climate change. It put climate change on the worldwide agenda for governments.

Most people also agree that not enough has been done to avoid dangerous climate change and that the original Kyoto targets were not strict enough. Since the first Kyoto, climate science has become more alarming and predictions of warming have become more severe. It is now widely held that temperatures are rising and, to prevent the climate from becoming dangerously unstable, emissions will need to be reduced by at least 80% around the world as quickly as possible.

Scotland's response



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Since 1990 net greenhouse gas emissions in Scotland have fallen by 18.7%. This is good news. However, analysis shows a small increase between 2005 and 2006. This is because Scotland produced more energy from coal-fired power stations during this period because of unstable gas prices. Gas prices have since dropped, and emissions fell again between 2006 and 2007, returning to the long-term declining trend.

The highest emissions in Scotland come from energy generation, transport and business, collectively accounting for around three-quarters of all Scottish emissions.

Scotland's Climate Change Act

The Climate Change (Scotland) Act¹³ is the most ambitious climate change law in the world. Following a comprehensive period of parliamentary scrutiny and amendment, the legislation was unanimously passed by the Scottish Parliament on 24 June 2009.

Taking forward this Act is a key commitment for the Government and places Scotland at the forefront of global efforts to tackle climate change.

The Act creates a long-term framework that will:

- introduce a statutory target to **reduce Scotland's greenhouse gas emissions by at least 80% by 2050**
- establish an interim target of **at least 42% emission reductions by 2020**
- establish a framework of **annual targets**
- include **emissions from international aviation and international shipping.**

'This framework will help build a sustainable future for Scotland. It will contribute to the country's sustainable economic growth by moving the public and private sectors towards a low carbon economy.'

(Scottish Government, 2009)

¹³ <http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact>

Accounting for consumerism

A report from the Stockholm Environment Institute¹⁴, published in April 2009, revealed that although Scotland's greenhouse gas emissions have decreased, the way they are measured does not tell us the whole story.

Scotland measures emissions that are produced in Scotland. This is consistent with reporting requirements for the Kyoto Protocol. However, this new report informs us about greenhouse gas emissions released throughout the world where goods and services are imported and consumed in Scotland. (For example, see how greenhouse gas emissions have rocketed in China.)

Some of the key findings of the report were:

- Three key areas of consumption make up household carbon impacts: housing (33%), transport (26%) and food and drink (19%).
- Transport was responsible for 60% per cent of the increase in the carbon footprint from 1992 to 2004. Over 45% comes from buying and maintaining cars, 40% is due to aviation, and the remainder comes from other public transport.
- Apart from transport, the growth in consumer emissions is due to things like leisure, clothes and communications equipment. Consumption of these things has nearly doubled between 1992 and 2004.

So although emissions in Scotland reduced overall between 1990 and 2007, consumer emissions grew by 11% over a similar period.

The main explanation for the discrepancy is that the manufacture of goods and materials in Scotland has declined, while imports have rocketed. The pollution caused by imports nearly tripled from 10.6 to 28 million tonnes between 1995 and 2004.

The Climate Change (Scotland) Act 2009 includes a requirement that Scottish Ministers provide a report to the Parliament every year, which will set out emissions associated with the consumption of goods and services in Scotland.

Scotland's National Outcomes

Scotland's National Outcomes¹⁵ also include measures working towards a reduction of the local and global environmental impact of our consumption and production.

'We face other increasing environmental pressures [...] such as constantly rising levels of consumption and ever greater competition for natural resources - fossil fuels, air, timber, water and land - all of which are already under pressure. That position cannot continue: as a nation we need to reduce our impact on both a local and global and environmental scale.'

(Scotland's National Outcomes - Environmental impact)

Find out more about how consumer goods are produced and consumed on The Story of Stuff: <http://storyofstuff.org/>

¹⁴ https://www.sei-international.org/mediamanager/documents/Publications/Future/scotland_policybrief_emissions.pdf

¹⁵ <http://www.gov.scot/About/Performance/scotPerforms/outcomes>

Facing up to climate change enquiry

In March 2011, the Royal Society of Edinburgh published its report entitled Facing up to climate change: breaking the barriers to a low carbon Scotland¹⁶. This report was a result of a national enquiry involving numerous organisation, individuals and public bodies. It highlights the wealth of activity undertaken in Scotland on the climate change issue and comes to key conclusions about the further responses which are required to bring about an effective transition to a low carbon economy.

Renewable energy



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'Our potential for electricity generation from renewables is up to 60GW - more than ten times our peak demand.'

(Alex Salmond, 2009)

Wind

Forty percent of all the wind energy in Europe blows over the UK, making it an ideal place for catching wind and turning it into energy. The Scottish Government aims to meet 50% of electricity demand from renewables by 2020, and much of that will come from wind power.

In May 2009, Europe's largest operating onshore wind farm at Whitelees¹⁷ in East Renfrewshire was switched on. It has the capacity to power 180,000 homes. When complete in 2011 the Clyde Windfarm in South Lanarkshire will be capable of powering up to 320,000 homes.

There are currently plans to build up to 10 wind farms off the coast of Scotland. Such settings get around objections on aesthetic grounds but there are concerns as to the impact these structures will have on marine species and migratory birds.

¹⁶ [https://www.royalsoced.org.uk/cms/files/advice-papers/inquiry/climate/RSE%20Inquiry%20Facing%20up%20to%20climate%20change%20Full%20Report%20\(low%20res\).pdf](https://www.royalsoced.org.uk/cms/files/advice-papers/inquiry/climate/RSE%20Inquiry%20Facing%20up%20to%20climate%20change%20Full%20Report%20(low%20res).pdf)

¹⁷ http://www.whiteleewindfarm.co.uk/about_windfarm?nav

Solar

Greenhouses are a way we have used solar power for hundreds of years, and are frequently used in horticulture to extend the growing season of many seasonal crops, protect from frost and even grow crops that require warmer weather than we have here in Scotland, like tomatoes and soft fruit.

Scotland is not a particularly sunny country but solar power is possible due to the long hours of daylight enjoyed in the summer. Solar panels are capable of producing hot water even on cloudy days and photovoltaic cells (which convert daylight directly into electricity) are becoming more common in public toilets, bus shelters and pay-and-display parking terminals, with solar powered ATMs coming soon.

Water

Hydro power comes from the force of falling water, and Scotland was one of the first countries in the world to harness electricity from this. 10% of Scotland's energy already comes from hydro power and will be further boosted by the opening of a new hydro scheme, the Glendoe Project in 2010.

Scotland also possesses huge wave and tidal energy resources and has the potential to produce 25% of Europe's tidal power and 10% of Europe's wave power.

Wave power is generated by capturing energy from snake-like devices that bob up and down on waves in the sea. Funding for the UK's first wave farm was announced in February 2007. It will be the world's largest, with a capacity of 3 MW and is part of a large marine power project in development in Scotland.

Tidal power

Tidal power comes from harnessing energy from the ebb and flow of tides. The stronger the tide, the more energy is generated. The Pentland Firth between Orkney and mainland Scotland has been described as the 'Saudi Arabia of tidal power' and may be capable of generating up to 10 GW. Several other tidal sites exist around Orkney and the West Coast. The European Marine Energy Centre (EMEC)¹⁸ based in Orkney is conducting world-leading research and testing of devices that harness renewable energy from waves and tides. In the coming years it is estimated that energy harnessed from the sea in Scotland will be enough to power 750,000 homes.

For further details about marine renewable energy visit the Clean Energy from the Sea online resource developed by the Sustainable Learning Partnership:

<https://learnforsustainability.wordpress.com/>

Carbon Capture and Storage (CCS)

Carbon capture and storage technologies are currently being trialled in a number of locations around the world. Plans for a large scale pilot scheme at Longannet Power Station in Fife fell through in 2011 due to the cost of the long pipeline required.

Carbon capture and storage technologies applied to a modern conventional power plant could reduce carbon dioxide emissions to the atmosphere by approximately 80–90%. However, capturing and compressing carbon dioxide as part of the process may increase the fuel needs of a coal-fired CCS plant by 25–40%. The [Intergovernmental Panel on Climate Change \(IPCC\)](#) estimates that carbon capture and storage could provide the equivalent of

¹⁸ <http://www.emec.org.uk/>

between 10% and 55% of the total carbon mitigation effort until year 2100.

CCS has been criticised however, as it could be used to prolong the use of coal fired power stations and therefore might not help us reduce our dependence on carbon fuels.

See the carbon capture and storage teaching resource produced by CSIRO/GCSSI
<http://www.globalccsinstitute.com/publications/introduction-carbon-capture-and-storage>.

You can also download diagrams and factsheets from the Global Carbon and Capture Institute: <http://www.globalccsinstitute.com/content/resources>

Energy saving

There are a range of energy saving technologies available which can all contribute significantly to reducing our demand for energy, from energy saving products such as washing machines, refrigerators and eco boilers to making sure we have effective insulation and double glazing in our buildings.

We can also make simple lifestyle choices such as not making unnecessary car journeys or wasting heat, switching electrical equipment TVs and computers off rather than leaving them on stand-by, using rechargeable batteries and wind-up gadgets such as torches and radios, and switching to green energy suppliers.

Find out more at the Energy Saving Trust: <http://www.energysavingtrust.org.uk/>.

Transport

Transport contributes a great deal to carbon emissions through the burning of fossil fuels. The Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007 (published in 2009) revealed that although Scotland's overall emissions fell by 18.7%, emissions from transport (not including Scotland's share of international aviation and international shipping emissions) rose by 9.8%.

Emissions from international aviation associated with Scotland are relatively small, but growing very fast – by 188.7% between 1990 and 2007. Much research, funding and piloting is now targeted towards finding alternative energy supplies for both personal and commercial modes of transport.

Biofuels

Biofuels are made from living things like plants, or from the waste they produce, for example:

- wood, wood chippings and straw
- pellets or liquids made from wood
- biogas (methane) from animals' excrement
- ethanol, diesel or other liquid fuels made from processing plant material or waste oil.

In theory, biofuels can reduce carbon emissions by providing an alternative to fossil fuels; however, there are drawbacks in simply converting to biofuels without finding ways of reducing the demand for fuel.

Biofuels can have a negative, and sometimes catastrophic, impact on the ecosystems we

rely on to absorb greenhouse gas emissions. Their production is energy intensive, and the amount of land required is vast, causing deforestation and reduction of land for crops, and has been linked to food shortages and depletion of native species in some countries.

Hybrid and electric vehicles

Hybrid and electric vehicles are already becoming popular. Hybrids work by using more than one source of power, such as an internal combustion engine powered by diesel or biofuel, and an electric motor powered by a battery. This system can be operated in many types of transport, including cars, trains, buses, shipping and aircraft.

Many critics, however, argue that electric vehicles don't yet offer much in the way of carbon reduction. One solution to this problem in development in Denmark involves vehicles storing energy generated from wind when turbines operate at full capacity, and feeding this back to the grid when it is needed as well as providing energy for travel.

Hydrogen

A new hydrogen-powered car was unveiled in London in summer 2009. The car is powered by a fuel cell which combines hydrogen with oxygen from the air to release only energy and clean water. One kilo of liquid hydrogen is enough to fuel the car for 300 kilometres. It also has an electric motor for each wheel, which according to its makers results in energy savings of 50%.

Agriculture

We need to learn to live in a world concerned about carbon and cut greenhouse gas emissions by 80% by 2050, yet we need to produce enough food to sustain a growing population. This poses a huge challenge for the future.

Food has increasingly been produced by industrial methods in the last 50 years. The problem is that industrial agriculture is oil intensive. It uses a lot of fossil fuel throughout the production and long-distance distribution cycle, along with a range of petroleum-based pesticides, herbicides and chemicals to protect crops from pests and disease and boost yields. This type of agriculture also tends to create large monocultures with single crops often covering hundreds of acres, which can be damaging to eco-systems and local economies as well as producing more greenhouse gases.

What can be done?

Scientists and innovators are continually seeking new ways of developing and using new technologies to improve farming, increase yields, and make crops healthier and more efficient.

Plant breeding and Marker Assisted Selection (MAS)

Plant breeders have been selecting and combining the best traits in crops and plants for thousands of years. Most of today's fruits and vegetables are the result of generations of selection and breeding. Plant breeding can be used to adapt crops to local conditions and resist pests and fungi, like potato blight. The Scottish Crop Research Institute¹⁹ is working on a range of crop and plant research, including developing varieties of potatoes to suit

¹⁹ <http://www.scri.ac.uk/>

Scotland's future climate

Marker Assisted Selection (MAS) is a new branch of crop research with great potential. It uses our new knowledge of the genome to identify specific traits in a plant's DNA. This greatly enhances traditional plant breeding. MAS can be used to make plants resistant to certain pests, survive certain climatic conditions like drought, or grow to a certain size or colour.

Genetic modification (GM)

Some scientists have been developing ways of modifying crops and food through genetic engineering, or modification. This involves taking DNA from one species and inserting it into the genes of another, often unrelated species. This new, or 'novel' technology is in its early stages of development, and has caused much controversy. Where supporters argue of its benefits for farming and food production, critics argue we don't yet understand its full implications for human health and the environment; it doesn't reduce our dependence on oil and claims of the benefits are unproven.

Sustainable alternatives

Many people believe that polyculture, diversity and working with nature can provide many and more sustainable solutions to our current challenges, and that in diversifying the food economy we will be much more resilient to future shocks. In doing so we can also reduce our collective agricultural carbon footprint.

Organic farming

The Organic Movement has been growing in significance for many years; and many farmers maintain that traditional fertilisers like manure, and methods such as crop rotation and interplanting provide good yields and healthy crops, and don't leave the chemical residues found in conventional farming. Animals are reared, often free-range, on natural diets and without the routine use of hormones and antibiotics. Organic farming aims for a shorter, more local distribution cycle, is less dependent on oil and other fossil fuel inputs, improves water use efficiency, and restores nutrients to the soil without having to use chemical fertilisers.

Find out more about organic farming on The Soil Association (Scotland) website:
<https://www.soilassociationscotland.org/>

Vertical farming

Vertical farming is an innovative idea which involves using high rise tower blocks or 'farmscrapers' to grow fruit and vegetables all year round using a system called hydroponics. Hydroponics is a method of growing plants without soil. The proposers of vertical farming argue that the system could save natural resources, protect crops from failure, reduce energy and transport costs and thus significantly reduce greenhouse gases.

Permaculture

The Permaculture system was first developed in 1978 by Bill Mollison, an Australian ecologist. It is a combination of 'permanent agriculture' and 'permanent culture.'

'Permaculture uses the inherent qualities of plants and animals combined with the natural characteristics of landscapes and structures to produce a life-supporting system for city and country, using the smallest practical area.'

From Introduction to Permaculture by Bill Mollison.

Find out more on The Permaculture Association website: <https://www.permaculture.org.uk/>

Architecture, planning and design



Image credit (Brighton Earthship): Dominic's pics. Published on Flickr. Available for use under a [Creative Commons Attribution 2.0 Generic](#) licence.

Low impact living - Earthships

An Earthship is a passive solar powered house made of natural and recycled materials, like earth-filled tyres, and built to utilise available local resources, especially energy from the sun or wind. It will also usually have its own special natural ventilation system. Earthships are generally 'off-grid' homes, minimising their reliance on public utilities and fossil fuels by catching their own water supply from rainwater, and treating and containing its own sewage in planter beds.

Earthships are intentionally designed exemplars of ways in which design can be used innovatively to create low impact living spaces.

In 2004, the very first Earthship in the UK was opened at Kinghorn Loch in Fife. It was built by volunteers of the SCI charity.

Making the best of what we have

It's not always feasible to create the ideal eco dwelling, and a majority of people live in cities. But you can improve the sustainability of any home by taking a range of measures – from installing more efficient heating systems, fridges, freezers and washing machines for example, installing double glazing and loft insulation to making simple lifestyle choices such as reducing, reusing and recycling, monitoring your energy usage and switching to a green energy supplier.

You can make a difference by growing your own food, in all sorts of spaces – both indoors and outdoors.

Eco pads

In this video from YouTube comedian, writer and actor Marcus Brigstocke reveals some of the eco-renovations he has made to his London home. <https://youtu.be/BYmk1fWLV9E>

Greenhouse gas emissions

The Kyoto Protocol requires the industrialised countries that signed up to cap their greenhouse gas emissions.

In October 2006 the United Nations Framework Convention on Climate Change (UNFCCC) released information showing that total greenhouse gas emissions across 41 industrialised countries actually increased by 2.4% between 2000 and 2004.

Given all the focus of attention on reducing emissions, why have we not seen a dramatic reduction in greenhouse gas emissions in global terms?

China

Under the first Kyoto agreement China was exempt as it was classed as a developing country. However, by 2008 China had overtaken the United States as the world's biggest emitter of carbon dioxide, accounting for a fifth of the world's greenhouse gas emissions.

Although the average person in China uses only 10-15% of the energy of the average US citizen, its economy has been developing quickly and emissions are rising fast. Since most of its electricity comes from coal, China has been building coal-fired power plants at a rate of roughly two a week for the past few years.

A significant proportion of emissions from China comes from manufacturing goods that will be exported and consumed in the rest of the world. We therefore benefit from products here in Scotland where emissions were produced in China.

Parallel to its rapid economic growth, China continues to struggle to bring a large percentage of its population out of poverty.

'China is still a developing country and the present task confronting China is to develop its economy and alleviate poverty, as well as raise the living standard of its people.'

(Chinese foreign ministry spokesman Qin Gang)

In 2007, China unveiled its climate change plan. While refusing to accept binding targets, China aims for a 20% share of renewable energy by 2020.

The United States

The United States did not ratify the Kyoto Protocol, citing the exemption of developing nations like China and India as the main reason for abstaining. The US is the second biggest emitter of greenhouse gases after China. Latest figures reveal total US greenhouse gas emissions increased 1.4% between 1996 and 1997 following a steady average annual upwards trend of 0.9% since 1990. In total, emissions from the US increased by 14.4% between 1990 and 1996.

As of 2009 the US is passing its first climate bill, which aims to reduce carbon emissions by 17% by 2020 and 83% by 2050. However, it has received some criticism as the targets

are much lower than those being pursued by most developed countries, and the calculation for cuts is based on 2005 emission levels not those of 1990, which the Kyoto signatories have been working to.

Australia

Australia is one of the biggest emitters per capita. In total, Australia's emissions grew 28.8% between 1990 and 2006.

If its Carbon Pricing Scheme²⁰ is introduced as planned in 2011, emissions will have to be reduced by up to 25% below 2000 levels by 2020. Many groups and scientists in Australia have however criticised the targets, claiming that they are insufficient to stop dangerous climate change.

National greenhouse accounts released in May 2009 showed Australia's emissions in 2009 were 1.1% more than in 2008. The energy sector has shown the biggest increase - 42% between 1990 and 2007, and another 1.5% in 2008.

A report from 2009, carried out on behalf of the Australian Government, said critical issues for Australia included a possible sea level rise of 80 cm by 2100, more droughts, a general drying trend, and more heat waves, floods and bushfires. The Great Barrier Reef could suffer because of an increasingly acidic and warm ocean.

Russia

Russia is the third biggest emitter of greenhouse gases after China and the United States. It ratified Kyoto in 2004.

In June 2009 Russia announced it would reduce emissions by 10-15% from 1990 levels. However, the picture is complicated by the fact that Russia was part of the much larger Soviet Union in 1990, where emissions were far higher than they are today. Some commentators have claimed that this could disguise a net increase in Russian emissions between 2007 and 2020.

India

Like China, India was exempt under the first Kyoto agreement, but its emissions are estimated to have risen by more than half in the 1990s. India is the world's fourth largest source of greenhouse gas emissions, and some studies suggest it could soon overtake Russia to become number three after the United States and China.

Pradipto Ghosh, India's Environment Secretary, said in 2007 that India would not curb its greenhouse gas emissions as long as the West continued to treat it as a 'second class global citizen' with less right to pollute than the developed world. At the heart of India's position on climate change is the notion that India - whose population is predicted to reach 1.5 billion by 2050 - must be allowed to pollute on a per capita basis equally with the West.

Prime Minister Dr Manmohan Singh said that while aiming to reduce poverty, India would ensure that its per capita emissions will never exceed those of developing countries.

'This is our challenge to the West. You do the best you can, and we'll match it.'
(Pradipto Ghosh, India's Environment Secretary in 2007)

²⁰ <http://www.environment.gov.au/climate-change>

Europe

Most countries in Europe have managed to cut their emissions, resulting in a net decline for the third consecutive year in 2007, according to the EU's greenhouse gases inventory report compiled by the European Environment Agency. The EU-27's overall domestic emissions were 9.3% below 1990 levels, which equalled a drop of 1.2% or 59 million tonnes of CO₂ equivalent compared to 2006. The EU-15 now stands 5% below its Kyoto Protocol base year levels.

In the UK emissions fell by 15.1% between 1990 and 2006.