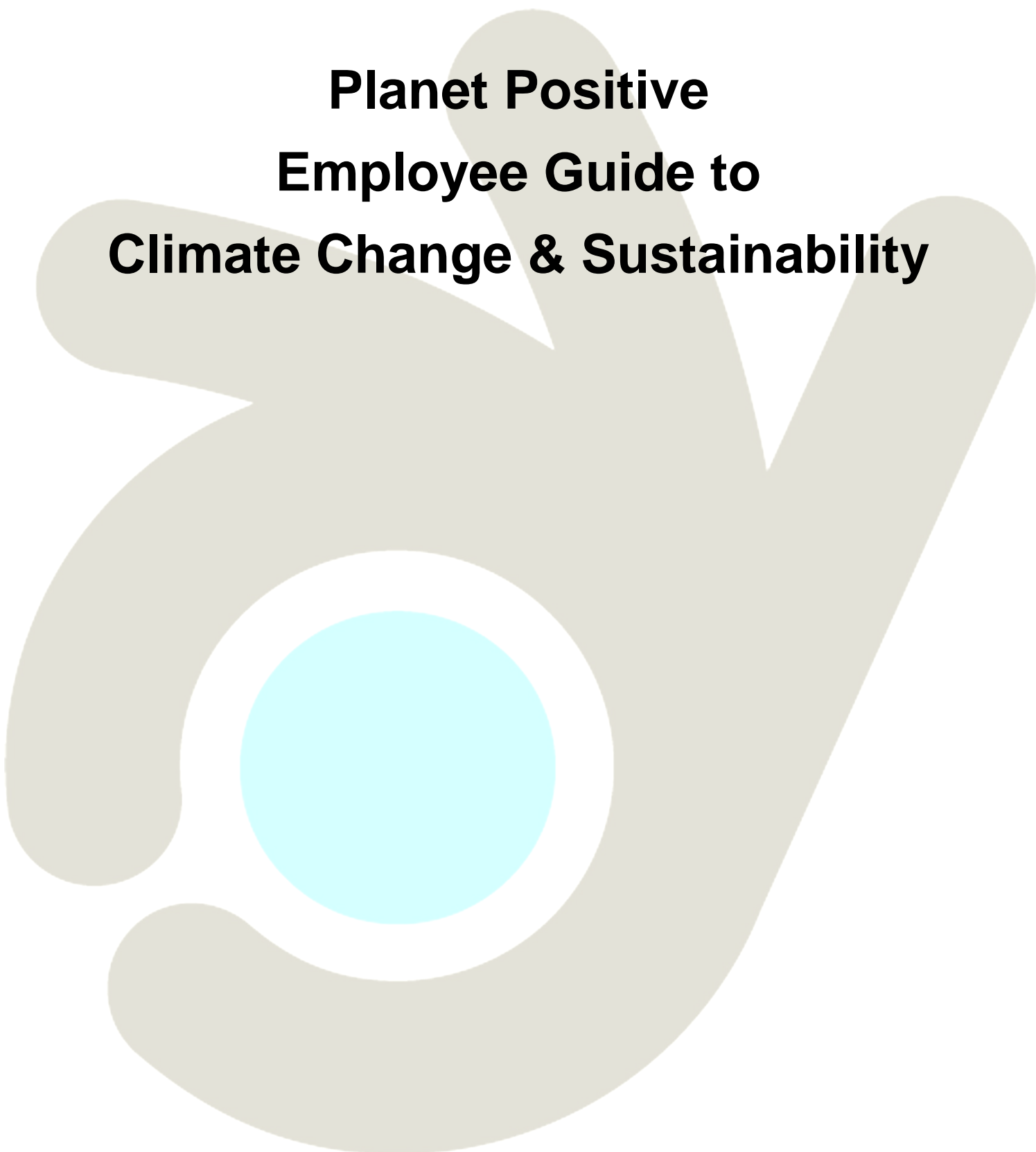


# **Planet Positive Employee Guide to Climate Change & Sustainability**



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## 1. What to focus on

There is a lot of information presented in this document, and the summary highlights the main messages we feel you should take to a school for your sustainability assembly or workshop. The detail provided in the rest of the report provides a valuable background and useful facts and figures which could all be drawn upon to make your presentation more interesting and robust.

### What is sustainability?

Sustainability is the long-term maintenance of well being, so that society, its members and its economics are able to meet their needs and express their greatest potential in the present, without detriment to biodiversity and natural ecosystems, while planning and acting to maintain these ideals for future generations.

### What is the triple bottom line?

Sustainability has three elements: social, environmental and economic, otherwise known as the Triple Bottom Line or 3BL. These three areas capture the expanded spectrum of values and criteria for organizational and societal success. It is a move away from the more traditional single bottom line approach, which considers only economic success. All investment projects supported by Planet Positive have confirmed 3BL benefits, which help to ensure that we are achieving a better way of living, and having a positive impact on the planet.

### What is climate change?

United Nations Framework Convention on Climate Change defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". In the last 100 years the Earth has warmed by 0.74°C (and by 0.4°C since the 1970s), meaning that global sea levels have gone up, glaciers and sea ice have melted, floods and droughts are on the increase, and heatwaves are worse. Moreover, we are committed to further unavoidable climate change from this past rise in temperature, including further sea level rises for centuries to come.

### So what? Is climate change a bad thing?

Global temperatures are predicted to rise by at least 4.2°C by 2100 (COP16). Rising temperatures have the potential to disrupt ecosystem function, making areas that were previously suitable for growing crops deserts and potentially wiping out 1000s of species of plants and animals that can't adapt to higher temperatures.

Climate change will contribute to rising sea levels, more extreme weather and increased incidence of extreme weather, flooding, rainforest destruction, loss of biodiversity, desertification and drought. All of these impacts will have a high economic cost to society globally.

### What is Planet Positive?

Planet Positive is an internationally recognized mark of environmental achievement. A business, product or service is Planet Positive if it has measured and verified a net positive impact on the planet, its ecosystems, and its people. By helping people understand and engage with sustainability issues, we can help them make a positive difference, and create a better way of living.

Planet Positive measures the environmental footprint of schools, businesses, products, events, services and people and helps them to reduce their footprint year on year. We help them to make a positive impact on the planet through investment in community sustainability projects such as rainforest protection, sand dam creation and schools programmes.

## It's not all doom and gloom!

Climate change is not all doom and gloom. We have the opportunity to slow the progress, and also design and implement sustainable technologies. By moving towards a low-carbon future, we can create new business opportunities, a greater sense of community, and a healthier lifestyle.

## What is low carbon?

Carbon is the word that is generally used to refer to carbon dioxide and other greenhouse gases. Carbon is a large component of fossil fuels, on which current society is entirely dependent. We use fossil fuels to make electricity and heat, and also to power our main modes of travel: trains, planes, cars and boats. We even use fossil fuels to make our food, as they are a major component of most fertilizers. We are a high-carbon society.

A low-carbon society will use much less fossil fuel, with electricity generated from renewable sources such as wind, tidal and solar power. Alternative low-carbon fuels for vehicles may also be invented and become more main stream. It is entirely possible to have a low-carbon society without losing the functionality to which we have become accustomed.

### Did You Know?

- Around 45% of the UK's carbon emissions comes from energy used every day in the home and during travel
- The average UK household emits 5.5 tonnes of carbon equivalent every year – that's the same weight as 2 Asian elephants!  
*(energysavingtrust.org.uk)*
- Average unmetered household water consumption = 150 litres per person/day or 54,750 litres annually
- Average metered household water consumption = 127 litres per person/day or 46,355 litres annually
  - Even at this volume this is enough water to fill your maximum luggage allowance on 158 British Airways flights  
*(www.defra.gov.uk/sustainable)*
- In the UK an average household uses at least 200kg of paper per year
- On average every person in the UK produces 500kg of household waste each year  
*(www.greenboxday.co.uk)*

## How can I make a difference?

The most important thing to know is that **you CAN make a difference**. Sometimes people think that whatever they do is too little, so it's not worth it, but it is! Think about ways that you can make a more positive impact on the planet, at home and at work... Ask the kids what they could do too. Here are some ideas that you could share with them:

### At School

When you leave a room:  
Turn off lights  
Turn off computers  
Make sure taps aren't dripping  
Recycle paper and drinks cans

### On the Move

Take the bus and train  
Walk if you can, don't drive  
Don't fly if you can help it  
Buy a bicycle (and use it)  
Share your car – pick up a friend

### At Home

Turn off lights  
Unplug mobile phone chargers  
Don't leave things on standby  
Only boil the water you need  
Recycle and compost

## Spread the word

We hope you enjoy learning a bit more about sustainability and how to become more sustainable. Now we'd like you to share your newfound knowledge. Planet Positive is all about communication and creating links within the community. You're already doing this by talking to the kids at your local school! Think about talking to your friends and family about sustainability, and how they can make a difference too. Ask the kids to spread the word as well. There's nothing like a bit of pester power!

## 2. Guide Outline

### 2.1 Introduction

This guide has been designed to prepare employees working as part of the Schools investment programme offered by Planet Positive as part of its environmental certification process. An overview of climate change and sustainability will be presented allowing presenters to familiarise themselves with the subject, its key facts, current developments and issues of controversy.

### 2.2 Planet Positive: Who we are and what we want to achieve

Planet Positive is an international mark of environmental achievement for businesses, schools and individuals who want to show their commitment to sustainability by measuring and verifying a net positive impact on the planet, its ecosystems and its people. Through working with organisations around the world and people who are directly affected by climate change we aim to make climate change relevant to everyone and to help people understand what they can do to make a difference, and to do so right away.

We have created this document to help inform and inspire you to take our message of environmental sustainability into the classroom and engage children in the issues that will affect them and future generations most of all. We hope that by engaging young people we can spread the idea of sustainability and therefore increase the speed of adoption of sustainable practices. We are therefore extremely grateful for your time and effort in helping us to make this a real possibility.

We understand that all our presenters are busy people and therefore this guide will explain the issues simply and will provide you with the information, enthusiasm and confidence to walk into that classroom or assembly room and make it a success.

### 2.3 Natural vs. Man-made climate change

Gradual climate change is a natural occurrence and includes patterns of temperature, precipitation, humidity, wind and seasons. Climate change also refers to changes that happen over a long period of time – it's not just the change in the weather! Throughout the history of the Earth there have been hot-house periods and ice ages – we are currently in the seventh ice age in the Earth's 4.6 billion year history.

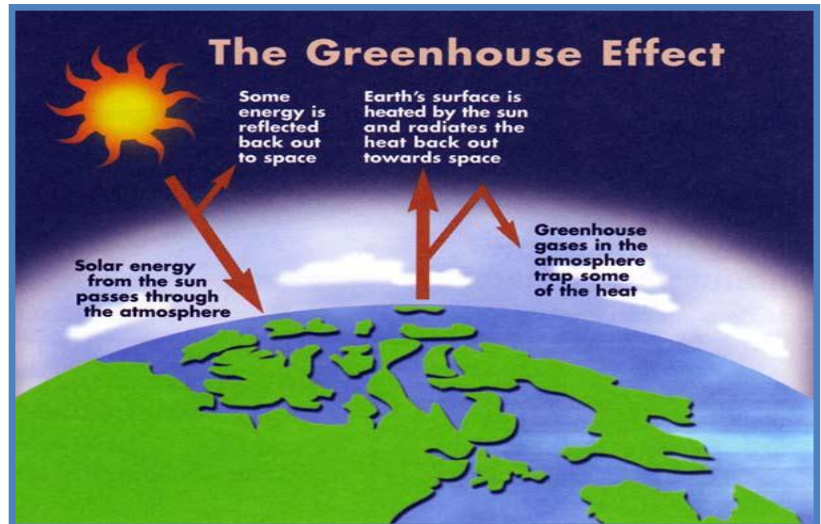
Natural climate change is so slow that it is not likely that the difference can be seen in many lifetimes. However, climate is changing much more drastically and dramatically since the industrial revolution in the 18<sup>th</sup> century as a result of human activities. For example, average temperatures in the Arctic have increased at almost twice the global rate in the past 100 years. Temperatures on our Earth's surface increased by an estimated 0.8°C between 1900 and 2005. This is a marked difference to the rate of change in the last 500 years. Since 1500s temperature has increased by approximately 1°C; however 80% of this increase (the 0.8°C) happened in the last 100 years.

There is more carbon dioxide in the atmosphere now than at any point in the last 650,000 years. This is what worries environmentalists, governments, and the general public – not that there is climate change, but at the rate the climate is changing because of human activities. When you hear about climate change in the news, they are more than likely referring to man-made global climate change. Likewise, climate change in this section refers to this form of climate change.

What often confuses people is that they equate climate change with only increased temperature. But with it will also come changing sea levels and temperatures, extreme weather, changes to plants and animals, food and water scarcity and higher levels of disease. This is explored further in Section 4; but it is important to establish upfront that climate change does not stop at making UK winters warmer.

## 2.4 The Science behind Climate Change – what causes it?

The greenhouse effect is the rise of the Earth’s temperature because certain gases in the atmosphere (like water vapour, carbon dioxide, nitrous oxide and methane) trap energy from the sun. The greenhouse gases act as a sort of blanket, keeping the heat in and warming the earth. This layer of greenhouse gases is normally a good thing – it keeps our Earth about 15°C warmer. The bad news is that we’re releasing more of these gases than we should. The greenhouse gases blanket is getting thicker and letting less and less heat out of our atmosphere heating up our Earth. Even a little extra warming may cause problems for humans, animals and plants.



These greenhouse gases are measured in units of tonnes carbon dioxide equivalent (tCO<sub>2</sub>e) allowing the generation of a total ‘carbon footprint’. This unit is generated using the global warming potential (GWP) of each gas as shown in the table below.

Greenhouse Gas	Chemical formula	Global Warming Potential
Carbon Dioxide	CO <sub>2</sub>	1
Methane	CH <sub>4</sub>	21
Nitrous Oxide	NO <sub>x</sub>	310
Sulphur Hexafluoride	SF <sub>6</sub>	23,900
Hydrofluorocarbons	HFCs	140 - 11,700
Perfluorocarbons	PFCs	6,500 – 23,900

Table 1: Global Warming Potential of Kyoto Greenhouse Gases (Source: IPCC 2007).

## 3. The History of Climate Change

### 3.1 First Warnings

In 1958 Charles David Keeling made the first direct measurement of atmospheric carbon dioxide (CO<sub>2</sub>) in Hawaii which from then on has been known as the Keeling Curve. The Keeling Curve was the first piece of evidence that there was rapidly increasing levels of CO<sub>2</sub> in the atmosphere. Before Keeling proved it, it was believed that the concentration of CO<sub>2</sub> in the atmosphere was affected by constant variability. Because it was measured for long enough, by 1960 the Keeling Curve was able to show that there were not just seasonal variations of CO<sub>2</sub> concentrations, but there is also a year-on-year increase.



Figure 1 Picture of Keeling taken from Scripps Institution of Oceanography

In 1967 two scientists, Syukuro Manabe and Richard Wetherald used a computer stimulation to demonstrate that increasing atmospheric CO<sub>2</sub>

concentrations would increase the altitude at which the Earth radiated heat to space. In 1975 they used computer stimulation to determine the effect of doubling CO<sub>2</sub>. The model found that this would cause stratospheric cooling, enhanced warming at high latitudes and an enhanced water cycle.

### 3.2 First Climate Change Conference

These findings motivated the world into action. In 1979 the world held its first climate change conference. It was essentially a scientific conference exploring how climate change would affect the world and human activities. The conference officially recognised climate change as a serious global problem. It issued a declaration calling on world's governments to "foresee and prevent future potential man-made changes in climate that might be adverse to the well-being of humanity".

### 3.3 The Intergovernmental Panel on Climate Change (IPCC)

In 1988 the United Nations and the World Meteorological Organisation established the Intergovernmental Panel on Climate Change (IPCC) to provide independent scientific advice on climate change. The IPCC provides advice by using all of the peer-reviewed research conducted throughout the world to arrive to conclusions. Through this process it monitors the potential impacts of climate change, highlights options to adapt to the changes and ways to halt the change. The IPCC has been crucial in bringing the scientific community together and by raising awareness, understanding and increasing confidence in the science regarding climate change.

### 3.4 The United Nations Framework Convention on Climate Change

The first report of the IPCC led to the negotiation of the United Nations Framework Convention on Climate Change. The Convention sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. Nearly every country has ratified the Convention, which means that almost every country understands that the climate system is a shared resource and that the global climate crisis requires a global solution. It came into force in 1994. The Convention didn't set any limits on greenhouse gas emissions for individual countries and doesn't contain enforcement mechanisms. Yet it does call on protocols to be set and updated in the future. From this requirement came the Kyoto Protocol.

### 3.5 Kyoto Protocol 1997

First adopted in 1997, 37 industrialised countries (including the UK) committed themselves to a reduction of four greenhouse gases – carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride – to an overall 5% lower than the 1990 levels by 2012. Different countries were assigned different targets according to criteria like their current carbon emission and current use of renewable energy. The target for the UK was 12.5% below 1990 levels. Unlike the Convention, the Kyoto protocol is a legally binding commitment. Although it was agreed to in 1997, it was only entered into force in 2005. The latest figures we have are from 2007 and from this we learn that emissions from these industrialised countries were about 4% less than the 1990 levels demonstrating that countries were about 80% of the way to their target.

### 3.6 Conference of Parties

The Conference of Parties (COP) is an annual meeting of more than 170 nations that have ratified the United Nations Framework Convention on Climate Change (UNFCCC). Its first session was held in Berlin in 1995 and its continued role has been the promotion and review of the implementation of the Convention. It will periodically review existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programs.

### 3.7 Future Developments

Individual country efforts may become more important as a top down global deal is proving harder to find and to enforce. As large businesses gradually realise the potential savings through energy efficiency and other advantages of a low carbon future the emphasis may move from nations to corporations as the main drivers of future carbon reduction efforts.

#### Crisis in the Confidence of the IPCC

The IPCC has received a lot of criticism lately. Several errors in its latest major assessment of climate science in 2007 have been discovered and there has been a lot of discussion and debate about the validity of the IPCC and their findings.

For example, the report said that the Himalayan glaciers could melt by 2035 based on an interview with a scientist in 1999 rather than a peer-reviewed resource. Several scientists have refuted that this is off by several hundred years and the IPCC has accepted it as a mistake.

In another instance, the IPCC did not check the reports of a Dutch government agency that reported that half the Netherlands were below the sea level.

As a result the United Nations has decided that the work of the IPCC will be independently reviewed by the InterAcademy Council (which consists of presidents from Universities around the world). The review will look closely at how the IPCC reports are prepared.

## What are the Impacts of Climate Change?

### 3.8 Rising Temperatures



Global temperatures are expected to rise by between 2.5 and 4.7°C by 2100 compared to pre-industrial levels. Climate change is happening. Temperatures have increased by nearly 0.8°C since the late 19<sup>th</sup> century and have risen by about 0.2°C per decade over the last 25 years. The naughties were confirmed as the warmest decade in England since records began in the 1660s. This may not seem like too much of a problem if taken at face value – warmer and shorter winters – yes please! But the increasing temperature levels, even an increase of 2°C, will lead to many other climate

changes, most of which aren't as happy as a pleasanter winter.

Permafrost, or permanently frozen carbon-rich soil found in northern Russia, Europe, Greenland and North America. As permafrost melts due to rising temperatures, it creates expanding water bodies, and emits large amounts of methane into the atmosphere. As methane is emitted, it contributes even more to climate change.

### 3.9 Changing Sea Levels

Temperature rises lead to changing sea levels. Heat leads to the expansion of ocean water, melting of mountain glaciers and small ice caps, and portions of the Greenland and Antarctica ice sheets to melt. We have already experienced sea level rising – globally it has already risen by 12 centimetres. In the UK, sea level is 10 centimetres higher today than in 1900. The scientific community believes that sea level is expected to rise between 13 centimetres and 95 centimetres in the next century. 13-95 is a very large range, but it shows that even the most conservative expectation is 13 centimetres.

Rising sea levels will inundate wetlands and other low lying areas, erode beaches, intensify flooding, and increase the level of salt in rivers, bays and groundwater tables.

Two-thirds of the world's cities with over five million people are located in the low-lying coastal areas within 9.1 metres of sea level.

There are many vulnerable areas in the UK – particularly the coastal areas of Wash, Norfolk and Suffolk and areas around Teeside. 62 Sites of Special Scientific Interest are threatened by sea level rise. There are over 26 million people in the UK that live in major urban areas in the coastal zone. The UK is already experiencing a flooding issue as people in areas like East Anglia know all too well. Sea level rise will intensify flooding in places like East Anglia.

### 3.10 Extreme Weather

Studies show that the rise in temperatures will increase the frequency and intensity of many kinds of extreme weather. While climate change cannot be attributed to a particular heat wave, or hurricane, the trends are clear.

With increased temperature there is a higher risk of downpours which like rising sea levels leads to more floods. From 1766 the amount of winter rainfall has risen in the UK. Over the last 45 years, rainfall has become heavier. In 2004 flash floods devastated the village of Boscastle in north Cornwall. Six centimetres of rain fell in two hours which caused two rivers to burst at their banks and about two billion litres of water to rush down the valley towards Bocastle according to the Met Office. 50 cars were lost, many businesses and homes damaged, a loss for the tourism industry, and a major rebuild project had to be carried out.

According to the Environment Agency 2009 Flooding in England report, one in six homes in England is at risk of flooding and over 2.4 million properties are at risk of flooding from rivers or the sea in England of which half a million are at significant risk. Floods don't just affect Great Britain either. 2010 saw record flooding in Pakistan, and every year reports of extreme floods around the world increase.

Higher temperatures lead to fiercer hurricanes as the storms derive their power from warm waters. Because of the hot and dry condition of hotter weather, wildfires are also likely to become more rampant. Higher temperatures also cause water to evaporate faster which leads to dryer soil which increases water shortages and puts livestock and crops at risk.

### 3.11 Rainforest Destruction

The impact of climate change on the Amazon rainforest could be much worse than previously predicted, new research suggests. Dr Chris Jones, of the Met Office's Hadley Centre for Climate Prediction and Research, said the Amazon may become "committed" to substantial change by rising temperatures long before any such change is apparent elsewhere.

A study found that while more CO<sub>2</sub> in the atmosphere meant trees grew bigger, they also died at a greater rate.

A loss of the Amazon rainforest, as well as being a disaster for wildlife and the people of the region, would make climate change worse because it would damage the region's ability to act as a carbon "sink", soaking up the main greenhouse gas, carbon dioxide.

The loss would be in addition to the losses presently caused by deforestation.

#### **The TEEB Report: - The Economics of Ecosystems & Biodiversity**

The Economics of Ecosystems and Biodiversity (TEEB) report is a global study, initiated by the G8 and five major developing economies that calculates the value of ecosystems and biodiversity.

The report argues that major advances in ecosystem and biodiversity sustainability are required to avoid substantial economic costs. For example, halving deforestation by 2030 could avoid damages by climate change of approximately \$3.7 trillion.

Therefore short-term investment costs could quickly become cost-neutral or even profitable when considering the impacts of ecosystem and biodiversity deterioration.

#### **Natural England: More than two species of plants and animals become extinct every year in England.**

We know about 500 species that have become extinct in England – all but a dozen have been killed off in the last two centuries by hunting, pollution, development, poor land management, invasive species and more recently climate change.

Animals that were once common are no longer regularly sighted – almost 1,000 other species face severe threats. The common toad, the common frog, the common skate and the once prolific corncrake are included in the list of those under threat.

### 3.12 Threat to Plants & Animals

Unfortunately, some species will be unable to adapt quickly enough to the changing climate. The rising temperatures have already led to the extinction of the golden toad and the harlequin frog. Polar bears are losing weight because they have 2 weeks less to hunt as spring breaks up the ice two weeks earlier. Fish stocks that used to stay in Cornwall have moved as far north as the Shetland Islands. Ten per cent of Europe's butterflies face extinction as a result of their loss of habitat caused by intensive farming, forest fires, tourism and climate change. It has caused a variation in the length of the different seasons changing the patterns of many things including the growth of trees and the feeding pattern of birds. If global temperatures rise by 2°C, 30% of all land living species will be threatened by an increase risk of extinction. The cost of this biodiversity deterioration has been described in the TEEB report suggesting large economic consequences of failure to reduce current impacts.

### 3.13 Desertification and drought

Changes in the world's climate will bring major shifts in food production. In some places, temperatures will rise and rainfall will increase; in others, rainfall will decrease. In addition, coastal flooding will reduce the amount of land available for agriculture. Due to the enormous uncertainties surrounding global climate change, estimates of cropland reductions vary widely--from 10 to 50 percent. But this much is clear: global warming is likely to alter production of rice, wheat, corn, soybeans, and potatoes--staples for billions of people and major food crops in both North America and Africa.

Drought in Southern Australia, partly caused by the Indian Ocean Dipole but exacerbated by higher general temperatures, with the heat in Melbourne reaching 48.8°C, the hottest since records began 150 years ago. Also drought is taking a particularly heavy toll in the Murray-Darling Basin, where 40% of Australia's agricultural produce is grown.

In 2005, parts of the Amazon basin experienced the worst drought in 100 years

In 2004 ethnic violence broke out between Black Muslim farmers and Arab Muslim herders in the Sudanese region of Darfur. Climate induced drought and lowering productivity of the land, together with an increasing local population, a corrupt government and ethnic rivalry have culminated in a humanitarian disaster of vulnerability to disease, human displacement, poverty and state-sponsored ethnic cleansing that still continues today. As J.Sachs has written: "Failure of rainfall contribute not only to famines and chronic hunger, but also to the onset of violence when hungry people clash over scarce food and water."

### 3.14 The Economic Cost

If we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, from now until forever. This is a conservative estimate. Taking into account a wider range of risks and impacts the estimated loss will be equivalent to 20% of GDP. According to the Association of British Insurers, It is expected that UK households will pay up to 4% extra each year due to extreme weather.

On the bright side, it will only cost us 1% of global GDP each year to mitigate climate change.

Which would you choose?

### 3.15 The Benefits of Mitigating Climate Change

There is a lot of focus on the doom and gloom of not responding to climate change; there is also a lot of focus on the costs and difficulties of changing our behaviours to protect our environment. What is often left out are the benefits of mitigating climate change and moving towards a more sustainable low-carbon future. A life not completely dependent on fresh air sucking carbon and fossil energy is actually a very good, healthy life.

A recent report by the UK government has found that nearly 50,000 people die early each year because of pollution. This pollution is caused the burning of the same fossil fuels that are also causing the climate change. Moving towards a low carbon future would reduce the amount of pollution in our atmosphere tremendously. We would be able to live a healthier (and fresh air filled) lifestyle.

A lot of climate change is also the result of wasting. If we employ technology to pick up the slack and bring to an end the tonnes of carbon we are emitting into the air just by being more efficient, we will address climate change. Who doesn't want efficiency?

And more about technology, there will have to be people trained to install our energy efficient technologies, people to build them, people to repair them, people to create them. This creates new jobs in an economy. Research done by Friends of the Earth has found that just by councils across England and Wales moving to decrease climate change emissions by insulating homes and businesses and fitting green energy in buildings, they would create 70,000 new jobs. What's wrong with more jobs?

The vision of a low carbon future isn't a sad, desperate one. It's bright, clear and prosperous.



## 4. Beyond Climate Change - Sustainability

### 4.1 Definition of Sustainability

Sustainability is a fundamental issue for all human endeavours globally. The definition of sustainable development is still debated, but can be summarised as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN, 1987).

Sustainability is the long-term maintenance of well being, so that society, its members and its economics are able to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, planning and acting to maintain these ideals for future generations.

Without increased sustainability amongst individuals, businesses and nations, climate change and other negative environmental impacts will continue to occur. This will impact on society in diverse ways ranging from climate-related sea-level rise and increased storm frequency to reduced biodiversity, water scarcity and reduced industrial and agricultural production.

### 4.2 Increasing Sustainability

In order to become more sustainable individuals and organisations need to address their impact or ‘footprint’ on the environment. Increasingly the term ‘carbon footprint’ is being used to describe the measurement of greenhouse gas emissions relating to a specific entity. However, environmental sustainability goes beyond carbon emissions and their impact on climate change encompassing issues of waste, water and biodiversity.

### 4.3 Triple Bottom Line

In order to become truly sustainable the triple bottom line should be addressed encompassing social, economic and environmental impacts.

Socially, increased sustainability will result in greater employment opportunities as new greener industries become established. Other benefits may include skills transfers as developed nations help developing nations establish their own sustainability plans. Quality of life will improve through the improvement of environmental conditions such as air and water quality. Reduced burning of fossil fuels will result in decreased emissions not only of greenhouse gases, but also dangerous heavy metals and carbon monoxide which have detrimental effects on health and the environment.

Economic benefits include increased marketing and sales for businesses that lead the way on increasing their sustainability. This is due to the increasing consumer awareness on issues such as carbon emissions and biodiversity as shown by the increasing importance of environmental certifications. Other benefits include reduced costs through energy efficiency and the longevity of businesses that depend on natural resources.

Environmental benefits of increased sustainability are perhaps the most varied of the triple bottom line. Reducing burning of fossil fuels, water consumption and the negative impacts of entities on ecosystems and biodiversity will have a huge variety of benefits. Reducing deforestation alone will have a whole variety of positive impacts preventing changes in weather patterns, soil quality, and water availability.

## 5. How can we become more sustainable?

### 5.1 At Home

Individuals are responsible for approximately 45% of greenhouse gas emissions ([energysavingtrust.org.uk](http://energysavingtrust.org.uk)) in the United Kingdom and therefore changes in the home are very important. Two main areas of change can occur: Investment and Behavioural. In a recent study by the Energy Savings Trust, it was found that without changes in behaviour investments often resulted in far lower energy savings than might have been expected. Therefore it is important that neither area is ignored when thinking about sustainability.

Each home in the UK produces approximately 6 tonnes of carbon a year ([energysavingtrust.org.uk](http://energysavingtrust.org.uk)), excluding transport emissions. The good news is that a lot of the changes you would make in your home to lower your carbon emissions will also save you money. A lot of the carbon emissions are a result of wasted energy – save this energy and not only do you cut emissions but you also reduce that bill!

#### Hot Tips:

1. Change the thermostat by 1 degree → This will save you 10% on your heating bill
2. Turn appliances off when you are not using them → Try not to keep them on standby as this still uses up to 85% of the energy they use when they are switched on ([energysavingtrust.org](http://energysavingtrust.org))
3. Replace your lights with energy saving bulbs → They can last up to 10 times longer and use up 80% less energy!
4. Turn off lights → Switching off four unnecessary light bulbs can save you £32 a year
5. Boil only enough water that you need in the kettle → It can save you £30 a year
6. Wash clothes at 30°C and hang out the clothes to dry on the line on a dry day → If you half the amount of time you use the dryer, it will save you £36 and 150 kg of carbon
7. Turn down the thermostat of your hot water → It could save 60£ a year and 342 kg of carbon
8. Take a quick shower → A five minute shower will generally use about a third of the water and energy it takes to have a full bath
9. Close curtain/blinds at night to stop heat from escaping through windows
10. Try not to waste food → The average household in the UK waste £424 annually on food that goes into the bin
11. Eat local, seasonal food
12. Invest in an energy monitor → E.g. the Owl Monitor; these are easy to set up and conveniently show you how much energy you are using, money you are spending and carbon you are emitting minute by minute
13. Buy a composter → Councils offer discounts a lot of the time

**Total Savings could equal more than  
£580 a year!**

#### Meet the Robinsons.

The Robinsons, a family of four living in the UK are committed to reducing their negative impact on the climate. They are using several water and energy saving techniques, saving the planet and money at the same time. What they do:

- Don't turn on lights; crack open the curtains a little to let in the daylight.
- Turning off heat completely during April-October and use it sparingly during the winter.
- Turning off electronic equipment on the wall.
- Using a jug to collect hot water in shower for shaving.

As a family they were able to reduce their carbon emissions from 12.7 tonnes to 10.9 tonnes in one year!

## 5.2 At work

The choices we make at work can have a huge impact on the overall UK carbon emissions. The workplace is one of the most important sources of indirect emissions. An average office in the UK emits 1.3 – 1.5 tonnes for each employee.

Many people have begun to make their homes a greener and less carbon intensive place to live in, but what many of us don't realize is that our workplace presents the best opportunity to make the biggest difference. Unfortunately, good environmental decisions at home are not always being translated into the workplace. A survey by Envirowise found that of 1,800 UK office workers a third took no action to reduce the amount of resources they used in the office like using less paper and electricity.

Yet, employees have a huge impact on the carbon footprint of a business, hence the overall carbon emissions. The key is to rethink what you are personally responsible for. What's emitted from your household is an obvious responsibility, but what you do in your workplace, the choices you make, is still your personal responsibility. And you can choose to make a difference. What is really interesting is that a lot can change by just not wasting. Offices in the UK waste at least £1.6 billion annually because of energy inefficiency according to the Carbon Trust (2010). This is equivalent to approximately 73,000 tonnes of carbon a day!

Behaviour changes that will reduce greenhouse gas emissions at work are easy – once you remember them. Often the hardest part of saving energy is remembering to do things like turn off your computer or the lights. Making a difference requires remembering to make a difference. If there aren't prompts around the office that remind you, make some of your own, for yourself or for your colleagues as well. Take the initiative to remember.

Some of the key areas include:

1. **Energy and electricity** → Offices waste over £2 billion each year because they aren't taking advantage of simple procedures and technologies to increase energy efficiency
  - Turn off the lights → Could reduce the average company's bill by 19%
  - Switch it off → Make sure all office equipment is turned off overnights and on the weekends
  - Don't use screensavers → Set up your computers to go to sleep when they aren't in use, which can cut energy use by 70%
  - Keep doors and windows closed when the heat is on → This will keep the heat in and the cold out and save a lot of energy in the meantime

### Paper Usage Facts & Figures

- An office worker goes through 1584 sheets of A4 in just one month.
- The average worker uses 50 sheets every day.
- Paper usage is rising by about 20%
- The paper industry ranks 4<sup>th</sup> in contribution to greenhouse gas emissions.

### Case Study: Whitbread

Whitbread's philosophy towards climate change and other social issues is that doing nothing is not an option. Changes in behaviour to protect the environment are a part of their *Good Together* plan. They have made several changes at their head office to save energy and carbon.

- Lights off policy overnight – the lights are hooked up to a programme that automatically switches off the lights between 11pm and 6pm.
- There are time switches on the vending machines that turn the machines off overnight and during the weekend.
- They have used voltage optimisation at the head office which ensures the equipment uses only the amount of energy it needs. This has saved around 11% of the energy they were wasting earlier.

2. **Paper and printing** → there is a vast amount of paper wastage in the offices in the UK. Research has shown that an office that actively thinks about using less paper uses 15 sheets a day compared to an office that doesn't and uses 100 sheets a day. It is estimated that UK businesses throw away 5 million tonnes of paper each year (wasteonline.org.uk).

- Use both sides of the paper
- Make memo pads → Reuse unwanted paper by making up memo pads
- Use the draft setting for printing → Printing in draft mode reduces ink use, but is still good enough to read
- Reduce margin settings so you can get more words on one page → This can reduce paper use by up to 14%. Also use a small font size, efficient fonts and always use the preview function before printing to avoid printing any mistakes
- Email memos rather than printing them out → Use group emails to broadcast important messages efficiently and inexpensively
- Recycle your office paper → For every tonne of recycled paper it can save up to 17 trees. UK businesses throw away 5 million tonnes of paper a year. So multiply 17 trees by 5 million, if all office paper was recycled, we would save 85 million trees!
- Digitise → Keep files on computers rather than in cabinets; review documents onscreen rather than printing them out.

**Benefits of Public Transportation that have nothing to do with Climate Change.**

**Safety.** Public transport is safer than driving a car because public transit vehicles are larger and driven by a trained operator. Riding a transit bus is 91 times safer than car travel.

**Better air quality.** Public transit contributes to better air quality because it produces way less emissions than cars. Better air quality means less respiratory diseases.

**Stimulates development.** It increases property development and redevelopment, creates jobs, increases property value and creates tax revenues.

**Reduces traffic.** Reduces the number of cars on the motorway and the roads which reduces traffic congestion. This will reduce commute time, reduce emissions and increase productivity.

**Improves communities.** Makes communities more liveable by improving the transportation access and opportunity of its residents. This leads to increased safety, more personal freedom and increased quality of life.

### 5.3 On the Move

Transport makes up approximately 21% of UK domestic carbon emissions. This is mainly from driving and air travel. Almost all of UK domestic transport emissions (85%) are from road transport. 58% of total transport emissions comes from passenger cars. Cutting your emissions in this area is more difficult than other areas like in your household and your workplace because a lot of the decisions you make are entrenched in a certain lifestyle and a lot of people consider them as decisions of convenience. However, a lot of the time, decisions to cut carbon in this sector are healthier decisions for yourself and for others. There is nothing wrong with a gradual lifestyle change – take it step by step. Start by taking the bus only once a week, or cycling to work once a week. You will be amazed by how convenience can pop up in unexpected places!

Travel emissions can be reduced by choosing vehicles that are more efficient and by changing the way you choose to travel.

### ***Choosing to drive your car less***

- Car travels account for more carbon emissions than any other form of transport in the UK, even more than air travel
- A good way to see the most efficient way of travelling is to use a tool by Transport Direct to compare the carbon emissions between different forms of transport. This tool will show you how much carbon you will emit when taking a car, compared to a train, to a bus.
- Nearly a quarter of all car trips are less than 2 miles which is easily doable by cycling. It will take you less than 15 minutes to cycle this distance, save £600 a year and help you burn 100 calories! And it will decrease your carbon emissions by 15% - just by cycling for short trips.
- A lot of car journeys are also less than 1 mile, which can easily be done by walking. It will take you 20 minutes, save you £160 year and help you to achieve a healthier, more active lifestyle.
- Taking public transport is often easier in cities and urban areas when traffic is heavy and a parking space few and far in between.
- Roads often have a bus lane, allowing buses to zoom past 5 o'clock traffic and bring you straight to your destination.

### ***When you drive, drive smarter***

- So we haven't convinced you that you don't need your car. But there are ways to save carbon emissions even when driving.
- Use a door-to-door journey planner from Transport Direct. By planning out exactly where you are going and how, you can reduce your journey time and distance travelled, saving you money, fuel and carbon.
- Combine trips. It's all about planning ahead. Can you get the groceries and the dry cleaning in one clean trip? Make a list, think ahead and try closer shops.
- Prepare your car ahead of time. Pump up tires (more air filled tyres offer less resistance), clear out extra weight in that packed with junk boot of yours, and service your beauty regularly.
- How you drive can also make a big difference. Drive at the appropriate (and legal) speed at around 70mph on motorways. Not only will you be staying clear of speeding fines, but you will also save 10% of fuel if you were driving at 80mph. Drive smoothly, and change gears at lower revs (2000rpm for diesel and 2500 for petrol). Don't leave your car idling if you're there for more than 3 minutes and don't use the air conditioner. Although, keep in mind that if you are going at speeds above 50-60 mph it would be more efficient to use the air conditioner than to have your windows open creating a drag effect.
- Share your car. The average commuter drives 20 miles a day. If you carpool with only one extra person, your will save 400 kg of carbon. Do you commute more than 12 miles a day?
- Car clubs are new, exciting, and extremely efficient. Members book a vehicle for periods from half an hour to more. There are cars at designated parking spots, you go there, pick up the car, and va-voom, you are on your way! They can work with annual fees, pay as you go, or on monthly invoices.

### **Fly less**

- Air travel accounts for 6.4% of UK carbon emissions. This is likely to grow if nothing is done about it to 10% by 2020. By choosing not to fly, or to fly less you are saving time and money, as well as carbon.
- Business meeting? Consider video or teleconferencing.
- Holiday in the UK. How much of your country have you seen? The UK is full of different sights, cultures and events.
- Take one longer holiday instead of a whole bunch of shorter ones. Promise, you'll be more relaxed.
- Consider taking the rail, the coach or even the boat instead of a flight. Flying may seem a lot quicker and convenient, but if you take into account the time it takes to travel to the airport, check-in time, flight delays, waiting for your baggage and heightened security at the airport, rail, boat or bus might turn out to be the better options.

### **5.4 Don't throw away carbon emissions**

On average, every person in the UK throws away their own body weight in rubbish every seven weeks. Every household produces one tonne of rubbish every year. UK households produced 30.5 million tonnes of waste in 2003/2004. 17% of this waste was collected for recycling. This isn't a bad figure – we did revert over 5 million tonnes of garbage from the landfill. But it's not enough either. Some neighbouring countries in the European Union recycle as much as 50% of their waste. Up to 60% of what ends up in the garbage can be recycled. Of what is in our trash, organic material, paper, glass, plastics and some metal can be recycled.



It's important to rethink waste – we need to see it as what it is, a valuable resource. In every item that is thrown away there is stored energy; there is no reason to throw it away and waste that energy. The unreleased energy contained in the average dustbin each year could power a television for 5,000 hours!

#### ***The Benefits of Recycling***

When you recycle, you are conserving raw materials. The more you reuse, the less new you have to create. The average person in the UK gets through 38 kg of newspapers per year and it takes 24 trees to make one tonne of newspaper.

Recycling also saves land that would otherwise be used for waste disposal. The problem today is that waste is competing for land space. There are over 1500 landfill sites in the UK and it is expected that England will run out of landfill capacity for household rubbish by the year

#### **Employees raise £850 by bringing in old mobiles .**

At the Whitbread head office the employees are encouraged to bring in their old mobile phones for recycling. Last year employees brought in 167 headsets raising £850 for the charities Hospitality Action and the Costa Foundation.

2020. It is difficult to open up new landfills, especially politically. Houses that are situated within a quarter of a mile are valued an average £5,500 lower than similar houses not near the landfill.

Recycling creates less pollution as there is no need to extract and process raw materials. Many recycling processes create less than half the pollution cause by traditional raw materials processing. Recycled paper produces 73% less air pollution than if it was made from raw materials.

Save energy. Recycling items usually take less energy than starting off with the brand new. For example, it takes 94% less energy to recycle aluminium then smelt the ore.

Current UK recycling is estimated to save more than 18 million tonnes of carbon a year. And as a result of our recycling, all of the newspapers you read are made in the UK with 100% recycled paper and over 80% of the of the glass recycled in the UK is made to use new bottles and jars.

A lot of people fear that recycling isn't beneficial because we aren't recycling properly and a lot of what we put in the recycling bin ends up being thrown away. This isn't true. 95% of what Britons put in their recycling bin last year was successfully recycled. It's also cheaper to recycle. It costs £45 to send a tonne of waste to the landfill.

### ***How to recycle different materials in your home.***

#### **Plastic**

275,000 tonnes of plastic are used in the UK each year – that's 15 million bottles per day. That's an astounding amount when you consider that the population is just over 60 million. That means that one in every four person in the UK throws away a plastic bottle daily. In the UK, families throw away about 40kg of plastic per year, 40kg which could have been recycled otherwise. Plastic is one of the worst items to throw away – it can take up to 500 years for plastic to decompose. Although there are about 50 types of plastic, there are three main types: opaque (HDPE), transparent which a seam running across the base (PVC) and transparent with a hard moulded spot in the centre of the case (PET). Most recycling facilities will take these types of plastics. {Insert recycling facilities in the area of this business}

#### **Paper**

Paper is separated into the following groups: magazines, newspapers, office paper, cardboard, phone directories. Most home recycling bins will accept all of these paper products.

#### **Glass**

Each family in the UK uses an average of 500 glass bottles and jars annually. Glass is separated into three colours: green brown and clear, all of which are widely recycled. Glass is one of the most widely recycled resources as it is relatively easy to reuse and to recreate. Glass is 100% recyclable and can be used again and again. This is a good thing considering that glass that is thrown into the landfills will never decompose.

#### **Electronic Waste (computer equipment like monitors, printers and laptops)**

Electronic waste is becoming increasingly larger and dangerous. It cannot be sent to the landfill because it contains a lot of dangerous chemicals that will be released in the atmosphere or leaked into the groundwater table if allowed to decompose. You must dispose of your e-waste either by returning the product to the manufacturer, taking the item to a professional waste disposal facility or donating the goods to a non-profit organisation.



### ***How to recycle in your office***

To set up a recycling service in your office you should do some research. Have a look at what your cleaning company and other companies have on offer and what the local council does to support these efforts. Most services will offer recycling facilities so the next step will be buying those colour coded bins!

Clear labelling and emailing reminders should engage the office staff and greatly increase the level of recycling.

### ***Composting***

#### **What is composting?**

Composting is a natural process. It happens on forests grounds and in your backyard, but we just call it mulching if we don't purposefully assist in the process. Once under the right conditions with the appropriate access to water and air, organic material (material that came from a once living organism like a plant or animal) will breakdown into rich organic soil.

There are two main types of composting:

- a. Backyard composting. If you have a big enough backyard and have garden waste to compost along with your kitchen waste you can build a compost or buy one.
- b. Vermicomposting. This a long word that just means using worms to boost the breakdown process of composting. This is most suitable for people with small gardens or who live in a flat as a worm composter takes up little space and alternatively can go in your home. The worms eat your kitchen waste and turn it into amazing fertiliser.

#### **Why should I compost?**

The average household in the UK throws away approximately 200 pounds of organic kitchen was every year. If you combine this with all of the leaves, grass clippings and other organic garden waste a lot can be saved if this were composted instead of sent to the landfill. It would reduce the size of your bin. If you look at what we learnt earlier about the components of your dustbin – if you composted the organic waste you can diminish that amount by a significant number.

Organic waste that ends up in the landfill is a significant contributor to greenhouse gases and hence climate change. Organic waste that breaks down in a landfill does so in anaerobic conditions – or in other words, without oxygen. When it breaks down without oxygen it creates a lot of methane – a greenhouse gas that isn't emitted as much as carbon dioxide, but that is 23 times more potent than carbon dioxide.

It is estimated that landfills in the UK release 1.5 million tonnes of methane into the atmosphere each year. Organic materials in the landfill account for a quarter of UK's emissions of methane.

What's more is you can use the compost to make your garden greener!

#### **How can I start?**

The best resource for getting information as well as getting a compost bin is the Recycle Now website - [http://www.recyclenow.com/home\\_composting/](http://www.recyclenow.com/home_composting/).

It's relatively easy to build your own bin in the backyard – it just needs slots for air circulation and a cover to keep out the rain or snow. Otherwise, councils usually subsidise the costs of buying a bin or a worm composter if it's purchased through them.

What you should add to your composter differs slightly according to the type of system you are using, however below is the list of the dos and don'ts of general composting.

**Yes, Please**

hair & fur  
shredded paper  
straw & hay  
animal bedding & sawdust  
crushed egg shells  
grass and plant cuttings  
raw fruit and vegetable trimmings  
teabags and coffee granules  
leaves

**No, Thank You**

meat or fish  
coal ash  
animal waste  
nappies and used tissue  
dairy products  
cooked foods  
coloured or treated paper  
chemically treated wood  
diseased plants  
persistent weeds

## 6. Frequently Asked Questions

Despite your best efforts to learn all the information and to leave no room for misunderstanding there will always be those questions that catch you out. This section will take you through a collection of common questions on this subject and are well worth taking a look through when preparing for your presentation. For an extremely comprehensive list of responses to all sceptical questions, see: <http://www.grist.org/article/series/skeptics/> or <http://actonco2.direct.gov.uk/home/climate-change-the-facts/Climate-change-myths-and-misconceptions.html>

People often say that they don't believe climate change is happening, or that there's no scientific proof of climate change and its effects. Often the people making these statements are uninformed, misinformed, cherry picking arguments to suit their needs, repeating urban myths, afraid, uncertain or doubting.

### Common myths and misconceptions

There's no evidence of climate change  
It's all a hoax  
The scientists can't agree  
The most recent IPCC report was wrong  
Glaciers are growing, not shrinking  
Antarctic sea ice is increasing, not decreasing  
We just had a really cold winter  
Warmer weather is better anyway  
Climate change is natural  
The climate is always changing  
It's nothing to do with CO<sub>2</sub>, it's the sun!

### 6.1 TOPIC: Ice Caps, Glaciers, and Ice Sheets Melting

**MYTH:** Global warming can't be happening because some glaciers and ice sheets are growing, not shrinking.

**FACT:** In most parts of the world, the retreat of glaciers has been dramatic. The best available scientific data indicate that Greenland's massive ice sheet is shrinking. Summer Arctic Ice also appears to be disappearing

Climate change has different impacts depending on where you are around the world. Whilst warming can result in ice melting in some locations, such as the West Antarctic Ice Sheet and coastal areas of Greenland, it can also result in increased evaporation and precipitation, which can lead to growth of other ice sheets such as parts of the East Antarctic Ice Sheet.

It is also important to understand that glaciers can be very different with some glaciers and ice sheets much more vulnerable to climate change than others. A large factor in this is their altitude with ice at or even below sea-level being the most vulnerable. These bodies of ice have the potential to respond rapidly and dramatically to sea-level change as a result of warming. In contrast, ice sheets high above sea-level are far less vulnerable to change, the best example being the East Antarctic Ice Sheet with the plateau region reaching over 4km above sea-level in some areas.

#### **Summer Arctic Ice**

2008 saw a record low in summer volume of sea ice, almost 70% lower than 1979 summer levels. Summer arctic ice appears to be disappearing more than 80 years ahead of IPCC's predictions. Winter ice is also steadily declining and thinning. Its thickness has decreased by 19% compared to previous 5 years. An ice free Arctic Summer could come as early as 2011-2015.

What are the consequences of this reduction in arctic summer ice?

Albedo is a measure of the reflectivity of the earth's surface. White ice has an albedo of .8-.9 this means that it reflects 80-90% of the solar radiation it receives. Dark surfaces, such as the sea/ocean, have an albedo of 0.1. So as arctic ice caps melt, the larger area of exposed ocean will 'flip' from reflecting 80-90% of the sun's energy to absorbing 90%. This is known as the albedo flip.

If you look at the IPCC's reports, most of their models lack robust treatment of such sea ice processes. However, researchers at National Center for Atmospheric Research (NCAR) have found that should rapid sea ice loss occur, that there will be a strong acceleration of Arctic land warming due to the albedo flip. Increased land warming could be 3.5 times great than previously predicted and some coastal regions could see an average 5 degrees Celsius temperature rise over the same 5-10 year period. However, this is very difficult to predict as there currently no climate models that predict an ice free Arctic as early as it seems to be occurring.

### ***Glaciers and Antarctica***

Between 1961 and 1997, the world's glaciers lost 890 cubic miles of ice. The consensus among scientists is that rising air temperatures are the most important factor behind the retreat of glaciers on a global scale over long time periods. Some glaciers in western Norway, Iceland and New Zealand have been expanding during the past few decades. That expansion is a result of regional increases in storm frequency and snowfall rather than colder temperatures — not at all incompatible with a global warming trend.

In Greenland, a NASA satellite that can measure the ice mass over the whole continent has found that, although there is variation from month to month, over the longer term, the ice is disappearing. In fact, there are worrisome signs that melting is accelerating: glaciers are moving into the ocean twice as fast as a decade ago, and, over time, more and more glaciers have started to accelerate

The only study that has shown increasing ice mass in Greenland only looked at the interior of the ice sheet, not at the edges where melting occurs. This is actually in line with climate model predictions that global warming would lead to a short-term accumulation of ice in the cold interior due to heavier snowfall. Similarly, scientists have predicted that Antarctica overall will gain ice in the near future due to heavier snowfall. The scientists who published the study were careful to point out that their results should not be used to conclude that Greenland's ice mass as a whole is growing. In addition, their data suggested that the accumulation of snow in the middle of the continent is likely to decrease over time as global warming continues.

The British Antarctica Survey tracked 300 unstudied glaciers. They discovered that mass loss from West Antarctic is large enough to outweigh mass gains in East Antarctic and to make the total Antarctic sea level contribution positive. a 2007 paper states that glaciers and ice caps are contributing to about 60% of ice delivered to world's oceans and the rate is increasing. In addition ice loss from mountain glaciers is underestimated by existing climate models (could contribute additional .25m by 2100).

## 6.2 TOPIC: Rising sea levels and warming oceans

**MYTH:** Melting ice shelves will not lead to sea-level rise

**FACT:** Floating ice shelves do not add directly to sea level rise. However, ice shelves have been argued as one of the most important controlling factors on the speed of ice movement. Ice shelves buttress the ice sheets slowing down the calving of ice into the oceans. When these ice shelves are removed the resistance to ice flow disappears leading to accelerated ice flow and further ice calving into the ocean. Therefore melting ice shelves do lead to sea-level rise indirectly and sometimes dramatically.

As Arctic Summer Ice disappears, warming will extend 1500km inland. The Greenland ice sheet will come under great warming pressure. 2004 studies state that the warming threshold of Greenland is 3 degrees Celsius - at which point ice sheet will melt and result in a 7m sea level rise. In 2004 studies stated that this would take 1000 years. However, polar explorers have found that the ice sheet height is falling in some places by up to 10m a year. it is difficult to see how a warming arctic which had lost its summer sea ice could maintain the Greenland ice sheet (direct quote by James Hansen, head of the NASA Goddard research institute).

The planet is still changing faster than the IPCC predicted. 2007 the IPCC stated that sea levels will rise by 18-59cm by 2100. The IPCC also noted that this projection does not include uncertainties in climate - carbon cycle feedbacks nor the full effects of changes in ice sheet flow. so the upper values cannot be considered the upper bounds for sea level rise.

Stefan Rhamstorf of the Potsdam Institute states that by 2100 we'll see sea level rise between .5-1.4 m above 1990 levels. This does not include an assessment of 'dynamic' ice sheet melt processes stated above. Also supported by research that ice loss in Antarctica is increasing by 75% in 1996-2006 as a result of speed up in the flow of its glaciers.

Basically there is a growing body of opinion that sea level rise is greater than the IPCC predicted. Also we should not fixate on whether this rise will be 1m, 2m or 5 m. Merely discussing sea level rise between 80cm to 2m is a magnitude greater than we have seen to date. Sir Nicholas stern describes the consequences of a one metre sea level rise as the following. Basically, currently, more than 200million people live in coastal floodplains, which is 2millionkm<sup>2</sup> of land and 1 trillion\$ worth of assets (this is all in less than ONE metre above current sea level). 1/4 of Bangladesh's population is within the coastal floodplain. Many of the world's major cities (22 of the top 50) are at risk of flooding from coastal surges. In almost every case, the city relies on costly flood defence.

Even a small rise in sea-level has the power to greatly impact upon peoples' everyday lives. This rise in sea-level can increase the chances of flooding and result in increasing salinity into coastal areas. This can reduce economic productivity and require expensive flood defence constructions. Increased flooding can also result in greatly increased insurance prices and in some areas difficulty in gaining any at all.

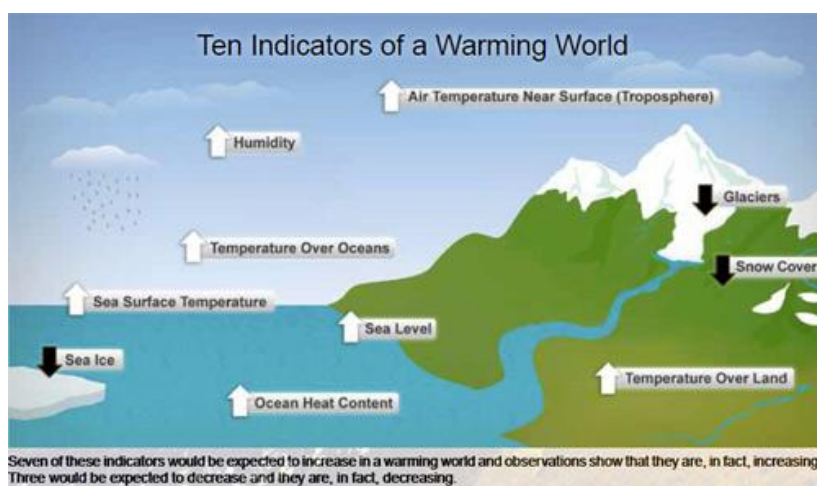
### 6.3 TOPIC: Isn't the climate cooling?

**MYTH:** Global warming doesn't exist, because we just had the coldest winter on record for years!

**FACT:** Even during a period of warming, it is still possible to experience extremely cold periods if a number of factors combine to make it so.

The question of global warming stopping is often raised in the light of a recent weather event - a big snowfall or drought breaking rain. Global warming is entirely compatible with these events; after all they are just weather. For climate change, it is the long term trends that are important; measured over decades or more, and those long term trends show that the globe is still, unfortunately, warming.

Generally climate refers to general trends in weather over a set period of time, typically 30 years, whilst weather such as the recent unusually cold spell is a much shorter term event. Short term weather such as the recent cold spell are a result of many factors including wind direction, temperature, humidity and season, which can produce periods of unusual weather that do not follow the more general trend. Therefore even during a period of warming, it is still possible to experience extremely cold periods if a number of factors combine to make it so.



All the indicators show that global warming is still happening. When looking for evidence of global warming, there are many different indicators that we should look for. Whilst it's natural to start with air temperatures, a more thorough examination should be as inclusive as possible; snow cover, ice melt, air temperatures over land and sea, even the sea temperatures themselves. A 2010 study included 10 key indicators, and as shown below, every one of them is moving in the direction expected of a warming globe.

### 6.4 TOPIC: Everyone says the climate change models are unreliable

**MYTH:** Scientists don't know what they're talking about. They can't agree, and the models are unreliable.

**FACT:** Scientists do agree, and climate change modelling is getting more and more sophisticated. Most models give a conservative estimate of climate change.

In a survey by Doran and Zimmerman (2009) 97% of climate experts agree humans are causing climate change. As further evidence develops and other theories are discarded it is becoming increasingly accepted that humans, through their emissions of CO<sub>2</sub> and other greenhouse gases are playing a significant role in current climate change.

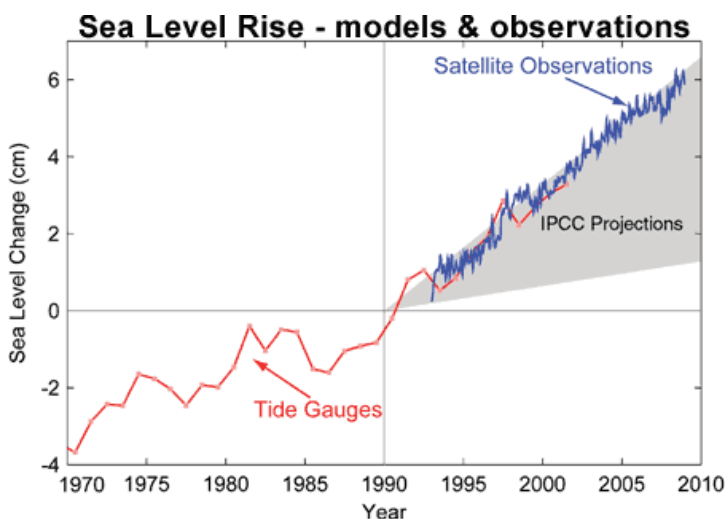
Climate models are mathematical representations of the interactions between the atmosphere, oceans, land surface, ice – and the sun. This is clearly a very complex task, so models are built to estimate *trends* rather than events. For example, a climate model can tell you it will be cold in winter, but it can't tell you what the temperature will be on a specific day – that's weather forecasting. Climate *trends* are weather, averaged out over time - usually 30 years. Trends are important because they eliminate - or "smooth out" - single events that may be extreme, but quite rare.

Climate models have to be tested to find out if they work. We can't wait for 30 years to see if a model is any good or not; models are tested against the past, against what we know happened. If a model can correctly predict trends from a starting point somewhere in the past, we could expect it to predict with reasonable certainty what might happen in the future.

So all models are first tested in a process called *Hindcasting*. The models used to predict future global warming can accurately map past climate changes. If they get the past right, there is no reason to think their predictions would be wrong. Testing models against the existing instrumental record suggested CO<sub>2</sub> must cause global warming, because the models could not simulate what had already happened *unless* the extra CO<sub>2</sub> was added to the model. Nothing else could account for the rise in temperatures over the last century.

Where models have been running for sufficient time, they have also been proved to make accurate predictions. For example, the eruption of Mt. Pinatubo allowed modellers to test the accuracy of models by feeding in the data about the eruption. The models successfully predicted the climatic response after the eruption. Models also correctly predicted other effects subsequently confirmed by observation, including greater warming in the Arctic and over land, greater warming at night, and stratospheric cooling.

The climate models, far from being melodramatic, may be conservative in the predictions they produce. For example, here's a graph of sea level rise:



Here, the models have understated the problem. In reality the events are all within the upper range of the model's predictions. There are other examples of models being too conservative, rather than alarmist as some portray them. All models have limits - uncertainties - for they are modelling chaotic systems. However, all models improve over time, and with increasing sources of real-world information such as satellites, the output of climate models can be constantly refined to increase their power and usefulness.

Sea level change. Tide gauge data are indicated in red and satellite data in blue. The grey band shows the projections of the IPCC Third Assessment report (Copenhagen Diagnosis 2009).

## 6.5 TOPIC: Isn't climate change a natural thing?

**MYTH:** The climate has changed before, this is just a natural warming phase

**FACT:** It's true that the climate does change. However, humans are adding greenhouse gases to the atmosphere at an alarming rate, and the climate is highly sensitive to the warming we are now causing.

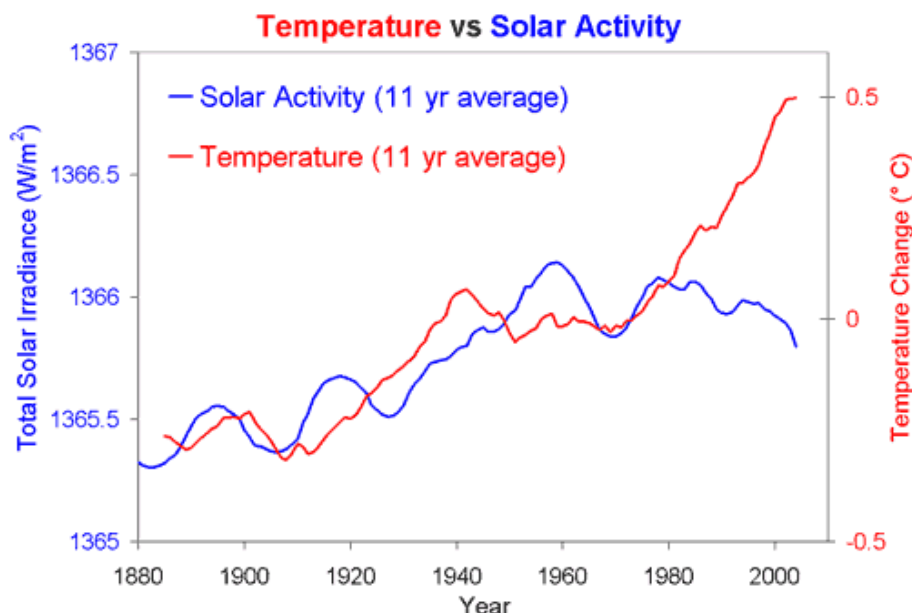
Climate change is indeed a natural ongoing effect that has led the Earth through periods of intense warmth and cold. Many people do not realise that the Earth is in fact still within an Ice Age and that this is simply one period of warmth in a cycle of warm and cold spells (called interglacials and glacials respectively). However, the levels of greenhouse gases currently within the atmosphere are higher than records suggest have existed for the last 800,000 years.

Clearly this is likely to result in significant increases in temperature and at an unnatural rate.

**MYTH:** it's the sun!

**FACT:** Yes, the sun is hot, but it's not getting hotter.

Until about 1960, measurements by scientists showed that the brightness and warmth of the sun, as seen from the Earth, was increasing. Over the same period temperature measurements of the air and sea showed that the Earth was gradually warming. It was not surprising therefore for most scientists to put two and two together and assume that it was the warming sun that was increasing the temperature of our planet.



However, between the 1960s and the present day the same solar measurements have shown that the energy from the sun is now decreasing. At the same time temperature measurements of the air and sea have shown that the Earth has continued to become warmer and warmer. This proves that it cannot be the sun; something else must be causing the Earth's temperature to rise.

So, while there is no credible science indicating that the sun is causing the observed increase in global temperature, it's the known physical properties of greenhouse gasses that provide us with the only real and measurable explanation of global warming.

## 6.6 TOPIC: Do we have to pick between the environment and the economy?

The short answer is no. The Stern report in 2006 was one of the highest profiles attempts to quantify the costs of climate change versus prevention and concluded that it would cost 1-2% of world GDP to prevent dangerous climate change, whilst the cost of doing nothing could extend to between 5 and 20% of global GDP.

Rajendra Pachauri, head of the IPCC argued in 2009 that preventing global climate change would provide a number of benefits including better energy security, new employment in green industries, more productive agriculture and lower air pollution, cutting health costs.

Therefore with large-scale investment in the reduction of climate change it is possible to actually save money in the medium- to long-term.

## 7. Test yourself

### Section 1:

1. Has the climate of our Earth always been changing?
2. What is the problem with today's climate change?
3. What is the green house effect?

### Answers

1. Yes, there has always been some degree of change, but nothing that we would have seen in our lifetime.
2. At the rate it is changing, that human activities are causing it, and the changing sea levels, extreme weather, threats to plants and animals, and the other effects of higher temperature.
3. Gases in the atmosphere act as a layer in the atmosphere trap the energy from the sun and warm the earth.

### Section 2

1. What did/does the Keeling Curve show?
2. What is the difference between the United Nations Framework Convention on Climate Change and the Kyoto Protocol?
3. What does the Copenhagen Accord recognise?

### Answers

1. That there is a year on year increase in carbon dioxide in the atmosphere.
2. The Framework was not legally binding and did not set any limits on carbon dioxide emissions for any individual country. The Kyoto Protocol is legally binding and it set targets of carbon dioxide emissions for different countries.
3. The Copenhagen Accord recognises that climate change is happening and that it is best for us to keep temperature rises to no more than 2°C.

### Section 3

1. What are the five effects of climate change that were discussed in this module?
2. Will sea level rise affect the United Kingdom?
3. If the temperature rises by 2°C, what's the percentage of land living species that will be threatened by a risk of extinction?
4. What are the estimated economic costs of climate change?

### Answers

1. Increased temperatures, rising sea levels, more instances of extreme weather, extinction threat to plants and animals and huge economic costs.
2. Yes, the coastal areas like Wash, Norfolk and Suffolk and areas around Teeside.
3. 30%
4. The lowest estimation is 5% of GDP each year; the highest estimation is 20% each year.

## 8. Further reading

The following references may be useful if you want to find out more:

- Climate Change: a Summary of Science. The Royal Society, 2010. <http://royalsociety.org/climate-change-summary-of-science/>
- How to talk to a climate skeptic: Responses to the most common sceptical arguments on global warming. <http://www.grist.org/article/series/skeptics/>

## 9. Glossary of terms

Carbon	An element, but also the word used to refer to carbon dioxide and other greenhouse gases
Carbon dioxide (CO <sub>2</sub> )	A naturally occurring gas, also a by-product of burning fossil fuels. It is the principle anthropogenic greenhouse gas, against which all other greenhouse gases are measured. It therefore has a global warming potential of 1.
Climate Change	A statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings or to persistent anthropogenic changes in the composition of the atmosphere or in land use.
CO <sub>2</sub> equivalent	The concentration of CO <sub>2</sub> that would cause the same amount of radiative forcing as a given mixture of CO <sub>2</sub> and other greenhouse gases
Conference of Parties (COP)	An annual meeting of all nations ratified to the UNFCCC to promote and review implementation of the Convention, and to review existing commitments.
Emissions	The release of carbon dioxide and other greenhouse gases to the atmosphere, primarily through burning fossil fuels.
Fossil fuel	Any fuel derived from hydrocarbon deposits, such as coal, petroleum, natural gas and peat. These fuels are irreplaceable, and their burning generates the greenhouse gas carbon dioxide
Global Warming Potential (GWP)	The effect of a greenhouse gas on the earth's radiative balance, or the ability of a gas to trap more (or less) heat. The effects of the different gases are measured against carbon dioxide or CO <sub>2</sub> which therefore has a global warming potential of 1.
Greenhouse effect	Greenhouse gases absorb infrared radiation, trapping heat within the atmosphere. An increase in concentration of greenhouse gases leads to further heat being trapped, and a net increase in temperature.
Greenhouse gases	The six gases defined by the Kyoto Protocol as contributing to climate change (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, perfluorocarbons). Water vapour is also a greenhouse gas.
Kyoto Protocol	An international legally binding agreement to reduce greenhouse gas emissions to an overall 5% lower than 1990 levels by 2012. It was adopted in the third session of the Conference of the Parties in Kyoto, Japan in 1997.
Low-carbon	Energies and practices which emit much less carbon than usual.

Sustainability The long-term maintenance of well being, so that society, its members and its economics are able to meet their needs and express their greatest potential in the present without detriment to biodiversity and natural ecosystems, while planning and acting to maintain these ideals for future generations.

Triple bottom line Considering success against social, environmental and economic impacts.

United Nations Framework Convention on Climate Change (UNFCCC) An overall framework for intergovernmental efforts to tackle the challenge posed by climate change, adopted in New York in 1992. (a.k.a. The Convention)

### Terms to avoid

Global Warming Global warming refers to an overall warming of the planet, based on average temperature over the entire surface. Climate change refers to changes in regional climate characteristics, including temperature, humidity, rainfall, wind and sever weather events. Global warming may in fact lead to the cooling of some regions. More detail can be found here [www.grinningplanet.com](http://www.grinningplanet.com)